INFORMATION TO USERS

This manuscript has been reproduced from the microfilm master. UMI films the text directly from the original or copy submitted. Thus, some thesis and dissertation copies are in typewriter face, while others may be from any type of computer printer.

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleedthrough, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send UMI a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

Oversize materials (e.g., maps, drawings, charts) are reproduced by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps.

Photographs included in the original manuscript have been reproduced xerographically in this copy. Higher quality 6" x 9" black and white photographic prints are available for any photographs or illustrations appearing in this copy for an additional charge. Contact UMI directly to order.

ProQuest Information and Learning
300 North Zeeb Road, Ann Arbor, MI 48106-1346 USA
800-521-0600

A Dissertation

entitled

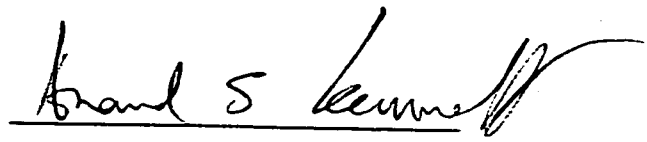
Inter-Organizational Information System Use In Supply Chain: Toward An Integration Of Competence Based And Transaction Cost Based Views Of The Firm

By

Zhengzhong Shi

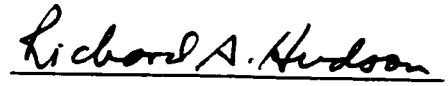
Submitted as partial fulfillment of the requirements for

the *Doctor of Philosophy Degree in Manufacturing Management*



Advisor: Dr. Anand S. Kunnathur

Advisor: Dr. T. S. Ragu-Nathan



Graduate School

College of Business Administration

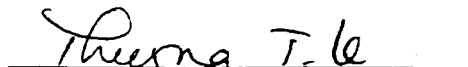
The University of Toledo

December 2001

UMI Number: 3030860

Bell & Howell Information and Learning Company
300 North Zeeb Road
P.O. Box 1346
Ann Arbor, MI 48106-1346

COMMITTEE MEMBERS:

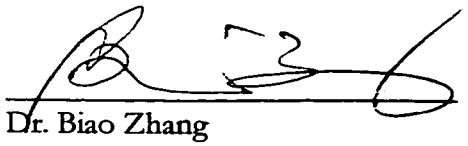


Dr. Thuong Le
Professor of Marketing

September 21, 2001

Dr. Walter W. Olson
Professor of Mechanical, Industrial
& Manufacturing Engineering

September 21, 2001



Dr. Biao Zhang
Associate Professor of Statistics

September 21, 2001

An Abstract Of

Inter-Organizational Information System Use In Supply Chain: Toward An Integration Of Competence Based And Transaction Cost Based Views Of The Firm

By

Zhengzhong Shi

Submitted as partial fulfillment of the requirements for

the *Doctor of Philosophy Degree in Manufacturing Management*

December 2001

The tremendous impact of inter-organizational information systems (IOS) on supply chain management has been becoming more and more visible with the fast growing business-to-business e-commerce phenomenon. This dramatic growth is stimulated and embraced by rapid development of Internet technologies, increasing IS management sophistication, and the spread of strategic alliances. Many case and survey studies have tried to investigate the various factors that will decide the success or failure of business-to-business e-commerce. Through an analysis of these studies, we find that there are two directions. The first direction follows the tradition of competence-based perspective by looking into firms' IS competence and the other is to investigate the relationships within which the focal firm is embedded. While both of these two streams of research provided many insights, an integration of these two streams seems to be more promising both at the theoretical and empirical levels. This dissertation is to investigate the IOS phenomenon in the supply chain by combining IS competence and supply

chain relationships, which are based on competence and transaction costs views. Research framework addresses both antecedents and consequences of IOS use, including competence, relationship, inter-firm transaction costs, explicit coordination, and buyer benefits variables. Empirical data are collected through interviews and surveys. The research model is then tested by applying LISREL package. Major findings are 1) institutional environment within which b-to-b e-commerce is established is critical to its success; 2) firms are not currently taking advantage of their IS function talents to tackle the b-to-b e-commerce hurdle; 3) the benefits of e-commerce will be manifested through the mediation of reduction of inter-firm transaction costs; and 4) in the Internet age, the inter-firm governance mechanism is moving toward the middle of market and hierarchy.

For my parents

Huixian Shi and Huiming Liu

Acknowledgements

To pursue a Ph. D degree is a very precious opportunity because it not only challenges me to explore and advance the knowledge of business in general and b-to-b e-commerce in particular, but also provides me with an opportunity to work with many very bright and kind people. Among them, Drs. Anand S. Kunnathur and T. S. Ragu-Nathan, as my dissertation co-chairs, have devoted a substantial portion of their valuable time to guide me through the dissertation process. The intense discussions at the beginning of dissertation proposal stage laid a solid foundation for the success of this dissertation. The succeeding careful directions through my data collection stage keep me motivated and confident to overcome the various barriers. The patience displayed by them in carefully reading through a succession of drafts of chapters of this dissertation makes me feel even guiltier of occupying too much of their very precious time. My appreciation and gratitude for their help will never be adequately expressed.

I am thankful to other committee members for their help in the dissertation process. Dr. Olson discussed with me about the potential sources of name list for the large-scale survey, the hypotheses, and the writing style. Dr. Zhang helped me have a better understanding of multivariate statistics and the beauty of mathematical thinking. Through taking his class of probability and measure, I discovered the similarity of proving a theorem in mathematics and making a convincing argument in social science. Dr. Le discussed with me the meaning of IOS use and the importance of narrowing the dissertation model to a doable level at the early stage of the dissertation process.

I am also in debt to many other professors and Ph. D fellow students. Among them are the former Ph. D program director - Dr. Mark Vonderembse, organizational behavior seminar

instructor - Dr. Williams Doll, my classmates and friends - Drs. Qiang Tu, Abraham Nham, Ahmad Syamil, and John Heinrichs. Their generous helps and constant encouragements made my dissertation process much more enjoyable and rewarding.

I am grateful to those managers who generously allow me to interview with them while they are very busy with their daily work. Further, this dissertation would not be possible without the support from more than 200 managers across this country who took their very precious time to answer my lengthy questionnaire.

I am thankful to the College of Business Administration, the University of Toledo, for supporting this dissertation through Ph. D program grants. I am also thankful to the College of Business Administration, North Dakota State University, for graciously permitting me to use their facilities. Last but not the least I wish to express my sincere and deep appreciation to Dr. Jay Leitch, Dean of College of Business Administration at NDSU, for his support and comments on the final draft of this dissertation.

Table of Contents

List of Tables

LIST OF FIGURES

1 INTRODUCTION

1.1 Introduction

The impact of inter-organizational information systems (IOS) use in supply chain operations, management and networking has been recognized and investigated in the academic world for last two decades. McFarlan (1984) pointed out that IOSs have hidden, second-order effects, that is, repercussions in other parts of the business. Cash and Konsynski (1985) presented potential ways of use of IOS to combat industrial competitive forces including new entrants, buyers, suppliers, substitute products, traditional rivals through changes in business processes, skills and staff requirements, organizational structure and business strategy. Johnston and Vitale (1988) applied Bakos and Treacy's (1986) model to discuss the role of IOS to enhance firms' bargaining power and efficiency. Venkatraman (1994), based on his empirical case study and previous theoretical literature, proposed that IOS could be used to redesign business networks (i.e., selecting appropriate business activities and arranging them in a network of relationships without fundamentally changing the business portfolio) and redefine business scope (i.e., business network redesign, but at the same time changing the business portfolio of the corporation).

Empirically, many success stories of IOS uses have been reported in literature. Lindsey et al. (1990) described how TELCOT, a computer-based system developed by the Plains Cotton Cooperative Association (PCCA), transformed PCCA from a small cotton merchant to a

major cotton broker by providing over 20,000 cotton producers, 40 buyers, and 200 gin operators with an electronic marketing service. Copeland and McKenney (1988) reported on the successful evolution of Airline Reservations Systems linking airlines, travel agents, and large corporations (American SABRE and United's APOLLO). Chatfield and Bjorn-Andersen (1997) reported how Japanese Airlines (JAL) took advantage of IOSs (i.e., AXESS Computer Reservation System and EDI-Electronic Data Interchange) to improve its competitiveness and leverage its strategic value chain as an engine of growth and a new source of competitive advantage. Teo et al. (1997) reported on the huge success of the TradeNet in Singapore, which has been used to transform Trade Development Board's organizational structure, business process, business network, and business scope. They pointed out phenomenal gains were achieved

However, not all firms trying to use IOS have been achieving the same levels of success. Webster (1995) reported that while Ford benefits from FordNet in Europe with German suppliers, it does not benefit from FordNet with Spanish suppliers. The reason is the different sophistication levels of IS infrastructure between German and Spanish suppliers. The fact that German suppliers have better internal IS infrastructures than their Spanish counterparts enables German suppliers to integrate FordNet into their internal systems easily and inexpensively. Clemons and Row (1993) reported limits to the potential strategic payoff from new EDI-enabled logistics management practices because of "considerable resistance" by expected adopters. Riggins and Mukhopadhyay (1994) discussed how trading partners implement and use information systems internally may directly affect the original firm's benefit. Chatfield and Yetton (2000), through cross case analysis, proposed that the strategic payoff from EDI is a function of EDI embeddedness, which represents the degree of the EDI

integration with internal systems, the degree of joint economic actions among IOS participants, and the degree of social ties among employees involved in the relationship from participating firms.

Researchers have been investigating the underlying reasons for the different levels of success of IOS use over the last decade. These analyses of IOS use have been in two directions. The first direction is to look into the participating firm's internal IS competence such as the IS infrastructure in Webster's (1995) research of FordNet, the large installed processing capacity, the established technical competence, the consistent exploitation of opportunities by management in the evolutionary process of Airline Reservation systems in Copeland and McKenney's (1988) research of American SABRE and United's APOLLO. The second direction is to look into the relationships among participating firms of the IOS, such as Clemons and Row's (1993) finding that "considerable resistance", from partners, limits the strategic payoff of IOS to the initiator, and Riggins and Mukhopadhyay's (1994) finding that, how trading partners implement and use the system internally may directly affect the original firm's benefit, both of which imply the relationship between firms does impact the IOS payoff. Further, Chatfield and Yetton (2000) directly pointed out the important impact of relationships (i.e., the degree of trust, joint problem solving and information exchange among IOS participating firms) on the EDI embeddedness, which, in turn, will modify the strategic payoff of the IOS initiator. Without doubt, these two streams of research are expanding our understanding of IOS success greatly.

While a strong IS management competence facilitates the development of an appropriate IOS and the integration of the IOS with firms' internal systems, relationships among partners will

dictate the degree of willingness of the partners to implement the systems and fully support the integration. Conversely, while inter-dependent and trusting relationships among partners require and support the implementation and integration of IOS, the IS management competence will decide the quality of the IOS, its integration with internal systems, its smooth implementation, and operations. Thus, there is a need to simultaneously look into both the internal IS management competence and relationships among partner firms. Research with both of these two perspectives in mind is emerging, but limited. Integration of these two streams of research seems to be complementary with the potential to provide more insights.

Lindsey's et al. (1990) research on TELCOT in cotton industry provided some evidence of the importance of both the IS management competence, such as the visionary management, the strong IS management leadership for system development, the effective IS development team structure, and the relationships among partners, such as the power of the sponsor to encourage participation. Upton and McAfee (1996), based on a case study of the virtual factory around McDonnell Douglas, proposed that to build a successful virtual factory, three dimensions have to be considered. The first dimension is the firm IT sophistication. The second is the stage of relationships among partner firms. The third is the level of IOS use (i.e., data transmission, data access, and access to applications) necessary to link those firms. But they did not investigate the relationships of these three dimensions.

In general, these case studies are important for establishing the IOS research stream. However, it is necessary to further this IOS research by both explicitly applying management theories and systematically investigating IOS use antecedents and its impacts on the inter-organizational process efficiency and effectiveness simultaneously. Further, while single case studies are useful

at the beginning stage of a research stream to probe potentially interesting variables and explore their relationships, to confirm the relationships among different constructs, a large-scale survey is necessary and required.

1.2 Problem Statement

This current dissertation study is to bridge the confirmation gap between the case analyses and the large scale survey analyses and fulfill the goal of establishing an integrated research stream. This is achieved through investigating the impacts of the IS management competence and the relationship among partner firms on the success of IOS use in supply chain and exploring IOS use impacts on inter-firm transaction costs, explicit coordination and buyer benefits in a large-scale survey setting.

Some of the research questions answered by this dissertation are: How to measure IS competence? How to measure the buyer-supplier relationship? How will a firm's IS competence and its relationship in supply chain influence the IOS use? How do a firm's relationships in the supply chain impact its explicit cooperation with other firms? How does the IOS use influence transaction cost (i.e., coordination cost, operation risk and opportunism) and explicit inter-firm cooperation? How do those costs reductions and explicit inter-firm cooperation enhance buyer benefits (i.e., strategic payoff)? Answers to these questions will further our understanding of IOS phenomena and can guide managers to better integrate their management of information systems, supply chain/network design and implementation.

1.3 Dissertation Structure

This dissertation has six chapters. The second chapter specifies the research framework, detailing the theoretical foundations, the constructs, and the hypotheses. The third chapter is the first stage of the empirical study to preliminarily validate the research framework and measurement items. It reports on the measurement item generation, field interviews, a pretest, and a pilot study. The fourth chapter details the validation of constructs measurement based on a large-scale survey of IS managers. The fifth chapter develops a structural equation modeling analysis to confirm or refute the proposed relationships among interested constructs. Finally, the sixth chapter summarizes the contributions from this study and discusses the potential for future research.

2 RESARCH FRAMEWORK

2.1 Introduction

This chapter describes the theoretical framework for this dissertation research. First, the two theoretical foundations – competence based view (for investigating IS management competence) and transaction cost based view (for investigating relationships among IOS participating firms) – are introduced. This introduction includes key concepts and arguments in both views. Second, an overview of the research framework is provided. Third, a detailed discussion of related theoretical constructs (e.g., IS competence, relationships among supply chain members, IOS use in supply chain, etc.) is presented. Fourth, hypotheses are used to formalize theoretical arguments on the relationships among the constructs discussed. These hypotheses will be empirically tested in the later chapters through analyses of data collected through interviews and surveys of IS managers.

2.2 Theoretical Foundations

Competence based view and transaction cost based view both have prominent theoretical origins and contribute to our understanding of firm behavior (Williamson, 1999), especially in the increasingly wired and networked information/knowledge society (Zaheer and Venkatraman, 1994). On the one hand, there are many aspects in which these two views are congruent. "Both take exception with orthodoxy, both are bounded rationality constructions, and both maintain that organizations matter. Also, ..., they deal with partly overlapping phenomena, often in complementary ways" (Williamson, 1999: 1098). On the other hand,

there are also challenges from each side. Criticisms from competence-based theorists on transaction cost based view are (1) it is not dynamic (i.e., considering only one business cycle without dealing with repeated transactions), (2) it includes limited consideration of learning, and (3) it does not go beyond generic governance to address strategy issues faced by particular firms with their distinctive strengths and disabilities. In the meantime, transaction cost theorists challenge competence based view to apply itself more assiduously to operationalization, including the need to choose and give definition to one or more units of analysis (e.g., routines) (Williamson, 1999). The following table compares these two views on their key concepts and theoretical roots.

Table 2.2-1 Comparison of Transaction Cost and Competence Based Views

Characteristics	Competence Based View	Transaction Cost Based View
Key Concepts	Core competence; set of skills, complementary assets, routines; isolating mechanisms (rareness, imitability, causal ambiguity)	Asset specificity (physical asset specificity, human asset specificity, site specificity); Transaction cost (coordination cost, operation risk, and opportunism; or searching cost, contracting cost, monitoring cost and enforcing cost); Governance (formal and informal contracts; hierarchy, market, and hybrid;)
Theoretical roots	Penrose, 1959; Schumpter, 1942; Richardson, 1972; Cybert and March, 1963; Nelson and Winter, 1982	Coase (1937; 1988); Williamson (1975, 1985, 1999)

Further, recent research by Combs and Ketchen (1999) finds that firms do not simply respond to the logic of only competence-based view or transaction cost based view, but rather react to contingencies identified by both. They suggest that future researchers need to recognize that when a study is driven by one of the perspectives, findings may be more robust if the other perspective is incorporated or, at a minimum, accounted for through the selection of control variables. Similarly, Siverman (1999) integrates transaction cost economics into resource-based[1] predictions concerning diversification and points out that the predictive power of the

[1] Here resource-based is similar to meaning of competence based view (Silverman, 1999).

resource-based view of the firm is greatly improved when resources are measured at a finer level[2]. Thus, on the one hand, at the substantive content level, by investigating both IS competence and relationship variables and their impacts on IOS use, insights into the antecedents and consequences of the increasingly important and prevailing IOS phenomenon in the long acclaimed information-based and knowledge-intensive post-modern society (e.g., Huber, 1984; Naisbitt, 1982; Doll and Vonderembse, 1991) can be better developed. On the other hand, at the theoretical level, an integration of both of these theoretical views will bring insights into their complementarities.

2.2.1 Competence Based View

Recent research in strategic management and organization theory has been focusing on the concept of capabilities/resources/competence (Wernerfelt 1984; Barney, 1991; Teece et. al. 1997; Prahalad and Hamel 1990; Nelson and Winter, 1982; Rumelt 1991). Williamson (1999: 1092) points out that much of competence perspective:

> "draws inspirations from Edith Penrose's influential book on *The Theory of the Growth of the Firm* (1959) and Joseph Schumpter's earlier book on *Capitalism, Socialism, and Democracy* (1942), especially as it relates to technical and organizational innovation. George Richardson's article on 'the organization of industry' (1972) is seminal. The book by Richard Cyert and James March on *A Behavioral Theory of the Firm* (1963) makes the case for a 'realism in process' approach to the study of organization. Richard Nelson and Sidney Winter's book on *An Evolutionary Theory of Economic Change* (1982) is in this same spirit and has a significant influence on the strategy literature. In short, the capabilities/competence perspective has distinguished antecedents, the overarching theme of which is the importance of process."

---

[2] This is one important challenge from transaction cost proponents (Williamson, 1999)

Givovanni Dosi and Teece (1998: 284) describe the competence perspective as follows:

> "a firm's distinctive competence needs to be understood as a reflection of distinctive organizational capabilities to coordinate and to learn. By 'organizational capabilities' we mean the capabilities of an enterprise to organize, manage, coordinate, or govern sets of activities. The set of activities that a firm can organize and coordinate better than other firms is its distinctive competencies. Posed differently, a distinctive competence is a differentiated set of skills, complementary assets, and organization routines which together allow a firm to coordinate a particular set of activities in a way that provides the basis for competitive advantage in a particular market or markets."

Kusunoki et al. (1999) point out that most research shares (1) organizational capabilities are not easily obtainable in the marketplace and are difficult to copy, therefore having firm-specific characteristics; (2) organizational capabilities are accumulated through long-term and continuous learning, therefore having path-dependent characteristics; and (3) organizational capabilities have the potential to become a source of sustainable competitive advantage on a long-term basis.

In general, there is a positive relationship between core competence and performance. Prahalad and Hamel (1990), through the comparison of American and Japanese firms, find that core competence is the key for sustainable competitive advantage. They point out "too many American companies have unwittingly surrendered core competencies by engaging in outsourcing" and thus loss competitive advantage. Zaheer and Zaheer (1997) empirically test the relationship from firm capabilities (i.e., alertness and responsiveness) to market influence in banking industry. They find that banks that are alert, i.e., use of their information networks in

ways that expand the range of information they are exposed, and responsive, i.e., those that act quickly in volatile markets, tend to exercise greater market influence in this industry.

Similarly, the linkage between competence based view and IS use in supply chain is that the success of an electronic market or electronic hierarchy requires the full support of firms' IS management competence. Case studies (e.g., Lindsey, et al. 1990; Copeland and McKenny, 1988) have demonstrated the impacts of IS management competence on the success of electronic markets in cotton and airline industries.

2.2.2 Transaction Cost Based-View

Williamson (1991: 282) argues that, "asset specificity increases the transaction costs of all forms of governance" due to opportunism (defined by Williamson, 1985, as 'self-interest seeking with guile'). Although investments in specialization boost productivity, the incentive to make transaction-specific investment is tempered by the fact that the more specialized a resource becomes, the lower its value in alternative uses. The figure 2.2-1 shows the key concepts and relationships in the transaction cost based view (Williamson, 1985; Dyer, 1997). Asset specificity impacts transaction costs and governance mechanisms. Transaction costs and governance mechanisms have impacts on supply chain coordination, value creation and appropriation. Firm and industrial history, culture and institutional environment have independent impacts on transaction costs.

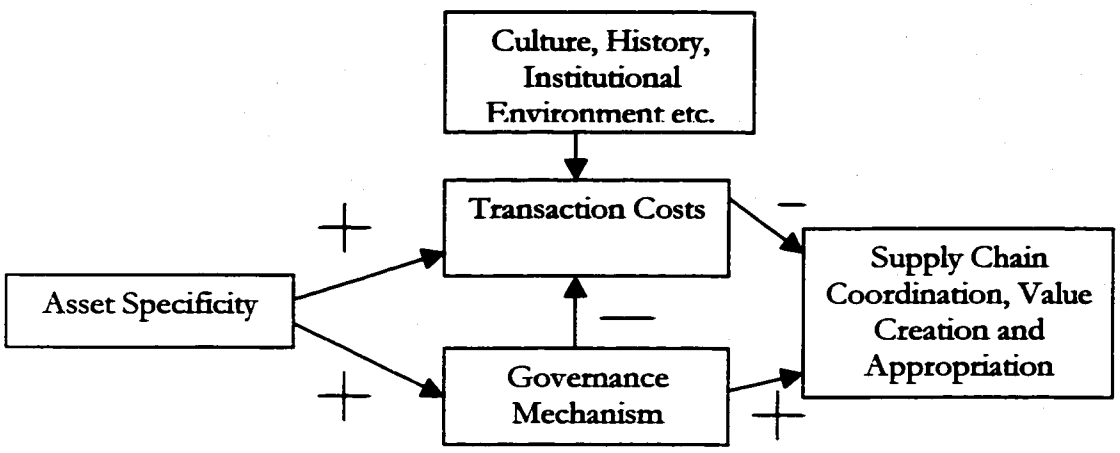


Figure 2.2-1 Key Concepts and Their Relationships in Transaction Cost Based View

There are three types of asset specificity (Wlliamson, 1979). First, site specificity refers to the situation whereby successive production/work stages that are immobile are located in close proximity to one another to improve coordination and economize on inventory and transportation/communication costs. Second, physical asset specificity refers to transaction-specific capital investments (e.g., in customized machinery, tools, dies, etc.) which allow product differentiation and improvement in quality by increasing product integrity. Third, human asset specificity refers to transaction-specific know-how accumulated by transactors through longstanding transaction relationships (e.g., dedicated supplier engineers who learn the systems, procedures, and individuals that are idiosyncratic to the buyer) which allows transactors to develop experience working together and accumulate specialized information, language, and know-how that allows them to communicate efficiently and effectively.

Transaction costs can be decomposed into four separate costs related to transactions (Williamson, 1985): (1) searching cost, including the costs of gathering information to identify and evaluate potential trading partners; (2) contracting costs, including the costs associated

with negotiating and writing an agreement; (3) monitoring costs, including costs associated with monitoring the agreement to ensure that each party fulfills the predetermined set of obligations; and (4) enforcement costs, including the costs associated with ex post bargaining and sanctioning a trading partner that does not perform according to the agreement. More related to this dissertation research, Clemons et al. (1993) divide transaction cost into coordination cost, operation risk, and opportunism risk[3]. The contingent value of a specialized resource (i.e., high in asset specificity) exposes its owner to a greater risk of opportunism than the owner of a generalized resource (Klein, Crawford, and Alchian, 1978). Thus, there is a need for certain governance mechanisms to prevent and/or reduce risks associated with operations and opportunisms.

There are different types of governance structure to prevent risks and opportunism. The term governance structure can also be called safeguards, which are mechanisms to bring about perception of fairness or equity among transactors. The purpose of safeguards is to provide, at minimum cost, the control and "trust" that is necessary for transactors to believe that engaging in the exchange will make them better off (Williamson, 1985).

The most prominent safeguard employed in Western economies is the legal contract. A legal contract specifies the obligations of each party and allows a transactor to go to a third party (i.e., courts/state) to sanction an opportunistic trading partner. For a low level of asset specificity, simple classic contracts are used which have low costs of writing, monitoring, and enforcing. As asset specificity increases, the costs associated with writing, negotiating, monitoring, and enforcing are becoming higher because of bounded rationality, situation

[3] These transaction costs will be discussed in detail in the later sections.

uncertainty, and complexity that prohibit complete contracts. As asset specificity increases to a certain point, hierarchy is necessary to guard opportunism. Other types of governance structure include self-enforcing agreements, "private ordering", or "trust" (Telser, 1980; Williamson, 1985; Sako, 1991). These self-enforcing safeguards include informal relational or goodwill trust (Dore, 1983; Bradach and Eccles, 1989; Sako, 1991) and reputation (Kreps and Wilson, 1982; Weigelt and Camerer, 1988), as well as formal financial hostages (Klein, 1980) and specialized investment hostages (Klein, 1980; Williamson, 1983). As with many other things, the setup of governance structure takes effort and commitment. Governance structure setup cost involves an initial, up-front investment that creates the safeguards, which in turn influence the ongoing transaction costs (i.e., bargaining, monitoring) in the continuing exchanges. Different safeguards are likely to have different set-up costs and result in different transaction costs over different time horizons.

Finally, as to the goals of the relationship governance management, Gulati and Singh (1998) propose the importance of both coordination and appropriation concerns in the supply chain relationships. Zajac and Olsen (1993) argue that transactors should also be concerned with maximizing transaction value through value creation rather than only with cost minimization. Transaction governance structure will influence the incentives of the transactors to engage in value creation such as "non-contractible" (e.g., innovation, quality, and responsiveness) and thus the effectiveness of the value creation. One good example is in the automotive industry. The willingness of auto suppliers to bring new ideas and new designs into their components design and production after initial design and production depends on whether the governance structure encourages them to invest into these innovations and makes sure they will be rewarded properly.

In addition to its increases with a higher level of asset specificity, transaction cost also changes independently from asset specificity because of other environment factors such as history, preferences, institutional environment etc. (Dyer, 1997). In any circumstance, however, Williamson (1985:Xiii) has argued that the central problem of economic organization is to "devise contract and governance structures that have the purpose and effect of economizing on bounded rationality while simultaneously safeguarding transactions against the hazards of opportunism."

Fundamentally, IS use in supply chain is a tool/channel that could and should be applied to implement the contracts and governance structures in order to better coordinate supply chain activities, create higher business value and more fairly appropriate profits. The first key linkage between IS use in supply chain and transaction cost is that IS use will reduce transaction costs such as coordination cost, operational risks, and opportunism due to IS's increasing information processing power, which can be used to monitor partners and coordinate with partners. The second key linkage is that IS is a more generic type of technology than other machinery or tools. This will reduce asset specificity, which, consequently, will reduce transaction cost and encourage more explicit coordination. These two linkages have been argued with theoretical deductions and supported empirically with anecdotes (Clemons et al. 1993).

2.2.3 Applications of Theoretical Perspectives on IS Use in Supply Chain

As mentioned in Chapter 1, some empirical studies have touched both competence based variables such as IS management leadership and IS infrastructure and relationship based

variables such as trust, joint problem solving and information exchange. Some insights have been proposed through these empirical studies. However, they do not have a comprehensive and in-depth theory grounded analysis and thus lack of the necessary rigor in research.

This dissertation builds on previous research and integrates these two perspectives to more thoroughly investigate the IOS use in supply chain phenomenon. Major objectives are to develop IS competence and relationship measures and find out the joint impacts of competence and relationship based variables on IOS use, IOS use's impacts on inter-firm transaction costs, explicit coordination, and buyer benefits. Extensive literature review and theoretical development will be presented after an overview of the research framework in the next section.

2.3 Research Framework: Overview

Our research framework is represented by Figure 2.3-1. IS competence (competence based view) and supply chain relationship factors (transaction cost based view) are regarded as input factors. IS use in supply chain, its impacts on transaction cost considerations (coordination cost, risk and opportunism), and explicit coordination are regarded as process variables. Buyer benefits[4] are regarded as the outputs. Key constructs and their relationships will be described in detail in the later sections.

IS competence and relationship variables are proposed to influence various process variables and these process variables have impacts on each other. Process variables will impact the component outsourcing success. These relationships are supported by some previous

[4] Sometimes we also use the term component outsourcing success to replace buyer benefits. These two terms are interchangeable in this dissertation.

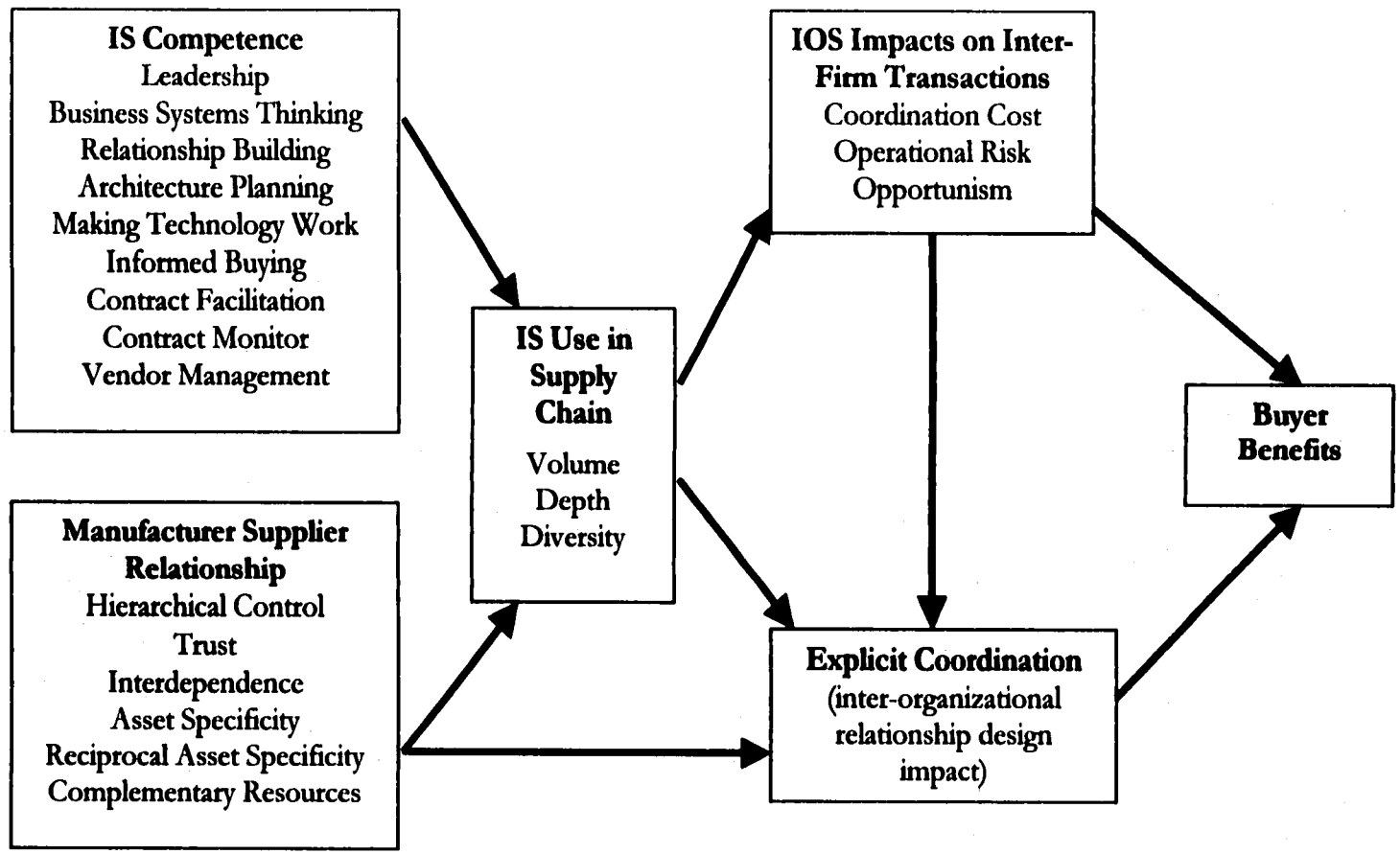


Figure 2.3-1 Research Framework

theoretical and empirical studies. One important case study (Upton and McAfee, 1996) points out that three dimensions need to be considered (i.e., stage of relationship between partners, IT sophistication, and level of required functionality) to describe the difficulty in building an information-sharing virtual factory. Their concept of IT sophistication is similar to the concept of IS competence or IT maturity. The stage of relationship is clearly the manufacturer-supplier[5] relationship used in the research framework. The level of required functionality is corresponding to the IS use in supply chain. We conceptualize this variable based on Massetti and Zmud (1996) including IS use depth, diversity, and volume. Upton and McAfee (1996) propose that a virtual factory should be able to support partnerships at all stages, allow firms with different IS sophistication to enter into this factory network securely but easily, and provide necessary IS functionality including data transmission, data access and tele-presence. Their case study and conceptualization imply that in order to be successful in the electronic age, supply chain firms with appropriate IS competence, supplier/customer relationships, IS use in supply chain, and explicit coordination are able to take advantage of the opportunities provided by the Internet economy. However, they do not have large-scale empirical research to test the relationships and there is no explicit management theory to back up their arguments. Cleary, this is an interesting and important research opportunity that will generate insightful findings.

The research model proposed in this section is stimulated by the early case study (Upton and McAfee, 1996) of a virtual factory. It is intended to integrate previous theoretical research in competence based and transaction cost based views and empirical research in IS competence,

[5] In this dissertation, manufacturers mean downstream firms and suppliers mean upstream firms. Manufacturers can be firms who produce material products or provide services.

manufacturer-supplier relationship[6], inter-organizational information system use and their impacts on explicit coordination, inter-firm transaction cost and buyer benefits into one holistic picture. We believe that this will help test relationships proposed in earlier case studies and provide evidences to illustrate the usefulness and complementary nature of the competence and transaction-cost based views.

2.4 Key Constructs: Their Definitions and Literature Review

2.4.1 IS Competence

2.4.1.1 Introduction

IS literature has developed a few conceptualizations and instruments for IS competence. The concept of IS competence has prominent origins and evolutes through intertwined theoretical conceptualizations, empirical case studies, and large scale empirical testing.

Churchill et al. (1969) use the concept of maturity to determine how managers use computer-based information systems. Nolan (1983) proposes there are six stages for IS maturity, namely, initiation, contagtion, control, integration, data administration, and maturity. Benbasat et al. (1980, 1984) develop a nine-item IT maturity instrument to classify firms into more mature and less mature groups. The stage of maturity can be regarded as IS competence with a higher level of maturity stage having a higher level of IS competence. The IT maturity concept is re-conceptualized as technology assimilation model by McFarlan (1984) including four stages (technology identification and investment, technology learning and adaptation, rationalization/management control and maturity/widespread technology transfer). Cooper and Zmud (1990) develop an IT implementation stage model including initiation, adoption, adaptation, acceptance, routinizartion, infusion. These stages try to capture to which degree IS

[6] Here in this dissertation, manufacturer-supplier relationship and supply chain relationships are inter-changeable.

is able to effectively contribute to organizational performance and used to its full potential (i.e., infusion). Clearly, firms may have different levels of management sophistication for different technologies. The IS competence of a firm, just like any other competence, is the historical accumulation of all the different maturity stages of various ITs in the firm.

Recently, Ross et al. (1996) define IS competence as the ability to control IT-related cost, deliver systems when needed, and effect business objectives through implementation, i.e., managing IS for organizational performance. Their IT assets include human assets, relationship assets and technological assets. Their human assets include IS staff's technical skills, their understanding of business processes, and the proactive attitude toward business problem solving. In a valuable relationship asset, IT and business unit management share the risk and responsibility for the effective application of IT in the firm through business partner ownership of and accountability for all IT projects, and top management leadership in establishing IT priorities. The technology asset consists of sharable technical platforms and databases. A valuable technology asset is essential for integrating systems and making IT applications cost effective in their operation and support.

Karimi et al. (1996) also develop an IT sophistication instrument including IT planning, IT control, IT organization, and IT integration capabilities and empirically test its impact on firms' responses to globalization. Teo and King's (1997) IS competence instrument consists of business knowledge of IS personnel and their IT capability, the computer facilities in the organizations, the reliability and efficiency of services provided by IS function, IS executive's ability to identify and plan for future challenges. They find that business competence of IS executive is the key factor in influencing IS-Business planning integration. Armstrong and

Sambamurthy (1999) find the significant impact of senior leadership knowledge (including CIO IT knowledge, CIO business knowledge, and top management IT knowledge), system of knowing (i.e., learning infrastructure for CIO, CEO, and other managers), strategic IT vision, and IT infrastructure sophistication on IT assimilation (i.e., support business strategy and value chain activities).

Based on three research strands (i.e., CIO roles, persona, and experiences; how target capabilities are delivered and the profile of the people who delivered them; and IS/IT outsourcing), Fenny and Willcocks (1998) propose nine IS core capabilities that a firm must possess to respond to recurring challenges over time. These nine IS core capabilities are leadership, business systems thinking, relationship building, architecture planning, making technology work, informed buying, contract facilitation, contract monitoring, and vendor management. These nine dimensions can be categorized into IS insourcing and outsourcing management with IS supply and demand management within each sourcing method and they are highly related to previous IS research in this area (e.g., Ross et al., 1996; Karimi, et al., 1996; Teo and King, 1997; Armstrong and Sambamurthy, 1999).

2.4.1.2 Leadership

Leadership is the capability of IS executives to integrate IS/IT effort with business purpose and activities (Feeny and Willcocks, 1998). Johnston and Carrico (1988) propose that leadership is both the vision to see the strategic opportunities and the personal force and persistence to overcome barriers to effective implementation. Earl and Feeny (1994) also propose that the added value from the CIO are obsessive and continuous focus on business imperatives (i.e., seeing the strategic opportunities), interpretation of external IT success

stories, establishment and maintenance of IS and business executive relationships, concentration of the IS development effort, and achievement of a shared and challenging vision of the role of IT (i.e., personal force and persistence to overcome barriers to effective implementation). Similarly, Feeny and Willcocks (1998) point out that effective IS/IT leaders devise the organizational structures and processes, put the capable people at the right place to address each challenging business area and to manage their interdependencies, set goals and direction for each challenging business area for IS, shape the values and culture of the IS function, influence the overall business perception of the role and contribution of IS/IT, build strong business/IT leaders relationship, and instill the belief that IS function's first duty is to contribute to achieving business solutions.

2.4.1.3 Business Systems Thinking

Business system thinking is capability of the IS executives and IS employees to understand the business process activities and their inter-relationships. This is the foundational capability for IS function to contribute to business performance through creatively redesigning business process, network and scope (Venkatraman, 1994). Teo and King's (1997) finding of the importance of IS mangers' business knowledge, Amstrong and Sarmarsarty's (1999) finding of the impact of CIO's business knowledge and knowing system on IT assimilation, Karami's et al. (1997) IT planning and integration dimensions of IS competence, and Ross's et al. (1996) conceptualization of human resource including IS personnel's understanding of business system all illustrate the convergence of different conceptualizations of this dimension of IS competence. Feeny and Willcocks (1998) find that managers are commonly concerned about the lack of progress in integrating business development with IS/IT capability. Many companies are still making investments to support aging and inefficient processes or adding

new processes that were designed without considering current IT capability. Thus, an above average level of business system thinking capability will definitely bring competitive advantages to the firm. Consequently, a thorough analysis of this dimension is necessary and required.

Business system thinking can be analyzed at both strategic and operational levels. At the strategic level, Henderson and Venkatraman (1993) propose a strategic alignment model for the integration of IT/IS strategy and business strategy. Chan et al. (1997) develop the realized IS strategy instrument and test the contributions of IS and business strategic alignment to both IS and business performance. Their empirical results clearly demonstrate the importance of aligning IS with business systems. Reich and Benbasat (1996) further articulate that the linkage between business objectives and IT objectives includes both intellectual (content) and social (mutual understanding between IS managers and business managers) aspects. Teo and King (1997) find that the business competence of the IS executive appear to be a key factor in influencing the extent of integration of business planning and IS planning.

At the operational level, Davenport and Short (1990) point out that new industrial engineers should focus increasingly on IT-enabled redesign of business processes and indicate that companies that can master the redesigning processes around IT will be well equipped to succeed in the new century. Venkatraman (1994) points out that the IT benefits accrue in those cases where IT investments accompany corresponding changes in organizational characteristics. The key here is to find out how the IT can change or transform business process. Thus, the capability of business process thinking definitely will both limit and enable the proposed IT impacts on business processes. Feeny and Willcocks (1998) also propose that, since experts in business systems thinking understand the connections and interdependencies

in business operations, they are able to build and communicate holistic views of the current organizational activities as a basis for envisioning new patterns and thus naturally leverage IS/IT capabilities for competitive advantage.

2.4.1.4 Relationship Building

Relationship building is the effort to get the business users constructively engaged in IS/IT issue (Feeny and Willcocks, 1998). Ross et al. (1996) regard relationship assets as one important dimension of IS competence. They find that "the more IT staff people and clients work together, the more they communicate, coordinate, negotiate, laugh, and cry together, up and down the hierarchy, the stronger the partnership becomes and the more effective both are planning, developing new applications, and using their current IT." Rockart et al. (1996) propose "the key people using IT in any organization are its functional, product and geographical line managers and thus their commitment to the IT/IS implementation will ultimately convert the new IS vision into business processes. IT personnel must develop strong, on-going partnerships with line managers". Nelson and Cooprider (1996) find that mutual trust and mutual influence between IS and line functions will impact IS performance through the mediation of shared knowledge between IS function and line function. This clearly illustrates the importance of relationship building between IS and line functions for IS success. In Teo and King's (1997) ten benchmark variables, there is a user participation aspect in information systems planning process, which also illustrates the importance of relationship building. Indeed, the whole research stream of end-user computing could be a testimony of the importance of relationship building.

Feeny and Willcocks (1998) point out that relationship building facilitates the wider dialogue

between business functions and IS communities. They propose that relationship building involves developing users' understanding of IT's potential, helping users and IT specialists work together, ensuring users' ownership and satisfaction, and enabling IS personnel better understand user needs. More importantly, relationship building should contribute to the creation of mutual confidence, harmony of purpose, and successful communication among those focused on the business and technical agendas

2.4.1.5 Architecture Planning

Feeny and Willcocks (1998) propose that architecture planning is the capability of the IS function to create a coherent blueprint for an administrative and technical platform that responds to both current and future business needs. They believe that architecture planners should develop the vision of an appropriate technical platform through insights into technology, suppliers, and business directions and formulate associated policies that ensure necessary integration and flexibility in IS services.

Broadbent, Weil, and Clair (1999) use a similar term IS infrastructure to conceptualize the IS architecture. Their definition of IS infrastructure contains (1) a set of infrastructure services that spanned organizational boundaries such as those between functions, business units, or firms (i.e., range), and (2) the ability of the infrastructure to reach particular constituencies inside and outside the firm to transfer information and process complex transactions (i.e., reach). Broadbent et al. (1999) contend that IT infrastructure is a firm resource that is difficult to imitate as it is created through a unique fusion of technology and human infrastructure. It is historical (path dependent), i.e., a firm's previous investments and its repertoire of routines both constrain and enable its future behavior. It is uncommon that different firms can have

same historical investments and development paths.

Even though architecture planning is sometimes outsourced, IT architecture planning cannot totally become IS suppliers' responsibility. As Earl (1996), Feeny and Willcocks (1998) and Larcity and Hirchheim (1993) point out, without in-house expertise, a company can not understand the viability of addressing new demands or the potential for meeting existing demands on a new technology platform with better economics. External suppliers place priority on moving to a lower cost platform unless it results in higher profits rather than lower revenues for the supplier. This point is also consistent with absorptive capacity argument by Cohen and Levinthal (1990), i.e., without enough in house research and development, it is difficult for firms to absorb new technology development because of path dependency.

2.4.1.6 Making Technology Work

It is the capability of IS personnel to rapidly achieve technical progress (Feeny and Willcocks, 1998). Ross (1996) regards technical skills as one dimension of his definition of human assets. Feeny and Willcocks (1998) propose that in an environment of complex, networked, multi-supplier systems, technical "fixers" make two critical contributions: they rapidly troubleshoot problems that do not belong to any other units, and they identify how to address business needs that can not be properly satisfied by standard technical approaches. Rocarkt et al (1996) point out that as companies purchasing packages from firms like SSA, SAP, Baan, IT staff must understand the system and adapt it to the platforms the firm can utilize, and troubleshoot code or table-driven procedures that were written outside the firm. Lee et al. (1995) clearly point out the increasing needs for skills and knowledge of technical specialties for IS managers in the future though technical skills and knowledge are not as important as technology

management, business knowledge, and interpersonal & management skills.

2.4.1.7 Informed Buying

It is the capability of IS purchasing personnel to manage the IS/IT sourcing strategy that meets the interests of the business (Feeny and Willcocks, 1998). They propose that informed buying involves analysis of the external market for IT/IS services, selection of a sourcing strategy to meet business needs and solve technology issues, and leading the tendering, contracting, and services management processes. Clearly, understanding business internal needs and technical criteria, insourcing and outsourcing options, and myths associated with outsourcing (Lacity and Hirschheim, 1993) are prerequisites of a successful buying.

2.4.1.8 Contract Facilitation

It is the capability of IS function to ensure the success of contracts for IS/IT services (Feeny and Willcocks, 1998). They point out that many users within the business receive various services from multiple supply points (external and internal) in detailed and lengthy service agreements and their interviewees point out " the users have been bitten a few times when they have dealt directly with suppliers." Feeny and Willcocks (1998) argue that contracts facilitation should provide a single point of contact through which the user can ensure that problems and conflicts are resolved fairly and promptly, within a framework of agreements and relationships. They also point out that although contract facilitation is sometimes set up to help manage excessive user demand and cost overruns with vendors, in general, it is a coordinating role that both vendors and users appreciate. Lacity and Hirchheim (1993) suggest that users should hire outsourcing experts to represent their interests. If the internal IS function can play this outsourcing expert role, this will definitely increase the firms' IS outsourcing effectiveness.

2.4.1.9 Contract Monitoring

It is the capability of the IS function to protect the business's contractual position over time (Feeny and Willcocks, 1998). They point out that while the contract facilitation works to make things happen every day, the contract monitoring ensures that business position is protected at all times and contract facilitation activities should be justified through monitoring IS service performance. They also propose that effective contract monitoring means holding suppliers to account on both existing service contracts and the developing performance standards of the services market. Lacity and Hirschheim (1993) also clearly point out that to successfully outsource IS, firms need to develop service level measures, develop service level reports, specify escalation procedures, include cash penalties for nonperformance, determine growth rate and adjust charges to changes in business. Clearly, all these monitoring practices are useful to ensure the IS service quality.

2.4.1.10 Vendor Development

It is the capability of IS function to identify and manage the potential added value of IS/IT service suppliers in the long run (Feeny and Willcocks, 1998). They point out that "the single most threatening aspect of IS/IT outsourcing is the substantial switching cost. It is in the company' interests to maximize the contribution of existing suppliers and also, when outsourcing, to guard against what we call mid-contract sag." Incentive system may be necessary to encourage IS suppliers to better contribute to the firm performance. They define vendor development as organizations looking beyond existing contractual arrangements to explore the long-term potentials for suppliers to create win-win situations in which the supplier increases revenues by providing services that increase business benefits. Vendor development is future-oriented and related to long-term success of the IS outsourcing.

2.4.1.11 Summary

Business system thinking is associated with IS demand management by providing the whole IS function with a thorough understanding of the intra- and inter- organizational processes which will be the carriers of various IS. Only through thorough system thinking, can IS managers and personnel find the opportunities for IS to enhance organizational performance. IS/IT leadership links IS supply and demand management through envisioning business opportunities (based on thorough business system thinking) that are enabled by IT and strategically allocate necessary resources to exploit these opportunities. Architecture planning is to transform the leaders' vision into a blueprint that will guide further implementation. Relationship building and making technology work focus on the IS supply management. For the sake of convenience, we could regard IS leadership, business system thinking, relationship building, architecture planning, and making technology work as IS insourcing competence. Obviously, informed buying, contract facilitation, contract monitoring, and vendor development are dimensions of IS outsourcing management. Informed buying is a necessary condition to implement the outputs of architecture planning through outsourcing. It is the linkage between IS demand and IS outsourcing supply. Other dimensions of IS outsourcing focus on IS supply management.

Loh and Venkatraman (1992) define IS outsourcing as the significant contribution by external vendors in the physical and/or human resources associated with the entire or specific components of the IT infrastructure in the user organization. They apply the degree of internalization of physical resources and the degree of internalization of human resources by the outsourcers as two dimensions to describe the degree of IS outsourcing. Firms can

outsource application development, data center, systems integration, systems design and planning, telecommunications/network, and outsource through timesharing. Different degrees of IS outsourcing can be project based or period based, or specific to a certain process or function. However, there are many risks associated with the IS outsourcing. Earl (1996) point out that weak management, inexperienced staff, business uncertainty, outdated technology skills, endemic uncertainty, hidden cost, lack of organizational learning, loss of innovative capacity, dangers of an external triangle, technological indivisibility and fuzzy focus are all negative effects related to IS outsourcing. Thus, with few firms being able to source IS totally internally, it is imperative for firms to develop the IS outsourcing capability to effectively use IS service market to facilitate its business process transformation in the revolutionary information technology markets.

Further, conceptually, IS insourcing capability will direct and influence the outsourcing capability since leadership, business system thinking, technical skills, IS-user relationships, and IS architecture planning provide the direction and organizational environment for the continuously successful outsourcing and they can not be replaced by outsourcing totally. Lacity and Hirchheim (1993) caution that outsourcing vendors are not necessarily strategic partners and more efficient than in house IS department. They point out that saving 10 to 50 percent can be achieved through insourcing. They also propose that whether or not a firm decides to outsource its IS function, the management of IS cannot be outsourced. This implies the importance of IS insourcing competence. An empirical research on the relationship between insourcing and outsourcing and their impacts on IS use, particularly in the supply chain, is interesting and promising. Table 2.4-1 is a summary of the 9 dimensions.

Table 2.4-1 List of Dimensions of IS Competence

Constructs	Definitions	Literature
IS Leadership	The capability of IS executives to integrate IS/IT effort with business purpose and activities	Rocket and Short, 1989; Feeny and Willcocks, 1998; King and Teo, 1997; Earl and Feeny, 1994
Business System Thinking	The capability of IS function to envision the business process that technology makes possible	Teo and King, 1997; Henderson and Venkatraman, 1993; Reich and Benbasat, 1996; Feeny and Willcocks, 1998; Davenport and Short, 1990; Venkatraman, 1994
Relationship Building	The efforts to get the business users constructively engaged in IS/IT issues	Ross, et al. 1996; Rockert, 1996; Nelson and Cooprider, 1996; Teo and King, 1997
Architecture Planning	The capability of the IS function to create a coherent blueprint for an administrative and technical platform that responds to both current and future business needs	Broadbent, Weill, and Clair 1999; Feeny and Willcocks, 1998;
Making Technology Work	The capability of IS function personnel to rapidly achieve technical progress	Feeny and Willcocks, 1998; Rockert et al. 1996; Lee et al. 1995
Informed Buying	The capability of IS purchasing personnel to manage the IS sourcing strategy that meets business interests	Feeny and Willcocks 1998; Earl, 1996
Contract Facilitation	The capability of IS function to ensure that problems and conflicts between users and IS service providers are resolved fairly and promptly	Feeny and Willcocks, 1998; Lacity and Hirchheim, 1993
Contract Monitoring	The capability of IS function to protect the business' contractual position over time.	Feeny and Willcocks, 1998; Lacity and Hirchheim, 1993
Vendor Management	The capability of IS function to look beyond existing contractual arrangements to explore the long term potentials for both its own firm and IS suppliers to create win-win situations	Feeny and Willcocks, 1998;

2.4.2 Manufacturer-Supplier Relationship

2.4.2.1 Introduction

Strategic alliance researchers define alliance as any voluntarily initiated cooperative agreement between firms that involves exchange, sharing, or co-development, and it includes contributions by partners of capital, technology, or firm-specific assets (e.g., Harrigan, 1986; Parkhe, 1993; Gulati, 1998). The relationship between component supplier and manufacturers is certainly one form of alliance. Gulai and Singh (1998) propose that three dimensions could be used to describe this relationship, namely, trust, hierarchical control and interdependence. Dyer and Singh (1998) propose that asset specificity, reciprocal asset specificity, and complementary resources are also important dimensions of the relationship. Asset specificity,

reciprocal asset specificity, and trust are important variables considered in transaction cost theory.

2.4.2.2 Hierarchical Control

The hierarchical control is the formal contractual structure participants use to formalize the mechanisms to cooperate between supply chain members. Prior research (Gulati and Singh 1998) has distinguished among different formal structures by evaluating the hierarchical elements they embody and the extent to which they replicate control and coordination features associated with organizations. The more there are hierarchical elements, the closer to an organization the inter-firm governance structure is (Williamson, 1985; Pisano, Russo, and Teece, 1988; Pisano, 1989; Gulati, 1995).

The need for hierarchical control in supply chain relationship is due to two types of concerns, namely, appropriation concerns and coordination concerns (Gulati and Singh, 1998). While appropriation concern is the main focus of traditional transaction cost economics (i.e., operational risks and opportunisms, originated from information asymmetry, small number of suppliers, asset specificity, loss of control of resources), Gulati and Singh (1998) believe that coordination concern, which is originated from the interdependence of the activities that span across organizational boundaries, is also very important. The logic for hierarchical controls as a response to appropriation concern is based on their ability to assert control by fiat, provide monitoring, and align incentives. The logic underlying the concern for coordination cost is their ability to provide superior task coordination, especially in situations involving high inter-dependence and coordination (Thompson, 1967, Barnard, 1938; Chandler, 1977).

Gulati and Singh (1998) empirically find the impacts of coordination and appropriation concerns of alliance partners on the extent of hierarchical elements in the governance structure. Galbraith (1977) also proposes that hierarchical control is a superior device for processing information originated from complex division of labor and the consequent required ongoing mutual adjustments.

Prior research on governance structure has only applied equity or non-equity to classify governance structures (Gulati and Singh, 1998). This approach masks the differences among different degrees of equity sharing (i.e., different degrees of hierarchical control). In alliances, hierarchical controls institutionalize, or formalize, interactions between partners (Van de Ven, 1976). Cooperative relationships among partners without traditional hierarchical controls are more complicated than internal coordination. Thus, designing hierarchical control into the inter-firm relationship is to reduce the risks and the loss of control of resources and facilitate coordination.

Gulati and Singh (1998) point out that hierarchical control elements include (1) a command structure and authority systems to put it in place, as well as systems for certifying which communications are authoritative, (2) incentive systems that facilitate performance measurement and link rewards to performance, (3) standard operating procedures that allow quick decisions to be made by anticipating those decisions in advance, (4) dispute resolution procedures that bypass courts and markets by specifying a hierarchy of entities or individuals to which appeals can be made, (5) non-market pricing systems, such as cost-plus systems, which enable greater precision in remuneration when changes in specification are made. These hierarchical elements are present to varying degrees for different governance structures.

As to a command structure and authority systems to put it in place, as well as systems for certifying which communications are authoritative, it is very difficult to write a complete contract because of the uncertainty in the market, technology, and organizational evolutions and thus clear command structure is not easily set up. Grossman and Hart (1986), Hart and Moore (1990), and Hart (1988) propose the theory of incomplete contracts. They point out that certain variables may be non-verifiable by a third party, such as a court or an arbitrator, even though they may be observed by parties entering in the relationship, in the sense that these parties can take actions and make decisions based on the outcomes of these variables. For example, when judging a supplier's effort to innovate in jointly developing a new product, both the focal firm and its supplier may be able to observe whether adequate innovation has been realized compared with industry norms and technological developments, but it may be impossible to demonstrate this to the satisfaction of a court. Thus the degree of the incompleteness of a contract is in reverse relationship with the hierarchical control of a governance structure. A high degree of contract incompleteness will imply a low level of hierarchical control in the relationship.

2.4.2.3 Trust

Hagen and Choe (1998) define trust as the expectation that the promise of another can be relied on and that, in unforeseen circumstances, the other will act in a spirit of cooperation with the trustor. As Arrow puts it, " Virtually every commercial transaction has within itself an element of trust" (1972: 357), which is certainly true of any transaction conducted over a period of time. Because it is impossible to monitor every detail in most exchanges, firm must always have a minimum level of trust (Das and Teng, 1998). Ring and Van de Ven (1992)

propose trust as a second source of confidence in partner cooperation besides control. Trust is especially valuable in alliances because, in varying degrees, firms have to rely on their partners' performance and remain vulnerable to partners' performance (Kumar, 1996). Transaction on the basis of trust, with its implicit, pre-existing and unspecified conditions for cooperation, economizes on the specification and monitoring of contracts (Nooteboom, 1996). Trust is extremely difficult to imitate and thus should be one source of sustainable competitive advantage. Mudambi and Helper (1998) argue that the strategic advantages of cooperative buyer-supplier relations can only be realized through an inter-temporal process, which takes the nature of the historical relationship into account (i.e., a process of building trusting relationship). North (1990) also proposes that trust among trading partners may facilitate the creation of relational rents.

2.4.2.4 Interdependence

Alliances are usually formed to create value in a way that each partner alone could not. Different logics for value creation require distinctly different levels of coordination (e.g., task decomposition and division of labor) among the partners (Borys and Jemison, 1989:241). The difficulties associated with decomposing tasks and specifying a precise division of labor across partners in the alliance require ongoing communication and decisions. Thompson (1967) points out that the level of interdependence could best encapsulate this concern. Gulati and Singh (1998) suggest, at one extreme, an alliance may have a simple division of labor with minimal ongoing adjustments that require each partner to share information about the progress of its initiatives for the partnership to achieve strategic goals; at the other extreme, the likely interdependence can be extensive, resulting from the anticipation of a complex and overlapping division of labor that will entail continuing mutual adjustments between partners

and require each partner to link specific activities with those of other partners closely and regularly.

In the manufacturer-supplier relationship, the most important exchanges are for product design and production management. For manufacturer, the degree to which that it depends on suppliers' cooperation to successfully design the products and the degree to which the manufacturer will depend on the supplier's on time delivery of high quality components and services in the right sequence at the proper time and place decide its dependence on the suppliers. Conversely, the supplier's dependence on the manufacturer is decided by the degree to which the supplier depends on the manufacturer places orders early enough for the supplier to fulfill the required delivery on time and the degree to which the supplier depends on the manufacturer's orders for its survival or success.

2.4.2.5 Asset Specificity/ Reciprocal Asset Specificity

Various supplier firms with different specific characteristics and features (e.g., firm history, culture, and alliance experiences) have unequal competence to understand and learn from a specific manufacturing firm and adapt to the emergent needs of the manufacturer. Asanuma (1989) develops a concept called relation-specific skill required on the part of the supplier to respond efficiently to the specific needs of the manufacturer firm. Formation of this skill requires that learning through repeated interactions with a particular manufacturer firm be added to the basic technological capability that the supplier has accumulated. Dyer and Singh (1998) also propose the concept of partner specific absorptive capacity that refers to the idea that a firm has developed the ability to recognize and assimilate valuable knowledge from a particular alliance partner. This capability is a function of the extent to which partners have

developed overlapping knowledge bases and the extent to which partners have developed interaction routines that maximize the frequency and intensity of socio-technical interactions. These partner-specific capabilities/assets are investments that will become less valuable if either of the firms in the relationship switches its partner. Similarly, reciprocal specific assets are those assets invested by the focal firm's partner. As described in the theoretical foundations, asset specificity is a key concept in transaction cost based theory.

2.4.2.6 Complementary Resource Endowments

Complementary resource endowments are defined as distinctive resources of alliance partners that collectively generate greater rents than the sum of those obtained from the individual endowments of each partner (Dyer and Singh, 1998). But they do not have the characteristics of partner specificity. In some instances a firm's ability to generate rents is depending on the co-utilization of its alliance partner's complementary resources. Complementary resource endowments have been the focus of much prior discussion on the formation and management of alliances and have been discussed widely as a key factor driving returns from alliances (Hamel, 1991; Harrigan, 1985; Hill and Hellriegel, 1994; Shan, Walker, and Kogut, 1994).

The differences between specific assets and complementary resource endowments are implicitly distinguished in Dyer and Singh (1998). Specific assets are applied in order to significantly adapt the firm's parts, operational routines, documents, skills and knowledge to the partner's demands. They will become less valued if the focal firm changes partners. Complementary resources are those distinct resources that need not be adjusted to partner's demands as specific assets do. Even though the focal firm may lose the synergistic effects of complementary resources when the focal firm changes its partner, these resources are still very

valuable. One clear example is the cooperative relationship between Nestle and Coca-Cola to distribute hot canned drinks through vending machines (a business largely unknown outside of Japan). There are complementary resources from both partners (i.e., Nestle's brand names and competence in developing and producing soluble coffee and tea products and Coca-Cola's powerful vending machine network (Hamel and Prahalad, 1994:187)). Suppose the cooperative relationship is broken, Nestle's brand name and competence on developing and producing soluble coffee and tea products are still very useful and valuable. So is Coca-Cola's powerful vending machine network in Japan and around the world. These competence and assets are complementary resources rather than specific assets.

2.4.2.7 Summary

In summary, the supply chain relationship could be described through these six dimensions. Interdependence is the motivation of initiating and maintaining this relationship. The interdependent nature of the supply chain relationship requires the ongoing adjustments and communication among cooperative members in terms of procedures, equipments, facilities, people's skills, production plans, etc. Complementary resources are also a kind of motivation for this relationship due to the desire for synergistic effects. These resources represent the accumulation of unintentional investments (relative to the partner) by firms over years of evolution and growth. They naturally become valuable and synergistic resources in this evolutionary process. Thus, they motivate firms to set up partnerships to explore these synergistic effects. Specific assets and reciprocal specific assets are intentional investments to execute the relationship processes to accomplish predefined goals by the firm and its partner. The higher the degree of the interdependence, the higher the level of the specific assets

investments by the firms in the relationship. The goal is to more effectively accomplish the interdependent economic activities.

Both trust and hierarchical control are sources of confidence that the firm has on its partner to take actions to benefit both parties rather than other opportunistic actions to exploit the relationship. The higher the level of interdependence, and consequent asset and reciprocal asset investments, the higher the level of trust and hierarchical control are needed to make the interdependence come true. Clearly, trust and hierarchical control complement with each other. Zaheer and Venkatraman (1995) propose that if trust is measured before the setup of hierarchical control, there should be a negative relationship between these two variables because a high level of trust could be itself enough to guarantee mutual benefits. However, if hierarchical control is set up to build up trust, there should be a positive relationship between these two variables. This is because a high level of hierarchical control is necessary to institute a certain type of order to make the transactions succeed over time and thus build up trust. While, there are some relationships among these six variables, together, they describe different aspects of the relationship between supply chain members. Table 2.4-3 is a summary of all the dimensions described in the following sections.

Table 2.4-2 List of Sub-Constructs for the Manufacturer-Supplier Relationship

Constructs	Definitions	Literature
Hierarchical Control	The extent to which the relationship replicate the control and coordination features associated with organizations	Gulati and Singh, 1998; Williamson, 1985; Pisano, Russo, and Teece, 1988; Pisano, 1989; Gulati, 1995a; Grossman and Hart, 1986; Hart and Moore, 1990; Hart, 1988; Thompson, 1967, Barnard, 1938; Chandler, 1977;. Galbraith (1977: 93); Van de Ven, 1976
Trust	The expectation that the promise of another can be replied on and that, in unforeseen circumstances, the other will act in a sprit of cooperation with the trustor	North, 1990; Hagen and choe, 1998; Ring and Van de Ven, 1992; Arrow, 1972; Das and Teng, 1998; Kumar, 1996; Nooteboom, 1996; Nahapiet and Ghoshal, 1998;
Interdependence	The complexity of ongoing coordination of activities to be completed jointly or individually across organizational boundaries and the difficulties associated with decomposing tasks and specifying a precise division of labor across partners in the alliance represent the degree of interdependence	Thompson, 1967; Gulati and Singh, 1998
Asset Specificity	Those assets that are not as valuable as before when the relationship with the partner is broken. These assets are invested by the focal firm.	Williamson, 1985; Dyer and Singh, 1998; Asanuma, 1989
Reciprocal Assets Specificity	Those assets that are not as valuable as before when the relationship with the partner is broken. These assets are invested by the focal firm's partner.	
Complementary Resource Endowment	The distinctive resources of alliance partners that collectively generate greater rents than the sum of those obtained from the individual endowments of each partner without the characteristics of partner specificity	Dyer and Singh, 1998; Hamel, 1991; Harrigan, 1985; Hilland Hellriegel, 1994; Shan, Walker, and Kogut, 1994; Teece, 1987

2.4.3 IOS Use in Supply Chain[7]

Clearly, IS use is the necessary condition for IS to contribute to organizational performance. Delone and Mclean (1992) propose a sequence of six categories of information system success, which includes system use. They define system use as the recipient consumption of the output

[7] In this dissertation, **IOS** use in supply chain is interchangeable with **IS** use in supply chain.

of an information system. Saarinen (1996) also includes IS use into their extended IS success construct. While there are many research papers investigating IS use at the intra-organizational end user level (See review by Doll and Torkzadeh, 1998), research on IS use at the inter-organizational level is limited. In the following, we first have a brief discussion of two types of inter-organizational information systems and then discuss IOS use in supply chain and its measurement.

2.4.3.1 IOS Types

Malone et al. (1987) propose two types of inter-organizational electronic systems including electronic market system and electronic hierarchy system. Electronic market system automatically links the firm to many other supplier or customer firms. Electronic hierarchy system links those firms with predefined relationships. Similarly, Bakos (1991a) distinguishes the information link from the electronic market. He proposes that an inter-organizational information link is an IOS at the interface of the value-added chains of a supplier and a customer in a vertical market, representing an investment in bilateral integration. An electronic marketplace is an IOS that allows participating buyers and sellers to exchange information about market prices and product offerings, representing an investment in multilateral information sharing. The key distinction between information link and electronic market is that the former exists in a bilateral setting where a relationship between a supplier and a customer has already been established, while the latter functions in a multilateral setting with the goal to establish bilateral buyer-supplier relationships. Real world systems are usually a combination of information link and electronic market systems (i.e., an IOS can have both e-market functions and e-hierarchy functions such as IOS for the bank which includes buyer-supplier matching functions – e-market function and account management – information link

between the bank and the customer). After a bilateral relationship has been established, e-market system is basically same as information link (i.e., e-hierarchy). Kumar and van Dissel (1996) classify inter-organizational information systems into three types (i.e., pooled information resource IOS, value/supply chain IOS, and networked IOS). Clearly, all these three type of IOS could be the combination of e-market and e-hierarchy depending on the relationships among participating firms are pre-defined or established through the electronic systems.

Theoretically, electronic market system may have a higher volume of transactions between suppliers and customers due to its wide reach, but electronic hierarchies may have a higher level of depth and diversity of transactions with predefined customers and suppliers. For electronic hierarchy system to increase the number of partners in the system, firms need to negotiate beforehand. Electronic market system can be regarded as the same as the electronic hierarchy system after a relationship have been built through this system. Empirical research on electronic links among firms has already emerged and IS use in supply chain instrument has been developed through case studies and survey studies.

2.4.3.2 Measurement of IOS Linkage

Massetti and Zmud (1996) propose four dimensions of EDI use based on case studies. The four dimensions are depth, diversity, breadth, and volume[8]. Depth means the degree of inter-penetration of partners' business processes through IOS. Breadth means the degree to which the firm has electronic links with its partners. Diversity means the number of different business documents and transactions completed through IOS. Volume means the amount of

[8] Breadth will not be included in this research model because of the survey design. See details in Chapter 3.

documents and transactions completed through IOS. Truman (2000) proposes the concept of interface integration that means the integration between EDI systems and firm internal systems and is similar to Massetti and Zmud's (1996) depth dimension. Angeles and Nath (2000) develop three levels of EDI implementation measurement, which is similar to Massetti and Zmud's depth dimension of the IS use in supply chain. The highest level is the use of inter-organizational information systems to reengineer intra- and inter- organizational processes. Choudhury et al. (1998) propose that electronic market could have identification, or/and selection, or/and execution functions with more functions having a deeper level of IS linkage between firms in the supply chain. Ng et al. (1998) report their studies on World Wide Web use in 300 randomly selected web sites and find an increasing sophistication in use as well as increasing diversity of business sectors. But majority of the companies are still using Web site as a marketing tool rather than transaction facility, implying a lower level of IS depth linkage between supply chain firms. Hart and Saunders (1998), based on Massetti and Zmud's (1996) conceptualization, develop EDI use measurement items for volume and diversity. Together, some researchers have already investigated different types of electronic links and their business implications. Table 2.4-3 is a summary of the three dimensions of IOS use.

Table 2.4-3 List of Sub-Constructs for IS use in Supply Chain

Constructs	Definitions	Literature
Volume	The extent to which a firm's document exchanges are handled through IOS	Massetti and Zmud, 1996
Diversity	The extent to which different type of a firm's business documents are handled through IOS	
Depth	The extent to which a firm's business processes are interwined with those of its trading partners through IOS	
Breadth	The extent to which a firm has developed IOS with each of its trading partners	

2.4.4 Inter-Firm Transaction Cost in Supply Chain

Clemons et al. (1993) divide transaction cost into coordination cost, operation risk and opportunism risk. These three dimensions of the inter-firm transaction cost will be discussed in the following sections.

2.4.4.1 Coordination Cost

Clemons' et al. (1993) coordination cost includes the cost of exchanging information on products (e.g., price, product characteristics, and product availability and demand) and incorporating that information into decision process, the cost incurred by the firm due to delays in the communication channel, the cost of sharing design changes rapidly, the cost of informing and being informed of changes in delivery schedules of the product.

As to these coordination costs, Gulati and Singh (1998) propose that they originate from the complexity of ongoing coordination of activities to be completed jointly or individually across organizational boundaries. Clemons et al. (1993) argue that some causes of coordination cost

are uncertainties regarding the delivery times of specified quantities of the component, the availability of the component, the supplier's ability to customerize the outsourcing component to meet specific demands on short notice, and the actions taken to reduce uncertainty or to mitigate its effects.

2.4.4.2 Operation Risk

Clemons et al. (1993) define operation risk as the risk that the other parties in the transaction willfully misrepresent or withhold information, or under-perform (i.e., shirk) their agreed-upon responsibilities. It originates from differences in objectives among the parties and is supported by information asymmetries between parties, or by difficulties in enforcing agreements. Examples are the inabilities of measuring supplied component quality (based on which supplier may under-perform) and incomplete or unenforceable contract where partners cannot provide enough evidence to the satisfaction of a court even though each party in the relationship is aware of the shirking.

2.4.4.3 Opportunisms

Williamson (1985) defines opportunism as self interest seeking with guile. Opportunism originates from the difference in bargaining power between prior special investments and after making these special investments. The firm that makes the special investment is locked in the relationship, otherwise it has to take the prohibitive switching cost. Three sources of opportunism have been identified in transaction cost literature and management literature. First, relationship specific investment exposes the firm to the opportunistic behavior of its partner. For example, customer may ask to renegotiate a contract once the supplier has already invested specific assets such as dedicated machineries. Second, a small number of component suppliers are another source of opportunism since after the firm and its suppliers have

invested into specific assets, the firm may find it difficult to switch to other suppliers quickly due to fewer alternative options and this may increase the monopoly power of the few suppliers. Third, the possibility of loss of resource control, especially for information and knowledge intensive resources, is also one important factor for opportunism. For example, a manufacturer may find that its competitors may quickly use its proprietary product technology or production technologies or even its supplier may turn into its competitors. Bakos and Brynjolfsson (1993) argue that in order to get full benefits from the manufacturer–supplier relationship, it is necessary for the supplier to increase investment in non-contractible resources such as quality, innovation, and information sharing. These non-contractible resources are originated from bounded rationality that produces only incomplete contracts. They argue that it requires buyers to reduce the number of suppliers to add incentives to suppliers. However, this increases chances for opportunistic behavior.

2.4.4.4 Summary

In summary, coordination cost is the cost associated with task execution. Operational risk is the cost of willfully under performing the tasks in production/service process as required in the contracts. Opportunism is the cost associated with renegotiation of the contract or breakdown of the relationship. Clearly, coordination cost is related to coordination concern. Opportunism is related to appropriation concern. Operational risk is in between and related to both coordination concern due to misrepresentation of information and appropriation concern due to the impact of this misbehavior on the bottom line. Table 2.4-4 is a summary of these three dimensions of inter-firm transaction cost.

Table 2.4-4 List of Sub-Constructs for Inter-firm Transaction Cost

Constructs	Definition	Literature
Coordination Cost	The cost associated with on going communications and decisions through IOS	Clemons et al., 1993; Gulati and Singh, 1998
Operation Risk	The risk that the other parties in the transaction willfully misrepresent or withhold, or under-perform their agreed-upon responsibilities	Clemons et al., 1993;
Opportunism	Self interest seeking with guile originated from the difference in bargaining power between the prior special investments and after making these special investments	Williamson, 1985; Clemons et al., 1993;

2.4.5 Explicit Coordination

Explicit coordination is the extent to which decisions are coordinated through processes and information that are specific to the relationship. Clemons et al. (1993) clearly define explicit coordination as the degree to which operational decisions are integrated between economic activities across organizational boundaries. They argue explicit coordination is quite different from ownership. The purpose of explicit coordination is to increase resource utilization and value. Similarly, Bensaou (1997) define inter-organizational cooperation[9] as the joint efforts by buyer and supplier firms to design product and process, coordinate quality and delivery, and train and educate personnel. However, the downside of the explicit coordination/inter-firm cooperation is to expose the focal firm to opportunistic behavior by the other party. Table 2.4-5 is a summary of the definition of explicit coordination and previous research.

[9] Here in this dissertation, explicit coordination is equivalent to inter-firm cooperation and joint effort. They are interchangeable.

Table 2.4-5 Definition and Literature of Explicit Coordination

Constructs	Definition	Literature
Explicit Coordination	The extent to which decisions are coordinated through processes and information that are specific to the relationship.	Clemons and Row (1992); Clemons et al. (1993). Bensaou, 1997

2.4.6 Buyer Benefits

Whether an economy is efficient or not is decided by the benefits buyers can obtain in the economic transactions. The inefficient system is where the suppliers obtain most of the consumer surplus (Grover and Ramanlal, 1999). Grover et al. (1996), based on previous research, develop a comprehensive instrument to measure IS outsourcing success including strategic factors, economic factors, and technological factors, which we will adapt to our use in this dissertation for the construct of buyer benefits. The following are the descriptions of these factors.

Strategic factors: (1) Focus on core business. Since companies are often distracted from their fundamental strategic thrusts in the marketplace by the ongoing impediments associated with an increasingly innovative, complex component design and production, outsourcing allows companies refocus their business efforts towards critical component design and production. Outsourcing allows companies refocus their limited engineers on product/process development activities that promote final product competitiveness. (2) Enhanced product development and production competence. Since product development and production are the key competence for manufacturing firms, outsourcing allows the manufacturer leverage the competence of one or more specialized component suppliers without internalizing all the required competence. (3) Enhanced product development and production staff expertise. Through the inter-firm relationships, engineers can learn from partner's engineers on

technologies and even administrative systems. And thus engineers can improve their capabilities.

Economic factors: (1) Through outsourcing, component supplier may be in a position to exploit economies of scale and/scope in areas of equipment, facilities, and human resources since it may have many customers. This may not be available to the manufacturer. (2) With the outsourcing component, the cost structure is becoming predictable since there are usually clear contract. One study by Stern and Kaufmann (1985) points out that the actual and potential benefits of EDI that manufacturers and distributors listed, are (a) reduced order lead time; (b) higher service levels; (c) fewer out of stock situations; (d) improved communication about deals, promotions, price changes, and product availability; (e) lower inventory costs; (f) better accuracy in ordering, shipping, and receiving; and (g) a reduction in labor costs. These benefits are most likely cost associated.

Technological factors: Access to leading edge technology. Outsouring allows the manufacturer to gain immediate access to otherwise unavailable state-of-the-art technology. This increases the manufacturer's competitiveness in delivering final product. Naturally, outsourcing allows the manufacturer to avoid the obsolescence risk if the manufacturer can access the leading technology. Table 2.4-6 is the summary of three dimensions of the strategic payoff (i.e., buyer benefits).

Table 2.4-6 List of Sub-Constructs for Effects of Reduced Cost and Risk

Constructs	Definitions	Literature
Strategic Success	Focus on core business, enhanced product development and production competence, and enhanced product development and production staff expertise	Grover et al. 1996
Economic Success	Economy of scale and scope , Clear cost structure	
Technological Success	Access to leading edge technology	

2.4.7 Summary

This section discussed all the theoretical constructs in the research model through extensive literature review and integration. These discussions lay down the foundations to investigate the relationships among these constructs in the next section.

2.5 Theoretical Model: Hypotheses

The theoretical model proposes that IS competence (including IS leadership, business system thinking, relationship building, architecture planning, making technology work, informed buying, contract facilitation, contract monitoring, and vendor management) is positively related to IS use in supply chain (including depth, volume, and diversity). Manufacturer-supplier relationship (including hierarchical control, interdependence, trust, asset specificity and reciprocal asset specificity, complementary resources) is positively related to both IOS use and explicit coordination in supply chain. IOS use will be able to reduce inter-firm transaction cost and increase explicit coordination. The impact of IOS to reduce inter-firm transaction costs will be positively related to both explicit coordination and buyer benefits. Finally, explicit coordination is positively related to buyer benefits. The following table and figure summarize the hypotheses.

Table 2.5-1 List of Hypotheses of the Research Model

Hypotheses
Hypothesis 1: IS competence is positively related to IOS use in supply chain
Hypothesis 2: The manufacturer-supplier relationship is positively related to IOS use in supply chain
Hypothesis 3: The manufacturer-supplier relationship is positively related to explicit coordination
Hypothesis 4: IOS use in supply chain impacts inter-firm transactions
Hypothesis 5: The more IOS use in the supply chain, the more the explicit coordination between supply chain members
Hypothesis 6: The higher the impact of IOS use on inter-firm transactions, the more the explicit coordination between supply chain members
Hypothesis 7: The higher the impact of IOS use on inter-firm transactions, the higher the buyer benefits
Hypothesis 8: The explicit coordination between supply chain members is positively related to buyer benefits

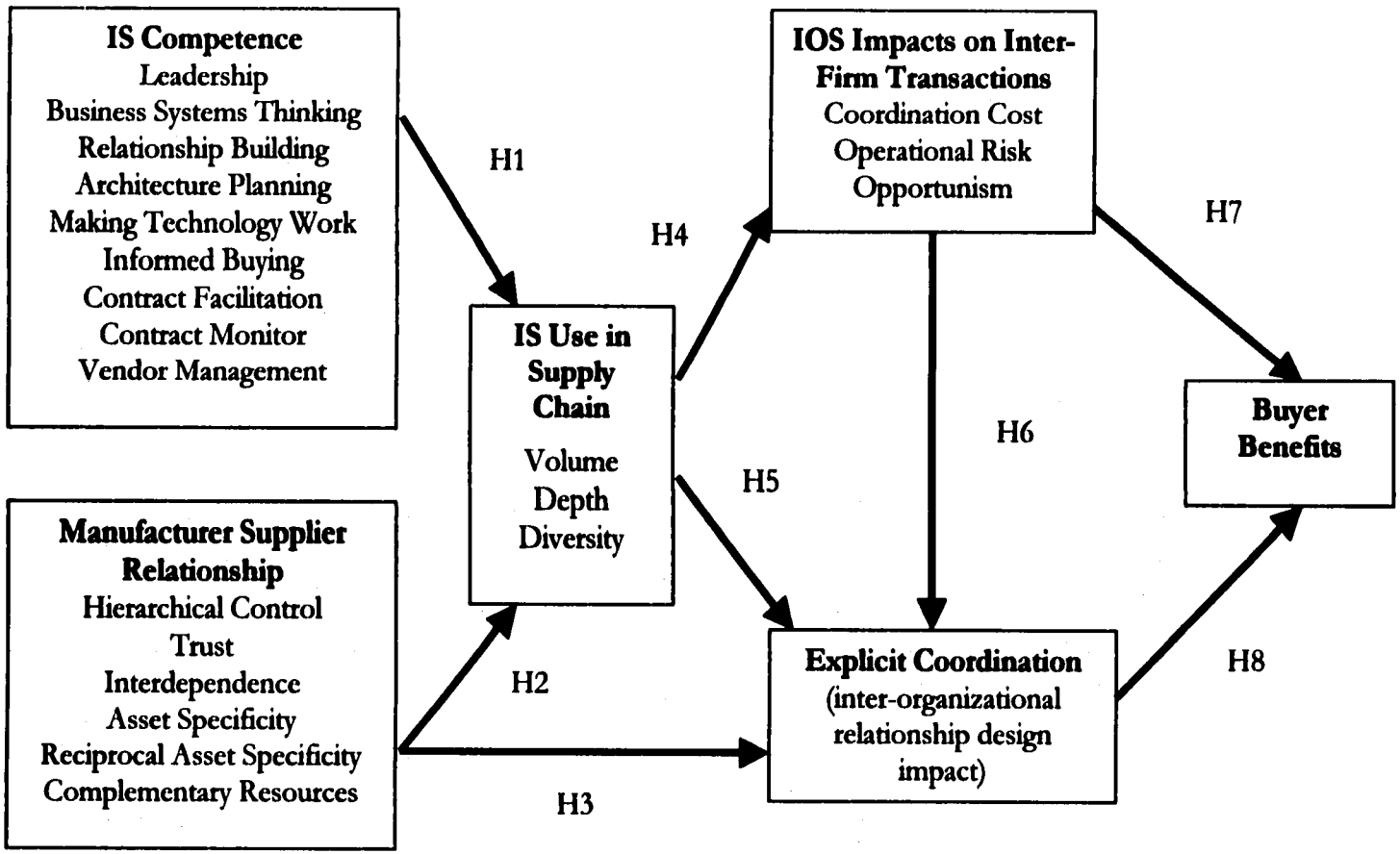


Figure 2.5-1 Hypotheses

2.5.1 Hypothesis 1: IS Competence is Positively Related to IOS Use in Supply Chain

IS competence will significantly influence the appropriate user involvement and participation in IOS development, effective IS and line function relationship for IOS implementation, tight linkage between inter- and intra- organizational information systems for better organizational performance, healthy IOS outsourcing, and IOS use enabled business opportunity capturing for advancing business strategies. Prior empirical research based on competence/resource-based view has already shown this competence-IOS linkage.

Copeland and McKenney (1988) point out three implications for the strategic use of inter-organizational information systems based on their study of the airline industry. First, a large installed processing capacity (i.e., physical competence which is a part of IS infrastructure) can be a source of economies of scale and scope. Second, an established technical competence can be a necessary requirement for gaining competitive advantage, and finally, the sustainable advantage need not be the result of extraordinary vision, but the result of the consistent exploitation of opportunities revealed during the evolution of adaptable systems (i.e., IS leadership and business system thinking). Lindsey et al. (1990) find four factors are critical to the success of TELCOT (an electronic market system in cotton industry). First, TELCOT was initiated and championed by responsive but visionary management (i.e., IS leadership). Second, the producers, one of the project's major stakeholders, were eager for change and powerful enough to encourage all the other necessary users (gin operators and buyers) to participate in the system (i.e., relationship competence). Third, there were capable people to effectively manage to develop the system (i.e., making technology work-IS personnel level). And finally, the information systems team was structured to facilitate communication and problem solving so that all members were pulling together to develop the system (i.e., making technology work-

IS function level). Srinivasan et al. (1994) find that the coordination for increased frequency and timeliness of JIT (just in time) shipments can be facilitated substantially using EDI (Electronic Data Interchange). Suppliers with the capacity to electronically receive shipment schedules and integrate the information into their internal systems have sharply lower shipment errors. This illustrates the important impacts of internal information system architecture and its interface with IOS on the benefits of IOS, and further, these benefits motivate more IOS use to enhance business performance. All these research papers together demonstrate the linkage between IS competence and IS use in supply chain. Thus, we have:

Hypothesis 1: IS competence is positively related to IOS use in supply chain.

The following parts are detailed theoretical analysis of this linkage between IS competence and IOS use in supply chain. IS leadership contributes to both setting up an appropriate context (i.e., strategic direction, policies, procedures, etc.) for the IS and user function to identify business opportunities and allocating necessary resources to implement IS designs properly and timely. IS leadership is the linkage between IS demand management and IS supply management. Copeland and McKenney (1988) point out the success of SABRE is the result of consistent exploitation of opportunities (i.e., management competence) revealed during the evolution of adaptable systems. Lindsey et al. (1990) find TELCOT is initiated and championed by responsive but visionary management (i.e., IS leadership). Clearly, there is a relationship between IS leadership and IOS use in supply chain.

Business systems thinking is the foundational capability for IS and user function to find ways of enhancing current business process efficiency, reengineering business processes, redesigning business networks, and redefining business scopes (Venkatraman, 1994). It is a process of

creative destruction and may both extend/expand the existing useful capabilities/assets and destroy the existing obsolete capabilities/assets (Schumpter, 1942). Business system thinking enables firms to dynamically and appropriately adapt, integrate, and reconfigure internal and external organizational skills, resources, and functional competence to match the requirements of a changing environment for both internal and inter-organizational business processes.

Business system thinking is also required for constant organizational learning. To understand and design a business process is to exploit existing knowledge to routinely modify business processes incrementally or/and explore new knowledge to creatively transform business processes radically (March 1991). This learning perspective makes business system thinking especially important for creative use of inter-organizational information system. The history of American SABRE clearly demonstrates the evolutionary path of the impact of management's learning and thinking process on their strategic movements. Clark and Stoddard (1996) through case study of manufacturer, wholesaler, and retailer relationship find that a merger of technological and process change is needed to achieve dramatic performance improvements both within the organization and with channel partners. They point out that inter-organizational business process design, in the form of Customer Replenish Process (CRP) using EDI, represents a dramatic performance improvement for the channel overall, benefiting both retailers and manufacturers. Their research implies the importance of business system thinking/learning for leveraging other IS competence (i.e., technological competence). Venkatraman (1994) also repeatedly emphasizes, "IT's potential benefits are directly related to the degree of change in organizational routines (strategies, structure, processes, and skills)." This implies that business system thinking is critical.

Further, it is this business system thinking capability that really differentiates the internal IS staff and external IS service provider. Better and unique understanding of intra-firm business processes and the interaction processes between the focal firm and out side customers and suppliers by the IS function may give the focal firm an edge over other firms in terms of using IOS more effectively, since this understanding is kind of sticky tacit knowledge that is not easy to be imitated by other competing firms.

Relationship building between IS function and line function has long been proposed as one important dimension that will influence IS use and consequently on IS performance. As Rockart et al. (1996) argued: " The key people using technology in any organization are its functional, product, and geographical line managers. They provide the strategic and tactical direction and the commitment to implementation that converts visions of new systems into improved organizational processes. Thus, IT personnel at all levels must develop strong, on-going partnerships with line managers. Only through these relationships can the necessary communication occur to ensure that both business and technology capabilities are integrated into effective solutions for each level of the business." Clearly, for inter-organizational information system to contribute to business efficiency and effectiveness, user acceptance and active involvement are critical for IOS effective use.

Architecture planning is the capability of the IS function to create a coherent blueprint for an administrative and technical platform that responds to both current and future business needs (Feeny and Willcocks, 1998). Architecture planning provides a proper IS platform (both administrative and technical) based on which applications are built.

Webster (1995) provides the example of Fordnet. While over 50 percent of its German suppliers are able to integrate the EDI messages from Fordnet with their own in-house computing applications, most of its Spanish suppliers have low levels of office automation and simply view and print Ford's EDI messages and thus EDI has no impacts on the internal operations and only means extra expenses. This illustrates the IS infrastructure's impact on the degree to which firms could take full advantage of IOS. Broadbent et al. (1999) find that all firms need a basic level of IT infrastructure capability to implement business process redesign (BPR) and firms with a higher level of IT infrastructure capabilities, are able to implement extensive changes to their business process over relatively short time frames. They suggest that before embarking on any form of BPR, managers should complete a business audit of their IT infrastructure capabilities, since these capabilities have important impact on the speed and nature of business process redesign. Clearly, their research implies the importance of a proper IT infrastructure for a successful IOS enabled inter-organizational business process redesign.

Recent research by Truman (2000) points out that the linkage between interface integration (i.e., the linkage between EDI and internal information systems) and internal system integration are positively related. Thus, different IS infrastructures (i.e., representing different degrees of internal system integration) will support IOS use in supply chain in various ways. Together, all these papers propose that there is a positive relationship between IS architecture planning and IOS use in supply chain.

Making technology work is critical for smooth routine operations and promptly fixing uncertain IS breakdowns to meet the needs in line functions. Further, with the rapid development of new technologies, there is an imperative challenge for firms to absorb

emerging new technologies and apply those technologies to its business processes appropriately and timely. The capability of making technology work will facilitate the assimilation process of new technology. Cohen and Levinthal's (1990) research on absorptive capacity clearly point out that firm's own R&D will impact absorptive capacity, which will influence the assimilation of extra-industry knowledge. Their research supports the argument that firm's making technology work competence will impact firm's capability to absorb new technology developments and successfully apply those technologies into their business process and network redesign. Clearly, technologies used to develop IOS are changing dramatically over last several decades. Thus, the capability of making technology work will certainly facilitate IOS use and its integration with internal systems.

Informed buying, contract facilitation, contract monitoring, and vendor development are new competence dimensions emerged from IS outsourcing. These dimensions certainly will influence IS use efficiency and effectiveness through ensuring IS service buyers to obtain the required services, and IS service providers accountable on their agreements, and continuously updating the contracts according to the new trends and opportunities. Clearly, with the development of the increasingly complex IOS-enabled business operations, no single firm is able to source all its IS internally. Firms have to develop IS outsourcing capabilities to use IS service market to facilitate its business process transformation, especially at the inter-organizational processes level. The fact that major big automobile companies contract with Oracle and Commerce One to develop auto-exchange demonstrates the importance of IS outsourcing for business-to-business e-commerce (i.e., IOS use in supply chain). Thus, a higher level of IS outsourcing capability will be positively related to IOS use in supply chain.

In summary, the relationship between IS competence and IOS use in supply chain is theoretically supported.

2.5.2 Hypothesis 2: The Manufacturer-Supplier Relationship Is Positively Related To IOS Use In Supply Chain

Dyer and Singh (1998) propose a relational view on competitive advantage and lay the theoretical foundation for us to argue the important role of relationship for the IS use in supply chain. They argue that relational rents are possible when alliance partners combine, exchange, or invest in idiosyncratic assets, knowledge, or resources/ capabilities, or/and employ effective governance mechanisms that lower transaction cost and permit the realization of rents through the synergistic combination of assets, knowledge, or capabilities. Their main thesis is that the relationship is one important source of competitive advantage over other firms without this kind of inter-firm relationship or with only inferior quality of this relationship. Moran and Ghoshal (1999) also propose that exchanges through relationships not only facilitate the continual reallocation of resources to more productive uses, but also changes and reprioritizes the services that are possible and/or motivated for each party and stimulate the perception of new combinations. Thus, exchanges influence the nature and extent of the potential that is created in the first place, thereby influencing the ultimate path that the process of value creation takes for the economic system as a whole.

Inter-organizational information systems are certainly one important element for implementing the proposed inter-organizational relationship exchange mechanisms by facilitating information exchanging and knowledge sharing. On the one hand, relationship factors as a whole are the institutional environment within which inter-organizational information systems are used to enhance/reengineer supply chain relationships. On the other hand, within the

relationship context, IOS can modify or/and transform the relationship process. This is to say that inter-organizational systems are technologies designed and implemented to operationalize the relationships among partners in the alliance. The structurability of the relationship can be programmed and embedded in the IOS (Kumar and Dissel, 1996). The fundamental function of IOS is as a medium and channel for the socialization, externalization, internalization, and combination of information and knowledge between partner organizations. Agents of manufacturers and suppliers can complete business transactions effectively through IOS. Without these activities, organizations just cannot survive, let alone prosper.

Williams (1997) investigates the relationship between inter-organizational relationship (IOR) and inter-organizational information systems (IOS). He applies Oliver's (1990) dimensions to classify IOR into hierarchical, solar, centreless and swingle. His research points out the critical linkage from IOR to IOS and the importance of inter-organizational relationship asset. Webster (1995) discusses the design and implementation of electronic data interchange in a major UK motor manufacturer to illustrate the way in which powerful users seek to have their interests articulated in information systems and highlight the economic, political and culture factors that have conditioned the design and use of this system. Riggins and Mukhopadhyay (1994) also propose that without supplier's internal integration of IOS with intra-organizational information systems, the buyer cannot reap the full benefits of the IOS implementation. They point out that firms need to engage in business partner reengineering and suggest that buyers with substantial leverage over their suppliers may require trading partners to implement the system in a particular way or not be considered for future business. Their study illustrates the potential impact of interdependent benefits on the buyer's ability to reap expected benefits from the buyer-initiated system. Chatfield and Yetton (2000) directly point out the important

impact of relationships (i.e., the degree of trust, joint problem solving and information exchange among IOS participating firms) on the EDI embeddedness, which, in turn, will modify the strategic payoff of the IOS initiator.

Venkatraman (1994) also point out "there is absolutely no evidence that deploying proprietary inter-organizational systems per se provides any competitive advantage". He finds in his insurance industry data that the agents who have redesigned their business processes to exploit the interfacing functionality performed significantly better than those agents who simply automated their inefficient business processes. To redesign intra- and inter- organizational business processes requires changes in procedures, skills, and roles of all related firms. This implies the difficulties embedded in the use of IOS. Hence, at the inter-organizational business process redesign level, without a cooperative relationship environment, IOS use in supply is difficult.

All the above empirical research clearly illustrate the relationship between supply chain members is an important social (institutional) capital (Nahapiet and Goshal, 1998) based on which mutual benefits are gained by supply chain members through IS use in supply chain. Thus, an appropriate IOR motivates IS use in supply chain.

Hypothesis 2: The manufacturer-supplier relationship is positively related to IOS use in supply chain.

The following parts are detailed analysis of the linkage between supply chain relationship and IOS use in supply chain. Hierarchical control elements in the supply chain relationship clearly point out both the roles/ procedures of each partner and the associated information necessary

for successful coordination. They have the characteristics of explicit knowledge (Zack, 1999). Truman (2000) points out that the inter-organizational boundary–spanning role could be characterized as either routine, formal, and programmed (i.e., mechanical coordination mode) or non-routine, informal, and ad hoc (i.e., human coordination mode). Those hierarchical control elements are clearly the elements in the mechanical coordination mode. Thus, they are easier to be coded into inter-organization information systems and retrieved than implicit knowledge. Since inter-organization information systems make it possible for firms to access and manage their partners' various processes, products, procedures, planning and operating data (i.e., explicit knowledge), more hierarchical control elements will motivate more use of IOS to reduce coordination costs and associated risks.

Without doubt, trust is one critical element of social capital (Nahapiet and Ghoshal 1998) in the supply chain relationships. Different degrees of trust among supply chain members will definitely influence their use of inter-organizational information systems to exchange proprietary and sensitive information and share knowledge such as production plan, new product design, cooperative technology development etc.

Zaheer and Venkatraman (1994) empirically find that trust positively related to electronic integration in insurance industry. Hart and Saunders (1998) find that with trust, firms would increase their EDI use in terms of volume and diversity, which may be not possible without its existence simply because EDI use may be related to procedural changes that introduce certain vulnerabilities for an EDI partner. One good example is that, on the one hand, using EDI may increase the number of orders and decrease the customer safety stock level and thus make the customer more dependent on the supplier. On the other hand, the supplier may be taking the

risk of customer's inflated demand forecast that will make the supplier waste its production capacity and inventory. Trust can mitigate these vulnerabilities by allowing firms to take advantage of the otherwise risky new opportunities for improving inter-firm cooperation, which requires an openness to change that might prove more "costly" to certain partner.

Meier (1995) proposes that participation in an IOS should not be viewed as a zero-sum game but rather as a challenge in mutually beneficial management of relationships among IOS participants and trust is a key ingredient in establishing and maintaining a successful IOS because of the mutual dependency of system participants and the ensuring coordination requirements. He also agues that technology can be copied easily, but a trusting relationship is an enormous asset that is not easily imitated by competing firms and thus the introduction and usage of an IOS should be based not only on short term assessment of cost or functional advantage but on a long term perspective on the relationships between IOS participants. Kumar and van Dissel (1996) also points out that inter-organizational information systems are "human activity systems" and therefore subject to all the risks and foibles of joint human endeavor. They argue that the sheer variety of reciprocal relationships would require the use of human agents and mechanisms such as trust to identify, assess, and manage the dynamically occurring risks in this networked IOS situation.

Thinking in a different way, Ghoshal and Moran (1996) argue that transaction cost economics (TCE) is bad for practice for the reason of TCE being too pessimistic about human nature to be cooperative. While opportunism is certainly one important aspect of human nature, a balanced and realistic view must also be embedded into our research, i.e., one that requires a certain degree of circumspection and distrust and simultaneously justifies a certain portion of

esteem and confidence. This self-esteem and confidence will certainly encourage IS use for knowledge and information sharing in supply chain. Clearly, this self-esteem and confidence could be transformed into trust with which firms could comfortably cooperate without wholly depending on hierarchical control. Thus, trust encourages partners to share more operational information such as inventory level, production plan as well as product design, new technology and strategic plans. Consequently, inter-organizational system, as a medium and channel, is certainly encouraged by trust.

Interdependence is the degree to which supply chain members are dependent on mutual adjustments and coordination for business success. Thompson (1967, p. 58) points out: "with pooled inter-dependence, action can proceed without regard to action in other positions ... With sequential inter-dependence, however, each position in the set must be readjusted if any one of them acts improperly ... With reciprocal interdependence ... the actions of each position in the set must be adjusted to the actions of one or more others in the set". Cleary, as pointed by Galbraith (1977), the higher the degree of interdependence among partners, the greater the amount of information they must process while the alliance is in progress. IOS, as a channel for communications between partners in the supply chain, clearly has an important role to facilitate interdependent inter-organizational business processes.

Rockart and Short (1989) propose that information technology provides a new approach to manage the oldest organizational problem: the interdependence (i.e., the concurrence of effort along multiple dimensions of the organization). Managerial strategies based on optimizing operations within functional departments, product lines, or geographical organizations will simply not be adequate in the future. Since inter-organizational information systems are

designed to exchange information and have the operationalized relationship activities embedded in it, the more interdependent the supply chain members are, the higher the motivation for those firms to use IS to coordinate with each other in order to be more efficient and effective.

A firm may choose to seek advantages through investments into capabilities/ assets/resources that are specialized in conjunctions with the assets/resources/capabilities of its alliance partners (Klein, Crawford, and Alchian, 1978; Teece, 1987). Productivity gains in the value chain are possible when firms are willing to make relational specific investment (Perry, 1989; Williamson, 1985). Dyer (1996) finds a positive relationship between relation-specific investments and performance in a sample of automakers and their suppliers. Saxenian (1994) points out that Hewlett Packard and other Silicon Valley firms greatly improved performance by developing long-term partnerships with physically proximate suppliers that greatly facilitates the collaboration required for fast-changing and complex technologies. Parkhe (1993) proposes that the commitment of "non-recoverable investments" in a sample of strategic alliances was positively related to performance. However, higher asset specificity will expose focal firms in high risk of opportunistic behavior (Willisomson, 1985)

Following this line of thinking, Zaheer and Venkatraman (1995) propose that a high level of business process asset specificity creates an increased requirement for the governance to offset the dependence caused by such specific assets. Put differently, a higher degree of dependence due to higher investments made in business processes (e.g., human assets, physical assets and site assets) requires that the relationship include greater safeguards to make sure their transaction specific assets will not be appropriated opportunistically.

Based on their belief that IS can significantly reduce the cost of communication, increase monitoring power and facilitate market transaction, Clemons et al. (1993) propose that inter-organizational information system has the power to safeguard the risks associated with asset specificity. For example, BZW, a major integrated securities firm, appears to place its customers in a position of vulnerability by brokers' reliance upon system TRADE (provided by BZW) for pricing as well executing their customers orders. However, information technology provides utterly reliable monitoring that prevents BZW from shirking and offering less than best performance (Clemons, et al. 1993). The procedures used by those brokers and their trust on TRADE system can be seen as specific assets they have with BZW. Without information technology linking brokers and BZW, there will not be so much reliance on one single securities firm. Thus, there is a positive relationship from asset specificity to IS use in supply chain. Indeed, Zaheer and Venkatraman (1994) empirically find that asset specificity is positively related to electronic integration in insurance industry.

As to reciprocal specific assets (that is invested into the relationship by the focal firm's partner), following the logics in asset specificity, they will definitely encourage the focal firm's partner use inter-organizational information systems to coordinate with the focal firm for benefiting from its investments. While reciprocal investments, as a kind of hostage, have reduced the needs of the focal firm for safeguards (Heide and John, 1988), which will, in turn, de-motivate the focal firm to use IS in supply chain to monitor its partners' behavior and reduce operational risks (Zaheer and Venkatraman, 1994), there are also cooperative benefits for the focal firm to use IS in supply chain to coordinate with its partner when its partner is more cooperative. This seems to have been attested by Zaheer and Venkatraman's (1995)

empirical finding that rejects their hypothesis that there is a negative relationship between reciprocal investments and electronic integration[10].

Though complementary resources are not relationship specific assets, it can also significantly contribute to supply chain performance through synergistic effects. Since IS use in supply chain enhances coordination of economic activities among members, it may be able to help realize the potential synergistic effect from complementary resources. Hence, complementary resources may motivate supply chain members to intentionally use IS to promote the synergistic effects.

In summary, based on the above discussions, the linkage between the supply chain relationship and IOS use in supply chain is supported.

2.5.3 Hypothesis 3: The Manufacturer-Supplier Relationship Is Positively Related To Explicit Coordination

As mentioned earlier, explicit coordination is the degree to which operational decisions are integrated among economic activities by two independent firms through processes and necessary information. Hierarchical control clearly defines the procedures for coordinating between supply chain members and it also points out the dispute resolution procedures in case of opportunistic behavior from the partner, thus it will facilitate explicit coordination and safeguard the opportunism exposed to explicit coordination partners.

Trust is the degree to which one side could reliably depend on the other side's promise and cooperative behavior. It is significantly impacted by the historically accumulative relational

[10] They find the sign is negative but it is not statistical significantly and the new data set may support the reverse hypothesis.

interactions between partners. Uzzi (1996) find that trust, not the contract, act as the governance mechanism of highly embedded relationships. Trust facilitates voluntary, non-obligating exchanges of organizational resources, services, and information between firms. This reinforces exchanges of sensitive information and productive joint problem solving such as product design and planning. Clearly, a higher level of trust in the relationship will encourage a higher level of explicit coordination since the opportunism generated by explicit coordination is believed to be low. Interdependence is the degree to which there needs continuous adjustments, communications, and decision-making in the repeated business transactions in the supply chain. A higher level of interdependence clearly motivates more explicit coordination in order to benefit both of the upstream and down stream members.

Asset specificity is supposed to be used to generate a higher level of productivity through specialization. With specific assets, firms should have better tools/procedures to coordinate and collaborate on joint projects. Since reciprocal investments by the focal firm's partner will reduce the focal firm's needs to safeguard its own specific assets, this may encourage the focal firm to invest more specific assets into the relationship to be more cooperative and effective. These mutual investments may generate positive feedback cycles and thus, stimulate even more explicit coordination.

Further, on the one hand, complementary resources may motivate firms in the relationship to cooperate in order to maximize the mutual synergistic benefits since without more explicit coordination, the synergistic effects cannot be fully achieved. On the other hand, the nature of complementary resources, due to their stable value even without the relationship with their

partners, make firms not so afraid of their partners' opportunistic behaviors. Thus, this may encourage firms to be more cooperative.

Zaheer and Venkatraman (1995) investigate the relationships from trust, asset specificity, and reciprocal investments to quasi-vertical integration and joint action. Their results show positive relationships between trust and quasi-vertical integration, trust and joint action (which is similar to explicit coordination), asset specificity and quasi-vertical integration, quasi-vertical integration and joint actions. Their empirical findings clearly support our argument on the relationship in supply chain and explicit coordination. Thus, we propose:

Hypothesis 3: The manufacturer-supplier relationship is positively related to explicit coordination.

2.5.4 Hypothesis 4: IOS Use In Supply Chain Impacts Inter-Firm Transactions

Malone et al. (1987) propose that use of IT will significantly reduce coordination cost between firms. Clemons, Reddi, and Row (1993) also point out that information technology can reduce the coordination cost since IT reduces the unit cost of both communicating and reacting to information. Further, as pointed out by Galbraith's early observation that firms can substitute information flows for excess capacity or slack in other resources, improving forecasting and reducing order cycles can reduce safety stock inventory, and slack-manufacturing capacity[11] can also be reduced if planning and scheduling are improved. Thus, with the increasingly decreased cost of computer technologies and the increasingly powerful computer systems, IS use in supply chain will certainly decrease the coordination cost.

[11] We could regard these as coordination cost

Clemons et al. (1993) propose that the increased information availability and processing capacity of IT enable operations risk to be reduced through improved monitoring and incentives alignments. Early information technology researcher Zuboff (1984) points out the monitoring (informating) effect of IT in factories besides automating effect. Since IT can be applied to improve the capability of firms to monitor their partners' behavior and accordingly adjust the rewarding system, information technology will definitely reduce the information misrepresentation or withholding or under-performance against agreement. Examples are that computers can be used to maintain records of the delivery performance of the supplier or information regarding complaints about the supplier (Clemons et al. 1993). Systems may also be linked to production processes and schedules of the supplier to monitor the quality of the supplied products. Hence, any under-performance, shirking, or information misrepresenting will be detected and this certainly prevents partners from doing these again. Increased information processing capacity also reduces operation risk by enabling more effective incentive structures. This is manifested in the relationship between manufacturer and retailers through using the checkout scanner system such that manufacturers precisely know where and when their products are going and in what prices (Clemons, et al. 1993). The information will help manufacturer decide the division of promotion benefits with retailers while helping better supply retailers. Thus, there is a negative relationship from IS use and operation risk.

Opportunism originates from three sources, namely asset specificity, loss of resource control and small number of partners (Clemons et al. 1993). IS has been clearly proposed to reduce asset specificity and electronic market makes it very easy to shift suppliers at a very low searching cost (Bako, 1991b). But it is unclear empirically whether it will increase or decrease

the possibility of loss of resource control. Consequently, opportunism due to asset specificity and small number of suppliers will be reduced. Opportunism due to the loss of resource control could be reduced depending on the IS design and IS policies and procedures.

As to the relationship to the asset specificity, information technology is somehow different from other traditional specific investments because of its open technological standards, reusable software, intuitive human-computer interface, and compatibilities for different versions of packages. These features make information technology less transaction specific than traditional assets such as equipment, machinery, and tools (Clemons, et al, 1993). One good example is that McKesson Drug' Economost system does not increase McKesson's monopoly power since drug stores can easily switch to alternative system without incurring much cost due to the less specific IT investment and the availability of other Drug supplier such as Bergen Brunswig. Although IT cannot be said as not-specific assets, it has already reduced the specificity to a great extent and thus reduces the opportunisms.

As to the IT impact on the loss of resource control, there is no clear theoretical argument. On the one hand, IT makes knowledge and information more codified and thus easy to be copied and used by other parties. On the other hand, IT has very strong capabilities to secure that only those authorized personnel can access certain information. IT management competence will certainly influence this loss of control of electronic information and expertise by design proper systems and policies and implement them appropriately. Since in general IS management is becoming more sophisticated, we believe that firms could better utilize IS capability to control the loss of resources through IOS. Thus, there is a negative relationship from IS use to opportunism.

In summary, based on the above discussions, we propose:

Hypothesis 4: IOS use in supply chain impacts inter-firm transactions.

2.5.5 Hypothesis 5: The More IOS Use In the Supply Chain, The More The Explicit Coordination Between Supply Chain Members

Venkatraman (1994) contends, "IT has become a fundamental enabler in creating and maintaining a flexible business network." It enables two levels of inter-organizational business transformation: (1) business network redesign, which refers to the redesign of the nature of exchange among multiple participants in a business network and (2) business scope redefinition, which refers to redefining the corporate scope (e.g., what is done inside the firm, what is obtained through special partnerships and related arrangements, etc.). Bakos (1991a) proposes that an information link can improve coordination at the interface between a customer and its suppliers, creating efficiencies such as better management of inventories and improved data and information sharing. He also proposes that electronic market system promotes the match of buyers and suppliers and facilitates transactions. Clearly, both information link and electronic market enhance the coordination among suppliers and buyers. Consequently, even without reducing coordination cost, operation risk, and opportunism, IS use in supply chain will definitely enhance the explicit coordination between supplier and buyers due to the opportunities provided by its intentionally designed physical functionality (such as business network redesign, business scope redefinition, and matching of buyer and supplier). Some empirical evidences have already been generated to verify this relationship. Even though not all of them prove its validity, none of the empirical research has invalidated this relationship.

Short and Venkatraman (1992) highlights the fact that although initial benefits from IT comes from the redesign of business process internal to AHSC and Baxter (namely, order entry, delivery turnaround, etc.), the new emphasis is on assuming the materials management activities of customers (hospitals) and thereby redefining the business roles of the firm as well as the business scope. Teo et al. (1997) find that Trade Development Board of Singapore has taken advantage of the TradeNet (i.e., a well-established EDI system in Singapore) opportunity to drastically transform not only its own organizational structure and business processes, but also its business network and business scope for better coordination of business activities. Chatfield and Bjorn-Anderson (1997) find that JAL's time based competitiveness has been improved through its IOS-enabled inter-firm joint product innovation cycle time reduction. Vijayasarathy and Robey (1997) empirically test the relationship from EDI use through channel intensity, formalization and information quality to channel cooperation and conflict. They find positive relationship from EDI use through channel intensity and formalization to channel cooperation. Their findings support the argument that EDI use improves cooperation between trading partners and leads to greater satisfaction and performance in electronically mediated business transactions. Kambil and Short (1994) apply role-linkage perspective to analyze the tax preparation and return market. They find that electronic integration significantly increases the roles and linkages of industry players, implying more explicit coordination, and thus, the business network has been redesigned. Holland (1995) finds that IOS use enhances the cooperative relationships in the textile industry and the competitiveness of the whole supply chain.

Bensaou (1997) uses the phrase - degree of buyer-supplier cooperation - to describe to which degree there exists explicit joint effort and cooperation between two companies in the areas of long range planning, product planning, product engineering (component design), process engineering, tooling development, technical assistant, and training/education. He finds IS use in supply chain significantly and positively related buyer-supplier cooperation and explain a significant portion of the cooperation variance in the Japanese data but not significant positive in American data though[12]. Prosser and Nickl (1997) investigate the impacts of EDI on inter—organizational integration from transaction cost based view. Their results show that open EDI furthers market coordination by reducing asset specificity and by making additional partners available, but the degree of inter-organizational integration and mutual dependence is not necessarily reduced by the use of open EDI systems.

Clearly, all these studies point out that IS use in supply chain has positive impacts on the explicit coordination in the supply chain through business network redesign and business scope redefinition (i.e., expanding /extending /enhancing /refining inter-organizational processes). Thus, we propose:

Hypothesis 5: The more IOS use in the supply chain, the more the explicit coordination between supply chain members.

[12] This may be due to the time he gathered his data when American firms just started to explore the benefits of Japanese cooperative relationships.

2.5.6 Hypothesis 6: The Higher The Impact Of IOS Use On Inter-Firm Transactions, The More The Explicit Coordination Between Supply Chain Members

Clemons et al. (1993) propose that there would be more explicit coordination with fewer suppliers and less need for ownership under the condition of reduced coordination cost, risk and opportunism through IS use in supply chain (i.e., interactions among partners will go to the middle between market and hierarchy). This is consistent with Willamson's (1975) argument that increased explicit cooperation will expose the focal firm to its partner's opportunistic behavior and thus, if IOS use could reduce cost, risk, and opportunism, then this reduction will certainly encourage explicit coordination until the cost, risk and opportunism level match the explicit coordination level at the margin. Thus, we have:

Hypothesis 6: The higher the impact of IOS use on inter-firm transactions, the more the explicit coordination between supply chain members.

2.5.7 Hypothesis 7: The Higher The Impact Of IOS Use On Inter-Firm Transactions, The Higher The Buyer Benefits

Reduced inter-firm transactional coordination cost, operational risk and opportunism clearly reduce the total cost for both the buyer and supplier to execute the existing inter-firm transactions. If we assume both of the total buyer sales and supplier sales keep stable, this implies increased buyer and supplier benefits. Further, this increased buyer/supplier benefits may stimulate partners in the transactions to design even better transactional mechanisms to further reduce the inter-firm transaction costs, risks, and opportunistic behavior, which may generate even higher levels of buyer/supplier benefits. Thus, with focus on buyer benefits, we have,

Hypothesis 7: The higher the impact of IOS use on inter-firm transactions, the higher the buyer benefits.

2.5.8 Hypothesis 8: The Explicit Coordination Between Supply Chain Members Is Positively Related To Buyer Benefits

Clearly, increasing explicit coordination among supply chain members will, on the one hand, enhance the synergistic utility of limited resources from partner firms by eliminating waste and focusing resources on the business activities with more benefits, and on the other hand, the scarce resources such as managerial attention could be allocated to other more important areas for enhancing organizational performance by outsourcing routine business through the explicit coordination (Williamson, 1985; Penrose, 1959). Dyer and Singh's (1997) relational view for competitive advantage also support the relationship between explicit coordination and buyer benefits (i.e., outsourcing success). For example, Chatfield and Bjorn-Anderson (1997) find that JAL's collaboration with IOS-transformed virtual value chain firms significantly contributed to JAL's business growth and competitiveness such as customer service, sales, value chain logistics coordination, and cost reduction. Moran and Ghoshal (1999) point out the dual roles of exchange – to facilitate the continual reallocation of resources to more productive uses (i.e., combinations) and to change and reprioritize the services that are possible and/or motivated for each party and thus stimulate the perception of new combinations. Clearly, more explicit coordination means more exchanges between partners. Thus we have,

Hypothesis 8: The explicit coordination between supply chain members is positively and significantly related to buyer benefits.

2.6 Chapter Summary

The chapter is intended to build theoretical arguments for later empirical tests. Competence based and transaction cost based theoretical views are first presented. An overview of the research framework is then provided. Key constructs are introduced through extensive literature review and integration. Relationships among key constructs are subsequently hypothesized based on substantive theoretical, case, and survey studies. The next three chapters will be the instrument development and hypotheses testing.

3 INSTRUMENT DEVELOPMENT AND RESEARCH MODEL VALIDATION AND -- PHASE ONE

3.1 Introduction

This chapter will report measurement items generation, field interviews, a pretest, and a pilot study. First, construct measurement items are generated based on previous relevant theoretical and empirical research. These measurement items are used in the interview stage to explain to those managers the meanings of the theoretical constructs at an operational level. Second, through interviews, the researcher wants to test the validity of the interested constructs and their sub-dimensions and the relationships among those constructs (i.e., research model) in the real field context. Third, a pretest is used to solicit comments, suggestions, and ideas for improving the quality of measurement items. Fourth, a pilot study is used to further test the quality of the measurement items. This is to ensure that items entering into the final large-scale study will be reliable and valid since the cost of a large-scale survey is very high and quality measurement items are the basis for a good research.

3.2 Item Generation

Proper generation of measurement items of a construct fundamentally determines their content validity. Content validity means the measurement items cover the content domain of a theoretical construct (Churchill, 1979). A list of initial items was generated based on a comprehensive review of literature. The general literature basis for the items in each construct will be discussed in the following paragraphs.

IS competence is the ability to control IT-related costs, deliver systems when needed, and effect business objectives through implementations (Ross, et al. 1996). Fenny and Willcocks' (1998) nine IS core capabilities are used to represent the sub-dimensions of the IS competence construct. IS leadership and business systems thinking measurement items are generated based on Feeny and Willcocks, 1998, and King and Teo, 1997; relationship building measurement items are generated based on Feeny and Willcocks, 1998, and Ross, et al. 1996; architecture planning on Broadbent, Weill, and Clair 1999, and Feeny and Willcocks, 1998; making technology working on Feeny and Willcocks, 1998, and Rockert et al. 1996; informed buying on Feeny and Willcocks 1998, and Earl, 1996; contract facilitation, contract monitoring, and vendor management measurement items are generated based on Feeny and Willcocks, 1998, and Lacity and Hirchheim, 1993.

Relationship between supply chain members is the structure and process for the interactions between the manufacturer and the supplier's economic activities (Zaheer and Venkatraman, 1995). It includes hierarchical control, trust, interdependence, asset specificity and reciprocal asset specificity, and complementary resource endowment (Dyer and Singh, 1998; Gulati and Singh, 1998; Zaheer and Venkatraman, 1995; Asanuma, 1989). Hierarchical control measurement items are generated based on Gulati and Singh, 1998; Trust on Nooteboom, 1996; interdependence on Gulati and Singh, 1998; relationship-specific assets and reciprocal assets on and Asanuma (1989); and complementary resource measurement items are generated based on Dyer and Singh (1998).

Information systems use in supply chain is the organizational use of IOS to exchange information in order to complete business transactions with business partners. Massetti and

Zmud's (1996) IOS use depth, diversity, and volume are used as the three sub-dimensions[13]. The measurement items of these three sub-dimensions are generated based on Massetti and Zmud (1996), Hart and Saunders (1998), and Angeles and Nath (2000).

Explicit coordination is the extent to which decisions are coordinated through processes and information that are specific to the relationship (Clemns and Row, 1993). The measurement items are adopted from Bensaou (1997). Buyer benefits (or strategic payoff) are the achievement of strategic, economic and technological goals of the relationship participants (Grover et al. 1994). Its measurement items are adopted from Grover et al. (1994).

3.3 Field Interviews

Automobile suppliers are contacted for field interviews. The purpose of these interviews is to validate constructs and their relationships. Three managers from two automobile suppliers agreed to have four interviews with the researcher (See details in the following). The first company is D-Corporation. Its major concern is to deal with their customers such as Ford, GM and DaimlerChrysler. Its annual purchasing cost is US$8 billion. Two managers, a quality manager and an IS director, agreed to have three interviews with the researcher. The second company is A-Corporation. Its Auto-Supply Division IS director agreed to have one interview with the researcher. The four interviews are as the following:

- *Interview 1: D-Corporation, with the quality manager and the IS Director; 1 hour and 45 minutes*
- *Interview 2: D-Corporation, with the quality manager and the IS Director; 1 hour*
- *Interview 3: D-Corporation, with the IS Director; 2 hours and 15 minutes*
- *Interview 4: A-Corporation, with the IS Director; 1 hour*

[13] The breadth dimension is not included. This is because the context of the survey is to focus on one relationship with a major customer/supplier for the most important product traded through that relationship. See details in pilot study section.

The following sections are an analysis of these interviews by linking evidences from interviews to the proposed constructs and theoretical relationships and thus provide some validity checks. The analysis is divided into four sections including: constructs validation, research model validation, research designs, and potential future research directions.

3.3.1 Constructs Validation

3.3.1.1 Evidences of the Validity of IS Competence

IS COMPETENCE IN GENERAL

Interview 1: (IS Director) He believes that all the dimensions in the IS competence construct are understandable and useful. He points out that currently his corporation focuses more on its internal IS competence and it has not yet started to consider its component supplier's IS competence. Yet, he believes that this is one area that they may need to look into in the future.

IS – USER RELATIONSHIP

Interview 2: (Quality Manager) E-mail crash. He stayed at a hotel in Washington and checked his email and found over one thousand unread emails. He took over several hours to clean it up. However, the next day, there were again another one thousand unread emails. He cleaned it again and felt frustrated. The same thing happened to an engineer in headquarter. That engineer cleaned his mailbox several times and he was a really nice and honest guy. Afterwards, they got to know that IS function was trying to update the email system. However, they did not inform the user functions. The important part of this story is the response from IS function when asked about the email crash by users. " Why do we need to tell you?" This is the attitude toward users from IS function. Both the quality manager and the engineer felt frustrated and angry about the IS function's behavior and responses. Clearly, cooperative relationship was seriously damaged.

Interview 2: (IS Director) *He emphasizes that IS director now is more like a relationship portfolio manager.*

IS ARCHITECTURE PLANNING

Interview 3: (IS Director) *D-Corporation acquired some plants in Europe. He visited Europe one week before. The purpose of his visiting is to integrate the IS in those plants with IS in the D-Corporation headquarter. Within one month, they successfully integrated accounting information systems with headquarter systems since their accounting system is a global system. However, they had not integrated production-planning system and other systems with IS in headquarter.*

Interview 3: (IS Director) *He points out that there are 14 different ERP systems in his division, which cannot talk to each other. In D-Corporation Corporation, there are more than 30 or 40 ERP systems that cannot talk with each other. They use PeopleSoft for human resources management but SAP for other functions. This is a big problem. There are two methods they are considering: The first is to throw all those systems away and buy new systems that can meet the needs. The second is to connect those systems.*

Clearly, these interviews show that IS architecture planning is a critical IS competence.

MAKING TECHNOLOGY WORK

Interview 4: (IS Director) *He believes that technical skills are very important and are scarce in the market.*

IS OUTSOURCING

Interview 2: (IS Director) *He thinks IS vendor management is important, even though they have not done it.*

Interview 4: (IS Director) *He is particularly interested in the four IS outsourcing dimensions, namely, informed buying, contract facilitation, contract monitor, and vendor management. He cautioned that IS outsourcing should be carefully implemented. Which competence needs to be outsourced and which needs to be reserved are big decisions. The first concern is the effectiveness and efficiency of the IS outsourcing services. The second is the capability of the firm to absorb new technologies after outsourcing.*

Clearly, these interviews show that IS outsourcing is important but needs to have a well-designed plan to implement IS outsourcing. IS outsourcing should be directed by firms' long term IS strategy that is going to direct long term IS competence building.

3.3.1.2 Evidences of the Validity of Supply Chain Relationship Dimensions

HIERARCHICAL CONTROL

Interview 1: (IS Director) *There are procedures to follow to decompose the tasks between the manufacturer and the supplier.*

Interview 1: (IS Director) *If D-Corporation comes up with new product designs which will reduce total costs, there exit profits appropriation systems based on which D-Corporation and its customers share the benefits derived from the new designs or technologies.*

Interview 2: (IS Director) *There are cross-functional teams in D-Corporation to manage customer relationships. For example, they have Ford group with people coming from different functions to manage the relationship with Ford. They have Nissan group as well.*

Clearly, in the relationship with its customers, D-Corporation does have some hierarchical control mechanisms.

ASSET SPECIFICITY AND COMPLEMENTARY RESOURCES

Interview 1: (Quality Manager and IS Director) Both managers understand the differences between specific asset and complementary resources after explanation.

Clearly, these interviews show the validity of the hierarchical control, asset specificity, reciprocal asset specificity, and complementary resource. As to other dimensions, they will be addressed in some interviews in the model validation section

3.3.1.3 Evidences of the Validity of IOS Use

IOS USE DEPTH

Interview 1: (Quality Manager) He points out that there is a need to build a IS linkage between D-Corporation and Ford to electronically transfer quality data. Currently, Ford transfers quarterly D-Corporation supply performance data to his division in a paper format. This will certainly keep D-Corporation informed of their performance and stimulates its efforts for quality improvements. However, there is a need to electronically link the performance data document to D-Corporation such that D-Corporation does not need to re-enter those quality data for analysis. He suggests that the first step is to set up a Web site in Ford and D-Corporation can access those data. The second step is to directly access and download those data by the systems in D-Corporation and automatically input these data into applications in D-Corporation.

Interview 1: (IS Director) He points out that there are two generations of IOS. This first generation IOS is the traditional EDI for enhancing transaction efficiency. This EDI system is supported through the value added network (i.e., proprietary systems). The future of the inter-organizational information systems is to develop an open system. Currently, D-Corporation is designing their own components and transfers product design files to Ford and get Ford's approval, and then go ahead to produce. There is no direct linkage so far to transfer CAD design in Ford back to D-Corporation CAE/CAM systems. Simply, there is no need to do this at this time. But this is a potential for future improvement.

Interview 3 (IS Director) He is excited about the idea to link the repair shop system to D-Corporation components/parts document system so that workers in the repair shop can directly access the document of the parts they are repairing. Clearly, this is an information link between D-Corporation and its customers. In this case, D-Corporation may develop competitive advantage over time by improving service level for after-market and the IOS may enhance D-Corporation's reputation in the customer community. A truck company just asked them for this type of IOS linkage. He thinks truck industry is more customized than automobile industry. He believes that automobile industry may need to learn from truck industry in terms of mass customization through IOS use to provide customized services.

Interview 3: (IS Director) He understands that file transferring, application to application linkage, and directly accessing databases are three levels of IOS depth. With a higher level of IS linkage, business processes across organizational boundaries are more tightly intertwined and the potential to transform these inter- and intra- organizational processes becomes higher.

Interview 4: (IS Director) He *clearly points out that file transfer is the lowest level. Application to application level is the current state for the majority of firms. Distributed database system (i.e., applications can process the data in another side's computer system to enhance efficiency and effectiveness) is the next step for most firms. It is a big jump from the second level.*

Interview 3: (IS Director) He *believes that using IS depth, volume and diversity measurement is better than the stages of IOS use (transaction processing, inventory movement, process linkage, and knowledge sharing) proposed by Venkatraman (1994).*

Interview 4: (IS Director) He *questions whether there is an intermediate level between level two and level three.* His *example of this intermediate level is that one partner can access the data of the other through Internet. The level of this type of linkage depends on whether the access is automatically done or manually done. If it is automatically done, it is at the second level and can be the third level if the application directly manages the data in the other side's computer system as a distributed database system. If the access is manually done through human intervention, then it is at the first level, i.e., transferring data through* HTML *file.*

IOS USE DIVERSITY

Interview 4: (IS Director) While he believes that purchasing is an important area of e-commerce, he also points out that e-engineering and e-new product development and introduction are clearly becoming more and more important in the near future. Firms *are dependent on the new product's speed to market through e-channels.*

Clearly, these interviews support the conceptualization of IOS use, including depth and diversity.

3.3.1.4 Constructs Validity In General

Interview 1: (Quality Manager and IS Director) After the researcher explained each construct, they could understand most of the constructs dimensions and can link the dimensions into their real world examples.

3.3.2 Research Model Validation

3.3.2.1 Research Model Validity in General

Interview 1: (IS Director) Business to business e-commerce is the big bet in the automobile industry. However, there is an intensive competition on the standards of e-commerce. Currently, there are several standards for the business-to-business e-commerce in automobile industry. Ford has auto-exchange. GM has Trade-exchange. D-Corporation itself is developing an e-commerce standard. The compatibility issue of all these systems is becoming important for the smooth communications among these companies, including both OEMs and suppliers. The ideal future of this e-commerce is to have the capability for all the companies in the industry to freely conduct businesses with all other partners they want to.

Interview 1: (IS Director) For D-Corporation, it has many information links with their customers. A lot of research work has been going on in the supply chain management in the automotive industry. A magazine (Action Line) covers many issues on how IOS could support and revolutionize supply chain management.

Interview 1: (IS Director) *He points out that for D-Corporation, the key driver that this firm is investing into IT projects is that there is not only the need for inter-firm e-commerce, but there is a huge demand for the company to be able to share its engineers' tacit knowledge across its world-wide plants and facilities. This is the key source of competitive advantage in the long run. Sharing tacit knowledge is the biggest driver that huge investments into IT have been made in D-Corporation. However, the IT linkages to its suppliers for sharing knowledge are not currently addressed but it is a good project for the future.*

Interview 2: (IS Director) *He is anxious to know the final survey results.*

Interview 3: (IS Director) *There is a huge potential for his company (first tier supplier) to develop e-channel with its suppliers. D-Corporation has announced recently to spend huge amount of money on the development of its own supplier base.*

Clearly, these interviews prove the importance of the integrated research in the interaction area between IOS and supply chain management, which is the major thesis of the research model in this dissertation.

3.3.2.2 IS Architecture and IOS Depth

Interview 1: (IS Director) *He pointed out that there are two levels of IS management (i.e., the corporation level and the division level). There is a demand for the corporation to have consistent systems such that its customer can have a single point of contact to the corporation rather than contact each division separately. One example is that Ford only wants to deal with one D-Corporation rather than so many divisions of D-Corporation. They just want to send one big package of orders to D-Corporation several times everyday rather than different divisions.*

This illustrates the important impact of internal IS infrastructure on success IOS use.

3.3.2.3 The Impact of Supplier Relationship Factors on IOS Use

Interview 4: (IS Director). *He points out that a higher level of IOS depth is more associated with the relationship between partners.*

SPECIFIC ASSET AND COMPLEMENTARY RESOURCES AND IOS USE

Interview 1:(Quality Manager and IS Director) *They believe that high levels of the specific asset and complementary resources will motivate more IOS use.*

TRUST AND IOS USE

Interview 3: (IS Director) *He specifically emphasizes the importance of trust in the use of electronic system in the automobile industry. He mentions that OEM still does not want to directly link their quality system to D-Corporation IS. Thus, D-Corporation has to manually re-enter the quality data into their systems to generate quality control chart. The OEM's argument is that only through a manual process, will supplier firms check the data. With an automatic downloading of data from OEM web site, OEM wanders whether suppliers will check the quality data seriously. Clearly, there is not enough trust.*

3.3.2.4 The Simultaneous Impacts of Trust and IS Competence on IOS use

Interview 3: (IS Director) *He points out that, finally, it is the people who will decide the use of IS. He tells the researcher that several salespersons in his division complain that the purchasing people in Ford do not want to use an existing system to communicate with them. He believes that it is the lack of the necessary trust and/or the in-competency of the purchasing people in Ford that make people in Ford refuse to use an existing IOS.*

3.3.2.5 The Impacts of IOS Use on Opportunism

Interview 1: (Quality Manager) For D-Corporation, recently they are installing an information system that will monitor all the products delivered by suppliers and thus can monitor their behavior. Already they have got calls from their suppliers to show the scariness to the increased monitoring power of D-Corporation. They cannot play any games on the prices of the products they supplied any more. This certainly will reduce their opportunistic behaviors.

3.3.2.6 The Impacts of IOS Use on Operational Risk

Interview 1: (Quality Manager and IS Director) These two managers believe that IOS use reduces operational risks (reducing the information asymmetry, and under-performance).

3.3.2.7 The impacts of Opportunism on Buyer Benefits

Interview 1:(Quality Manager) He points out that supplier opportunistic behaviors, such as applying technologies and procedures from one manufacturer to serve other manufacturers, may cause that particular manufacturer loss some benefits derived from new technologies and procedures.

3.3.2.8 The Impact of Supplier Relationship on Buyer Benefits

Interview 1:(Quality Manager and IS Director) They agree that there is a relationship between the manufacturer-supplier relationship and the buyer benefits.

3.3.3 Research Design

3.3.3.1 Wording Issues

Interview 1: (Quality Manager and IS Director) Both these two managers cannot understand the questions and research framework fully at the beginning. The quality manager clearly points out that there have different vocabularies in different industries. This situation requires a careful design and test of survey questions before administrating a large-scale survey that will target several industries.

Interview 3 (IS Director) The words for survey questions need to be carefully selected to make IS managers easily understand.

3.3.3.2 Customer Relationship or Supplier Relationship?

Interview 2: (IS Director) He is more interested in the relationship with the company's customer rather than its suppliers in terms of IOS use. There are more transactions and its customer is more powerful.

Interview 3: (IS Director) The research context is very important and need to be made very clear for respondents. This issue requires a careful design of the context within which the respondents answer those survey questions.

Interview 4: (IS Director). He points out that the relationship with customers and its own suppliers are both quite very important.

These comments tell the researcher that in the survey there is need to question the relationship the respondent is interested in.

3.3.3.3 Respondents

Interview 2: (IS Director) As to the appropriate respondents, he thinks that this questionnaire should be answered by IS mangers and they could consult with manufacturer managers for those questions they are not very knowledgeable.

Interview 3: (IS Director) He believes that the division level IT director is the best respondent for these questions. He suggests that I may buy mailing list from CIO magazine (www.cio.com). He even thinks that IS directors can evaluate their customer's IS competence based on their perception.

3.3.4 Potential Future Research Issues

3.3.4.1 Environmental Factors

Interview 1: (IS Director) He clearly points out that the ownership of suppliers depends on the technology. If the technology is special and they do not want others to know, they prefer to own their suppliers. They use in-house suppliers to do advanced technology research and keep the technology ahead of competitors and only transfer these technologies to its dedicated suppliers. For example, while they have outside suppliers, they have in-house suppliers for their major products.

Interview 1: (Quality Manager) He points out that component complexity will influence the decision to implement EDI system.

Environmental factors such component technology, production technology, component complexity will influence supply chain firms' IOS use and inter-firm cooperation behavior. This issue could be addressed in the future.

3.3.4.2 Multiple Responses

Interview 4: (IS Director) He points out that the opinions from IS directors, engineers, and purchasing personnel are quite different. It is necessary to get to understand who should respond this survey.

This issue indicates that the future research could compare the responses from different groups of people in firms. Multi-responses from the same organization always provide more information for research.

3.3.4.3 Productivity and Profitability

Interview 1:(Quality Manager) The positive side of the supplier opportunistic behavior is as suppliers learn how to use technologies and procedures from a particular manufacturer, they could use those technologies and procedures to serve other manufacturers. Thus, the total industry productivity will be improved. Customers get most of the benefits.

This interview shows the impacts of supplier opportunistic behavior on the consumer benefits. Technologies not necessarily increase firms' profitability even though they may increase firms' productivity (Hitt and Brynjolffsson, 1996).

3.3.5 Summary

These field interviews partially confirmed the validity of the constructs and the research model. They also provided important directions for questionnaire design and potential future research.

3.4 Pretest

After interviews, a pretest is implemented to further enhance the measurement items design. Questionnaire was presented to two dissertation-stage Ph. D candidates, three Professors (two are in IS area and the other is in the operation management field), and one IS divisional

director (one IS director in the field interview). They provided many insightful comments and worked with the researcher to improve the quality of all the questions. There are total 169 suggestions from these selected respondents for pretest. This pretest significantly enhanced the questionnaire design.

3.5 Pilot Study: Sampling and Methods

3.5.1 Sampling

Prior to the administration of the large-scale study, a pilot study was carried out. This is the last opportunity to enhance the reliability and validity of construct measurement items and refine research design. 500 names were randomly selected from a name list containing 3925 IS executives provided by Applied Computer Research, Inc. The criteria for the name list are

1. Top computer executives
2. Manufacturing and service companies

Further, those companies must meet at least one of the following requirements:

3. There are more than 25 IS employees
4. There are more than 300 desktop systems
5. Those companies belong to Fortune 1000, or Forbes 500, or the InformationWeek 500.

IS managers/directors/CIOs are required to choose a relationship (a specific customer or supplier relationship) they would like to focus on. Then, a major final product/service or a major component traded in that relationship should be chosen. The transactions with that product/component should be completed through IOS use. The following instruction and

diagram are presented in the questionnaire to set up the context for the respondents to answer questions.

> *Please pick one relationship from the following diagram and one component traded in the relationship. For this relationship, your business unit uses IS to coordinate various activities with your partner for that chosen component. Please circle the corresponding number.*

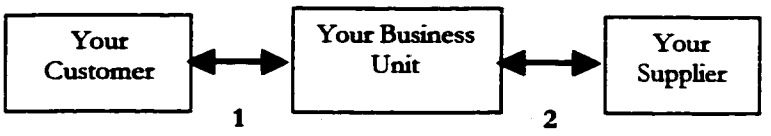


Figure 3.5-1 The Choice of the Interested Relationship by the Respondents

The first wave mailing was administrated in late Spring semester. The second wave mailing was administrated two weeks later. A follow-up postcard was mailed one week later after the second mailing. Phone calls were also made to 500 IS executives after the second wave mailing.

Based on the phone calls, there are many reasons for no responses. First, most IS executives are very busy with their everyday work and most of time a voice message was left. Second, there are retirements, restrictions from the company policy, on vocations, undeliverable addresses, changes of the office location, changes of departments, changes of jobs, and some managers do not have enough knowledge to respond. Third, the questionnaire is pretty lengthy. It contains 167 questions and has six pages. Total responses are 31. However, one response has too little variance and the respondent may just randomly answer all the questions and another response has too many missing values, and thus they are eliminated from analysis. Finally, there are 29 useful responses from IS managers. The useful data response rate is

29/500=6%. The real response rate should be higher considering the above listed reasons for non-responses.

3.5.2 Pilot Study Methods

With the 29 responses, corrected-item total correlation (CITC) is used to purify the measurement items, the Cronbach alpha is used to test the reliability of the measurement items, and the dimensional level factor analysis is used to test the unidimensionality.

The need to purify measurement items (i.e., getting rid of "garbage items") before administratering factor analysis is emphasized by Churchill (1979). When items are put into factor analysis before going through the purification, factor analysis tends to result in multiple dimensions, making the interpretation of each factor difficult. Purification was carried out through corrected-item total correlation (each items' correlation with the sum of other items in its dimension). Items were deleted iteratively if their corrected item total correction score was below 0.5, unless there are clear reasons for keeping the items in spite of low item total correlation. Cronbach alphas are also calculated both before and after purification.

After purifying the items, a factor analysis of the remaining items for each dimension was conducted to assess the unidimensionality of the remained items. The purpose is to eliminate items that were not factorially pure (Weiss, 1970). However, for those items with cross loadings, they may still be kept for the large-scale study if the researcher believes that they are worth keeping due to theoretical reasons and the nature of a pilot study. In these situations, while these items provide more opportunities for quality research, the tradeoff is that we are taking the risk of wasting limited survey space.

Further, if a factor analysis (with Extraction Method: Principal Component Analysis and Rotation Method: Oblimin with Kaiser Normalization) reveals more than one factor, it has to be determined whether to eliminate additional factors or conclude that the construct is more complex than originally anticipated. At this time, the revision of constructs and research model should be carried based on theoretical arguments.

Once dimensionality is ensured and there are some item deletions, the reliability (internal consistency) of the remaining items is examined again using Cronbach's alpha. Items were eliminated if deleting such items would result in close to or higher than 0.80 alpha score and the content of the scale was not significantly altered. Following the guidelines established by Nunnally (1978), a higher than 0.70 for alpha was pursued in maintaining or deleting items, although in certain cases, alpha level of 0.5 to 0.7 was also regarded as adequate, considering the exploratory nature of this stage. Finally, in order to ensure the quality of items and reduce the total length of the questionnaire, for dimensions with more than 7 items after previous revisions, those items with factor loadings less than or equal to 0.70 will be deleted unless there is a strong reason for not deleting the item.

3.6 Results of Pilot Study

In presenting the results of pilot study, the following acronyms were used to number the questionnaire items in each sub-construct.

Table 3.6-1 List of Acronyms

IS Competence	
LEAD	Leadership
BUST	Business System Thinking
INFRA	Architecture Planning
TECH	Making Technology Work
INFOB	Informed Buying
CONF	Contract Facilitation
CONM	Contract Monitoring
VENM	Vendor Management
Manufacturer-Supplier Relationship	
HC	Hierarchical Control
INTER	Interdependence
TRUST	Trust
AS	Asset Specificity
RAS	Reciprocal Asset Specificity
CR	Complementary Resources
IS Use in Supply Chain	
ISUD	Depth of IS Use in Supply Chain
ISUV	Volume of IS Use in Supply Chain
ISUDIV	Diversity of IS Use in Supply Chain
Inter-Firm Transaction in Supply Chain	
COCOST	Coordination Cost
OPRISK	Operation Risk
OPPOR	Opportunism
Other Variables	
BB	Buyer Benefits
EC	Explicit Coordination

3.6.1 IS Competence

3.6.1.1 Measurement Items

IS competence has nine dimensions and the following table lists all the items for each of the nine sub-constructs.

Table 3.6-2 List of Measurement Items of IS Competence

Code Names	Questionnaire Items
	Leadership
LEAD1	IS executives actively design IS structures and IS processes
LEAD2	IS executives actively address business needs
LEAD3	IS executives actively manage the inter-dependence among different business needs
LEAD4	IS executives assign proper personnel to meet each business function needs
LEAD5	IS executives strongly influence business executives' perception of IS contribution to business performance.
LEAD6	IS executives establish business and IS relationships at the executive level.
LEAD7	IS executives share a vision for IS with business executives.
LEAD8	IS executives determine the values and culture of the IS function.
LEAD9	IS executives lead IS staff to contribute to achieving business solutions.
	Business System Thinking
BUST1	IS function has the capability to integrate business development with IT/IS capability.
BUST2	IS function does not make IS/IT investments that support aging business processes.
BUST3	IS function does not make IS/IT investments that support inadequate business processes.
BUST4	IS function discourages adding new processes without considering current IS/IT capability.
BUST5	IS function understands connections and interdependencies among business activities.
BUST6	IS specialists build holistic views of the current organizational processes and activities.
BUST7	IS specialists communicate holistic views of the current organizational processes and activities.
BUST8	IS function is involved in every significant business initiative
	Relationship Building
ISUR1	There are frequent interactions between IS function personnel and other user function personnel
ISUR2	There are efforts to actively develop users' understanding of IS potential.
ISUR3	There are efforts to help users and IT specialists work together.
ISUR4	There are efforts to ensure users' satisfaction with the various information systems.
ISUR5	There are efforts to ensure users' unreserved acceptance of the provided information systems.
ISUR6	Interaction between IS "techies" and "users" is encouraged to reduce any culture gap
ISUR7	There are efforts to increase the mutual confidence and trust between IS personnel and users
ISUR8	There are efforts to make IS personnel and users perceive a shared purpose
	Architecture Planning
INFRA1	IS function has a well developed vision of an appropriate IS infrastructure for supporting the firm's business
INFRA2	IS function has a well developed vision of an appropriate IS infrastructure for supporting its links with suppliers and customers
INFRA3	IS personnel have designed IS infrastructures to ensure necessary integration of IS services
INFRA4	IS personnel have designed IS infrastructures to ensure necessary flexibility of IS services
INFRA5	IS personnel have created a coherent blueprint for IS infrastructure that responds to current business needs
INFRA6	IS personnel have created a coherent blueprint for IS infrastructure that responds to future business needs
INFRA7	IS personnel manage the IS infrastructure to achieve the necessary interrelationships across the business unit's

	different operations
INFRA8	IS personnel manage the IS infrastructure to ensure efficiencies across the business unit's different operations
Making Technology Work	
TECH1	IS function can rapidly troubleshoot unusual problems
TECH2	IS function can identify innovative solutions for non-routine business needs
TECH3	IS function can provide solutions for business needs that cannot be properly satisfied by standard approach.
TECH4	IS personnel are productive in programming.
TECH5	IS personnel can work in a wide range of technical areas
TECH6	IS personnel have a solid understanding of IT fundamental knowledge to fix IS breakdowns
Informed Buying	
INFOB1	IS purchasing personnel have the capability to select the right IS sourcing strategy
INFOB2	IS purchasing personnel make decisions based on business needs
INFOB3	IS purchasing personnel understand the firm's technological criteria
INFOB4	IS purchasing personnel analyzes the externally available IS/IT services
INFOB5	IS purchasing personnel lead tendering process in IS outsourcing
INFOB6	IS purchasing personnel lead contracting process in IS outsourcing
INFOB7	IS purchasing personnel lead service management process in IS outsourcing
INFOB8	IS purchasing personnel understand the internal IS service options
Contract Facilitation	
CONF1	User functions have a single point of contact provided by IS function in the IS outsourcing process
CONF2	User functions can ensure that conflicts at the contracting stage are resolved fairly
CONF3	User functions can ensure that conflicts at the contracting stage are resolved promptly
CONF4	IS function facilitates the contracting process between user functions and the IS suppliers
CONF5	IS function coordinates activities between users and the IS suppliers at the contracting stage
Contract Monitoring	
CONM1	There are processes to ensure that all IS outsourcing agreements are met and protected at all times.
CONM2	IS suppliers are held accountable on existing contracts
CONM3	IS suppliers are held accountable on the developing standards in IS services market.
CONM4	IS suppliers are held accountable on the evolving IS functionality in IS services market.
CONM5	There are reports highlighting IS suppliers' achievement against industry benchmarks
CONM6	There are reports highlighting IS suppliers' achievement against standards in the contracts.
Vendor Management	
VENM1	There are efforts to explore the potential to create win-win situations for both your business unit and IS suppliers
VENM2	There is an annual meeting with IS suppliers to develop new IS outsourcing.
VENM3	There is an annual meeting with IS suppliers to enhance current IS outsourcing.
VENM4	There are efforts to make IS suppliers understand your business unit's operations and processes.
VENM5	There are efforts to grow with your IS suppliers over time.

3.6.1.2 Reliability Analysis

The following table lists the CITC for each dimension of the IS competence construct for purification. Leadership has 9 items and all are kept at this stage. Business system thinking has 8 items. BUST2 is deleted due to a low CITC. BUST3 is also deleted due to its CITC below 0.5 after BUST2 is deleted. A careful examination of these two items shows that they both are negative statements. Aging business processes do not mean they are not useful. Inadequate business processes may need IS support to become adequate and thus this item is unclear. Consequently, it is decided to delete these two items. The final alpha is 0.8405. Relationship building (8 items), architecture planning (8 items), making technology work (6 items), informed buying (8 items), contract facilitation (5 items), contract monitoring (6 items) and vendor management (5 items) all have good CITCs and reliabilities and all the items are kept for further analysis.

Table 3.6-3 List of CITC and Alpha for IS Competence

Items	Initial CITC	Final CITC	Alpha if deleted	Alpha Score
Leadership				
LEAD1	.6112	.6112	.9227	Initial Alpha=0.9238 Final Alpha=0.9238
LEAD2	.8729	.8729	.9070	
LEAD3	.7243	.7243	.9154	
LEAD4	.7727	.7727	.9119	
LEAD5	.5511	.5511	.9265	
LEAD6	.8295	.8295	.9089	
LEAD7	.7775	.7775	.9116	
LEAD8	.6636	.6636	.9190	
LEAD9	.7994	.7994	.9117	
Business System Thinking				
BUST1	.6319	.6245	.8163	Initial Alpha=0.8405 Final Alpha=0.8405
BUST2	.3612	Dropped r1[14]		
BUST3	.5760	Dropped r2		
BUST4	.5753	.5054	.8402	
BUST5	.6298	.6311	.8128	
BUST6	.7589	.7714	.7912	
BUST7	.5473	.6374	.8120	
BUST8	.5898	.6595	.8148	
Relationship Building				
ISUR1	.4996	.4996	.9407	Initial Alpha=0.9315 Final Alpha=0.9315
ISUR2	.7724	.7724	.9219	
ISUR3	.8816	.8816	.9133	
ISUR4	.8871	.8871	.9127	
ISUR5	.7628	.7628	.9230	
ISUR6	.7057	.7057	.9265	
ISUR7	.7744	.7744	.9220	
ISUR8	.8540	.8540	.9167	
Architecture Planning				
INFRA1	.8214	.8214	.9306	Initial Alpha=0.9405 Final Alpha=0.9405
INFRA2	.7466	.7466	.9357	
INFRA3	.8119	.8119	.9319	
INFRA4	.8095	.8095	.9323	
INFRA5	.8428	.8428	.9288	
INFRA6	.6985	.6985	.9402	
INFRA7	.8690	.8690	.9273	

[14] r1 means the first round testing. r2 means the second round testing and so on and so forth.

INFRA8	.7758	.7758	.9340	
Making Technology Work				
TECH1	.7013	.7013	.9119	Initial Alpha=0.9162 Final Alpha=0.9162
TECH2	.7430	.7430	.9047	
TECH3	.6863	.6863	.9120	
TECH4	.7989	.7989	.8962	
TECH5	.7954	.7954	.8965	
TECH6	.8862	.8862	.8830	
Informed Buying				
INFOB1	.8656	.8656	.9568	Initial Alpha=0.9625 Final Alpha=0.9625
INFOB2	.8373	.8373	.9588	
INFOB3	.9102	.9102	.9541	
INFOB4	.7506	.7506	.9632	
INFOB5	.9078	.9078	.9542	
INFOB6	.8477	.8477	.9580	
INFOB7	.8588	.8588	.9572	
INFOB8	.8686	.8686	.9566	
Contract Facilitation				
CONF1	.7968	.7968	.9076	Initial Alpha=0.9234 Final Alpha=0.9234
CONF2	.8293	.8293	.9009	
CONF3	.8504	.8504	.8963	
CONF4	.7539	.7539	.9159	
CONF5	.7859	.7859	.9093	
Contract Monitoring				
CONM1	.7176	.7176	.8873	Initial Alpha=0.9019 Final Alpha=0.9019
CONM2	.6992	.6992	.8904	
CONM3	.8222	.8222	.8706	
CONM4	.8152	.8152	.8717	
CONM5	.6484	.6484	.8984	
CONM6	.7221	.7221	.8875	
Vendor Management				
VENM1	.5613	.5613	.8463	Initial Alpha=0.8520 Final Alpha=0.8520
VENM2	.8155	.8155	.7769	
VENM3	.8064	.8064	.7804	
VENM4	.5822	.5822	.8425	
VENM5	.5854	.5854	.8409	

3.6.1.3 Unidimentionality Analysis

The factor analysis is applied at the dimension level for unidimenality analysis. The following table shows the results of factor analysis at the dimension level[15]. Leadership, business system thinking, relationship building, making technology work, informed buying, and contract facilitation have good factor loadings for all their items. However, LEAD1 and LEAD5, and ISUR1 are deleted since there are more than 7 items for these two sub dimensions and their factor loadings are less than 0.70.

For architecture planning, INFRA1, 2, 5, 6 form one factor and INFRA3, 4, 7, 8 form another factor. A careful examination of the questions shows that items 1, 2, 5, 6 are related to vision and blueprint and items 3, 4, 7, 8 are related to operational infrastructure services. The first factor can be regarded as strategic management of infrastructure and the second factor can be regarded as operational management of infrastructure.

For contract monitoring, first round factor analysis shows two factors with items 1, 2, 3, 4 as one factor and items 5 and 6 as another factor. A careful examination of the questions shows that items 1 to 4 ask whether there are processes to ensure that IS suppliers provide the required services according to contracts and industry standards, while questions 5 and 6 ask whether there are reports highlighting IS suppliers' achievements against contracts and industry standards. The second factor seems to be an incentive system to encourage IS suppliers to deliver excellent services and recognize their achievements rather than just monitoring. Thus these two items are combined with vendor management dimension items and then a factor analysis is executed for vendor management dimension. The factor analysis

[15] Factor loadings that are less than 0.45 will not be presented to streamline the analysis.

shows that there are two factors again. CONM5 and CONM6, VENM1, VENM2, and VENM3 make up one factor. The second factor consists of VENM4 and VENM5. A careful examination of the items for these two factors shows that the first factor is more short term oriented and is at the operational level management of vendors, while the second factor is more long term oriented and at the strategic level of vendor management. The first factor is named as the operational vendor management and the second factor as the strategic vendor management.

Table 3.6-4 List of Factor Loadings for IS Competence

Items	Initial Loading	Final Loading[16]
Leadership (KMO=0.871; 0.873)		
LEAD1	.693(dropped)	
LEAD2	.914	.924
LEAD3	.792	.808
LEAD4	.836	.853
LEAD5	.621(dropped)	
LEAD6	.880	.899
LEAD7	.826	.824
LEAD8	.740	.740
LEAD9	.849	.836
Business System Thinking (KMO=0.790)		
BUST1	.748	.748
BUST4	.641	.641
BUST5	.759	.759
BUST6	.867	.867
BUST7	.765	.765
BUST8	.783	.783
Relationship Building (KMO=0.864; 0.869)		
ISUR1	.579(dropped)	
ISUR2	.826	.817
ISUR3	.907	.890
ISUR4	.923	.929

[16] For those dimensions where no items have been deleted, final loadings are same as the initial loadings. Otherwise, they are different.

ISUR5	.835		.857	
ISUR6	.782		.791	
ISUR7	.839		.844	
ISUR8	.900		.908	
Architecture Planning (KMO=0.773)				
INFRA1		.777	Alpha=0.9182	
INFRA2		.726		
INFRA5		.877		
INFRA6		.906		
INFRA3	.917		Alpha=0.9624	
INFRA4	.908			
INFRA7	.866			
INFRA8	.845			
Making Technology Work (KMO=0.856)				
TECH1	.788		.788	
TECH2	.828		.828	
TECH3	.781		.781	
TECH4	.867		.867	
TECH5	.869		.869	
TECH6	.920		.920	
Informed Buying (KMO=0.878)				
INFOB1	.903		.903	
INFOB2	.880		.880	
INFOB3	.937		.937	
INFOB4	.804		.804	
INFOB5	.929		.929	
INFOB6	.881		.881	
INFOB7	.889		.889	
INFOB8	.901		.901	
Contract Facilitation (KMO=0.812)				
CONF1	.871		.871	
CONF2	.898		.898	
CONF3	.913		.913	
CONF4	.839		.839	
CONF5	.862		.862	
Contract Monitoring (First Round KMO=0.726; Second Round KMO=0.719)				
CONM1	.709		.810	Alpha=0.9211
CONM2	.899		.892	
CONM3	.898		.944	
CONM4	.914		.949	

CONM5		.946	Moved to Vendor Management Dimension
CONM6		.925	
Vendor Management (First Round KMO=0.632)			
CONM5	.928		Alpha=0.9216
CONM6	.915		
VENM1	.868		
VENM2	.754		
VENM3	.769		
VENM4		.955	Alpha=0.9250
VENM5		.915	

3.6.1.4 Decisions and Summary

Architecture planning and informed buying have 8 items. Leadership, relationship building, and vendor management have 7 items. Business system thinking and making technology work have 6 items left. Contract facilitation has 5 items left and contract monitoring has 4 items left. There are 58 items for the IS competence construct left for the large-scale study.

3.6.2 Manufacturer-Supplier Relationship

3.6.2.1 Measurement Items

The following table lists all the measurement items used for the pilot study of the relationship between supply chain members construct. This construct has six dimensions including hierarchical control (8 items), interdependence (7 items), trust (5 items), asset specificity (8 items), reciprocal asset specificity (8 items), and complementary resources (5 items).

Table 3.6-5 List of Measurement Items for Manufacturer-Supplier Relationship

Code Names	Questionnaire Items
Hierarchical Control	
HC1	There is a clear command and control system in the relationship
HC2	There is a well defined incentive system in the relationship
HC3	There are many standard operating procedures in the relationship
HC4	There are clear dispute resolution procedures in the relationship
HC5	When changes in specifications of the component are made, cost-plus system is used to adjust the remuneration for each partner
HC6	Your business unit has long-term contract with the major partner
HC7	When there is a dispute, you can access a third-party enforcer to resolve the dispute.
HC8	When there is a dispute, you can safeguard your rights in the relationship by freezing financial investments from the partner
Interdependence	
INTER1	The ongoing coordination of activities is complex in the relationship
INTER2	It is difficult to decompose tasks in the relationship
INTER3	It is difficult to specify a precise division of labor in the relationship
INTER4	Ongoing communications are necessary for the relationship functioning well
INTER5	Ongoing decision making is necessary for the relationship functioning well
INTER6	There are continuing adjustments in the relationship
INTER7	It is required for each partner to link specific activities with the other partner closely and regularly
Trust	
TRUST1	You have never had the feeling of being misled by your partner
TRUST2	Both sides are expected not to make demands that seriously damage the interests of the other
TRUST3	The stronger side is expected not to pursue its interests at all costs
TRUST4	Informal agreements have the same significance as formal contracts
TRUST5	Most of the procedures have become well accepted and routines
Asset Specificity	
AS1	Your business unit has built production facilities close to your partner
AS2	Your business unit has built product development facilities close to the partner
AS3	Your business unit has customized machinery to accommodate your partner's needs
AS4	Your business unit has customized tools to accommodate your partner's needs
AS5	Your business unit has dedicated personnel who learn the systems specific to the partner
AS6	Your business unit has dedicated personnel who learn the procedures specific to the partner
AS7	Your business unit has dedicated personnel who learn the individuals specific to the partner
AS8	Your business unit has accumulated specialized knowledge and information about the partner over time
Reciprocal Asset Specificity	
RAS1	Your partner has built production facilities close to your business unit
RAS2	Your partner has built product development facilities close to your business unit

RAS3	Your partner has customized machinery to accommodate your business unit's needs
RAS4	Your partner has customized tools to accommodate your business unit's needs
RAS5	Your partner has dedicated personnel who learn the systems special to your business unit
RAS6	Your partner has dedicated personnel who learn the procedures special to your business unit
RAS7	Your partner has dedicated personnel who learn the individuals special to your business unit
RAS8	Your partner has accumulated specialized knowledge and information about your business unit over time
Complementary Resources	
CR1	There are complementary but non-relationship specific resources (e.g., reputation, specialized expertise) in the relationship
CR2	Combined complementary but non-relationship specific resources (e.g., reputation, specialized expertise) from partners in the relationship are becoming difficult to imitate by other firms
CR3	Combined complementary but non-relationship specific resources (e.g., reputation, specialized expertise) in the relationship are becoming valuable
CR4	Combined complementary but non-relationship specific resources (e.g., reputation, specialized expertise) in the relationship are becoming scarce
CR5	Combined complementary but non-relationship specific resources (e.g., reputation, specialized expertise) in the relationship have synergistic effects

3.6.2.2 Reliability Analysis

The following table shows the CITCs for all the six dimensions of the construct of relationship. For hierarchical control, HC1, HC4, HC6, and HC8, are eliminated iteratively because of low CITCs. The final alpha is 0.8098. For interdependence, INTER1, INTER2, and INTER3 are deleted iteratively because of their lower CITCs. The final alpha is 0.9356. For trust dimension, TRUST1 and TRUST4 are eliminated iteratively because of lower CITCs. The final alpha is 0.8712. For asset specificity, AS8 is eliminated because of a low CITC. The final alpha is 0.8861. For reciprocal asset specificity, all items are kept. The final alpha is 0.8607. For complementary resources, CR1 and CR4 are eliminated for the same reason and the final alpha is 0.8224.

Table 3.6-6 List of CITC and Alpha in Manufacturer-Supplier Relationship

Items	Initial CITC	Final CITC	Alpha if deleted(Initial)	Alpha Score
Hierarchical Control				
HC1	.1331	Dropped r1		Initial Alpha=0.7607 Final Alpha=0.8098
HC2	.5639	.5098	.8125	
HC3	.6785	.6813	.7407	
HC4	.4770	Dropped r3		
HC5	.6290	.6270	0.7630	
HC6	.3350	Dropped r4		
HC7	.6760	.7097	0.7194	
HC8	.1914	Dropped r2		
Interdependence				
INTER1	.5603	Dropped r3		Initial Alpha=0.8044 Final Alpha=0.9356
INTER2	.5807	Dropped r2		
INTER3	.1014	Dropped r1		
INTER4	.6629	.8995	.9018	
INTER5	.6620	.8836	.9040	
INTER6	.7540	.8933	.9024	
INTER7	.5566	.7399	.9557	
Trust				
TRUST1	.3612	Dropped r2		Initial Alpha=0.7621 Final Alpha=0.8712
TRUST2	.7269	.7437	.8271	
TRUST3	.7290	.8658	.7081	
TRUST4	.3435	Dropped r1		
TRUST5	.5620	.6641	.8949	
Asset Specificity				
AS1	.5772	.6159	.8787	Initial Alpha=0.8694 Final Alpha=0.8861
AS2	.5806	.6176	.8780	
AS3	.6834	.6909	.8681	
AS4	.7003	.7014	.8665	
AS5	.7811	.7730	.8592	
AS6	.7571	.7208	.8654	
AS7	.7090	.6660	.8716	
AS8	.1786	Dropped r1		
Reciprocal Asset Specificity				
RAS1	.5275	.5275	.8563	Initial Alpha=0.8607 Final Alpha=0.8607
RAS2	.5388	.5388	.8548	
RAS3	.7783	.7783	.8217	

RAS4	.7111	.7111	.8310	
RAS5	.5574	.5574	.8498	
RAS6	.5626	.5626	.8503	
RAS7	.7120	.7120	.8332	
RAS8	.5538	.5538	.8501	
Complementary Resources				
CR1	.2525	Dropped r1		Initial Alpha=0.7406 Final Alpha=0.8224
CR2	.6454	.8160	.6069	
CR3	.6663	.7305	.7001	
CR4	.4022	Dropped r2		
CR5	.6419	.5684	.8722	

3.6.2.3 Unidimensionality Analysis

A factor analysis is applied at the dimension level for unidimensionality analysis. The following table shows the results of the factor analysis. Hierarchical control, interdependence, trust, and complementary resources display good unidimensionality with all loadings greater than 0.70.

The analysis of asset specificity shows two factors with AS3 cross loading on both factors. After dropping AS3 and dong the factor analysis one more time, there are two factors but all items neatly loaded on one single factor without cross loadings. After a careful examination of the questions, it was found that the first two questions are related to physical/site assets such as production facilities and product development facilities. The items 4, 5, 6, and 7 are associated with the dedicated personnel, which is human asset. It is reasonable to have two factors to capture this division. The same situation happens to reciprocal asset specificity. RAS3 is dropped and RAS 1, 2 make up the first factor and RAS 4, 5, 6, 7, 8 make up the second factor.

Table 3.6-7 List of Factor Loadings for Manufacturer-Supplier Relationship

Items	Initial Factor Loading			Final Factor Loading		
Hierarchical Control KMO=0.654						
HC2	.718			.718		
HC3	.839			.839		
HC5	.791			.791		
HC7	.848			.848		
Interdependence KMO=0.850						
INTER4	.950			.950		
INTER5	.942			.942		
INTER6	.945			.945		
INTER7	.842			.842		
Trust KMO=0.643						
TRUST2	.887			.887		
TRUST3	.948			.948		
TRUST5	.837			.837		
Asset Specificity KMO1=0.724; KMO2=0.720						
AS1		.940		Dropped		
AS2		.958				
AS3	.492	.623				
AS4	.691			.693		Alpha=0.9150
AS5	.876			.894		
AS6	.947			.959		
AS7	.956			.959		
Reciprocal Asset Specificity KMO=0.660; 0.648						
RAS1		.949		Dropped		
RAS2		.954				
RAS3	.585	.571				
RAS5			.941		.947	Alpha=0.9377
RAS6			.921		.921	
RAS4	.669			.663	Alpha=0.8568	
RAS7	.856			.886		
RAS8	.955			.959		
Complementary Resources KMO=0.639						
CR2	.927			.927		
CR3	.877			.877		
CR5	.780			.780		

3.6.2.4 Decisions and Summary

Factor analysis shows that asset specificity has two factors (physical/site and human specific assets). It is believed that in this information age, human assets are more interesting. This is supported by Zaheer and Venkatraman (1994)' finding on the relationship between business process asset (including human and procedure specific assets) and electronic integration. Thus, the first factor is deleted (i.e., physical asset specificity) and items 4, 5, 6, 7 are kept to measure human assets specificity[17]. As to item AS8, since it is clearly associated human assets in terms of their knowledge about partner and the corresponding item is included in the reciprocal asset specificity dimension, thus this item is also kept for further validation with the risk of wasting survey space. Thus, there are 5 items left.

As for reciprocal asset specificity, factor analysis shows that there are three factors. Following the argument for asset specificity, RAS1 and 2 are deleted since they are measuring physical/site asset specificity. RAS3 is deleted due to a very high cross loading. A second factor analysis was applied to items RAS4, 5, 6, 7,8. Two factors emerge. RAS4, 7, 8 form one factor and RAS5, 6 form the second factor. A careful examination of these two factors, we cannot not find any specific reasons for having two factors. This may be due to small sample size effect. It is decided that all these items will be kept for the large-scale validation.

In a word, the asset specificity and the reciprocal asset specificity both have 5 items for the large-scale study. Hierarchical control and interdependence have 4 items each. Trust and complementary resources have 3 items each. Totally, there are 24 items for the relationship construct in the large-scale study.

---

[17] As to AS4, it is a physical/site assets item but it is more closely related to the human asset than other physical asset items (i.e., tools can be certain software and thus related to human skills).

3.6.3 IOS Use in Supply Chain

3.6.3.1 Measurement Items

The following table displays all the measurement items for this construct. It includes three dimensions. They are depth, diversity, and volume.

Table 3.6-8 List of Measurement Items for IOS Use in Supply Chain

IOS Use Depth	
ISUD1	Your IS applications transfer files to your partner's application automatically
ISUD2	Your partner's IS applications transfer files to your IS applications automatically
ISUD3	Your IS applications and your partner's applications can communicate with each other automatically.
ISUD4	Your IS applications can directly access the data base in your partner's computer systems
ISUD5	Your partner's IS applications can directly access the data base in your computer systems
IOS Use Diversity	
ISUDIV1	Purchasing personnel exchange data in electronic form with the partner
ISUDIV2	Engineering personnel exchange data in electronic form with the partner
ISUDIV3	Quality personnel exchange data in electronic form with the partner
ISUDIV4	Production control personnel exchange data in electronic form with the partner
ISUDIV5	Transportation personnel exchange data in electronic form with the partner
ISUDIV6	Payment personnel exchange data in electronic form with the partner
IOS Use Volume	
ISUV1	A high percentage of the total transactions with the partner is conducted through the IS in the relationship

3.6.3.2 Reliability Analysis

The following table shows the CITCs and reliability of IS use in supply chain. IS use depth has five items and all of them have high CITCs and the final alpha is 0.9168. IS use diversity has six items and item 2 has a low CITC and thus is deleted. The final alpha is 0.8827. IS use volume has only one item and thus will not be checked here.

Table 3.6-9 List of CITC and Alpha for IOS Use in Supply Chain

Items	Initial CITC	Final CITC	Alpha if deleted(Initial)	Alpha Score
IOS Use Depth				
ISUD1	.8786	.8786	.8790	Initial Alpha=0.9168 Final Alpha=0.9168
ISUD2	.8720	.8720	.8802	
ISUD3	.8626	.8626	.8824	
ISUD4	.6533	.6533	.9250	
ISUD5	.6776	.6776	.9192	
IOS Use Diversity				
ISUDIV1	.5732	0.6047	0.8861	Initial Alpha=0.8705 Final Alpha=0.8827
ISUDIV2	.4578	Dropped r1		
ISUDIV3	.8284	.7509	.8499	
ISUDIV4	.7838	.8046	.8363	
ISUDIV5	.7903	.7998	.8398	
ISUDIV6	.6188	.6502	.8728	

3.6.3.3 Unidimensionality Analysis

The following table shows the dimensional level factor analysis for the IS use depth and diversity. The results show good unidimensionalities for both the depth and the diversity dimensions.

Table 3.6-10 List of Factor Loadings for IOS Use in Supply Chain

Items	Initial Factor Loading	Final Factor Loading
IOS Use Depth KMO=0.751		
ISUD1	.938	.938
ISUD2	.933	.933
ISUD3	.924	.924
ISUD4	.757	.757
ISUD5	.776	.776
IOS Use Diversity KMO=0.854		
ISUDIV1	.732	.732
ISUDIV3	.854	.854
ISUDIV4	.893	.893
ISUDIV5	.885	.885
ISUDIV6	.771	.771

3.6.3.4 Decisions and Summary

According the previous analysis, both IS use depth and diversity have 5 items left. However, item 2 which is related to engineering department use of IS across organizational boundaries, theoretically should be included. The lack of a good CITC with other items may be due to the small sample size. It is decided that ISDIV2 is kept for the large-scale study. For IS use volume dimension, one more item (i.e., a large number of documents associated with the partner are exchanged through IS) is added. Thus totally, 13 items are used to measure IS use in supply chain.

3.6.4 IOS impacts on Inter-firm Transactions

3.6.4.1 Measurement Items

The following table displays all the measurement items of the three dimensions of the IS impacts on inter-firm transactions, including coordination cost, operation risk, and opportunism. Each dimension has 5 items.

Table 3.6-11 List of Measurement Items for IOS impacts on Inter-firm Transactions

Coordination Cost	
COCOST1	The cost of exchanging product information (price, product characteristics, availability, and demand) with your partner has become low through IS use
COCOST2	The cost of incorporating exchanged information into the decision process has become low through IS use
COCOST3	The cost incurred due to delays in the communication channel with the partner has become low through IS use
COCOST4	The cost to share design changes quickly with the partner has become low through IS use
COCOST5	The cost to inform and to be informed of changes in delivery schedules of the component has become low through IS use
Operation Risk	
OPRISK1	It is less likely for any side in the relationship to deliberately misrepresent information through IS use
OPRISK2	It is less likely for any side in the relationship to withhold important information through IS use
OPRISK3	It is less likely to have inconsistent information in the relationship through IS use
OPRISK4	It is less likely to have incompatible information in the relationship through IS use
OPRISK5	It is less likely for any side in the relationship to under-perform its agreed-upon responsibilities (e.g., inferior component quality) through IS use
Opportunism	
OPPOR1	Tacit engineering knowledge can be easily transferred to the other side opportunistically through IS use in the relationship
OPPOR2	Production skills can be easily transferred to the other side opportunistically through IS use in the relationship
OPPOR3	Opportunistic behavior is reduced because of less relationship specific investments by both sides through IS use
OPPOR4	Having small number of partners does not increase opportunistic behavior through IS use
OPPOR5	Opportunistic behavior is reduced because of the monitoring effect of the IS use in the relationship

3.6.4.2 Reliability Analysis

The following table displays the CITCs for purifying measurement items. All items show good CITCs and scales have good reliabilities. All the items are kept.

Table 3.6-12 List of CITC and Alpha for Inter-firm Transaction Costs

Items	Initial CITC	Final CITC	Alpha if deleted(Initial)	Alpha Score
Coordination Cost				
COCOST1	.8965	.8965	.9226	Initial Alpha=0.9444 Final Alpha=0.9444
COCOST2	.9310	.9310	.9175	
COCOST3	.8515	.8515	.9338	
COCOST4	.7253	.7253	.9536	
COCOST5	.8816	.8816	.9255	
Operation Risk				
OPRISK1	.7009	.7009	.9365	Initial Alpha=0.9315 Final Alpha=0.9315
OPRISK2	.9133	.9133	.9003	
OPRISK3	.8920	.8920	.9014	
OPRISK4	.9072	.9072	.8979	
OPRISK5	.7025	.7025	.9370	
Opportunism				
OPPOR1	.8234	.8234	.8894	Initial Alpha=0.9161 Final Alpha=0.9161
OPPOR2	.7306	.7306	.9096	
OPPOR3	.8500	.8500	.8836	
OPPOR4	.6576	.6576	.9216	
OPPOR5	.8751	.8751	.8794	

3.6.4.3 Unidimensionality Analysis

The factor analysis results are displayed in the following table. All items are significantly loaded on their own dimensions. The results show good unidimensionality for these three dimensions.

Table 3.6-13 List of Factor Loadings for IOS Impacts on Inter-firm Transaction

Items	Initial Factor Loading	Final Factor Loading
Coordination Cost KMO=0.786		
COCOST1	.937	.937
COCOST2	.957	.957
COCOST3	.904	.904
COCOST4	.815	.815
COCOST5	.925	.925
Operation Risk KMO=0.785		
OPRISK1	.801	.801
OPRISK2	.949	.949
OPRISK3	.937	.937
OPRISK4	.944	.944
OPRISK5	.801	.801
Opportunism KMO=0.752		
OPPOR1	.896	.896
OPPOR2	.829	.829
OPPOR3	.908	.908
OPPOR4	.770	.770
OPPOR5	.927	.927

3.6.4.4 Decisions and Summary

For this construct, 15 items are kept for the large-scale study.

3.6.5 Explicit Coordination and Buyer Benefits

3.6.5.1 Measurement Items

The following table displays all the measurement items for the explicit coordination (i.e., joint efforts) and buyer benefits. Explicit Coordination has 9 items and buyer benefit has 11 items.

Table 3.6-14 List of Measurement Items for Explicit Coordination and Buyer Benefits

Explicit Coordination	
EC1	Your business unit's operational decisions are highly integrated with those of your partner
EC2	There are coordinating processes that are specific to the relationship
EC3	Joint technical assistance
EC4	Joint effort in product planning
EC5	Joint effort in product engineering
EC6	Joint process engineering
EC7	Joint training /education
EC8	Joint tooling development
Buyer Benefits	
	Strategic Buyer Benefits
BB1	The buyer has been able to refocus on core business.
BB2	The buyer has enhanced the final product competitiveness.
BB3	The buyer has increased access to skilled personnel from the partner
	Economic Buyer Benefits
BB4	The buyer benefits from the economies of scale of the human resources of the partner
BB5	The buyer benefits from the economies of scale of the technology resources of the partner
BB6	The buyer has increased control of the component design costs
BB7	The buyer has increased control of the production costs
	Technological Benefits
BB8	The buyer has reduced the risk of product technology obsolescence
BB9	The buyer has reduced the risk of process technology obsolescence
BB10	The buyer has increased access to key process technologies
BB11	The buyer has increased access to key product technologies

3.6.5.2 Reliability Analysis

The following table displays the CITCs for each dimension's items. For the explicit coordination/joint effort dimension, EC7, and EC8 are iteratively eliminated because of low CITCs. A careful examination of these three items does not show any specific theoretical reasons for these eliminations. It may be that the nature of the samples included in this pilot study determines the applicability of these items. For buyer benefits, all items show good CITCs and this dimension has good reliability. For buyer benefits, all the items have good CITCs and thus will be kept for further analysis.

Table 3.6-15 List of CITC and Alpha for Explicit Coordination and Buyer Benefits

Items	Initial CITC	Final CITC	Alpha if deleted(Initial)	Alpha Score
Explicit Coordination				
EC1	.4599	.5698	.8157	Initial Alpha=0.6959 Final Alpha=0.8291
EC2	.2956	.5402	.8140	
EC3	.6859	.7040	.7855	
EC4	.4707	.6988	.7798	
EC5	.5509	.6273	.7971	
EC6	.6859	.5304	.8171	
EC7	-.1206	Dropped r1		
EC8	.3385	Dropped r2		
Buyer Benefits				
	Strategic Buyer Benefits			Initial Alpha=0.9496 Final Alpha=0.9496
BB1	.8989	.8989	.9242	
BB2	.8689	.8689	.9508	
BB3	.9308	.9308	.8984	
	Economic Buyer Benefits			Initial Alpha=0.8955 Final Alpha=0.8955
BB4	.7919	.7919	.8609	
BB5	.7557	.7557	.8701	
BB6	.7523	.7523	.8721	
BB7	.7870	.7870	.8586	
	Technological Buyer Benefits			Initial Alpha=0.9623 Final Alpha=0.9623
BB8	.8676	.8676	.9619	
BB9	.9136	.9136	.9484	
BB10	.9263	.9263	.9448	
BB11	.9199	.9199	.9465	

3.6.5.3 Unididmensionality Analysis

Factor analysis results for the two dimensions are listed in the following table. Explicit coordination shows that there are two factors. EC1 and EC2 make up one factor. EC3, EC4, EC5, and EC6 make up another factor. The first factor is about the explicit coordination in the general sense. The second factor asks specific questions on joint effort on functional areas. EC3 and EC4 have cross loadings on the other factor. A careful examination of these two items shows that they are measuring joint technical assistance and joint effort on product planning and these are important functional areas for cooperation. Thus, it is decided that

these two items will be kept with the risk of wasting limited survey space. For the buyer benefits dimensions, all sub-dimensions have clean items. Thus, all the items will be kept.

Table 3.6-16 List of Factor Loadings for Explicit Coordination and Buyer Benefits

Items	Initial Factor Loading		Final factor Loading
Explicit Coordination KMO=0.712			
EC1		.821	General joint efforts
EC2		.937	
EC3	.606	.545	Functional area joint efforts
EC4	.638	.530	
EC5	.900		
EC6	.858		
Buyer Benefits			
	Strategic Buyer Benefits KMO=0.751		
BB1	.954		
BB2	.941		
BB3	.970		
	Economic Buyer Benefits KMO=0.683		
BB4	.890		
BB5	.875		
BB6	.857		
BB7	.878		
	Technological Buyer Benefits KMO=0.769		
BB8	.924		
BB9	.951		
BB10	.960		
BB11	.957		

3.6.5.4 Decisions and Summary

6 items are kept for the joint effort (i.e., explicit coordination). And 11 items will be kept for the buyer benefits (i.e., component outsourcing success) construct.

3.7 Chapter Summary

This chapter first reported the generation of measurement items based on previous research. Then it validated the research model and measurement items through field interviews. A pretest was used to enhance the quality of these measurement items. Finally, a pilot test was implemented to further test the measurement items' reliability and unidimenationality. The results show that the research model is valid. In the meantime, the quality of the measurements items has been dramatically improved. The next chapter is the instrument development based on a large-scale survey.

4 INSTRUMENT DEVELOPMENT--PHASE TWO

4.1 Introduction

Through field interviews, a pretest, and a pilot study, both the research model and the construct measurement items have been partially validated in real industry settings and in a small sample size. The logical next step is to further validate the measurement instrument in a large sample size. This is the goal of this current chapter. The next chapter will use structural equation modeling technique to test the research model based on the instruments developed in this chapter.

4.2 Sampling and Data

4.2.1 Sampling

A name list containing 3425 IS executives, provided by Applied Computer Research, Inc., was used for the large-scale survey study. The criteria for the name list are

- Top computer executives
- Manufacturing and service companies

Further, those companies must meet at least one of the following requirements:

- There are more than 25 IS employees
- There are more than 300 desktop systems
- Those companies belong to Fortune 1000, or Forbes 500, or the InformationWeek 500.

IS managers/directors/CIOs were requested to choose a relationship (a specific customer or supplier relationship) they would like to focus on. Then, a major final product/service or a major component traded in that relationship should be chosen. The transactions with that product/component should be completed through IOS use. The following instruction and diagram are presented in the questionnaire to set up the context for the respondents to answer questions.

> *Please pick one relationship from the following diagram and one component traded in the relationship. For this relationship, your business unit uses IS to coordinate various activities with your partner for that chosen component. Please circle the corresponding number.*

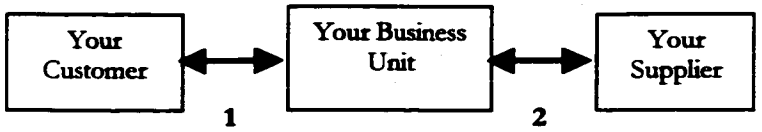


Figure 4.2-1 The Choice of the Interested Relationship by the Respondents

In this research, two sets of surveys were administered. The first set included two waves of surveys and two waves of reminders mailed out in the summer time. The first wave of surveys was mailed to 3425 top IS executives. Two weeks later, a wave of yellow post card reminders was mailed out. Again, two weeks later after the mailing of post cards, a second wave of surveys was mailed out. Three weeks later after the second wave of surveys, another wave of yellow post card reminders was mailed out. There was a total 82 useful responses. This ended the first set of surveys.

The second set of surveys was implemented in the next four months to the original sample. First, there were again four waves of mailing. The first wave of surveys were sent out in the early Fall semester. Three weeks later, a reminder letter was mailed out. Three weeks later after the reminder, another wave of surveys were mailed out. Finally, a third wave of surveys was

mailed out after the holiday season. Second, a web site dedicated to this survey research was also developed to make the survey easy to be accessed and responded. Third, during the Fall semester, in order to improve response rate and probe the reasons why IS directors/managers do not respond, three hundred phones calls were made. The typical reasons for no responses are company policy, traveling, retirements, no time, moving, and quitting jobs. Finally, 123 responses were received. This ended the second set of surveys.

4.2.2 Data

As indicated above, there are 82 useful responses from the 1st set of surveys and 123 useful responses from the 2nd set of surveys. Together, 205 useful responses were received from these two sets of surveys. In the meantime, there are 198 returned without answers to the questions in the survey. This is due to various reasons such as company policy restrictions, undeliverable addresses, retirements, moving, etc. Considering all these situations, the effective response rate is 205/(3425-198)=6.35%. Response demographics are shown in the following tables.

64 percent of responses are from manufacturing, 17 percent from services, and 15 percent from other industries such as transportation. As to firm size, 26 percent have 1000 to 2499 employees and 33 percent have over 2500 employees. Clearly, big firms are more likely to respond this business-to-business e-commerce survey. The numbers of IS employees in responding firms are distributed pretty even from less than 10 to over 200. Sales of the responding firms are likely to be larger than 100 million, which is consistent with firm size.

19 percent of the respondents are CIOs, 35 percent of the respondents are IS directors, and 21 percent are IS Managers. 59 percent of the responding firms are the final product and service provider and 24 percent are first tier suppliers. 22 percent of the IOS reported are electronic markets and 41 percent of the IOS are one to one electronic integration linkage. 36 percent of IOSs are initiated by the responding firms and 44 percent of IOSs are initiated by the responding firms in conjunction with their partners. 37 percent of respondents choose the customer relationship and 15 percent of respondents choose the supplier relationship. Interestingly, 48 percent of the respondents did not indicate the relationship of their choice. This may be due to security reasons or the design of the question/directions is not clear enough. And this issue should be paid more attention in the future research.

As to non-respondent bias, three tests of homogeneity have been implemented to compare the proportions of first set respondents and the second set respondents on firm size, number of IS employees, and sales. The assumption is that the second set respondents are regarded as non-respondents since there is no detailed information about respondents in the original name list. The three Chi-Square values are 9.101(firm size), 6.899(number of IS employees), and 5.632 (Sales). The critical value for 0.95 confidence of Chi-Square test with 13 degrees is 22.362. All the Chi-Square values are less than 22.362 and thus there are no statistical differences between the first set respondents and the second set respondents in terms of firm size, number of IS employees, and sales. Thus, it is concluded that non-respondent bias does not exist in these data.

Table 4.2-1 Responses from Two Sets of Surveys

Set	Frequency	Percent
1st Set	82	40.000
2nd Set (Web Responses)	33	27
2nd Set (Mailing responses)	90	73
2nd Set	123	60.000
Total	205	100

Table 4.2-2 Industry

Industry	Frequency	Percent
Manufacturing	131	64
Services	34	17
Others (e.g., transportation)	31	15
Unspecified	9	4
Total	205	100

Table 4.2-3 Firm Size

Number of Employees	Frequency	Percent
Less Than 100	11	5
100-249	12	6
250 to 499	19	9
500 to 999	34	17
1000 to 2499	54	26
Over 2500	67	33
Unspecified	8	4
Total	205	100

Table 4.2-4 Number of IS Employees

Number of IS Employees	Frequency	Percent
Less Than 10	21	10
11-25	43	21
26-50	44	21
51-100	30	15
101-200	25	12
Over 200	35	17
Unspecified	7	3
Total	205	100

Table 4.2-5 Sales Volume

Annual Sales ($)	Frequency	Percent
Less than 10 million	5	2
10 to 49.9 million	9	4
50 to 99.9 million	13	6
100 to 499.9 million	51	25
500 to 1 billion	48	23
Over 1 Billion	69	34
Unspecified	10	5
Total	205	100

Table 4.2-6 Respondents Managerial Positions

Position	Frequency	Percent
CIO	39	19
IS Director	71	35
Vice President	23	11
IS Manager	43	21
Unspecified	22	11
Total	205	100

Table 4.2-7 Responding Firms' Position in the Supply Chain

Position in Supply Chain	Frequency	Percent
Final Product/Service Provider	120	59
First Tier Supplier	49	24
Second Tier Supplier	14	7
Other (Third Tier etc.)	4	2
Unspecified	18	9
Total	205	100

Table 4.2-8 Type of IOS

Type of IOS	Frequency	Percent
Part of an electronic market with many suppliers and many buyers in the system	45	22
One to one connection between the buyer and the supplier	85	41
One buyer and many suppliers	22	11
One supplier and many buyers	15	7
Other (e.g., Email systems)	10	5
Unspecified	28	14
Total	205	100

Table 4.2-9 IOS Initiator

IOS Initiator	Frequency	Percent
Your Partner	4	2
Your Business Unit	73	36
A Third Party	2	1
Your Business Unit and Your Partner	91	44
Your Business Unit and a Third Party	14	7
Your Partner and a Third Party	2	1
Other (e.g., more than three parties involved or no IOS)	7	3
Unspecified	12	6
Total	205	100

Table 4.2-10 Choice of Relationship Context

Relationship Type	Frequency	Percent
Customer Relationship	76	37
Supplier Relationship	30	15
Unspecified	99	48
Total	205	100

Table 4.2-11 Comparison of Firm Sizes of the Respondents from Two Sets of Surveys

Number of Employees	1st Set		2nd Set	
	Frequency	Percent	Frequency	Percent
Less Than 100	3	4	8	7
100-249	4	5	8	7
250 to 499	6	7	13	11
500 to 999	18	22	16	13
1000 to 2499	18	22	36	29
Over 2500	32	39	35	28
Unspecified	1	1	7	6
Total	82	100	123	100

Table 4.2-12 Comparison of the Number of IS Employees of the Respondents from Two Sets of Surveys

Number of IS Employees	1st Set		2nd Set	
	Frequency	Percent	Frequency	Percent
Less Than 10	7	9	14	11
11-25	18	22	25	20
26-50	23	28	21	17
51-100	11	13	19	15
101-200	7	9	18	15
Over 200	15	18	20	16
Unspecified	1	1	6	5
Total	82	100	123	100

Table 4.2-13 Comparison of the Sales Volume of the Respondents from Two Sets of Surveys

Annual Sales ($)	1st Set		2nd Set	
	Frequency	Percent	Frequency	Percent
Less than 10 million	0	0	5	4
10 to 49.9 million	4	5	5	4
50 to 99.9 million	6	7	7	6
100 to 499.9 million	20	24	31	25
500 to 1 billion	17	21	31	25
Over 1 Billion	32	39	37	30
Unspecified	3	4	7	6
Total	82	100	123	100

4.3 Large-Scale Instrument Assessment Methodology

In general, the instrument assessment methods used in the large-scale survey are similar to those used in the pilot study. However, there are some additional tests in the large-scale setting. First, a construct level exploratory factor analysis will be implemented to assess the unidimensionality, convergent validity and discriminate validity of all measurement instruments. Second, the predictive validity of the construct instruments will also be preliminarily examined by checking the correlations among different constructs.

The statistical package SPSS 8.0 for Windows is used to conduct all the statistical analysis. The measurement items are first purified by examining the Corrected Item-to-Total Correlation (CITC) score of each item with respect to its designated dimension of a construct. The CITC score is a very good indicator of how well each item contributes to the internal consistency of a particular construct dimension, which is represented by Cronbach Alpha (Cronbach, 1951). As a general rule, items with a CITC score of lower than 0.50 should be removed. However, a slightly lower CITC score may be acceptable if that particular item is considered to be important theoretically. On the other hand, certain items with CITC score above 0.50 may also be removed if their deletion can improve the overall reliability of the specific dimension. This can be determined by examining the "Alpha if deleted" score. Also, it must be noted that low CITC scores may sometimes indicate multiple underlying factors in the current dimension.

To further ensure the unidimensionality and convergent validity of measurement instrument, the purified items under each construct dimension are submitted as a group to a dimensional level exploratory factor analysis. Factor analysis is an important data reduction and summarization method. It analyzes the interrelationships among a large number of variables

and then explains these variables in terms of their common underlying dimensions (factors). One of the first decisions in factor analysis is to choose a factor extraction method and the type of input matrix. The widely accepted Principal Component analysis method was selected and the correlation matrix was used as input.

Another important decision in factor analysis is the type of factor rotation. By rotating the factor axes, researchers expect to achieve a simpler, theoretically more meaningful factor pattern. The current study used the most popular VARIMAX factor rotation method. VARIMAX method focuses on simplifying the columns of the factor matrix, thus giving a clearer separation of the factors than any other methods (Hair et al., 1992, pp. 236). The MEANSUB command is used to replace the missing values with the mean score for that item. A scale with a good internal consistency should have all items loaded on one single factor. If multiple factors emerge, the possibility of splitting the items into multiple dimensions is carefully examined, and theoretical justifications are sought.

The entire group of items under each construct are then thrown into a construct-level exploratory factor analysis to check for their discriminant validity among different dimensions. Once again, Principal Component extraction, VARIMAX rotation, and MEANSUB command are used. As a general rule of thumb, when the sample size is 50 or large, factor loadings greater than 0.30 are considered to be significant; loadings of 0.40 are considered more important; and loadings of greater than 0.50 are very significant (Hair, et al., 1992, pp. 239). To ensure the high quality of the instrument development process in the current study, 0.50 is used as the cutoff score for factor loadings, i.e., items with loadings lower than 0.50 will generally be removed. To streamline the final results, factor loadings below 0.4 are not

reported. Items with serious cross-loadings (i.e., an item loaded very close to 0.50 on both factors) will be generally dropped.

The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy is calculated for all dimensional level and construct level factor analysis. This measure ensures that the effective sample size is adequate for the current factor analysis. Generally, a KMO score in the 0.90's is considered outstanding, the 0.80's as very good, the 0.70's as average, 0.60's as tolerable, 0.50's as miserable, and below 0.50 as unacceptable.

Finally, the Cronbach's Alpha reliability coefficients are calculated for all the dimensions to make sure that they are all above the minimum suggested value. An Alpha score of higher than 0.70 is generally considered to be acceptable (Nunally, 1978). To check the predictive validity of the resulting measurement instruments, a composite score for each construct will be calculated by taking the average of all remaining items in the construct. Pearson correlation coefficients among these composite construct measures will then be calculated to determine the significance of hypothesized relationships.

4.4 Construct Reliability and Validity

4.4.1 IS Competence

4.4.1.1 Measurement Items

The following table shows the measurement items in the large-scale study for IS competence. IS competence (ISC) is represented by 9 dimensions and has 57 items.

Table 4.4-1 List of Measurement Items for IS Competence

Leadership	
LEAD2	IS executives actively address business needs
LEAD3	IS executives actively manage the inter-dependence among different business needs
LEAD4	IS executives assign proper personnel to meet each business function needs
LEAD6	IS executives establish business and IS relationships at the executive level.
LEAD7	IS executives share a vision for IS with business executives.
LEAD8	IS executives determine the values and culture of the IS function.
LEAD9	IS executives lead IS staff to contribute to achieving business solutions.
Business System Thinking	
BUST1	IS function has the capability to integrate business development with IT/IS capability.
BUST4	IS function discourages adding new processes without considering current IS/IT capability.
BUST5	IS function understands connections and interdependencies among business activities.
BUST6	IS specialists build holistic views of the current organizational processes and activities.
BUST7	IS specialists communicate holistic views of the current organizational processes and activities.
BUST8	IS function is involved in every significant business initiative
Relationship Building	
ISUR2	There are efforts to actively develop users' understanding of IS potential.
ISUR3	There are efforts to help users and IT specialists work together.
ISUR4	There are efforts to ensure users' satisfaction with the various information systems.
ISUR5	There are efforts to ensure users' unreserved acceptance of the provided information systems.
ISUR6	Interaction between IS "techies" and "users" is encouraged to reduce any culture gap
ISUR7	There are efforts to increase the mutual confidence and trust between IS personnel and users
ISUR8	There are efforts to make IS personnel and users perceive a shared purpose
Architecture Planning	
INFRA1	IS function has a well developed vision of an appropriate IS infrastructure for supporting the firm's business
INFRA2	IS function has a well developed vision of an appropriate IS infrastructure for supporting its links with suppliers and customers
INFRA3	IS personnel have designed IS infrastructures to ensure necessary integration of IS services
INFRA4	IS personnel have designed IS infrastructures to ensure necessary flexibility of IS services
INFRA5	IS personnel have created a coherent blueprint for IS infrastructure that responds to current business needs

INFRA6	IS personnel have created a coherent blueprint for IS infrastructure that responds to future business needs
INFRA7	IS personnel manage the IS infrastructure to achieve the necessary interrelationships across the business unit's different operations
INFRA8	IS personnel manage the IS infrastructure to ensure efficiencies across the business unit's different operations
	Making Technology Work
TECH1	IS function can rapidly troubleshoot unusual problems
TECH2	IS function can identify innovative solutions for non-routine business needs
TECH3	IS function can provide solutions for business needs that cannot be properly satisfied by standard approach.
TECH4	IS personnel are productive in programming.
TECH5	IS personnel can work in a wide range of technical areas
TECH6	IS personnel have a solid understanding of IT fundamental knowledge to fix IS breakdowns
	Informed Buying
INFOB1	IS purchasing personnel have the capability to select the right IS sourcing strategy
INFOB2	IS purchasing personnel make decisions based on business needs
INFOB3	IS purchasing personnel understand the firm's technological criteria
INFOB4	IS purchasing personnel analyzes the externally available IS/IT services
INFOB5	IS purchasing personnel lead tendering process in IS outsourcing
INFOB6	IS purchasing personnel lead contracting process in IS outsourcing
INFOB7	IS purchasing personnel lead service management process in IS outsourcing
INFOB8	IS purchasing personnel understand the internal IS service options
	Contract Facilitation
CONF1	User functions have a single point of contact provided by IS function in the IS outsourcing process
CONF2	User functions can ensure that conflicts at the contracting stage are resolved fairly
CONF3	User functions can ensure that conflicts at the contracting stage are resolved promptly
CONF4	IS function facilitates the contracting process between user functions and the IS suppliers
CONF5	IS function coordinates activities between users and the IS suppliers at the contracting stage
	Contract Monitoring
CONM1	There are processes to ensure that all IS outsourcing agreements are met and protected at all times.
CONM2	IS suppliers are held accountable on existing contracts
CONM3	IS suppliers are held accountable on the developing standards in IS services market.
CONM4	IS suppliers are held accountable on the evolving IS functionality in IS services market.
	Vendor Management
VENM0	There are reports highlighting IS suppliers' achievement against industry bench marks
VENM00	There are reports highlighting IS suppliers' achievement against standards in the contracts.
VENM1	There are efforts to explore the potential to create win-win situations for both your business unit and IS suppliers
VENM2	There is an annual meeting with IS suppliers to develop new IS outsourcing.
VENM3	There is an annual meeting with IS suppliers to enhance current IS outsourcing.
VENM4	There are efforts to make IS suppliers understand your business unit's operations and processes.
VENM5	There are efforts to grow with your IS suppliers over time.

4.4.1.2 Reliability Analysis

The following table shows the CITCs of all the items and Alphas for each dimension of the IS competence construct.

Table 4.4-2 List of CITC and Alpha for IS Competence

Items	Initial CITC	Final CITC	Alpha if deleted	Alpha Score
Leadership				
LEAD2	0.722	0.722	0.8751	Initial Alpha=0.8949 Final Alpha=0.8949
LEAD3	0.6751	0.6751	0.8784	
LEAD4	0.6965	0.6965	0.8758	
LEAD6	0.695	0.695	0.876	
LEAD7	0.7186	0.7186	0.8735	
LEAD8	0.6083	0.6083	0.887	
LEAD9	0.744	0.744	0.8703	
Business System Thinking				
BUST1	0.4078	0.4321 (F1)[18]	0.5985	Initial Alpha=0.7392 F1Alpha=0.6716 F2 Alpha=0.9169 F1 (Functional Level) F2(Individual Level)
BUST4	0.2112	Dropped r1		
BUST5	0.5644	0.5557(F1)	0.4075	
BUST6	0.5833	0.8466(F2)		
BUST7	0.6126	0.8466(F2)		
BUST8	0.465	0.4450(F1)	0.6265	
Relationship Building				
ISUR2	0.6633	0.6751	0.8978	Initial Alpha=0.8849 Final Alpha=0.9065
ISUR3	0.7521	0.7665	0.8828	
ISUR4	0.7244	0.7309	0.8885	
ISUR5	0.7139	0.7242	0.8896	
ISUR6	0.3479	Dropped r1		
ISUR7	0.7702	0.7865	0.88	
ISUR8	0.7573	0.7601	0.8835	
Architecture Planning				
INFRA1	0.6802	0.6802	0.9155	Initial Alpha=0.9225 Final Alpha=0.9225
INFRA2	0.6056	0.6056	0.9225	
INFRA3	0.6982	0.6982	0.9142	
INFRA4	0.7582	0.7582	0.9099	
INFRA5	0.8476	0.8476	0.9015	
INFRA6	0.8282	0.8282	0.9033	

[18] F1 means factor one and F2 means factor 2. These are used to present multiple factors in one single dimension.

INFRA7	0.7915	0.7915	0.9068	
INFRA8	0.7096	0.7096	0.9132	
Making Technology Work				
TECH1	0.6288	0.6035(F1)	0.8085	Initial Alpha=0.8098 F1 Alpha=0.8151 F2 Alpha=0.7544 F1: IS Function View F2: IS Personnel View
TECH2	0.6109	0.7203(F1)	0.6899	
TECH3	0.5486	0.6774(F1)	0.7339	
TECH4	0.4904	0.5285 (F2)	0.7232	
TECH5	0.5501	0.5886 (F2)	0.6380	
TECH6	0.5806	0.6191 (F2)	0.6259	
Informed Buying				
INFOB1	0.7197	0.7197	0.9337	Initial Alpha=0.9380 Final Alpha=0.9380
INFOB2	0.7119	0.7119	0.9342	
INFOB3	0.7261	0.7261	0.9333	
INFOB4	0.7833	0.7833	0.9292	
INFOB5	0.8278	0.8278	0.926	
INFOB6	0.8124	0.8124	0.9272	
INFOB7	0.8183	0.8183	0.9269	
INFOB8	0.8472	0.8472	0.9246	
Contract Facilitation				
CONF1	0.5592	0.6236 (F1)	0.9206	Initial Alpha=0.7816 F1 Alpha=0.8668 F2 Alpha=0.7973 F1: User View F2: IS Function View
CONF2	0.696	0.8244(F1)	0.7365	
CONF3	0.6986	0.7963 (F1)	0.7632	
CONF4	0.465	0.6630 (F2)		
CONF5	0.4005	0.6630 (F2)		
Contract Monitoring				
CONM1	0.5722	0.5722	0.8448	Initial Alpha=0.8406 Final Alpha=0.8406
CONM2	0.5656	0.5656	0.8413	
CONM3	0.7808	0.7808	0.7487	
CONM4	0.7955	0.7955	0.742	
Vendor Management				
VENM0	0.6826	0.6826	0.8544	Initial Alpha=0.8749 Final Alpha=0.8749
VENM00	0.7492	0.7492	0.8449	
VENM1	0.5742	0.5742	0.8681	
VENM2	0.7203	0.7203	0.8492	
VENM3	0.7625	0.7625	0.8428	
VENM4	0.5424	0.5424	0.8714	
VENM5	0.571	0.571	0.8684	

Decisions and Summary: For the business system thinking dimension, initial CITC analysis shows that BUST4 has a low CITC. After deleting BUST4, CITC analysis still shows that BUST1 and

BUST8 have low CITCs. This motivates the researcher to do a factor analysis to see whether there are two factors in this dimension. Factor analysis clearly shows that there are two factors with BUST 6 and BUST7 forming one factor and BUST1, 5, 8 forming another factor. Then CITCs are calculated for both of these two factors and they are displayed in the above table. Although BUST1 and BUST8 have CITCs (0.4323 and 0.4471) lower than 0.5, a careful examination of these two measurement items show that BUST1 captures whether IS function has the capability to integrate business development with IT/IS capability and BUST8 represents whether IS function is involved in every significant business initiative. BUST1 and BUST8, together with BUST5 (i.e., IS function understands connections and interdependencies among business activities), describe the business thinking capability at the functional level. BUST6 and BUST7 captures whether IS specialists build and communicate a holistic view of organizational processes. These two items capture the business thinking capability at an individual level. The relationship between the functional level and the individual level business system thinking capability is that while the individual level business system thinking capability is the foundation for the functional level business system thinking, the individual capabilities can not be fully utilized to achieve their potential value without functional infrastructure such as policies, procedures, and meetings. Thus, this business system thinking dimension is divided into two sub-dimensions. The first sub-dimension is called FBUST (i.e., Functional Level BUST) and the second sub-dimension is called IBUST (i.e., Individual Level BUST).

For the making technology work dimension, through reliability analysis, it is easy to see that TECH4 has a low CITC. It means TECH4 needs to be removed. However, after deleting TECH4 and running a reliability analysis again, it is found that TECH5 and TECH6 (due to

low CITCs) need to be removed. This tells us that TECH4, TECH5, and TECH6 may form a new dimension. A factor analysis is implemented to verify this idea. The result of the factor analysis clearly shows two factors. Further, after carefully reading the items, it is clear that TECH1-3 focus on IS function's capability to fix technical problems and TECH4-6 focus on IS personnel's technical skills. Conceptually, IS personnel's technical skills are the basis for IS function to fix organizational technical problems but are not sufficient conditions since for IS function to be responsive to organizational technical needs, appropriate IS function procedures and policies and other infrastructure should be in place to properly assign IS personnel to organizational technical problems. Based on this conceptual analysis, reliability analyses for TECH1-3 and TECH4-6 are implemented separately and good reliabilities are found for both groups. Thus, it is decided to keep all the items and two sub-constructs of making technology work are formed.

Similarly, for the dimension of contract facilitation, after the initial reliability analysis, it is clear that CONF5 needs to be deleted due to a low CITC. However, after deleting CONF5 and rerunning reliability analysis, CONF4 needs to be deleted due to a low CITC. This tells the researcher that there may have two sub-dimensions. A factor analysis is implemented to verify this idea and the results of the factor analysis clearly show that there are indeed two factors. Further, a careful examination of all the items of contract facilitation is carried out. Conceptually, it is clear that CONF1-3 are from the user's point of view and CONF4-5 are from the IS function's point of view. Thus, the dimension is decided to be divided into two factors. Reliability analyses are implemented for CONF1-3 and CONF4-5 separately and good reliabilities are found.

All other dimensions have items with good CITCs and Alphas, indicating good reliabilities.

4.4.1.3 Unidimensionality Analysis

The following table shows the dimensional level factor analysis to validate the each dimension's unidimensionality.

Table 4.4-3 List of Factor Loadings for IS Competence (Dimensional Level)

Items	Initial Loading		Final Loading
Leadership (KMO=0.825)			
LEAD2	.809		.809
LEAD3	.775		.775
LEAD4	.786		.786
LEAD6	.786		.786
LEAD7	.801		.801
LEAD8	.704		.704
LEAD9	.819		.819
Business System Thinking (KMO=0.676)			
BUST1		.813(F1)	F1 Functional Level BUST F2 Individual Level BUST
BUST5		.795(F1)	
BUST6	.934(F2)		
BUST7	.932(F2)		
BUST8		.639(F1)	
Relationship Building (KMO=0.849)			
ISUR2	.772		.772
ISUR3	.840		.840
ISUR4	.817		.817
ISUR5	.814		.814
ISUR7	.863		.863
ISUR8	.846		.846
Architecture Planning (KMO=0.888)			
INFRA1	.744		.744
INFRA2	.678		.678
INFRA3	.779		.779
INFRA4	.830		.830
INFRA5	.895		.895
INFRA6	.877		.877
INFRA7	.851		.851
INFRA8	.784		.784
Making Technology Work (KMO=0.789)			

TECH1	.718(F1)		F1 IS Functional Level Technical Skills F2 IS Personnel Level Technical Skills
TECH2	.874(F1)		
TECH3	.879(F1)		
TECH4		.767(F2)	
TECH5		.800(F2)	
TECH6		.817(F2)	
Informed Buying (KMO=0.905)			
INFOB1	.789		.789
INFOB2	.783		.783
INFOB3	.796		.796
INFOB4	.839		.839
INFOB5	.868		.868
INFOB6	.856		.856
INFOB7	.861		.861
INFOB8	.888		.888
Contract Facilitation (KMO=0.665)			
CONF1	.799(F1)		F1 Contract Facilitation from User Perspective F2 Contract Facilitation from IS Function Perspective
CONF2	.800(F1)		
CONF3	.908(F1)		
CONF4		.890(F2)	
CONF5		.913(F2)	
Contract Monitoring (KMO=0.731)			
CONM1	.740		.740
CONM2	.733		.733
CONM3	.903		.903
CONM4	.911		.911
Vendor Management (KMO=0.751)			
VENM0	.838 (F1)		F1 Operational Vendor Management F2 Strategic Vendor Management
VENM00	.873(F1)		
VENM1		.882(F2)	
VENM2	.872(F1)		
VENM3	.869(F1)		
VENM4		.831(F2)	
VENM5		.888(F2)	

Business system thinking, as pointed out in the reliability analysis, has two sub-dimensions. BUST1, 5, 8 form the first sub-dimension focusing on IS functional level business system

Business system thinking, as pointed out in the reliability analysis, has two sub-dimensions. BUST1, 5, 8 form the first sub-dimension focusing on IS functional level business system thinking capability and BUST6 and 7 form the second sub-dimension focusing on the IS individual level business system thinking. Making technology work has two sub-dimensions as pointed out by previous reliability analysis. TECH1 to 3 form the first sub-dimension focusing on IS functional level technical skills and TECH4 to 6 form the second sub-dimension focusing on IS personnel level technical skills. Similarly, contract facilitation has two sub-dimensions as pointed out by reliability analysis. CONF1 to 3 form the user perspective of contract facilitation and CONF4 and 5 form the IS function perspective of contract facilitation.

As to vendor management dimension, based on the factor analysis, two sub-dimensions emerge. A careful examination of the items shows that items VENM0, VENM00, VENM2, and VENM3 focus on operational level vendor management and the other three items (VENM1, VENM4, and VENM5) focus on the strategic level vendor management with a long-term view. Reliability analysis shows that the operational level vendor management instrument has an Alpha of 0.9089 with all items' CITCs greater than 0.7 and the strategic level of vendor management instrument has an Alpha of 0.8681 with all items' CITCs greater than 0.69. Clearly, it is empirically and conceptually sound to divide the original vendor management into two sub-dimensions including both operational and strategic level vendor management.

As to leadership, relationship building, architecture planning, informed buying, and contract monitoring, dimensional factor analyses confirm that these are single dimensions.

4.4.1.4 Construct Level Factor Analysis

All the remaining items in the IS competence construct are subject to a factor analysis to verify the discriminant and convergent validity at the construct level. The following table shows factor loadings for all the items

Table 4.4-4 Factor Analysis of IS Competence Measurement Items with KMO=0.902

Items	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12
Leadership												
LEAD2		.724										
LEAD3		.691										
LEAD4		.623										
LEAD6		.698										
LEAD7		.690										
LEAD8		.669										.408
LEAD9		.674										
Business System Thinking												
BUST1						.555						
BUST5						.437						
BUST8							.631					
BUST6											.775	
BUST7											.763	
IS-User Relationship												
ISUR2					.672							
ISUR3					.669							
ISUR4					.760							
ISUR5					.737							
ISUR7					.702							
ISUR8					.670							
Architecture Planning												
INFRA1				.420			.426					
INFRA2							.572					
INFRA3				.713								
INFRA4				.792								
INFRA5				.766								
INFRA6				.699								
INFRA7				.687								
INFRA8				.584								
Making Technology Work-IS Functional Level												
TECH1						.668						

TECH2						.741						
TECH3						.785						
Items	**F1**	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**	**F8**	**F9**	**F10**	**F11**	**F12**
Making Technology Work-IS Personnel Level												
TECH4							.			.703		
TECH5										.663		
TECH6										.709		
Informed Buying												
INFOB1	.605											
INFOB2	.616											
INFOB3	.641											
INFOB4	.759											
INFOB5	.843											
INFOB6	.863											
INFOB7	.854											
INFOB8	.813											
Contract Facilitation												
CONF1								.673				
CONF2								.842				
CONF3								.771				
CONF4							.639					
CONF5							.507					
Contract Monitoring												
CONM1			.627									
CONM2												.675
CONM3			.570									
CONM4			.536						.418			.416
Strategic Vendor Management												
VENM4									.618			
VENM5									.716			
VENM1									.638			
Operational Vendor Management												
VENM0			.775									
VENM00			.821									
VENM2			.850									
VENM3			.840									
Eigen Value	19.916	4.626	2.875	2.414	2.066	1.67	1.621	1.482	1.341	1.304	1.155	1.041
%Variance	35.564	8.261	5.133	4.311	3.689	2.982	2.894	2.646	2.394	2.328	2.062	1.859
Cumulative	35.564	43.825	48.959	53.27	56.959	59.941	62.835	65.48	67.874	70.203	72.265	74.124

Decisions and Summary: For IS leadership, item LEAD8 has a cross loading on F12. Thus it will be deleted. For business system thinking, BUST1 and BUST5 load on F6, which is the IS functional level technical skill. BUST8 loads on F7, which is the IS view of its capability of

contract facilitation. Thus, BUST1, 5, and 8 will be deleted. BUST6, 7 form a solid dimension, which focuses on IS personnel's business system thinking capability. Based on the empirical data, IS functional level business system thinking capability could be represented by many other dimensions in the IS competence construct and thus there is no need for that sub-dimension.

IS-user relationship items form a solid dimension with all items loading on one single factor. As to architecture planning, the first two items load on F7 and thus they will be deleted. TECH1 to 3 neatly load on one single factor forming the IS functional level technical skills. TECH4 to 6 also nicely load on one single factor forming the IS personnel level technical skills. Informed buying items nicely load on one single factor and all items will be kept.

CONF1 to 3 load on one single factor forming the user perspective of contract facilitation. CONF4 and 5 load on one single factor forming IS function view of its capability to facilitate IS contracts. CONM4 has cross loadings and thus will be removed. CONM1 and CONM3 heavily load on operational level vendor management. After a careful examination of these two items, it is easy to see that they can be regarded as part of operational level vendor management and thus they will be merged with operational level vendor management items. CONM2 loads on F12, which is a mix of items from several dimensions, thus it will be removed. VENM4, 5, and 1 nicely form one single factor, namely, strategic vendor management. And finally, VENM0, 00, 2, and 3 form the operational level vendor management in conjunction with CONM1 and 3. The following table shows the second round of factor analysis.

Table 4.4-5 Factor Analysis of IS Competence (1st Revision) KMO=0.905

Items	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
Leadership										
LEAD2					.773					
LEAD3					.724					
LEAD4					.597					
LEAD6					.772					
LEAD7					.702					
LEAD9					.635					
Business System Thinking										
BUST6										.783
BUST7										.761
IS-User Relationship										
ISUR2				.700						
ISUR3				.691						
ISUR4				.748						
ISUR5				.733						
ISUR7				.684						
ISUR8				.655						
Architecture Planning										
INFRA3		.714								
INFRA4		.790								
INFRA5		.765								
INFRA6		.722								
INFRA7		.681								
INFRA8		.601								
Making Technology Work-IS Functional Level										
TECH1						.674				
TECH2						.750				
TECH3						.783				
Making Technology Work-IS Personnel Level										
TECH4									.696	
TECH5									.689	
TECH6									.731	
Informed Buying										
INFOB1	.627									
INFOB2	.630									
INFOB3	.661									
INFOB4	.778									
INFOB5	.825									
INFOB6	.846									
INFOB7	.845									
INFOB8	.823									
Contract Facilitation										

CONF1								.660		
CONF2								.850		
CONF3								.808		
CONF4										.540
CONF5										
Operational Vendor Management										
CONM1			.630							
CONM3			.599							
VENM0			.765							
VENM00			.823							
VENM2			.848							
VENM3			.853							
Strategic Vendor Management										
VENM4							.663			
VENM5							.742			
VENM1							.710			
Eigen Value	17.51	3.948	2.742	2.355	1.916	1.605	1.504	1.382	1.259	1.128
%Variance	36.479	8.224	5.713	4.907	3.991	3.344	3.133	2.88	2.623	2.351
Cumulative	36.479	44.703	50.416	55.323	59.314	62.657	65.791	68.671	71.293	73.644

Decisions and Summary: CONF 4 and 5 need to be removed after the first revision. This implies that user perspective of IS function capability to facilitate the IS contracts is more important and unique than IS functional perspective of its facilitation of IS contracts. The following table shows the factor loadings after 2nd revision and all the factors have clean items loadings.

Table 4.4-6 Factor Analysis of IS Competence (2nd Revision) KMO=0.905

Items	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
Leadership										
LEAD2					.779					
LEAD3					.724					
LEAD4					.604					
LEAD6					.774					
LEAD7					.707					
LEAD9					.637					
Business System Thinking										
BUST6										.824
BUST7										.804
IS-User Relationship										
ISUR2				.706						
ISUR3				.689						
ISUR4				.779						
ISUR5				.705						

ISUR7				.693						
ISUR8				.668						
Architecture Planning										
INFRA3		.711								
INFRA4		.796								
INFRA5		.773								
INFRA6		.733								
INFRA7		.694								
INFRA8		.607								
Making Technology Work-IS Functional Level										
TECH1							.675			
TECH2							.753			
TECH3							.791			
Making Technology Work-IS Personnel Level										
TECH4									.683	
TECH5									.708	
TECH6									.736	
Informed Buying										
INFOB1	.631									
INFOB2	.633									
INFOB3	.663									
INFOB4	.778									
INFOB5	.826									
INFOB6	.846									
INFOB7	.844									
INFOB8	.825									
Contract Facilitation										
CONF1						.666				
CONF2						.849				
CONF3						.806				
Operational Vendor Management										
CONM1			.627							
CONM3			.600							
VENM0			.762							
VENM00			.825							
VENM2			.853							
VENM3			.860							
Strategic Vendor Management										
VENM4								.672		
VENM5								.747		
VENM1								.710		
Eigen Value	16.84	3.927	2.738	2.347	1.89	1.539	1.491	1.314	1.226	1.098
%Variance	36.608	8.536	5.951	5.103	4.108	3.345	3.241	2.856	2.665	2.387
Cumulative	36.608	45.144	51.096	56.198	60.306	63.651	66.892	69.747	72.412	74.799

4.4.2 Manufacturer-Supplier Relationship

4.4.2.1 Measurement Items

The relationship between supply chain members has six dimensions including hierarchical control (4 items), interdependence (4 items), trust (3 items), asset specificity (5 items), reciprocal asset specificity (5 items), and complementary resources (3 items).

Table 4.4-7 Measurement Items for Manufacturer-Supplier Relationship

Code Names	Questionnaire Items
Hierarchical Control	
HC2	There is a well defined incentive system in the relationship
HC3	There are many standard operating procedures in the relationship
HC5	When changes in specifications of the component are made, cost-plus system is used to adjust the remuneration for each partner
HC7	When there is a dispute, you can access a third-party enforcer to resolve the dispute.
Interdependence	
INTER4	Ongoing communications are necessary for the relationship functioning well
INTER5	Ongoing decision making is necessary for the relationship functioning well
INTER6	There are continuing adjustments in the relationship
INTER7	It is required for each partner to link specific activities with the other partner closely and regularly
Trust	
TRUST2	Both sides are expected not to make demands that seriously damage the interests of the other
TRUST3	The stronger side is expected not to pursue its interests at all costs
TRUST5	Most of the procedures have become well accepted and routines
Asset Specificity	
AS4	Your business unit has customized tools to accommodate your partner's needs
AS5	Your business unit has dedicated personnel who learn the systems specific to the partner
AS6	Your business unit has dedicated personnel who learn the procedures specific to the partner
AS7	Your business unit has dedicated personnel who learn the individuals specific to the partner
AS8	Your business unit has accumulated specialized knowledge and information about the partner over time
Reciprocal Asset Specificity	
RAS4	Your partner has customized tools to accommodate your business unit's needs
RAS5	Your partner has dedicated personnel who learn the systems special to your business unit
RAS6	Your partner has dedicated personnel who learn the procedures special to your business unit
RAS7	Your partner has dedicated personnel who learn the individuals special to your business unit
RAS8	Your partner has accumulated specialized knowledge and information about your business unit over time
Complementary Resources	

CR2	Combined complementary but non-relationship specific resources (e.g., reputation, specialized expertise) from partners in the relationship are becoming difficult to imitate by other firms
CR3	Combined complementary but non-relationship specific resources (e.g., reputation, specialized expertise) in the relationship are becoming valuable
CR5	Combined complementary but non-relationship specific resources (e.g., reputation, specialized expertise) in the relationship have synergistic effects

4.4.2.2 Reliability Analysis

As to hierarchical control, after first round analysis, HC7 is deleted due to a low CITC. A careful examination of this item reveals that it is related to a third party enforcer rather than the control mechanism within the relationship. This may be regarded as the control environment rather than the hierarchical control itself. The second round analysis shows that HC5 has a 0.445 CITC, which is lower than 0.5. However, a careful examination of this item reveals that it measures whether there are cost-plus adjustment systems when changes are made. Conceptually, this is relevant and important. Thus, it is decided to keep this item for the further analysis. HC Alpha is 0.6858, which is very close to 0.7.

All items for interdependence load well on this factor. As to Trust, TRUST5 has a low CITC of 0.4273, and thus is deleted. Both asset specificity and reciprocal asset specificity items have good CITCs and reliabilities. As to complementary resources items, CR2 is deleted and the final alpha is 0.7766. A careful examination of this item, CR2 measures the degree of difficulty for other firms to imitate the complementary resources. IS managers may think that this attribute is not as important and clear as two other items (CR3 and CR5) which focus on the value and the synergistic effects. It is decided that CR3 and CR5 are kept for further analysis.

Table 4.4-8 List of CITC and Alpha for Manufacturer-Supplier Relationship

Items	Initial CITC	Final CITC	Alpha if deleted	Alpha Score
Hierarchical Control				
HC2	0.5405	0.5392	0.5356	Initial Alpha=0.6884 Final Alpha=0.6858
HC3	0.4681	0.5133	0.5725	
HC5	0.4999	0.445	0.6616	
HC7	0.3736	Dropped		
Interdependence				
INTER4	0.6159	0.6159	0.7774	Initial Alpha=0.819 Final Alpha=0.819
INTER5	0.7619	0.7619	0.7028	
INTER6	0.5916	0.5916	0.7850	
INTER7	0.5893	0.5893	0.7918	
Trust				
TRUST2	0.6009	0.6234		Initial Alpha=0.722 Final Alpha=0.7680
TRUST3	0.6381	0.6234		
TRUST5	0.4267	Dropped		
Asset Specificity				
AS4	0.599	0.599	0.9396	Initial Alpha=0.9203 Final Alpha=0.9203
AS5	0.8826	0.8826	0.8787	
AS6	0.9012	0.9012	0.8752	
AS7	0.8261	0.8261	0.8913	
AS8	0.7675	0.7675	0.9047	
Reciprocal Asset Specificity				
RAS4	0.6184	0.6184	0.9446	Initial Alpha=0.9262 Final Alpha=0.9262
RAS5	0.8907	0.8907	0.8926	
RAS6	0.8925	0.8925	0.8922	
RAS7	0.8488	0.8488	0.901	
RAS8	0.7945	0.7945	0.9116	
Complementary Resources				
CR2	0.3187	Dropped		Initial Alpha=0.6568 Final Alpha=0.7766
CR3	0.5431	0.6347		
CR5	0.5734	0.6347		

4.4.2.3 Unidimensionality Analysis

The following table shows the dimensional level factor analysis to validate the unidimensionality.

Table 4.4-9 List of Factor Loadings for Unidimensionality Analysis of the Manufacturer-Supplier Relationship

Items	Initial Factor Loading	Final Factor Loading
Hierarchical Control KMO=0.655		
HC2	.817	.817
HC3	.798	.798
HC5	.735	.735
Interdependence KMO=0.770		
INTER4	.795	.795
INTER5	.891	.891
INTER6	.768	.768
INTER7	.765	.765
Trust KMO=0.500		
TRUST2	.901	0.901
TRUST3	.901	0.901
Asset Specificity KMO1=0.861		
AS4	.711	.711
AS5	.935	.935
AS6	.946	.946
AS7	.900	.900
AS8	.859	.859
Reciprocal Asset Specificity KMO=0.865		
RAS4	.727	.727
RAS5	.938	.938
RAS6	.941	.941
RAS7	.913	.913
RAS8	.872	.872
Complementary Resources KMO=0.5		
CR3	.904	.904
CR5	.904	.904

All dimensions' items have good loadings. Trust and complementary resource have low KMOs due to only two items in their dimensions.

4.4.2.4 Construct Level Factor Analysis

All the remaining items in the Supply Chain Relationship construct are subject to a factor analysis to verify the discriminant and convergent validity at the construct level. There are total 21 items for this construct. The following table shows factor loadings for all the items

Table 4.4-10 List of Factor Loadings at the Construct Level for Manufacturer-Supplier Relationship KMO=0.860

	F1	F2	F3	F4	F5	F6
Hierarchical Control						
HC2				.777		
HC3				.680		
HC5				.697		
Interdependence						
INTER4			.775			
INTER5			.846			
INTER6			.739			
INTER7			.594			
Trust						
TRUST2					.853	
TRUST3					.874	
Asset Specificity						
AS4	.666					
AS5	.903					
AS6	.920					
AS7	.857					
AS8	.807					
Reciprocal Asset Specificity						
RAS4		.682				
RAS5		.877				
RAS6		.897				
RAS7		.876				
RAS8		.823				
Complementary Resources						
CR3						.810
CR5						.795
Eigen Value	7.528	2.472	2.134	1.47	1.289	1.034
%Variance	35.848	11.771	10.16	7	6.14	4.924
Cumulative %	35.848	47.619	57.779	64.779	70.918	75.842

All items load on their respect dimensions very well, indicating good discriminant and convergent validity.

4.4.3 IOS Use in Supply Chain

4.4.3.1 Measurement Items

The following table displays all the measurement items for this construct. It includes three dimensions. They are depth, volume, and diversity.

Table 4.4-11 Measurement Items for IOS Use in Supply Chain

IOS Use Depth	
ISUD1	Your IS applications transfer files to your partner's application automatically
ISUD2	Your partner's IS applications transfer files to your IS applications automatically
ISUD3	Your IS applications and your partner's applications can communicate with each other automatically.
ISUD4	Your IS applications can directly access the data base in your partner's computer systems
ISUD5	Your partner's IS applications can directly access the data base in your computer systems
IOS Use Diversity	
ISUDIV1	Purchasing personnel exchange data in electronic form with the partner
ISUDIV2	Engineering personnel exchange data in electronic form with the partner
ISUDIV3	Quality personnel exchange data in electronic form with the partner
ISUDIV4	Production control personnel exchange data in electronic form with the partner
ISUDIV5	Transportation personnel exchange data in electronic form with the partner
ISUDIV6	Payment personnel exchange data in electronic form with the partner
IOS Use Volume	
ISUV1	A high percentage of the total transactions with the partner is conducted through the IS
ISUV2	A large number of documents associated with the partner are exchanged through the IS

4.4.3.2 Reliability Analysis

The following table shows the CITCs and reliability of IS use in supply chin. ISUD5 has a CITC of 0.464, but it is close to 0.5 and thus ISUD5 is kept for further analysis. All other items for IS use depth, IS use diversity, and IS use volume items have good CITCs and all dimensions have good reliabilities (>0.8).

Table 4.4-12 List of CITC and Alpha for IOS Use in Supply Chain

Items	Initial CITC	Final CITC	Alpha if deleted(Initial)	Alpha Score
IOS Use Depth				
ISUD1	0.634	0.634	0.7624	Initial Alpha=0.8106 Final Alpha=0.8106
ISUD2	0.615	0.6150	0.7674	
ISUD3	0.7044	0.7044	0.7393	
ISUD4	0.5771	0.5771	0.779	
ISUD5	0.4639	0.4639	0.8129	
IOS Use Diversity				
ISUDIV1	0.5328	0.5328	0.8317	Initial Alpha=0.8412 Final Alpha=0.8412
ISUDIV2	0.5643	0.5643	0.8267	
ISUDIV3	0.6839	0.6839	0.8030	
ISUDIV4	0.7179	0.7179	0.7947	
ISUDIV5	0.6232	0.6232	0.8148	
ISUDIV6	0.5969	0.5969	0.8198	
IOS Use Volume				
ISUV1	0.7079	0.7059		Initial Alpha=0.8276 Final Alpha=0.8276
ISUV2	0.7079	0.7059		

4.4.3.3 Unidimensionality Analysis

The following table shows the results of the dimensional level factor analysis for depth, diversity, and volume.

Table 4.4-13 List of Factor Loadings for IOS Use in Supply Chain for Unidimensionality Analysis

Items	1st round Factor Loading			2nd round Factor Loading
IS Use Depth KMO=0.695				
ISUD1	.909(F1)	CITC 0.7841	Alpha =0.8710	
ISUD2	.914(F1)	CITC0.7765		
ISUD3	.796(F1)	CITC 0.6980		
ISUD4	.893(F2)	CITC 0.7263	Alpha =0.8415	
ISUD5	.931(F2)	CITC 0.7263		
IS Use Diversity KMO=0.823				
ISUDIV1	.668			.668
ISUDIV2	.703			.703
ISUDIV3	.798			.798
ISUDIV4	.830			.830
ISUDIV5	.752			.752
ISUDIV6	.727			.727
IS Use Volume KMO=0.5				
ISUV1	.924			
ISUV2	.924			

A factor analysis of IS use depth shows that there are two factors. ISUD1, ISUD2, and ISUD3 form the first factor. This factor measures whether the firm has IOS link with its partner at the first and second levels of IOS linkage in the relationship. But there is no capability to directly access partners' databases. Thus it means a low level of business process inter-penetration. ISUD4 and ISUD5 form the second factor. These two items measure whether there are direct database accesses in the relationship. This implies a high level of business process inter-penetration in the relationship. A factor analysis of IS use diversity and IS use volume shows good factor loadings on single factors.

4.4.3.4 Construct Level Factor Analysis

All the remaining items in the IS Use in Supply Chain construct are subject to a factor analysis to verify the discriminant and convergent validity at the construct level. There are total 13 items for this construct. The following table shows factor loadings for all the items

Table 4.4-14 List of Factor Loadings for IS Use in Supply Chain at the Construct Level with KMO 0.845

	F1	F2	F3
IOS Use Depth			
ISUD1	.852		
ISUD2	.841		
ISUD3	**.685**	**.418**	
ISUD4			.808
ISUD5			.886
IOS Use Diversity			
ISUDIV1	**.525**	**.437**	
ISUDIV2		.732	
ISUDIV3		.810	
ISUDIV4		.769	
ISUDIV5		.690	
ISUDIV6	**.610**	**.456**	
IOS Use Volume			
ISUV1	.618		.461
ISUV2	.608		.509
Eigen Value	5.957	1.385	1.327
Variance %	45.824	10.65	10.204
Cumulative %	45.824	56.474	66.678

The above factor analysis shows that ISUD3, ISUDIV1 and ISUDIV6 have cross-loadings. Conceptually, these cross loadings mean that purchasing and payment departments are highly related to IOS use volume and the second level of IOS use depth is related to both volume and diversity. Thus, they can not represent distinct dimensions and will be deleted. ISUV1 and ISUV2 also have cross loadings. However, they are kept for the next round of analysis since they are the only two items for IS use volume. The second round factor analysis results are revealed in the following table.

Table 4.4-15 List of Factor Loadings for IOS Use in Supply Chain at the Construct Level with KMO 0.763

	F1	F2	F3
IOS Use Depth			
ISUD1		.820	
ISUD2		.850	
ISUD4			.818
ISUD5			.902
IOS Use Diversity			
ISUDIV2	.750		
ISUDIV3	.824		
ISUDIV4	.804		
ISUDIV5	.693		
IOS Use Volume			
ISUV1		.675	
ISUV2		**.696**	**.434**
Eigen Value	4.472	1.362	1.259
Variance %	44.723	13.616	12.589
Cumulative %	44.723	58.339	70.927

ISUV2 has cross loadings and thus it is removed. The following table shows the third round of factor analysis.

Table 4.4-16 List of Factor Loadings for IOS Use in Supply Chain at the Construct Level with KMO 0.739

	F1	F2	F3
IOS Use Depth			
ISUD4			0.852
ISUD5			0.923
IOS Use Diversity			
ISUDIV2	0.754		
ISUDIV3	0.82		
ISUDIV4	0.793		
ISUDIV5	0.714		
IOS Use Volume			
ISUV1		0.573	
ISUD1		0.886	
ISUD2		0.897	
Eigen Value	4.062	1.267	1.207
Variance %	45.131	14.081	13.41
Cumulative %	45.131	59.212	72.622

ISUD1, ISUD2, and ISUV1 together form one factor, namely, volume. This implies that the first level of IOS use is highly related to volume. ISUD4 and ISUD5 form one factor, indicating the third level IOS use as a unique characteristic to differentiate different firms. ISDIV2, 3, 4 form the diversity factor.

4.4.4 IOS Impacts on Inter-Firm Transaction

4.4.4.1 Measurement Items

The following table displays all the measurement items of the three dimensions of the IS impacts on Inter-firm transaction characteristics including coordination cost, operation risk, and opportunism. Each dimension has 5 items.

Table 4.4-17 List of Measurement Items for OIS Impacts on Inter-Firm Transactions

Coordination Cost	
COCOST1	The cost of exchanging product information (price, product characteristics, availability, and demand) with your partner has become low through IS use
COCOST2	The cost of incorporating exchanged information into the decision process has become low through IS use
COCOST3	The cost incurred due to delays in the communication channel with the partner has become low through IS use
COCOST4	The cost to share design changes quickly with the partner has become low through IS use
COCOST5	The cost to inform and to be informed of changes in delivery schedules of the component has become low through IS use
Operation Risk	
OPRISK1	It is less likely for any side in the relationship to deliberately misrepresent information through IS use
OPRISK2	It is less likely for any side in the relationship to withhold important information through IS use
OPRISK3	It is less likely to have inconsistent information in the relationship through IS use
OPRISK4	It is less likely to have incompatible information in the relationship through IS use
OPRISK5	It is less likely for any side in the relationship to under-perform its agreed-upon responsibilities (e.g., inferior component quality) through IS use
Opportunism	
OPPOR1	Tacit engineering knowledge can be easily transferred to the other side opportunistically through IS use in the relationship
OPPOR2	Production skills can be easily transferred to the other side opportunistically through IS use in the relationship
OPPOR3	Opportunistic behavior is reduced because of less relationship specific investments by both sides through IS use
OPPOR4	Having small number of partners does not increase opportunistic behavior through IS use
OPPOR5	Opportunistic behavior is reduced because of the monitoring effect of the IS use in the relationship

4.4.4.2 Reliability Analysis

The following table displays the CITCs for the purification of items. Items for coordination cost and operational risk have good CITCs and both of them have good reliabilities. As to opportunism, OPPOR1 has a CITC of 0.498, which is very close 0.5, and thus is kept for the further analysis.

Table 4.4-18 List of CITC and Alpha for IOS Impacts on Inter-Firm Transactions

Items	Initial CITC	Final CITC	Alpha if deleted(Initial)	Alpha Score
Coordination Cost				
COCOST1	0.6891	0.6891	0.8384	Initial Alpha=0.8678 Final Alpha=0.8678
COCOST2	0.7605	0.7605	0.8216	
COCOST3	0.7107	0.7107	0.833	
COCOST4	0.6548	0.6548	0.8484	
COCOST5	0.6371	0.6371	0.8509	
Operation Risk				
OPRISK1	0.6928	0.6928	0.8451	Initial Alpha=0.8714 Final Alpha=0.8714
OPRISK2	0.7126	0.7126	0.8461	
OPRISK3	0.6952	0.6952	0.8446	
OPRISK4	0.7284	0.7284	0.8361	
OPRISK5	0.6574	0.6574	0.8537	
Opportunism				
OPPOR1	0.498	0.498	0.8004	Initial Alpha=0.809 Final Alpha=0.809
OPPOR2	0.66	0.66	0.751	
OPPOR3	0.609	0.609	0.7678	
OPPOR4	0.567	0.567	0.78	
OPPOR5	0.6502	0.6502	0.7545	

4.4.4.3 Unidimensionality Analysis

The dimensional factor analysis results are displayed in the following table. Again all items significantly loaded on their own dimensions. The results show good unidimensionality for all these three dimensions.

Table 4.4-19 List of Factor Loadings for IOS Impacts on Inter-Firm Transactions

Items	Initial Factor Loading	Final Factor Loading
Coordination Cost KMO=0.853		
COCOST1	.812	.812
COCOST2	.862	.862
COCOST3	.827	.827
COCOST4	.779	.779
COCOST5	.763	.763
Operation Risk KMO=0.790		
OPRISK1	.808	.808
OPRISK2	.825	.825
OPRISK3	.811	.811
OPRISK4	.838	.838
OPRISK5	.781	.781
Opportunism KMO=0.761		
OPPOR1	.650	.650
OPPOR2	.792	.792
OPPOR3	.776	.776
OPPOR4	.739	.739
OPPOR5	.807	.807

4.4.4.4 Construct Level Factor Analysis

All the remaining items in the IS Impacts on Inter-Firm Transaction Costs construct are subject to a factor analysis to verify the discriminant and convergent validity at the construct level. There are total 15 items for this construct. The factor analysis shows four factors. OPPOR1 is heavily loaded on the fourth factor. Thus it is decided to remove this item and run a second factor analysis.

Table 4.4-20 List of Factor Loadings for IOS Impacts on Inter-Firm Transaction at the Construct Level KMO=0.846

ITEMS	F1	F2	F3	F4
Coordination Cost				
COCOST1		.814		
COCOST2		.842		
COCOST3		.805		
COCOST4		.621		.573
COCOST5		.685		
Operational Risk				
OPRISK1	.794			
OPRISK2	.758			
OPRISK3	.778			
OPRISK4	.814			
OPRISK5	.712			
Opportunism				
OPPOR1				.808
OPPOR2			.406	.706
OPPOR3			.807	
OPPOR4			.774	
OPPOR5			.805	
Eigen Value	6.084	1.946	1.653	1.023
Variance %	40.559	12.976	11.02	6.822
Cumulative %	40.559	53.535	64.555	71.377

The following table shows the factor loadings after the second factor analysis. All items are loaded on their designated factors.

Table 4.4-21 List of Factor Loadings for IOS Impacts on Inter-Firm Transaction at the Construct Level KMO=0.842

ITEMS	F1	F2	F3
Coordination Cost			
COCOST1		.824	
COCOST2		.839	
COCOST3		.795	
COCOST4		.720	
COCOST5		.697	
Operational Risk			
OPRISK1	.814		
OPRISK2	.792		
OPRISK3	.759		
OPRISK4	.798		
OPRISK5	.728		
Opportunism			
OPPOR2			.590
OPPOR3			.775
OPPOR4			.806
OPPOR5			.811
Eigen Value	5.706	1.941	1.645
Variance %	40.756	13.862	11.748
Cumulative %	40.756	54.617	66.365

4.4.5 Explicit Coordination and Buyer Benefits

4.4.5.1 Measurement Items

The following table displays all the measurement items for the constructs explicit coordination and buyer benefits. Explicit Coordination has 6 items and buyer benefits construct has 12 items.

Table 4.4-22 List of Measurement Items For Explicit Coordination and Buyer Benefits

Explicit Coordination	
EC1	Your business unit's operational decisions are highly integrated with those of your partner
EC2	There are coordinating processes that are specific to the relationship
EC3	Joint technical assistance
EC4	Joint product planning
EC5	Joint product engineering
EC6	Joint process engineering
Buyer Benefits	
	Strategic Buyer Benefits
BB1	The buyer has been able to refocus on core business.
BB2	The buyer has enhanced the final product competitiveness.
BB3	The buyer has increased access to skilled personnel from the partner
	Economic Buyer Benefits
BB4	The buyer benefits from the economies of scale of the human resources of the partner
BB5	The buyer benefits from the economies of scale of the technology resources of the partner
BB6	The buyer has increased control of the component design costs
BB7	The buyer has increased control of the production costs
	Technological Benefits
BB8	The buyer has reduced the risk of product technology obsolescence
BB9	The buyer has reduced the risk of process technology obsolescence
BB10	The buyer has increased access to key process technologies
BB11	The buyer has increased access to key product technologies

4.4.5.2 Reliability Analysis

The following table lists the CITC and Alpha for the explicit coordination and buyer benefits.

Table 4.4-23 List of CITCs and Alphas for Explicit Coordination and Buyer Benefits

Items	Initial CITC	Final CITC	Alpha if deleted(Initial)	Alpha Score
Explicit Coordination				
EC1	0.5893	0.5893	0.8448	Initial Alpha=0.8573 Final Alpha=0.8573
EC2	0.5461	0.5461	0.8519	
EC3	0.6245	0.6245	0.8388	
EC4	0.7196	0.7196	0.8206	
EC5	0.6759	0.6759	0.8296	
EC6	0.7371	0.7371	0.8171	
Buyer Benefits				
	Strategic Buyer Benefits			Initial Alpha=0.8647 Final Alpha=0.8647
BB1	0.7410	0.7410	0.8108	
BB2	0.7491	0.7491	0.8034	
BB3	0.7367	0.7367	0.8150	
	Economic Buyer Benefits			Initial Alpha=0.805 Final Alpha=0.805
BB4	0.6375	0.6375	0.7447	
BB5	0.6101	0.6101	0.7569	
BB6	0.6105	0.6105	0.7565	
BB7	0.6164	0.6164	0.7551	
	Technological Buyer Benefits			Initial Alpha=0.8752 Final Alpha=0.8752
BB8	0.777	0.777	0.8202	
BB9	0.7474	0.7474	0.8328	
BB10	0.6886	0.6886	0.8552	
BB11	0.7169	0.7169	0.8455	

Reliability analysis shows that explicit coordination and buyer benefits have good measurement items and their reliabilities are higher than 0.8.

4.4.5.3 Unidimensionality Analysis

The dimensional factor analysis of buyer benefits is displayed in the following table. Again all items significantly loaded on their own dimensions. The results show good unidimensionality for all these three dimensions.

Table 4.4-24 List of Factor Loadings for Buyer Benefits

Items	Initial Loadings	Final Loadings
	Strategic Buyer Benefits KMO=0.738	
BB1	.886	.886
BB2	.891	.891
BB3	.884	.884
	Economic Buyer Benefits KMO=0.646	
BB4	.821	.821
BB5	.804	.804
BB6	.772	.772
BB7	.780	.780
	Technological Buyer Benefits KMO=0.668	
BB8	.876	.876
BB9	.857	.857
BB10	.831	.831
BB11	.848	.848

4.4.5.4 Construct Level of Factor Analysis

Explicit coordination shows one clean factor with good loadings. It is different from the pilot study where there are two factors. This difference may be due to the sample size effect.

Table 4.4-25 List of Factor Loadings for Explicit Coordination

Items	Initial Factor Loading	Final factor Loading
Explicit Coordination KMO=0.828		
EC1	.718	.718
EC2	.675	.675
EC3	.745	.745
EC4	.821	.821
EC5	.787	.787
EC6	.835	.835

The following table shows the factor loadings of buyer benefits. Two sub-dimensions emerge. Economic dimension items BB6, 7 have cross loadings on both strategic dimension and technological dimension. BB4 and 5 load on strategic dimension. Thus, BB6 and 7 will be removed and the economic dimension will disappear.

Table 4.4-26 List of Factor Loadings for Buyer Benefits KMO=0.835

Items	F1	F2
BB1	.817	
BB2	.775	
BB3	.784	
BB4	.737	
BB5	.742	
BB6	.543	.471
BB7	.515	.546
BB8		.854
BB9		.827
BB10		.772
BB11		.780
Eigen Value	5.818	1.378
Variance %	52.893	12.529
Cumulative %	52.893	65.422

The following table shows the results of the second round factor analysis.

Table 4.4-27 List of Factor Loadings for Buyer Benefits (Revised) KMO=0.798

ITEMS	F1	F2
BB1	.819	
BB2	.775	
BB3	.785	
BB4	.751	
BB5	.766	
BB8		.853
BB9		.825
BB10		.782
BB11		.803
Eigen Value	4.882	54.247
Variance %	1.376	15.287
Cumulative %	4.882	54.247

Two clean factors come out. The strategic sub-dimension (BB1 to BB3) and economic sub-dimension (BB4, 5) merge as one sub-dimension and technological sub-dimension items (BB8 to 11) form the other sub-dimension individually. Reliabilities and CITCs for these two sub-dimensions are listed in the following two tables.

Table 4.4-28 CITC and Reliability of Buyer Benefits (Economic and Strategic) Alpha=0.8748

ITEMS	CITC	Alpha if Item Deleted
BB1	0.704	0.848
BB2	0.7137	0.8457
BB3	0.7323	0.8411
BB4	0.6635	0.8577
BB5	0.7029	0.8483

Table 4.4-29 CITC and Reliability for Buyer Benefits (Technological) Alpha=0.8752

ITEMS	CITC	Alpha if Item Deleted
BB8	0.777	0.8202
BB9	0.7474	0.8328
BB10	0.6886	0.8552
BB11	0.7169	0.8455

4.4.6 Summary of the Large-Scale Instrument Development

The following table presents a summary of the large-scale instrument development results. At the construct level, all KMOs are from 0.739 to 0.905, indicating average to very excellent sample adequacy. At the dimensional level, all Alphas are greater than 0.7 except hierarchical control with an Alpha value of 0.6858, and 20 out of 25 dimensions's Alphas are greater than 0.8. All dimensional KMOs are from 0.633 to 0.905 except 2 items dimensions, indicating average to excellent sample adequacy. 15 out of 25 dimensions have KMOs greater than 0.7. Overall, the final measurement instruments for all 6 constructs are found to be valid and reliable.

Table 4.4-30 Summary of the Large-Scale Instrument Development

Construct-Level Analysis Results	Dimension-Level Analysis Results			
	Dimension Name	# of Items	Alpha (α)	KMO
IS Competence (ISC) 46 items KMO=0.905 10 Dimensions	Leadership (LEAD)	6	0.8900	0.828
	Business System Thinking-IS Individual Level (BUST)	2	0.9169	0.500
	IS-User Relationship (ISUR)	6	0.9065	0.849
	Architecture Planning (INFRA)	5	0.9240	0.857
	Making Technology Work-IS Functional Level (TECH)	3	0.8151	0.697
	Making Technology Work-Is Personnel Level (TECH)	3	0.7544	0.682
	Informed Buying (INFORB)	8	0.9380	0.905
	Contract Facilitation-User Perspective (CONF)	3	0.8668	0.676
	Operational Level Vendor Management (VENM and CONM)	6	0.9097	0.809
	Strategic Vendor Management (VENM)	3	0.8681	0.725
Manufacturer-Supplier Relationship (MSR) 21 items KMO=0.860 6 dimensions	Hierarchical Control	3	0.6858	0655
	Interdependence	4	0.8190	0.770
	Trust	2	0.7680	0.500
	Asset Specificity	5	0.9203	0.861
	Reciprocal Asset Specificity	5	0.9262	0.865
	Complementary Resources	2	0.7766	0.500
IOS Use in Supply Chain (ISU) 9 items KMO=0.739 3 Dimensions	IOS Use Depth	2	0.8415	0.500
	IOS Use Diversity	4	0.8208	0.749
	IOS Use Volume	3	0.7670	0.633
IOS Impacts on Inter-firm Transactions (IFT) 14 items KMO=0.842 3 Dimensions	Coordination Cost	5	0.8678	0.853
	Operational Risk	5	0.8714	0.790
	Opportunism	4	0.8055	0.790
Explicit Coordination (EC) 6 items KMO=0.825 1 Dimension	Explicit Coordination	6	0.8573	0.828
Buyer Benefits (BB) 9 items KMO=0.798 2 Dimensions	Strategic Buyer Benefits	5	0.8748	0.790
	Technological Buyer Benefits	4	0.8752	0.668

4.4.7 Hypotheses Testing at the Bi-Correlation Level

The following table shows the bi-correlations among constructs in the research model. All the values of the constructs are calculated based on the measurement items developed in the chapter. All the relationships hypothesized in our research framework are significant by the preliminary check[19].

Table 4.4-31 Hypotheses Testing at the Bi-Correlation Level

Hypotheses	Independent Variable	Dependent Variable	Pearson Correlation
Hypothesis 1	IS competence (ISC)	IS use in supply chain (ISU)	0.280**
Hypothesis 2	Relationship between supply chain members (MSR)	IS use in supply chain (ISU)	0.401**
Hypothesis 3	Relationship in supply chain (MSR)	Explicit coordination (EC)	0.584**
Hypothesis 4	IS use in supply chain (ISU)	Impact of IOS to reduce inter-firm transaction costs (IFT)	0.578**
Hypothesis 5	IS use in supply chain (ISU)	Explicit Coordination (EC)	0.507**
Hypothesis 6	Impact of IOS to reduce inter-firm transaction cost (IFT)	Explicit Coordination (EC)	0.552**
Hypothesis 7	Impact of IOS to reduce inter-firm transaction cost (IFT)	Buyer Benefits (BB)	0.510**
Hypothesis 8	Explicit Coordination (EC)	Buyer Benefits (BB)	0.349**

** Correlation is significant at the 0.01 level.

[19] The fact that bi-correlation is significant does not mean that those relationships will be significant when they are simultaneously tested. Thus, this is just a preliminary check.

4.5 Chapter Summary

This chapter further validates the constructs' reliability and validity in a large sample setting. Through theoretical justifications and statistical analyses of CITCs, Alphas, and factor loadings, some deletions have been made to the measurement items to improve the reliability and validity. A bi-correlation based hypotheses testing shows that all hypotheses are preliminarily supported. The next chapter is to test hypotheses by applying structural equation modeling technique.

5 RESEARCH MODEL VALIDATION -- PHASE TWO

5.1 Introduction

Although the bi-correlations are statistically significant for all hypothesized relationships, these may not be true when all the relationships are put together in a multivariate complex model due to the interactions among variables. Thus, in this chapter, hypotheses will be tested in a simultaneous manner using the structured equation modeling (SEM) with LISREL (Joreskog and Sorbom, 1989) package. Following the hypotheses testing, discussions of these relationships are presented.

5.2 Structure Equation Model Analysis

A major methodological breakthrough in the study of complex interrelations among variables has been the development and application of SEM (Joreskog, 1977). SEM is widely recognized as a powerful method for capturing and explicating complex multivariate relations in social science data. It represents the unification of two methodological traditions: factor analysis originating from psychology and psychometrics, and simultaneous equations (path analytic) modeling originating from econometrics (Kaplan and Elliot, 1997). Therefore, The standard SEM is composed of two parts – the *measurement model* (a sub-model in SEM that specifies the indicators of each construct and assess the reliability of each construct for later use in estimating the causal relationships) and the *structural model* (The set of dependence relationships linking the model constructs). Measurement models will be used to test whether

mean scores can be used to verify the proposed research model. The structural model will be used to test the significance of the proposed paths.

The general *structural model* can be expressed as follows:

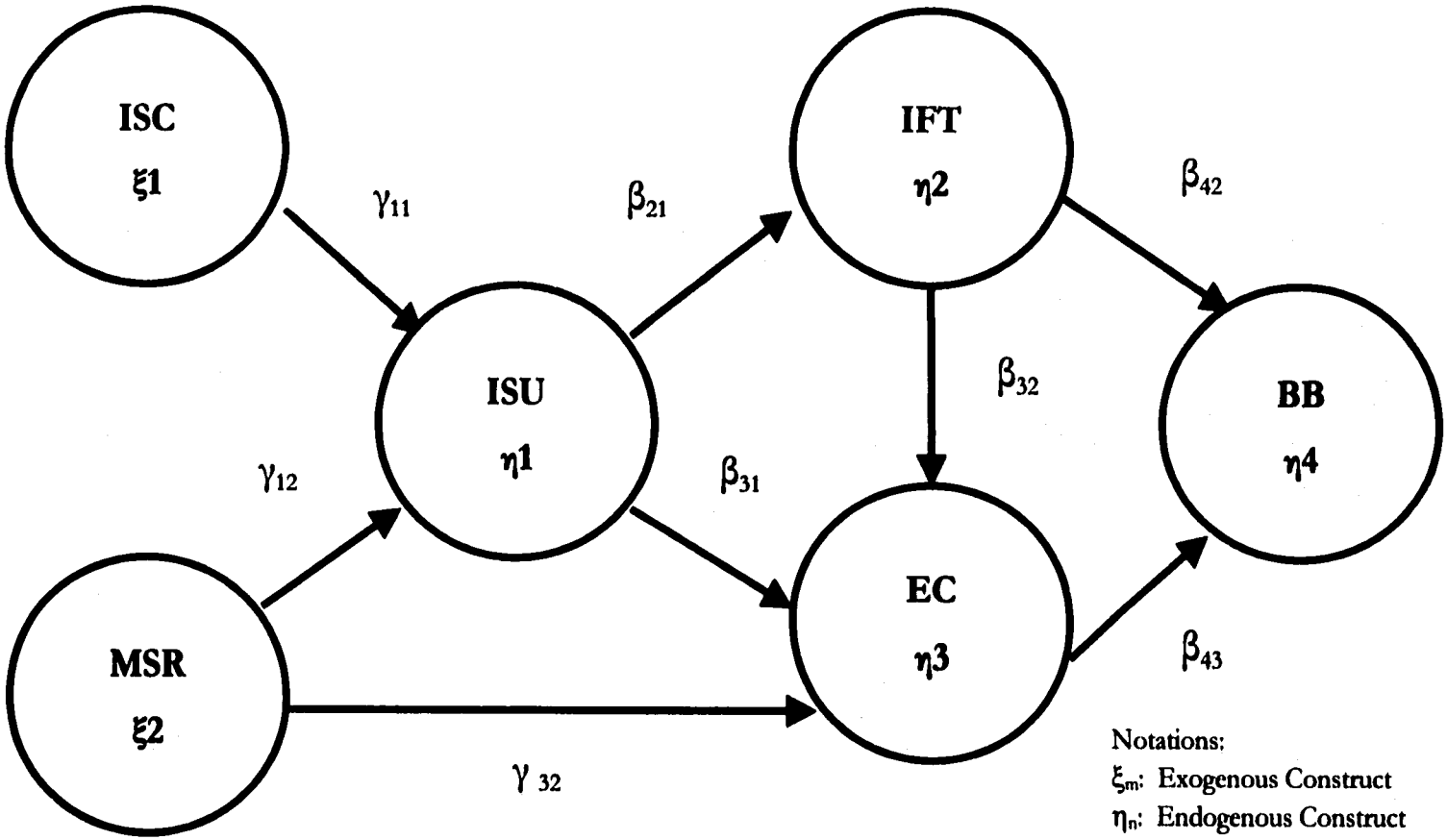
$$\eta = B\eta + \Gamma\xi + \zeta$$

Where, η is an m × 1 random vector of latent dependent, or endogenous variables.
ξ is an n × 1 random vector of latent independent, or exogenous variables.
B is an m × m matrix of coefficients of the η-variables in the structural model.
Γ is an n × n matrix of coefficients of the ξ-variables in the structural model.
ζ is an m × 1 vector of random errors in the structural relationships.

5.3 The Hypothesized Structural Model

The proposed structural model depicted in Figure 5.3-1 is a replicate of the theoretical framework presented in Chapter Two using the mathematical expression presented above. There are six variables in the model: IS Competence (ISC) - ξ_1, Manufacturer-Supplier Relationship (MSR) - ξ_2, IS Use in Supply China (ISU)- η_1, IOS impacts on Inter-firm Transaction Costs (IFT) - η_2, Explicit Coordination/Joint Effort (EC) - η_3, Buyer Benefits (BB) - η_4. ISC and MSR are regarded as independent (exogenous) ξ-variables, and all others are dependent (endogenous) η-variables.

The 8 hypotheses proposed in Chapter 2 are represented by the 8 causal relationships in the model. Hypothesis 1 is represented in Figure 5.3-1 by the relationship γ_{11} (ISC → ISU); Hypothesis 2 is represented by the relationship γ_{12} (MSR → ISU); Hypothesis 3 is represented by the relationship γ_{32} (MSR → EC); Hypothesis 4 is represented by the relationship β_{21} (ISU → IFT); Hypothesis 5 is represented by the relationship β_{31} (ISU → EC); Hypothesis 6 is



Notations:

ξ_m: Exogenous Construct

η_n: Endogenous Construct

γ_{nm}: Exogenous to Endogenous Relationship

β_{nn}: Endogenous to Endogenous Relationship

ISC -- IS Competence
MSR -- Manufacturer-Supplier Relationship
ISU -- IS Use in Supply Chain
IFT -- IOS Impacts on Inter-firm Transactions
EC -- Explicit Coordination
BB – Buyer Benefits

5.3-1 Proposed Structural Equation Model

represented by the relationship β_{32} (IFT → EC); Hypothesis 7 is represented by the relationship β_{42} (BB → IFT); Hypothesis 8 is represented by the relationship β_{43} (BB → EC).

5.4 LISREL Structural Model Indices

The widely used program LISREL (Linear Structural Relations) by Joreskog and Sorbom (1989) will be applied. There is no single statistic that can best describe the strength of a model. Instead, researchers have developed a number of goodness-of-fit measures to assess the results. Two important types of indices are overall fit and comparative fit indices. Another important type of index is the modification index, which is used to revise model to enhance the model fit indices with appropriate theoretical justifications. The LISREL algorithm provides several such statistics that can be used to evaluate the hypothesized model and modify the research model.

5.4.1 Model Fit Indices

5.4.1.1 Overall Fit Indices

χ2 measure

The first measure of overall fit is the **chi-square statistic (χ^2).** Low values, which result in significance levels greater than 0.05, indicate that the actual and predicted input matrices are not statistically different, hence a good fit between proposed model and the empirical data. However, the χ^2 is often criticized for its over-sensitivity to sample size, especially in cases where the sample size exceeds 200 respondents (Hair et al., 1992, pp. 490). As sample size increases, this measure has a greater tendency to indicate significant differences for equivalent models.

Goodness-of-fit index (GFI) and Adjusted Goodness of Fit (AGFI)

The second measure of overall fit is the **Goodness-of-fit index (GFI)**. GFI can be considered to be a measure of the proportion of variance and covariance that the proposed model is able to explain. If the number of parameters is also taken into account in computing this measure, the resulting index is called **adjusted goodness-of-fit index (AGFI)**. The basic objective of AGFI is to diagnose whether model fit has been achieved by "overfitting" the data with too many coefficients. The GFI and AGIF range between 0 (poor fit) to 1 (perfect fit). Generally, a GFI of greater than 0.90 is considered as acceptable (Segars and Grover, 1993). A recommended acceptance value of AGFI is 0.80 or greater (Segars and Grover, 1993).

Root Mean Square Residual (RMSR)

Another overall fit measure is the **Root Mean Square Residual (RMSR)** – an average of the residuals between observed and estimated input matrices. A smaller value of RMSR represents a better model fit. The recommended maximum value of RMSR is 0.1 (Chau, 1997). The standardized RMSR (SRMR) was used in the analysis.

5.4.1.2 Comparative Fit Measures

This class of measures compare the proposed model to a baseline model (null model) – a realistic model that all other models should be expected to exceed.

Normed Fit Index (NFI),

One of the most popular measures of this kind is the **Normed Fit Index (NFI)**, which ranges from 0 (no fit at all) to 1 (perfect fit). A commonly recommended value is 0.90 or greater (Hair et al., 1992).

Root Mean Square Error of Approximation (RMSEA)

Alternative fit indices are based on the concept of non-centrality parameter (NCP) proposed by Steiger and Lind (1980), which reflects the extent to which a proposed model does not fit the data through measuring the degree of shifting of a chi-square distribution. The larger the shift, the worse the model fit. RMSEA index is an index in this category. Some researchers have suggested that a value of RMSEA of less than 0.05 is indicative of the model being a reasonable approximation to data (Browne and Cudeck, 1993). Raykov and Marcoulides (2000) point out that if the left endpoint of the 90% confidence interval of the RMSEA index is considerably smaller than 0.05 or the interval not too wide, it can be argued that the model is a plausible means of describing the data.

Comparative Fit Index (CFI)

The **Comparative Fit Index (CFI)** also follows the logic of RMSEA and is defined as the ratio of improvement in noncentrality (moving from the null to the proposed model) to the noncentrality of the null model. In general, CFI in the mid- 0.90s or above is usually associated with models that are plausible approximations of the reality represented by the data.

5.4.2 Modification Indices

The LISREL program also provides modification indices that suggest possible ways of improving the model fit, such as uncovering new relationships among constructs. However, the modification must be based on theoretical justifications.

5.5 LISREL Structural Model Testing

First, LISREL package was used to test measurement models to check whether those dimensions constitute a construct. Second, the hypothesized relationships will be tested based on the LISREL structural model specified in Figure 5.3-1and the model fit properties will be

evaluated using the fit statistics discussed above. Composite mean scores computed for each construct will be used as input to the LISREL structural modeling process.

5.5.1 Confirmatory Factor Analysis of Measurement Models

Confirmatory factor analysis was applied to analyze IS competence (10 dimensions), IS outsourcing competence[20] (4 dimensions), supply chain relationship (6 dimensions), and explicit coordination (6 items) individually. As to IS use in supply chain, inter-firm transaction costs, and buyer benefits, since they have only 2 or 3 dimensions, LISREL cannot provide real/accurate lamdas and model fit indices. Thus, a correlation model with these three constructs will be analyzed to check whether their respective dimensions hold together. The table 5.5-1 shows all the analysis results.

IS competence, IS outsourcing competence, and supply chain relationship have good GFIs, AGFIs, and SRMRs. As to RMSEAs, IS competence and IS outsourcing competence have RMSEAs slightly greater than 0.1. Supply chain relationship has an excellent RMSEA. The first model of explicit coordination shows a big gap between AGFI and GFI. After checking model modification indices, it is decided that EC2 will be removed due to its correlation with other items. The revised measurement model of explicit coordination has good GFI, AGFI, RMESA, and SRMR. As to the correlation model of ISU, IFT, and BB, model fit indices are also good. Further, after checking all the lamdas, it is found that all the lamdas are between 0.5 and 0.82 except the trust dimension of the supply chain relationship with a lamda of 0.42 (<0.5). Considering the importance of the TRUST dimension, it will be kept for further analysis. In summary, all the dimensions and items, with reasonable lamdas and model fit

[20] IS outsourcing will be used to discuss model revision in the next section.

Table 5.5-1 Measurement Model Lamdas and Fit Indices

IS Competence									
LEAD	BUST	ISUR	INFRA	TECHF	TECHP	INFOB	CONF	OVENM	SVENM
0.71	0.57	0.76	0.80	0.56	0.56	0.65	0.54	0.58	0.70
RMSEA=0.102; GFI=0.90; AGFI=0.85; SRMR=0.061									
IS Outsourcing Competence									
						INFOB	CONF	OVENM	SVENM
						0.75	0.66	0.69	0.62
RMSEA=0.106; GFI=0.98; AGFI=0.92; SRMR=0.031									
Supply Chain Relationship									
HC	INTER	TRUST	AS	RAS	CR				
0.59	0.65	0.42	0.59	0.62	0.65				
RMSEA=0.035; GFI=0.98; AGFI=0.96; SRMR=0.035									
Explicit Coordination (6 ITEMS)									
EC1	EC2	EC3	EC4	EC5	EC6				
0.61	0.55	0.67	0.80	0.76	0.82				
RMSEA=0.162; GFI=0.91; AGFI=0.80; SRMR=0.070									
Explicit Coordination (5 ITEMS)									
EC1		EC3	EC4	EC5	EC6				
0.57		0.66	0.81	0.78	0.82				
RMSEA=0.027; GFI=0.99; AGFI=0.97; SRMR=0.019									
ISU, IFT, AND BB CORRLEATION MODEL									
ISUD	ISUDIV	ISUV	COCOST	OPRISK	OPPOR	BBS	BBT		
0.55	0.69	0.71	0.80	0.54	0.59	0.80	0.70		
RMSEA=0.065; GFI=0.96; AGFI=0.92; SRMR=0.044									

indices, form their respective factors after one item deletion. Thus, mean scores can be used to verify the proposed relationships in the research model.

5.5.2 LISREL Structural Modeling Results

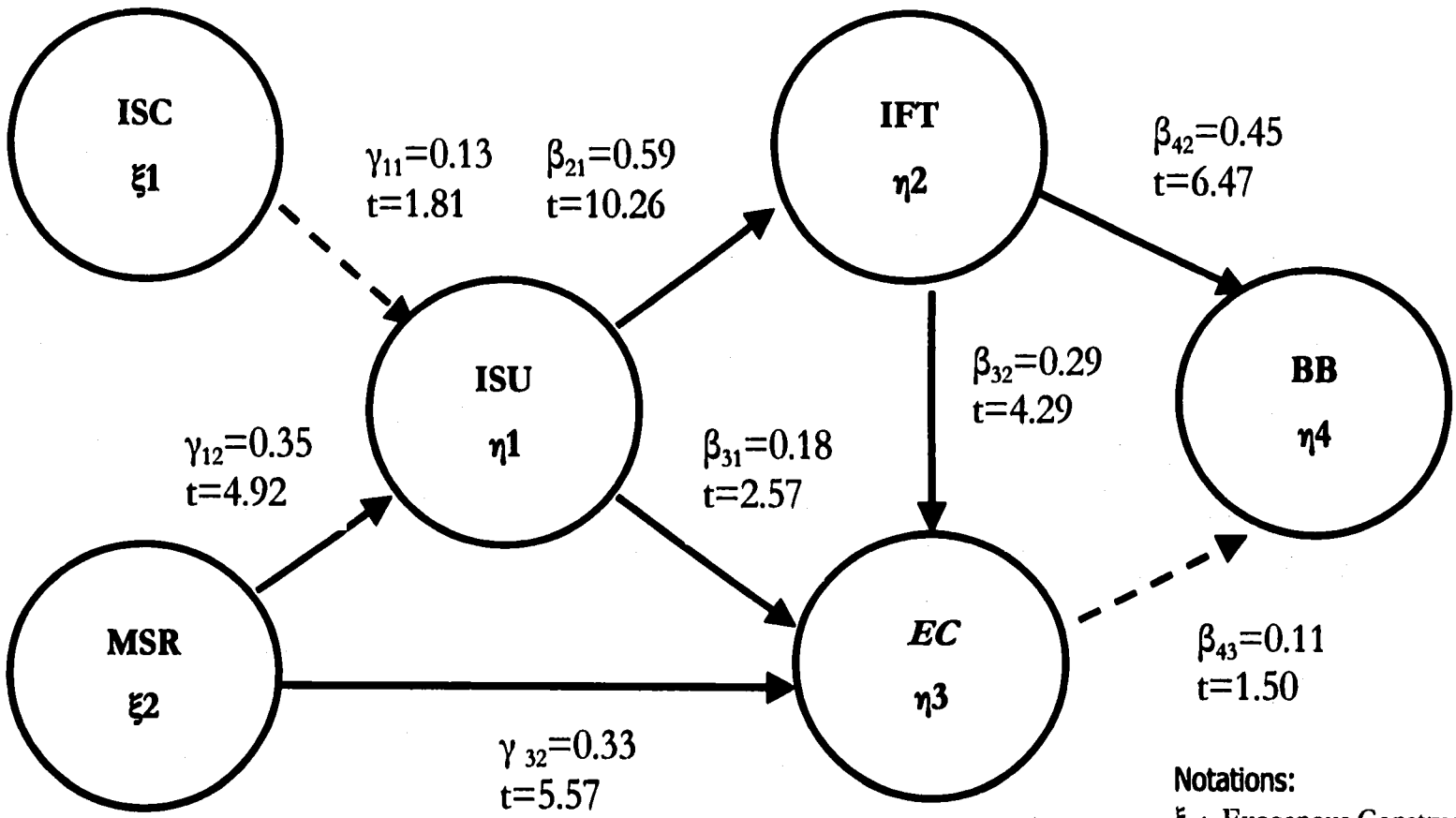
Figure 5.5-1 displays the path diagram from the LISREL structural modeling analysis. Detailed results are also presented in Table 5.5 -2. Out of the 8 hypothesized relationships, 6 were not rejected. Hypotheses 2, 3, 4, 5, 6, and 7 all have a t-value of greater than 2.00, indicating the relationships are significant at the 0.05 level. The t-values for Hypotheses 1 and 8 are 1.81 and 1.50 respectively, insignificant at the 0.05 level. Therefore, all research hypotheses except Hypotheses 1 and 8 are supported by the LISREL structural modeling results.

GFI, AGFI, NFI, and CFI show that there is a reasonable model fit. However, REMEA (0.124) is higher than 0.05. Its 90% confidence interval lower bound is 0.076, which is slightly higher than 0.05. Further, there is a gap between GFI (0.96) and AGFI (0.86). These values, with the two non-significant relationships, demonstrate there is a need for future research of the variables and relationships in the research model (see details in discussions).

Table 5.5-2 LISREL Structural Modeling Results

Hypotheses	Relationship	LISREL Coefficients	t-value	Significant (α=0.05)?
H1	ISC → ISU	0.13	1.81	No
H2	MSR → ISU	0.35	4.92	Yes
H3	MSR → EC	0.33	5.57	Yes
H4	ISU → IFT	0.59	10.26	Yes
H5	ISU → EC	0.18	2.57	Yes
H6	IFT → EC	0.29	4.29	Yes
H7	IFT → BB	0.45	6.47	Yes
H8	EC → BB	0.11	1.50	No
GFI=0.96, AGFI=0.86, NFI=0.93, CFI=0.94, SRMR=0.081, RMSEA=0.124 RMSEA 90% CI (0.076; 0.18).				

Figure 5.5-1 LISREL Structural Modeling Results



ISC -- IS Competence
MSR -- Manufacturer-Supplier Relationship
ISU -- IS Use in Supply Chain
IFT -- IOS Impacts on Inter-firm Transactions
EC -- Explicit Coordination
BB – Buyer Benefits

Model Fit Indies
GFI=0.96
AGFI=0.86
NFI=0.93
CFI=0.94
SRMR=0.082
RMSEA=0.124
RMSEA 90% CI (0.076; 0.18)

Notations:
ξ_m: Exogenous Construct
η_n: Endogenous Construct
γ_{nm}: Exogenous to Endogenous Relationship
β_{nn}: Endogenous to Endogenous Relationship
- - Dotted lines represent non-significant paths

5.6 Discussions

The previous section applied the structural equation model technique to test the relationships hypothesized in Chapter 2. Statistically significant positive relationships were found between the supply chain relationship and IOS use in supply chain (H2), supply chain relationship and explicit coordination (H3), IOS use in supply chain and inter-firm transaction costs reduction through IOS (H4), IOS use and explicit coordination (H5), inter-firm transaction costs reduction through IOS use and explicit coordination (H6), and inter-firm transaction costs reduction through IOS and buyer benefits (H7). The relationships between IS competence and IOS use in supply chain (H1) and explicit coordination and buyer benefits (H8) were insignificant. The following are discussions of these relationships.

5.6.1 Hypothesis 1: IS Competence Is Positively Related To IOS Use In Supply Chain

The lack of a significant relationship between IS competence and IOS use in supply chain is very surprising. Considering the increasing importance of IS function in the business process and network redesign, theoretically, IS competence of a firm should have its role in the process of implementing and operating an IOS (Konsynsiki, 1989).

Recent alliances between automobile companies and major database and commerce companies to develop electronic markets in the automobile industry provide some empirical evidence of the linkage between IS outsourcing capability and IS use in supply chain[21]. Applegate et al. (1999), through more than eight years of field research on Kodak, General Dynamics, and

[21] On February 25, 2000, General Motors, Ford and DaimlerChrysler announced their intent to form a worldwide business-to-business marketplace. Renault and Nissan announced intention to join the exchange in April. This new venture, Covisint, will be established as an independent company and will offer products and services designed to help auto makers and suppliers alike achieve unprecedented efficiencies throughout the supply chain. Currently, Oracle and CommerceOne are the two primary technology providers to the planned venture. (http://www.generalmotors.com/cgi-bin/pr_display.pl?1376)

over two dozen other outsourcing situations, conclude that IS outsourcing is not a "flash in the pan" management fad but a harbinger of a traditional IT department transformation and provides a glimpse at the emerging organizational structures of the information economy, implying the impact of IS outsourcing on the IS use in supply chain to reengineer inter-organizational business processes. Hence, future research should investigate IS outsourcing competence and its impacts on IS use in supply chain.

Further, the relationship between other dimensions such as IS leadership, business system thinking, making technology work, etc. and outsourcing dimensions are also very interesting. This line of research should help develop systematic theories on the IS competence and guide IS function and its personnel to judiciously develop their capability and competence.

Clearly, in this increasingly information and knowledge intensive society, the importance of various IS competence dimensions challenge IS managers and personnel to be more knowledgeable on both business and IS worlds. Thus, the IS competence research and its relationship with IOS is necessary and promising.

5.6.2 Hypothesis 2: The Manufacturer-Supplier Relationship Is Positively Related To IOS Use In Supply Chain

The fact that manufacturer-supplier relationship is positively and significantly related to IS use in supply chain confirms the theoretical argument that technology itself cannot determine the technology users' behavior. Technological determinism dooms to be a failure. The relationship process and structure, such as hierarchical control, trust, asset specificity and reciprocal asset specificity, complementary resources and interdependence, significantly impact the use of

technology in the information economy. Technology may provide the economic opportunities but it is the relationship that will make the effective use of technology come true.

As argued by many social network researchers (e.g., Gulati, 1998), any single firm is embedded in a network of other related firms. The relationship-strength of the focal firm with other firms has major impacts on the focal firm's capability to evolve and develop as an individual entity. The significant impact of manufacturer-supplier relationship on IOS use in supply chain clearly verifies this theoretical argument in the sense that IOS use is becoming a necessity for firm to evolve and develop in its business environment.

5.6.3 Hypothesis 3: The Manufacturer-Supplier Relationship Is Positively Related To Explicit Coordination

This hypothesis is not rejected by the empirical data. With a high level of hierarchical control, partners in the relationship clearly understand the responsibilities and procedures to accomplish the goals of the relationship. With high levels of asset specificity, reciprocal asset specificity, and complementary resources, firms feel the urge to take advantage of the synergistic effects of these resources and thus obtain the highest potential benefits. Interdependence naturally pushes firms to be more cooperative in order to be able to complete their own production process and sales goals. A high level of trust eliminates the worry on partners' opportunistic behaviors and thus encourages explicit coordination and more efficient allocation of managerial attention.

5.6.4 Hypothesis 4: IOS Use In Supply Chain Impacts Inter-Firm Transactions

This relationship is not rejected by the empirical data. This confirms the function of IOS to reduce the inter-firm transaction costs proposed by many scholars. IS reduces the asset

specificity and coordination costs and increases the monitoring power of all the players in the relationship. The fact that firms could easily access more potential partners, switch among them, and be aware of their partners' behavior, forces all partners to behave more responsibly, and thus, reduces the risk and opportunism in the repeated business transactions.

5.6.5 Hypothesis 5: The More IOS Use In the Supply Chain, The More The Explicit Coordination Between Supply Chain Members

Empirically, IS use in supply chain impacts the level of explicit coordination. This confirms the argument that IS can be used to reengineer/redesign/redefine inter-organizational business processes due to its intentionally designed functionality. This result is in contrast to Bensaou 's(1997) finding, where no significant relationship has been found in US automobile industry. One explanation is that, after so many years of organizational learning of IOS, finally, firms are able to effectively use IOS to enhance their cooperation for a better allocation and use of the limited resources, and thus, a higher productivity and potentially, a higher profitability, while providing more services and benefits to the customers.

5.6.6 Hypothesis 6: The Higher The Impact Of IOS Use On Inter-Firm Transactions, The More The Explicit Coordination Between Supply Chain Members

The positive relationship between the inter-firm transaction cost reduction effect of IOS use and the explicit coordination fails to encounter transaction cost theoretical arguments by Coase (1937) and many others. Coase (1937) finds a very simple but very powerful principle to determine whether an economic activity should be included in the firm or exchanged through market (which is one type of explicit coordination). He proposes that: "at the margin, the costs of organizing within the firm will be equal to either the costs of organizing in another

firm or to the costs involved in leaving the transaction to be organized by the price mechanism." Thus, reduced coordination cost, operational risk and opportunism will motivate firms to outsource more activities to other firms (i.e., explicit coordination) and eliminate some of the advantages of vertical ownership (i.e., better coordination). Along this line of thinking, Willamson (1975) argued that increased explicit cooperation will expose the focal firm to its partner's opportunistic behavior. Thus, if IOS use could reduce cost, risk, and opportunism, then this reduction will certainly encourage explicit coordination until the cost, risk, and opportunism level match the explicit coordination level at the margin.

5.6.7 Hypothesis 7: The Higher The Impact Of IOS Use On Inter-Firm Transactions, The Higher The Buyer Benefits

As argued in Chapter 2, reduced inter-firm transactional coordination cost, operational risk and opportunism clearly decrease the total cost for the buyer/supplier to execute the existing inter-firm transactions. If assuming both total buyer sales and supplier sales keep stable, the reduced costs clearly imply the increased buyer/supplier benefits. Further, these increased buyer/supplier benefits may stimulate partners in the transactions to design even better transactional mechanisms to further reduce the inter-firm transaction costs, risks, and opportunistic behaviors, which may generate even higher levels of buyer/supplier benefits. This empirical test fails to encounter this theoretical argument.

5.6.8 Hypothesis 8: The Explicit Coordination Between Supply Chain Members Is Positively Related To Buyer Benefits

The proposed relationship between joint effort (i.e., explicit coordination) and buyer benefits is not statistically significant. However, it appears counterintuitive to see no impacts from explicit coordination on buyer benefits, especially in the context of more and more inter-firm

transactions in this inter-connected business world through the Internet technology. It is thus conjectured that there may have an indirect relationship between EC and buyer benefits (e.g., explicit coordination may influence cost reduction capability of IOS which will impact buyer benefits).

Recently, Chatfield and Yetton (2000) propose a model of EDI embeddedness based on sociological theories on cooperative relationship (Uzzi, 1996, 1997) and MIT 90s model (Scott Morton, 1991). They propose that a high level of EDI embeddedness means the simultaneous existence of joint economic actions, social ties and EDI (technological linkage) and further, they find that the strategic payoff from EDI is a positive function of this EDI embeddness.

Clearly, future empirical findings of 1) the impacts of IS use in supply chain (i.e., technology linkage in supply chain) and explicit coordination (i.e., joint economic actions) on the capability of IOS use to reduce inter-firm transaction costs and 2) the impacts of inter-firm transactions costs reduction through IOS use on buyer benefits will help confirm the Chatfield and Yetton's (2000) concept of EDI embeddedness in a large-scale settings with more diverse types of IOSs.

5.7 Chapter Summary

This chapter applies structure equation model technique with the LISREL package to test the hypotheses proposed in Chapter 2. All hypotheses except H1 and H8 are not rejected by the empirical data analysis. Supply chain member relationship significantly impacts IS use in supply chain and explicit coordination. IS use in supply chain is significantly related to explicit coordination and inter-firm transaction cost reduction. The level of the inter-firm transaction

cost reduction through IOS use is also positively related to explicit coordination and buyer benefits.

Future research is needed to investigate the systematic relationships among various IS competence dimensions and their relations to IS use in supply chain. Simply putting all the IS dimensions together seems to be not helping the competence based view of IS use in supply chain. Another line of future research is to investigate the EDI embeddedness concept. It is interesting to investigate how IOS use (i.e., technological linkage) and explicit cooperation (i.e., joint actions) influence the buyer benefits from IOS linkages among supply chain members.

This large-scale test of the hypothesized relationships should help develop a better understanding of the effective and efficient development and use of IOS to economize inter-firm transactions and thus promote industry and global economies. The next chapter is a summary of the contributions and some additional future research directions.

6 CONTRIBUTIONS AND FUTURE RESEARCH

6.1 Contributions

6.1.1 Scale Development

This dissertation developed and validated measurement scales for IS competence, manufacturer-supplier relationship, IS use in supply chain, inter-firm transaction costs, explicit coordination and buyer benefits by following rigorous procedures. These procedures include an extensive literature review, field interviews, a pretest, a pilot study, and a large-scale study. Researchers could reuse the final scales in similar research settings. These scales can also help managers better understand the concepts and thus better apply them into their everyday work.

6.1.2 Confirmations of Relationships

This dissertation integrates both the competence based view and the transaction cost based view to look into the IS use in supply chain phenomenon in this early Internet time. First, supply chain relationship (consisting of variables based on transaction cost theory) is found to have major impacts on the extent of IOS use and the inter-firm collaboration. It is the critical institutional environment within which IOS is used and explicit coordination is executed. Technology itself cannot make business transactions more effective and efficient. It is the appropriate match between technology and human interactions that will achieve the potential of the technology and prompt inter-firm cooperation.

Second, the fact that the linkage between IS competence and IS use in supply chain is found to be insignificant may indicate that most firms are not currently involving IS functions into their e-commerce efforts and thus illustrates why a few firms that indeed involve IS functions into their organizational and inter-organizational development will have better IOS use in supply chain, more integration of IOS into their internal IS, more comprehensive and refined business process redesign, and ultimately more successful e-commerce efforts[22].

Third, this dissertation explicitly includes inter-firm transaction costs (coordination costs, operational risk, and opportunism) into the research model with intention to elucidate the mechanism with which IOS use could benefit buyers and thus enhance the whole economy based on transaction cost theory.

Fourth, the finding of the impacts of IS use in supply chain on the extent of explicit coordination provides some evidence that in the Internet age, firms will apply governance mechanisms that locate between the market and the hierarchy (Clemons, Reddi, and Rows, 1993) to work with their partners. This confirms the argument of moving towards the "middle" by Clemons, Reddi, and Rows (1993).

6.2 Future Research

Besides the future research directions proposed in Chapter 5, that is, building a comprehensive model on the relationships among various IS dimensions, finding how some dimensions (such as outsourcing dimensions) impact IS use in supply chain, and validating the EDI embeddedness concept proposed by Chatfield and Yetton (2000), there are two other potential research directions.

---

[22] This can be tested by collecting data on the degree of IS function involvement in IOS use and the level of IOS use.

The first is the impact of IS use in supply chain on a firm's decision of its vertical and horizontal integration. Even though this dissertation has touched the vertical scope of the firm by investigating the degree of explicit coordination, it does not directly address the IOS impacts on the coverage of supply chain activities (i.e., business network and scope). Further, the impact of IOS use on the firm's diversification is an even broader topic for future research. This line of research may have significant implications on the impacts of e-commerce on anti-trust law, multi-national firm management, and organizational and inter-organizational structure in the Internet age.

The second future research topic is to consider industry factors such as product/process complexity and dynamism and industry concentration/fragmentation. The product that can meet customer needs is the goal of all the IOS use, relationship with suppliers and customers, explicit coordination, and the low levels of inter-firm transaction costs. The production process is the means to achieve this goal. It would be interesting to see the impacts of different products and processes on the business-to-business e-commerce behaviors. Further, on the one hand, a fragmented industry structure may cause more intensive competition and thus the reduction of transaction costs may be an important way for buyers to benefit from the supply chain relationships. Indeed, the insignificant relationship between explicit coordination and buyer benefits in the LISREL model may indicate this point. On the other hand, a concentrated industry structure may cause more collaboration among the few dominant firms and thus buyers will benefit more from explicit coordination. In summary, alternative theory-based models with some industrial control variables must be tested to further advance the knowledge of b-to-b e-commerce phenomenon.

REFERENCES

Anderson, J. and J. Narus, "A Model of Distributor Firm and Manufacturer Firm Working Partnerships," *Journal of Marketing*, 54, (January 1990), 42-58.

Angeles, R. and R. Nath, "An Empirical Study of EDI Trading Partner Selection Criteria in Customer-Supplier Relationships," *Information & Management*, 37, (2000), 241-255.

Applegate, L. M., F. W. McFarlan, and J. L. McKenney, Corporate Information Systems Management, 5th Edition, McGraw-Hill, Boston, (1999).

Armstrong, C. P. and V. Sambamurthy, "Information Technology Assimilation in Firms: The Influence of Senior Leadership and IT Infrastructures," *Information Systems Research*, 10, 4, December (1999), 304-327.

Arrow, K. J., *Gifts and Exchanges*, Philosophy and Public Affairs. 1, (1972), 343-362.

Asanuma, B., "Manufacturer-Supplier Relationships in Japan and the Concept of Relation-Specific Skill," *Journal of the Japanese and International Economics*, 3, (1989), 1-30.

Bakos, J. Y, "Information Links and Electronic Marketplaces: The Role of Interorganizational Information Systems in Vertical Markets," *Journal of Management Information Systems*, 8, 2 (Fall 1991a), 31-52.

Bakos, J. Y, "A Strategic Analysis of Electronic Marketplaces," *MIS Quarterly*, September (1991b), 295-310.

Bakos, J. Y. and E. Brynjolfsson, "Information Technology, Incentives, and the Optimal Number of Suppliers," *Journal of Management Information Systems*, 10, 2, (Fall 1993), 37-53.

Bakos, J. Y. and M. E. Treacy, "Information Technology and Corporate Strategy: A Research Perspective," *MIS Quarterly*, June (1986), 107-119.

Barnard, C. I., The Functions of the Executive, Cambridge, MA, Harvard University Press, (1938).

Barney, J., "Firm Resources and Sustained Competitive Advantage," Journal of Management, 17, 1, (1991), 99-120.

Benbasat, I., A. S. Dexter, and R. W. Mantha, "Impact of Organizational Maturity on Information System Skill Needs," *MIS Quarterly*, 4, 1, (March 1980), 21-34.

Benbasat, I., A. S. Dexter, D. H. Drury, and R. C. Goldstein, "A Critique of the Stage Hypothesis: Theory and Empirical Evidence," *Communications of the ACM*, 27, 5, (MAY 1984), 476-485.

Bensaou, M. and N. Venkatraman, "Configurations of Inter-organizational Relationships: A Comparison between U.S. and Japanese Automakers," *Management Science,* 41, 9, (1995), 1471-1492.

Bensaou, M., "Inter-organizational Cooperation: The Role of The Information Technology An Empirical Comparison of US and Japanese Supplier Relations," *Information Systems Research,* 8, 2, June (1997).

Borys, B. and D. B. Jemison, "Interdependence and Hierarchy in Organizations," *Social Science Research,* 1, (1972), 1-24.

Browne, M. W. and R. Cudeck, "Alternative Ways of Assessing Model Fit," in K. A. Bollen, & J. S. Long (Eds.), *Testing Structural Equitation Models,* Newbury Park, CA, Sage, (1993).

Bradach, J. L. and R.. Eccles, " Markets, versus Hierarchies: From Ideal Types to Plural Forms," *Annual Review of Sociology,* 15, (1989), 97-118.

Broadbent, M. P. Weill, and D. St. Clair, "The Implications of Information Technology Infrastructure for Business Process Redesign," *MIS Quarterly,* 23, 2, (1999), 159-182.

Cash, J. I. And B. R. Konsynski, "IS Redraws Competitive Boundaries," *Harvard Business Review,* 63, 2, March-April (1985), 134-142.

Chan, Y. E., S. L. Huff, D. W. Barclay, and D. G. Copeland, "Business Strategic Orientation, Information Systems Strategic Orientation, and Strategic Alignment," *Information Systems Research,* 8, 2, June (1997), 125-150.

Chandler, A. D., Jr., *The Visible Hand: The Managerial Revolution in American Business,* Cambridge, MA, Harvard University Press, (1977).

Chatfield, A. T. and N. Bjorn-Andersen, "The Impact of IOS Enabled Business Process Change on Business Outcomes: Transformation of the Value Chain of Japan Airlines," *Journal of Management Information Systems,* 14, 1, (Summer 1997), 13-40.

Chatfield, A. T. and P. Yetton, "Strategic Payoff from EDI as a Function of EDI Embeddedness," *Journal of Management Information Systems,* 16, 4, (Spring 2000), 195-224.

Chau, P. Y. K., "Reexamining a Model for Evaluating Information Center Success Using a Structural Equation Modeling Approach," *Decision Sciences,* 28, 2, (1997), 309-334.

Choudhury, V., K. S. Hartzel, and B. R. Konsynski, "Uses and Consequences of Electronic Markets: An Empirical Investigation in the Aircraft Parts Industry," *MIS Quarterly,* December (1998).

Churchill, G. A., "A Paradigm for Developing Better Measures of Marketing Constructs," *Journal of Marketing Research,* 16, (1979), 64-73.

Churchill, N. C., J. H.. Kempster, and M. Uretsky, *Computer Based Information Systems for Management: A Survey.* New York: National Association of Accountants, (1969).

Ciborra, C., *Teams, Markets, and Systems: Business Innovation and Information Technology*, Cambridge University Press, Cambridge, UK, (1993).

Clark, T. H. and D. B. Stoddard, "Interorganizational business process redesign: Merging technological and process innovation," *Journal of Management Information Systems*, 13, 2, Fall (1996).

Clemons, E. and M. Row, "Information technology and Industrial Cooperation: The Changing Economics of Coordination and Ownership," *Journal of Management Information Systems*, 9, 2, (Fall 1992), 9-28.

Clemons, E. K., S. P. Reddi, and M. C. Row, "The Impact of Information Technology on the Organizational of Economic Activity: The 'Move to the Middle' Hypothesis," *Journal of Management Information Systems*, 10, 2, (Fall 1993), 9-35.

Coase, R. H., "The Nature of the Firm," *Economica*, (November 1937).

Cohen, W. M. and D. A. Levinthal, "Absorptive Capacity: A New Perspective on Learning and Innovation," *Administrative Science Quarterly*, 35, (1990), 128-152.

Combs, J. G., and D. J. Ketchen, Jr., "Explaining Interfirm Cooperation and Performance: Toward a Reconciliation of Predictions from the Resourced-Based View and Organizational Economics," *Strategic Management Journal*, 20, (1999), 867-888.

Cooper, R. B. and R. W. Zmud, "Information Technology Implementation Research: A Technological Diffusion Approach," *Management Science*, 36, 2, (1990), 123-137.

Copeland, D. G. and J. L. McKenney, "Airline Reservations Systems: Lessons from History," *MIS Quarterly*, September (1988), 353-370.

Cronbach, L. J., "Coefficient Alpha and the Internal Structure of Tests," *Psychometrika*, 16, (1951), 297-334.

Cyert, R. and J. March, *A Behavioral Theory of the Firm*, Prentice-Hall, Englewood Cliffs, NJ, (1963).

Das, T. K., and B. Teng, "Between Trust and Control: Developing Confidence in Partner Cooperation in Alliances," *Academy of Management Review*, 23, 3, (1998), 491-512.

Davenport, T. H. and J. E. Short, " The New Industrial Engineering: Information technology and Business Process Redesign," *Sloan Management Review*, Summer (1990), 11-27.

DeLone, W. H. and E. R. McLean, "Information Systems Success: The Quest for the Dependent Variable," *Information Systems Research*, 3, 1, (1992), 60-95.

Doll, W. J. and G. Torkzadeh, "Developing a Multidimensional Measure of System-Use in an Organizational Context," *Information & Management*, 33, (1998), 171-185.

Doll, W. J. and M. A. Vonderembse, "The Evolution of Manufacturing Systems: Towards the Post-Industrial Enterprise," *OMEGA Int. J. of Management Science*, 19, 5, (1991), 401-411.

Dore, R., "Goodwill and the Spirit of Market Capitalism," *British Journal of Sociology*, 34, 4, (1983), 459-482.

Dosi, G. and D. Teece, "Organizational Competencies and the Boundaries of the Firm," In R. Arena and C. Longhi (eds.), *Markets and Organization*. Springer-Verlag, New York, (1998), 281-301.

Dyer, J. H., "Specialized Supplier Networks as a Source of Competitive Advantage: Evidence from the Auto Industry," *Strategic Management Journal*, 12, (1996), 271-292.

Dyer, J. H. and H. Singh, "The Relational View: Cooperative Strategy and Sources of Interorganizational Competitive Advantage," *Academy of Management Review*, 23, 4, (1998), 660-679.

Earl, M. J. and D. F. Feeny, "Is your CIO Adding Value?" *Sloan Management Review*, Spring (1994), 11- 20.

Earl, M. J., " The Risks of Outsourcing IT," *Sloan Management Review*, Spring (1996), 26-32.

Feeny, D. F. and L. P. Willcocks, "Core IS Capabilities for Exploiting Information Technology," *Sloan Management Review*, (Spring 1998), 9-21.

Galbraith, J. R., Organization Design, Reading, MA, Addision-Wesley, (1985).

Ghoshal, S. and P. Moran, "Bad for Practice: A Critique of the Transaction Cost Theory," *Academy of Management Review*, 21, 1, (1996).

Grossman, S., and O. Hart, "The Costs and benefits of Ownership: A Theory of Vertical and Lateral Integration," *Journal of Political Economy*, 4, (1986), 691-717.

Grover, V. M. J. Cheon, and J. T. C. Teng, "A Descriptive Study on the Outsourcing of Information Systems Functions," *Information & Management*, 27, (1994), 33-44.

Grover, V., M. J. Cheon, and J. T. C. Teng, "The Effect of Service Quality and Partnership on the Outsourcing of Information Systems Functions," *Journal of Management Information Systems*, 12, 4, (Spring 1996), 89-116.

Grover, V. and P. Ramanlal, "Six Myths of Information and Markets: Information Technology Networks, Electronic Commerce, and the Battle for Consumer Surplus," *MIS Quarterly*, 23, 4, December (1999), 465-494.

Gulati, R., "Alliance and Networks," *Strategic Management Journal*, 19, (1998), 293-317.

Gulati, R., "Does Familiarity Breed Trust? The Implications of repeated Ties for Contractual Choice in Alliances," *Academy of Management Journal*, 38, (1995), 85-112.

Gulati, R. and H. Singh, "The Architecture of Cooperation: Managing Coordination Costs and Appropriation Concerns in Strategic Alliances," *Administrative Science Quarterly*, 43, (1998), 781-814.

Hagen, J. M. and S. Choe, "Trust in Japanese Interfirm Relations: Institutional Sanctions Matter," *Academy of Management Review*. 23, 3, (1998), 589-600.

Hair, J. F., R. E. Anderson, R. L. Tatham, and W. C. Black, *Multivariate Data Analysis with Readings,* Third Edition, Macmillan Publishing Company, New York, NY, (1992).

Hamel, G., "Competition for Competence and Interpartner Learning within International Strategic Alliances," *Strategic Management Journal*, 12 (Winter Special Issue 1991), 83-104.

Hamel, G. and C. K. Prahalad, *Competing for the Future*, Bsonton, Harvard Business School Press, (1994).

Harrigan, K. Strategic Flexibility, Lexington, MA, Lexington Books, (1985).

Harrigan, K. R., *Managing for Joint Ventures Success*, Lexington Books, MA, (1986).

Hart, O. D. Incomplete Contracts and the Theory of the Firm, *Journal of Law, Economics and Organization*, (Spring 1988), 119-139.

Hart, O. and J. Moore, "Property Rights and the Nature of the Firm," *Journal of Political Economy*, 98, (December 1990), 1119-1158.

Hart, P. J. and C. S. Saunders, "Emerging Electronic Partnerships: Antecedents and Dimensions of EDI Use from the Supplier's Perspective," *Journal of Management Information Systems*, 14, 4, (Spring 1998), 87-111.

Harvard Business School, " American Gem Market System," *Case#N9-189-088,* (1988).

Heezen J. and W. Baets, "The Impact of Electronic Markets: The Case of the Dutch Flower Auctions," *Journal of Strategic Information Systems*, 5, (1996), 317-333.

Heide, J. B. and G. John, "The Role of Dependence-Balancing in Safguarding Transaction-Specific Assets in Conventional Channels," *Journal of Marketing*, 52, (1988), 20-35.

Henderson, J. C. and N. Venkatraman, "Strategic Alignment: Leveraging Information Technology for Transforming Organizations," *IBM Systems Journal*, 32, 1, (1993), 4-16.

Hill, R. C. and D. Hellriegel, "Critical Contigencies in Joint Venture Management: Some Lessons from Managers," Organization Science, 5, (1994), 594-607.

Holland, C. P., "Cooperative Supply Chain Management: the Impact of Inter-organizational Information Systems," *Journal of Strategic Information Systems*, 4, 2, (1995), 117-133.

Huber, G. P., "The Nature and Design of Post-Industrial Organizations," *Management Science*, 30, 8, (1984), 928-951.

Johnston, H. R. and S. R. Carrico, "Developing Capabilities to Use Information Strategically," *MIS Quarterly*, March (1988), 37-47.

Johnston, H. R. and M. R. Vitale, "Creating Competitive Advantage with Interorganizational Information Systems," *MIS Quarterly*, June (1988), 153-165.

Joreskog, K. G., "Structural Equation Modeling in the Social Sciences: Specification, Estimation and Testing," In P. R. Krishnaiah (Ed.), *Applications of Statistics*. Amsterdam, North-Holland, (1977).

Joreskog, K. G. and D. Sorbom, *LISREL VII User's Guide*, Scientific Software, Inc., Moorsville, IN, (1989).

Kambil, A. and J. E. Short, "Electronic Integration and Business Network Redesign: A Roles-Linkage Perspective," *Journal of Management Information Systems*, 10, 4, (Spring 1994), 59-83.

Kaplan, D. and P. R. Elliot, "A Didactic Example of Multilevel Structural Equation Modeling Applicable to the Study of Organizations," *Structural Equation Modeling*, 4, 1, (1997), 1-24.

Karimi, J., Y. P. Gupta, and T. M. Somers, "Impact of Competitive Strategy and Information Technology Maturity on Firms' Strategic response to Globalization," *Journal of Management Information Systems*, 12, 4, (Spring 1996), 55-88.

King, W. R. and T. S. H. Teo, " Integration between Business Planning and Information Systems Planning: Validating a Stage Hypothesis," *Decision Sciences*, 28, 2, (Spring 1997), 279-308.

Klein, B., R. G. Crawford, and A. A. Alchian, "Vertical Integration, Appropriable Rents, and the Competitive Contracting Process," *Journal of Law and Economics*, 21, (1978), 297-326.

Klein, B., "Transaction Cost Determinants of 'Unfair' Contractual Arrangements," *American Economic Review*, 70, 2, (1980), 356-362.

Kreps, D. and R. Wilson, "Reputation and Imperfect Information," *Journal of Economic Theory*, 27, (1982), 253-279.

Kumar, N., "The Power of Trust in Manufacturer-Retailer Relationship," *Harvard Business Review*, 74, 6, (1996), 92-106.

Kumar, K. and H. G. van Dissel, "Sustainable Collaboration: Managing Conflict and Cooperation in Inter-organization Systems," *MIS Quarterly*, September (1996).

Kusunoki, K. I. Nonaka, and A. Nagata, "Organizational Cpabilities in Product Development of Japanese Firms: A Conceptual Framework and Empirical Findings," *Organization Science*, 9, 6, November-December (1998), 699-718.

Lacity, M. C. and R. Hirschheim, "The Information Systems Outsourcing Bandwagon," *Sloan Management Review*, Fall, (1993), 73-86.

Lee, D. M. S., E. M. Trauth, and D. Farwell, "Critical Skills and Knowledge Requirements of IS Professionals: A Joint Academic/Industry Investigation," *MIS Quarterly*, September (1995), 313-340.

Lindsey, D., P. H. Cheney, G. M. Kasper, and B. Ives, "TELCOT: An Application of Information Technology for Competitive Advantage in the Cotton Industry," *MIS Quarterly*, December (1990), 347-357.

Loh,, L. and N. Venkatraman, "Determinants of Information Technology Outsourcing: A Cross-Sectional Analysis," *Journal of Management Information Systems*, 9, 1, (Summer 1992), 7-24.

Massetti, B. and R. W. Zmud, "Measuring the Extent of EDI Usage in Complex Organizations: Strategies and Illustrative Examples," *MIS Quarterly*, September (1996).

March, J. G., "Exploration and Exploitation in Organizational Learning," Organization Science, 2, (1991), 71-87.

Malone, T. W., J. Yates, and R. I. Benjamin, "Electronic Markets and Electronic Hierarchies," *Communications of the ACM*, 30, 6, June (1987), 484-497.

McFarlan, F. W., "Information Technology Changes the Way You Compete," *Harvard Business Review*, 62, 3, (May-June, 1984), 98-103.

Meier, J., "The Importance of relationship Management in Establishing Successful Interorganizational Systems," *Journal of Strategic Information Systems*, 4, 2, (1995), 135-148.

Mohr, J. and R. Spekman, "Characteristics of Partnership Success: Partnership Attributes, Communication Behavior, and Conflict Resolution Techniques," *Strategic Management Journal*, 15, (1994), 135-152.

Moran, P. and S. Ghoshal, "Markets, Firms, and the Process of Economic Development," *Academy of Management Review*, 24, 3, (1999), 390-412.

Mudambi, R. and S. Helper, "The 'Close but Adversarial' Model of Supplier Relations in the US Auto Industry," *Strategic Management Journal*, 19, (1998), 775-792.

Nahapiet, J and S. Ghoshal, "Social Capital, Intellectual Capital, and the Organizational Advantage," *Academy of Management Review*, 23, 2, (1998), 242-266.

Naisbitt, J. *Megatrends*, Warner Books, New York, (1982).

Nelson, K. M. and J. G. Cooprider, "The Contribution of Shared Knowledge to IS Group Performance," *MIS Quarterly*, December (1996), 409-432.

Nelson, R. and S. Winter, *An Evolutionary Theory of Economic Change*, Harvard University Press, Cambridge, MA, (1982).

Ng. H., Y. J. Pan, and T. D. Wilson, "Business Use of the World Wide Web: A Report on Further Investigations," *International Journal of Information Management*, 18, 5, (1998), 291-314.

Nolan, R. L., "Managing the Advanced Stages: Key Research Issue," *Seventy-fifth Anniversary Colloquium Series*, Division of Research, Harvard Business School, July 10-13, (1983).

Nooteboom, B., "Trust, Opportunism and Governance: A Process and Control Model," *Organization Studies*, 17, 6, (1996).

Nooteboom, B. H. Berger, and N. G. Noorderhaven, "Effects of Trust and Governance on relational Risk," *Academy of Management Journal*, 40, 2, (1997), 308-338.

North, D., *Institutions, Intuitional Change and Economic History*, Cambridge, England, Cambridge University Press, (1990).

Nunnally, J. C. *Psychometric Theory*, McGraw Hill, New York, (1978).

Oliver, C., "Determinants of Interorganizational Relations: Integration and Future Directions," *Academy of Management Review*, 15, 2, (1990), 241-265.

Parkhe, A., "Strategic Alliance Structuring: A Game Theoretic and Transaction Cost Examination of Interfirm Cooperation," *Academy of Management Journal*, 36, (1993), 794-829.

Penrose, E., *The Theory of Growth of the Firm*, John Wiley, New York, (1959)

Perry, M. K., "Vertical Integration," In R. Schumalensee & R. Willig (Eds.), *Handbook of Industrial Organization*, Amsterdam, North Holland, (1989), 185-255.

Pisano, G. P. "Using Equity Participation to Support Exchange: Evidence from the Biotechnology Industry," *Journal of Law, Economics, and Organization*, 5, (1989), 109-126.

Pisano, G. P. M. V. Russo, and D. Teece, "Joint Ventures and Collaborative Agreements in the Telecommunications Equipment Industry." In D. Mowery (ed.), *International Collaborative Ventures in U.S. Manufacturing*,Cambridge, MA: Ballinger, (1988), 23-70.

Prahalad, C. K. and G. Hamel, "The Core Competence of the Corporation," *Harvard Business Review*, May-June (1990), 79-91.

Prosser, A. and A. Nickl, "The Impact of Interorganizational Integration," *Int. J. Production Economics*, 52, (1997), 269-281.

RaghuNathan, T.S. and W. R. King, "The Impact of Information Systems Planning on the Organization," *Omega*, 16,2, (1988), 85-93.

Raghunathan, B. and T. S. Raghunathan, "Adaptation of a Planning Systems Success Model to Information Systems Planning," *Information Systems Research*, 5,3, (1994), 326-340.

Raykov, T. and G. A. Marcoulides, *A First Course In Structural Equation Modeling*, Lawrence Erlbaum Associates, Publishers, Mahwah, New Jersey, (2000).

Reich, B. H. and I. Benbasat, "Measuring the Linkage between Business and Information Technology Objectives," *MIS Quarterly*, March (1996).

Richardson, G. "The Organization of Industry," *Economical Journal*, 72, (September 1972), 883-896.

Riggins, F. J. and T. Mukhopadhyay, "Inter-dependent Benefits from Inter-organizational Systems: Opportunities for Business Partner Reengineering," *Journal of Management Information Systems*, 11, 2, Fall (1994), 37-57.

Ring, S. P. and A. Van de Ven, "Structuring Cooperative Relationships between Organizations," *Strategic Management Journal*, 13, (1992), 483-498.

Rockart, J. E., M. J. Earl, and J. W. Ross, "Eight Imperatives for the New IT Organization," *Sloan Management Review*, Fall (1996), 43-55.

Rockart, J. F. and J. E. Short, "IT in the 1990s: Managing Organizational Interdependence," *Sloan Management Review*, Winter, (1989), 7-17.

Ross, J. W. C. M. Beath, and D. L. Goodhue, "Develop Long-Term Competitiveness through IT Assets," *Sloan Management Review*, Fall (1996), 31-42.

Rumelt, R. P., "How Much Does Industry Matter?" *Strategic Management Journal*, 12, 3, Mar 1991.

Saarinen, T., "An Expanded Instrument for Evaluating Information System Success," *Information & Management*, 31 (1996), 103-118.

Sako, M., "The Role of 'Trust' in Japanese Buyer-Supplier Relationships," *Ricerche Economiche*, 45, (2-3), (1991), 449-474.

Saxenian, A., *Regional Advantage*, Cambridge, MA, Harvard University Press, (1994).

Schumpter, J. A., *Capitalism, Socialism, and Democracy*, Harper & Row, New York, (1942).

Segars, A. H. and V. Grover, "Re-Examining Perceived Ease of Use and Usefulness: A Confirmatory Factor Analysis," *MIS Quarterly*, December, (1993), 17-525.

Segars, A. H. and V. Grover, "Strategic Information Systems Planning Success: An Investigation of the Construct and Its Measurement," *MIS Quarterly*, June (1998), 139-162.

Shan,W. G. Walker, and B. Kogut, "Interfirm Cooperation and Startup Innovation in the Biotechnology Industry," *Strategic Management Journal*, 12, 449-474.

Short, J. E. and N. Venkatraman, "Beyond Business Process redesign: Redefining Baxer's Business Network," *Sloan Management Review*, Fall, (1992), 7-21.

Silverman, B. S., "Technological Resources and the Direction of Corporate Diversification: Toward an Integration of the resource-Based View and Transaction Cost Economics," *Management Science*, 45, 8, August (1999), 1109-1124.

Steiger, J. H. and J. C. Lind, "Statistically Based Tests for the Number of Common Factors," Psychometric Society Annual Meeting, Iowa City, IA, (June 1980).

Stump, R. L. and V. Sriram, "Employing Information Technology in Purchasing: Buyer-Supplier Relationships and Size of the Supplier Base," *Industrial Marketing Management*, 26, (1997), 127-136.

Scott, J. E., "Facilitating Interorganizational Learning with Information Technology," *Journal of Management Information Systems*, 17, 2, (Fall 2000), 81-113.

Scott Morton, M. ed. *The Corporation of the 1990s: Information Technology and Organizational Transformation*, New York, Oxford University Press, (1991).

Simchi-Levi, D., P. Kaminsky, and E. Simchi-Levi, *Designing and Managing the Supply Chain*, McGraw-Hill, 2000.

Srinivasan, K., S. Kere, and T. Mukhopadhyay, "Impact of Electronic Data Interchange Technology on JIT Shipments," Management Science, 40, 10, October (1994), 1291-1304.

Stern, L. W. and P. J. Kaufmann, "Electronic Data Interchange in Selected Consumer Goods Industries: An Interorganizational Perspective," In R.D. Buzzell (ed.), *Marketing in an Electronic Age*, Boston, Harvard Business School Press, (1985), 185-219.

Teece, D. J., "Profitomg from technological Innovation: Implications for Integration, Collaboration, Licensing and Public Policy," In D. J. Teece (ED.), *The Competitive Challenge: Strategies for Industrial Innovation and Renewal*, Cambridge, MA, Ballinger, (1987), 185-219.

Teece, D. J., G. Pisano, and A. Shuen, "Dynamic Capabilities and Strategic Management," *Strategic Management Journal*, 18, 7, (1997), 509-533.

Telser, L. G., "A Theory of Self-Enforcing Agreements," *Journal of Business*, 53, 1, (1980), 27-44.

Teo, H., B. C. Y. Tan, and K. Wei, "Organizational Transformation Using Electronic Data Interchange: The Case of TradeNet in Singapore," *Journal of Management Information Systems*, 13, 4, (Spring 1997), 139-165.

Teo, T. S. H. and W. King, "Integration of Business Planning and Information Systems Planning: An Evolutionary-Contingency Perspective," *Journal of Management Information Systems*, 14, 1, (Summer, 1997), 185-214.

Thompson, J. D., *Organizations in Action: Social Science Bases of Administration*, New York, McGraw-Hill, (1967).

Truman, G. E., "Integration in Electronic Exchange Environments," *Journal of Management Information Systems*, 17,1 (Summer 2000), 209-244.

Upton, D. M. and A. McAfee, "The Real Virtual Factory," *Harvard Business Review*, July-August, (1996), 123-133.

Uzzi, B., "The Sources and Consequences of Embeddedness for the Economic Performance of Organizations: The Network Effect," *American Sociological Review*, 61, August, (1996), 674-698.

Uzzi, B., "Social Structure and Competition in Interfirm Networks: the Paradox of Embeddedness," *Administrative Science Quarterly*, 42, 1, (March (1997), 35-67.

Van de Ven, A. H., "On the Nature, Formation and Maintenance of relations among Organizations," *Academy of Management Review*, 1, (1976), 24-36.

Venkatraman, N., "IT-Enabled Business Transformation: From Automation to Business Scope redefinition," *Sloan Management Review*, Winter (1994), 73-87.

Vijayasarthy, L. R. and D. Robey, "The Effect of EDI on Market Channel Relationships in Retailing," *Information & Management*, 33, (1997), 73-86.

Weigelt, K. and C. Camerer, "Reputation and Corporate Strategy: A Review of recent Theory and Applications," *Strategic Management Journal*, 9, 5, (1988), 443, 454.

Webster, J. "Networks of Collaboration or Conflict? Electronic Data InterChange and Power in the Supply Chain," Journal of Strategic Information Systems, 4,1, (1995), 31-42.

Weiss, D. J., "Factor Analysis in Counseling Research," *Journal of Counseling Psychology*, 17, (1970), 477-485.

Wernerfelt, B., "A Resource-Based View of the Firm," *Strategic Management Journal*, 5, 2, (1984), 171-180.

Williams, T., "Interorganisational Information Systems: Issues Affecting Interorganisational Cooperation," *Journal of Strategic Information Systems*, 6, 3, December, (1997), 231-250.

Williamson, O. E. *Markets and Hierarchies: Analysis and Antitrust Implications*, Free Press, New York, (1975).

Williamson, O. E., "Transaction-Cost Economics: The governance of Contractual Relations," *Journal of Law and Economics*, 22, (1979), 233-261.

Williamson, O. E., "Credible Commitments: Using Hostages to Support Exchange," *American Economic Review*, 73, 4, (1983), 519-535.

Williamson, O. E., *The Economic Institutions of Capitalism*, Free Press, New York, (1985).

Williamson, O. E., "Comparative Economic Organization: The Analysis of Discrete Structural Alternatives," *Administrative Science Quarterly*, 36, (1991), 269-296.

Williamson, O. E., "Strategy Research: Governance and Competence Perspectives," *Strategic Management Journal*, 20, (1999), 1087-1108.

Zack, M. H., "Managing Codified Knowledge," *Sloan Management Review*, Summer, (1999), 45-58.

Zaheer, A. and N. Venkatraman, "Determinants of Electronic Integration in the Insurance Industry: An Empirical Test," *Management Science*, 40, 5, May (1994), 549-566.

Zaheer, A. and N. Venkatraman, "Relational Governance as an Interorganizational Strategy: An Empirical Test of the Role of Trust in Economic Exchange," *Strategic Management Journal*, 16, (1995), 373-392.

Zaheer, A. and S. Zaheer, "Catching the Wave: Alertness, Responsiveness, and Market Influence in Global Electronic Networks," *Management Science*, 43, 11, November (1997), 1493-1509.

Zajac, E. J. and C. P. Olsen, "From Transaction Cost to Transaction Value Analysis: Implications for the Study of Interorganizational Strategies," *Journal of Management Studies*, 30, 1, (1993), 131-145.

Zuboff, S. *In the Age of the Smart Machine: The Future of Work and Power*, Basic Books, New York, (1984).

APPENDIX: A NATIONAL SURVEY ON INFORMATION SYSTEMS USE (E-COMMERCE) IN SUPPLY CHAIN

Note: IS (Information systems) and IT (Information technology) are used interchangeably here. A business unit can be a firm or a division of a large corporation.

...About the IS Competence of Your Firm

Please respond to each statement by circling the appropriate response to the following scale:

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neutral	Slightly Agree	Moderately Agree	Strongly Agree

IS executives....

actively address business needs	1	2	3	4	5	6	7
actively manage the inter-dependence among different business needs	1	2	3	4	5	6	7
assign proper personnel to meet each business function needs	1	2	3	4	5	6	7
establish business and IS relationships at the executive level	1	2	3	4	5	6	7
share a vision for IS with business executives	1	2	3	4	5	6	7
determine the values and culture of the IS function	1	2	3	4	5	6	7
lead IS staff to contribute to achieving business solutions	1	2	3	4	5	6	7

IS function...

has the capability to integrate business development with IT/IS capability.	1	2	3	4	5	6	7
discourages adding new processes without considering current IS/IT capability	1	2	3	4	5	6	7
understands connections and interdependencies among business activities	1	2	3	4	5	6	7
can rapidly troubleshoot unusual problems	1	2	3	4	5	6	7
can identify innovative solutions for non-routine business needs	1	2	3	4	5	6	7
can provide solutions for business needs that cannot be properly satisfied by standard approach	1	2	3	4	5	6	7
is involved in every significant business initiative	1	2	3	4	5	6	7
has a well developed vision of an appropriate IS infrastructure for supporting the firm's business	1	2	3	4	5	6	7
has a well developed vision of an appropriate IS infrastructure for supporting its links with suppliers and customers	1	2	3	4	5	6	7
facilitates the contracting process between user functions and the IS suppliers	1	2	3	4	5	6	7
coordinates activities between users and the IS suppliers	1	2	3	4	5	6	7

There are efforts to ...

actively develop users' understanding of IS potential	1	2	3	4	5	6	7
help users and IT specialists work together	1	2	3	4	5	6	7
ensure users' satisfaction with the various information systems	1	2	3	4	5	6	7
ensure users' unreserved acceptance of the provided information systems	1	2	3	4	5	6	7
increase the mutual confidence and trust between IS personnel and users	1	2	3	4	5	6	7
make IS personnel and users perceive a shared purpose	1	2	3	4	5	6	7
make IS suppliers understand your business unit's operations and processes	1	2	3	4	5	6	7
grow with your IS suppliers over time	1	2	3	4	5	6	7
try to create win-win situations for both your business unit and IS suppliers	1	2	3	4	5	6	7

IS personnel have ...

designed IS infrastructures to ensure necessary integration of IS services	1	2	3	4	5	6	7
designed IS infrastructures to ensure necessary flexibility of IS services	1	2	3	4	5	6	7
created a coherent blueprint for IS infrastructure that responds to current business needs	1	2	3	4	5	6	7
created a coherent blueprint for IS infrastructure that responds to future business needs	1	2	3	4	5	6	7
managed the IS infrastructure to achieve the necessary interrelationships across the business unit's different operations	1	2	3	4	5	6	7
managed the IS infrastructure to ensure efficiencies across the business unit's different operations	1	2	3	4	5	6	7
been productive in programming	1	2	3	4	5	6	7
been working in a wide range of technical areas	1	2	3	4	5	6	7
had a solid understanding of IT fundamental knowledge to fix IS breakdowns	1	2	3	4	5	6	7

IS specialists ...

build holistic views of the current organizational processes and activities	1	2	3	4	5	6	7
communicate holistic views of the current organizational processes and activities	1	2	3	4	5	6	7

IS purchasing personnel...

have the capability to select the right IS sourcing strategy	1	2	3	4	5	6	7
make decisions based on business needs	1	2	3	4	5	6	7
understand the firm's technological criteria	1	2	3	4	5	6	7
analyze the externally available IS/IT services	1	2	3	4	5	6	7
lead tendering process in IS outsourcing	1	2	3	4	5	6	7

lead contracting process in IS outsourcing	1 2 3 4 5 6 7
lead service management process in IS outsourcing	1 2 3 4 5 6 7
understand the internal IS service options	1 2 3 4 5 6 7

User functions...

have a single point of contact provided by IS function in IS outsourcing process	1 2 3 4 5 6 7
are confident that conflicts in IS outsourcing will be resolved fairly by IS function	1 2 3 4 5 6 7
are confident that conflicts in IS outsourcing will be resolved promptly by IS function	1 2 3 4 5 6 7

There are ...

processes to ensure that all IS outsourcing agreements are met and protected at all times	1 2 3 4 5 6 7
reports highlighting IS suppliers' achievement against industry benchmarks	1 2 3 4 5 6 7
reports highlighting IS suppliers' achievement against standards in the contracts	1 2 3 4 5 6 7
annual meetings with IS suppliers to develop new IS outsourcing	1 2 3 4 5 6 7
annual meetings with IS suppliers to enhance current IS outsourcing	1 2 3 4 5 6 7

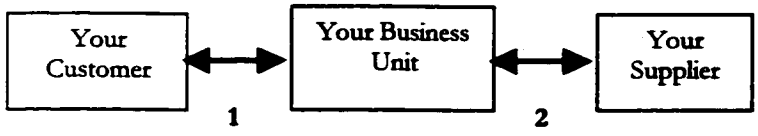
IS suppliers are ...

held accountable on existing contracts	1 2 3 4 5 6 7
held accountable on the developing standards in IS services market	1 2 3 4 5 6 7
held accountable on the evolving IS functionality in IS services market	1 2 3 4 5 6 7

Interaction between IS "techies" and "users" is encouraged to reduce any culture gap	1 2 3 4 5 6 7

All the following questions are based on the *relationship* with a *particular* supplier or customer for a *particular* component.

Please pick one relationship from the following diagram and one component traded in the relationship. For this relationship, your business unit uses IS to coordinate various activities with your partner for that chosen component. Please circle the corresponding number.



Your business unit (division) is mainly:

( ) Final Product/Service Provider ( ) First Tier Supplier

( ) Second Tier Supplier ( ) Other____

...About the Relationship with Your Partner

Please respond to each statement by circling the appropriate response to the following scale:

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neutral	Slightly Agree	Moderately Agree	Strongly Agree

There is a well defined incentive system in the relationship	1	2	3	4	5	6	7
There are many standard operating procedures in the relationship	1	2	3	4	5	6	7
When changes in specifications of the component are made, cost-plus system is used to adjust the remuneration for each partner	1	2	3	4	5	6	7
When there is a dispute, you can access a third-party enforcer to resolve the dispute	1	2	3	4	5	6	7
Ongoing communications are necessary for the relationship functioning well	1	2	3	4	5	6	7
Ongoing decision making is necessary for the relationship functioning well	1	2	3	4	5	6	7
There are continuing adjustments in the relationship	1	2	3	4	5	6	7
It is required for each partner to link specific activities with the other partner closely and regularly	1	2	3	4	5	6	7
Both sides are expected not to make demands that seriously damage the interests of the other	1	2	3	4	5	6	7
The stronger side is expected not to pursue its interests at all costs	1	2	3	4	5	6	7
Most of the procedures have become well accepted and routines	1	2	3	4	5	6	7
Your business unit has ...							
customized tools to accommodate your partner's needs	1	2	3	4	5	6	7
dedicated personnel who learn the systems specific to the partner	1	2	3	4	5	6	7
dedicated personnel who learn the procedures specific to the partner	1	2	3	4	5	6	7
dedicated personnel who learn the individuals specific to the partner	1	2	3	4	5	6	7
accumulated specialized knowledge and information about the partner over time	1	2	3	4	5	6	7
Your partner has ...							
customized tools to accommodate your business unit's needs	1	2	3	4	5	6	7
dedicated personnel who learn the systems special to your business unit	1	2	3	4	5	6	7
dedicated personnel who learn the procedures special to your business unit	1	2	3	4	5	6	7
dedicated personnel who learn the individuals special to your business unit	1	2	3	4	5	6	7
accumulated specialized knowledge and information about your business unit over time	1	2	3	4	5	6	7

Combined complementary but non-relationship specific resources (e.g., reputation, specialized expertise) in the relationship...

are becoming valuable	1 2 3 4 5 6 7
have synergistic effects	1 2 3 4 5 6 7
are becoming difficult to imitate by other firms	1 2 3 4 5 6 7
Your business unit's operational decisions are highly integrated with those of your partner	1 2 3 4 5 6 7
There are coordinating processes that are specific to the relationship	1 2 3 4 5 6 7

There is joint effort and cooperation between your business unit and your partner in:

technical assistance	1 2 3 4 5 6 7
product planning	1 2 3 4 5 6 7
product engineering	1 2 3 4 5 6 7
process engineering	1 2 3 4 5 6 7

...*About IS Use in the Relationship With Your Partner*

Please respond to each statement by circling the appropriate response to the following scale:

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neutral	Slightly Agree	Moderately Agree	Strongly Agree

Your IS applications transfer files to your partner automatically	1 2 3 4 5 6 7
Your partner's IS applications transfer files to your business unit automatically	1 2 3 4 5 6 7
Your IS applications and your partner's applications can communicate with each other automatically.	1 2 3 4 5 6 7
Your IS applications can directly access the data base in your partner's computer systems	1 2 3 4 5 6 7
Your partner's IS applications can directly access the data base in your computer systems	1 2 3 4 5 6 7
A high percentage of the total transactions with the partner is conducted through the IS	1 2 3 4 5 6 7
A large number of documents associated with the partner are exchanged through the IS	1 2 3 4 5 6 7

To which degree that you agree that the following functions exchange electronic data with your partner?

Purchasing	1 2 3 4 5 6 7
Engineering	1 2 3 4 5 6 7
Quality Control	1 2 3 4 5 6 7
Production Control	1 2 3 4 5 6 7
Transportation	1 2 3 4 5 6 7
Payment	1 2 3 4 5 6 7

...About the Impacts of IS Use in the Relationship

Please respond to each statement by circling the appropriate response to the following scale:

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neutral	Slightly Agree	Moderately Agree	Strongly Agree

To which degree you agree that IS use in the relationship has reduced the following costs?

cost of exchanging product information (e.g., price and product characteristics)	1	2	3	4	5	6	7
cost of incorporating exchanged information into the decision process	1	2	3	4	5	6	7
cost incurred due to delays in the communication channel with the partner	1	2	3	4	5	6	7
cost to share design changes quickly with the partner	1	2	3	4	5	6	7
cost to inform and to be informed of changes in delivery schedules of the component	1	2	3	4	5	6	7

It is less likely ...

for any side in the relationship to deliberately misrepresent information	1	2	3	4	5	6	7
for any side in the relationship to withhold important information	1	2	3	4	5	6	7
to have inconsistent information in the relationship through IS use	1	2	3	4	5	6	7
to have incompatible information in the relationship through IS use	1	2	3	4	5	6	7
for any side to under-perform its agreed-upon responsibilities (e.g., inferior component quality) through IS use	1	2	3	4	5	6	7

Through IS use in the relationship...

tacit engineering knowledge can be easily transferred to the other side opportunistically	1	2	3	4	5	6	7
production skills can be easily transferred to the other side opportunistically	1	2	3	4	5	6	7
opportunistic behavior is reduced because of less relationship specific investments by both sides	1	2	3	4	5	6	7
having small number of partners does not increase opportunistic behavior	1	2	3	4	5	6	7
opportunistic behavior is reduced because of the monitoring effect of the IS use in the relationship	1	2	3	4	5	6	7

...About the Buyer Benefits in the Relationship

Please respond to each statement by circling the appropriate response to the following scale:

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neutral	Slightly Agree	Moderately Agree	Strongly Agree

Through outsourcing the component by the component buyer, the buyer ...

is able to refocus on core business.	1	2	3	4	5	6	7
has enhanced the final product competitiveness.	1	2	3	4	5	6	7

has increased access to skilled personnel from the partner	1	2	3	4	5	6	7
benefits from the economies of scale of the human resources of the partner	1	2	3	4	5	6	7
benefits from the economies of scale of the technology resources of the partner	1	2	3	4	5	6	7
has increased control of the component design costs	1	2	3	4	5	6	7
has increased control of the production costs	1	2	3	4	5	6	7
has reduced the risk of product technology obsolescence	1	2	3	4	5	6	7
has reduced the risk of process technology obsolescence	1	2	3	4	5	6	7
has increased access to key process technologies	1	2	3	4	5	6	7
has increased access to key product technologies	1	2	3	4	5	6	7

...Some Background Information

The information systems in the relationship are set up by

( ) your partner ( ) your business unit ( ) a third party

( ) your business unit and your partner

( ) you business unit and a third party

( ) your partner and a third party

( ) other_____

The information system in the relationship

( ) is a part of an electronic market with many suppliers and many buyers in the system

( ) is one to one connection between the buyer and the supplier

( ) has one buyer and many suppliers in it

( ) has one supplier and many buyers in it

( ) other_____

What is your present job title?

( ) CIO ( ) IS Director ( ) Other

( ) Vice President ( ) IS Manager

The number of employees in your business unit:

( ) 100 - 249 ( ) 250 – 499 ( )500 – 999

( ) 1,000 - 2,499 ( ) 2,500 and over ( ) Other

The number of IS employees in IS function in your business unit:

( ) Less than 10 ( ) 11 - 25 ( ) 26-50

( ) 51 - 100 ( ) 101-200 ( )over 200

The average annual sales $ (in millions) for your business unit.

( ) Less than 10 ( ) 10 - 49.9 ( ) 50 - 99.9

( ) 100 - 499.9 ( ) 500 - 1 billion ( )Over 1 billion

Please indicate your firm's industry:

( ) Manufacturing _____ ( ) Service _____ ( )Other _____