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Georgia State University

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The author of this dissertation is:

Stephen M. Du
45 South Killingly Road, Foster, RI 02825

The director of this dissertation is:

Dr. Arun Rai
Regents' Professor and Harkins Chair of Information Systems
Center for Process Innovation & Computer Information Systems Department
J. Mack Robinson College of Business
Georgia State University
35 Broad Street NW, Atlanta, GA 30303

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**Effect of Digital Enablement of Business-to-Business Exchange on Customer Outcomes:
The Role of Information Systems Quality and Relationship Characteristics**

by

Stephen Mark Du

A Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree
of
Doctor of Philosophy
in the Robinson College of Business
of
Georgia State University

GEORGIA STATE UNIVERSITY
ROBINSON COLLEGE OF BUSINESS
2010

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Stephen Mark Du
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ACCEPTANCE

This dissertation was prepared under the direction of the candidate's Dissertation Committee. It has been approved and accepted by all members of that committee, and it has been accepted in partial fulfillment of the requirements for the degree of Doctor in Philosophy in Business Administration in the Robinson College of Business of Georgia State University.

Dean: *H. Fenwick Huss*
J. Mack Robinson College of Business

Dissertation Committee:

Dr. Arun Rai (Chair)
Dr. Wesley J. Johnston
Dr. Ephraim R. McLean
Dr. Viswanath Venkatesh (University of Arkansas)

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Completing this dissertation has truly been a journey for myself and those close to me. Although an endeavor such as this calls for a great deal of attention, everything else in the world continues nevertheless. While enjoying the work of this study, I also experienced joy from the birth of two sons and sadness from the passing of my parents.

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Finally but most importantly, thank you to my family for supporting this personal quest. I am especially thankful to my wife, Dianne, for pushing me when I needed it most.

*This thesis is dedicated to the memory of my father,
Darfoon Du, who felt strongly about the value of education.*

ABSTRACT

Effect of Digital Enablement of Business-to-Business Exchange on Customer Outcomes: The Role of Information Systems Quality and Relationship Characteristics

By

Stephen Mark Du

Committee Chair: *Dr. Arun Rai*

Major Department: *Computer Information Systems*

This study extends our understanding of how information systems impact business value creation by examining the effect of digital enablement of business-to-business exchange on customer outcomes. We shed light on the connection between information technology investment and firm performance by focusing on how information technology is used (Devaraj and Kohli 2003) in an industrial services context and by highlighting the importance of indirect effects (Mittal and Nault 2009). A conceptual model is developed that combines a customer centric perspective (Sheth et al. 2000) with elements from the information systems success framework (DeLone and McLean 1992, DeLone and McLean 2003). Mediating factors are identified in the chain of effects from information technology specific business-to-business service quality characteristics to customer outcomes. In addition, we consider two contextual factors, relationship duration and customer dependence, which are known to alter the nature of buyer-supplier relationships but which have received little attention in research on digital enablement of business-to-business exchange.

An empirical test of hypothesized relationships was performed using subjective and objective archival data from business-to-business exchange relationships for a logistics services vendor. All expected main effects were confirmed. Customer satisfaction was found to be a

significant mediator in the chain of effects from information technology specific business-to-business service quality characteristics to customer outcomes. In addition, logistics service quality was found to mediate the relationships between system quality and customer satisfaction and between information quality and customer satisfaction. The hypothesized moderating effects, however, were not found to be significant. Robustness of the findings was confirmed by testing model hypotheses using data from exchange relationships with customers in two different industries, manufacturing and wholesale trade. Differences in analysis results are consistent with industry differences.

This study contributes to the literatures on interorganizational information systems (Rai et al. 2006) and information technology business value (Melville et al. 2004) by identifying mediating mechanisms in the chain of effects from digital enablement of exchange to customer outcomes. Explication of mediating mechanisms improves our understanding about the indirect nature of impacts from information technology. This study also contributes to the literature on information systems by extending DeLone and McLean's (2003) model of information systems success to the context of business-to-business exchange relationships. In addition, this study contributes to the literature on services marketing (Zeithaml and Bitner 2003, Berry and Parasuraman 1993) by showing how system quality and information quality impact logistics service quality and customer satisfaction in a business-to-business exchange context.

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Effect of Digital Enablement of Business-to-Business Exchange on Customer Outcomes: The Role of Information Systems Quality and Relationship Characteristics

Chapter 1 Introduction

Section 1. Overview

One of the most important changes occurring in modern industry is the increasing digital enablement of exchange between firms (Richard and Devinney 2005). Digital enablement is the ability to perform business processes using information technology (Smolander 2003). In 2007, the value of electronic commerce for U.S. manufacturers and merchant wholesalers was 27.8% of all business-to-business exchange for those firms and growing at an annual rate of 11.6% (U.S. Census Bureau 2009). Digital enablement of business processes is seen as a central catalyst in the acceleration of competition across industries in the United States (McAfee and Brynjolfsson 2008). As information technologies mature and become more easily acquired, digital enablement for a firm is likely to be applied to an increasing number of processes and for an increasing number of business partners. As this linkage between firm performance and information technology usage deepens, it becomes increasingly important to understand how information systems can be successfully utilized in this context.

Because differences in the meaning of “exchange” can be found in the literature, it is helpful to provide clarification of the intended meaning for this study. Bagozzi (1975) suggested that the central marketing concept of exchange between buyer and seller should be broadened from the traditional view focused on direct exchanges of tangible entities to include more complex types of exchange such as reciprocal relationships and mutual relationships in which participants

communicate with and influence others in the satisfaction of their needs. In this study, “exchange” refers to all transaction related interactions between a business customer and a vendor in the context of their interorganizational relationship for the duration of their relationship. These interactions include gathering information prior to purchase, monitoring status of an order during delivery, and inquiries regarding an order after it has been completed. Gulati and Sytch (2007) characterized dyadic exchange relationships more generally as economic arrangements that involve the exchange of resources between participants. Morgan and Hunt (1994) noted increasing academic and practitioner interest in relationship marketing, a paradigm emphasizing the importance of buyer-supplier exchange that spans a longer duration compared to more discrete market transactions. Business customer relationships tend to involve multiple transactions or exchanges. Thus, this study uses the term “exchange” to refer to interactions between customer and vendor across all of their transactions. In addition to the longevity of an exchange relationship, we also consider how informational aspects of each transaction can be enriched through digital enablement.

This study is also distinguished from literature on third party electronic exchanges. There are many published studies that examine arrangements called “electronic exchanges” in which transactions between buyers and sellers are facilitated with services provided by a third party (see for example: Scott and Scott 2004; Skjott-Larsen et al. 2003; Kaplan and Sawhney 2000). This third party may be an independent entity or sponsored by one or more of the exchange participants. This arrangement forms a triad between buyer, seller, and the third party for the purpose of conducting transactions. In contrast, the chosen unit of analysis for this study is the dyad formed by a buyer and seller for the duration of their exchange relationship. Furthermore,

the presence or absence of a third party exchange arrangement as described above is not pertinent to the results from this study. Rather, we are concerned with customer perceptions in the context of their relationship with the vendor.

Information systems are used in business-to-business exchange to enable capabilities that improve firm performance. As participation in multi-firm value chains increases, a fundamental unit of analysis for understanding performance outcome is the dyadic relationship (Anderson, et al. 1994). Manufacturing firms, for example, achieve greater process efficiencies by utilizing information systems to manage their relationships with suppliers (Saeed et al. 2005). One explanation for how information systems enable such performance improvements is that decoupling digital activities from physical activities permits more beneficial organizational arrangements (Evans and Wurster 1997). It has been shown, for example, that performance benefits can be obtained by disaggregating customer contact activities into those achievable through digital interaction and those requiring physical interaction (Apte and Mason 1995).

Two key performance indicators in business-to-business exchange are customer perceptions of service quality and customer satisfaction. Both of these indicators are influenced by customer perceptions in the context of the exchange relationship (Crosby et al. 1990). Service quality has been increasing in importance for industrial sellers because of competitive pressures that heighten the salience of market factors such as customer retention rates (Parasuraman 1998). Customer satisfaction is a popular performance metric not only because of its relevance to the customer experience, but also because of its links to financial outcomes. Customer satisfaction has been shown to be a statistically significant indicator of a firm's future financial performance (Ittner and Larcker 1998). In addition, there is empirical evidence of positive relationships

between customer satisfaction and financial indicators such as net cash flow and stock market return (Fornell et al. 2006). In a services context, it can be more challenging to obtain financial returns from increased customer satisfaction when this requires costly customization efforts (Anderson et al. 1997). However, digital enablement of exchange may alleviate this cost because it improves the firm's ability to gather customer information that is pertinent to increasing customer satisfaction (Rust and Kannan 2003).

Prior research on digital enablement of business-to-business exchange has emphasized different aspects of enablement, reflecting differences in the underlying information system and in the nature of the exchange relationship. Table 1 provides an illustrative selection of recent studies. Earlier studies examined proprietary systems that were designed to bring competitive advantage to their sponsoring firm by increasing switching costs and by creating information asymmetries that favored the focal firm (Rackoff et al. 1985; Johnston and Vitale 1988). Digital enablement of business-to-business exchange that favors a focal firm is also found in recent studies of systems that use standardized technologies such as Electronic Data Interchange (Mukhopadhyay and Kekre 2002). In this context, there are many multidisciplinary research streams that focus on performance aspects of multi-firm value chains (e.g., Gurbuz et al. 2007).

Recent studies of digital enablement for business-to-business exchange are including more relational aspects as influential factors. For example, researchers are examining the importance of trust (Ratnasingam 2005) and loyalty (Lam et al. 2004) to firm performance. Increasing competition resulting from globalization has heightened interest among firms in relationship management and customer retention rates. When customers have alternatives in the marketplace and low switching costs, then aspects of relationship quality such as customer satisfaction and

customer perceived service quality become important factors to repeat patronage (Lam et al. 2004).

Year	Authors	Description
2007	Krishnan et al.	<i>Information Systems Research</i> special issue focusing on the extended enterprise.
2007	Malhotra et al.	Role of electronic standards in adaptive partnership capabilities.
2007	Saraf et al.	Flexibility and integration capabilities of information systems are found to augment relational value in business-to-business exchange by facilitating knowledge sharing and process coupling.
2007	Bala and Venkatesh	Mechanisms that influence assimilation of information technology enabled process standards for business-to-business exchange.
2007	Tanriverdi et al.	Information technology detachability and process modularity as antecedents to firm decisions to unbundle and reconfigure value chain processes.
2007	Mishra et al.	Impact of digital enablement and domain specific knowledge on procurement process performance.
2005	Richard and Devinney	Importance of modular strategy in realizing economic rents from digital enablement of business-to-business exchange.
2005	Saeed et al.	Business customer perspective on how aspects of digitally enabled exchange such as external integration, breadth, and initiation impact the benefits achieved.
2002	Jap and Mohr	Influence of exchange relationship context (i.e. transactional versus relational) on outcomes obtained from digital enablement.

Table 1. Illustrative Examples of Recent Research on Digital Enablement of Business-to-Business Exchange

Another perspective is increasing emergence of the extended enterprise (Krishnan et al. 2007). In the extended enterprise, a firm collaborates with its business partners to produce superior market offerings. This arrangement is consistent with the relational view of organizations (Dyer and Singh 1998) in which cooperation among firms is hypothesized to generate greater value than what is possible through traditional arms-length transactions. Establishing and maintaining cooperative relationships with business partners generally requires negotiation to identify agreements that will satisfy all parties involved. Success in negotiation is often improved by an appreciation for perspectives and perceptions held by other negotiating parties.

Digital enablement introduces digital activities that replace or enhance associated physical

activities. For example, many paper-based forms have been replaced by electronic messaging systems. For logistics activities, electronic manifests can be transmitted ahead of physical shipments to facilitate better planning and coordination with supply chain partners. Thus, a digital activity can be performed at a different time, at a different location, and by different employees than its associated physical activity. This separation of digital activity from physical activity adds a new electronic aspect to traditional concerns, such as service quality. Separating digital and physical flows facilitates more comprehensive process improvements by permitting each type of flow to be optimized separately, utilizing design methods that are more appropriate for each (Mason-Jones and Towill 1999). For example, the separation of digital and physical flows can lead to improvements in supply chain performance because it enables operational flexibility that can offset risks and uncertainties stemming from variability in market demand (Pagh and Cooper 1998).

Firms that have succeeded in digitally enabling exchange with suppliers and customers illustrate its potential benefits such as reduced cost of operations, improved operational performance, and increased revenue. Intel Corporation, for example, reduced its cost of indirect materials by over \$300M in the first three years of operation using digitally enabled procurement processes (Ghiya and Powers 2005). Nanjing Jin Cheng Motorcycle Corporation, one of the top motorcycle manufacturers in China, implemented digitally enabled workflow processes in its supply chain to obtain significant performance improvements such as 25% reduction in inventory levels, 15% increase in warehouse turnover of finished product, and 10% reduction in working capital (Liu et al. 2005b). Boeing Corporation created a significant new source of revenue by enabling online sales of spare aircraft parts to customers who were otherwise unreachable (Wise and

Baumgartner 1999). In addition to direct benefits, digital enablement can provide organizational capabilities that enable subsequent opportunities. For example, John Deere provides premium customer service by enhancing the availability of replacement parts with digitally enabled logistics services.

In addition to individual examples, there is a growing body of scientific evidence that confirms the positive impact of digital enablement on firm performance (e.g., Rai et al. 2006, Mithas et al. 2005, Barua et al. 2004). These studies examined organizational capabilities that are enabled by digitization and considered characteristics of the firm, its suppliers, and its customers as antecedents. One empirical study, for example, showed that customer knowledge acquisition mediates the link between digitally enabled customer relationship management and customer satisfaction (Mithas et al. 2005).

The customer centric view (Sheth et al. 2000) has emerged as an important management practice for achieving success in competitive industries. Adopting a customer centric view can improve firm performance according to research in related conceptual areas such as market segmentation (Mentzer et al. 2004), customer equity (Rust et al. 2004), and customer portfolio theory (Johnson and Selnes 2004). A focus on customers is especially crucial for business-to-business exchange because of the heightened importance of customer differences in industrial markets compared to those in consumer markets (Ulaga and Chacour 2001). Digital enablement of business-to-business exchange supports customer centric management practices by providing relevant capabilities such as gathering information about customer preferences (Mithas et al. 2005), tracking customer buying behaviors (Kumar and Petersen 2005), and personalizing customer facing processes (Lee et al. 2008; Bitner et al. 2000).

This study focuses on exchange outcomes for business customers because of important differences from other types of customers. In particular, business customers are distinguished from consumers because of differences in revenue, purchasing behavior, and attitudes toward the exchange relationship. Differences in revenue between consumers and business customers reflect their contrasting purposes for purchasing. Consumers, by definition, purchase goods and services for personal use. In contrast, business buyers purchase for organizations. Large organizations, for example, require large quantities of office supplies to support the number of employees that perform office work. In addition, business buyers purchase good and services that are factor inputs to their own production processes. The greater potential revenue that is available more often from business customers is important because it can justify investment in relationship specific assets such as dedicated account managers or information technology. When an investment results in increased customer revenue that exceeds the cost of the investment then it is justified.

Differences in purchasing behavior between business customers and consumers reflect their contrasting decision processes. For example, it is hypothesized that consumer buying tends to be influenced more by emotions whereas business buying tends to be more rational (Stock 2005; Rook 1987). These differences would affect customer attention to different aspects of their exchange relationship and subsequent purchasing intentions. Much of the consumer marketing literature examines how consumer attitudes influence buying behavior (Smith et al. 2008). Correspondingly, there is a great deal of literature that examines industrial purchasing processes. This has been particularly helpful to practitioners for managing their industrial sales strategies. Similarly, differences in customer attitudes toward their exchange relationship reflect their

contrasting needs and perceptions. Consumers that attend to their emotional needs, for example, may be strongly influenced by a perceived status attained from purchasing a particular product brand. In contrast, business customers that follow a more rationalized decision-making process, for example, are likely to solicit vendor evaluations from internal managers when renegotiating a purchase contract.

Although the potential performance advantages from digital enablement of business-to-business exchange are known, fully realizing the benefits can be challenging because it requires investment of resources and cooperation from both partners in the buyer-supplier exchange relationship. Partner perceptions and attitudes toward the relationship will influence decision-making that affects success. Aspects of the buyer-supplier relationship such as relationship duration and customer dependence can influence customer motivations (Hoetker et al. 2007; Liu et al. 2005a). For information systems to be successfully utilized in this context, firms need to understand how digital enablement affects buyer-supplier relationships in order to appropriately manage associated organizational investments.

Few studies of digital enablement adopt a customer centric perspective. A better understanding of customer specific perspectives on this issue is needed. In particular, there is little scholarly research that examines the impact of digital enablement on customer satisfaction and customer loyalty in the context of a business-to-business exchange relationship. Researchers in the marketing discipline have recognized the importance of this topic because of potential differences with traditional employee to customer interaction (Bitner et al. 2000) and subsequent implications for value outcomes (Parasuraman and Grewal 2000). Since service quality has been established as a key factor in customer satisfaction (Cronin and Taylor 1992), digital enablement

of exchange processes would be expected to influence customer satisfaction through its effect on customer perceived service quality.

LaPlaca and Katrichis (2009) reviewed twenty-four mainstream marketing journals over a seventy-one year period to determine the extent to which research on business-to-business related topics were represented in the literature. They found that the proportion of business-to-business related articles (6.7%) clearly did not reflect the financial importance of this economic segment, which has been estimated to be at least 50% (LaPlaca and Katrichis 2009) and as high as 80% (Lichtenthal and Mummalaneni 2009) at the national level. Most of the existing business-to-business related marketing literature examines buyer behavior, sales management, or marketing relationships. Less than 5% of the existing business-to-business related marketing literature is concerned with electronic commerce.

Section 2. Research Objective

Figure 1 presents a conceptual model for this study. The objective of this study is to deepen understanding of how digital enablement of business-to-business exchange impacts relationship outcomes by examining its influence on customer perceptions and attitudes. By adopting a customer centric perspective to focus on customer specific mechanisms, we identify customer satisfaction as a key indicator for exchange success. These concerns led to the following research questions:

- How do information technology specific characteristics of business-to-business service quality influence customer satisfaction and financial outcomes in digitally enabled business-to-business service?

- How do relationship characteristics moderate linkages between information technology specific characteristics of business-to-business service quality and customer satisfaction in digitally enabled business-to-business service?

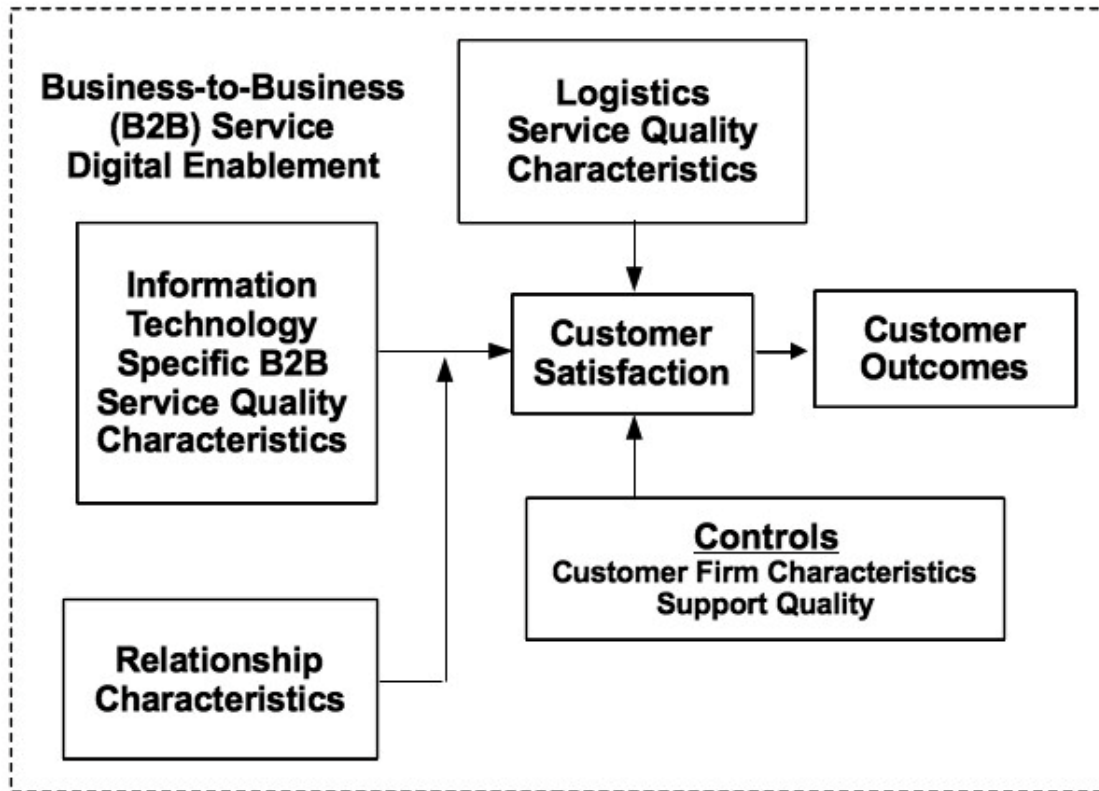


Figure 1. Conceptual Model

This study will contribute to the literature by providing an examination of how customer perceptions and attitudes in business-to-business exchange are influenced by digital enablement. A conceptual model is developed that combines a customer centric perspective (Sheth et al. 2000) with elements from the information systems success framework (DeLone and McLean 2003). Findings from this study complements existing research on digital enablement by enriching demand-side perspectives of the extended enterprise (Krishnan et al. 2007). Empirical tests of hypothesized relationships provide additional contributions that augment the theoretical

work. Specifically, an assessment of influences from information technology specific characteristics of business-to-business service quality to customer satisfaction provides support for the notion of digital service quality as an important factor in relationship performance. Findings from this study provide insights regarding digital enablement of business-to-business exchange and impact of digitization on relationship outcomes. Implications of these insights are relevant to managerial decision-making for interorganizational system design, business-to-business relationships, and organizational capabilities.

To summarize, the following contributions are obtained from this research:

- Conceptualize information technology specific characteristics of business-to-business service quality in digitally enabled service.
- Provide empirical evidence to support the above notion and its effect on business-to-business relationship outcomes.
- Empirically examine the effect of business-to-business relationship characteristics on how digital enablement of exchange influences customer perceptions and attitudes.
- Provide guidelines for how firms should digitally enable business-to-business services to improve relationship outcomes.
- Identify types of business customer relationships that would benefit most from digital enablement of exchange.

In the next chapter, the research model for this study is presented followed by specification of constructs and relationships in the model. The empirical study is then described in the following

chapter, including data collection, instrument refinement and validation, and analysis results. A discussion of the results from this research and its implications is provided in the concluding chapter.

Chapter 2 Research Model and Hypotheses

Section 1. Theoretical Logic

Development of the research model for this study combines a customer centric perspective with elements from the information systems success model (DeLone and McLean 2003). The customer centric perspective focuses attention on how a firm can fulfill customers' needs by attending to aspects of exchange relationships such as service quality. The information systems success framework provides a theoretical model for explaining the role of the information systems artifact in delivering benefits. Combining the information systems success framework with a customer centric perspective in the business-to-business exchange context provides an approach for examining how digital enablement impacts business customers.

Conceptualization of the model for this study extends existing theory regarding creation of business value through utilization of information technology in a business-to-business context. In the literature, business value is generally defined as the impact of information technology on firm performance (Devaraj and Kohli 2003, Hitt and Brynjolfsson 1996, Mukhopadhyay et al. 1995). A diversity of perspectives has been employed by information system researchers to examine the impact of information technology on business value creation (Melville et al. 2004). For example, information technology is often assessed by proxy through examination of associated characteristics such as investment costs (Devaraj and Kohli 2000). Another approach has been to focus on the impact of information technology in combination with organizational activities such as production operations or order fulfillment (Kraemer et al. 2000).

More recently, there has been interest in considering the impact of information technology on

intermediate organizational factors as a means for understanding its effect on firm performance (Radhakrishnan et al. 2008, Mooney et al. 1996). This perspective is similar to value chain analysis (Porter 1985) in which desired firm outcomes are improved by considering the effect of changes to intermediate organizational processes. In this study, digital enablement of business-to-business exchange is posited to impact customer outcomes through its effect on mediating factors such as service quality, customer satisfaction, and customer loyalty. In the remainder of this section, we consider the role of these mediating factors in understanding how digital enablement of business-to-business exchange impacts customer outcomes.

Adopting a customer oriented perspective on how digital enablement of exchange impacts customer outcomes surfaces the importance of mediating factors in the chain of value creating effects. In this study, digital enablement of exchange is posited to improve service quality. The quality of service delivery activities is known to be a key factor in customer satisfaction response. Customer satisfaction, in turn, contributes to customer loyalty attitudes. Finally, customer loyalty is expected to influence customer purchase decision-making, and the resulting customer revenue.

Research on information system success has explored a number of perspectives that consider how and when information systems provide benefits to individuals and organizations (e.g. DeLone and McLean 2004; Seddon et al. 1999; DeLone and McLean 1992). Net benefits provided by an information system, for example, is likely to be different in different contexts. On the one hand, an individual might value the extent to which an information system helps reduce the time required to perform tasks. In contrast, a firm might utilize a customer facing information system because of its role in improving customer perceived service quality and customer

satisfaction.

For digital enablement of business-to-business exchange, information system success would be expected to have a significant role in achieving desired outcomes from exchange relationships. In this context, then, net benefits of information system success should include elements of performance for business-to-business exchange relationships. In this study, attention is focused on net benefits that are affected by exchange partner perceptions. When exchange encounters are digitally enabled, then informational activities are performed separately from their associated physical activities. This electronic interaction creates an experience that may be perceived differently by different exchange partners. Customer satisfaction, for example, is an indicator of business-to-business exchange performance that is affected by exchange partner perceptions. Opportunities for firm growth are obtained from creating customer value by understanding where help is desired. This understanding requires considering the customer's perspective (Bettencourt and Ulwick 2008).

From a customer centric perspective, customer satisfaction is a key indicator of exchange success. Research that examines marketing practices underscores the fundamental role of customer satisfaction. Customer satisfaction represents an aggregate evaluation of the exchange relationship (Oliver 1993) based on all past experiences within the relationship (Anderson, et al. 1994), which indicates how well customer needs have been fulfilled (Oliver 1997). Selecting customer satisfaction as an outcome variable will facilitate the comparison of results from this study with those in the marketing literature.

There is a significant body of literature that establishes service quality as a key factor in

customer satisfaction (Cronin and Taylor 1992). A service that is judged as having superior quality is generally viewed as providing greater value, which leads to more favorable feelings of satisfaction (Storbacka et al. 1994). Since most customers evaluate services using multiple criteria, service quality is conceptualized as a multidimensional construct. Studies of consumer markets, for example, have identified five dimensions of service quality (Parasuraman et al. 1988). Attempts to assess these dimensions in industrial contexts, however, have met with mixed results (Zolkiewski et al. 2007). Apparently, differences between industrial buyers and consumers lead to differences in how service quality is viewed in a business-to-business exchange context.

In this study, we consider how digital enablement of exchange influences customer satisfaction through its effect on business-to-business service quality. Digital enablement of customer facing business processes, for example, can contribute to customer appreciation of their exchange relationship when it enhances their competitive advantage (McAfee and Brynjolfsson 2008). We focus on characteristics of business-to-business service quality that are specific to digital enablement and examine their importance relative to generic characteristics of business-to-business service quality. Three characteristics of business-to-business service quality that are specific to digital enablement are identified in the information systems success model (DeLone and McLean 2003). Two characteristics, system quality and information quality, are related to the information systems artifact. The third characteristic, information technology support quality, is related to associated technical staff. Because the objectives of this study emphasize the information systems artifact, we treat information technology support quality as a control. This technical support quality is complemented in our model by also including quality of relationship

support as a control.

Although the importance of digital enablement to buyer-supplier relationships is acknowledged in the literature, there are few scholarly studies that examine the impact of digital enablement on business-to-business exchange from a customer centric perspective. Prior research on digital enablement in this context has drawn from management theories such as the resource-based view (e.g. Mishra et al. 2007) and organizational capabilities (e.g. Rai et al. 2006), and focused on outcomes pertaining to operational and financial performance of the focal firm. The customer centric perspective provides a complementary view of digital enablement that enriches existing knowledge.

A customer centric approach illuminates how the information systems artifact impacts the fulfillment of customer needs in a business-to-business exchange context. A deeper understanding of expected customer impact from digital enablement will improve the firm's ability to manage downstream relationships in the extended enterprise. Sheth (2007), a prominent researcher in the marketing field recently highlighted the need for research to deepen understanding of digital enablement in business-to-business exchange particularly for demand side relationships.

Prior research on digital enablement has identified organizational capabilities, such as process integration (Rai et al. 2006), knowledge acquisition (Mithas et al. 2005), and online informational capabilities (Barua et al. 2004) that lead to superior firm performance. These benefits derive from digital enablement because capabilities of information technology, such as unbundling information flows from physical flows, gathering and storing customer knowledge,

and resolving syntactic and semantic differences between systems, respectively, enable processes in a firm's infrastructure that are combined to form the higher order capabilities. For example, unbundling information flows from physical flows facilitates sharing information with partners to permit coordination of activities, which leads to process integration. However, this conceptualization of the information technology artifact only provides indirect relationships to the organizational capabilities of interest as illustrated in the example above.

In addition to examining characteristics of digital enablement that influence customer satisfaction in business-to-business exchange, we also consider influential factors from the relationship context. Relationship duration and customer dependence are two contextual factors that are known to alter the nature of relationships but have received little attention in digital enablement research. To maintain emphasis on the customer centric perspective, we limit our analysis to mechanisms that influence customer satisfaction. Figure 2 presents a diagram for the research model.

Section 2. Hypotheses

Table 2 summarizes definitions for the constructs in this study.

Customer Satisfaction.

Customer satisfaction is an attitude that is formed in response to experiences gained in the context of a business-to-business exchange relationship (Oliver 1997, Ganesan 1994, Oliver 1993). This attitude reflects the customer's feeling that their needs have been fulfilled. Customer needs include the need to derive value from exchange and the need to minimize exchange costs (Hallowell 1996). High customer satisfaction will strengthen an exchange relationship through

its positive effect on commitment to the relationship (Ganesan 1994). In this study, customer satisfaction is a core indicator for evaluating exchange success. The fundamental role of satisfaction in exchange is its influence on customer decision-making that is related to purchasing behavior.

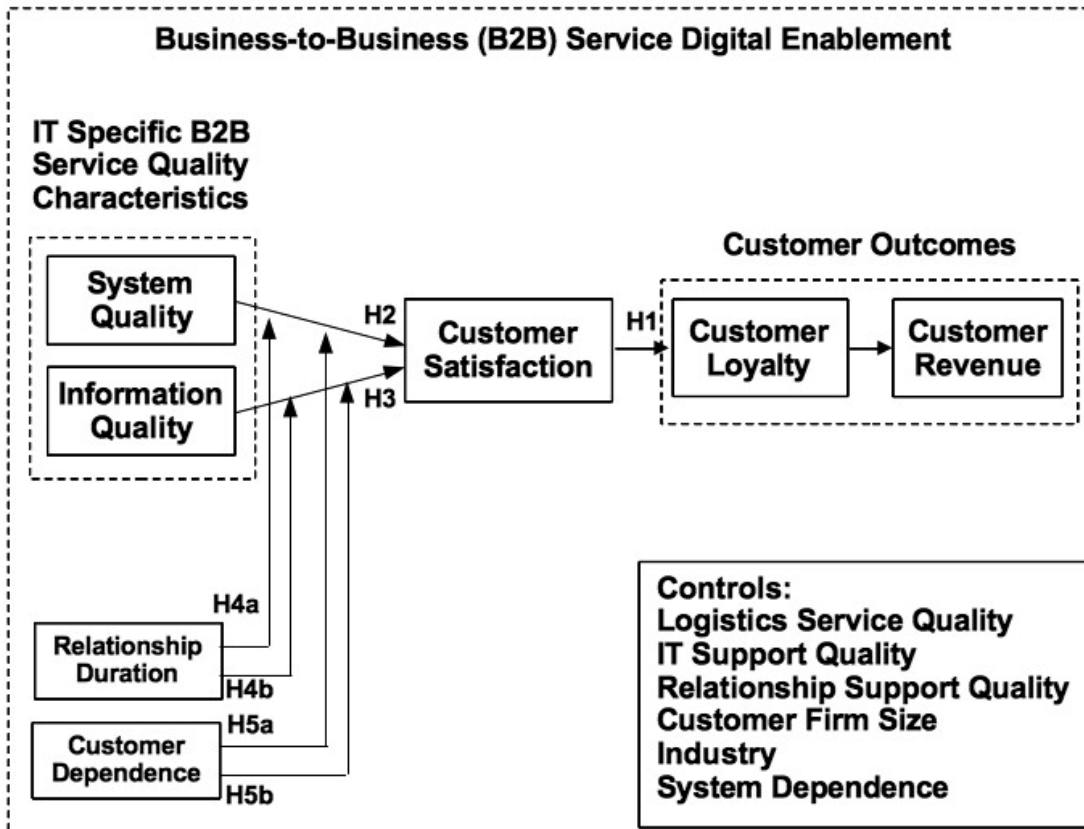


Figure 2. Research Model

Prior to performing a purchase, the customer must decide from which supplier the purchase will be made. If the decision involves significant commitment of resources, such as the decision to renew a procurement contract, then it may involve multiple decision-makers in a multi-step decision process. Alternatively, the customer may simply choose from one or more preapproved suppliers to initiate a transaction. In both of these examples, differences in feelings of satisfaction between suppliers can influence which one is chosen for exchange. Satisfaction

functions as a heuristic, providing an accessible guide for managing firm performance. More satisfied customers have less incentive to consider other suppliers. In contrast, less satisfied

Construct	Definition
Customer Satisfaction	An attitude that represents a customer's response to their accumulated experience in the context of a B2B exchange relationship (Oliver 1997, Ganesan 1994, Oliver 1993)
Customer Outcomes	
Customer Loyalty	A customer's commitment to continue a B2B exchange relationship (Narayandas 2005; Oliver 1999)
Customer Revenue	Financial value of services provided to a customer
IT Specific Characteristics of B2B Service Quality	
System Quality	A customer's belief about how information is processed and delivered during digitally enabled exchange (Wixom and Todd 2005; Shih 2004; Pitt et al. 1995)
Information Quality	A customer's belief about the output provided by a supplier's information system (Wixom and Todd 2005; Shih 2004; Pitt et al. 1995)
Moderators	
Relationship Duration	The period of time during which two firms have been doing business continuously (Kotabe et al. 2003)
Customer Dependence	The degree to which a customer needs to maintain their relationship with a supplier to attain desired goals (Ganesan 1994)
Controls	
Logistics Service Quality	The customer evaluation of a logistics service provider's performance for non-digital activities (Parasuraman et al. 1985)
IT Support Quality	Customer perception of how well the supplier provided services that the customer needed to use the supplier's information system
Relationship Support Quality	Customer perception of how able the supplier's representative was in meeting the customer's needs
Customer Firm Size	Used as a proxy for the complexity of a firm's business activities (Damanpour 1996; Moldoveanu and Bauer 2004)
Industry	A group of firms that provides similar products and/or services (Clarke 1989)
System Dependence	The degree to which the customer needs to use the supplier's information system to perform transactions

Table 2. Construct Definitions and Sources

customers are motivated to consider alternative suppliers for potential improvement to value

received (Anderson and Mittal 2000).

There has been a great deal of research that examines the link between customer satisfaction and supplier firm performance (e.g. Fornell et al. 2006; Dresner and Xu 1995). Satisfaction surveys grew in popularity among businesses during the 1990s, prompting academic scrutiny into the strength of this relationship. One possible argument against the relevance of customer satisfaction, for example, is that business buyers are expected to make purchase decisions based on objective criteria such as quality and pricing. Thus, feelings of satisfaction might be less relevant in predicting firm performance compared to other factors. Nevertheless, empirical studies have demonstrated a significant positive relationship between customer satisfaction and financial measures of firm performance (Ittner and Larcker 1998). In this study, we include a similar test to confirm the validity of our satisfaction measure as an indicator of firm performance. One outcome of customer satisfaction that is closely related to the purchase decision is customer loyalty.

Customer Outcomes.

As described above, customer satisfaction is expected to strengthen firm financial performance through its effect on customer behaviors. Two customer outcomes that are assessed in this study are customer loyalty and customer revenue. Customer revenue is defined as the financial value of customer transactions in the exchange relationship. Customer loyalty is defined as a commitment to continue an exchange relationship (Narayandas 2005; Oliver 1999). This conceptualization of loyalty as an attitude (Hallowell 1996) is similar to satisfaction in its involvement in purchase decision-making as described above. Loyalty differs from satisfaction in how it functions and when it is applied. As a commitment, loyalty indicates a preference for certain exchange

relationships over others. Thus, when there are alternatives available in a purchase decision, higher loyalty for a supplier will increase its likelihood for selection. When other factors, such as quality or price favor alternatives, loyalty can override these criteria in purchase decision-making. Thus, loyalty is valuable because it can strengthen the financial performance of a supplier. The rationale for loyal behavior is that the customer has some reason for wishing to continue a supplier relationship. For example, the supplier may have created goodwill in a past encounter by demonstrating a willingness to resolve problems expeditiously.

Loyalty can also increase as the customer experiences consistently favorable satisfaction in repeated exchange encounters (Storbacka et al. 1994). Their loyalty would reflect a desire to continue exchange in a similar manner. In particular, a customer may attribute their feelings of satisfaction to a computer-based system that is used to perform exchange with the supplier. Loyalty would reflect the customer's reluctance to forgo additional satisfactory experiences by switching to a less familiar and potentially less satisfactory supplier (Srinivasan and Ratchford 1991). The impact of customer satisfaction on purchase intentions and loyalty has been well documented in the literature (Oliver 1997; Ralston 1996; Zeithaml et al. 1996; Bolton and Drew 1991).

Understanding the impact from digital enablement of exchange on the bottom line is of primary importance for practitioners. Having an estimate of the expected return from initiatives such as developing improvements to customer facing information systems allows executives to allocate resources among alternative organizational activities in an optimal fashion. Including measures of revenue in the empirical test of the hypothesized model for this study permits quantification of the relationships in the chain of effects from digital enablement of exchange to customer

outcomes, which would provide the ability to estimate expected return. Given the discussion above, we confirm this relationship by testing the following hypothesis:

Hypothesis 1 (H1): Higher customer satisfaction is associated with more favorable customer outcomes.

Since customer satisfaction results from a customer's evaluation of past exchange encounters (Anderson et al. 1997), the nature or quality of this exchange will be a factor in its success. Customer perception of exchange service quality has been established as an antecedent to customer satisfaction (Cronin and Taylor 1992), where service quality can be framed as a belief about how service is delivered (Olsen 2002). When exchange is digitally enabled, however, then a customer's experience of digital activities will be distinct from their experience with physical activities. Correspondingly, we focus on characteristics of service quality that are specific to the supplier's information system.

When the digital aspect of service quality is examined through the lens of the information systems success framework (DeLone and McLean 2003), two constructs that provide elaboration are identified. System quality and information quality are conceptualized within this framework to describe desired characteristics of an information system related to its use. Just as service quality is framed as a belief about service delivery (Olsen 2002), system quality and information quality can also be framed as beliefs about the underlying information system (Wixom and Todd 2005). Thus, these quality constructs are conceptually consistent.

System quality.

System quality is defined as a customer's belief about how information is processed and

delivered during digitally enabled exchange (Wixom and Todd 2005; Shih 2004; Pitt et al. 1995). Experience with a system will affect attitudes toward that system (Negash et al. 2003). This effect on attitudes will occur because of the resulting beliefs about what capabilities are available and what outcomes are possible with the system (Kraut et al. 1989). System quality includes elements such as ease of use. When a system is easier for the customer to use, it requires less effort or sacrifice. Thus as increasing system quality reduces the sacrifice or cost required from a customer, this will result in feelings of greater satisfaction.

Hypothesis 2 (H2): Higher system quality is associated with higher customer satisfaction.

Information quality.

Information quality is defined as a belief about the output provided by a supplier's information system (Wixom and Todd 2005; Shih 2004; Pitt et al. 1995). Given that the information provided by a system is valuable to a customer, its potential value may be reduced if it is of poor quality (Ballou et al. 1998). Higher information quality indicates that the customer finds the information system output to be more desirable because it is more useful and thus more valuable. When information quality increases, this causes the perceived value received to increase, resulting in feelings of greater satisfaction.

Hypothesis 3 (H3): Higher information quality is associated with higher customer satisfaction.

Included in the above discussion regarding the effects on customer satisfaction from system quality and information quality is the assumption that customers utilize the information system of interest. It is argued that customers are able to form beliefs about system quality and

information quality based on their experiences with the system and its output. These beliefs affect customer satisfaction which leads to firm benefits. In the DeLone and McLean (2003) model, system use mediates between system quality and net benefits as well as between information quality and net benefits. Thus, system use would be expected to play a role in this model. However, variance of system use is also expected to diminish in exchange contexts where there is full operational dependence on the system of interest. To account for this expectation, we show system dependence in the model as a control with a fixed value of 100%. We find general support for this assumption in the empirical data for this study. Because system dependence is expected to be high and variance in system use will be limited, system use is not theorized in this study.

Moderators.

Relationship duration. The duration of a buyer-supplier relationship describes the period of time during which two firms have been doing business continuously (Kotabe et al. 2003).

Relationship duration can be influenced by extrinsic factors such as the market structure in which the relationship exists, and by intrinsic factors such as the handling of critical episodes (Storbacka et al. 1994). Some researchers have identified distinct phases that characterize relationships of different duration, such as “exploration, buildup, maturity, and decline” (Jap and Ganesan 2000). Others have examined how interorganizational relationships evolve through repeated sequences of “negotiation, commitment, and execution stages” (Ring and Van de Ven 1994). Time and repeated transactions provide opportunities for business partners to learn from each other. Given the opportunity and potential benefits, firms are expected to adapt organizational structures and routines when this improves performance. Value in a longer

duration buyer-supplier relationship arises from the development of mutual knowledge of partners' capabilities and routines, trust between partners, and relationship-specific routines for coordination of activities (Hoetker et al. 2007). Disincentives to adaptation include barriers such as investment cost, conflict with existing processes, and risks of higher switching costs. Also, the potential benefit may be limited if, for example, the frequency of exchange is low. In particular, investment in system and process integration between partners offers potentially significant benefits but also requires significant investment.

On average, we would expect potential differences in the nature of a buyer-supplier relationship based on its duration. Longer duration relationships are more likely to have established routines and structures compared to those of shorter duration (Biehl et al. 2006). Buyer-supplier relationships of longer duration are generally characterized by higher perceived switching costs because of “learned procedures, established norms, personal relationships, and other transaction-specific investments” (Liu et al. 2005a).

We expect that when there is adaptation in a buyer-supplier relationship, then the customer will have a heightened sensitivity to variations in supplier service quality levels. Because the customer has a closer connection to supplier fulfillment processes, there is more likely to be an increased awareness of process characteristics. Thus, when supplier service performance improves, the customer will benefit more and be more aware of the value gain. Similarly, when supplier service performance degrades, customers that are more closely attuned to supplier performance will be more attentive to the shortfall in benefits.

Hypothesis 4a (H4a): The observed relationship between system quality and customer

satisfaction is strengthened on average for longer duration buyer-supplier relationships.

Hypothesis 4b (H4b): The observed relationship between information quality and customer satisfaction is strengthened on average for longer duration buyer-supplier relationships.

Customer dependence. Customer dependence is defined as the extent to which a customer needs to maintain their buyer-supplier relationship to achieve desired goals (Ganesan 1994).

Dependence is a powerful concept that explains organizational decision-making and behavior in very fundamental terms. When a customer has high dependence in a relationship, then they also have strong motivation to continue conducting exchange, even when there are disadvantages involved. In contrast, when a customer has low dependence in a buyer-supplier relationship, they would be expected to easily switch to a different supplier that offers more favorable value.

Dependence can originate from constraints external or internal to the firm. Both types of constraints assume that the customer's need is critical to firm performance. External constraints include limited choices for alternative suppliers or few substitute solutions that can fulfill the customer's needs. Internal constraints include investments that have been dedicated to the buyer-supplier relationship and that would be difficult to redeploy elsewhere. Integration of systems and processes to those of a supplier firm often require significant investment of organizational resources that would be difficult to redeploy. A supplier may also use adaptations to create dependence by making alternatives more costly for the customer (Cannon and Homburg 2001).

We expect that highly dependent customers will be more attentive to their relationship because any changes in service quality will have a greater impact on their own operations. In contrast, a

less dependent customer will receive a level of service quality that derives from a combination of sources. Changes in service quality from any one source will be buffered by the other sources. Thus, a less dependent customer will be less sensitive to incremental changes in service characteristics compared to more dependent customers.

Hypothesis 5a (H5a): The relationship between system quality and customer satisfaction is strengthened when customer dependence is increased.

Hypothesis 5b (H5b): The relationship between information quality and customer satisfaction is strengthened when customer dependence is increased.

Controls.

Additional factors are identified in this study, which are expected to influence the customer's satisfaction response.

Logistics service quality. Logistics service quality is the customer evaluation of a supplier's performance for non-digital activities (Parasuraman et al. 1985). The SERVQUAL model, first developed by Parasuraman et al. (1988) has been widely tested as a means of measuring customer perceptions of service quality. The SERVQUAL model contains five dimensions, namely tangibles, reliability, responsiveness, assurance and empathy. The SERVQUAL model has been tested for measuring service quality in e-commerce settings (e.g. Lee and Lin 2005). However, research that examines service quality across different industries suggests that the importance of the various components of service quality will change in different contexts (Cronin and Taylor 1992). It is widely accepted in the literature that when a customer's cognitive evaluation of service quality results in a positive perception, this will improve the customer's

feeling of satisfaction (Olorunniwo et al. 2006). A key reason why service quality affects customer satisfaction is because of its close connection with perceived value (McDougall and Levesque 2000).

IT support quality. The quality of services that are provided by a support staff to the users of an information system have been identified as an additional factor that contribute to its success (DeLone and McLean 2003). In the literature, this construct is frequently referred to as “IS service quality” (e.g., Pitt et al. 1995) or “IT service quality” (e.g., Jia et al. 2008). To distinguish these support services from the core logistics services provided in the exchange relationship, this study will refer to “IT support quality” as a customer's perception regarding quality of services provided by the vendor to assist the customer in their use of the vendor's information system.

Relationship support quality. Relationship support quality is defined as a customer's perception regarding the ability of the supplier's representative in meeting the customer's needs. Customer contact is recognized as an important component of services (Chase 1981). In particular, the quality of the interaction between a customer and a service provider's representatives are known to influence relationship outcomes such as customer satisfaction (Crosby et al. 1990; Bearden et al. 1998).

Customer Firm Size. Customer firm size is used as a proxy for the complexity of the firm's business activities. Size is one of the most important factors affecting the structure and processes of an organization (Damanpour 1996). For example, customer firms of different size would be expected to manage their information systems utilization differently (DeLone 1981). The computational complexity of certain organizational tasks grows exponentially with the size of the

task (Moldoveanu and Bauer 2004). Thus, two firms of different size and complexity will have different needs in their outsourcing relationships for similar tasks. Addressing the difference in their needs may require more than simply scaling the volume of services provided. In particular, their satisfaction with the same level of quality may differ because of their difference in task requirements.

Industry. The concept of “industry” is widely used to refer to groups of firms that provide similar products and/or services (Clarke 1989). For example, the Financial Accounting Standards Board defines an industry segment as “a component of an enterprise engaged in providing a product or service, or a group of related products or services primarily to unaffiliated customers (i.e., customers outside the enterprise) for a profit” (Lang and Stulz 1994). Included in this definition is the notion of “activities of establishments” or what is carried on at a location by a controlling ownership. (Nightingale 1978). Furthermore, this definition includes the expectation that firms in the same industry use similar business processes to produce goods or services (U.S. Census Bureau 2001). This definition of industry based on similarity of business processes suggests that firms within the same industry that engage in digitally enabled exchange will have similar usage patterns. In contrast, firms from different industries that utilize dissimilar business processes in digitally enabled exchange are expected to exhibit more heterogeneity in outcomes, such as their satisfaction response.

System dependence. System dependence is defined as the degree to which a customer needs to use the supplier's information system to perform transactions. As discussed previously, variance of system use is expected to diminish in exchange contexts where there is full operational dependence on the system of interest.

Chapter 3 Empirical Study

Section 1. Method

This study seeks to extend existing information systems theory by evaluating hypotheses in a business-to-business exchange context and by examining potential mediating and moderating factors. To facilitate comparison with published findings in the information systems literature, it is helpful to adopt a positivist method paradigm since most prior studies have followed a similar approach (Orlikowski and Baroudi 1991). Refinement of the findings from this study would be obtained by examining digital enablement of business-to-business exchange through a complementary paradigmatic lens. A number of alternative methodological approaches exist that would be expected to enrich the findings from this study. Paradigmatic diversity in the information systems field has nurtured a wide array of ontological perspectives with accompanying epistemological approaches (Robey 1996).

Research Context.

The logistics services industry was chosen to provide an empirical context for this study. In this subsection, we discuss the suitability of this context for investigating the articulated research questions. In particular, we find that the economic importance of and heterogeneity among business-to-business exchange relationships in this industry provide a rich context for examining a broad range of customer behaviors. In addition, the information intensive nature of logistics service processes increases the salience for digital enablement of business-to-business exchange thereby improving our ability to test the hypotheses developed in the previous chapter.

Context can be viewed as “situational opportunities and constraints” (Johns 2006) that influence organizational behavior. Since contextual factors are considered to be common across a population of interest, it can be helpful to conceptualize context at a higher level of analysis. Industry characteristics, for example, can function as contextual factors for its member firms. Another sense of context is that it can affect the salience of characteristic factors. The style of an individual's clothing, for example, can have more importance in a business context compared to a non-business context. Specifying a context can define the stakeholders, goals, and focus of attention for a phenomenon. In this study, we seek to contextualize the information systems success model (DeLone and McLean 1992, DeLone and McLean 2003) within digitally enabled buyer-supplier relationships by adopting a customer centric view. We examined a population of such relationships for logistics services. It is important to identify the context of a study and any potentially influential contextual factors so that the study results may be compared with related research in different contexts. In this study, exchange relationships in the logistics industry were selected because they are expected to exhibit behaviors that are responsive to differences in informational capabilities.

The logistics services industry is a relatively new market, having formed over the past thirty years. The first major logistics services providers emerged in the 1980s as an extension of the traditional transportation function in firms (Hertz and Alfredsson 2003). Customers were interested in decreasing their transportation costs and were attracted to the opportunity for reducing their investment in the physical assets needed to perform the transportation function. Deregulation of the trucking industry in the 1990s provided a further stimulus to this market by creating a situation that prompted many smaller firms to enter the industry as service providers

(Johnson and Schneider 1995). More recently, the scope of services offered by providers has broadened as customers grow increasingly interested in supply chain management practices and in coordinating their international operations.

Logistics services include the physical movement of materials across potentially large distances for delivery at a desired date and location. For the service provider, cost efficient performance of logistics activities requires careful attention to details such as material dimensions, weight, travel time, and total volume of material flow. Coordination of this material flow with available transport facilities is aided by a corresponding flow of information that is used to direct activities at critical decision points. The information critical nature of this activity creates significant opportunities for performance improvement by utilizing information systems. For most firms, the logistics function draws attention because of its economic impact. Worldwide revenue for third party logistics services is estimated to have been \$370 billion, one third of which was spent in North America (Coyle et al. 2009).

Larger logistics service providers seek to grow their market share and profitability by providing more sophisticated logistics capabilities that can create strategic value for customers. One way for established firms to grow market share is through acquisition of smaller competitors. Firms with significant resources are better able to invest in technologies such as information systems to provide superior capabilities for customers. However, customers are often reluctant to commit resources to a specific relationship when this will increase dependence on a single vendor (Son et al. 2005). In the logistics services industry, customers have been slow to adopt vendor-provided information systems (Selviaridis and Spring 2007).

Because logistics management is used across a broad range of industries, the population of customers for logistics services exhibits heterogeneity in a number of dimensions such as the importance of logistics services, the types of business processes that are linked to logistics, and the patterns of buying behaviors that are followed. The importance of logistics services for customers depends on a variety of factors such as its relative cost compared to other business activities, the extent to which internal logistics capabilities are utilized compared to outsourced services, and the degree to which logistics impacts firm performance. Variations in these and other factors across and within industries create a rich context in which customer needs are developed. The automobile manufacturing industry, for example, is a heavy user of logistics services. Many automotive components are produced by partner firms and must be delivered for assembly. In addition to the weight of these components, the timing of their delivery is a factor in maintaining successful logistics performance, particularly when requirements of just-in-time processes increase sensitivity to schedule fluctuations.

Thus, customer decision-making for procurement of logistics services is influenced by a number of different factors that vary depending on the customer's industrial context. In addition, the importance of logistics both for cost and strategic reasons can draw management attention, raising the level of scrutiny on logistics related activities. This scrutiny is reflected in the focus on service quality and customer satisfaction that is prevalent in services industries such as this one. Since many repeat transactions are typical of transportation and logistics services, customers are apt to develop a heightened awareness of strengths and weaknesses in their exchange relationships with logistics services vendors.

The information intensive nature of logistics creates opportunity for customers to benefit from

digital enablement of logistics services. Since physical aspects of logistics activities requires tracking large volumes of detailed information such as size, weight, distance, and time, the challenge of cost effectively maintaining high levels of service quality increases as the volume of activity grows. This is an appropriate application for information systems as modern information technologies are particularly well suited to overcoming distance related challenges of monitoring and control. As a result, coordination capabilities obtained from advanced logistics systems have emerged to support market demand for increased product variety and faster order lead times (Lewis and Talalayevsky 1997).

The logistics industry provides a context in which widespread use of inter-firm informational exchange has demonstrated the potential for value creation from information technology deployment. However, inconsistent performance outcomes show that there remains much to be understood about the connection between information technology capability and organizational success (Closs et al. 1997). Both strategy and structure of the logistics function for firms are directly influenced by information technology capabilities (Bowersox and Daugherty 1995). In practice, there is a wide diversity of logistics capability and corresponding performance among firms (Closs and Xu 2000). For many firms, traditional standardized logistics practices provide a level of cost and service quality that is less than ideal in customer segments that have specialized needs such as lower cost or superior service (Fuller et al. 1993).

In summary, the logistics services industry provides an empirical context that is appropriate for testing the hypotheses developed in this study. Applicability of logistics across a broad range of industries provides a rich context in which heterogeneity of exchange relationships may be observed. Greater variance in customer characteristics improves our ability to observe

phenomena. In addition, high information intensity of logistics business processes increases the salience for digital enablement of business-to-business exchange as a factor in relationship performance.

Data Sources.

The empirical data for this study were obtained by combining measures from two different types of archival sources. The use of multiple data sources can reduce the likelihood of problems stemming from common methods bias (Podsakoff et al. 2003). One data source, based on survey methodology, provided subjective measures such as customer satisfaction, loyalty, and perceived service quality. Another data source, based on operational records, provided objective measures such as customer use of information systems, duration of relationship, system configuration, and industry. Combining subjective and objective measures for each exchange relationship in the data sample created a means for examining the influence of digitally enabled exchange on customer perceptions and attitudes. We also expected that including objective measures of system use would improve validity of the empirical results. It has been shown that subjective measures of system use tend to produce inflated values compared to measures of actual use (Straub et al. 1995).

Subjective measures for customer perceptions and attitudes in the context of their exchange relationship were based on a standardized practitioner survey. The logistics services vendor that provided the field site for this study sponsors a periodic survey of firms in their target market. The survey is maintained and administered by a professional service that specializes in performing market surveys. This third party randomly selected customer firms from target

market segments to obtain a survey response that is representative of the overall population of potential business customers for logistics services. Target market segments were defined by geographic location within the United States and by volume of logistics services used. Responses were obtained from customers surveyed in four separate collection efforts between January 2004 and July 2006. Respondents at the selected firms answered questions that were provided via telephone by interviewers who followed predefined scripts. Customers that provided survey responses represented the diversity of firms that outsource logistics services. Firms that shipped fewer than one package per week were excluded from the survey. Informants at each firm were also qualified during the survey interview to include only those with sufficient responsibility and thus knowledgeable enough to provide the requested evaluation.

Objective data were drawn from a data warehouse that archived operational records of all customer activity for the logistics services vendor that provided the field site for this study. Thus, objective measures were available for the full population of customers in exchange relationships with the seller focal firm. Customers below a minimum level of activity were excluded from the study to maintain our focus on business-to-business exchange relationships. Information about customer use of computer-based systems provided by the logistics services vendor was obtained as annual aggregate values for 2003 and 2004. In addition, we obtained a record of which vendor-provided systems were implemented by each customer as of the end of 2006. Other related information such as relationship duration, revenue, industry, and vendor-provided support was also obtained from the data warehouse.

The objective data were organized according to the physical location from which each customer transaction was originated. This reflects the importance of physical requirements for logistics

services. Larger customers usually originated logistics services from multiple operational locations. It is often the case that different operational locations for the same firm will emphasize different types of logistics services and utilize vendor-provided information systems in different configurations. For example, a customer location with more intense physical operations is more likely to integrate internal systems with the vendor's system to streamline exchange of transactional information. Given the importance of physical location, the unit of analysis for this study was defined as an exchange relationship between the logistics service vendor and a customer location that originates transactions. It was appropriate to define the unit of analysis in this way to allow for potential differences in utilization of, experience with, and reaction to digital enablement of exchange among different customer locations.

Subjective and objective data sources were combined for each business customer location that provided a survey response. Table 3 presents a summary of customer profile characteristics for the combined data sets that were selected for analysis. Data were obtained for exchange relationships with customers in the manufacturing industry and in the wholesale trade industry, two industry contexts that have a high need for logistics services. Customer survey responses that were excluded from the matched sample represented firms that originated less than a minimum volume of transactions and thus would not be expected to exhibit observable effects from digital enablement.

Instrument Development

In this investigation, an instrument developed by practitioners for assessing service quality was adapted and validated for theory testing. Because this research seeks to extend elements from the

information systems success theory (DeLone and McLean 1992, DeLone and McLean 2003) into the business-to-business exchange context where there has been little prior theory testing, it is important that measures are truly representative of the target domain. Thus, in addition to employing measures that are documented in the literature as representative for the study constructs and appropriate for the empirical context, Q-Sorting methodology (Stephenson 1953, Moore and Benbasat 1991) and subject matter expert review provided further assessment of content validity.

Description	Minimum	Median	Mean	Maximum	Number of Customer Locations	Industry
Number of employees at location	1 1	40 15	182 32	15000 500	259 220	Manufacturing Wholesale Trade
Total customer revenue (\$1000s)	1.9 1.1	43 49	75 79	1907 1099	267 220	Manufacturing Wholesale Trade
Avg. # of packages shipped per week	3.5 0.6	70 110	134 195	4071 3679	267 220	Manufacturing Wholesale Trade
Duration of relationship (years)	1.1 1.5	12.2 12.2	12.2 11.8	22.1 22.1	133 121	Manufacturing Wholesale Trade

Table 3. Sample Profiles for Exchange Relationships with Customers (Manufacturing Industry and Wholesale Trade Industry)

Q-Sorting is a method for evaluating item wording by asking participants to identify the context or domain that is appropriate for each item. Comparison of responses from multiple participants is used to confirm the appropriateness of an item for the target domain and to identify problematic items. A two-stage exercise was employed to generate evaluations of content validity for construct items and subconstructs into which the items were categorized. In the first stage, participants performed an unstructured Q-sort to provide validation of subconstructs. In the second stage, participants performed a structured Q-sort to provide validation for individual items and their categorization into subconstructs. The procedure that was employed in this study

is one that has been used by previous information systems researchers (Kankanhalli et al. 2005; Moore and Benbasat 1991) for obtaining conceptual validation of instrumentation in studies of organizational information technologies. It is a variation of the Q-sort methodology (Stephenson 1953), which was originally developed to investigate subjectivity in studies of human behavior.

Preliminary assessment of the original survey instrument indicated that evaluation of measure items using a procedure such as Q-sorting would be appropriate to improve the validity of measures for empirical testing of the research model. The customer survey had been developed by the focal vendor of this study and administered for business purposes every six months for two years. It was designed to assess customer perceptions of shipping service quality using 63 performance-based items of evaluation. Although the original instrument groups these items into 19 subcategories of service quality, an exploratory principal components analysis indicated that a smaller number of factors based on these items would be more appropriate to provide a reliable representation of perceived service quality. Through the Q-sorting procedure, thirty items (48% of the original set) were identified as appropriate components for six subconstruct categories based on inter-rater agreement.

Through this exercise, ambiguity was indicated for a subset of the subconstructs and construct items in the proposed operationalization of shipping service quality. Three possible reasons for this ambiguity are conceptual overlap, specialized language, and task difficulty. Conceptual overlap may exist between some of the subconstructs and between some of the individual construct items. Two of the original categories, for example, that appear to be conceptually similar are “Rate Negotiation” and “Value.” In the structured Q-sort exercise, participants reported difficulty with the “Delivery Services” category. Of the original 63 items examined in

this exercise, 52% were categorized inconsistently by more than half of the respondents. Because the original items in the instrument were developed by practitioners and designed for use with shipping services customers, there may be some domain specific language with specialized meaning included in the item wording. For example, respondents commented that they were not sure of the meaning for “delivery services,” “price guarantee,” and “adjustment to bills.”

Customers who have more experience with shipping services may share a commonly understood definition for these terms. In addition, business customers with higher volume requirements may perform different exchange activities with shipping vendors compared to private consumers.

Finally, difficulty of the Q-sorting task may have limited the ability of participants to fully conceptualize items and categories, especially in the unstructured phase. In addition to confusion caused by conceptual overlap in items and categories, participants may have been limited by their ability to fully comprehend the number of categories and items presented to them. One participant in the unstructured phase commented that they could have spent “all day” rearranging their grouping of items into categories.

Seven subject matter experts for the business-to-business exchange context were also recruited to review items for their appropriateness. Each participant first evaluated items independently from the other participants. Subsequently, the participants met as a group to discuss items that received differing evaluations in order to reach a consensus on item appropriateness. With these procedures providing assurance of content validity for the measurement items in the target domain, we can maintain high confidence that representation of the business-to-business exchange context was achieved. Table 4 provides a list of the final set of constructs and their corresponding measurement items from the survey instrument.

<p>Construct/Items</p> <p>Customer Satisfaction:</p> <ul style="list-style-type: none"> • SAT1: Still thinking about shipping within the U.S., I will ask you to rate your overall satisfaction with your small package shipping companies, considering everything. On a scale from 0 to 100, where 0 means you are “not at all satisfied,” and 100 means you are “completely satisfied,” how satisfied are you with vendor? • SAT2: Considering all the topics we covered, I will ask you again about your overall satisfaction with vendor's domestic shipping. This time we will use a scale where '0' means “not at all satisfied,” and '100' means “completely satisfied.” Overall, how satisfied are you with vendor? • SAT3: Please use a 1-10 scale, where '1' means 'Much worse than expected', and '10' means 'Much better than expected'. Compared to your expectations, what score would you give based on your experiences with vendor?
<p>Customer Outcome</p> <p>Customer Loyalty:</p> <ul style="list-style-type: none"> • LOY1: On a scale where '1' means “not at all loyal” and '10' means “completely loyal,” please rate how loyal you are to vendor. • LOY2: On a scale where '1' means “completely disagree,” and '10' means “completely agree” please rate this statement: “I am comfortable enough with vendor that I do not seriously consider offers from other shipping companies.”
<p>IT Specific Characteristics of B2B Service Quality</p> <p>System Quality (Please use a scale from 1 to 10 where 10 means "excellent performance" and 1 means "terrible performance."):</p> <ul style="list-style-type: none"> • SQ1: Regarding ease of use, please rate vendor on easy-to-follow shipping procedures • SQ2: Please rate vendor on providing easy-to-use shipping applications <p>Information Quality (Please use a scale from 1 to 10 where 10 means "excellent performance" and 1 means "terrible performance."):</p> <ul style="list-style-type: none"> • IQ1: Regarding shipment tracking, please rate vendor on providing information quickly • IQ2: Regarding shipment tracking, please rate vendor on providing information accurately • IQ3: Regarding transit information, please rate vendor on providing accurate information about shipments in transit • IQ4: Regarding transit information, please rate vendor on providing information quickly
<p>Controls</p> <p><i>Logistics Service Quality</i></p> <p>Operational Flexibility (Please use a scale from 1 to 10 where 10 means "excellent performance" and 1 means "terrible performance."):</p> <ul style="list-style-type: none"> • OF1: Regarding flexibility, please rate vendor on meeting your different requests • OF2: Regarding flexibility, please rate vendor on adapting its operations to your business

<p>needs</p> <ul style="list-style-type: none"> • OF3: Regarding pickup service, please rate vendor on adjusting pickup schedules to meet your needs
<p>Economic Value (Please use a scale from 1 to 10 where 10 means "excellent performance" and 1 means "terrible performance."):</p> <ul style="list-style-type: none"> • EV1: Considering the overall VALUE of using vendor, please rate it on providing quality shipping services worth the price • EV2: Considering the overall VALUE of using vendor, please rate it on providing competitive rates
<p>IT Support Quality (Please use a scale from 1 to 10 where 10 means "excellent performance" and 1 means "terrible performance."):</p> <ul style="list-style-type: none"> • Please rate vendor on servicing its shipping applications and hardware
<p>Relationship Support Quality (Please use a scale from 1 to 10 where 10 means "excellent performance" and 1 means "terrible performance."):</p> <ul style="list-style-type: none"> • RSUP1: Please rate your vendor Account Executive on being professional and courteous • RSUP2: Please rate your vendor Account Executive on being knowledgeable about your business • RSUP3: Please rate your vendor Account Executive on being available to you when needed • RSUP4: Please rate your vendor Account Executive on having authority to make immediate decisions

Table 4. Customer Survey Measurement Items

Measures

Table 5 provides a summary of measures employed for the research model constructs.

Measurement items for constructs were consistent with existing published measures.

Instrumentation included both reflective and formative construct measures (Jarvis et al. 2003;

Petter et al. 2007). Coding of system characteristics was performed in collaboration with subject

matter experts from private industry. Survey data were matched to operational data using

customer and location identifiers. In addition to subjective measures generated by survey

instrumentation, archival data from the service provider's operational records provided objective

measures for customer system characteristics, relationship duration, and other background

information.

Customer satisfaction was measured by asking the customer to rate their overall satisfaction and their satisfaction relative to expectations. These measures are widely used in scholarly studies of

Construct	Source	Type	Measure Definition
Customer Satisfaction	Customer survey	Reflective	2 items (0 to 100 scale) and 1 item (1 to 10 scale)
Customer Outcomes			
Customer Loyalty	Customer survey	Reflective	2 items (1 to 10 scale)
Customer Revenue	Archival	Single Item	Aggregate dollar value of customer transactions in 2006
IT Specific Characteristics of B2B Service Quality			
System Quality	Customer survey	Formative	2 items (1 to 10 scale)
Information Quality	Customer survey	Formative	4 items (1 to 10 scale)
Moderators			
Customer Dependence	Self-report	Single item	Percent of volume outsourced to focal supplier
Relationship Duration	Archival	Single item	Number of years since account was opened
Controls			
<i>Logistics Service Quality:</i> Operational Flexibility	Customer survey	Formative	3 items (1 to 10 scale)
Economic Value	Customer survey	Formative	2 items (1 to 10 scale)
IT Support Quality	Customer survey	Reflective	1 item (1 to 10 scale)
Relationship Support Quality	Customer survey	Reflective	4 items (1 to 10 scale)
Customer Firm Size	Archival Customer survey	Single item Single item	Number of employees at location Total customer spending on logistics services
Industry	Archival	Single item	4 digit SIC code
System Dependence	Archival	Single item	Percent of outsourced volume that is transacted digitally

Table 5. Measurement of Constructs

satisfaction (e.g., Gustafsson et al. 2005, Fornell et al. 1996). Overall satisfaction was assessed twice - once near the beginning of the survey and again near the end after assessing all service

quality measures.

Customer Outcomes. Customer-centric relationship outcome was assessed using a subjective measure of customer loyalty and an archival measure of customer revenue. The customer loyalty measure was similar to that used in previous studies (e.g., Zeithaml et al. 1996). It captured the customer's self-assessment of loyalty and the extent that they considered other vendors.

Customer revenue was obtained from the vendor's operational records as an annual aggregate dollar amount of customer transactions for 2006.

IT Specific Characteristics of B2B Service Quality. System quality and information quality were assessed with formative survey items similar to those used in previous studies (e.g., McKinney et al. 2002, Negash et al. 2003). System quality assessed ease of use for shipping procedures and for shipping applications. Information quality assessed timeliness and accuracy for shipment tracking and for transit information.

Moderators. For customer dependence, customers reported the percentage of their total shipping volume that was sourced with the focal vendor. Relationship duration was determined from the vendor's operational records by identifying the earliest creation date among all active accounts at each customer location.

Controls. Logistics service quality as perceived by business customers was assessed on two dimensions - flexibility and economic value. These aspects of service quality are frequently found in published studies and represent the most salient aspects of service quality for this context. All dimensions were assessed using multiple item formative indicators that asked informants to rate the vendor's performance on a scale from 1 to 10, where 1 represented

“terrible performance” and 10 represented “excellent performance”. Individual items for these dimensions are described in Table 8. Information technology support quality and relationship support quality were also assessed with survey items as described in Table 8. Customer firm size and industry were available from the vendor's archive of customer background information. The types of systems implemented at each customer location were also available from the vendor's archives. Finally, system dependence was calculated from the vendor's operational records, which recorded the volume of transactions originated from each customer location categorized by the type of information system used.

Transformations

Evaluation of measures in preparation for hypothesis testing included an assessment of their distributional properties. Several were found to differ substantially from the Gaussian normal distribution that is considered ideal for regression analysis. Specifically, the skewness and kurtosis of several measures differed by more than 1.0 from zero as shown in Table 6. These non-normal measure distributions were classified into two categories: broad ranged and left skewed.

Three measures - number of employees in the customer firm, customer revenue, and total customer spending - were classified as having broad ranged non-normal distributions. Each has data values that span at least four orders of magnitude. Values for the number of employees, for example, range from 1 to 15000, or four orders of magnitude. Furthermore, the frequency of smaller values predominate, resulting in right skewed distributions. These measures reflect the broad range of firm sizes that is typical of industry populations. Empirical studies of firm size in

Variable	Before Transformation				After Transformation				Distribution Characteristics	Transformation Applied
	Skewness		Kurtosis		Skewness		Kurtosis			
	M	W	M	W	M	W	M	W		
Customer Satisfaction	-1.6	-1.3	3.8	2.0	-0.3	-0.1	-0.6	-0.6	Skewed Rating	Reflected Log
Customer Outcomes										
Customer Loyalty	-1.7	-1.2	3.5	0.9	-0.4	-0.3	-0.7	-1.0	Skewed Rating	Reflected Log
Customer Revenue	2.5	4.0	7.7	22.5	-2.2	-0.8	8.2	1.7	Broad Range	Log
IT Specific Characteristics of B2B Service Quality										
System Quality	-2.7	-1.8	11.7	4.6	-0.8	-0.6	-0.1	-0.7	Skewed Rating	Reflected Log
Information Quality	-1.5	-1.5	2.7	3.4	-0.5	-0.4	-0.9	-0.9	Skewed Rating	Reflected Log
Moderators										
Customer Dependence	-1.3	-1.9	0.8	2.5	NA	NA	NA	NA	Satisfactory	None
Relationship Duration	0.1	-0.1	-1.2	-1.2	NA	NA	NA	NA	Satisfactory	None
Controls										
<i>Logistics Service Quality</i>										
Operational Flexibility	-1.6	-1.2	3.2	1.7	-0.3	-0.1	-0.9	-1.0	Skewed Rating	Reflected Log
Economic Value	-1.8	-1.1	5.2	1.0	-0.2	-0.1	-0.9	-1.1	Skewed Rating	Reflected Log
IT Support Quality	-2.5	-2.3	8.3	6.3	-1.0	-0.8	-0.1	-0.4	Skewed Rating	Reflected Log
Relationship Support Quality	-2.0	-1.4	5.4	1.5	-0.6	-0.4	-0.5	-0.8	Skewed Rating	Reflected Log
<i>Customer Firm Size</i>										
Number of Employees	13.5	5.3	199.1	33.4	-0.2	0.3	0.4	0.1	Broad Range	Log
Total Customer Spending	5.9	4.7	43.1	29.5	0.0	-0.6	0.0	1.2	Broad Range	Log

Table 6. Variable Transformations for Manufacturing Industry (M) and Wholesale Trade Industry (W) Samples

industry populations have found that their distribution can be modeled with a power function.

This distribution is theorized to result from a firm's differential ability to grow, which is proportional to their size. Econometric literature (Emerson and Strenio 1983) recommends using a logarithm function to transform broad ranged measure distributions into a form that is more

suitable for analysis procedures. The logarithm transform would also convert a power function into the gaussian normal form. For the three measures with broad ranged distribution of data values, a log transform provides satisfactory improvement to their distributional properties.

Eight measures were classified as left skewed non-normal distributions. All of these are based on customer survey items that asked respondents to rate various aspects of vendor performance using Likert type scales. More often than not, customers tended to rate vendor performance highly. For example, 29% of respondents rated the vendor's flexibility as 10 out of 10 and 53% rated the vendor's flexibility as 9 out of 10 or higher. Figure 3 also shows a histogram of satisfaction scores that illustrates this skew.

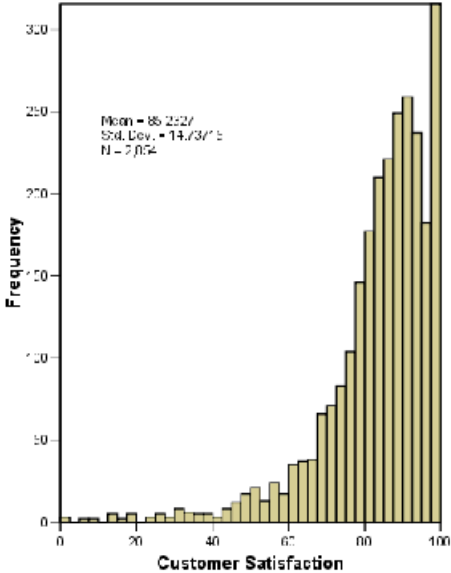


Figure 3. Skew in Customer Satisfaction Measure

This upward tendency in vendor ratings suggests that a large proportion of customers in the

survey sample considered many or all aspects of vendor performance to be excellent. Previous studies have found a similar tendency in customer satisfaction and performance survey ratings (Peterson and Wilson 1992). For example, when convenience retailer CVS implemented a process change that raised their customer satisfaction level by five percentage points, from 86% to 91%, it was viewed as a dramatic improvement to firm performance (McAfee and Brynjolfsson 2008). One explanation for this upward tendency is that when customer satisfaction decreases or when a customer feels that vendor performance is lower, then it is more likely that the customer will terminate their relationship with the vendor and exit the customer population. Another factor in customer ratings is the vendor's effort at meeting customer needs. The focal vendor in this study, like many firms, actively seeks to improve customer satisfaction and constantly strives to improve the quality of services provided to customers. A third possible explanation for higher customer survey ratings is that the survey sample may include a biased subset of customers compared to the total population. More satisfied customers, for example, may have been more willing to participate in the survey for this study. Because the survey data for this study were generated by a third party, assessment of response bias is not available. However, some assurance of survey response validity is obtained from the favorable reputation of this third party for providing professional survey services.

Econometrics literature (Emerson and Strenio 1983) recommends using a reflected logarithm function to transform left skewed measure distributions into a form that is more suitable for analysis procedures. Reflection is first necessary to reorient the data values into a right skewed distribution with a minimum value of one. After applying the logarithm function, a second reflection is used to restore the original data value sequence. Applying the logarithm function

increases desired separation between data values near the high end of the rating scales to facilitate analysis. As shown in Table 6, the reflected log transform satisfactorily improves the distributional properties of left skewed measures in this study for data values from exchange relationships with customers in the manufacturing industry. Similar improvement is obtained for data values from exchange relationships with customers in the wholesale trade industry.

Further evaluation of these measure transformations during regression analysis supported their role in improving the analysis results. Inspection of scatter plots presented in Figure 4 for standardized residuals and corresponding predicted model values showed evidence of heteroskedasticity when the transformations were omitted. Regression results were compared for analysis with no measure transformations, analysis with only the dependent variable (customer satisfaction) transformed, and analysis with all identified measure transformations. Only the analysis with all transformations exhibited the desired lack of heteroskedasticity.

Section 2. Analysis and Results

Examination of the research model in the selected empirical context provided partial support for hypotheses developed in this study. Post hoc analysis indicated the presence of additional mediating paths in the causal chain that relates quality characteristics of customer facing information systems to customer outcomes for the vendor firm. Robustness of the research model was also examined by testing the study hypotheses in two different customer industry contexts. Observations were obtained for exchange relationships with customers in the manufacturing industry and in the wholesale trade industry. Comparison of results between customers from these two different industries provided corroborating evidence to support the conceptual model

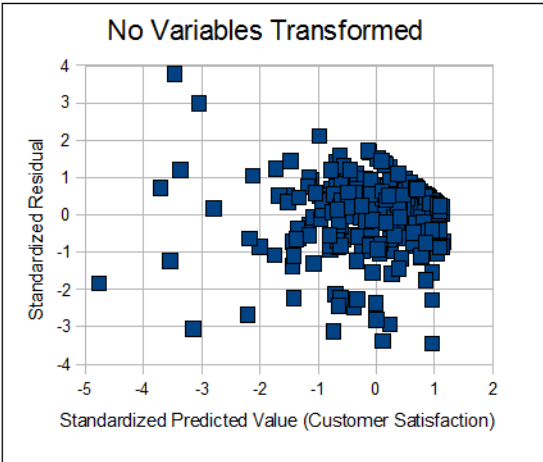
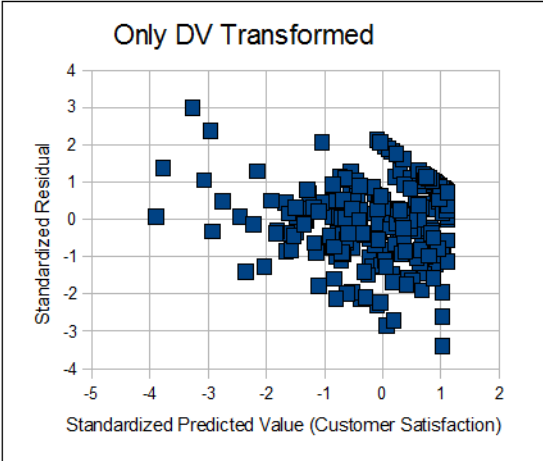
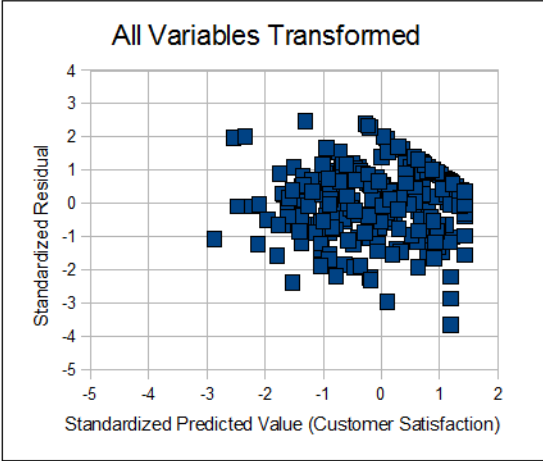


Figure 4. Measure Transformations Reduced Heteroskedasticity

with variations that are consistent with industry differences. In both industry contexts, the hypothesized chain of effects from system quality and information quality, through customer satisfaction to customer loyalty were found to be significant. In addition, the relationship between customer loyalty and customer revenue was found to be significant for exchange relationships with customers in the manufacturing industry.

Measurement Model Evaluation.

The starting point for empirical analysis is assessment of instrumentation validity. According to Straub et al. (2004), instrumentation validity is the first touchstone of empirical study validation upon which rests internal validity and statistical conclusion validity. Without confidence in instrumentation validity, other types of validity are moot and study conclusions are meaningless. Table 7 summarizes statistical properties of the study measures, including number of cases, mean, standard deviation, reliabilities, and square root of average variance extracted for the manufacturing industry and wholesale trade industry samples. All measures exhibit a range of values that reflect the expected heterogeneity of customers in this empirical context. All reliability assessments exceed the standard acceptable criteria of 0.70 for minimum Cronbach's α and for composite reliability. Although the standard reliability tests are not a criteria for validity of formative measures, in this study Cronbach's α for all formative measures also exceed 0.70, which indicates high internal consistency. In addition, square root of average variance extracted exceeds 0.707 for all measures. For reflective measures this indicates that the amount of variance captured is greater than variance due to measurement error (Straub et al. 2004).

Table 8 presents interconstruct correlations for data samples of exchange relationships with

Name	Manufacturing Industry						Wholesale Trade Industry					
	N	Mean	SD	α	CR	$\sqrt{\text{AVE}}$	N	Mean	SD	α	CR	$\sqrt{\text{AVE}}$
SAT	267	0.72	0.21	0.83	0.90	0.87	220	0.68	0.21	0.71	0.92	0.89
LOY	265	0.65	0.28	0.84	0.92	0.93	218	0.66	0.28	0.76	0.85	0.90
REV	264	4.59	0.71	NA ^a	NA ^a	1.00	216	4.68	0.53	NA ^a	NA ^a	1.00
SYSQ	266	0.80	0.21	0.83	NA ^b	0.90	220	0.78	0.23	0.83	NA ^b	0.90
INFQ	266	0.79	0.21	0.88	NA ^b	0.84	218	0.78	0.21	0.88	NA ^b	0.84
NEMP	259	1.61	0.67	NA ^a	NA ^a	1.00	220	1.19	0.49	NA ^a	NA ^a	1.00
SPND	267	4.62	0.68	NA ^a	NA ^a	1.00	220	4.79	0.60	NA ^a	NA ^a	1.00
DUR	133	12.2	6.18	NA ^a	NA ^a	1.00	121	11.8	7.39	NA ^a	NA ^a	1.00
DEP	267	79.5	25.7	NA ^a	NA ^a	1.00	220	84.3	25.2	NA ^a	NA ^a	1.00
FLEX	265	0.69	0.25	0.83	NA ^b	0.83	219	0.68	0.25	0.83	NA ^b	0.84
VALU	260	0.70	0.25	0.88	NA ^b	0.91	209	0.66	0.26	0.88	NA ^b	0.94
ISUP	226	0.80	0.26	NA ^a	NA ^a	1.00	181	0.77	0.27	NA ^a	NA ^a	1.00
RSUP	202	0.72	0.25	0.87	0.91	0.85	166	0.71	0.24	0.87	0.99	0.86

Table 7. Construct Means, Standard Deviations, and Reliabilities for Manufacturing and Wholesale Trade Industries

^aCronbach's α and Composite Reliability are not reported for constructs with single item measures

^bComposite Reliability is not reported for constructs with formative measures

Legend:	LOY	Customer Loyalty	DUR	Relationship Duration	
SD	Standard Deviation	REV	Customer Revenue	DEP	Customer Dependence
α	Cronbach's α	SYSQ	System Quality	FLEX	Operational Flexibility
CR	Composite Reliability	INFQ	Information Quality	VALU	Economic Value
$\sqrt{\text{AVE}}$	Sqrt of Average Variance Extracted	NEMP	Number of Employees	ISUP	IT Support Quality
SAT	Customer Satisfaction	SPND	Total Customer Spending	RSUP	Relationship Support Quality

customers from the manufacturing industry and from the wholesale trade industry. Correlations among the constructs show patterns that are similar between the two industry contexts. For example, correlation between customer satisfaction and customer loyalty is consistently high. Likewise, the two components of logistics service quality, operational flexibility and economic value, have a consistently high correlation with customer satisfaction. Assessment of

discriminant validity for the reflective measures may be obtained by comparing square root of average variance extracted from Table 7 with corresponding off-diagonal elements in Table 8 (Fornell and Larcker 1981). Since the square root of average variance extracted for all measures is greater than its corresponding interconstruct correlation coefficients, discriminant validity is supported. Table 9 presents factor loadings of measurement items on the study constructs obtained from confirmatory factor analysis using SmartPLS (Ringle et al. 2005). All items load much more strongly on their corresponding composite construct compared to other constructs. This result demonstrates convergent and discriminant validity of the measures (Straub et al. 2004). Thus, we can conclude that the measurement model is satisfactory. Another technique for assessing convergent and discriminant validity that can be applied to both reflective and formative measures is the examination of item-to-construct correlations (Loch et al. 2003, Keil et al. 2003). This procedure provides an evaluation that is similar to the multitrait-multimethod matrix (Campbell and Fiske 1959) validation process. Table 10 presents item-to-construct correlation coefficients for study measures using data values from exchange relationships with customers in the manufacturing industry and from exchange relationships with customers in the wholesale trade industry. All items correlate more strongly with their corresponding composite construct compared to other constructs. This result demonstrates convergent and discriminant validity providing further support of a satisfactory measurement model.

Overview of Analysis Procedure

Multiple regression analysis (Hair et al. 1998, Cohen and Cohen 1983) was employed to test the model hypotheses. Multiple regression analysis is appropriate for models with a single metric dependent variable and multiple independent variables. In addition, multiple regression analysis

is expected to facilitate evaluation of study hypotheses because of its ease of interpretation, robustness to violations of the underlying assumptions, and increased precision for larger sample sizes (Mason and Perreault 1991). Because standard regression analysis techniques assume a model structure that does not provide for endogenous variables, it was necessary to evaluate the study hypotheses as shown in Figure 2 by estimating model coefficients in steps. In each analysis step, all controls were included except for system utilization. Since system dependence is high for customers as discussed previously, system utilization is modeled as a constant unity value for all observations.

Name	SAT	LOY	REV	SYSQ	INFQ	NEMP	SPND	DUR	DEP	FLEX	VALU	ISUP	RSUP
SAT		0.76***	0.06	0.55***	0.50***	0.11	-.01	0.03	0.16*	0.69***	0.70***	0.53***	0.57***
LOY	0.68***		0.07	0.55***	0.50***	0.07	-.01	0.03	0.25***	0.59***	0.59***	0.51***	0.51***
REV	0.05	0.17**		0.02	0.03	0.13*	0.35***	-.07	0.06	0.05	0.00	0.00	0.12
SYSQ	0.63***	0.51***	0.06		0.67***	-.04	-.01	-.08	0.11	0.61***	0.59***	0.69***	0.53***
INFQ	0.60***	0.45***	-.07	0.63***		-.04	-.03	-.07	0.12+	0.58***	0.58***	0.49***	0.49***
NEMP	-.02	-.03	0.17*	-.09	-.04		0.31***	0.14+	-.05	0.00	0.02	-.14+	0.22**
SPND	0.02	0.03	0.39***	0.07	-.04	0.21***		0.02	-.14*	-.03	-.05	-.03	0.13
DUR	0.03	0.08	0.15+	0.10	0.04	0.10	-.02		0.15+	0.01	0.01	-.06	-.01
DEP	0.23***	0.26***	0.10	0.12+	0.12*	-.15*	-.08	-.09		0.12+	0.17*	0.09	0.10
FLEX	0.66***	0.55***	0.03	0.62***	0.61***	-.03	-.01	0.12	0.17**		0.63***	0.54***	0.57***
VALU	0.70***	0.61***	0.13*	0.63***	0.62***	-.08	0.02	0.12	0.18**	0.68***		0.43***	0.50***
ISUP	0.53***	0.43***	-.03	0.70***	0.53***	-.16*	-.10	0.11	0.11+	0.58***	0.49***		0.46***
RSUP	0.58***	0.49***	0.08	0.48***	0.55***	0.10	0.07	0.04	0.03	0.53***	0.53***	0.45***	

Table 8. Interconstruct Correlations for Manufacturing and Wholesale Trade Industries

*Correlation coefficients for manufacturing industry in lower left cells.
Correlation coefficients for wholesale trade industry in upper right cells.
+p<.10, *p<.05, **p<.01, ***p<.001*

Items	Factors													
	Customer Satisfaction (SAT)		Customer Loyalty (LOY)		System Quality (SYSQ)		Information Quality (INFQ)		Operational Flexibility (FLEX)		Economic Value (VALU)		Relationship Support Quality (RSUP)	
	M	W	M	W	M	W	M	W	M	W	M	W	M	W
SAT1	0.82	0.86	0.47	0.68	0.48	0.53	0.27	0.46	0.41	0.66	0.62	0.67	0.25	0.29
SAT2	0.89	0.87	0.58	0.63	0.54	0.38	0.40	0.34	0.55	0.50	0.60	0.55	0.44	0.43
SAT3	0.89	0.92	0.68	0.00	0.57	0.41	0.51	0.34	0.64	0.57	0.64	0.67	0.46	0.58
LOY1	0.61	0.66	0.93	0.90	0.47	0.39	0.35	0.33	0.53	0.47	0.57	0.49	0.41	0.37
LOY2	0.64	0.68	0.92	0.91	0.43	0.48	0.30	0.45	0.49	0.60	0.52	0.59	0.35	0.48
SYSQ1	0.61	0.40	0.50	0.37	0.97	0.83	0.50	0.48	0.56	0.53	0.58	0.45	0.39	0.37
SYSQ2	0.48	0.49	0.34	0.48	0.82	0.96	0.49	0.60	0.49	0.55	0.52	0.58	0.27	0.38
INFQ1	0.43	0.32	0.30	0.32	0.46	0.42	0.83	0.68	0.43	0.39	0.41	0.38	0.34	0.30
INFQ2	0.40	0.34	0.32	0.36	0.44	0.49	0.84	0.82	0.44	0.44	0.40	0.48	0.32	0.31
INFQ3	0.37	0.43	0.31	0.39	0.50	0.60	0.90	0.94	0.46	0.52	0.45	0.53	0.38	0.34
INFQ4	0.43	0.38	0.30	0.42	0.46	0.53	0.89	0.90	0.46	0.49	0.43	0.52	0.37	0.32
FLEX1	0.61	0.62	0.53	0.56	0.54	0.51	0.48	0.45	0.95	0.90	0.62	0.59	0.53	0.54
FLEX2	0.60	0.61	0.52	0.55	0.54	0.59	0.48	0.55	0.94	0.96	0.62	0.65	0.48	0.44
FLEX3	0.35	0.39	0.33	0.35	0.43	0.40	0.39	0.33	0.65	0.62	0.41	0.43	0.29	0.37
VALU1	0.69	0.62	0.56	0.58	0.55	0.54	0.48	0.55	0.60	0.62	0.95	0.91	0.40	0.43
VALU2	0.63	0.71	0.53	0.56	0.60	0.56	0.43	0.54	0.62	0.64	0.92	0.96	0.42	0.44
RSUP1	0.38	0.38	0.35	0.42	0.31	0.39	0.35	0.33	0.48	0.45	0.35	0.36	0.83	0.82
RSUP2	0.37	0.39	0.28	0.40	0.28	0.39	0.30	0.36	0.40	0.49	0.38	0.38	0.84	0.88
RSUP3	0.42	0.42	0.38	0.37	0.36	0.31	0.35	0.23	0.46	0.39	0.39	0.35	0.89	0.86
RSUP4	0.36	0.50	0.40	0.45	0.35	0.35	0.40	0.34	0.43	0.51	0.36	0.50	0.84	0.90

**Table 9. Factor Loadings
for Manufacturing (M) and Wholesale Trade (W) Industries**

To integrate the findings obtained from regression analysis, mediation analysis (Preacher and Hayes 2008, Baron and Kenny 1986) was also performed. Mediation analysis provides a method for evaluating the path structure of the research model by examining the role of intervening factors in the hypothesized chain of effects from quality characteristics of information system to customer revenue. For example, since customer loyalty is modeled as an outcome from customer

Items	Constructs													
	Customer Satisfaction (SAT)		Customer Loyalty (LOY)		System Quality (SYSQ)		Information Quality (INFQ)		Operational Flexibility (FLEX)		Economic Value (VALU)		Relationship Support Quality (RSUP)	
	M	W	M	W	M	W	M	W	M	W	M	W	M	W
SAT1	0.70	0.73	0.44	0.61	0.45	0.37	0.27	0.31	0.38	0.44	0.50	0.55	0.36	0.28
SAT2	0.78	0.81	0.56	0.64	0.53	0.42	0.41	0.35	0.53	0.53	0.57	0.61	0.47	0.43
SAT3	0.93	0.92	0.67	0.68	0.58	0.54	0.54	0.49	0.63	0.64	0.64	0.63	0.55	0.60
LOY1	0.59	0.65	0.85	0.84	0.44	0.42	0.35	0.36	0.49	0.43	0.56	0.45	0.46	0.40
LOY2	0.61	0.66	0.89	0.89	0.42	0.49	0.31	0.44	0.46	0.55	0.48	0.57	0.43	0.51
SYSQ1	0.59	0.50	0.51	0.52	0.89	0.91	0.52	0.60	0.57	0.52	0.56	0.55	0.49	0.42
SYSQ2	0.52	0.46	0.41	0.45	0.84	0.89	0.53	0.56	0.54	0.57	0.56	0.50	0.37	0.49
INFQ1	0.54	0.40	0.40	0.40	0.54	0.52	0.85	0.81	0.52	0.44	0.52	0.49	0.45	0.35
INFQ2	0.49	0.38	0.40	0.37	0.51	0.44	0.84	0.82	0.49	0.40	0.49	0.38	0.44	0.39
INFQ3	0.45	0.46	0.36	0.44	0.54	0.62	0.85	0.88	0.50	0.50	0.51	0.53	0.48	0.41
INFQ4	0.51	0.41	0.37	0.46	0.52	0.55	0.86	0.84	0.53	0.47	0.53	0.52	0.47	0.37
FLEX1	0.63	0.62	0.54	0.58	0.58	0.59	0.50	0.59	0.86	0.86	0.62	0.63	0.53	0.54
FLEX2	0.63	0.62	0.53	0.56	0.56	0.51	0.50	0.46	0.87	0.86	0.62	0.54	0.49	0.47
FLEX3	0.40	0.47	0.34	0.36	0.39	0.43	0.40	0.41	0.73	0.76	0.42	0.45	0.34	0.44
VALU1	0.67	0.71	0.57	0.59	0.59	0.57	0.50	0.55	0.62	0.61	0.88	0.92	0.46	0.48
VALU2	0.62	0.63	0.55	0.59	0.57	0.56	0.47	0.53	0.60	0.59	0.89	0.89	0.49	0.46
RSUP1	0.45	0.46	0.38	0.47	0.45	0.52	0.41	0.45	0.48	0.48	0.40	0.40	0.70	0.76
RSUP2	0.38	0.49	0.33	0.45	0.31	0.48	0.35	0.45	0.40	0.52	0.37	0.42	0.82	0.86
RSUP3	0.49	0.47	0.39	0.37	0.37	0.40	0.42	0.30	0.47	0.43	0.43	0.37	0.84	0.84
RSUP4	0.43	0.57	0.46	0.49	0.41	0.42	0.45	0.40	0.42	0.54	0.40	0.50	0.84	0.86

**Table 10. Item-to-Construct Correlations
for Manufacturing (M) and Wholesale Trade (W) Industries**

All correlations are significant at the 0.01 level (2-tailed)

satisfaction as well as an antecedent to customer revenue, mediation analysis can be used to examine this path structure by characterizing the role of customer loyalty in the relationship between customer satisfaction and customer revenue, such as whether it fully mediates or partially mediates the relationship. As recommended in the literature (Preacher and Hayes 2004), Sobel, Aroian, and Goodman tests were used to test the significance of mediation. Alternatively,

an intervening factor such as customer loyalty may provide a path for an indirect effect without mediation. An indirect effect is defined as a path in which the predictor variable has a significant relationship with an intervening variable, which in turn has a significant relationship with the dependent variable (Preacher and Hayes 2004). Mediation is defined as an indirect effect in which the total effect (i.e. the relationship between predictor and dependent variable without controlling for the intervening variable) is also significant (Baron and Kenny 1986). When the total effect is not significant, then care must be exercised during interpretation (Holmbeck 1997).

Table 11 provides a summary of the analysis procedure steps that were followed. In the first step, regression analysis was applied to a model that specified customer loyalty as the dependent variable. For the second analysis step, customer revenue was specified as the dependent variable in the regression model. In the third step, mediation analysis was used to examine the role of customer loyalty in the path between customer satisfaction and customer revenue. Results from steps one, two, and three of the analysis permit evaluation of Hypothesis 1, which posits a positive relationship between customer satisfaction and customer outcomes. In the fourth step of the analysis, regression coefficients were estimated for a model that specified customer satisfaction as the dependent variable. Results from step four of the analysis permit evaluation of Hypotheses 2 and 3, which posit positive relationships between system quality and customer satisfaction and between information quality and customer satisfaction, respectively. In the fifth step, mediation analysis was used to examine the role of customer satisfaction in the paths between system quality and customer loyalty and between information quality and customer loyalty. Coefficients for moderating effects were estimated in a final regression analysis step. Results from the final analysis step permit evaluation of Hypotheses 4a, 4b, 5a, and 5b, which

posit moderating effects from relationship duration and customer dependence. The overall objective of this approach was to evaluate the hypothesized chain of effects from system quality and information quality through their influence on intermediating factors, customer satisfaction and customer loyalty, to their effect on vendor performance as realized in customer revenue. Thus, a progression of regression analyses were used to trace the significance of hypothesized factors at successive vantage points along this path. Furthermore, regression coefficients obtained from these analyses were used to characterize factor effects as to whether they are direct or indirect (Preacher and Hayes 2004) and whether they are fully or partially mediated by intervening factors.

Step	Type of Effect	Paths Examined	Hypotheses Tested
1	Direct	Customer Satisfaction → Customer Loyalty	H1
2	Direct	Customer Loyalty → Customer Revenue	
3	Mediation	Customer Satisfaction → Customer Loyalty → Customer Revenue	
4	Direct	System Quality → Customer Satisfaction Information Quality → Customer Satisfaction	H2 H3
5	Mediation	System Quality → Customer Satisfaction → Customer Loyalty Information Quality → Customer Satisfaction → Customer Loyalty	
6	Moderation	[System Quality x Duration] → Customer Satisfaction [Information Quality x Duration] → Customer Satisfaction [System Quality x Dependence] → Customer Satisfaction [Information Quality x Dependence] → Customer Satisfaction	H4a H4b H5a H5b

Table 11. Summary of Analysis Procedure Steps

Hypothesis Tests

In the first step of the analysis, customer loyalty was specified as the dependent variable using regression to examine the significance of customer satisfaction as a predictor. As shown in Table 12, customer satisfaction was found to be a significant predictor ($p < 0.001$) of customer loyalty

for exchange relationships with customers in the manufacturing industry and with customers in the wholesale trade industry. After controlling for operational flexibility, economic value, information technology support quality, and relational support quality, customer satisfaction explained 10.2% of the observed variance in the manufacturing industry context and 12.2% of the observed variance in the wholesale trade industry context. No other controls were found to be significant. Total R^2 was 0.49 for the manufacturing industry and 0.59 for the wholesale trade industry.

Variables	Manufacturing Industry				Wholesale Trade Industry			
	Model 1		Model 2		Model 1		Model 2	
(Constant)	0.12**	(.04)	-.02	(.04)	-.02	(.06)	-.10+	(.05)
Operational Flexibility	0.28***	(.07)	0.09	(.07)	0.30***	(.08)	0.08	(.07)
Economic Value	0.48***	(.07)	0.25**	(.08)	0.31***	(.07)	0.08	(.07)
IT Support Quality	0.09	(.07)	0.04	(.06)	0.20**	(.07)	0.11+	(.06)
Relational Support Quality	0.17*	(.07)	0.08	(.07)	0.16*	(.08)	0.05	(.07)
Customer Satisfaction			0.61***	(.08)			0.78***	(.09)
R^2	.413		.498		.457		.595	
Adjusted R^2	.404		.488		.447		.585	
R^2 change			.085***				.138***	
F	46.0***		51.8***		45.2***		62.8***	

Table 12. Analysis Step 1: Test of Direct Effect of Customer Satisfaction for Manufacturing and Wholesale Trade Industries^a

^aUnstandardized coefficients are given, with standard errors in parentheses.
 $n = 267$ for manufacturing industry. $n = 219$ for wholesale trade industry.
 + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

In the second step of the analysis, customer revenue was specified as the dependent variable using regression to examine the significance of customer loyalty as a predictor. As shown in Table 13, customer loyalty was found to be a significant predictor ($p < 0.01$) of customer revenue for exchange relationships with customers in the manufacturing industry. After controlling for

the size of the customer firm, its total spending on logistics activities, operational flexibility, and economic value, customer loyalty explained 2.6% of the observed variance in the manufacturing industry context. No other controls were found to be significant. Total R^2 was 0.19 for the manufacturing industry. For exchange relationships with customers in the wholesale trade industry, no significant relationship was found between customer loyalty and customer revenue.

Variables	Manufacturing Industry				Wholesale Trade Industry			
	Model 1		Model 2		Model 1		Model 2	
(Constant)	2.64***	(.28)	2.39***	(.29)	3.16***	(.29)	3.15***	(.30)
Number of Employees	0.10	(.06)	0.10+	(.06)	0.03	(.07)	0.03	(.07)
Total Customer Spending	0.39***	(.06)	0.38***	(.06)	0.29***	(.06)	0.29***	(.06)
Operational Flexibility	-.03	(.03)	-.04	(.03)	0.17	(.17)	0.11	(.19)
Economic Value	0.06*	(.03)	0.04	(.03)	-.07	(.17)	-.12	(.18)
Customer Loyalty			0.41**	(.14)			0.13	(.16)
R^2	.182		.198		.123		.126	
Adjusted R^2	.169		.183		.107		.105	
R^2 change			.017*				.003	
F	14.5***		12.9***		7.5***		6.2***	

Table 13. Analysis Step 2: Test of Direct Effect of Customer Loyalty for Manufacturing and Wholesale Trade Industries ^a

^aUnstandardized coefficients are given, with standard errors in parentheses.
n = 267 for manufacturing industry. *n* = 219 for wholesale trade industry.

p*<.05, *p*<.01, ****p*<.001

In the third step, mediation analysis was used to examine the role of customer loyalty in the path between customer satisfaction and customer revenue for exchange relationships with customers in the manufacturing industry. Since no significant relationship was found between customer loyalty and customer revenue in the wholesale trade industry context, no corresponding mediation analysis was necessary. Following the procedure described by Baron and Kenny

(1986), mediation analysis was accomplished by comparing regression coefficients estimated for two alternative models as shown in Figure 5. In the direct model that did not include customer loyalty, no significant relationship was found between customer satisfaction and customer revenue. When customer loyalty was included as an intervening variable, then significant relationships were found, as shown in Model B of Figure 5. This indicates that customer satisfaction has an indirect effect on customer revenue in the manufacturing industry context with customer loyalty providing an intervening path for this effect. These findings together with the findings from the first two steps of the analysis provide partial support for Hypothesis 1, which posited that customer satisfaction has a positive relationship with vendor firm customer outcomes. Support was found for Hypothesis 1 in the manufacturing industry context, but not in the wholesale trade industry context.

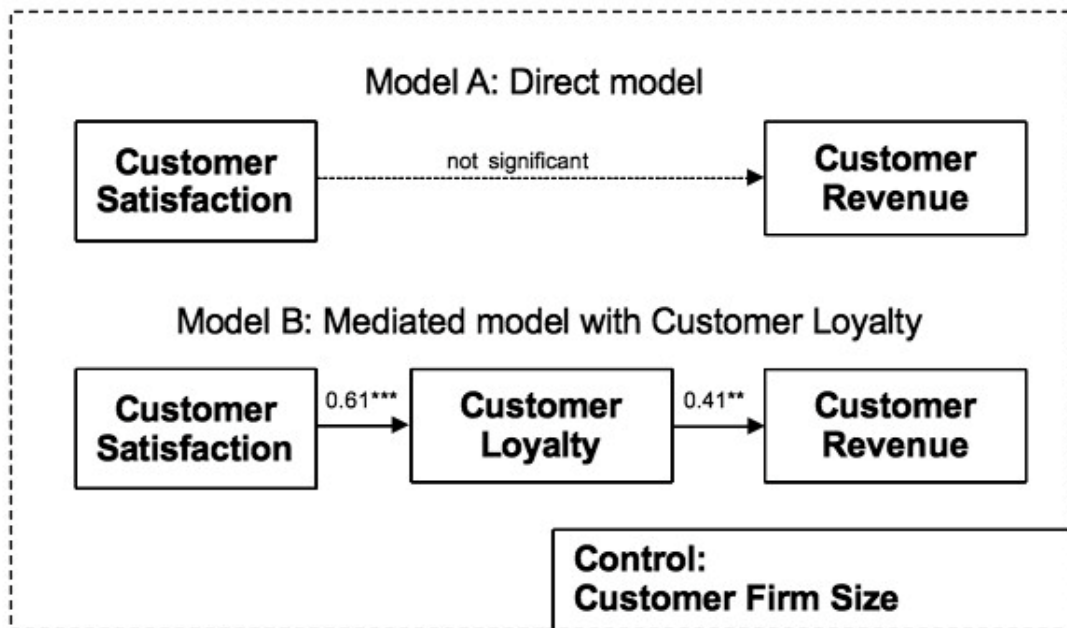


Figure 5. Analysis Step 3: Test of the Mediating Role of Customer Loyalty
 p<.01, *p<.001

In the fourth step of the analysis, customer satisfaction was specified as the dependent variable using regression to examine the significance of system quality and information quality as predictors. As shown in Table 14, system quality was found to be a significant predictor ($p < 0.01$) of customer satisfaction for exchange relationships with customers in the manufacturing industry. After controlling for logistics service quality, information technology support quality, and relational support quality, system quality explained 2.2% of the observed variance in the manufacturing industry context. No other controls were found to be significant. Total R^2 was 0.60 for the manufacturing industry. For exchange relationships with customers in the wholesale trade industry, no significant relationship was found between system quality and customer satisfaction. Furthermore, no significant relationship was found between information quality and customer satisfaction for both industry contexts. These findings provides partial support for Hypothesis 2, which posited that system quality has a positive relationship with customer satisfaction. Support was found for Hypothesis 2 in the manufacturing industry context, but not in the wholesale trade industry context. Hypothesis 3, which posited that information quality has a positive relationship with customer satisfaction, is not supported by these findings. However, in a post hoc analysis described later in this chapter, it was found that logistics service quality fully the relationships between system quality and customer satisfaction and between information quality and customer satisfaction for both industry contexts.

In the fifth step, mediation analysis was used to examine the role of customer satisfaction in the paths that link system quality to customer loyalty and information quality to customer loyalty. The alternative models examined in this analysis are shown in Figures 6 and 7. The direct model, shown as Model A in Figures 6 and 7, was used to examine the full effect of system quality and

Variables	Manufacturing Industry		Wholesale Trade Industry	
	Model 1	Model 2	Model 1	Model 2
(Constant)	.13*** (.04)	.08* (.04)	.10* (.04)	0.10* (.04)
Operational Flexibility	.23*** (.05)	.19*** (.05)	.29*** (.05)	0.29*** (.05)
Economic Value	.33*** (.05)	.26*** (.05)	.30*** (.05)	0.31*** (.05)
IT Support Quality	.09* (.04)	.02 (.05)	.12** (.04)	0.13** (.05)
Relational Support Quality	.16*** (.05)	.14** (.05)	.14** (.05)	0.14** (.05)
System Quality		.18** (.06)		-.01 (.06)
Information Quality		.09 (.06)		-.03 (.06)
R^2	.574	.596	.610	.610
Adjusted R^2	.568	.586	.602	.599
R^2 change		.022**		.001
F	88.3***	63.9***	83.9***	55.6***

Table 14. Analysis Step 4: Test of Direct Effect of System Quality and Information Quality for Manufacturing and Wholesale Trade Industries ^a

^aUnstandardized coefficients are given, with standard errors in parentheses.

$n = 267$ for manufacturing industry. $n = 219$ for wholesale trade industry.

* $p < .05$, ** $p < .01$, *** $p < .001$

information quality on customer loyalty. That is, regression coefficients were estimated for a model with customer loyalty as the dependent variable, and system quality and information quality as independent variables. Customer satisfaction was not included in this model. As shown in Model A of Figure 6, for exchange relationships with customers in the manufacturing industry, system quality and customer loyalty were found to have a significant relationship, whereas no significant relationship was found between information quality and customer loyalty. For exchange relationships with customers in the wholesale trade industry as shown in Model A of Figure 7, both system quality and information quality were found to have a significant relationship with customer loyalty. In both industry contexts, logistics service quality was found to have a significant effect on customer loyalty for the direct model. No other controls were

found to be significant.

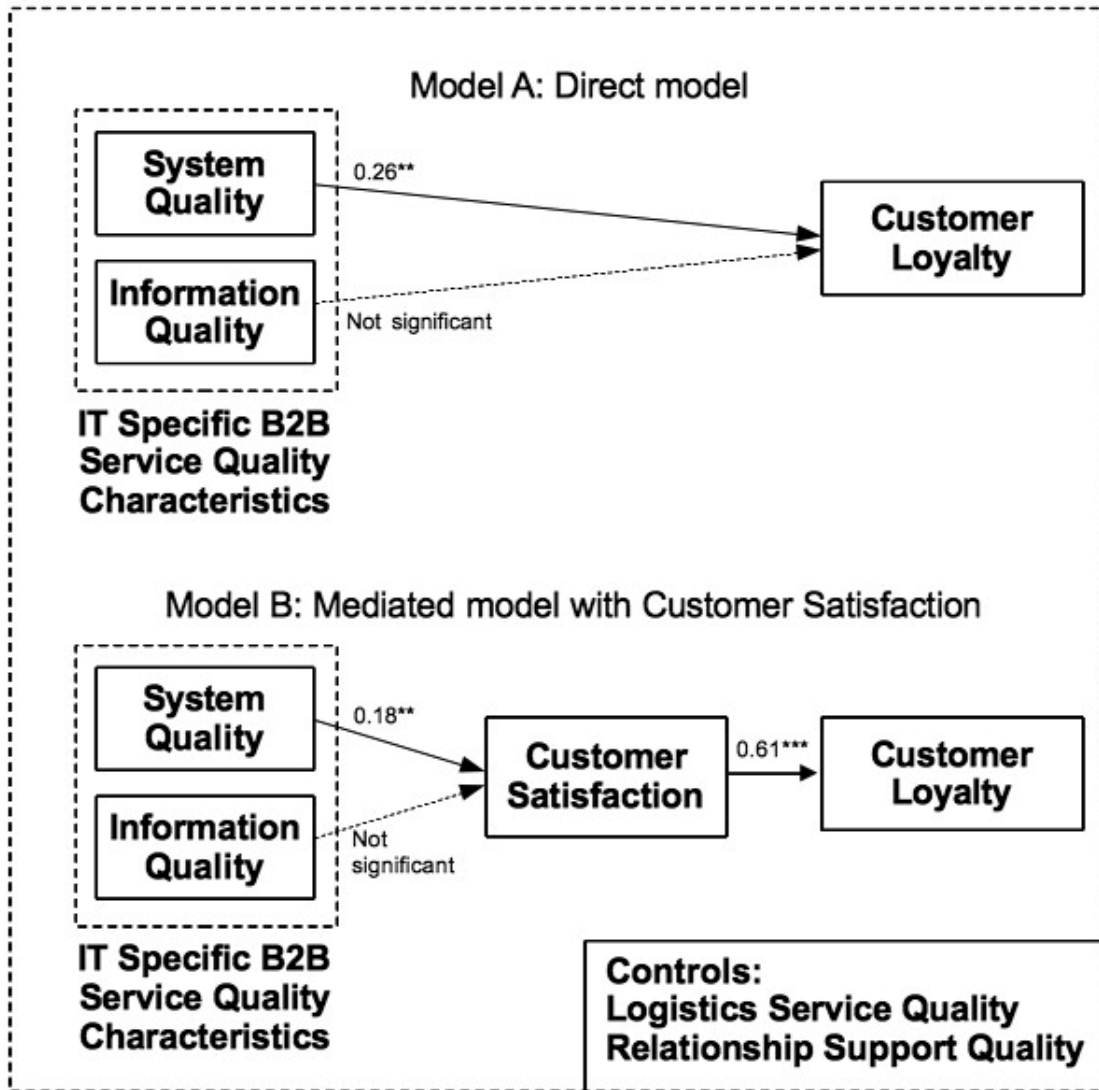


Figure 6. Analysis Step 5: Test of the Mediating Role of Customer Satisfaction for Manufacturing Industry
p<.01, *p<.001

In the alternate model for this step of the analysis, customer satisfaction was included as an intervening variable in the paths between system quality and customer loyalty and between information quality and customer loyalty, shown as Model B in Figures 6 and 7. Regression analysis was employed to estimate model coefficients. In both industry contexts, relationships in

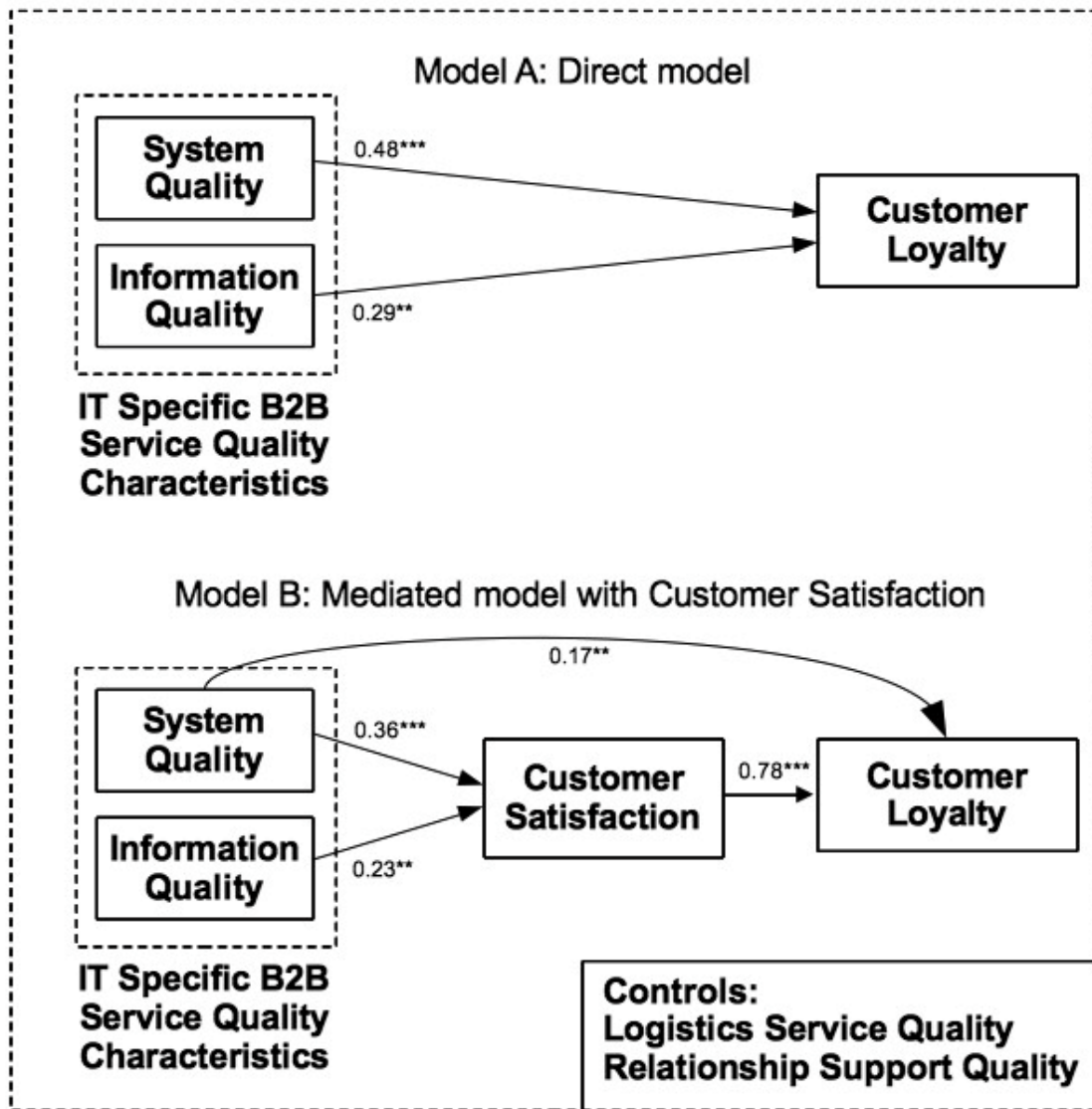


Figure 7. Analysis Step 5: Test of the Mediating Role of Customer Satisfaction for Wholesale Trade Industry

p<.01, *p<.001

the path from system quality through customer satisfaction to customer loyalty were significant. In the manufacturing industry context as shown in Model B of Figure 6, no significant relationship was found between information quality and customer satisfaction when controlling for logistics service quality and relationship support quality. In contrast, a significant relationship

was found between information quality and customer satisfaction in the wholesale trade industry context as shown in Model B of Figure 7. No significant direct path was found between information quality and customer loyalty in the mediated model for both industry contexts. However, a difference in significance between the two industry contexts was found for the direct path between system quality and customer loyalty in the mediated model. In the manufacturing industry context as shown in Model B of Figure 6, no significant direct path was found between system quality and customer loyalty in the mediated model. In contrast, a significant direct path was found between system quality and customer loyalty in the mediated model for the wholesale trade industry context as shown in Model B of Figure 7. In both industry contexts, logistics service quality and relationship support quality were found to be significant for the mediated model. No other controls were found to be significant. Three mediated relationships are indicated by these results. First, customer satisfaction is found to fully mediate the relationship between system quality and customer loyalty for exchange relationships with customers in the manufacturing industry. Second, customer satisfaction is found to partially mediate the relationship between system quality and customer loyalty for exchange relationships with customers in the wholesale trade industry. Third, customer satisfaction is found to fully mediate the relationship between information quality and customer loyalty for exchange relationships with customers in the wholesale trade industry. Since no significant relationships were found between information quality and customer loyalty or between information quality and customer satisfaction in the manufacturing industry context, no corresponding mediation analysis was necessary. Using Sobel, Aroian, and Goodman tests (Preacher and Hayes 2004), all three mediations are found to be significant ($p < 0.001$).

In the final step of the analysis, moderating effects of relationship duration and customer dependence were evaluated using regression following the procedure outlined by Sharma et al. (1981). Since the moderators are hypothesized to influence the relationships between system quality and customer satisfaction and between information quality and customer satisfaction, customer satisfaction was specified as the dependent variable in the regression model. Following recommended guidelines (Irwin and McClelland 2001), the measures were mean centered prior to regression analysis to minimize potential collinearity issues. Moderation effects were assessed by examining the significance of interaction terms over and beyond any main effects of the model variables. Interaction terms were obtained by crossing the moderator variables with system quality and information quality. As shown in Tables 15a and 15b, no significant moderating effects were found in either industry context. Thus, no support was found for Hypotheses 4a and 4b, which posited that relationship duration moderates the relationships between system quality and customer satisfaction and between information quality and customer satisfaction, respectively. Also, the regression results provided no support for Hypotheses 5a and 5b, which posited that customer dependence moderates the relationships between system quality and customer satisfaction and between information quality and customer satisfaction, respectively.

Examination of underlying model assumptions was performed prior to evaluation of hypotheses. Figure 8 provides a typical distribution of the residuals from regression analysis in this study. As described earlier, measure transformations were used to reduce heteroskedasticity. All variance inflation factors in the regression analyses were less than 3, indicating that there were no multicollinearity issues. In addition to testing model hypotheses as described above, robustness

Variables	Manufacturing Industry						Wholesale Trade Industry					
	Model 1		Model 2		Model 3		Model 1		Model 2		Model 3	
(Constant)	.13***	(.04)	.30***	(.06)	.31***	(.06)	1.39**	(0.42)	0.93	(0.77)	0.97+	(.59)
Operational Flexibility	.23***	(.05)	.18***	(.05)	.18***	(.05)	0.24***	(0.07)	0.25**	(0.08)	0.29**	(.05)
Economic Value	.33***	(.05)	.25***	(.05)	.25***	(.05)	0.31***	(0.06)	0.32***	(0.07)	0.31**	(.05)
IT Support Quality	.09*	(.04)	.01	(.05)	.01	(.05)	0.11*	(0.05)	0.14*	(0.07)	0.13**	(.05)
Relational Support Quality	.16***	(.05)	.15**	(.05)	.15**	(.05)	0.13*	(0.06)	0.14*	(0.07)	0.13*	(.05)
Relationship Duration (DUR)			.00	(.00)	.16**	(.06)			0.01	(0.02)	0.01	(.02)
Customer Dependence (DEP)			.00**	(.00)	.11+	(.06)			0.00	(0.00)	0.00	(.00)
System Quality (SYSQ)			.18**	(.06)	.00	(.00)			-.05	(0.10)	-.01	(.07)
Information Quality (INFQ)			.09	(.06)	.00*	(.00)			-.03	(0.09)	-.02	(.06)
SYSQ x DUR					.00	(.01)					0.01	(.01)
INFQ x DUR					.00	(.01)					0.00	(.01)
SYSQ x DEP					.00+	(.00)					0.00	(.00)
INFQ x DEP					.00	(.00)					0.00	(.00)
R^2	.596		.624		.632		.625		.630		.633	
Adjusted R^2	.584		.600		.595		.611		.600		.587	
R^2 change			.028+		.008				.004		.003	
F	46.9***		25.5***		17.0***		43.8***		21.5***		13.9***	

Table 15a. Analysis Step 6: Test of Moderation Effects for Manufacturing and Wholesale Trade Industries: Controls, Direct Effects, and Full Model ^a

^aUnstandardized coefficients are given, with standard errors in parentheses.

+p<.10, *p<.05, **p<.01, ***p<.001

Variables	Manufacturing Industry								Wholesale Trade Industry							
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
(Constant)	.30***	(.06)	.30***	(.06)	.31***	(.06)	.30***	(.06)	0.97+	(0.58)	0.94	(0.58)	0.93	(0.58)	0.95	(0.58)
Operational Flexibility	.18***	(.05)	.18***	(.05)	.18***	(.05)	.18***	(.05)	0.29**	(0.05)	0.29**	(0.05)	0.29**	(0.05)	0.29**	(0.05)
Economic Value	.25***	(.05)	.25***	(.05)	.25***	(.05)	.25***	(.05)	0.31***	(0.05)	0.30***	(0.05)	0.30***	(0.05)	0.30***	(0.05)
IT Support Quality	.01	(.05)	.01	(.05)	.01	(.05)	.02	(.05)	0.13**	(0.05)	0.13**	(0.05)	0.13**	(0.05)	0.13**	(0.05)
Relational Support Quality	.15**	(.05)	.15**	(.05)	.15**	(.05)	.15**	(.05)	0.13*	(0.05)	0.13*	(0.05)	0.14**	(0.05)	0.13*	(0.05)
Relationship Duration (DUR)	.00	(.00)	.00	(.00)	.00	(.00)	.00	(.00)	0.01	(0.02)	0.01	(0.02)	0.01	(0.02)	0.01	(0.02)
Customer Dependence (DEP)	.00**	(.00)	.00*	(.00)	.00*	(.00)	.00*	(.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
System Quality (SYSQ)	.18**	(.06)	.18**	(.06)	.16**	(.06)	.18**	(.06)	-.01	(0.06)	0.00	(0.06)	0.00	(0.06)	0.00	(0.06)
Information Quality (INFQ)	.09	(.06)	.09	(.06)	.11+	(.06)	.08	(.06)	-.02	(0.06)	-.03	(0.06)	-.03	(0.06)	-.03	(0.06)
SYSQ x DUR	.00	(.01)							0.01	(0.01)						
INFQ x DUR			.00	(.01)							0.01	(0.01)				
SYSQ x DEP					.00+	(.00)							0.00	(0.00)		
INFQ x DEP							.00	(.00)							0.00	(0.00)
R^2	.625		.624		.629		.625		.632		.631		.630		.630	
Adjusted R^2	.598		.597		.602		.597		.599		.598		.597		.597	
R^2 change	.001		.000		.005		.001		.003		.002		.000		.000	
F	22.6***		22.7***		23.2***		22.8***		19.3***		19.0***		19.1***		19.1***	

**Table 15b. Analysis Step 6: Test of Moderation Effects for Manufacturing and Wholesale Trade Industries:
Individual Interaction Terms ^a**

^aUnstandardized coefficients are given, with standard errors in parentheses.
+p<.10, *p<.05, **p<.01, ***p<.001

of the findings were evaluated by examining sensitivity of the results to leverage point exclusion (Hair et al. 1998) and to Winsorization (Dewan et al. 2007, Keselman et al. 2000). Leverage points were identified by examining standardized residuals, studentized deleted residuals, Cook's D, and DFBETA values. Winsorization is an alternative method for minimizing the effect of outliers by rescaling extreme data values rather than excluding them. 1%, 5%, and 10% Winsorization was utilized in the sensitivity analysis. In all cases, hypothesis test results were unchanged. In particular, the lack of significance was unchanged for all interaction terms in the moderation tests.

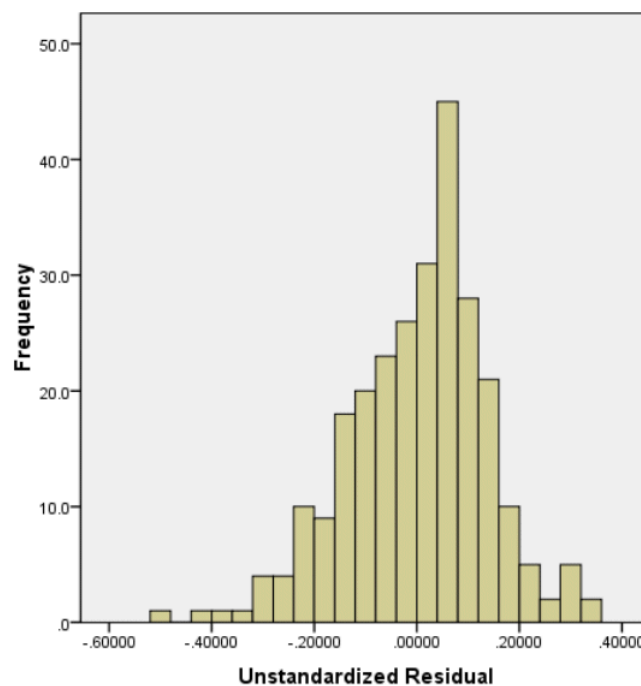


Figure 8. Distribution of Residuals for Manufacturing Industry

Post Hoc Analysis of Logistics Service Quality as a Mediator

In a post hoc analysis, the role of logistics service quality was examined as an intervening

variable in the paths between system quality and customer satisfaction and between information quality and customer satisfaction. Since logistics service quality had been identified as a control for this study, no associated hypotheses were developed. In this empirical context, however, it is found that logistics service quality has a crucial role in deriving firm benefits from digital enablement of business-to-business exchange. Two alternative models that were examined are provided in Figures 9 and 10. In the direct model that did not include logistics service quality, shown as Model A in Figures 9 and 10, significant relationships were found between system quality and customer satisfaction and between information quality and customer satisfaction in both industry contexts. When logistics service quality characteristics were included as intervening variables, then significant relationships were found as indicated in Model B of Figures 9 and 10. This result replicates the previous finding in step 4 of the earlier analysis. System quality is found to have a significant relationship with customer satisfaction when controlling for logistics service quality. In addition, no significant relationship is found between information quality and customer satisfaction when controlling for logistics service quality. Furthermore, this analysis indicates that logistics service quality partially mediates the relationship between system quality and customer satisfaction and fully mediates the relationship between information quality and customer satisfaction. Using Sobel, Aroian, and Goodman tests (Preacher and Hayes 2004), both the partial mediation and full mediation effects are found to be statistically significant ($p < 0.001$).

Summary of Results

Results from the preceding regression and mediation analyses are summarized in Tables 16 and 17. Estimated path coefficients from regression analysis are presented in Table 16 for business-

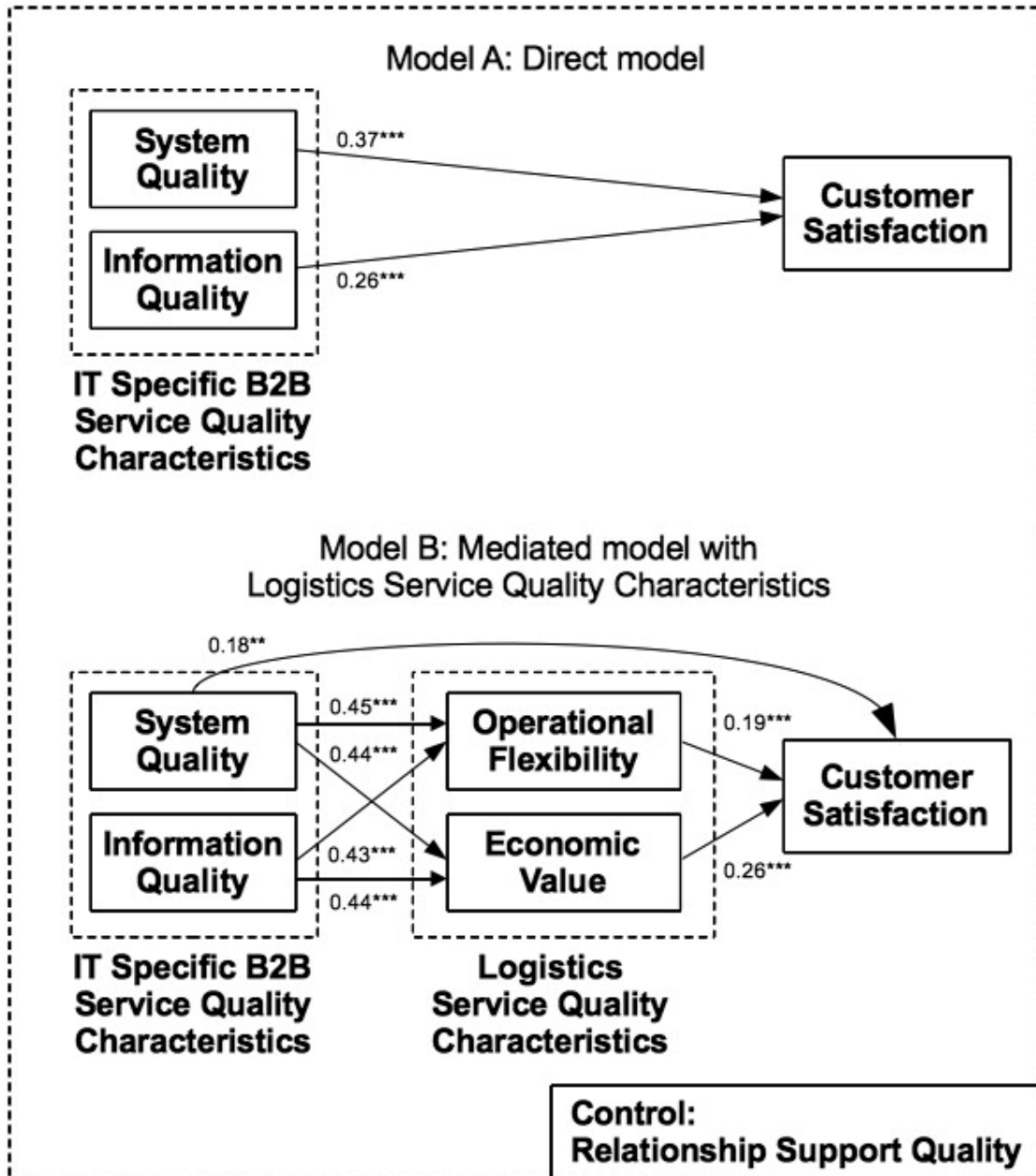


Figure 9. Post Hoc Analysis: Test of Mediating Role of Logistics Service Quality Characteristics for Manufacturing Industry
 p<.01, *p<.001

to-business relationships with customers in the manufacturing industry and in the whole sale trade industry. This table lists the paths in the chain of effects from information technology

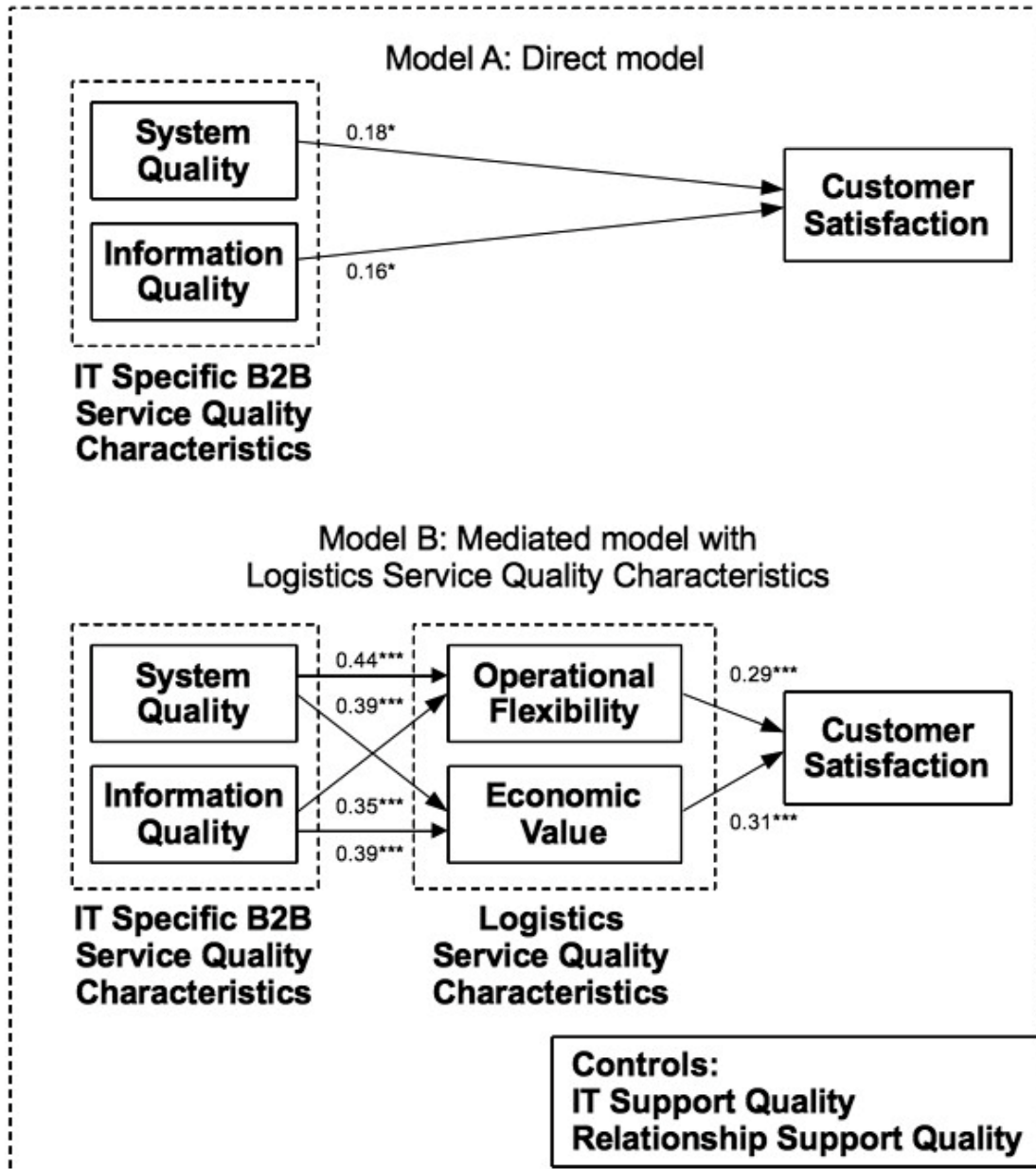


Figure 10. Post Hoc Analysis: Test of Mediating Role of Logistics Service Quality Characteristics for Wholesale Trade Industry

*p<.05, ***p<.001

specific business-to-business service quality characteristics, system quality and information quality, to customer outcomes, customer loyalty and customer revenue. Intervening variables form links in this chain of effects. Logistics service quality characteristics, operational flexibility and economic value, and customer satisfaction are identified as intervening variables. In

addition, customer loyalty is modeled as a predictor for customer revenue, a relationship that is widely accepted in the services marketing literature (Narayandas 2005, Hallowell 1996). Of the ten paths modeled, nine were found to be significant in the manufacturing industry context and seven were found to be significant in the wholesale trade industry context. The relationship between system quality and customer satisfaction was found to be significant in the manufacturing industry context, but not found to be significant in the wholesale trade industry context. The relationship between information quality and customer satisfaction was not found to be significant in either industry context. The relationship between customer loyalty and customer revenue was found to be significant in the manufacturing industry context, but not found to be significant in the wholesale trade industry context.

Path	Manufacturing Industry	Wholesale Trade Industry
System Quality → Operational Flexibility	0.45***	0.44***
Information Quality → Operational Flexibility	0.43***	0.35***
System Quality → Economic Value	0.44***	0.39***
Information Quality → Economic Value	0.44***	0.39***
System Quality → Customer Satisfaction	0.18**	-0.01
Information Quality → Customer Satisfaction	0.09	-0.03
Operational Flexibility → Customer Satisfaction	0.19***	0.29***
Economic Value → Customer Satisfaction	0.26***	0.31***
Customer Satisfaction → Customer Loyalty	0.61***	0.78***
Customer Loyalty → Customer Revenue	0.41**	0.13

Table 16. Summary of Path Coefficients from OLS Analysis

p<.01, *p<.001

Results from mediation analyses are summarized in Table 17. For each intervening variable, its role in the chain of effects from information technology specific business-to-business service quality characteristics to customer outcomes is shown for each industry context based on the

corresponding mediation analysis results. Logistics service quality characteristics, operational flexibility and economic value, were found to partially or fully mediate the relationships between system quality and customer satisfaction and between information quality and customer satisfaction in both industry contexts. Customer satisfaction was found to partially or fully mediate the relationship between system quality and customer loyalty in both industry contexts. Customer satisfaction was also found to fully mediate the relationship between information quality and customer loyalty in the wholesale trade industry context. In the manufacturing industry context, however, no corresponding mediation analysis was performed for customer satisfaction because no significant relationship was found between information quality and customer loyalty or between information quality and customer satisfaction.

Path	Intervening Variable	Manufacturing Industry	Wholesale Trade Industry
System Quality → Customer Satisfaction	Operational Flexibility	Partial Mediation	Full Mediation
Information Quality → Customer Satisfaction	Economic Value	Full Mediation	Full Mediation
Customer Satisfaction → Customer Revenue	Customer Loyalty	Indirect Effect	N/A
System Quality → Customer Loyalty	Customer Satisfaction	Full Mediation	Partial Mediation
Information Quality → Customer Loyalty	Customer Satisfaction	N/A	Full Mediation

Table 17. Summary of Mediation Analysis Results

Chapter 4 Discussion and Conclusion

Section 1. Summary of Results

Table 18 presents the summary of results from the previous chapter for evaluating study hypotheses in both industry contexts. Hypotheses 1, 2, and 3 posited a chain of effects from system quality and information quality, through customer satisfaction, to customer loyalty and customer revenue. Support was found for Hypothesis 1 in the manufacturing industry context. In the wholesale trade industry context, Hypothesis 1 was partially supported because although the effect of customer satisfaction on customer loyalty was found to be significant, no significant relationship was found between customer loyalty and customer revenue. A significant effect between system quality and customer satisfaction provided support for Hypothesis 2 in both industry contexts. Similarly, a significant effect between information quality and customer satisfaction provided support for Hypothesis 3 in both industry contexts. Finally, no significant findings were obtained in either industry context to support Hypotheses 4a, 4b, 5a, or 5b regarding the moderating effects of exchange relationship duration and customer dependence.

Figure 11 shows the path coefficients estimated with the inclusion of logistics service quality characteristics as mediators of the relationships between system quality and customer satisfaction and between information quality and customer satisfaction. In the manufacturing industry context, a significant direct effect was found between system quality and customer satisfaction as well as a significant indirect effect through the logistics service quality characteristics. In the wholesale trade industry context, only an indirect effect through the logistics service quality characteristics was found to be significant in the relationship between system quality and

customer satisfaction. For the relationship between information quality and customer satisfaction, only an indirect effect through the logistics service quality characteristics was found to be significant in both industry contexts.

Hypothesis Tested	Paths Examined	Manufacturing Industry (N=264)	Wholesale Trade Industry (N=217)
H1	Customer Satisfaction → Customer Loyalty → Customer Revenue	Supported	Partially Supported
H2	System Quality → Customer Satisfaction	Supported	Supported
H3	Information Quality → Customer Satisfaction	Supported	Supported
H4a	[System Quality x Duration] → Customer Satisfaction	Not supported	Not supported
H4b	[Information Quality x Duration] → Customer Satisfaction	Not supported	Not supported
H5a	[System Quality x Dependence] → Customer Satisfaction	Not supported	Not supported
H5b	[Information Quality x Dependence] → Customer Satisfaction	Not supported	Not supported

Table 18. Summary of Hypothesis Test Results

Section 2. Theoretical Implications

The conceptual model in this study integrates constructs from the information systems literature and from the literature on services marketing. Information systems researchers have begun to consider the role of services marketing related concepts such as service quality (Jia et al. 2008; Pitt et al. 1995), customer satisfaction (Cenfetelli et al. 2008), and customer loyalty (Mithas et al. 2006) in the nomological network for information systems success. Correspondingly, services marketing researchers have begun to consider the role of information systems related concepts such as information quality and systems quality (Zeithaml et al. 2002) in the nomological network for services marketing. Thus, this study provides a bridge that links concepts from these

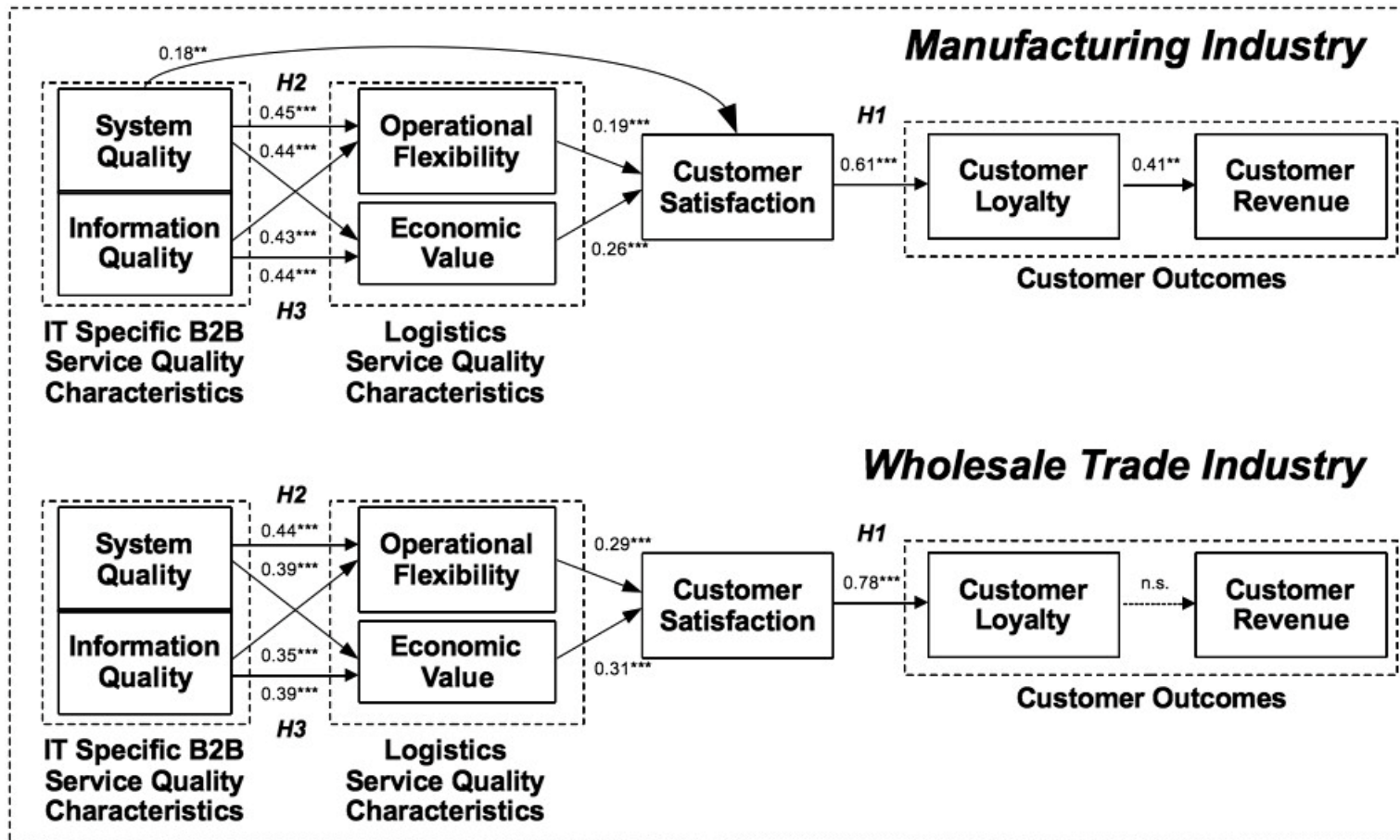


Figure 11. Estimated Path Coefficients from Hypothesis Testing
 p<.01, *p<.001

bodies of literature. In addition, this study contributes to the literature by identifying mediating mechanisms in the chain of effects from digital enablement to firm financial outcomes.

Explication of mediating mechanisms improves our understanding about the indirect nature of impacts from information technology.

Information Systems Success in a B2B Context

This study contributes to the literature on information systems by extending DeLone and McLean's (2003) model of information systems success to the context of business-to-business exchange relationships. This extension includes reconceptualizing constructs at the dyadic level of analysis and reframing constructs using a customer centric perspective (Sheth et al. 2000). These modifications acknowledge the role of customers in co-production and co-creation of services in this context. Including customer perspectives in the model permits assessment of information systems contribution to firm effectiveness in meeting market demand. In addition, mediating factors were identified in the path of effects from system quality and information quality to customer revenue.

All constructs were conceptualized at the level of the customer-vendor exchange relationship. Prior studies have focused on individual and organizational benefits of information systems success (Petter and McLean 2009). However, improved understanding of success for interorganizational information systems is needed as firms increasingly integrate systems and processes with business partners. In addition, the dyadic level of analysis is appropriate in a services context where customers participate in co-production and co-creation (Payne et al. 2008; Bettencourt et al. 2002). Thus, conceptualization of information systems success at the dyadic

level of analysis surfaced the importance of relational factors such as service quality, relationship support quality, and customer loyalty. Market exchange with business customers tends to reflect relational factors more compared with consumer buying (Coviello et al. 2002).

An emphasis on information systems success for demand side processes was achieved by reframing model constructs to a customer centric perspective (Sheth et al. 2000). Much of existing research emphasizes supply side processes and how information technology is used to reduce costs (Croom 2005). However, better understanding is needed for customer facing processes and how information technology can be used to increase revenue (Avlonitis and Karayanni 2000). The customer centric perspective focuses on how customer needs are fulfilled, which is the underlying aspect of market demand. Thus, performance and outcome measures were defined from the customer's perspective. Service quality, system quality, and information quality were assessed in terms of how customer needs are fulfilled. Customer satisfaction, customer loyalty, and customer revenue focused on customer outcomes in the context of their exchange relationship.

This study included both proximal and distal dependent variables. Acknowledging the indirect nature of how benefits are derived from digital enablement, this study included customer satisfaction as a mediating factor in the path from digital enablement to firm financial outcomes. Customer revenue is also assessed to provide a means for evaluating information systems success in a form that is readily compared with other firm capabilities. However, customer revenue is an outcome that is distanced from digital enablement through intervening factors. Customer satisfaction, in contrast, provides a means for more directly assessing customer response to digitally enabled interactions with their service provider. While it is established that

firm financial performance is positively related to customer satisfaction, there are few studies that have examined how customer satisfaction is affected by digital enablement.

Respecification of dependent variables in this context clarified how information system success is dependent on factors unrelated to information technology. Employing customer satisfaction as an indicator of information system success at the dyadic level corresponds to the common practice of assessing user satisfaction at the individual level. While user satisfaction reflects individual perception of user benefits from digital enablement, customer satisfaction reflects perception of relationship benefits. However, customer satisfaction is qualitatively different from user satisfaction because it reflects an evaluation of the exchange relationship itself rather than just the information system used in the relationship. For most firms, information technology is only one of many factor inputs to production. Thus, the results from this study permit an assessment of information systems success relative to other exchange relationship success factors.

This study also contributes to the literature that examines the indirect effect of digital enablement on firm performance. In particular, support was found for Mittal and Nault's (2009) proposition that indirect effects of digital enablement predominate in information intensive industrial contexts. In the research model for this study, customer satisfaction and customer loyalty were included as mediators between quality characteristics of digital enablement and customer revenue. In addition to validating this chain of effects, logistics service quality was found to mediate between quality characteristics of digital enablement and customer satisfaction. Thus, the results indicate that customers in the logistics services industry value quality characteristics

of customer facing information systems primarily as they contribute to the quality of logistics services provided by the vendor.

Generic Mechanisms of IS Success in B2B Exchange

Customer behaviors that are fundamental to the customer-vendor exchange relationship context can be observed across a wide range of industries. Two findings from this study were observed both for exchange relationships with customers in the manufacturing industry and for exchange relationships with customers in the wholesale trade industry. Firms in these two industries are similar in their high need for logistics services and different in how logistics services are utilized in their business operations.

One finding from this study that was observed to hold in both selected industry contexts is the positive relationship between customer satisfaction and customer loyalty. This replicates a finding that is well established in the marketing literature (Storbacka et al. 1994). A customer's satisfaction with an exchange relationship will influence their preferences in future purchase decision-making because satisfaction raises the expectation of favorable exchange outcomes. This expectation contributes to loyalty as satisfactory transactions are consistently experienced in repeated exchanges. Digital enablement impacts relationship performance through this fundamental mechanism of exchange and enhances the customer experience through improvements to both product and process. Furthermore, because digital enablement often requires significant investment of resources, more favorable returns are accrued from longer term relationships, which are more likely to occur for customers with greater loyalty.

Another finding from this study that was observed to hold in both industry contexts is the positive relationship between information quality and customer satisfaction which is fully mediated by logistics service quality. Full mediation indicates that there are no significant alternative mechanisms whereby information quality influences customer satisfaction. Thus, customer satisfaction is only impacted by information quality through its effect on logistics service quality. This is an illustration of enabling technology (Porter 2001) in which improvements from information systems are embedded in the services that are experienced by customers. This indirect effect also demonstrates how firm capabilities are structured hierarchically to deliver desired outcomes. In this case, the quality of logistics services are derived in part from the quality of information provided by customer facing systems. The broad importance of service quality provides an explanation for why this relationship would be expected to hold across a broad range of customer industries.

Industry Specific Mechanisms of IS Success in B2B Exchange

Industries differ in their structure and in the business processes that are critical to member firm performance. Two additional findings from this study were observed to manifest differently for exchange relationships with customers in the manufacturing industry compared to exchange relationships with customers in the wholesale trade industry. These differences in the findings are consistent with differences in the structure and with differences in the business processes for the selected industry contexts.

One finding from this study that was observed to manifest differently in the two selected industry contexts is the association between customer loyalty and customer revenue. For exchange relationships with customers in the manufacturing industry, customer loyalty was found to have a

significant positive association with customer revenue. In contrast, no significant association was found between these two customer outcomes for exchange relationships with customers in the wholesale trade industry. This association is critical to whether improvements in system quality and information quality of customer facing systems are likely to translate into firm financial benefits. Thus, although digital enablement is expected to positively influence customer satisfaction and customer loyalty for business-to-business exchange relationships, whether the effect of digital enablement on customer revenue is significant depends on the industry context.

Another finding from this study that was observed to manifest differently in the two selected industrial contexts is the association between system quality and customer satisfaction. For exchange relationships with customers in the manufacturing industry, system quality has a significant positive association with customer satisfaction which is partially mediated by logistics service quality. In contrast, the positive association between system quality and customer satisfaction is fully mediated by logistics service quality for exchange relationships with customers in the wholesale trade industry. The observed partial mediation indicates that system quality influences customer satisfaction through other mechanisms besides its impact on logistics service quality for customers in the manufacturing industry.

One possible explanation for this partial mediation that pertains to differences between these two industries is the importance of integrating systems and processes between firms and their logistics service providers. In the manufacturing industry, coordination and timing of movement through the supply chain can be important when there are interdependencies in processes such as for product assembly. Integration of information systems are often motivated by the need to improve coordination. The wholesale trade industry, in contrast, would be expected to exhibit

less sensitivity to the timing of package delivery due to the lack of interdependent operational processes. Since wholesale trade focuses more on movement of inventory rather than transforming factor inputs into finished goods, process performance is generally improved by the ability to choose from alternative sources of inventory rather than by working more closely with a single source. Thus, firms in the wholesale trade industry are less likely to be concerned about their ability to closely integrate systems and processes with a logistics services vendor.

Services Marketing and Digital Enablement

Finally, this study contributes to the literature on services marketing (Zeithaml and Bitner 2003, Berry and Parasuraman 1993) by showing how system quality and information quality impact logistics service quality and customer satisfaction in a business-to-business exchange context. Services marketing researchers have begin to consider how new information technologies should be included in the marketing concept (Parasuraman and Grewal 2000, Bitner et al. 2000). Gummesson (1992), for example, suggested that the quality of Internet-based services should be considered as a separate component of service quality to reflect its importance in firm activities. In this study, we found evidence to support the role of information technology as an enabler of service quality rather than as a separate component.

The Role of Relationship Context

In this study, it was hypothesized that relationship duration would moderate the association between system quality and customer satisfaction and between information quality and customer satisfaction. However, no significant effects were found between the corresponding interactions and customer satisfaction. One possible explanation for this lack of findings is that the measure

employed for relationship duration was based on elapsed time for customer transactional activity. The effect hypothesized in this study is based on the premise that the nature of business-to-business exchange relationships evolve over time. More mature relationships are expected to exhibit closer ties that affect the strength of the associations between system quality and customer satisfaction and between information quality and customer satisfaction. However, this evaluation in the nature of exchange relationships may not correlate well with the elapsed time. Some customers, for example, might develop close ties more rapidly than others. Other customers might remain at arms-length indefinitely. Thus, to detect this effect, it may be necessary to employ a different operationalization.

Section 3. Practical Implications

This study has implications for firms that seek to improve performance through investments in customer facing information systems. We have shown a positive impact on customer satisfaction, customer loyalty, and customer revenue from improvements in system quality and information quality of digitally enabled business-to-business exchange. By adopting a customer centric perspective (Sheth et al. 2000), we identified a chain of effects from digital enablement of business-to-business exchange to customer outcomes. Furthermore, since customer revenue is included in customer outcomes for this study, significant financial benefit can be expected from incremental improvements to system quality and information quality of customer facing information systems for logistics services providers based on the results from this study.

In competitive business markets, firms need to effectively utilize information technologies to obtain financial gains from improved interactions with customers. Increasingly, firms are finding that focusing on customer impacts is an effective means for achieving the desired performance

improvements (Rust et al. 2010). In this study, we found that the impact from digital enablement of exchange on customer revenue is mediated by customer perceived service quality, customer satisfaction, and customer loyalty. Thus, managers need to also attend to such customer outcomes in order to realize financial returns from investments in information technology.

There may be reluctance to invest in an information system because benefits are indirect and thus more difficult to measure (Avlonitis and Karayanni 2000). The findings from this study suggest guidelines that can alleviate reluctance by improving a firm's ability to maximize benefits gained from these investments. When the path of effects from technology investments to financial returns is mediated by intervening factors, then it is critical to manage mediating mechanisms as well as the originating investment to maximize financial return. In this study, logistics service quality was identified as an important mediating factor between quality characteristics of customer facing information systems and customer outcomes. Thus, firms that invest in this technology should implement and monitor service quality metrics to assess proximal impacts before evaluating more distal outcomes such as changes in customer behavior.

Another finding from this study with implications for business managers is the difference in effects observed between industry contexts. One difference is the significance of the direct effect between system quality and customer satisfaction. This suggests that there would be additional financial value from information system improvements for certain customer groups. This study found significance for customers in the manufacturing industry but not for customers in the wholesale trade industry. Thus, logistics service providers should evaluate the potential from improving system quality by considering opportunities and expected response for specific customer groups.

Additional implications for business managers are obtained by considering the key role of service quality in this context. Beyond establishing and monitoring metrics of service quality to assess the impact from digital enablement of exchange, IT managers should also seek to strengthen this impact since improvements to service quality are expected to improve exchange relationship outcomes. This also provides motivation to encourage collaboration between system development teams and service delivery teams to facilitate impact of information system improvements on logistics service quality.

Section 4. Limitations and Future Research

Limitations of this thesis must be considered before generalizing the conclusions to wider contexts. Although the results provide encouraging support for the forwarded concepts, certain aspects of the empirical study limit our ability to fully answer the research questions. Practical considerations such as limitations in cost and time provide an underlying constraint on any single study, thereby creating value in the ability to compare and combine result from multiple studies. This thesis was enriched by observations of customers at a field site provided by a focal vendor. Selecting this empirical source also required acceptance of the limiting aspects contained therein. These limitations are described below.

As stated previously, the empirical study reflected observations for a random sample of existing customers for a single focal vendor of logistics services. Only customers with greater than a defined minimum level of transactional activity were included to position the context within business-to-business exchange relationships. In addition, hypothesis testing was performed for exchange relationships with customers from two selected industries - manufacturing and wholesale trade. Thus, the theoretical scope within which the hypothesized model has been tested

is defined by these boundaries. Applying the model beyond this scope would require assumptions regarding generalizability of the theoretical relationships.

Additional limitations stem from the archival nature of the data obtained for this study. Often the purpose for which archival data were generated differs from subsequent research objectives. In particular, the instrumentation that was used to generate the archival survey data used in this study were developed to support business activities of the focal vendor. Evaluation of psychographic properties identified many items that could not be included because they did not satisfy the expected measurement criteria. Neither improvement of individual survey items nor inclusion of additional items were available as remedies to limitations of the measurement model. Consequently, certain constructs were assessed with representative rather than comprehensive measurement items.

Additional limitations of the archival data source are a consequence of the random sampling approach employed to generate survey responses. In particular, there may exist some degree of bias in the sample of customers selected. We observed upward skew in the distribution of customer satisfaction ratings. Although we argued that this distribution is representative of the entire business customer population, there remains the possibility of bias. Also, the sampling approach precluded our ability to perform longitudinal analysis because repeated measures at different time points were not available for testing. The resulting cross-sectional analysis requires assumptions regarding causality of the hypothesized relationships.

Potential avenues for future research are suggested from these empirical limitations. For example, the findings can be refined and extended by further testing the conceptual model in additional empirical contexts such as non-IT intensive or non-service industries.

Finally, the empirical study provided in this thesis supports the hypothesized model based on the selected epistemological perspectives. We chose to examine digital enablement by extending the IS success model to an interorganizational level of analysis using a customer centric perspective. Complementary research methods would extend the findings from this study by providing closer examination of IS success mechanisms. For example, qualitative study of customer perceptions for digitally enabled services might be expected to surface new insights regarding mediation effects.

Section 5. Conclusion

In this study, we have demonstrated that improvements to system quality and information quality for customer facing information systems will have a significant positive effect on customer loyalty and customer revenue in an industrial services context. This finding was obtained by considering the impact from digitally enabled business-to-business exchange on intermediate factors in business value creation. Prior studies of information technology business value have considered the role of digital enablement in supply chain integration capabilities (Rai et al. 2006), organizational resources (Wade and Hulland 2004, Bharadwaj 2000), and emergent opportunities (Sambamurthy et al. 2003). Thus, the importance of mediation in information technology business value creation extends our understanding of how digitally enabled business-to-business exchange impacts firm performance.

In addition to its role in business value creation, digitally enabled business-to-business exchange is increasingly important, as shown in this study, for the quality of services in exchange relationships. There is a growing recognition in the marketing literature for a digital aspect of service quality. Most studies have been concerned with quality aspects of websites for consumers

(e.g., Zeithaml et al. 2002; Montoya-Weiss et al. 2003). In these analyses, the digital aspects of service quality are considered to be a subset of the broader service quality construct. Some researchers have suggested that there are important differences for the digital side of service quality. Gummesson (1992), for example, argued for a separate aspect of service quality specific to information technology. According to Gummesson's argument, a digital aspect of service quality is merited because of the increasing number of firms that rely on information technology as part of its service delivery process, and because many customers now interact with a firm's information system during service delivery.

In this study, we have confirmed that quality characteristics of customer facing information systems have a significant effect on customer perceptions and resulting behavior. However, our findings indicate that these digital aspects of service quality are not necessarily separate from the customer's evaluation of core services provided by a vendor. In particular, we found that the effects of system quality and information quality on customer satisfaction were mediated by the customer's perception of logistics service quality.

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