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Performance Impacts of Extent of Information Technology Usage

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ABSTRACT

The link between IT investment and firm performance is indirect due to the effect of moderating variables. Employing a sample of 589 manufacturing firms based in the U.S., building on resource- and knowledge-based theories and the marketing literature, we use structural equation modeling to investigate the relationship between firm extent of IT usage, knowledge acquisition from customers and suppliers, competitive advantage and firm financial performance. Our results indicate that firm extent of IT usage positively impacts both knowledge from both customers and suppliers, which positively affect firm competitive advantage that, in turn, positively impacts firm financial performance. Further, our results indicate that both knowledge and competitive advantage play a mediating role between firm extent of IT usage and its financial performance.

INTRODUCTION

Information technology (hereafter IT) has become the generally accepted term that encompasses a broad array of communication media and devices such as voice mail, e-mail, voice and videoconferencing, the internet, groupware and corporate intranets, car phones, fax machines, and personal digital assistants (Li, Ryerson, Timothy, Shih & Frederick, 2008). Many companies have invested heavily in IT in the expectation of enhancing their performance. However, research to date on whether IT contributes to firm performance has persistently yielded mixed results. For example, Anand, Manz and Glick (1998) argue that for firms to be successful they must complement IT with knowledge, and Tippins and Sohi (2003) suggest that the performance of IT can be enhanced when firms use it to develop knowledge stores about its customers, markets, and about other factors that influence performance. From the knowledge-based view of the firm, knowledge is an important resource for sustainable competitive advantage (Liao & Hu, 2007). Knowledge provides useful ideas related to internal and external opportunities and threats that are relevant in formulating strategy to gain competitive advantage in terms of quality improvement and lower costs (Zhang & Lado, 2001), and reduced time-to-market (Porter, 1980; Wang & Ahmed, 2004).

In our study, knowledge is viewed as an intangible resource that enables a firm to perform certain critical value-chain activities better than competitors. Since IT in the supply chain process has various forms (Wu, Tsai, Chen, & Wu, 2006), we limit its use in the context of this study to firm knowledge about customers and suppliers. This context is important because "information technology tools enable access to data and information and they sanction vital communication between stakeholders, both upstream and downstream" (Hong & Schniederjans, 2000). Competitive advantage is reflected in firm operational outcomes (product quality, product cost and time-to-market) that are expected to have better market outcomes that are reflected in firm financial performance. Thus, it is important to understand the relationship between operational outcomes and market outcomes because operational success cannot be viewed as an end goal because profitability is ultimately driven by market success (Tatikonda & Montoya-Weiss, 2001).

Much of the prior literature has sought to examine the direct effect that IT may have on firm financial performance (Lea, 2005) However, this approach ignores possible indirect effects through other variables, and thus may have underestimated the impact of IT on financial performance. Also, despite the theoretical strength of the idea that the application of knowledge creates competitive advantage for firms, no research that we are aware of has demonstrated the influence of IT use on supply chain knowledge acquisition as reflected in firm knowledge acquisition from customers and suppliers to achieve competitive advantage. Spender (1996) suggests that, of the various resources available to the firm, knowledge is arguably the most important. Therefore, recognizing that IT is most likely to affect firm competitive advantage, as reflected in its operational outcomes, through knowledge acquisition and that this competitive advantage will affect firm financial performance, we develop and test hypotheses based on an integrated structural framework representing the relationship between firm extent of IT usage, knowledge acquisition from the supply chain, competitive advantage and financial performance.

The contribution of this study is to empirically assess how the extent of IT usage can lead to firm performance. More specifically, drawing from the literature (e.g. knowledge-based view, resource based view, supply chain management and marketing management literature), this study uses manufacturing firm extent of IT usage as an antecedent of knowledge from customers and suppliers. We expect that firms that report high levels of IT usage will also report high levels of knowledge from both customers and suppliers. Furthermore, high levels of knowledge from customers and suppliers are expected to lead to firm competitive advantage (Tippins & Sohi, 2003) that, in turn, are expected to lead to firm financial performance.

The remainder of the paper is structured in four sections. The next section presents the literature review and hypotheses development. This is followed by sections that discuss the research method and present results. Finally, conclusions are discussed.

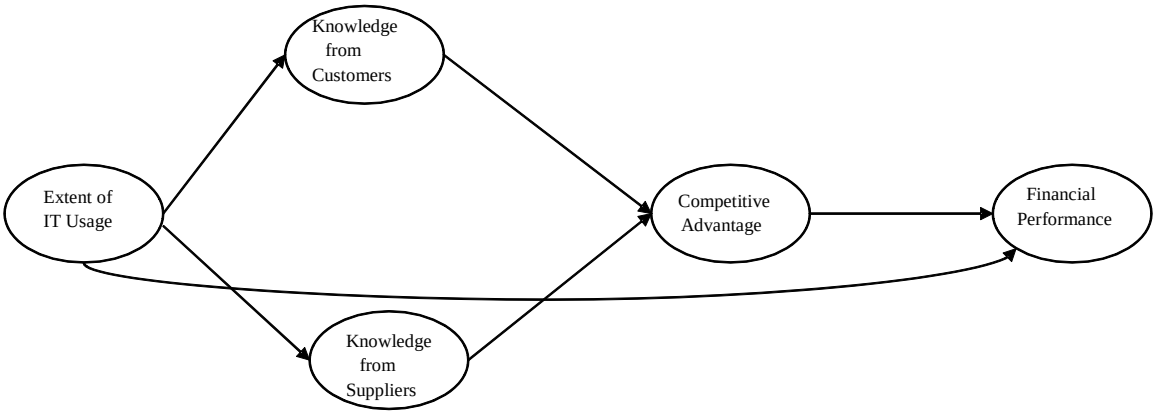
LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

This study defines extent of IT usage to reflect the extent to which a firm uses its own IT to augment its supply chain capabilities. Knowledge from customers (suppliers) deals with "information that the firm acquires to improve competitive advantage as reflected in operational

outcomes, a key indicator of performance that focuses on promoting high-quality products, low production costs, and reduced cycle time (days from receipt of raw materials to customer receipt). However, profitability reflects firm market outcome."

Figure 1 illustrates the model guiding our study. This model examines (1) the impact of IT use on firm knowledge from its customers and suppliers, (2) the effects of firm knowledge from its customers and suppliers on firm competitive advantage and (3) the effect of firm competitive advantage on firm profitability. We elaborate on the constructs in the model and state our hypotheses in the following sections.

Figure 1: Conceptual model.



Extent of IT Usage and Knowledge from Supply Chain

In examining the creation of knowledge, most of the prior empirical research has focused on research and development expenditures as inputs into knowledge creation, and patents as outputs (Foray, 2004). However, recently, organizations have been strongly encouraged to adopt activities that generate knowledge that is embedded in the skills and experience of its employees, as well as in its processes, policies, and information repositories (Fedor, Ghosh, Caldwell, Maurer, 2003). To this end, many firms have begun to develop strategies that focus on information technology as a resource to facilitate the effective collection and utilization of information (e.g., Bharadwaj, 2000). IT, with its protocols and platform standards, provides an ideal mechanism for connecting widely dispersed entities via a common system (e.g., intranets) and enabling firm members to access more easily the knowledge that is stored in memory bins, so that new information can be interpreted and synthesized with existing knowledge (Tippins & Sohi, 2003; Jitpaiboon, Ragu-Nathan, & Vonderembe, 2006; Fedorowicz, Gogan, & Ray, 2004; Ojala & Nahar, 2006). The design of electronic systems affects how organizational members engage in perspective making and perspective taking and thus helps build "communities of knowing" (Sambamurthy, Bharadwaj, & Grover, 2003). IT systems expand the range of knowledge sharing among communities of practice (Riege, 2005). In their empirical study, Ritter and Gemunden (2003) demonstrate that access to information resources is an important

antecedent of network management competence, the ability to exchange knowledge with other actors in the network.

Sambamurthy et al. (2003) argue that the deployment of the right IT systems may enable "agile" processes in the customer interface with firms, and thereby help in proactively managing customer information. Karimi, Somers and Gupta (2001) report that firms with better IT planning and integration are more effective at managing IT to improve customer service and customer relationships, thus enhancing their customer relationship management (CRM) programs. Similarly, Murphy (1996) suggests that IT can play an ever-increasing role in understanding customer needs, serving customers better, responding faster to customer inquiries, and communicating more efficiently with customers.

In addition to enhancing CRM, Clemons and Row (1992) and Foss (1994) suggest that the extent of IT usage can support knowledge from suppliers and, thereby, potentially enhance supplier relationship management (SRM) programs. Additionally, Roberts and Mackay (1998) conducted a study suggesting the role of IT in supporting supplier relationship. These authors particularly note IT's positive role in supporting the supplier interface in electronic commerce. Thus, this literature suggests a synergistic role of IT with SRM programs.

In conclusion, a firm's extent of IT usage in managing, coordinating and monitoring relationships influences the extent of knowledge sharing. Therefore, we argue that the more IT resources are used to make knowledge-sharing happen, the more such resources can become a catalyst for sharing knowledge with customers and suppliers. Consequently, we formulate the following hypotheses:

H1: The degree of IT usage positively influences the degree of customer supply chain knowledge.

H2: The degree of IT usage positively influences the degree of supplier supply chain knowledge.

Knowledge from Supply Chain and Competitive Advantage

The role that integrated clusters of firm-specific resources play in determining sustainable competitive advantage has been the focus of much research (Liao & Hu, 2007). To the extent that firm specific resources are scarce, idiosyncratic, non-substitutable, difficult to imitate, and non-tradeable (and are effectively applied in the marketplace), resources are advantageously rent-generating, hence providing superior firm performance (Barney, 1991; Teece, Pisano, & Shuen, 1997). This resource-based perspective is based on the premise that selected characteristics of resources create factor market imperfections that exclude competitors' access (Droge, Claycomb, & Germain, 2003). Since competition is being viewed more and more as knowledge-based, then the focus of management necessarily must shift to knowledge resources and away from only focus on a combination of physical and labor resources (Liebeskind, 1996).

Knowledge-based theories of the firm advocate the creation and application of knowledge. The knowledge-based view argues that firms are heterogeneous with respect to knowledge resources

(DeCarolis & Deeds, 1999), heterogeneity being prerequisite for creating and sustaining competitive advantage (Grant, 2002). Heterogeneity's genesis lies partly in the "stickiness" and inimitability of knowledge resources (at least in the short run). Even in the longer run, knowledge can be difficult for others to imitate directly or indirectly (Wernerfelt, 1995), implying that heterogeneity can persist. In summary, the knowledge-based view argues that heterogeneous and inimitable knowledge resources are the primary sources of value and the main determinants of performance differences across firms; that is, persistent performance differences among firms develop because of knowledge asymmetries (Kogut & Zander, 1992; Kuwada, 1998).

Supply chain knowledge acquisition can shorten product development cycles, leading, ceteris paribus, to a greater rate of new product introductions. According to Zahra, Ireland and Hitt (2000), knowledge diversity increases the speed of processing, thereby reducing product development cycles. Supply chain knowledge application is exemplified by the Bombardier Challenger 300 business jet (previously the Bombardier Continental), which was developed, tested, and assembled by applying knowledge from the supply chain. The result of applying knowledge from its supply chain was cost efficiency in design and manufacture, as well as a decrease of two years in the typical time between program launch and first delivery (Siekman, 2002).

Yli-Renko et al. (2001) note that learning from key customers may result in such benefits as design economies, inbound or outbound logistics economies, or even manufacturing economies, and that knowledge acquired from customers may also help a firm produce and deliver products or services to customers at lower cost and higher speed (Lin, Huang, & Lin, 2002). This suggests that the more knowledge a firm acquires about customer needs and ways of doing business, the more efficiently it will be able to provide its product or service. This is in support of Hunt and Morgan (1995) who state that knowledge from customers should allow the firm to respond to changes in consumer preferences and enable it to build and sustain the competitive advantage. Therefore, it seems reasonably expected that knowledge from customers enhances firm’s competitive advantage

H3: Knowledge from customers positively influences firm competitive advantage

Knowledge from supplier may occur through long term relational contracting with suppliers (Gerwin, 1993). “Since supplier may possess resources that complement those of the local firm, knowledge from suppliers may generate positive externalities and allow the firm to capture spillover from its suppliers (Lorenzoni &Lipparini, 1999).” Cannon and Homburg (2001) argue that when a supplier openly shares information, the buying firm gains insights about the acquisition and use of the supplier's products. This may also ensure improving the quality of the final product, eliminating rework and reducing costs (Koufteros, Vonderember, & Jayaram, 2005; Storey, 1994). In addition, knowledge from supplier may simplify the organizational process and reduce lead time (Christopher & Ryals, 1999). Therefore, as suggested by Barney (1991), the knowledge from the supplier process has the characteristics of an organizational capability and it is expected to have a positive impact on firm performance by constituting a competitive advantage.

Similar to the effects of knowledge from customers, it might be reasonably expected that knowledge from suppliers enhances firm's competitive advantage. Therefore,

H4: Knowledge from suppliers positively influences firm competitive advantage

Competitive Advantage and Financial Performance

Quality improvement strategy broadly captures a firm's attempts to differentiate itself from its rivals using a variety of marketing and marketing-related activities (Hambrick, 1983). Quality enhancement programs are important ways for achieving product differentiation and can result in an ability to price above market, which is possible because of the customer's perception that the product is special in some way (Berman, Wicks, Kotha, & Jones, 1999) and can lead to greater customer realization (the difference between the customer's cost and benefit). This ability to command a premium price could, in turn, lead to greater profitability (Kotha & Vadlamani, 1995; Porter, 1980).

Cost efficiency measures assess the degree to which costs per unit of output are low (Berman et al, 1999). This strategy can provide above-average returns because it allows the firm who is successful at achieving lower unit costs to choose (1) to continue selling at market and achieve a higher unit margin, or (2) to lower prices to expand market share and earn a higher aggregate gross margin (Haarla, 2003; Porter, 1980, 1985). To the extent that a firm succeeds in driving down costs per unit of output, thereby increasing gross margins by choosing on of the strategies above, firm profitability should, ceteris paribus, increase (Porter, 1980; Rust, Moorman & Dickson, 2002).

For firms that compete by being first to market with new products, being able to develop products faster than competitors supports the organization's strategy by enabling quicker response to changing technologies and customer demands (Clark, 1989). Firms that succeed in developing and marketing their products faster than competitors can obtain first-mover advantages (Maiga & Jacobs, 2008) which can allow them to garner dominant market share (Langerak & Hultink, 2005). Stalk and Hout (1990) suggest that if a time-based competitor can establish a response three or four times faster than its competitors, it will grow at least three times faster than the market and will be at least twice as profitable as the typical industry competitor.

Based on the above discussions, we argue that firm competitive advantage, as reflected in its product quality, improved cost, and reduced cycle time should positively affect its profitability. Consequently, we formulate the following hypothesis:

H5: Firm competitive advantage positively influences firm profitability.

RESEARCH DESIGN AND METHODS

The process of developing the measurement instrument is based on prior literature. There are 19 items (see Appendix) that emerged from the study: five for extent of IT usage, four for knowledge from customers, four for knowledge from suppliers, three for competitive advantage,

and three for financial performance. All items were based on a seven-point Likert scale. The next step involved the collection of data through a large-scale administration.

We randomly selected 1,600 chief executive officers (CEOs), from each firm using Dun and Bradstreet, 2005. The CEOs are used as our primary contacts[1]. We mailed three copies of the questionnaire with self-addressed, postage-paid envelopes for returning the completed questionnaire directly to the researchers. The questionnaires were then to be completed by the CEO, the chief information officer (CIO) and/or chief operating officer (COO). The survey cover letter promised anonymity and described the objectives of the study. To increase the response rate, we sent follow-up letters and another copy of the questionnaire to those who had not responded. Only firms with at least two respondents were included in the study. This resulted in 589 firms out of the initial sample of 1,600 firms, representing 36.81% response rate (see Table 1).

Table 1: Responses received (number of firms).

First wave of responses received	613
Second wave of responses received	109
Total sample received	722
Les firms with only one respondent	98
Less incomplete responses	35
Usable responses	589

Nonresponse bias is always a concern in survey research. To investigate the likelihood of nonresponse bias in the data, we compared certain key attributes of 60 randomly selected respondents (firm size in terms of the total number of employees and annual sales) to those of a group of 60 randomly selected nonrespondents. We obtained firm size and sales data from Compustat. T-tests revealed no significant differences between the mean size ($t = 1.42$) and the mean sales ($t = 1.15$). To further confirm the representativeness of our sample, we tested for statistical differences in the responses between the early and late waves of survey respondents, with the last wave of surveys received considered representative of nonrespondents (Armstrong & Overton, 1977). The reasoning behind this practice is that the last wave of respondents should be most like that of non-respondents, compared to the first wave. T-tests are performed to compare the mean scores of the early and late responses. The t-tests yield no statistically significant differences among the survey items, providing some assurance that the sample of firms responding to the questionnaire was closely representative of the broader population surveyed (Siegel, 1956).

Next, we calculated the interrespondent reliability using Spearman-Brown interclass correlation coefficient (Shrout & Fleiss, 1979). These preliminary results indicated that interrespondent reliability was high across all questions in the survey (ranging from .71 to .83). Therefore, we averaged the responses for a firm to arrive at a representation of variable values for firm as a whole.

[1] For precautions against retrospective biases and errors we used multiple informants.

Construct Measures

The five constructs used in the proposed model in this study are extent of IT usage, knowledge from customers, knowledge from suppliers, competitive advantage, and financial performance. The construct items have a seven-point response format (see the appendix containing the brief research questionnaire used to measure the self-reported variables). The construct items are discussed below.

Extent of IT Usage: Following Tippins and Sohi (2003), we measure extent of IT usage with the following inquiries: (1) "We routinely utilize computer-based systems to access information from our supply chain partners from outside databases;" (2) "We have set procedures for collecting information from supply chain partners from online sources;" (3) "We use computer-based systems to analyze supply chain partner information;" (4) "We utilize decision-support systems frequently when it comes to managing supply chain partner information;" and (5) "We rely on computer-based systems to acquire, store, and process information about our supply chain partners." We measure the items on a seven-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = slightly disagree, 4 = neutral, 5 = slightly agree, 6 = agree, 7 = strongly agree)

Knowledge from Customers: Based on prior studies (Droge et al., 2003; Wu et al., 2006), we measure knowledge from customers by asking respondents to indicate the extent to which the knowledge they acquired from customers has improved using the following: (1) "Knowledge from customers that lowers your production costs;" (2) "Knowledge from customers that improves outbound delivery and inventory management;" (3) "Knowledge from customers that improves your product quality;" and (4) "Overall, our knowledge from our customers is superior to the knowledge our competitors acquire from their customers." Respondents were asked to provide ratings on the four items using a seven-point Likert-scale: (1 = Significantly worse, 4 = About the same, and 7 = Significantly better).

Knowledge from Suppliers: Following prior literature (Droge et al., 2003; Wu et al., 2006), we measure knowledge from suppliers by asking respondents to indicate the extent to which the knowledge they acquired from suppliers has improved using the following: (1) "Knowledge from suppliers that lowers your production costs;" (2) "Knowledge from suppliers that improves inbound delivery;" (3) "Knowledge from suppliers that improves your product quality;" and (4) "Overall, our knowledge from our suppliers is superior to the knowledge our competitors acquire from their suppliers." Respondents were asked to provide ratings on the four items using a seven-point Likert-scale: (1 = Significantly worse, 4 = About the same, and 7 = Significantly better)

*Competitive Advantage***:** Based on prior studies (e.g. Porter, 1980; Wang & Ahmed, 2004), respondents are asked to indicate on a seven-point Likert scale the extent to which they experienced improvement the following measures over the past three years compared to their competitors: (1) "The extent to which you offer higher quality products than your competitor;" (2) "The extent to which you offer lower cost products among your competitors;" and (3) "In comparison with our competitors, our company is faster in bringing new products into the market." Respondents were asked to provide ratings on the three items using a seven-point Likert-scale (1 = "Extremely low improvement," 2 = "Very low improvement," 3 = "Below

average improvement," 4 = "Average improvement," 5 = "Above average improvement," 6 = "Very high improvement," and 7 = "Extremely high improvement").

Financial Performance: We measure financial performance by asking respondents to indicate the level of improvement in the following items over the past three years compared to their competitors[2]: (1) "Average annual rate of growth in sales;" (2) "Average annual rate of growth in return on total assets;" and (3) "Average annual rate of growth in return on sales." Respondents were asked to provide ratings on the three items using a seven-point Likert-scale (1 = "Extremely low improvement," 2 = "Very low improvement," 3 = "Below average improvement," 4 = "Average improvement," 5 = "Above average improvement," 6 = "Very high improvement," and 7 = "Extremely high improvement").

RESULTS

In this section, we first present the descriptive statistics. Then we examine the research model depicted in Figure 1 using structural equation modeling with a two-stage model-building process (Joreskog & Sorbom, 1993; Hair, Anderson, Tatham & Black, 1998; Maruyana, 1998), in which the measurement model is tested before testing the structural model. The measurement models specify how hypothetical constructs are measured in terms of observed variables (Pijpers, Bemelmans, Heemestra & Monfort, 2001; Tan, 2001), while the structural model depicts the hypothesized relationships between latent constructs. Hence, we examine the measurement model first; then the structural model is examined.

Descriptive Statistics

The profile of the responding firms in Table 2, Panel A indicates that they constitute a broad spectrum of manufacturers as defined by the two-digit SIC code. The sample composition has the largest representation in electronic and electrical equipment (12.733 percent), chemical and allied products (12.394 percent), apparel and other textile products (8.829 percent), food and kindred products (8.319 percent) followed by transportation equipment (7.980 percent), paper and allied products (7.810 percent), primary metal industries (7.640 percent), and industrial machinery equipment (7.131 percent). Additional information on respondents' characteristics is provided in Table 2, Panel B. Answers to the question regarding number of years at present position showed that the respondents have a mean of 13.56 years in their current position. To the number-of-years-in-management question, respondents indicated a mean of 18.37 years. It appears from their positions and tenure that the respondents are knowledgeable and experienced, have access to information upon which to provide reliable perceptions, and are otherwise well qualified to provide the information required. The results also show that the average number of employees is 1,545, and mean sales of $234.797 millions.

[2] Respondents rated performance over the past three years to offset particularly good or bad years attributable to unusual circumstances (Miller, 1991).

Table 2: Respondents' characteristics.

Panel A: Industry classification

	SIC	Number of firms in sample (n = 589)	% of sample
Food and kindred products	20	49	8.319
Textile mill products	22	41	6.961
Apparel and other textile products	23	52	8.829
Lumber and wood products	24	6	1.019
Furniture and fixtures	25	13	2.207
Paper and allied products	26	46	7.810
Chemicals and allied products	28	73	12.394
Petroleum and coal products	29	15	2.547
Rubber and plastics products	30	21	3.565
Stone, clay and glass products	32	8	1.358
Primary metal industries	33	45	7.640
Fabricated metal products	34	34	5.772
Industrial machinery and equipment	35	42	7.131
Electronic, electrical equipment	36	75	12.733
Transportation equipment	37	47	7.980
Instruments and related products	38	22	3.735
Total		589	100

Panel B: Other characteristics of respondents

	Minimum	Maximum	Mean	Standard deviation
Length at present position (years)	7	18	13.56	2.93
Length in management (years)	11	23	18.37	5.47
Number of employees	679	2,873	1,545	348
Sales (millions)	124.322	464.983	234.797	195.657

Measurement and Structural Model Methods

The measurement model is tested first, followed by the testing of the structural model. This should be done in order to avoid the possible interactions between the measurement and structural models. In addition, confirmatory factor analysis (CFA) is performed on a covariance

matrix using maximum likelihood estimation and on the entire set of items simultaneously (Anderson, Gerbing & Hunter, 1987). Convergent validity is assessed by examining the significance of individual item loadings through t-tests. The overall fit of a hypothesized model can be assessed using fit indices such as the ratio of chi-square to degrees of freedom, Bentler and Bonnet's (1980) normed fit index (NFI), Bentler's (1980) comparative fit index (CFI), James et al.'s (1982) goodness-of-fit index (GFI), and Steiger and Lind's (1980) root mean square error of approximation (RMSEA). Discriminant validity can be assessed by comparing the average variance extracted (AVE) to the squared correlation between constructs (Fornell & Larker, 1981). Reliability estimation is left for last because in the absence of a valid construct, reliability may not be relevant (Koufteros, 1999). To test hypotheses, a structural model was evaluated. If a model fits the data adequately, the t-values of the structural path coefficients (i.e., γ and β) can be used to test the research hypotheses.

Measurement Model: The posited measurement model appears to be supported by the factor loadings and various fit indices. All factor loadings are above .70 and most above .80, and the significance of the t- values (Table 3) associated with factor to item loadings exceeds the critical value at the .05 significant level. The fit indices, along with t-values, provide evidence of convergent as well as discriminant validity (See bottom of Table 3). The ratio chi-square to degrees of freedom results in a ratio of 1.97. The GFI was .92 and NFI was .93, whereas the CFI was 0.94 and the RMSEA was .048. All of the items have statistically significant relationships with their factors.

Table 3: Analysis of measurement model.

Construct		Standardized loading	T-value
Extent of IT Usage			
1.	We routinely utilize computer-based systems to access information from our supply chain partners from outside databases	0.847	28.365
2.	We have set procedures for collecting information from supply chain partners from online sources	0.915	39.760
3.	We use computer-based systems to analyze supply chain partner information	0.701	21.853
4.	We utilize decision-support systems frequently when it comes to managing supply chain partner information	0.713	19.241
5.	We rely on computer-based systems to acquire, store, and process information about our supply chain partners	0.961	___*
Knowledge from Customers			
1.	Knowledge from customers that lowers your production costs	0.886	25.594
2.	Knowledge from customers that improves outbound delivery and inventory management	0.794	22.068
3.	Knowledge from customers that improves your product	0.716	19.784

	quality		
4.	Overall, our knowledge from our customers is superior to the knowledge our competitors acquire from their customers	0.980	____*
Knowledge from Suppliers			
1.	Knowledge from suppliers that lowers your production costs	0.877	42.153
2.	Knowledge from suppliers that improves inbound delivery	0.804	26.484
3.	Knowledge from suppliers that improves your product quality	0.808	29.340
4.	Overall, our knowledge from our suppliers is superior to the knowledge our competitors acquire from their suppliers	0.982	____*
Competitive Advantage			
1.	The extent to which you offer higher quality products than your competitor	0.703	16.117
2.	The extent to which you offer lower cost products among your competitors	0.828	17.907
3.	In comparison with our competitors, our company is faster in bringing new products into the market	0.907	____*
Financial Performance			
1.	Average annual rate of growth in sales	0.819	18.717
2.	Average annual rate of growth in return on total assets	0.783	23.369
3.	Average annual rate of growth in return on sales	0.892	____*

Fit indices: ($\chi 2$/df = 1.97, GFI = 0.92, NFI = 0.93, CFI = 0.94, IFI = 0.94, and RMSEA = 0.048)
* Indicates a parameter is fixed at 1.0 in the original solution

Table 4 also provides descriptive statistics, composite reliabilities, average variance extracted (AVE), and correlations among the constructs. Evidence of discriminant validity is provided by comparing the squared correlation of two constructs against their individual AVE. The squared correlations were lower than their corresponding AVE for the latent variables. The composite reliabilities and AVE estimates for each construct exceed customary acceptable levels. Overall, there is comforting support for the models to allow us to proceed with an evaluation of the structural model and hypotheses testing.

Table 4: Descriptive statistics - mean, standard deviation, correlation, reliability, and discriminant analysis.

	Mean	Standard Deviation	1	2	3	4	5
(1) Extent of IT Usage	27.927	6.551	0.926[a], 0.777[b]				
(2) Knowledge from Customers	24.518	5.443	0.115[c**], 0.02[d]	0.909, 0.788			
(3) Knowledge from Suppliers	21.954	5.497	0.171**, 0.03	0.190**, 0.03	0.936, 0.839		
(4) Competitive Advantage	15.090	4.197	0.085*, 0.00	0.491**, 0.02	0.224**, 0.03	0.908, 0.845	
(5) Financial Performance	16.043	5.114	0.062, 0.00	0.020, 0.00	0.061, 0.00	0.136*, 0.00	0.893, 0.890

[a] Reliabilities are on the diagonal.
[b] Average variance extracted is on the diagonal.
[c] Correlation [**significant at the 0.01 level, *significant at the 0.05 level (2-tailed)]
[d] Square correlation
For discriminant validity, average variance extracted (diagonal elements denoted b) should be larger than the square correlations (off-diagonal elements denoted d) (Fornell & Larcker, 1981).

The overall structural model fit appears to be reasonable (e.g., chi-square to degrees of freedom = 2.327; GFI = 0.986; NFI = 0.906; CFI = 0.924; RMSEA = 0.041 (See bottom of Table 5), and we proceed with testing of hypotheses. Next, we examine the standardized parameter estimates for our model by using the significance of individual path coefficients to evaluate the hypotheses. Hypotheses Hl and H2 state that extent of IT usage will positively influence both knowledge from customers and knowledge from suppliers, respectively. The results support these hypotheses (Table 5, Fig. 2). Specifically, higher levels of IT usage are associated with both higher levels of knowledge from customers ($\gamma_{1,1}$ = 0.115, t = 2.814) and knowledge from suppliers ($\gamma_{2,1}$ = 0.171, t = 4.215). IT usage may be necessary if both knowledge from customers and suppliers are to materialize at significant levels.

Knowledge from customers is hypothesized to affect competitive advantage (H3). The results indicate that knowledge from customers has statistically significant and positive relationship with firm competitive advantage ($\beta_{3,1}$ = 0.470 , t = 13.086). Similarly, knowledge from suppliers is hypothesized to affect competitive advantage (H4). The results indicate that knowledge from suppliers has statistically significant and positive relationship with competitive advantage ($\beta_{3,2}$ = 0.137, t = 3.812). Businesses that possess the ability to gain knowledge from their customers and suppliers and to act on that knowledge are best positioned to achieve competitive advantage (Tuominen et al., 1997). Hence, the contributions of knowledge from both customers and suppliers in enhancing firm competitive advantage cannot be ignored.

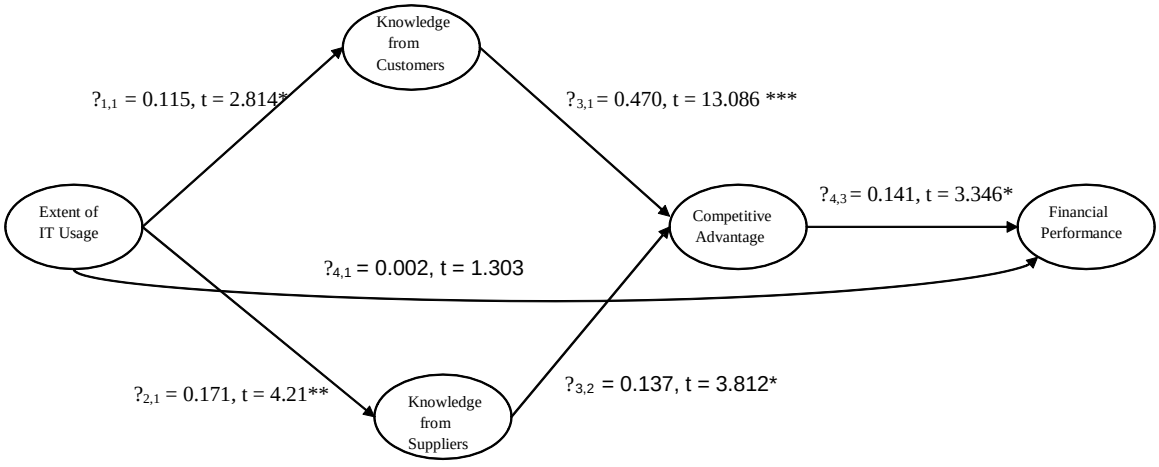
Hypothesis H5 argues for a positive relationship between competitive advantage and firm financial performance. This hypothesis is strongly supported. Higher level of competitive advantage is associated with higher levels of financial performance ($\beta_{4,3}$ = 0.141, t = 3.346). Table 5 and Figure 2 show the estimates and significance of the hypothesized paths for the structural model. Further analysis indicates that the direct effect of extent of IT usage on firm performance is not significant ($\gamma_{4,1}$ = 0.002, t = 1.303) (see Figure 2).

Table 5: Standardized path coefficient estimates for the structural model.

	Direct effects	Indirect effects	Total effects
Extent of IT Usage			
Knowledge from Customers	0.115* (2.814)**	------	0.115 (2.814)
Knowledge from Suppliers	0.171 (4.215)		0.171 (4.215)
Competitive Advantage	------	0.078 (3.636)	0.078 (3.636
Financial Performance -	-----	0.011 (2.462)	0.011 (2.462)
Knowledge from Customers			
Competitive Advantage	0.470 (13.086)	------	0.470 (13.086)
Financial Performance	------	0.064 (3.241)	0.064 (3.241)
Knowledge from Suppliers			
Competitive Advantage	0.137 (3.812)	------	0.137 (3.812)
Financial Performance -	-----	0.019 (2.515)	0.019 (2.515)
Competitive Advantage			
Financial Performance	0.141 (3.346)	------	0.0141 (3.346)

Fit indices: χ^2/df = 2.327; GFI = 0.986; NFI = 0.906; CFI = 0.924; RMSEA = 0.041
* path coefficient
** t-value

Figure 2: Standardized structural model path coefficients and significance.



Chi-square to degrees of freedom = 2.327; GFI = 0.986; NFI = 0.906; CFI = 0.924; RMSEA = 0.041

* p < 0.05, ** p< 0.01 **p < 0.001

CONCLUSIONS

This study uses manufacturing firm extent of IT usage as an antecedent of knowledge from customers and suppliers. Firms that reported high levels of IT usage also reported high levels of knowledge from both customers and suppliers. Furthermore, high levels of knowledge from customers and suppliers are conducive to firm competitive advantage that, in turn, leads to firm financial performance. The fact that knowledge from customers and suppliers is significantly related to firm competitive advantage provides further support for the robustness of the knowledge-based view. This is consistent with Zahra et al. (2000) who argue that increases in knowledge strengthen other core competencies and may therefore lead to greater efficiencies. Our study is also consistent with prior literature that suggests that IT does not have a direct impact on firm performance (e.g. Makadok, 2001; Powell & Dent-Micallef, 1997). Therefore, this study indicates that by leveraging IT to acquire knowledge from customers and suppliers and by exploiting this knowledge firms may accomplish strategic and entrepreneurial objectives in the form of competitive advantage. In addition, a firm possessing these knowledge capabilities can shield itself from immediate competitive imitation since such capabilities are developed over time and are deeply embedded in organizational routines, providing the basis of sustained competitive advantage (e.g. Bharadwaj, 2000) that is ultimately translated into firm financial performance.

However, at least four limitations of this study should be noted. First, surveys are not without disadvantages. Surveys measure beliefs, which may not always coincide with actions. Surveys lack variable manipulation (Krumwiede, 1998); therefore, "cause" cannot be inferred from this study. In addition, the survey method, as presented, does limit the use of open-ended questions and face-to-face data gathering and the richness such data provides. Second, this study has used a limited set of variables in the model to test the consequences of extent of IT usage. Further research might build on this study and others to provide a more complete understanding and eventually an integrated theory that provides better insights into IT profitability. Third, this study was limited to manufacturing firms. This narrow focus helped to control for industry-specific differences that might have otherwise masked significant effects. Future studies conducted in other industry settings may shed light on the generalizability of the theoretical positions developed here. Fourth, this study relied on cross-sectional data. Collecting longitudinal data can offer richer implications.

Despite the above limitations, this study is important in practice as it contributes significantly to the literature by improving our understanding of how firms can use IT to achieve financial performance. In particular, managers need to recognize the role of knowledge acquisition and competitive advantage in realizing the value of IT resources. As the resource-based view argues, IT resources offer benefits when they are embedded in specific organizational process (Barney, 1991). Findings suggest that extent of IT usage can help realize these benefits through knowledge acquisition and achieving competitive advantage.

REFERENCES

Anand, V., Manz, C. C., & Glick, W. H. (1998). An Organizational Memory Approach to Information Management. *Academy of Management Review,* 23(4), 796–809.

Anderson, J. C., Gerbing, D. W., & Hunter, J. E. (1987). On the Assessment of Unidimensional Measurement: Internal and External Consistency, and Overall Consistency Criteria. *Journal of Marketing Research, 24,* 432-437.

Armstrong, J. S. & Overton, T. S. (1977). Estimating Nonresponse Bias in Mail Survey. *Journal of Marketing Research,* 14(3), 396–421.

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

Bentler, P. (1980). Multivariate Analysis with Latent Variables: Causal Modeling. *Annual Review of Psychology,* 31, 419-456.

Bentler, P. & Bonnet, D. G. (1980). Significance Tests and Goodness-of-Fit in the Analysis of Covariante Structures. *Psychological Bulletin,* 88, 588-606.

Berman, S. L., Wicks, A. C, Kotha, S., & Jones, T. M. (1999). Does Stakeholder Orientation Matter? The Relationship Between Stakeholder Management Models and Firm Financial Performance. *Academy of Management Journal,* 42, 488-508.

Bharadwaj, A. S. (2000). A Resource-Based Perspective on Information Technology Capability and Firm Performance: An Empirical Investigation. *MIS Quarterly,* 24(1), 169–196.

Cannon J. P., & Homburg C. (2001). Buyer–Supplier Relationships and Customer Firm Costs. *Journal of Marketing,* 65, 29–43.

Christopher, M. & Ryals, L. (1999). Supply Chain Strategy, its Impact on Shareholder Value. *The International Journal of Logistics Management,* 10(1), 143-172.

Clark, K. B. (1989). Project Scope and Project Performance: The Effects of Parts Strategy and Supplier Involvement on Product Development. *Management Science,* 35(10), 1247–63.

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

Decarolis D. & Deeds D. L. (1999). The Impact of Stocks and Flows of Organizational Knowledge on Firm Performance: An Empirical Investigation of the Biotechnology Industry. *Strategic Management Journal,* 20, 953-968

Droge C., Claycomb, C., & Germain, R. (2003). Does Knowledge Mediate the Effect of Context on Performance? Some Initial Evidence. *Decision Sciences,* 34(3), 541-568.

Fedor, D. B., Ghosh, S., Caldwell, S. D., Maurer, T. J., & Singhal, V. R. (2003). The Effects of KM on Team Members' Ratings of Project Success and Impact. *Decision Sciences,* 34(3), 513-39.

Fedorowicz, J., Gogan, J. L., & Ray, A. W. (2004). The Ecology of Interorganizational Information. *Journal of International Technology and Information management,* 13(2), 73-86.

Foray, D. (2004). *The economics of knowledge*. The MIT Press, Cambridge

Fornell, C. & Larker, D. F. (1981). Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. *Journal of Marketing Research*, 18(1), 39-50.

Foss, L. (1994). Entrepreneurship: The impact of human capital, a social network and business resources on start-up, unpublished PhD thesis, Norwegian School of Economics and Business Administration, Bergen.

Gerwin D. (1993). Manufacturing Flexibility: A Strategic Perspective. *Management Science*, 39(4), 395–410.

Grant, R. M. (2002). The Resource-Based Theory of Competitive Advantage. *Strategy: Critical Perspectives on Business and Management,* 33(3), 135-151.

Haarla A. (2003). Product differentiation: Does it provide competitive advantage for a printing paper company? Ph.D. Thesis, Helsinki University of Technology, Dept. of Forest Products Technology, Laboratory of Paper Technology, Helsinki, Finland.

Hair, J. F., Anderson, R. E., Tatham, R. L., & Black, W. C. (1998). Multivariate data analysis. Upper Saddle River, NJ: Prentice Hal

Hambrick, D. C. (1982). Environmental Scanning and Organizational Strategy. *Strategic Management Journal*, 3, 159–174.

Hambrick, D. C. (1983). Some Tests of the Effectiveness and Functional Attributes of Miles and Snow's strategic types. *Academy of Management Journal*, 26, 5-26.

Hong, S. K. & Schniederjans, M. J. (2000). Balancing Concurrent Engineering Environmental Factors for Improved Product Development Performance. *International Journal of Production Research*, 38(8), 1779–1800.

Hunt, S. D. & Morgan, R. M. (1995). The Comparative Advantage Theory of Competition. *Journal of Marketing*, 59, 1-15.

James, L. R., Mulaik, S. A., & Brett, J. M. (1982). Causal analysis: Assumptions, models, and data. Beverly Hills: Sage.

Jelinek, M. (1979). Institutionalizing innovation: A study of organizational learning systems. New York: Praeger.

Jitpaiboon, T., Ragu-Nathan, T. S., & Vonderembe, M. A. (2006). An Empirically Derived Taxonomy of Information Systems Integration. *Journal of International Technology and Information management*, 15(2), 17-38.

Joreskog, K. G. & Sorbom, D. (1993). LISREL 8: User's reference guide. Chicago: Scientific Software International.

Karimi, R., Somers, T. M., & Gupta, Y. P. (2001). Impact of Information Technology Management Practices on Customer Service. *Journal of Management Information Systems*, 17(4), 125-58.

Kotha, S. & Vadlamani, B. L. (1995). Assessing Generic Strategies: An Empirical Investigation of Two Competing Typologies in Discrete Manufacturing Industries. *Strategic Management Journal*, 16(l), 75-83.

Koufteros, X. A. (1999). Testing a Model of Pull Production: A Paradigm for Manufacturing Research Using Structural Equation Modeling. *Journal of Operations Management*, 17, 467–488.

Koufteros, X. A., Vonderembse, M. A., & Jayaram, J. (2005). Internal and External Integration for Product Development: The Contingency Effects of Uncertainty, Equivocality, and Platform Strategy. *Decision Sciences*, 36(1), 97–133.

Krumwiede, K. (1998). The Implementation Stages of Activity-Based Costing and the Impact of Contextual and Organizational Factors. *Journal of Management Accounting Research*, 10, 239–77.

Langerak, F. & Hultink, E. J. (2005). The Impact of New Product Development Acceleration Approaches on Speed and Profitability: Lessons for Pioneers and Fast Followers. *IEEE Transactions on Engineering Management* 52(1), 30–42.

Lea, B. R. (2005). Leveraging Information Technology to Gain Competitive Advantage: A Case Study on General Electric Consumer Products. *Journal of International Technology and Information Management*, 1(1), 25-40

Li, Q., Rynson, W. H., Timothy, L., Shih, K., & Frederick, W. B. L. (2008). Technology Supports for Distributed and Collaborative Learning over the Internet. *ACM Transactions on Internet Technology*, 8(2), 1-24.

Liao, S. H. & Hu, T. C. (2007). Knowledge Transfer and Competitive Advantage on Environmental Uncertainty: An Empirical Study of the Taiwan Semiconductor Industry. *Technovation*, 27(6-7), 402-411.

Liebeskind, J. (1996). Knowledge, Strategy and the Theory of the Firm. *Strategic Management Journal*, 17 (Special Issue), 93-108.

Lin, F., Huang, S., & Lin, S. (2002). Effects of Information Sharing on Supply Chain Performance in Electronic Commerce. *IEEE Transactions on Engineering Management*, 49(3), 258– 268.

Lorenzoni, G. & Lipparini, A. (1999). The Leveraging of Inter-firm Relationships as a Distinctive Organizational Capability. *Strategic Management Journal* 20(4), 317–339.

Maiga, A. S. & Jacobs, F. A. (2008). Extent of ABC Use and its Consequences. *Contemporary Accounting Research* 25(2), 533-566.

Makadok, R. (2001). Toward a Synthesis of the Resource-Based and Dynamic- Capability Views of Rent Creation. *Strategic Management Journal*, 22, 387-401.

Maruyana, G. M. (1998). Basics of structural equation modeling. London. Sage Publications, Inc.

Miller, D. (1991). Stale in the Saddle: CEO Tenure and the Match between Organization and Environment. *Management Science*, 37(1), 34–52.

Murphy, J. A. (1996). Retail banking. In F. Buttle (ed.) Relationship marketing: Theory and practice. London: Paul Chapman Publishing, 74- 90.

Ojala, A. & Nahar, N. (2006). Cross-border IT-support for the Management of International Subsidiary Operations: The Diffusion of Innovations-based Conceptual Model. *Journal of International Technology and Information management*, 15(2), 75-86.

Pijpers, G. G. M., Bemelmans, T. M. A., Heemstra, F. J., & Monfort, K. (2001). Senior Executives Use of Information Technology. *Information and Software Technology*, 43, 959-971.

Porter, M.E. (1980). Competitive advantage. New York: Free Press.

Porter, M. E. (1985). Competitive advantage: Creating and sustaining superior performance. New York: Free Press

Riege, A. (2005). Three-dozen Knowledge-Sharing Barriers Managers must Consider. *Journal of Knowledge Management*, 9(3), 18-35.

Ritter, T. & Gemunden, H. G. (2003). Network competence: It's Impact on Innovation Success and its Antecedents. *Journal of Business Research*, 56, 745–755.

Roberts, B. & Mackay, M. (1998). IT Supporting Supplier Relationships: The Role of E-Commerce. *European Journal Purchasing Supply Management*, 4, 175-184

Rust, R. T., Moorman, C., & Dickson, P. R. (2002). Getting Return on Quality: Revenue Expansion, Cost Reduction, or Both? *Journal of Marketing*, 66(4), 7–24.

Sambamurthy V., Bharadwaj A., & Grover, V. (2003). Shaping Agility through Digital Options: Reconceptualizing the Role of Information Technology in Contemporary Firms. *MIS Quarterly,* 2(27), 237-263.

Shrout P. E. & Fleiss J. L. (1979) Intraclass Correlations: Uses in Assessing Rater Reliability. *Psychological Bulletin*, 86, 420-428.

Siekman, P. (2002). The Snap-Together Business Jet. Fortune, 145 (2), 104A–104H.

Spender, J. C. (1996). Making Knowledge the Basis of a Dynamic Theory of the Firm. *Strategic Management Journal*, 17, 45–62.

Stalk, G., Jr. & Hout, H. (1990). Competing against time. New York: Free Press.

Steiger, J. H. & Lind, J. M. (1980). Statistically based tests for the number of common factors. Paper presented at the annual meeting of the Psychometric Society, Iowa City, IA.

Tan, K. C. (2001). A Framework of Supply Chain Management Literature. *European Journal of Purchasing & Supply Chain Management*, 7, 39-48.

Tatikonda, M. V. & Montoya-Weiss, M. M. (2001). Integrating Operations and Marketing Perspectives of Product Innovation. *Management Science*, 47(1), 151-172.

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

Tippins, M. & Sohi, R. (2003). IT Competency and Firm Performance: Is Organizational Learning a Missing Link? *Strategic Management Journal*, 24, 745-761.

Tuominen, M., Moller, K., & Rajala, A. (1997). Marketing capability: A nexus oflearning-based resources and a prerequisite for market orientation. Proceedings of the Annual Conference of the European Marketing Academy, (May), 1220-1240.

Wang, C. L. & Ahmed, P. K. (2004). The Development and Validation of the Organizational Innovativeness Construct Using Confirmatory Factor Analysis. *European Journal of Innovation Management*, 7(4), 303–313.

Wernerfelt, B. (1995). A Resource-based View of the Firm: Ten Years Later. *Strategic Management Journal*, 16(2), 171–174.

Wu, J. P., Tsai, R. J., Chen, C. C., & Wu, Y. C. (2006). An Integrative Model to Predict the Continuance Use of Electronic Learning Systems: Hints for Teaching. *International Journal on E-Learning*, 5(2), 287–302.

Yli-Renko, H., Autio, E., & Sapienza, H. J. (2001). Social Capital, Knowledge Acquisitions, and Knowledge Exploitation in Young Technology-based Firms. *Strategic Management Journal*, 22(6), 587-613.

Zahra, S. A., Ireland, R., & Hitt, M. (2000). International Expansion by New Venture Firms: International Diversity, Mode of Market Entry, Technological Learning, and Performance. *Academy of Management Journal* 43(5): 925–950.

Zhang, M. J. & Lado, A. A. (2001). Information Systems and Competitive Advantage: A Competency-Based View. *Technovation* 21(3), 147-156.

APPENDIX

Extent of IT Usage (Tippins & Sohi, 2003)

		1 = stongly disagree	7 = strongly agree
1.	We routinely utilize computer-based systems to access information from our supply chain partners from outside databases	1 2 3 4 5 6 7	
2.	We have set procedures for collecting information from supply chain partners from online sources	1 2 3 4 5 6 7	
3.	We use computer-based systems to analyze supply chain partner information	1 2 3 4 5 6 7	
4.	We utilize decision-support systems frequently when it comes to managing supply chain partner information	1 2 3 4 5 6 7	
5.	We rely on computer-based systems to acquire, store, and process information about our supply chain partners	1 2 3 4 5 6 7	

Knowledge from Customers (Droge et al., 2003; Wu et al., 2006)

		1= significanty worse	7 =significantly better
1.	Knowledge from customers that lowers your production costs	1 2 3 4 5 6 7	
2.	Knowledge from customers that improves outbound delivery and inventory management	1 2 3 4 5 6 7	
3.	Knowledge from customers that improves your product quality	1 2 3 4 5 6 7	
4.	Overall, our knowledge from our customers is superior to the knowledge our competitors acquire from their customers	1 2 3 4 5 6 7	

Knowledge from Suppliers (Droge et al., 2003; Wu et al., 2006)

		1= significanty worse	7 =significantly better
1.	Knowledge from suppliers that lowers your production costs	1 2 3 4 5 6 7	
2.	Knowledge from suppliers that improves inbound delivery	1 2 3 4 5 6 7	
3.	Knowledge from suppliers that improves your product quality	1 2 3 4 5 6 7	
4.	Overall, our knowledge from our suppliers is superior to the knowledge our competitors acquire from their suppliers	1 2 3 4 5 6 7	

Competitive Advantage (Porter, 1980; Wang & Ahmed, 2004)

	1 = extremely low improvement	7 = extremely high improvement
1. The extent to which you offer higher quality products than your competitor,	1 2 3 4 5 6 7	
2. The extent to which you offer lower cost products among your competitors	1 2 3 4 5 6 7	
3. In comparison with our competitors, our company is faster in bringing new products into the market	1 2 3 4 5 6 7	

Financial Performance (Chenhall, 1997; Swamidass & Newell, 1987)

	1 = extremely low improvement	7 = extremely high improvement
Average annual rate of growth in sales	1 2 3 4 5 6 7	
Average annual rate of growth in return on total assets	1 2 3 4 5 6 7	
Average annual rate of growth in return on sales	1 2 3 4 5 6 7	