



The effect of individual, network, and collaborative competencies on the supply chain management system

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ABSTRACT

The role of human capital as a source of competitive advantage has long been recognized; however, there has been little research into the competencies required in the supply chain management system. This paper strengthens the ties between supply chain and human resource management by examining the competencies inherent in successful supply chain management systems. Using structural equation modeling we assess the linkages between individual, network and inter-organizational competencies, investment in strategic partnership and firm performance. The findings reveal that both organizational awareness (competency at the individual level) and supply network competency (competency at the organizational level) have significant and positive effects on collaborative awareness. The importance of inter-organizational competencies is supported by the significant positive effect that collaborative awareness has on investment in strategic planning. Implications for human resource managers and supply chain managers are also provided.

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1. Introduction

It has become increasingly important to build organizational competencies that enable employees to combine and leverage their individual knowledge for greater organizational advantage (Athey and Orth, 1999). An area where these bundles of knowledge, skills and abilities that are key to developing and realizing organizational goals would appear to be particularly relevant is supply chain management which, when utilized effectively, can be used strategically to create added value to the firm (McCarter and Northcraft, 2007). To date, there has been little research into the competencies required of successful supply chain systems. This is probably due in no small part to the lack of literature linking the operations management and human resources (HR) fields (Ahmad and Schroeder, 2003; Koulikoff-Souvion and Harrison, 2007). As Scarbrough (2000) has pointed out, there have been few studies of the implications for organizational or employee practices of supply chain relationships, despite its growing importance. Although historically separate fields, supply chain management and human resource management are “intimately tied together” in practically all business environments (Boudreau et al., 2003, p. 179).

One of this paper's contributions is to strengthen the ties between supply chain and HR management by examining the competencies inherent in successful supply chain management systems that would encourage investment in strategic partnership with suppliers. At the individual level, the importance of supply chain management professionals' competency in effective supply chain management has been restricted to case studies. An empirical study designed to validate competency embedded in human resource would be valuable to provide a foundation for understanding this subject and provide implications to supply chain and human resource management practitioners. Supply chain managers must routinely share information, develop relationships, cooperate, and use collaborative skills with suppliers and internal and external customers. Internally, they must understand, collaborate and resolve differences with the various business functions within their own company. This study draws on knowledge management literature on competency to develop a definition of organizational awareness competency at the individual level within a firm.

Little empirical analyses have investigated competencies at different levels as an important strategic tool in supply chain management. We have identified three key areas where these competencies are necessary: at the individual supply chain manager level; within the supply network itself; and the collaboration requirements with suppliers. Although the latter component has been researched with some frequency, the competencies required of the supply chain manager and that of the network itself have yet to receive much attention (Gammelgaard and Larson, 2001). Thus,

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the second contribution of this paper is to investigate the competencies required at the “front end” of the supply chain management system.

Stank et al. (2001) suggest that both internal and external collaboration are necessary for successful supply chain performance. The combination of the organizational awareness on the part of the supply chain manager and the competency of the supply network should result in a trusting, long-term relationship with the supplier, a term we call collaborative awareness in this paper. Successful supply chain relationships should consist of partners that are willing to provide assistance to one another without exception; it is a relationship both parties are committed to and satisfied with. A relationship such as this, built on trust and commitment, should in turn result in an investment in strategic partnership, wherein suppliers are included in planning, problem solving, continuous improvement and product development processes. Development of a partnership with suppliers is widely recognized today as a potent tool for supply chain improvement. Until now, there has been little insight into how supply chain professional competencies are associated with partnership development. Successful supply chain managers collaborate often with other functions and engage in joint problem solving of operational issues and strategic issues, which facilitates inter-organizational partnership to take place and to be effective. This paper will make a third major contribution by examining the competencies required in successful strategic partnership development, and will extend the competency literature to include inter-organizational competencies.

2. Background and hypotheses

2.1. Competencies

The concept of competencies has expanded since their initial introduction by McClelland (1973) and Lawler (1994), moving from the field of human resource management to various business disciplines. Competencies have been studied extensively at the individual and team level, and more recently at the firm level, but rarely (if ever) at the inter-organizational level.

In the context of human resource management, competencies are considered to be composed of the knowledge, skills and abilities that are associated with high performance on the job at an individual level (Mirabile, 1997). At the team level, competency is influenced by individual competency and one's capacity to interact with other team members as well. Recent studies recognize team competencies consist of not only technical competency but also social competency, in particular teamwork and communication. Kauffeld (2006) studied four self-management team competences including knowledge, skills, ability to communicate and cooperate, and willingness to create collaborative learning environment. Through social interaction, behaviors, knowledge, skills and perceptions of individual team members are mutually influenced. Thus, social competency plays a critical role in whether technical competencies are put into practice effectively. From a strategic perspective, the idea has expanded to the firm level to include “core” competencies as the unique intellectual, process or product competencies that give a firm a competitive advantage (Prahalad and Hamel, 1990), and where the collective learning and performance capabilities of the organization contribute to firm success (Athey and Orth, 1999). Athey and Orth (1999) suggest that as technology and globalization have changed the ways business is conducted, competencies must include process capabilities that enhance organizational or business performance (p. 217).

In the field of supply chain management, the concept of competency has focused not as much on the individual as on the relationship between the parties in the supply chain (i.e., at a team level). In this context, competence is seen as an internal activity that an organization performs with proficiency, and many competencies (e.g., continuous product innovation) are seen as inherently multidisciplinary and cross functional (Koufteros et al., 2010).

The definition of what competencies are will continue to change as organizations strive to meet rapidly changing business needs (Athey and Orth, 1999). Miles and Snow (2007), in their article on the evolution of supply chain management, commented that “Many observers of today's global business arena agree that new business and organizational models are needed if firms and economies are to fully utilize their knowledge base to continually generate new products, services, and markets” (p. 461). Furthermore, Lavie (2006) proposed that organizational competitive advantage in a networked context requires consideration of the focal organization's own resources along with the partner resource endowments. Thus, as the success of the firm becomes more dependent on the relationships and networks it establishes outside the firm, the development of inter-organizational competencies seems inevitable.

The model for our study merges the fields of human resource management and supply chain management to capture individual, team, and interorganizational competencies between supply chain partners, and how these competencies lead to behavior that results in better performance of the firm (see Fig. 1). Our model is based on a model for HR practitioners (Parry, 1996), which has been adapted for the supply chain management context. In Parry's (1996) model, employees must have competencies (knowledge, skills, and abilities) that are applied in the form of behavior, which produces outputs that yield results; in other words:

Competencies → Behavior → Outputs → Results

In our model, the competencies are at the individual level in the form of organizational awareness; within the supply network itself (supply network competency) as measured by the network's operational, flexibility and spanning competencies; and inter-organizationally by the amount of collaborative awareness between the firms. Behavior is measured by the strategic investment that the focal firm makes with its suppliers (investment in strategic partnership). Since supply chain management is about coordinating the activities of all supply chain members in an effective and efficient way, it is essential to define metrics to measure the results of management efforts to supply chain members and customers as well. In typical supply chain management research, outputs and results are defined as performance (Chen and Paulraj, 2004; Closs and Mollenkopf, 2004). Therefore, in our model, cost, reliability and customer responsiveness are the determinants of the focal firm's overall performance.

2.1.1. Collaborative awareness(CA)

Each party in a supply chain has distinct competencies and behaviors that give each firm its unique competitive advantage. For a supply chain relationship to be successful, the parties must have an awareness of their shared goals and working processes, and must overcome difficulties caused by these differences in competencies in order to achieve common goals. In several different management information systems studies, the concept of “awareness of collaboration” has been explored as social interaction in group work (Schmidt, 2002); a system for simultaneous use of multiple users (Lauwers and Lantz, 1990); and as knowledge that is constructed technologically (Gutwin and Greenberg, 2004). In the supply chain context, collaboration requires management of information and operations across organizational boundaries and maintenance of the social relationship between the parties. In this study, collaborative awareness is defined at the organizational level as the

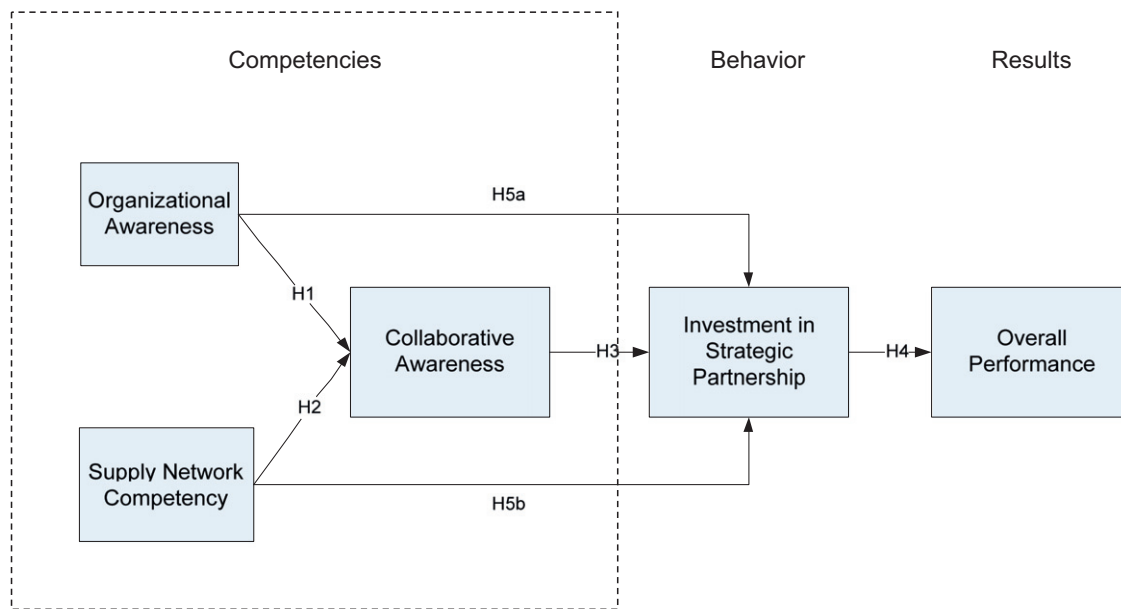


Fig. 1. Hypothesized model structure.

extent to which a firm perceives its trust in and committed relationship with their supply chain partners. This relationship, which exploits both the tacit and explicit knowledge of the networked firms, will result in inter-organizational competencies that create a strategic advantage for the focal firm.

Recent empirical evidence supports this perspective that collaborative buyer–supplier relationships lead to better supply chain performance (Stank et al., 2001), increased profits, and improved competitive advantage (Jap, 1999). In his study of the human resource implications of suppliers as viewed from the supplier firms, Scarbrough (2000) found that higher levels of collaboration resulted in greater operational efficiency in terms of inventory levels, fill rates, returned products and levels of satisfaction. Over time, parties that develop relationships based on trust and reciprocity end up having greater access to knowledge and opportunities (Inkpen and Tsang, 2005) and partner resources (Gulati, 1995).

Collaborative awareness is composed of a blend of trusting and committed relationships, which are a key to competitive success. Researchers have argued that effective supply chain collaborations are based on trusting relationships that focus on continuous improvement (Love and Gunasekaran, 1999; Dyer and Chu, 2003). Trust improves supply chain effectiveness (Doney and Cannon, 1997); it has been found to produce a positive effect on alliances (Koza and Lewin, 1998) and enhances cooperation from alliance partners (Das and Teng, 1998). Trust is developed when the parties in the relationship cooperate with each other, are committed to one another, and act in the best interest of the relationship (Hansson, 2001).

Thus it seems clear that trust between the parties and commitment to the relationship by both firms must be core competencies of the inter-firm supply chain relationship. In other words, focal firms engaged in effective supply chain management will have a relationship with their suppliers that is one they are both committed to, and one in which both parties act in the best interests of the relationship.

2.1.2. Organizational awareness(OA)

It has been well established that human resources are an important source of sustained competitive advantage (Barney, 1991; Mabey et al., 1998). An individual's knowledge, experience, capabilities, and skills form the competencies that are key to an

organization's ability to realize and develop its business (Svelby, 1990; Hansson, 2001). In their study of the competencies of project managers, Dainty et al. (2005) found that superior performers had a marked affinity for organizational awareness, which has been defined as a "heightened understanding of organizational strategy, clarity around common group struggles, a unified view of the need for change, and an appreciation for the various roles across the larger organization" (Arena, 2004, p. 9). Thus we would expect that this knowledge of the big picture, i.e., organizational awareness, would lead to better strategic thinking. The researchers found that this knowledge was "essential" for the project manager who served as an interface with the project supply chain (Dainty et al., 2005, p. 43). In their article on the antecedents of supply chain effectiveness, Crook et al. (2008) state that knowledge of "big picture" business skills are necessary to high performing supply chain managers (p. 165). Similarly, Gammelgaard and Larson (2001), in a study of logistic practitioners found that the "ability to see the big picture" was one of the top four most important skills for supply chain managers (p. 46).

In this study, the extent to which an individual understands business functions, practices and inter-functional collaboration within a firm is defined as organizational awareness. The assumption in previous studies on inter-organizational relationships is that a firm builds trust and commitment in the relationship to gain access to its partner's resources, skills and knowledge through social ties between them. However, those social ties are carried out by individuals. It is thus reasonable to believe that supply chain professionals influence a firm's awareness of the value in their collaborative relationship with suppliers. Being able to go beyond that which is routine and required of one's job and recognizing the broader context of the "big picture" is a key component of being a good strategic thinker (Fairholm and Card, 2009). Managers with supply chain responsibilities who have "big picture" skills would be expected to have an understanding of the other business functions or processes within their organizations. When a supply chain professional is knowledgeable about cross-functional problems, exploiting opportunities, and resolve internal political constraints, this forms a knowledge base within a firm that would shape behavior and perception. These "boundary spanners" influence trust in individuals and organizations

(Zhang et al., 2011). A firm is more likely to understand and value relationships with external partners when they perceive their supply chain professionals as knowledgeable about mutual commitment, cross-functional involvement and coordination across multiple boundaries in value creation. Therefore, it is expected that:

H1: *Organizational awareness has a significant positive impact on the collaborative awareness of the focal firm.*

2.1.3. Supply network competency(SNC)

As pointed out by numerous researchers, the traditional company versus company competition is changing toward a business model where supply chains compete against supply chains (Vickery et al., 1999; Cox et al., 2003). Because networks extend the resources that companies can make use of, companies must effectively acquire the capability to achieve and explore the competitive advantages in synergy across the supply chain. In the context of supply chain, supply networks are thought to build competencies and exploit complementary resources (Ketchen and Hult, 2007; Miles and Snow, 2007). Resources accumulated from the network are difficult to imitate. Companies who invest in network capability have access to resources in a flexible way and can further achieve sustainable competitive advantages. Supply network studies have examined a variety of supplier attributes, for example, technical competence and cooperativeness (McCutcheon et al., 1997); operations (Chow et al., 2008); and responsiveness (Narasimhan et al., 2004). For this study, we chose to use suppliers' operational, flexibility, and spanning competencies as indicators of the overall supply network competency.

Operational competency includes suppliers' ability to provide high quality products, reliable delivery and superior performance (Chow et al., 2008). Flexibility competency refers to the suppliers' willingness and ability to respond to the changes requested by buyers. Flexibility in the sourcing side of the supply chain plays a direct role in the performance of the downstream supply chain. Often, it is the ability and willingness to accommodate that limits the ability of a manufacturer to respond effectively and rapidly to customer demands (Gunasekaran, 1999). Spanning competency was developed in research of management information systems to depict the ability enabling information systems (IS) and business people to share and integrate their knowledge (Orlikowski, 1991). Successful IS development relies on integrating diverse business knowledge in collaboration between information technology and business personnel. Therefore, spanning competency involves the ability of IS and business people to acquire each other's knowledge. Each group's knowledge perspectives must be accessible to the other. In the context of the supply chain, each participant in a supply chain has highly specialized knowledge about processes and practices in their respective domains. It is important to span the boundaries between supply chain participants and integrate information needed to meet customer needs. According to Day (1994), spanning competency is about information dissemination in coordinating complex process. In our study, spanning competency refers to an organization's willingness and ability to distribute and share various information within and across firm boundaries (Zhang and Lim, 2006). A supplier's spanning competency enables information visibility and supply chain integration, which are the most important prerequisites of problem solving and decision making in supply chain management (Prajogo and Olhager, 2012; Ding et al., 2011). Having access to a wide variety of information from suppliers facilitates inter-firm uncertainty reduction and reinforces trust across the supply chain.

Companies that have superior competencies in the supply network commit to higher performance compared with

organizations that do not possess such network competence (Crook et al., 2008). With higher degrees of supply network competencies, companies will have stronger beliefs that their supply partners will act and perform in a consistent manner. Companies will be willing to contribute time, money, or other resources to the network because they are confident that their supply partners will also collaborate. The supply network competency reinforces the feelings of ownership of supplier resources and further enhances trust and commitment. Based on this discussion, we bring forward the following hypothesis:

H2: *Supply network competency has a significant positive impact on the collaborative awareness of the focal firm.*

2.2. Investment in strategic partnership(ISP)

A supply chain is composed of a network of interdependent relationships (Ahuja, 2000). Acknowledging that one firm is dependent upon another is a key factor in developing supply chain partnerships (Sheu et al., 2006). Firms that are highly interdependent engage in information sharing activities and joint operational planning, which can be related to the firms' long term relationship orientation (Vanpoucke and Vereecke, 2010). Information sharing aims to capture and disseminate timely and relevant information to enable decision makers to plan and control operations (Simatupang and Sridharan, 2002). Beyond the functional perspective, successful supply chains must view their information as a strategic asset and a source of competitive advantages (Mason-Jones and Towill, 1997). Strategic partnering goes beyond just sharing information, however. Other important components include jointly creating strategic plans and sharing strategic information (Varamaki and Vesalainen, 2003). In addition, goal setting between partners gives them a sense that they are "in this together" and are mutually interested in each other's success (Tjosvold, 1988, p. 430). The goal setting process provides a foundation for trust between the parties, one they can build upon and which will ultimately lead to mutual success and improvement (Vanpoucke and Vereecke, 2010).

By including suppliers in the planning and goal setting process, and providing them with pertinent information, all members within the supply chain can "seamlessly" work together to serve the end consumer (Towill, 1996). This cooperation can create an environment in which the inter-firm competencies can be developed (Miles and Snow, 2007), and one in which the suppliers would become more trusting of and committed to the relationship. Thus, we would expect

H3: *A focal firm's collaborative awareness has a significant positive impact on its investment in strategic partnerships.*

2.3. Overall performance

Overall performance refers to the extent to which a company can meet end-customer requirements, and operate efficiently to deliver high quality performance. The definition implies that overall performance measures effectiveness and efficiency in relation to how well the goals are met. In the supply chain context, effectiveness has an outward-looking perspective and is concerned with the extent to which the end-customer demands are satisfied. Efficiency, on the other hand, is an inward-looking factor that reflects how well the resources are utilized in the achievement of output (Lai et al., 2002). Three dimensions of supply chain performance are adopted in this study. The cost performance takes an inward-looking perspective to focus on the efficiency with which the supply chain operates. Reliability and customer responsiveness are outcome-based indicators of the

extent to which a supply chain is performing the promised activities dependably and accurately and the extent to which the company can quickly respond to customer requests.

Investment in strategic partnership can be explained as a process of inter-organizational interaction and working with suppliers over the long-term. The link between strategic partnership and business performance has received a great deal of attention. A high level of strategic partnership practices helps to reduce delivery cycle time, reduce operating cost and improve productivity (Ryu et al., 2009). Vachon and Klassen (2008) have demonstrated the essentiality of supply chain partnership and its positive impact on manufacturing operational performance. Thus, we would expect:

H4: *A focal firm's investment in strategic partnerships has a significant positive impact on the overall performance of the supply chain system.*

2.4. Mediation effect of collaborative awareness

To invest in a long term supplier partnership is to build social capital, which is characterized by path dependence and social complexity. Bassellier and Benbasat (2004) concluded that organizational knowledge had a greater influence on business partnerships than did managerial knowledge. Managers with supply chain responsibilities with organizational awareness would be expected to create knowledge base and social capital within their organizations. Such knowledge and experience in social capital development would motivate and facilitate a firm to open information, knowledge and assets to their partner. The contribution of organizational awareness to development of strategic partnerships may depend on trust and commitment to a supplier relationship. In other words, the stronger the buyer's conception of trust and commitment in the buyer–supplier relationship, the more realized supply chain professionals' contribution to a firm's engagement in continuous improvement programs in that relationship. Consequently, for an individual to have an impact on the strategic partnership between supply chain partners there must be a trusting and collaborative relationship between the partners. Thus we would expect:

H5a: *The relationship between organizational awareness and investment in strategic partnership is mediated by the collaborative awareness of the focal firm.*

Competency in the supply base serves as a key resource to create and enhance a firm's own capability and performance. Wu et al. (2011) concluded that suppliers' capabilities, particularly innovativeness and quality, significantly enhance strategic partnership in semiconductor industries. Acquiring knowledge, resources or capabilities from the supply base is embedded in socially complex inter-firm partnerships (Oh and Rhee, 2008). However, partnership is not appropriate for every supplier. Lettice et al. (2010) described partnership as a continual process that constitutes a major investment in terms of time and human resources; and the benefits may take years to justify the investment. The more trusted the suppliers, the more extensive assistance and training a buyer would like to invest. In that way, a firm intends to get the most out of supply network competency. Thus we would expect:

H5b: *The relationship between supply network competency and investment in strategic partnership is mediated by the collaborative awareness of the focal firm.*

3. Methods

3.1. Data collection

The data were collected by sending an electronic survey to approximately 5707 U.S.-based companies in the summer of 2006. Since this research focuses on supply chain management practices and inter-organizational competencies, the respondents were limited to purchasing/manufacturing/materials executives and included CEOs, presidents, vice presidents, managers, and directors. The list of respondents was obtained from two sources: RSA Teleservices and Lead411. RSA Teleservices is a leading direct marketing consulting company and provider and compiler of business to business mailing lists, executive contact databases, and outsourced executive lists. RSA Teleservices has the largest Fortune 500 and Fortune 1000 executive contact database. Lead411 is a web based application suite that provides detailed and comprehensive company intelligence. The respondents in the sample represent six industries defined at the two-digit SIC level: 23 Apparel and Other Textile Products; 30 Rubber and Plastics; 34 Fabricated Metal Products; 35 Industrial and Commercial Machinery; 36 Electronic and Other Electric Equipment; and 37 Transportation Equipment. They were chosen because they are typical manufacturing industries and this paper focuses on a manufacturer's perception of the relationship between competencies and a successful supply chain management system.

An email was sent to the sample population inviting them to participate in the study with a brief description of the research. With 560 undeliverable messages, the valid sample size was 5147. Individuals were directed to reply with a blank email thus implying their consent to participate in the study. We then sent a follow up email in which the respondents were directed to respond to the survey by clicking on the link that would take them to the on-line questionnaire; or sending it via fax by clicking on the link that would take them to the PDF format of the questionnaire on the website; or requesting a hard copy from the researcher. After three waves of invitation, a total of 288 respondents either agreed to participate or received the questionnaire for consideration, yielding 201 usable responses for 69.8% response rate. Table 1 summarizes characteristics of respondents and companies.

Traditionally, a response rate is defined as the proportion of all cases completed to all eligible units ever contacted. However, a few recent studies in Operations Management, with similar data collection processes, have reported the response rate by dividing the number of completed interviews by the number of individuals who agreed to participate in the research (Schroeder et al., 2002; Swink et al., 2005). Using this methodology, 201 completed usable questionnaires were received from 288 respondents who agree to participate, for a 70% response rate.

Comparisons between the sample of 5147 and the 201 respondents indicated no significant group differences regarding the proportion of industry representation ($\chi^2 = 7.52$, $df = 6$, $p > 0.1$). In addition, non-response bias is viewed as a continuum, ranging from fast responders to slow responders. Therefore, non-respondent bias was analyzed by comparing (1) respondents who responded in the initial and the second wave ($\chi^2 = 9.42$, $df = 6$, $p > 0.1$); and (2) respondents who responded in the second and the third wave in terms of the proportion of SIC codes ($\chi^2 = 3.96$, $df = 6$, $p > 0.1$). Results indicate no significant difference regarding when they responded.

3.2. Measurement instruments

The questions in the survey were based on those that have appeared in other scales to measure the constructs we were examining. Respondents were asked to express their level of

Table 1
Descriptive statistics, inter-construct correlations, and average variance extracted.

		Mean	STD	1	2	3	4	5	6	7	8	9
1	Operational competency (OC)	4.04	.71	.61								
2	Flexibility competency (FC)	4.02	.82	.41*	.71							
3	Spanning competency (SC)	3.64	1.06	.34*	.37*	.79						
4	Organizational awareness (OA)	4.41	.63	.17**	.09	.04	.68					
5	Collaborative awareness (CA)	3.04	1.09	.25*	.34*	.59*	.08	.60				
6	Investment in strategic partnership (ISP)	3.82	.84	.47*	.43*	.32*	.13	.38*	.59			
7	Cost (CT)	3.24	.90	.29*	.32*	.16**	.15**	.22*	.31*	.54		
8	Reliability (RE)	4.36	.68	.40*	.27*	.12	.12	.27*	.24*	.31*	.65	
9	Customer responsiveness (CR)	3.81	.81	.33*	.21*	.21*	.21*	.30*	.22*	.29*	.44*	.55

Average variance extracted (AVE) is reported along the diagonal.

* Significant at the .01 level.

** Significant at the .05 level.

agreement using a Likert scale with five statements. In developing scales to measure the three dimensions of supply network competency, we drew on the aspects of supply chain competence (Chow et al., 2008) to assess the operational capabilities and skills developed over time to increase quality and enhance competitive position. Three items were used to measure operational competence. Flexibility and spanning competency reflect the supplier's capabilities and willingness to respond to changes. Two items each to measure flexibility competency and spanning competency were developed.

Lacking standard scales, we developed items to measure the construct of organizational awareness. In developing these scales, we drew on the study of knowledge management in the context of operations and supply chain management (Chen and Paulraj, 2004; Closs and Mollenkopf, 2004; Li et al., 2006). Organizational awareness was measured with three items to capture the extent to which the supply chain professionals are involved in knowledge sharing through cross-functional operations.

Collaborative awareness was measured with four items including the extent to which a company is committed to the partnership and finds it worthwhile, the extent to which each partner carries out its responsibilities and commitments, and the satisfaction with the relationship. They were adapted from studies by Li et al. (2006) and Mentzer et al. (2000).

Investment in strategic partnership has been studied at length in operations management research. Reflecting the conceptual discussion, investment in strategic partnership is defined as establishing long-term relationships with suppliers for a lasting competitiveness. Five items were generated through supply chain management and purchasing literature (Humphreys et al., 2004; Gosain et al., 2005; Li et al., 2006).

For overall performance, four items adapted from Lai et al.'s work (2002) were used to measure cost; while three items each to measure reliability were adapted from Lai et al. (2002) that assess supply chain performance in transport logistics. We measured customer responsiveness using three items following the work of Jayaram et al. (1999) on time-based competition including customer responsiveness.

4. Results

4.1. Measurement validation and reliability

Validity assesses the extent to which the instrument measures what it intends to measure, including discriminant and convergent validity. Discriminant validity measures the independence of each dimension in a construct (Bagozzi and Phillips, 1982). It can be assessed by examining the degree to which the items share more variance with their intended construct than any variance

that the construct shares with other constructs (Fornell and Larcker, 1981; Segars, 1997). If the AVE for each construct is greater than its shared variance with any other constructs, the requirement for discriminant validity is fully satisfied. That is, discriminant validity is supported if the squared root of AVE for each construct is greater than the correlations between the constructs and all the other constructs. AVE values reported in Table 1 indicate satisfactory discriminant validity of all the constructs.

Supply network competency is considered a multidimensional concept. For multi-dimension constructs, one important aspect of discriminant validity is the validation of second-order constructs using structural equation modeling (AMOS). Chi-square per degree of freedom, root mean square error of approximation (RMSEA), goodness of fit index (GFI), adjusted goodness of fit index (AGFI), comparative fit index (CFI) and Tucker–Lewis index (TLI) were selected as the criteria. A RMSEA value less than .05 indicates good fit; values as high as .08 represent reasonable errors of approximation in the population (Browne and Cudeck, 1993, p. 445). Many researchers interpret index scores of GFI, AGFI and CFI in the range of .80–.89 as representing reasonable fit; scores of .90 or higher are considered as evidence of good fit (Bentler, 1992; Byrne, 2001). χ^2/df value less than 2.00 and TLI value close to .95 indicate adequate model fit (Wheaton et al., 1977). The fit indices for the second-order model was judged to have a good fit with $\chi^2/df=1.573$, $p<.101$, GFI=.98, AGFI=.94, CFI=.99, TLI=.99 and RMSEA=.054. Operational competency, flexibility competency, and spanning competency have factor loadings of .64, .73, and .56, respectively, on supply network competency. All loadings are significant ($p<.001$).

Convergent validity is demonstrated when the indicators of a construct have acceptable fit on a first-order factor model (Hair et al., 1998). First-order factor models are those in which correlations among the observed variables can be described by a smaller number of latent variables. The first-order model was judged to have satisfactory fit ($\chi^2/df=1.504$, $p<.001$, GFI=.86, AGFI=.82, CFI=.95, TLI=.94 and RMSEA=.05). In addition, all the standardized item-factor loadings are .68 or higher ($p<.001$), also indicating good convergent validity for the measurement items.

Reliability measures the consistency of an instrument. Cronbach's alpha and AVE are used to assess the reliability of the constructs. The composite reliability is acceptable when Cronbach's alpha is higher than .70 (Nunnally, 1978). All constructs show adequate reliability since Cronbach's alpha values are all greater than .70 (Table 2). The AVE scores of all constructs in this study are above .50 (Table 1), indicating satisfying reliability (Fornell and Larcker, 1981). Table 1 also shows that, because none of correlation coefficients is .70 or higher, there is no indication of multicollinearity.

4.2. Analysis of the structural model

The structural model was assessed using structural equation modeling by examining the path coefficients, their statistical significance, and the overall model fit. Fig. 2 displays the path diagram resulting from the structural modeling analysis using AMOS. The results demonstrate that all the measurements have significant loadings to their corresponding second-order construct. Overall, the model has a satisfactory fit with $\chi^2/df=1.941$, $p<.001$, GFI=.88, AGFI=.84, CFI=.93, TLI=.91, and RMSEA=.069. In this research, RMSEA, GFI, AGFI, and CFI fit indices show the model fits the data reasonably well. The results of the analysis show support for the structure of the theoretical model of interorganizational and network awareness.

The results also indicate that higher levels of supply network competency and organizational awareness lead to a higher degree of collaborative awareness. Both hypothesized relationships (H_1 and H_2) are found to be statistically significant ($\gamma=.88$, $p<.001$; $\gamma=.13$, $p<.05$, respectively). The most fundamental strategic resources are the knowledge and skills that an organization accumulates over time. For middle managers and senior executives, the understanding and awareness of interdependence and necessity of collaboration is critical to build competencies residing in the supplier relationship. The collaborative competency relates to a supply chain participant's perceptions of its partner's capability to perform superiorly and its willingness to share the risks. According to the analysis, supply network competency is also an antecedent of collaborative awareness. In the business model where supply chains compete against supply chains, suppliers should play a key role in creating and delivering value to customers. This expectation sharpens top management's focus on the value-added potential of their supply base.

Table 2
SEM results for mediation effect of collaborative awareness.

Model	χ^2	df	GFI	CFI	RMSEA
Model 1 (OA → ISP)	31.099	19	.98	1.00	.026
Model 2 (OA → CA → ISP)	84.696	52	.94	.97	.056
Model 3 (OA → CA → ISP and OA → ISP)	74.505	51	.95	.97	.050
Model 4 (SNC → ISP)	46.928	19	.95	.95	.086
Model 5 (SNC → CA → ISP)	132.262	52	.90	.94	.088
Model 6 (SNC → CA → ISP and SNC → ISP)	119.972	51	.91	.95	.082

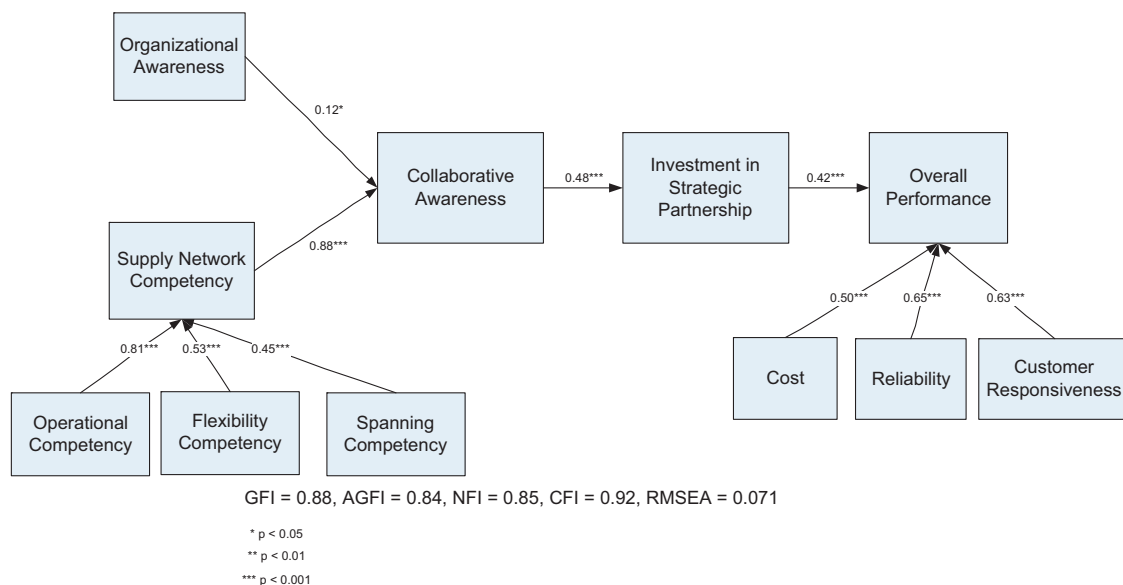


Fig. 2. Effects of competencies on the supply chain management system.

Overall, these results support the belief that enhanced supplier performance and management's recognition of cross-functional collaboration and inter-organizational coordination encourage companies to take advantage of opportunities to build trust and commitment in buyer-supplier relationship.

Hypothesis 3 was supported as well. As expected, collaborative awareness has direct and strong positive effect on companies' investment in strategic partnership. The path coefficient of this relationship is .51 with a p -value less than .001. Recognizing the competency residing in supplier relationship, companies are more likely to invest in joint efforts, communication, early supplier involvement in research and development, and planning and fostering interdependency. This analysis yields interesting insights into purchasing. Purchasing managers should take a more strategic view of what they do, moving beyond the typical transaction focus of purchasing and towards evolution to a strategic focus of procurement. Rather than capability, suppliers' attitude is one of the most important aspects of the development of strategic partnership (Rossetti and Choi, 2008). From the supplier's point of view, this significant relationship implies that enhanced operational performance is not enough to keep a long-term customer relationship. Suppliers should become integrated into their major customers' processes and more tied to their goals to convey commitment and willingness to share risks and reward and maintain the relationship over a longer period of time.

The relationship proposed in **Hypothesis 4** was also found to be significant ($\beta=.60$, $p<.001$), which indicates that there is positive relationship between a company's investment in strategic partnership and its overall performance. The statistical significance of **Hypothesis 4** verifies that suppliers are undoubtedly becoming increasingly important for the success of today's companies. Firms rely heavily on external sources for products, services, technology, knowledge, and innovation. Strategic supplier partnership opens opportunities for both buyers and suppliers to leverage their advantages to deliver value throughout the supply chain. This finding also offer supports to Japanese supply management practices, particularly those of Toyota and Honda (Nelson et al., 1998). At Honda and Toyota, suppliers are treated as a part of the family. They both emphasize long-term association, mutual planning and problem solving efforts with suppliers. These investments in partnerships ensure open communication channels, quicker resolution of problematic issues and higher responsiveness.

Following the methodology suggested by Holmbeck (1997), we examined collaborative awareness as a mediator in the relationship between organizational awareness and collaborative awareness. Model 1 examines the direct relationship between organizational awareness and investment in strategic partnership. The result shows that the relationship is significant ($\beta=.143$, $p<.1$). A comparison was made between the fit of Model 2 and Model 3. The Chi-square was significant ($\Delta\chi^2(1)=10.191$, $p<.01$), suggesting that Model 3 has a better fit. The path coefficient between organizational awareness and collaborative awareness and investment in strategic partnership is reduced to .038 ($p=.669$), yielding fully support for H_{5a}.

The same steps were followed to examine the mediating role of collaborative awareness in the relationship between supply network competency and investment in strategic partnership. Model 4 examines the direct relationship between supply network competency and investment in strategic partnership (H_{5b}), and the result is significant (Table 2). Model 5 includes the mediator collaborative awareness but the path from supply network competency to investment in strategic partnership is constrained at zero. The model also provides an adequate fit to the data. Model 6 is different from Model 5 in that the supply network competency to investment in strategic partnership path is not constrained. The Chi-square test indicates that Model 6's overall fit is significantly better than Model 5 ($\Delta\chi^2(1)=12.29$, $p<.001$). In addition, the path coefficient between supply network competency and investment in strategic partnership is reduced from .659 to .258 when the mediator is taken into consideration. However, the relationship remains significant. These results provide support for partial mediation effect of collaborative awareness in the relationship between supply network competency and investment in strategic partnership.

5. Discussion

5.1. Theoretical contribution

This study explores the effect of individual and organizational competencies on supply chain management practices and performance, an area that heretofore has received relatively little attention. The importance of competencies in providing competitive advantage has been previously demonstrated at the individual and organizational level. This paper expands the literature on competencies within a firm by empirically investigating the effect of individual, organizational and inter-organizational competencies on effective supply chain management. The findings reveal that both organizational awareness (competency at the individual level) and supply network competency (competency at the organizational level) have significant and positive effects on collaborative awareness. The importance of inter-organizational competencies was supported by the significant positive relationship between collaborative awareness and investment in strategic planning.

Human capital has long been recognized as a source of competitive advantage (Barney, 1991) and companies develop the competencies of their employees to create competitive advantage (Lawler, 1994). Recent studies have urged more research to explore the role of human resources in facilitating supply chain relationship development (Koulikoff-Souvion and Harrison, 2007). Our model supports previous research that has found that individual competency is known to provide competitive advantage in the supply chain relationship. Sustained competitive advantage depends on the collaborative efforts of its skilled, capable, knowledge employees (Afzouni, 2007). Our measure of individual competency – organizational awareness – was

based on the supply chain manager's understanding of business functions, collaborating with those business functions, and jointly resolving problems across organizational lines. In the context of operations and supply chain management, therefore, the Human Resources function plays a critical role in generating value by fostering individual competencies and in accumulating cross-functional knowledge within a firm.

Supply chain researchers have called for shifting the view of inter-organizational relationships from arm's length to one of collaboration (Handfield and Bechtel, 2002; Liker and Choi, 2004). One of the contributions of this paper is the extension of the competency literature to include inter-organizational competencies. The competencies that were supported within the network—collaboration, information sharing, problem solving—were also found to be critical in developing inter-organizational competencies that support the supply chain relationship. In addition, the inclusion of partners in the goal setting process can produce a trusting relationship which will, in turn, result in meeting end-customer requirements and improve the efficiency and effectiveness of the firm.

In line with the rich body of literature on strategic partnership, this study illustrates a direction along which businesses can create value from strategic partnerships. Investment in strategic partnership enhances multifunctional and inter-organizational interaction and coordination. It contributes to improving overall performance through enhancing supplier performance and coordination among supply chain partners. Coordination among independent firms, such as raw-material suppliers, manufacturers, and retailers, enables firms to progressively improve business processes in response to rapidly changing market conditions. Poor coordination among the chain members can cause dysfunctional operational performance. Some of the negative consequences of poor coordination include higher inventory costs, longer delivery times, higher transportation costs, higher levels of loss and damage, and lowered customer service (Lee et al., 1999).

This study also contributes important insights into the mediation effect of collaborative awareness on the relationships between supply network competency, organizational awareness and investment in strategic partnership. This would imply that both individual and organizational competencies are dependent upon inter-organizational competencies to affect the strategic partnership, with the latter (supply in network competencies) partially dependent and the former (organizational awareness) fully dependent upon collaborative awareness. Strategic partnerships are socially complex relationships, involving communication, teamwork and social interactions, that result in the development of tacit and explicit knowledge between the parties. Thus, in order for competencies at the organizational and individual level to contribute to the development of strategic partnerships, there must be a level of trust and commitment that has already been established between the parties.

The factor analysis yielded an interesting related result—a measure of supply network competency. The competencies leading to high supply base performance can be grouped into operational, flexibility, and spanning areas. Increasing environmental turbulence requires the supply base to be designed with change in mind. As a result, firms will be able to more aggressively anticipate changes and adapt their supply chains. Managing flexibility on the supply side motivates the speed, ease, and cost of responding to new knowledge, new technologies, market changes, or other developments that arise during the course of work (Sanchez and Perez, 2005). With the driving force of outsourcing and growing complexity of supply networks, companies should look for sourcing strategies that can help to build a flexible and responsive supply base. Other than operations

excellence and the ability to adapt to changes, spanning competency of a supplier contributes to supply network competency. The supplier's information spanning competency commits to providing better and more accurate and timely information to buyers. Facilitated by the spanning competency, synchronized replenishment plans can be created, which leading to closer matching of production and distribution to current demand (Billington and Johnson, 2005; Lee and Whang, 2005). Suppliers' willingness to share information implies the existence of trust and commitment from the supply side; with ability to share information, information can flow freely to help design, implement, and manage initiatives that create added value, resulting in the enhancement of trust and commitment from the buyer side.

5.2. Implication for practitioners

This study has identified several competencies required to develop successful strategic partnerships. To be successful, supply chain managers must have an awareness of different business functions, and have collaborative and problem solving skills. These competencies have implications for training, recruitment and selection, succession planning and individual and team development, for example, the need for job rotation to improve business knowledge. Since the relationship with suppliers is fundamental to success, HR managers must look for cooperative employees with good business knowledge and with good interpersonal skills who engage in the sharing of information. From a training perspective, supply chain managers must increase their business competence, especially their organization-specific knowledge, to facilitate interactions. Training should include a deep understanding of the organization's functional areas and becoming a business problem-solver. Cross-functional teams and process capabilities are important to achieving business results and HR managers must create an environment that encourages the development of empowered teams.

It is critical to understand that a trusting and committed supplier relationship can be an inimitable competitive weapon at the supply chain level. As the environment is changing faster than ever before, it is difficult for firms to be competitive if companies insist on focusing on internal operations only. In many innovative product categories, such as computer and electronic devices, uncertainty of customer requirements and demand is a fact of life and creating a capable and responsive supply chain is one method of dealing with uncertainty. For instance, companies are allowing customers to provide specific desired product information and are producing goods for those specific customers. A company may, rather than producing a large range of products itself, use a network of suppliers to deliver such product mix. In today's business, the achievement of high-level performances in terms of cost, quality and customer responsiveness is more dependent on the quality and effectiveness of the supply network. Without a good understanding of competency built into the supply base and at the inter-organizational level, it is less clear what it takes to create a successful strategic partnerships and how competencies' further impact performance outcomes. In general, the development of the concept of supply network competency provides guidelines to supply chain management practices. Supply chain management practices should involve suppliers in quality improvement and operational efficiency, encouraging information sharing and searching for new ways to develop a supply base that can adapt to changes in an effective and efficient way.

Previous research has shown that an effective model performance measurement is essential for a successful supply chain management system (Chen and Paulraj, 2004; Hausman, 2005). By monitoring and measuring performance, companies can be

constantly looking for innovative ways for continuous improvement across the supply chain. It is another contribution of this study to develop reliable and valid performance measurements in the supply chain context. Our findings suggest that cost, reliability, and customer responsiveness are three dimensions related to overall performance. For practitioners, this overall performance measurement can be primarily used as a communication tool between the company and its supplier or between individual departments. Furthermore, the performance measurements help management understand overall supply chain performance rather than only the performance of the individual chain member, recognizing what is important to the business, and enhancing continual improvement of end-customer service.

6. Limitations and future research

There are several limitations in this paper. First and foremost, since we developed new measurements of supply network competency, organizational awareness and collaborative awareness, these measurements would need replication to strengthen its findings. We still believe, however, that it has conceptual and practical importance to the field of supply chain management. Second, although there were over 200 firms in the study, the response rate was still very low and, again, replication of the study would strengthen the conclusions of the paper. Increasingly, it is challenging to gather data. In view of this, researchers

Table A1
Demographic information (in %).

Job title	
CEO/President	33.83
Director	23.38
Manager	24.38
Others	18.41
Job functions (Respondents marked all that apply)	
Purchasing	35.32
Transportation	18.41
Manufacturing/Operations	34.83
Distribution	10.95
Supply chain management	24.88
Logistics	29.85
Sales	31.34
Other	14.93
Years worked at the organization	
Less than 2 years	13.43
2–5 years	24.88
6–10 years	16.92
More than 10 years	44.28
Industry–SIC code	
Apparel and Other Textile Products (23)	1.99
Rubber and Plastics (30)	2.99
Fabricated Metal Products (34)	5.47
Industrial and Commercial Machinery (35)	22.89
Electronic and Other Electric Equipment (36)	49.75
Transportation Equipment (37)	6.97
Other	9.95
Number of employees in the company	
Less than 100	26.87
101–250	18.41
251–500	11.94
501–1000	11.44
Over 1000	30.85
Average annual sales	
Less than \$10 million	18.41
\$10 to \$24.9 million	13.43
\$25 to \$49.9 million	9.45
\$50 to \$99.9 million	10.45
More than \$100 million	45.77

use different methods to get better response rates such as contacting the interested respondents first and then sending the actual questionnaire. It has been proposed that the response rate must be defined and calculated in different ways to justify the complexity of research design, sampling process, and the practical difficulties of contacting and assessing potential survey participants (AAPOR, 2006). Ettlie and Pavlou (2006) reported a response rate of 2.025% followed by an effective response rate of 9.2% in order to adjust to a call-back process for data collection. Although the use of this methodology is not very common, the related fields have called for a move toward more web-based survey methodology development. Finally, the firms in the survey were based in the United States and generalization to non-US firms may not be appropriate.

From a strategic HR perspective, further exploration into those areas that provide a strategic competitive advantage would be useful, in particular knowledge and social capital. The knowledge-based view has been identified as a key source of strategic competitive advantage because it allows for effective combinations of knowledge that make the creation of new knowledge possible (Kogut and Zander, 1993). Examination of the tacit and explicit knowledge between the supply chain partners, and the process of information sharing should be undertaken. Social capital has been identified as a unique form of capital that facilitates the exchange of information between partners, creates

intellectual capital, improves cross-functional team effectiveness, strengthens supplier relations, and improves inter-firm learning (Scarborough, 2000). Further exploration of the interpersonal skills needed to enhance social networking would add much to the literature on the effectiveness of the supply chain performance.

The difference in competencies required in SMEs vs. larger firms could also be pursued. In particular, expansion of the concept of organizational awareness to explore how individual competencies may lead to collaborative awareness, and the role that organizational structure plays in an individual's need to be "aware" are two areas that could offer insight into the role that firm size plays. Research into the role that power plays in strategic partnerships would be beneficial as well. Future research should also consider other individual level and supply network competencies that might improve inter-organizational competencies embedded in the relationship. For instance, the flexibility competency on the supply side only focuses on the willingness and capability to adapt to changes. As early as 1996, Lau argued that flexibility is associated not only with manufacturing capabilities, but is also important for the linkages between manufacturing units and their suppliers across the supply chain. In future studies, supply flexibility competency should be expanded and examined from a network-oriented perspective. Prior work on strategic and supply chain flexibility might provide a useful basis for such investigation.

Table B1

Factor loadings and reliability scores.

Constructs/Measurement items	Standardized loading	Cronbach's alpha
<i>Operational competency</i>		
Major suppliers provide high quality and reliable products	.74	.86
Major suppliers provide high delivery performance	.74	
Overall, our major suppliers' performance is good	.85	
<i>Flexibility competency</i>		
Major suppliers are willing to accommodate changes that we request	.85	.89
Major suppliers are able to accommodate changes that we request	.83	
<i>Spanning competency</i>		
Major suppliers are willing to share information to accommodate changes that we request	.89	.93
Major suppliers are able to share information to accommodate changes that we request	.89	
<i>Organizational awareness</i>		
The extent of understanding of other business functions/processes within your company	.74	.78
The extent of collaboration with other business functions within your company in your day-to-day work	.87	
The extent of jointly resolving operations problems with other business functions within your company	.85	
<i>Collaborative awareness</i>		
We feel that we can trust our major suppliers completely.	.82	.90
The relationship our company has with major suppliers is something we are committed to	.70	
Our major suppliers are willing to provide assistance to us without exception	.76	
We are delighted with your relationships with our major suppliers	.82	
<i>Investment in strategic partnership</i>		
We regularly solve problems jointly with our major suppliers	.77	.86
We include our major suppliers in our planning and goal-setting activities	.84	
We have continuous improvement programs that include our major suppliers	.68	
We share extensive information with our major suppliers	.83	
We actively involve our major suppliers in new product development processes	.70	
<i>Cost</i>		
We have low inventory costs	.73	.76
We have low production costs	.69	
We have low transportation and handling costs	.78	
<i>Reliability</i>		
We provide reliable delivery	.85	.83
We provide reliable products	.72	
We fulfill promises for customer orders	.84	
<i>Customer responsiveness</i>		
We rapidly handle customer complaints	.68	.73
We rapidly develop new ways of customer service	.78	
We respond well to customer demands for nonstandard features	.77	

7. Conclusion

This paper reinforces the importance of the management of human capital in the strategic performance of the firm. A firm's competitiveness is tied to enhancing its human capital through the development of the competencies of its employees and by creating unique, distinctive and difficult to imitate core competencies. HR professionals engaged in the strategic management of the firm's human resources should consider employees as strategic asset and a critical investment in a firm's performance, and create an atmosphere in which these competencies can thrive. Furthermore, it is becoming increasingly important to build organizational and process competencies that will enable employees to combine and leverage their individual knowledge for greater organizational advantage and HR must play a key role in developing these competencies.

Appendix A

See Table A1.

Appendix B

See Table B1.

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