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BUILDING SOCIAL CAPITAL WITH IT AND COLLABORATION IN SUPPLY CHAINS: AN EMPIRICAL INVESTIGATION

Social, Behavioral and Organizational Aspects of Information Systems

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Abstract

The importance of managing the extended enterprise is a recurrent theme, and many consider supply chains to be the next frontier of opportunities to improve profitability and competitive advantage for organizations. Building on prior work that has identified the value creation capabilities of integrated digital platforms and relational conditions, the paper draws upon social capital theory to develop an organizing framework for developing supply chain integration capabilities. We assert that both IT and relational capabilities constitute the social capital available to firms in the supply network and draw upon Nahapiet and Ghosal's (1998) work to identify the specific facets structural, relational and cognitive social capital that are relevant in the context of supply chain integration. This framework enables us to evaluate structural relational and cognitive social capital as a platform for managing collective action and as a source of creating and sharing knowledge. A research model is developed and empirically validated that investigates the impact of different facets of social capital on supply chain integration, and subsequently supply chain integration on firm performance. Data from 110 manufacturing and retail firms was used to test the model to provide empirical support for the proposed research model.

Keywords: Social capital, supply chain integration, supply chain relationships IT integration, Digitization

Introduction

Organizations have been paying increasing attention to their supply chains in recent years. Many consider supply chains as the next frontier of opportunities to improve profitability and competitive advantage for organizations (Reilly 2004; Sambamurthy et al. 2003; Simchi-Levi et al. 2002). One analysis suggests that U. S. manufacturers could realize \$488 billion in operating margins by improving their supply chain management (Reilly 2004). Taking note, many organizations today are launching initiatives to integrate their end-to-end supply chains, i.e., from lower

tier suppliers to the final consumer (Lee 2000; Ramdas et al. 2000; Tyndall 1998). The emphasis on supply chain management as a competitive imperative requires capabilities for orchestrating a network of organizations that form a supply chain, rather than a focus on individual organizations and their resource base (Evans et al. 1999; Lambert et al. 1998). The shift emphasizes partner resources, collaborative relationships, and network membership as sources of competitive advantage (Dyer 2000; Dyer et al. 1998).

Integrated supply chains provide operational visibility, coordinated plans and streamlined flow of goods, which collectively compress the time interval between order placement and fulfillment (Tyndall 1998). Past research has examined how firms can effectively apply IT to integrate information, physical, and financial flows across the extended supply chain. For instance, Rai et al. (2006) enumerate a key causal process for digitally-enabled value creation in supply chains: digital integration capabilities when leveraged to establish supply chain process integration capabilities enhance firm performance, especially with respect to operational excellence and revenue growth. As a complement to the perspective of digital enablement of integrated supply chain processes, Patnayakuni et al. (2006) probe how one specific type of flow – information – can be promoted between a focal firm and its partners. They conclude that organizations that adopt a relational view of the firm (Dyer 1997; Dyer 2000), embrace a long-term orientation towards their partners, invest in relationship specific investments and establish relational routines to interact with them will exhibit higher levels of information flow integration .

Past research on technology-enabled integration of supply chain processes and relational orientation for information integration, while providing valuable insights, do not inform us about how technology and relationships *collectively* provide resources for the integration of supply chain processes, which, arguably, should result in increased firm performance. Given the failure of numerous supply chain-related IT projects to change processes and create value, such as Nike's failed i2 project, and the centrality of relationship management to supply chains, an integrative perspective that reconciles the roles of IT and relationship management must be developed and tested.

To address this gap in the literature, we draw upon the social capital perspective which views networks as valuable social capital and define it as “as the sum of the actual and potential resources embedded within, available through and derived from the network of relationships” (Nahapiet et al. 1998; p. 243). We assert that both IT and relational capabilities constitute the social capital available to firms in the network, which provides a platform for managing collective action (Leana et al. 1999) that should result in superior and sustainable firm performance.

We develop our theoretical arguments and research model by drawing on Nahapiet and Ghosal's (1998) work on social capital and mapping the three forms of capital – structural, relational and cognitive – to properties related to IT and relationships. Specifically, we identify Digitization, Cross-functional Application Integration and Data Consistency as forms of social capital that reside in IT capabilities and Long-term Orientation, Relational Asset Specificity, and Relational Interaction Routines as forms of social capital that reside in relational capabilities. A research model that interrelates the three forms of capital with supply chain process integration is developed and tested. The analysis provides strong support for the hypotheses proposed in the research model. The results show that three forms of social capital have significant positive association with supply chain integration and collectively explain 52.6% of the variance in supply chain integration and 19.5% of the variance in organization performance.

The paper makes the following contributions: (1) provides social capital theory as an organizing framework for organizing the drivers of supply chain resource flow integration and extends prior work on supply chain integration (2) this platform of social capital as a lens for looking at drivers of supply chain integration enables organizations to evaluate them as a platform for organizing different resources for collective action as supply chain networks (3) it establishes the importance of leveraging social capital for the integration of supply chain processes and firm performance and (4) it suggests that the “knowledge and knowing capability of the social collectivity” which Nahapiet and Ghoshal refer to as the intellectual capital may also be the key supply chain resource for architecting the integration of supply chain processes.

In the next section, we examine social capital theory and its applicability to integration of supply chains. We then develop the research model and corresponding relationships. This is followed by an explanation of the research methods employed for data collection and analytical techniques used to validate the measurement of constructs and test the research model.

The Relevance of Social Capital

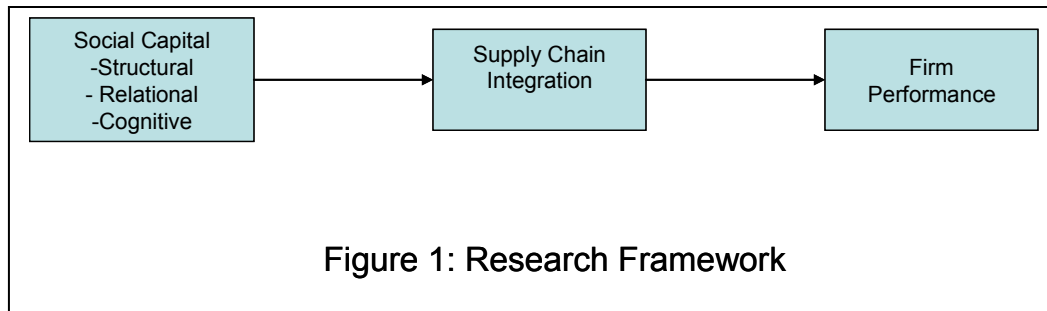
The concept of social capital at its core is a simple and elegant idea of social capital as an asset that is embedded in relationships (Bourdieu 1986; Leana et al. 1999; Walker et al. 1997). Unlike some other forms of capital, social capital is owned jointly by the parties in a relationship and cannot be traded easily. It provides an alternative rationale for the structure of firms and markets which stands in contrast to the transaction cost perspective. The social capital view argues that organizations offer a superior institutional arrangement to other arrangements, such as markets, by virtue of the resources available to them social relations within the firm and networks of which the firm is a member. Beyond the central idea of social capital as an asset inherent in social relations and networks, it has been subject to different and sometimes contradictory interpretations.

Social capital has been applied to investigate problems related to growth and performance at multiple levels of analysis. For example, it has been specified as a characteristic of nations (Fukuyama 1995) and also defined narrowly as a resource available to an individual by virtue of their location in a network by transmitting information across disjoint nodes (Burt 1997). It has also been applied at the level of the organization in the context of organizational practices (Leana et al. 1999) as well as to understand network formation and industry growth in high tech industries (Walker et al. 1997). Since social capital is generally concerned with the nature of relationships and network ties, it is relevant to studying inter-organizational interactions and arrangements (Baker 1990).

In this paper we adopt Nahapiet and Ghoshal's (1998) perspective of social capital as a resource. While the focus of their theorization is on developing a coherent theory of organizations as knowledge systems, we apply it to the context of supply chains. We draw upon their work in conceptualizing social capital and analyzing its impacts in this study. Of particular relevance to this study is the definition of social capital in terms of three distinct, albeit related, facets – *structural*, *relational* and *cognitive*.

The structural facet represents the pattern of relationships between network nodes, simply described in terms of 'who you can reach and how you can reach them' (Nahapiet et al. 1998; pg. 244). The key attributes of this facet of social capital include the presence or absence of ties, network configuration or morphology, the characteristics of ties and their potential appropriability. The relational facet of social capital is reflective of the nature of relationships between partners and the influence it is likely to have over their behavior. Attributes of the relational facet are considered to be trust and trustworthiness, obligations and expectations, among others. Finally, the third facet identified as the cognitive facet, refers to those resources that enable 'shared representations, interpretations and systems of meaning' among partners. They draw upon earlier work by researchers like Cicourel (1973) and Orr (Orr 1990) to describe the cognitive facet of social capital in terms of shared codes, language and narratives.

Nahapiet and Ghoshal (1998) further suggest two distinct themes for the consequences of social capital for action, 'allocative' efficiency which is considered to increase the efficiency of action and 'adaptive' efficiency that supports creativity and learning that lead to newer forms of organization and relationships. High levels of social capital, it is argued, will promote efficient diffusion of information among partners and reduce the cost of transactions to improve firm performance. Given that our focus in this study by considering the impact of social capital on supply chain integration, our focus is on allocative efficiency. The impact of social capital on adaptive efficiency, especially when studying adaptive supply chains, would likely provide valuable and interesting insights. However, the focus of such an investigation would be on outcomes such as creativity, learning, and new forms of cooperative association, which are not included in the scope of our current investigation.



The discussion forms the basis of our research framework shown in Figure 1. Social capital of a focal firm is considered as a resource that can be leveraged for managing collective action among supply chain partners leading to supply chain integration. Integrated supply chain processes in turn are considered to influence firm performance.

Development of Model and Hypotheses

Supply Chain Process Integration

Supply Chain Process Integration is defined as the degree to which a focal firm has integrated the flow of information and materials with its supply chain partners (Rai et al. 2006). Another important flow that has been mentioned, albeit inadequately researched, is financial flows in the supply chain (Mabert et al. 1998). The dominant concern in supply chain management has been in managing material flows (Stevens 1990) and the attendant information flows (Lee et al. 1997), we limit our attention on these two flows. Similarly, knowledge flows are discussed in the literature (Carlile 2002) which sometimes overlap in their definition to include information flows, we do not consider them as a distinct flow in this study. Accordingly, Supply Chain Process Integration is composed of two sub-constructs: Information Flow Integration and Physical Flow Integration in our study.

Information Flow Integration

Information flow integration is defined as the extent to which operational, tactical, and strategic information are shared between a focal firm and its supply chain partners (Rai et al. 2006). Information about operations, tactics and strategy can be shared with supply chain partners. Sharing operational information sharing can leverage the economies of scale and expertise across organizations (Seidmann et al. 1997). For example, inventory holding information, when shared, can reduce total inventory in the supply chain (Lee et al. 1997). Similarly, production and delivery schedules can be shared to enhance operational efficiencies through improved coordination of allocated resources, activities, and roles across the supply chain (Lee et al. 2000). Tactical information can include performance metrics associated with execution of tasks and their outcomes that can be shared.

Physical Flow Integration

Physical flow integration is defined as the degree to which a focal firm uses global optimization with its supply chain partners to manage the stocking and flow of materials and finished goods (Rai et al. 2006). A variety of supply chain initiatives have been deployed by organizations to manage their inventory in a more efficient and effective manner. Such initiatives include just in time delivery (Lowson et al. 1999), automatic replenishment, vendor managed inventory programs (Daugherty et al. 1999; Ellinger et al. 1999), and contracting with logistics providers for inventory management services (Richardson 1999; van Hoek 2000). Optimally staging inventory across the supply chain is another approach to improve inventory management in the supply chain (Arntzen et al. 1995; Vidal et al. 2000). Physical flow includes both downstream and upstream flows where downstream flows consist of raw material, subassemblies and finished goods, and upstream flows consist of products that are returned or need to be repaired. Multi-echelon optimization of costs, just in time deliveries, joint management of inventory with suppliers and logistics partners, and distribution network configuration for optimal staging of inventory are considered as indicative of physical flow integration in this study.

Forms of Social Capital for Supply Chain Process Integration

Social capital theory is based on the premise that the network of relationships constitutes a valuable resource for the firm. As social capital resides in relationships, it is jointly owned by partners, and although it accrues value with usage and exchange, it cannot be traded easily (Burt 1992). Social capital also makes it possible for firms to achieve outcomes that are otherwise difficult to realize or can be realized only with considerable cost. It provides a structure to facilitate action of partners (Coleman 1990), by establishing a pattern of linkages for exchange (Bourdieu 1986). We suggest that both IT and relational capabilities can be used to develop social capital and leverage it in supply chain relationships.

By developing integrated digital platforms, IT can play a key role to integrate supply chain activities (Enslow 2000; Rai et al. 2002a). These platforms can be deployed for information sharing and coordination across the supply chain (Broadbent et al. 1999). Such well-integrated IT platform requires standards for the integration of data, applications, and processes to be negotiated and implemented (Ross 2003; Weill et al. 1998).

Though research suggests that IT lowers coordination costs, there has been a trend towards fewer suppliers. This move towards partnerships from markets was referred to as the “move to the middle” by Clemons et al. (1993), where intangibles such as trust and quality create value and promote a bias in favor of long-term contracts with fewer suppliers. Based on an extensive review of the literatures in information systems, operations management, and marketing, Patnayakuni et al. (2006) enumerate that supply chain partnerships can be effectively characterized in terms of: (a) investment by the supplier in relationship specific assets, (b) the extent of interaction and information exchange between the customer and supplier and (c) long-term orientation of the relationship. We now explore how the three facets of social capital – structural, relational, and cognitive – map to IT and relational constructs. We also develop our logic for their influence on supply chain integration, which in turn, influences firm performance.

Structural Social Capital for Supply Chain Integration

Structural capital, which is based on the concept of structural embeddedness, focuses on the configuration of nodes and linkages (Nahapiet et al. 1998). This form of social capital describes the overall pattern of connections, with a focus on who you can reach, how you can reach them. We examine the structural social capital of a focal firm in terms of the structure of its linkages. Specifically, we consider: (a) digitization, the ability of a focal firm to execute supply chain processes online, (b) applications integration, the ability of applications across functions and organizations to communicate in real-time, and (c) relationship specific assets. Collectively, they represent the structural social capital of the focal firm as they represent the constituents of the supply chain whether inbound, intra-organizational or outbound the organization can reach and how it can reach them. Such capabilities provide the focal firm with the ability to operate in a network-centric fashion and represent capabilities that can be appropriated in novel ways over time.

Digitization as a Form of Structural Social Capital

Digitization is defined as the degree to which the focal firm conducts its inbound, outbound and intra-organizational supply chain processes online. While there isn't a formal universally accepted definition for what it means to be 'online,' we use the term in the commonly accepted sense that data pertaining to events and transactions are captured, transmitted, and shared across the supply chain through the Internet. Digitization of core supply chain processes, including procurement, manufacturing, inventory management, logistics, distribution, transportation, and sales, can have a significant impact on coordinating resources across the supply chain and, consequently, organizational performance.

There are best practice exemplars of how digitization has enabled firms to improve their supply-chain wide processes by reducing asset intensity, operating costs and improving responsiveness to customers (Slywotzky et al. 2000). For example, United Parcel Service provides online package tracking on demand to the customer, while reducing the cost of tracking each transaction. It also enables UPS and its customers to reduce fixed assets assigned to traditional Private Branch Exchange (PBX)-based call centers. Digitization of supply chain processes can also provide the visibility required to integrate segmented processes and improve resource utilization for the execution of physically intensive processes. For example, digitization of inbound and outbound logistics provides inventory visibility across the supply chain that enables optimal placement of components and finished goods inventory so as to minimize costs and improve responsiveness. Dell Computers is a well-publicized example of a firm that uses information to leverage physical flows and financial flows and has achieved dramatic results in its asset productivity

and working capital efficiency (Magretta 1998). The company has developed its Web-enabled supply chain capabilities to the extent that, on average, it maintains four days of inventory and has streamlined financial flows to achieve negative cash conversion cycles (Fields 2002).

Based on the above discussion, we propose that the extent of digitization between a focal firm and its supply chain partners represents a network capability that contributes to the structural social capital of the firm.

Cross-Functional SCM Application Systems Integration as a Form of Structural Social Capital

Cross-Functional SCM Application Systems Integration is defined as the degree of real-time communication of a focal firm's function-specific SCM applications with each other and related ERP and CRM applications (Rai et al. 2006). Such integrated systems represent an asset for the management of cross-functional process dependencies (Rai et al. 2002a; Rai et al. 2002b). We consider two classes of applications: supply chain planning applications and supply chain execution applications (Kalakota et al. 1999). Planning applications support critical planning processes such as procurement, production, transportation and warehousing. Execution applications support critical execution processes such as order management, replenishment, production and distribution. Integrated execution applications enable supply chain visibility of processes and coordination with partner firms. Integration of planning and execution applications enables close coordination of and responsive adjustments between planning and execution processes. The connectivity provided by such application integration further provide the focal firm with the ability to coordinate supplier-facing (inbound) processes and customer-facing (outbound) with SCM processes of the focal firm. Such connectivity provides the firms with the ability to integrate their information flows and coordinate their physical flows across the supply chain. Based on this discussion, we suggest that Cross-Functional SCM Application Systems Integration contributes to the structural social capital of the firm.

Relational Asset Specificity as a Form of Structural Social Capital

Relational asset specificity is defined as the degree to which a firm makes partner-specific investments in tangible physical resources and intangible resources (Patnayakuni et al. 2006). Tangible resource investments include location-specific investments in production facilities such as customized tools and machinery, or building facilities close to the partner firm (Williamson 1985). Intangible resource investments are directed at developing knowledge related to a partner's procedures, culture, and technological know-how. Both domain-specific and business-process specific knowledge may be considered as relationship-specific intangible assets (Subramani 2004). Such assets tend to be specific to the focal firm as they are based on a unique understanding of context-sensitive procedures, culture etc. that facilitate interactions in a manner that is more likely to be inimitable than physical assets. Based on this discussion, we suggest that both tangible and intangible relationship specific investments are forms of structural social capital for the management of supply chains.

We identified three modalities – Digitization, Cross-functional SCM Applications Integration and Relationship Specific Investments – of structural social capital. We assert that structural social capital enables the focal firm to improve the integration of supply chain processes with its partners. Integration of applications across the supply chain as well as asset specific investments enable the sharing of information content and the better management of inventory across the end to end supply chain.

H1. Structural social capital of a focal firm, which is composed of Digitization, Cross-Functional SCM Applications Integration, and Relationship Specific Investments, has a positive association with supply chain process integration.

Relational Social Capital for Supply Chain Process Integration

The relational facet of social capital is concerned with the nature of relationships that have been developed between individuals or units based on their history of interactions (Granovetter 1992; Nahapiet et al. 1998). It refers to assets that have their basis in relationships and are behavioral, as opposed to structural (Nahapiet et al. 1998). Relational social capital provides for governance of partner relations (Dyer et al. 2003) that is based on trust rather than strict formal contracts. These attributes are exhibited in long-term orientation of relationship, which we identify as a key attribute of relational social capital for the management of supply chains.

Long-Term Orientation as a Form of Relational Social Capital

Long-term orientation is defined as the extent to which long-term considerations, mutual gains, and trust characterize a focal firm's relationships with its partners (Ganesan 1994). Such relationships are governed by self-

reinforcing mechanisms and mutual trust are considered to be more effective and less costly than formal governance mechanisms (Hill 1995). Additionally, relationships based on long-term orientation focus on mutual benefit and have an expectation of continued interaction and exchange (Noordewier et al. 1990), which would support supply chain integration. Based on the discussion, we propose the hypothesis;

H2. Relational social capital of a focal firm, which is assessed based on its long-term orientation for supply chain partners, has a positive association with supply chain integration.

Cognitive Social Capital for Supply Chain Process Integration

Cognitive social capital is the shared language, representation, interpretation and meaning established among partners (Cicourel 1973; Nahapiet et al. 1998). Cognitive social capital can be embodied in language, codes, narratives, and vision that are shared and provide the basis to recognize and realize mutually beneficial outcomes (Tsai et al. 1998). A shared language or system of codes which constitutes cognitive social capital is a means for partners to exchange information across the supply chain which is represented by information flow integration. In the context of supply chains, we suggest that Data Consistency and Relational Interaction Routines represent forms of cognitive capital

Data Consistency as a Form of Cognitive Social Capital

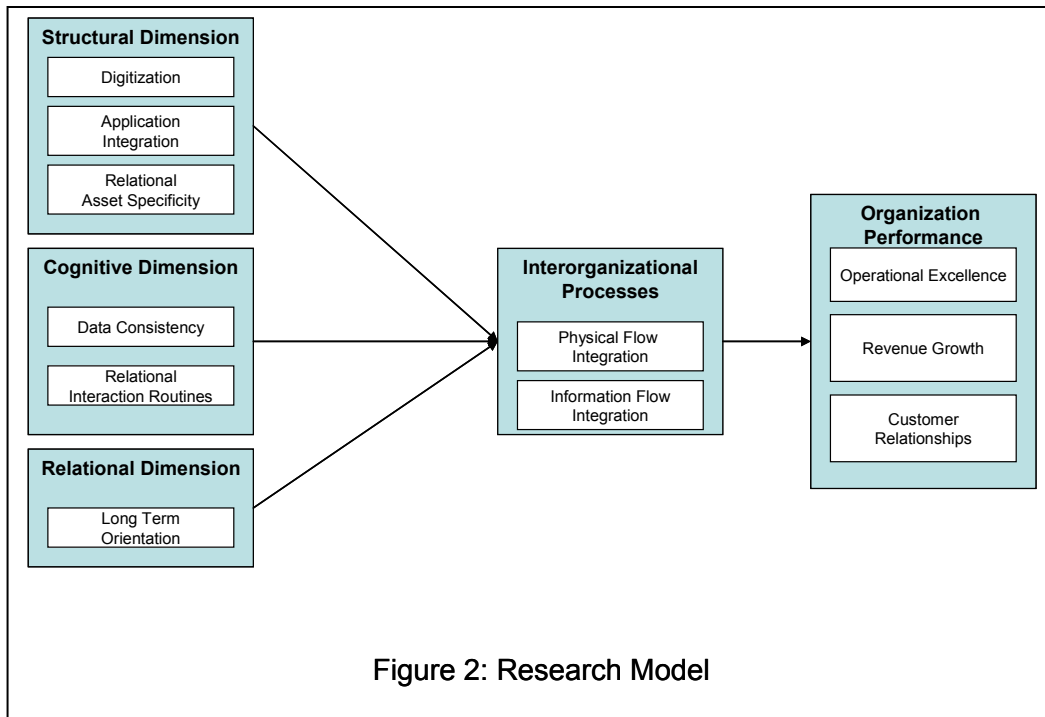
Data consistency is defined as the extent to which common data definitions and consistency in stored data have been established across a focal firm's supply chain (Rai et al. 2006). There are considerable problems in maintaining data consistency within an organization that achieving such capabilities with supply chain partners presents additional barriers. Across organizations, large distributed systems that may only be intermittently connected to exchange data, there are significant data consistency problems (Pitoura et al. 1999). A shared system of coding and capturing data in supply chains will depend on having common data definitions for key entities such as products, brands, geographical regions etc., as well as automated systems that promote accurate data capture at source. The presence of a consistent definition for exchanging data is an important asset that will enable process integration (Huber 1990; Malone 1987) with supply chain partners.

Relational Interaction Routines as a Form of Cognitive Social Capital

Relational Interaction Routines are defined as the degree to which informal and formal mechanisms between a focal firm and its partner have been established for exchange of information and knowledge (Patnayakuni et al. 2006). Routines are usually a formalized set of procedures that are built from prior organizational experience and learning (Davenport et al. 2000). Such routines represent an important mechanism for organizations to create cognitive social capital. Examples of such routines may include review meetings to share and implement best practices, negotiate design specifications, establish norms for sharing data etc. Mechanisms for regular exchange of information and knowledge are likely to provide for greater participation through shared decision making, collaborative practices and exchange of know-how as reflected in supply chain integration (Dwyer et al. 1987). Supply chain process integration will not take place unless interaction routines interact with other structural and relational dimensions of social capital to play their part in the creation and sharing of knowledge that process integration can take place. Such exchange of know-how and knowledge plays a key role in creation of knowledge (Kogut et al. 1996), that is 'sticky' and difficult to trade or replicate.

Well developed interaction routines structure the coordination and communication between a focal firm and its supply chain partners that enable more information and knowledge to be revealed and combined. Researchers have observed that partner-specific ability to absorb information and knowledge, through shared knowledge base, is established through interactions routines (Dyer et al. 1998). Formal interaction practices between supply chain partners that focused on know-how related to collaborative planning is known to have resulted in integration of information flows (Siemieniuch et al. 1999).

Cognitive social capital constitutes shared language, codes, and narratives. Data Consistency, the ability to have a standard set of codes for exchange and interpretation of data, and Relational Interaction Routines, the ability to foster the creation of partner-specific knowledge, are considered as forms of cognitive social capital. Firms that have access to cognitive social capital will be in a better position to create and manage integrated resource flows in their supply chain. Accordingly, we propose that:



H3. Cognitive social capital of a focal firm, which is composed of Data Consistency and Relational Interaction Routines, has a positive association with supply chain integration.

Supply Chain Process Integration for Firm Performance

We focus on aggregate Firm Performance that encompasses three dimensions: Operational Excellence, Revenue Growth, and Customer Relationships (Rai et al. 2006). Operations excellence is defined as a focal firm's productivity and operational responsiveness to its customers relative to its competition. Market-focused performance (Malhotra et al. 2005) is assessed along the dimensions of customer relationships (Groves et al. 1998) and revenue growth (Kalwani et al. 1995; Moorman 1995). Customer relationships focus on the bond and loyalty between a focal firm and its customers, and the knowledge about customer-related preferences relative to competitors. Market focused performance in terms of revenue growth includes sales from existing products and from new products and markets (Zahra et al. 2002).

Research has suggested that supply chain integration requires partners to: (1) share information at operational, tactical, and strategic levels (Ho et al. 2002; Simchi-Levi D. et al. 2000) and (2) adaptively optimize the staging and flow of physical goods (Lee et al. 2000). Such integration of information and physical flows provide firms with distinctive capabilities over their competitors that should result in superior firm performance. Accordingly, we propose that:

H4. Supply chain integration of a focal firm, which is composed of information flow integration and physical flow integration, has a positive association with firm performance relative to its competitors.

Research Methodology and Field Study

Instrument Development

A survey for collecting data was developed using guidelines and practices suggested in IS literature (for ex. Straub 1989). Since pre-existing validated measures were not available for many of the constructs used in the study, multi-item measures were developed for constructs by anchoring them in prior research, industry reports, and discussions

with members in the practice community. The objective was to develop measures that had face validity and had minimal overlap between constructs (Cronbach et al. 1955; Straub 1989). Subsequently a systematic process was used for validating the survey instrument which consisted of several iterations of the instrument and a three phase pilot test that included IS researchers and practitioners. In all 21 different experts were involved in various phases of developing the survey instrument.

Respondents were asked to select the organization's primary product(s) or product line(s) while responding to the questions on these constructs. Primary product(s) or product line(s) were defined as those that command a significant proportion of company revenues, usually 15 to 20 percent, or greater, of revenues. A seven-item Likert type scale where respondents were asked to state their agreement with a given statement on a scale that ranged from "strongly agree" to "strongly disagree" with its midpoint anchored as "neither agree nor disagree", was used for each items in the construct. Measures for firm performance, operational excellence, revenue growth, and customer relationships, were based on the subjective assessment of respondents. This approach is common in organizational research based on the premise that senior managers have reasonable information on organizational performance (Lawrence et al. 1967; Powell 1992). A semantic comparison scale was used for collecting data on firm performance where respondents were asked to rate the performance of their organization in comparison to their competitors as "much better than average," "better than average," "same as competitors-average," "slightly less than average" or "much less than average".

Data Collection

Target respondents for our study were considered to be senior managers overseeing the supply chain management initiatives and/or operations of the firm. The sampling frame was drawn from a list of attendees of the Annual Meeting of Council of Logistics Management¹ and consisted initially of approximately 1800 names that were randomly selected from the list. Next a number of filters to this list were applied. We focus on manufacturing and retail sectors of the economy in this study and removed all organizations that did not belong to manufacturing or retail industries based on their SIC codes. Only one name from each organization based on their professional title that reflected the profile of the target respondent was selected. The final list consisted of 432 manufacturing and retail organizations.

The first mailing of the survey was done using conventional mail and subsequently electronic communication was used to collect data. After the first conventional mail out, e-mail reminders were sent providing respondents the option of receiving another copy of the survey by regular mail or completing the survey online. At this stage a \$10.00 gift certificate was offered as an incentive for completing the survey. After accounting for undelivered and invalid mailing and incorrect e-mail addresses, the effective mail out were 360 surveys. We received a total of 110 combined responses via return mail, Web and e-mail resulting in an effective response rate of 30.55%.

Data collected was tested for non-response bias using analysis of variance techniques. A comparison of first and last quartile of respondents was used to test for non-response bias, based on the premise that the last group of respondents are most likely to be similar in characteristics to non-respondents (Armstrong et al. 1977). The two groups were compared on revenue, organization size, and other key study variables. The tests did not indicate any response bias across these variables. Similar comparisons were made across participants who responded by regular mail and those who completed the survey online. The analysis indicated that the two groups were statistically similar on all demographic and key study variables.

Organizations in the sample had an average revenue of 6.43 billion dollars (sd 11.23 billion, n = 103) and an average of 19.93 thousand employees (sd 40,540, n = 97). The median organization size was 4000 employees and the median organization revenue was 1.5 billion dollars. Forty-five percent of the respondents were from the logistics function, seventeen percent each from the supply chain and distribution functions, thirteen percent had responsibility for IT pertaining to the supply chain, six percent specified that their direct responsibility focused on e-commerce and digitization to support the supply chain, and three percent belonged to the purchasing function. Collectively, our respondents appear to hold positions that are well aligned to the subject matter of our current investigation and are likely to be well informed of relevant initiatives within their firms.

¹ Now known as the Council of Supply Chain Professionals.

Measurement Validation

The proposed research model conceptualizes structural and relational social capital, supply chain integration and firm performance as second order constructs formed by IT and relational constructs. We use Partial Least Squares (PLS)² for analyzing study data. We chose PLS because of the emphasis on theory development in this study as the analytical approach is generally recommended for predictive research models where the emphasis is on theory development rather than confirmatory analysis (Joreskog et al. 1982).

We first analyzed the measurement properties of the first order constructs by factor analyzing items grouped under second order construct (for example digitization, cross functional SCM application integration across supply chain partners and relational asset specificity under structural social capital). The expected factor structure was obtained in all four second order constructs (Appendix A). We also performed an alternative analysis to assess the factor structure of first order constructs in our study. Since PLS does not provide cross-loading information on other constructs, we used the procedure similar to the one described in Karahanna et al. (1999) and Smith et al. (Smith et al. 1996) to evaluate the factor structure³. Each item correlation with its own construct should be greater than its cross-correlation with other constructs, which was found to be the case.

Latent constructs may be modeled as either reflective or formative in structural models (Chin 1998). Based on their research of specification of latent constructs in marketing research, Jarvis (2003) suggest that the decision to model a construct as formative or reflective should be based on four major criteria; (i) direction of causality from construct to indicators, (ii) interchangeability of indicators, (iii) co-variation among indicators, and (iv) nomological net of construct indicators. Formative constructs indicators are considered to 'form' as opposed to 'reflect' constructs. Using these criteria all second order constructs are modeled as formative and all first order constructs except long-term orientation could be considered as formative constructs. Although adequate measurement properties in terms of internal consistency, discriminant validity and convergent validity have been shown for the first order constructs, as formative constructs these are not necessarily required of them (Jarvis et al. 2003).

A suggested criterion for assessing discriminant validity is that variance shared by a construct with its indicators should be greater than the variance shared with other constructs in the model. The average variance extracted from the measurement items can be used to assess the variance shared between a construct and its measurement items (Fornell et al. 1981). The square root of the average variance extracted (AVE), which is interpreted in the same way as correlation, is compared to the correlation of the constructs with other constructs in the research model. A construct is considered to be distinct from other constructs if the square root of the AVE is greater than its correlation with other latent constructs (Barclay et al. 1995). Appendix B provides the results of this analysis providing evidence discriminant validity and also provides descriptive data for the constructs.

Linear composite scores for each of the first order constructs were computed as described above, except for long term orientation which was modeled as reflective. Factor scores or multivariate means can also be used to compute linear composite scores. Using summated mean values of items offers the advantages of being replicable across samples. It is the recommended approach when new measures are developed and transferability is desired (Hair et al. 1998). Rozeboom (1979) also notes that linear composite scores based on different weighting schemes are highly correlated when the items are internally consistent, which is true in our case. The linear composite scores based on multivariate mean were then used as indicators for the second order constructs in the structural model.

² The analysis was done using PLS Graph 3.0 from Soft Modeling Inc.

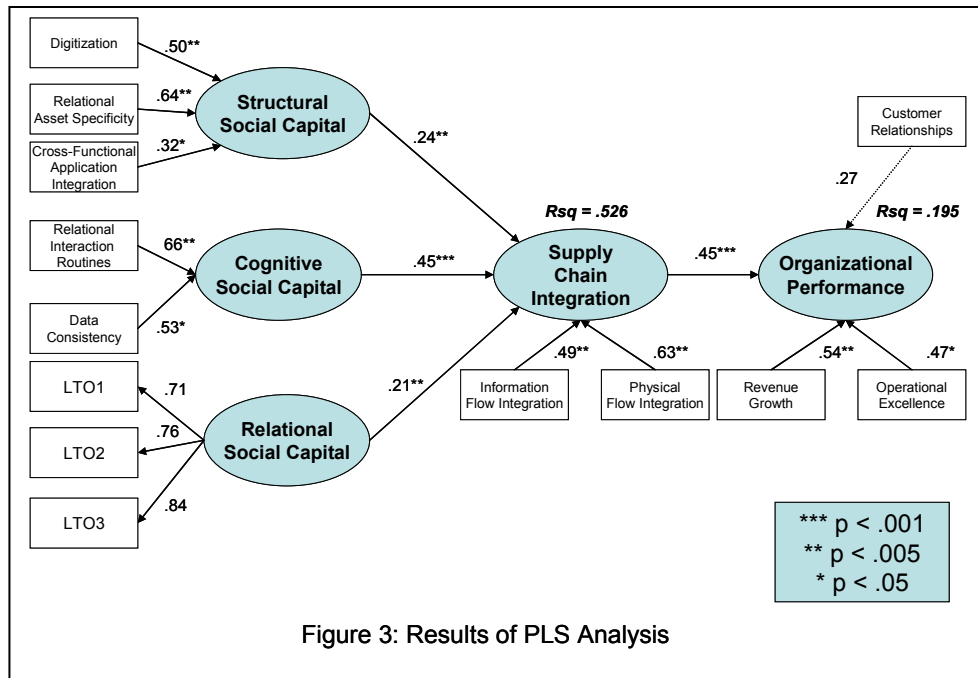


Figure 3: Results of PLS Analysis

Results

The research model was analyzed using PLS, the results from which provide coefficients for the paths between latent constructs. As PLS does not directly provide significance tests and confidence interval estimates of path coefficients in the research model, a bootstrapping technique was used. Bootstrap analysis was done with 500 subsamples and path coefficients were re-estimated using each of these samples. This approach is consistent with recommended practices for estimating significance of path coefficients and indicator loadings (Löhmoeller 1984) and has been used in prior IS studies (Chin et al. 1995).

Results of the analysis for the structural model are shown in Figure 3. The results indicate that the model explained 19.5 % of the variance in firm performance and 52.6% in supply chain integration. The path coefficients from structural, relational and cognitive facets of social capital to supply chain integration were .24, .21 and .45 respectively; all of which are significant at $p < .005$ level and above. The path from supply chain integration to organizational performance is also significant with a coefficient .45.

For formative constructs there are no minimum threshold values for indicator weights but rather are interpreted like beta coefficients in a standard regression model. All first order constructs except for customer relationship as an indicator of organizational performance had significant weights on their respective latent constructs. Overall, we find strong support for the proposed research model.

Assessing Common Method Bias

The data collection method used for the study utilizes perceptual responses from a single respondent for both dependent and independent variables in the study. This raises concerns that data is largely based on perceptions of the respondents rather than actual states of various phenomena and the use of a single respondent makes the analysis susceptible to common method bias. To assess the extent of the problem, we subjected the data to Harmon's single-factor test (Podsakoff et al. 1986). All items used in the study were subjected to an exploratory factor analysis. The factor analysis produced 12 factors, each with an eigenvalue of 1.0 or greater. The first factor explained 23.4% of the variance in all the items. A similar analysis was conducted with only multivariate means of all the constructs used in the study. The second factor analysis produced 3 factors where the first factor explained 35.3% of the variance in aggregated measures. In both analyses a single factor did not explain most of the variance in the study data suggesting that the data set may not be subject to common method bias.

Another approach to assess the vulnerability of study data to common method bias is to compare the responses to objective data available from alternate sources. The survey asked respondents to report their organization's revenues as part of demographic data. The data was then matched with revenue data from Compustat which was available for 57 organizations in our sample. Data for the rest of the sample were not available as they were not publicly traded firms, or because of incomplete data available from the response. The correlation between the two sets of revenue figures was .92 ($p = 0.00$) providing evidence that respondents were well informed and knowledgeable. Finally, different paths in the research models had different levels of significance further reducing concerns about common method bias. Collectively, the three different approaches to evaluate the potential susceptibility to common method bias, the Harmon one factor test, correlation with independently reported data, and different levels of path significance, suggest that common method bias is not a significant problem in the data set.

Discussion

Research and anecdotal evidence suggest that there are two recurrent themes that are prevalent in supply chain strategies. Organizations are looking applying integrative information technologies to coordinate key inter-organizational processes and collaborative relationships with their supply chain partners. Research on digitally enabled supply chains has suggested integrated IT infrastructure capabilities act as lower-order capabilities that support the creation of higher order capabilities such as supply chain integration (Rai et al. 2006). Complementing this approach, and in keeping with the emphasis on relational view of interorganizational relationships (Dyer 1997; Dyer 2000), Patnayakuni et al. (Patnayakuni et al. 2006) identify relational antecedents to information flow integration in the supply chain. In this study we draw upon social capital theory to identify the role of IT and relational capabilities in creating different forms of social capital for the firm that can be leveraged as a platform for managing collective action and for the creation and sharing of knowledge for supply chain process integration. The empirical analysis and results indicate support for the primary thesis put forth by our study suggesting that social capital theory provides a useful framework for firms to develop capabilities that will provide them with the assets that they can then draw upon to improve the performance of their supply chain.

Facets of Social Capital: IT and Relational Capabilities

The knowledge based view of the firm, that adopts the perspective that organizations are essentially social communities that are effective and efficient in creating and transferring knowledge (Kogut et al. 1992). In order to develop a coherent organizing theory for the knowledge perspective, Nahapiet and Ghoshal (1998) draw upon social capital theory to propose a theory for the creation of intellectual capital in firms. A significant contribution made by their work is to propose different facets of social capital as structural, relational and cognitive which provides an elegant and useful framework for understanding resources available to firms embedded in networks for the creation and sharing of knowledge. The notion that social capital represents the actual and potential resources that are embedded in network for the creation of intellectual capital has been demonstrated to be applicable across different levels of analysis (Nahapiet et al. 1998; Tsai et al. 1998; Walker et al. 1997). Given that the new model of competition is one of competition between supply chains, the social capital perspective is an appropriate theoretical lens for studying supply chain networks. In order for the supply chain to be the basis of competition, the social capital embedded in the chain should enable in the creation and sharing of knowledge in the supply chain. It is only when knowledge sharing and creation is enabled by the collective social network that we are likely to see performance impacts that span the supply chain as a whole.

Using the facets of social capital as an organizing framework we identify IT and relational capabilities that represent the three forms of social capital proposed by Nahapiet and Ghoshal (1998). Structural social capital is defined as the assets in the network that represent the impersonal configuration of linkages between members. In the context of supply chain and interorganizational networks, this would represent the access to capabilities that a firm based on the structure of its linkages with its supply chain partners. We proposed in our research model and found empirical support that digitization, cross functional SCM application systems integration, and relational asset specificity together form structural social capital. Each of the three constructs had significant weights on the latent construct labeled as structural social capital. They represent the capabilities that allow the firm to execute processes and coordinate activities in a manner that are likely to result in efficient allocation of resources and provide it with an advantage in competing in the market place.

Relational social capital describes the nature of relationships between members that are developed over a period of time based on prior interactions with a strong sense of continuity (Nahapiet et al. 1998). In contrast to access, this form of social capital has behavioral connotations in terms of the impact it has on how members relate to each other. Attributes such as trust, trustworthiness, obligations, expectations and norms are considered to be reflective of relational social capital. Long term orientation that permeates a firm's relationship with its partner provides a firm with capital that it can draw upon in managing its supply chain. The expectation of continuity coupled with a perspective that does not seek short term expediency provides firms with advantages in governance, reduced uncertainty, and platform for access to other resources such as information, market intelligence, and new product opportunities.

Nahapiet and Ghoshal (1998) argue that the cognitive dimension of social capital is perhaps one that has received the least attention in research. This facet of social capital refers to those resources that have been created in a network that enable shared representation, interpretation, and system of meaning (Cicourel 1973). They are considered to be resident in attributes such as shared codes and narratives. We proposed that data consistency and relational interaction routines contribute to the cognitive social capital. The importance of shared data definitions can hardly be overemphasized. This is necessary precursor to realizing highly desirable outcomes such as the ability to share information electronically, provide visibility across the supply chain and the ability to coordinate not only operational processes but other higher order activities. Similarly relational interaction routines form the basis for the creation of cognitive social capital in supply networks.

Our research has demonstrated that the social capital perspective offers an organizing framework for examining the drivers for the creation and sharing of knowledge in social networks that constitute the supply chain and this sharing of knowledge provides the necessary conditions for supply chain integration. Whereas it would be relatively trivial to consider IT related factors and relational factors under their respective conceptual umbrellas, the social capital perspective provides an alternative lens that helps to examine network resources at a more fundamental level. It should be recognized that the three facets are interrelated; similarly IT and relational capabilities cannot be looked at in isolation.

Limitations and Future Research Directions

We hope that the study has provided useful insights into supply chain integration and related phenomena. The use of social capital theory and looking at the network as a resource points towards opportunities that have the potential for further investigation. As our exercise was exploratory and an effort in combining different streams of research to suggest new theoretical directions, there are numerous limitations to this effort. First, owing to the inherent complexities of analyzing networks as a whole, the unit of analysis of this study was a focal firm and not a supply chain network. We examine aggregate supply chain capabilities and relational characteristics across the primary products for a focal firm. A primary drawback of this approach is that it results in aggregation across supply chains for products. Although a limitation, it allows us to focus on broader organization-level social capital and integration. Secondly, we focus on manufacturing and retail organizations and collected data from members of the Council for Logistics Management. Future studies should examine the constructs and relationships in other industrial sectors and from a broader representation of firms in the manufacturing and retail sectors. Third, in this study we have restricted our scope to selected IT and relational constructs. Variables such as structure of specific supply chains, number of tiers in the chain, types of supply chain applications, and types of business processes integrated, which have not been examined, should help us develop a better understanding of supply chain capabilities and collaborative behaviors in different contexts. For such investigation, the unit of analysis will need to be a supply network and not a focal firm [Straub, 2004 #1813]. Methodologically, collection of perceptual data from a single source in respondent firms leaves the results susceptible to common method bias. Although we discuss the issues and the analysis to suggest that this should not be a concern for the present study, use of tangible and objective measures in future studies would be desirable.

There are undoubtedly numerous opportunities for further research in this area, especially in view of the current interest and an insufficient number of empirical investigations in this domain. We have explored a subset of potentially relevant constructs that have been theoretically positioned in a certain way. There are opportunities for looking at other modes of building each of the facets of social capital as well as the potential for exploring interrelationships among them.

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Appendix A: Measurement Properties of Constructs				
Measurement Items		Factor Structure^a and Loadings		
Structural Social Capital		Digitization	CAI	RAS
<i>Digitization (DIG)</i>				
DIG1	Number of product parts and materials Procured through online trading exchanges and electronic catalogs.	.685		
DIG2	Proportion of INBOUND supply chain activities managed online (e.g. procurement, warehousing, payments).	.839		
DIG3	Proportion of INTRA- ORGANIZATION supply chain activities managed online (e.g. manufacturing, material requirement planning, product planning).	.764		
DIG4	Proportion of OUTBOUND supply chain activities managed online (e.g. orders received, billing, distribution, tracking).	.772		
DIG5	CUSTOMER SERVICE activities conducted online (e.g. answering questions, complaints, live chat).	.620		
<i>Cross Functional SCM Application Systems Integration (CAI)</i>				
The following applications communicate in real-time:				
CAI1	Supply chain planning applications (e.g. Demand planning, transportation planning, manufacturing planning).		.792	
CAI2	Supply chain transaction applications (e.g. Order management, procurement, manufacturing and distribution).		.864	
CAI3	Supply chain applications with internal applications of our organization (such as enterprise resource planning).		.813	
CAI4	Customer relationship applications with internal applications of our organization		.765	
<i>Relational Asset Specificity (RAS)</i>				
RAS1	Partner tools and machinery are customized to our needs.			.708
RAS2	Partners have dedicated significant investment and capacity to our relationship.			.871
RAS3	Partner knowledge of our procedures, culture and technological know-how is difficult to replace.			.739
Average Variance Extracted ^b		54.7%	65.5%	60.2%
Cronbach's Alpha/Composite Reliability ^c		.80/.83	.85/.86	.68/.73
Relational Social Capital				
<i>Long Term Orientation (LTO)</i>				
LTO1	We have long-term relationships with our strategic partners.		.766	
LTO2	In key partner relationships, trust and goodwill have the same, or greater significance than formal contracts.		.867	
LTO3	Both sides in the relationship do not make any demands that can hurt the relationship.		.745	
Average Variance Extracted			63.1%	
Cronbach's Alpha/Composite Reliability			.70/.76	

Appendix A: Measurement Properties of Constructs			
Measurement Items		Factor Structure^a and Loadings	
Cognitive Social Capital		Data Consistency	RIR
Data Consistency (DC)			
DC1	Automatic data capture systems are used (e.g. bar code) across the supply chain.	.768	
DC2	Definitions of key data elements (e.g. customer, order, part number) are common across the supply chain.	.853	
DC3	Same data (e.g. order status) stored in different databases across the supply chain is consistent.	.749	
Relational Interaction Routines (RIR)			
RIR1	We have created formal and informal arrangements for information exchange with our partners.		.819
RIR2	Partners are involved in quality and improvement initiatives.		.874
RIR3	We share best practices with our partners.		.881
RIR4	We learn about new technologies and markets from our partners.		.809
Average Variance Extracted		62.6%	71.6%
Cronbach's Alpha/Composite Reliability		.72/.76	.88/.88
Supply Chain Integration		IFI	PFI
Information Flow Integration (IFI)			
IFI1	Production and delivery schedules are shared across the supply chain.	.628	
IFI2	Performance metrics are shared across the supply chain.	.791	
IFI3	Supply chain members collaborate in arriving at demand forecasts.	.842	
IFI4	Our downstream partners (e.g. distributors, wholesalers, retailers) share their actual sales data with us.	.674	
IFI5	Inventory data are visible at all steps across the supply chain.	.664	
Physical Flow Integration (PFI)			
PFI1	Inventory holdings are minimized across the supply chain.		.827
PFI2	Supply chain wide inventory is jointly managed with suppliers and logistics partners (e.g. UPS, FedEx).		.671
PFI3	Suppliers and logistics partners deliver products and materials just in time.		.733
PFI4	Distribution networks are configured to minimize total supply chain –wide inventory costs.		.671
Average Variance Extracted		52.4%	53.0%
Cronbach's Alpha/Composite Reliability		.81/.82	.69/.70
Firm Performance		Operational Excellence	Revenue Growth Customer Relationship
Operational Excellence (OE)			
OE1	Product delivery cycle time.	.68	

Appendix A: Measurement Properties of Constructs			
Measurement Items		Factor Structure ^a and Loadings	
OE2	Timeliness of after sales service.	.81	
OE3	Productivity improvements (e.g. assets, operating costs, labor costs).	.77	
Revenue Growth (RG)			
RG1	Increasing sales of existing products.		.83
RG2	Finding new revenue streams (e.g. new products, new markets).		.83
Customer Relationship (CR)			
CR1	Strong and continuous bond with customers.		.74
CR2	Precise knowledge of customer buying patterns.		.92
Average Variance Extracted		57.1%	69.1%
Cronbach's Alpha/Composite Reliability		.66/.80	NA/.82
Notes			
<p>a) Rotated factor solution based on principal component analysis with varimax rotation. All cross-loadings below .40 are suppressed.</p> <p>b) Internal Consistency was calculated using Cronbach's alpha and a measure of composite reliability proposed by Fornell and Larcker's (1981) for assessing internal consistency of constructs in structural equation models using the formula</p> $\frac{(\sum \lambda_{yi})^2}{(\sum \lambda_{yi})^2 + \sum Var(\epsilon_i)}$ <p>where $Var(\epsilon_i) = 1 - \lambda_{yi}^2$ and λ is the item loading and ϵ is the error. Cronbach's alpha is not reported for two-item constructs.</p> <p>c) Average variance extracted is calculated using the formula</p> $\frac{\sum \lambda_{yi}^2}{\sum \lambda_{yi}^2 + \sum Var(\epsilon_i)}$ <p>where $Var(\epsilon_i) = 1 - \lambda_{yi}^2$ and λ is the item loading and ϵ is the error.</p>			

Appendix B: Assessment of Discriminant Validity											
Constructs	DIG	CAI	RAS	LTO	DC	RIR	IFI	PFI	OE	RG	CR
Digitization (DIG)	.739										
Cross Functional SCM Application Systems Integration (CAI)	.356	.809									
Relational Asset Specificity (RAS)	.022	.168	.776								
Long Term Orientation (LTO)	.151	.198	.301	.794							
Data Consistency (DC)	.323	.500	.095	.226	.791						
Relational Interaction Routines (RIR)	.212	.300	.385	.408	.362	.846					
Information Flow Integration (IFI)	.292	.374	.272	.285	.560	.498	.724				
Physical Flow Integration (PFI)	.318	.215	.407	.462	.372	.535	.557	.728			
Operational Excellence (OE)	.228	.203	.164	.306	.284	.303	.294	.307	.755		
Revenue Growth (RG)	.066	.120	.112	.134	.155	.253	.280	.309	.252	.831	
Customer Relationship (CR)	.091	.096	.323	.359	.172	.241	.156	.337	.398	.316	.836
Mean (Standard Deviation)	2.57 (.84)	4.61 (1.17)	4.31 (1.51)	5.05 (1.05)	4.57 (1.48)	4.94 (1.14)	4.05 (1.24)	3.93 (1.25)	3.63 (.67)	3.48 (.79)	3.77 (.73)
Cronbach's alpha	.80	.85	.68	.70	.72	.88	.81	.69	.66	NA	NA

