Supply Chain Information and Relational Alignments: Mediators of EDI on Firm Performance

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Abstract

Purpose – This study examines the effects of inter-organization information exchange on supply chain information and relational alignment. Drawing on literature on information systems, supply chain management, and logistics, we present a multidimensional framework for considering EDI adoption in supplier management and its effect on information and relational alignment.

Design/methodology/approach – Theories drawn from resource-dependent and transaction cost economics, and the resource-based view of the firm were used to establish hypotheses. Structural equation modeling using survey data of manufacturing firms was used to test the hypotheses and research model.

Findings – Results support the central premise that firms must consider EDI adoption in supplier management to improve information and relational alignment between supply chain partners. It is through this alignment that firms achieve superior performance.

Research limitations/implications – This study used a single respondent from each firm due to cost considerations, and hence might have affected the inter-rater reliability of the survey data.

Practical implications – Results show that firms should consider EDI adoption in supplier management because of its positive effect on information and relational alignment, which in turn impacts firm performance. However, EDI does not affect performance directly.

Originality/value – The role of EDI adoption in supplier management was examined and shown to indirectly affect firm performance via improved information and relational alignment. Moreover, supply chain information alignment was found to enhance relational alignment among supply chain partners.

Key Words – Supplier Management, Information Alignment, Relational Alignment, Electronic Data Interchange, Firm Performance.

Classifications – Research Paper
Introduction

Faced with intense global competition and shrinking product life cycles, firms have recognized that the seamless integration of operations and processes with those of supply chain partners can be a source of competitive advantage (Hammer, 2001). Firms have also embraced inter-organizational information systems such as electronic data interchange (EDI) to facilitate communication and information exchange with suppliers and customers (Subramani, 2004; Teo et al., 2003). Inter-organizational information systems play a key role in achieving competitive success (Hammer, 2001; Subramani, 2004). Indeed, research has shown that EDI use can help firms establish cooperative relationships and share vital information (Grover et al., 2003; Son et al., 2005). This can reduce the effects of information distortion which commonly manifests itself via the bullwhip effect, reduce response times, and enable firms to effectively combine internal process knowledge with that of suppliers’ to create unique, value adding capabilities.

While disagreement exists regarding the benefits and impact of EDI, its proponents report significant gains from its adoption (Mukhopadhyay et al., 1995; Craighead et al., 2006). A sizable body of literature in the information systems domain refers to the success of EDI implementation in terms of integration and utilization (Son et al., 2005; Lee and Lim, 2005; Sánchez and Pérez, 2005), and benefits such as enhanced data integrity, responsiveness, and product quality (Craighead et al., 2006). However, the literature focuses largely on identifying dimensions of EDI crucial to organizational success (Son et al., 2005), or key characteristics and benefits of EDI adoption and implementation (Lee and Lim, 2005; Sánchez and Pérez, 2005). Little attention has been given to the role of EDI in the context of supplier management and its subsequent impact on performance.
This study explores the impact of considering both buyer and supplier EDI capability in supplier management decisions on supply chain information and relational alignment, and performance. Firms must consider theirs and their supplier’s EDI capabilities when making decisions regarding supply chain configuration. We argue that this is a precursor of the information and relational alignment between supply chain partners that drives firm performance. We define EDI capability as the scope of a firm’s technology infrastructure for information exchange using EDI. Supply chain information alignment refers to the alignment of information flows and the use of compatible information systems between the buyer and supplier consistent with meeting strategic goals and customer requirements. The development of tightly coupled information infrastructures is one of several guiding principles for the effective design and execution of supply chain systems (Muckstadt et al., 2001). Supply chain information alignment includes the evaluation of formal and informal information sharing agreements, communication of future strategic needs, and creation of compatible information systems between trading partners. Supply chain relational alignment addresses the consistency between the buyer and supplier in terms of culture, relationship expectations, and flexibility to adapt to changing market needs. A key factor in supply chain relational alignment is that decision-making and actions are consistent among supply chain members. However, consistency exists only if strategic processes and performance measures are dynamically linked (McAdam and Baile, 2002). In the following section, the literature review and research hypotheses are presented. In subsequent sections, the survey instrument and statistical analyses are addressed followed by discussion of the results. Finally, conclusions and limitations of the study are provided.
**Literature Review**

*Information Technology, Information Sharing, and the Buyer-Supplier Relationship*

Prior literature suggests that information technology (IT) is an enabler of information sharing within the supply chain. Carr and Smeltzer (2002) observed a relationship between the use of direct computer-computer links and the richness of information shared. Sanders and Premus (2005) found that IT capability has a positive, direct effect on both internal and external collaboration, noting that information sharing is a key dimension of collaboration. Kim *et al.*, (2006) observed that both applied innovation and administrative innovation are positively related to systems integration, the ability to use IT for collaborative purposes. They also found that both systems integration and administrative innovation influence information sharing. Christiaanse (2005) suggested that EDI use facilitates timely, frequent information exchange. Walton and Gupta (1999) noted that information coupling between supply chain partners should be collaborative for partners to achieve the benefits of EDI. Prior literature does not offer definitive evidence of the role EDI plays in aligning information flows between supply chain partners and how this is a source of competitive edge. Moreover, there is little evidence of the role EDI capability plays in information alignment between buyers and suppliers.

Several studies have examined the relationship between IT deployment and the buyer-supplier relationship. They concluded that IT can enhance coordination (Bensaou and Anderson, 1999; Kim *et al.*, 2006), facilitate development of close relationships (Bensaou and Anderson, 1999), and reinforce and stabilize inter-organizational structures (Chae *et al.*, 2005). Studies of EDI offer similar results. Positive relationships between EDI use and buyer-supplier cooperation (Bensaou, 1997), supplier perceptions of mutual understanding and cooperation (Sánchez and Pérez, 2005), and supplier coordination (Hill and Scudder, 2002), have all been observed. Buyer-
supplier trust, interdependence, and commitment positively influence the diversity of EDI use (Lee and Lim, 2005), while customer power negative influences EDI usage (Son et al., 2005). Reciprocal investments and cooperation are also positively related to both the diversity and volume of EDI use (Son et al., 2005). Not only are trust and interdependence positively related to EDI integration and utilization, high levels of cooperation strengthen the relationship between reciprocal investments and diversity of EDI use (Lee and Lim, 2005). EDI use is also consistent with reduced conflict (Carr and Smeltzer (2002).

Studies of buyer-supplier relationships refer to the link between these relationships and information sharing. They suggest that cross-functional information sharing between buyer and supplier is directly related to the strength of their relationship (Martin and Grbac, 2003). Information sharing and trust also have a positive, direct effect on supply chain proximity, a measure of the physical distance between the buyer and supplier and a proxy for the closeness of the relationship (Narasimhan and Nair, 2005). The IT literature suggests a similar link. Kim et al., (2006) noted that both the use of IT for collaborative purposes and information exchange positively affect inter-organizational coordination. In the context of EDI specifically, Larson and Kulchitsky (2000) found that the quality of information shared and the closeness of the buyer-supplier relationship are related.

*Information Sharing and Performance*

Considerable empirical evidence of the benefits of EDI exists. Its use is consistent with cost reductions in broad terms (e.g., Manabe et al., 2005; Craighead et al., 2006) as well as in specific costs such as freight, inventory, and information handling (Mukhopadhyay et al., 1995). Improvements in several inventory related metrics are also reported (Dröge and Germain, 2000; Manabe et al., 2005). EDI use leads to reductions in the time to process a purchase request, the
timeliness and accuracy of supplier deliveries (Walton and Marucheck, 1996), customer responsiveness (Craighead et al., 2006), as well as broader measures of time based competition (Manabe et al., 2005). The speed and accuracy of EDI yields improvements in the management of process uncertainties and resulting process disruptions. EDI use is also associated with improvements in manufacturing processes (Manabe et al., 2005), product quality (Craighead et al., 2006), overall competitiveness and performance, and growth in sales and market share (Yusuf et al., 2004). EDI use also has benefits in terms of the ease of data entry and reductions in data errors (Craighead et al., 2006).

Downing (2002) compared firms using traditional EDI technologies with those using web-based EDI technologies. Results indicated that EDI use is consistent with high levels of internal/partner operational efficiency and overall process performance attributable to the use of IT. The use of web-based EDI was also consistent with higher levels of coordination with supply chain partners and overall performance than the use of traditional EDI technologies. In a broader IT context, Sanders and Premus (2005) found evidence of a direct relationship between IT capability and performance, measured in terms of improvements in cost, product quality, new product introduction time, and delivery speed.

Evidence of the influence of information flow on performance is limited. Kim et al., (2006) noted a direct positive relationship between information exchange and market performance, defined in terms of sales growth, market and product development. They also observed that information exchange positively influences the responsiveness of the partnership, which in turn has a positive impact on market performance. Larson and Kultchitsky (2000) found evidence of a positive and direct relationship between the quality of information shared and lead time performance, measured in terms of cycle time and on time delivery, and an indirect
relationship via the closeness of the buyer-supplier relationship. Walton and Marucheck (1996) observed that sharing information on production plans and capacity is positively associated with improvements in delivery performance.

Several studies suggest a positive relationship exists between the buyer-supplier relationship and performance in the context of information exchange. Relationship strength has a direct and positive impact on profitability and customer loyalty (Martin and Grbac, 2003), and supply chain proximity has a positive impact on performance measured as a composite of financial and market performance (Narasimhan and Nair, 2005). Kim et al., (2006) observed that inter-firm coordination positively and directly influences supply chain responsiveness, but influences market performance only indirectly via the positive influence of supply chain responsiveness on market performance. Two studies specific to EDI provide further evidence. Larson and Kultchitksy (2000) found that a close buyer-supplier relationship has a direct, positive impact on lead-time performance. Lee and Lim (2005) noted that the extent of EDI integration and utilization but not the diversity of its use, impact EDI performance, measured in terms of response time, errors, trust, and processing efficiency. The literature on buyer-supplier relationships also provides extensive evidence of the positive effect relationships can have on performance (Johnston et al., 2004).

**Research Hypotheses**

**Resource Dependence Theory**

Resource dependence theory was developed to describe inter-firm relationships (Pfeffer and Salancik, 1978). It proposes that firms seek to reduce uncertainty vis-à-vis scarce and valued resources by establishing relationships with other organizations in the value chain. It also suggests that organizations attempt to alter dependence relationships by reducing the dependency
on some partners or increasing the dependency of others on them, thereby shifting the power structure. The focus of the theory is not on resources themselves but on inter-organizational relationships that firms rely on to exchange or acquire external resources. Cannon et al., (2008) argued that the resource dependence perspective of information technology be assessed both on its technical merits and on whether it affects exchange uncertainty for adopting firms. Carr et al. (2008) claimed that suppliers who are dependent on a buyer for resources (i.e., sales) are more likely to cooperate and comply with buyer demands to, for example, participate in new product development or to modify processes to accommodate new product specifications.

The central premise of EDI is that it aids inter-organizational communication by coordinating information and material flows. Supply chain members seek to reduce uncertainty by utilizing formal and informal information sharing agreements, adopting compatible information systems, and sharing information such as future strategic needs and feedback from end users. Inter-organizational consistency in these activities leads to supply chain information alignment. Possessing EDI capability is thus a precursor to it being able to facilitate alignment of information needs between partner firms. Similarly, supply chain members attempt to reduce uncertainty and their dependence on others by nurturing collaborative relationships with trading partners. Organizations, particularly those that are highly dependent on others, are more willing to accommodate the demands of supply chain members to ensure high customer service levels in the presence of mutually beneficial buyer-supplier relationships. Consistency in efforts to achieve these relationships leads to supply chain relational alignment. A partner’s technology and data communication capabilities can affect efforts to foster cooperation and collaboration. This however requires the buying firm to consider supplier EDI capability when making
decisions about how to leverage the relationship. Possessing EDI capability also serves as a cue to whether the buyer sees technology as a driver of relationship development. We posit that,

\[ \text{H1: Consideration of EDI capability in supplier management positively affects supply chain information alignment.} \]

\[ \text{H2: Consideration of EDI capability in supplier management positively affects supply chain relational alignment.} \]

**Transaction Cost Economics Theory**

Williamson (1981) argued that uncertainty and opportunistic behavior are key determinants of transaction costs. Similar to resource dependence theory, transaction cost economics theory suggests that organizations aim to avoid uncertainty. However, it suggests that a reduction in exchange uncertainty is attractive only to the extent that it reduces transaction costs (Cannon et al., 2008). Research grounded in transaction cost economics generally focuses on the role of an organization as a mechanism to reduce exchange uncertainty. However, inter-organizational exchange also increases the risks of opportunism, particularly when a firm invests in an asset, such as information technology, that is specific to the exchange relationship. For example, an opportunistic buyer may force a committed supplier to lower prices once the supplier has invested in new assets for the exchange. Implementing a new technology such as EDI is a means to reducing transaction costs if it improves information processing capabilities and coordination. Information alignment among partner firms enhances visibility and reduces uncertainty. When supply chain information alignment is achieved, supply chain partners can reduce uncertainty and transaction costs by establishing collaborative relationships to achieve supply chain relational alignment. For example, inspection of incoming raw materials, a non-value added activity, can be eliminated by certifying supplier’s process or product. We posit that,
**H3:** Supply chain information alignment has a positive impact on supply chain relational alignment.

*Resource-Based View Theory*

While studies based on the theories of resource dependence and transaction cost economics focus on reducing dependency and uncertainty, the resource-based view of the firm (Wernefelt, 1984) argues that the key to a firm’s sustainable competitive advantage is how it develops and exploits unique, inimitable resources. This has been used to explain how information technology enhances process integration capability and thus firm performance (Ordanini and Rubera, 2008), and how supplier involvement positively affects strategic purchasing and performance. It also helps to explain why firms lacking certain competitive capabilities will promote collaborative relationships with supply chain partners to secure those capabilities (Oh and Rhee, 2008).

While encouraging suppliers to use EDI has been shown to affect purchasing procedures, its impact on performance has not been explored. Walton and Gupta (1999) argued that EDI’s effect on business processes is the key to understanding the impact of EDI on supply chain management. It is apparent that technologies such as EDI can be an inimitable resource that has a significant impact on manufacturing, information flow, and performance. The question that remains is to what extent does consideration of EDI capability in supplier management decisions affect performance? We posit that

**H4:** Consideration of EDI capability in supplier management positively affects firm performance.

As suggested by past research, EDI use can aid a firm in effectively managing manufacturing processes and uncertainty and can thus be an inimitable resource for achieving competitive advantage. Its ability to do so however depends on aligning internal manufacturing
processes, information systems, and relationships with those of supply chain partners. Performance improvements result from sharing key information in a timely manner, and working collaboratively towards common goals. Information technology, information sharing, collaborative relationships and supply chain integration (Meile and Field, 2008) have been shown to affect firm performance. The question that remains however is whether information alignment or relational alignment affect performance. Hence, we posit that,

\( H_5: \) Supply chain information alignment positively influences firm performance.

\( H_6: \) Supply chain relational alignment positively influences firm performance.

Figure 1 summarizes the proposed research model and hypotheses.

Survey Instrument, Respondent Profile and Reliability Analysis

A survey instrument was developed based on a review of pertinent literature and interviews with practitioners and academics. A senior operations manager from a large manufacturing firm in the U.S. assisted in the design of the initial survey instrument. Feedback on the initial design was then obtained from academics familiar with empirical research in study domain and senior operations managers. A revised survey instrument was finally pre-tested by a group of practitioners. The instrument incorporated four constructs: Consideration of EDI Capability in Supplier Management (EDI), Supply Chain Information Alignment (INFO), Supply Chain Relational Alignment (REL), and Firm Performance (PERF) (see Appendix). To increase measurement accuracy, multiple indicators were used to represent unobservable constructs.
(Bagozzi et al., 1991) and existing scales employed where possible. The EDI construct consisted of three variables that address supplier EDI capability in supplier selection and performance evaluation decisions, and buyer EDI capability in improving customer service (Sanders, 2007; Kim and Rogers, 2005). The INFO construct consisted of six variables that examine the extent of information sharing and communication, and the compatibility of inter-organizational information systems (Savitskie 2007, Moberg et al. 2002). The REL construct consisted of five measures that examine the role of the buyer-supplier relationship in achieving firm objectives (Kannan and Tan, 2006, Golicic and Mentzer, 2006). Using a five-point Likert scale, respondents were asked to indicate the importance of various practices in their firm’s efforts corresponding to each of the constructs. Firm Performance (PERF) was measured by asking respondents to indicate the level of their firm’s performance compared to that of major competitors on multiple performance dimensions. This surrogate measure of performance is used commonly in empirical research to overcome differences in performance attributable to industry and scale (e.g., Tan et al., 1998; Narasimhan and Nair, 2005).

Data was collected using standard mail survey procedures (Dillman, 1991) from senior purchasing and supply managers in the U.S., Europe, and New Zealand, identified from the Institute for Supply Management and the Association for Operations Management membership lists, and the KOMPASS commercial database (Basnet et al., 2003). The survey targeted respondents with the background and experience pertinent to the study. A total of 6,006 delivered surveys yielded 625 useable responses. The response rate of 10.41%, while lower than those of other empirical studies, is comparable to those of studies using similar population frames (e.g., Fawcett and Magnan, 2001; Frohlich and Westbrook, 2001). To test for non-response bias, surveys were separated into two groups based on return date, late arriving
questionnaires considered representative of non-respondents (Lambert and Harrington, 1990). t-tests on responses to a set of randomly selected questions and the number of employees and annual sales, indicated no statistically significant differences (α = 0.05) in mean responses, suggesting the absence of non-response bias. The Harman one-factor method was used to assess common method bias, exploratory factor analysis of each construct producing multiple factors (Podsakoff et al., 2003).

For each construct, internal consistency was estimated using standardized Cronbach’s α (Cronbach, 1951). Values of α in excess of 0.60 suggest that measurement scales are sufficiently reliable (Nunnally, 1988). Cronbach’s α for the four constructs ranged from 0.65 to 0.78. Composite reliability, a more parsimonious measure of scale reliability, was also used to verify the reliability of the constructs. Composite reliabilities in excess of 0.60 provided further evidence of scale reliability (Podsakoff et al., 2003).

Structural Equation Modeling

The two-step structural equation modeling approach was used in which measurement models were first tested individually and then simultaneously prior to testing the structural model (Anderson and Gerbing, 1988). Analysis based on the maximum likelihood estimation method was carried out using LISREL-SIMPLIS 8.72.

Measurement Models

The measurement scale for each latent variable was established by creating a reference indicator and setting its value to one (Anderson and Gerbing, 1988). The EDI measurement model has only three indicators and is thus a just-identified model with zero degrees of freedom. Although a unique solution exists for parameter estimates in a just-identified model, one cannot
reject the model due to it having zero degrees of freedom. While the model is thus not interesting from a statistical perspective, factor loadings of its paths are statistically significant (Figure 2). Each indicator loaded significantly on the construct providing evidence of convergent validity (Jöreskog and Sörbom, 1993).

The INFO measurement model exhibited evidence of correlation between the error terms for two items related to formal and informal information sharing agreements with suppliers and customers to facilitate collaboration (Q2A and Q2B). This is consistent with rapid advancements in IT enabling supply chain members to effectively collaborate and share information using formal and informal agreements (Dröge and Germain, 2000; Sanders and Premus, 2005). A corresponding error covariance term was added to the model. A second covariance term was added between the need to communicate the firm’s future strategic needs (Q2C) and customers’ future strategic needs throughout the supply chain (Q2D). A firm committed to sharing information on strategic needs with suppliers can be expected to see the value of sharing similar information from customers. A third covariance term was added between the need to communicate customers’ strategic needs (Q2D) and creating a compatible information system with supply chain members (Q2E). The need to communicate future strategic needs will be reduced if trading partners have compatible information systems that can exchange pertinent information. Figure 2 shows the revised measurement model. Goodness of fit measures indicated good model fit ($\chi^2 = 5.73$, df = 6, $\chi^2$/df = .96, RMSEA = .00, AGFI = .99, NFI = .99, CFI = 1.0). Standardized factor loadings ranged from 0.45 to 0.73, exhibited the expected positive sign, and were significant, thus demonstrating convergent validity.
Analysis of the REL measurement model indicated the need to add error covariance terms between the role of cultural match in supplier selection (Q3B) and both supplier relationship (Q3C) and the firm’s demand/service flexibility in improving customer satisfaction (Q3D). To build a mutually beneficial buyer-supplier relationship, there must be cultural alignment between the buyer and the supplier. Over-emphasizing demand/service flexibility may place unrealistic expectations on suppliers, and may indicate inadequate consideration of cultural fit. Standardized factor loadings were again positive (0.32 to 0.69) and significant, and goodness of fit indices consistent with good model fit ($\chi^2 = 5.47$, df = 3, $\chi^2$/df = 1.82, RMSEA = .04, AGFI = .98, NFI = .99, CFI = .99).

Analysis of the PERF measurement model suggested that overall product quality (Q4B) is correlated with overall customer service level (Q4E). This is consistent with high product quality leading to high levels of customer service (Tan et al., 1998). Analysis also suggested that strong overall competitive position (Q4D) can adversely affect return on assets (Q4B). This can occur if significant capital investments are needed, for example in new equipment and/or research and development, to achieve or maintain performance levels. Each indicator had the expected positive sign and loaded significantly on the construct. The revised measurement model (Figure 2) again fits the data well ($\chi^2 = 4.54$, df = 3, $\chi^2$/df = 1.51, RMSEA = .03, AGFI = .99, NFI = .99, CFI = 1.0).

The four measurement models were tested simultaneously by allowing the constructs to freely correlate with each other. Goodness of fit measures again indicated good fit ($\chi^2 = 321.5$, df = 139, $\chi^2$/df = 2.31, RMSEA = .05, AGFI = .93, NFI = .94, CFI = .97). To test for discriminant validity, correlations between each pair of latent variables were examined. All
correlation coefficients were significant and less than 0.5 in value, consistent with a high level of discriminant validity (Anderson and Gerbing, 1988, Table 1).

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**Structural Equation Model**

With the exception of the $\chi^2$ p-value, goodness of fit indices ($\chi^2 = 321.5$, df = 139, $\chi^2$/df = 2.31, RMSEA = .046, AGFI = .93, NFI = .90, CFI = .94) suggested that the saturated structural equation model (Figure 3) fit the data well. The structural equation model supports hypotheses $H_1$ ($\beta_1 = 0.35$) and $H_2$ ($\beta_2 = 0.49$) that consideration of EDI capability has a positive impact on information and relational alignment respectively. It also supports hypothesis $H_3$ ($\beta_4 = 0.27$) that information alignment has a positive impact on relational alignment, and hypothesis $H_6$ ($\beta_6 = 0.42$) that relational alignment has a positive influence on firm performance. However, support is not found for either consideration of EDI capability ($H_4$) or information alignment ($H_5$) having a direct effect on firm performance. Both affect performance only indirectly via their impact on supply chain relational alignment.

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$\chi^2$ statistics are sensitive to sample size and departures from the assumption of multivariate normality, large ($n > 200$) sample sizes tending to result in significant $\chi^2$ statistics (Schumacker and Lomax, 1996). The ratio of $\chi^2$ to degrees of freedom is thus a preferred measure.
Discussion and Managerial Implications

Support for hypothesis H₁ is consistent with the results of studies suggesting EDI use or adoption facilitates information sharing. The result here however is significant for two reasons. First, it illustrates the importance of considering firm and partner EDI capabilities as a driver of information sharing in the context of supplier management, and in particular when selecting and evaluating suppliers. It is the information sharing capabilities EDI provides that motivate information flows, not merely the use of the technology itself. It behooves firms to evaluate how information can and will be used, not just what data elements will be shared. This is similar in principle to the importance of administrative innovation described by Kim et al., (2006). Second, it demonstrates the importance of considering the strategic value of information flows, not merely their transactional value. It is thus pertinent to consider how information will be leveraged and how technology must facilitate this.

Evidence of the positive relationship between the consideration of EDI capability and relational alignment (H₂) highlights the significance of considering how, and for what purpose, information might be shared in the context of developing supply chain relationships. As suggested by prior research, merely sharing information across firm boundaries in a timely manner can facilitate relational alignment. However, consciously considering how internal and partner EDI capabilities might play a role in serving customers suggests a more strategic objective underlying information sharing. This has important consequences for relationship development. This finding is consistent with the conclusions of Son et al., (2005) and Grover et al., (2003) that effective EDI use enables organizations to establish cooperative relationships to share vital information. Support for hypothesis H₄ further demonstrates that the perceived value of EDI in linking firms goes beyond data transfer. The commitment to share strategic and not
just tactical information, and the development of the infrastructure to facilitate this, play a key role in binding firms to each other in support of common goals, and is a source of competitive advantage (Hammer, 2001). This finding supports the argument in the literature that information alignment enhances coordination (Bensaou and Anderson, 1999; Kim et al., 2006), facilitates development of close relationships (Bensaou and Anderson, 1999), and reinforces existing inter-organizational structures (Chae et al., 2005).

It is the binding of firms based on EDI capability, strategic use of information, and a commitment to achieving shared goals, that drives performance (H6). As suggested by prior research, information sharing from a transactional perspective plays an important role in enabling firms to work together to achieve positive outcomes. The results here suggest that what motivates this exchange is equally important. Technologies such as EDI are tools, and as with other tools, the scope of their use has limits. Leveraging the tool for competitive advantage requires appropriate definition of the context in which it will be deployed and establishment of the necessary infrastructure. The failure to support hypotheses H4 and H5 reinforces this conclusion. Merely considering EDI capability to be important or aligning information sharing, will not lead to performance improvements. At first glance, this may appear to contradict results of studies of EDI use. However, prior literature has emphasized only direct linkages between EDI use and performance and with few exceptions (e.g., Larson and Kulchitsky, 2000) did not examine the role of mediating variables. The results here are significant in demonstrating the role of these mediating variables – supply chain information and relational alignment.

The recently implemented Wal-Mart Remix initiatives support the findings and demonstrate the critical role of supply chain information and relational alignment in improving firm performance. As part of its quest to improve in-stock position and inventory turnover while
simultaneously reducing inventory, Wal-Mart embarked on the initiatives to limit inventory growth to no more than half of sales growth (Hoffman, 2006). Wal-Mart asked suppliers to deliver small quantities with high frequency to its distribution centers. However, this led to an increase in the number of less-than-truckload (LTL) shipments from vendors and created congestion at the distribution centers. To overcome this, third-party logistics providers were used to consolidate LTL shipments from multiple vendors into truck-load shipments at five strategically located consolidation centers throughout the U.S. Although the use of these logistics providers added another layer to the distribution system, Wal-Mart’s Retail Link information system allowed suppliers and logistics providers to coordinate shipment and order information effectively. This would not have been possible if the suppliers’ information systems were not compatible and aligned with the Retail Link system.

Another notable initiative associated with Remix is that a *velocity-based* approach replaced the traditional *category-based* approach to managing the distribution network. The 5,000 items with the greatest turnover are delivered to stores in specially marked Remix trailers, and goods transferred directly to display shelves instead of to the backroom. Small trolleys called Rocket Carts that are narrow enough to navigate store aisles are used to restock empty shelves during busy shopping hours. This eliminates the need to wait until store traffic is low and use large pallets. The ability to restock during busy shopping hours allows Wal-Mart to reduce the size of its display shelves, reduce inventory, and improve inventory turnover. In the fiscal year ending January 31, 2007, Wal-Mart’s sales increased 10.45 percent but its inventory increased by only 4.64 percent. The ability to exploit the Retail Link system to achieve information and relational alignment with suppliers was a key driver of this improved performance by enabling
the sharing of demand information with suppliers and allowing them to track inventory in the distribution system all the way to the store.

Conclusion

EDI has been viewed largely as a technology to allow firms to exchange data. However, EDI also serves as a means for alignment around shared objectives. The results show that merely considering EDI capability to be important or aligning information sharing will not lead to better performance. Prior literature, with few exceptions, has emphasized direct linkages between EDI use and performance without examining the role of mediating variables. The major contribution of this study is in demonstrating the role of supply chain information and relational alignment as mediating variables. The study not only illustrates the importance of attitudes towards EDI in facilitating this alignment, it demonstrates that the value of EDI comes in part, if not significantly, from efforts to build inter-firm relationships and aligning information flows in the context of these relationships. Developing elements of the ‘soft’ infrastructure including information and relationships is thus a key to enabling firms to work together for mutual benefit. This in turn requires that firms carefully consider their own as well as partner EDI capabilities when managing suppliers.

The study is not without its limitations. A challenge in conducting empirical research is the difficulty of obtaining a adequate sample. Multiple data sources were used to develop the sampling frame, respondents were pre-screened to ensure they had the knowledge and expertise to provide valid responses, and the survey instrument was extensively tested to ensure questions would be interpreted correctly. However, this cannot guarantee adequacy of the sample. This limitation is compounded by the reliance on a single respondent per firm which precludes testing for inter-rater reliability. The challenge of sampling, and specifically of acquiring sufficient data
from, for example, individual industry sectors, firms at different positions in the supply chain, and partner firms with different power relationships, also precludes conducting detailed contingency analysis. This however represents an opportunity for further research. Another area where additional data can facilitate further study is the breadth of the supply chain that firms actively engage. One might reasonably infer that information and relational alignment is related to whether a firm engages only partners proximate in the supply chain or also partners who are more than one tier away. Whether alignment drives broad engagement or the desire to involve more distant partners drives alignment is unclear, but is an important issue, particularly with high levels of outsourcing and a corresponding need to rely on supply chain partners. With increasingly disaggregated global supply chains, this takes on even greater significance. An additional avenue for future research is to examine, simultaneously, actual EDI capability and use. This will make it possible to make nuanced judgments about the influence of EDI on supply chain relationships, and help to develop a better understanding of the relationship between information sharing strategy, tactics, and performance in a supply chain context. As firms recognize the increasing importance of information that is rich in context as opposed to often context free data, how they create synergy between IT tools and inter-organizational relationships will take on greater significance.
Appendix

1. EDI Capability in Supplier Management (EDI)
How important are the following issues in your firm’s supply chain management efforts? (5 = very important, 1 = not important)
   A) Supplier EDI capability in their performance evaluation
   B) Supplier EDI capability in supplier selection decisions
   C) Your EDI capability in improving customer service

2. Supply Chain Information Alignment (INFO)
How important are the following issues in your firm’s supply chain management efforts? (5 = very important, 1 = not important)
   A) Use of informal information sharing agreements with suppliers and customers
   B) Use of formal information sharing agreements with suppliers and customers
   C) Communicating your firm’s future strategic needs to your suppliers
   D) Communicating customers’ future strategic needs throughout the supply chain
   E) Creating a compatible information system with suppliers and customers
   F) Contacting end users to get feedback on performance and customer service

3. Supply Chain Relational Alignment (REL)
How important are the following issues in your firm’s supply chain management efforts? (5 = very important, 1 = not important)
   A) Supplier volume flexibility in supplier performance evaluation
   B) Cultural match in supplier selection decisions
   C) Supplier relationships in supplier selection decisions
   D) Your demand/service flexibility in improving customer satisfaction
   E) Your customer service system in improving customer satisfaction

4. Firm Performance (PERF)
Please indicate the level of your firm’s performance compared to your major industrial competitors in terms of: (5 = high, 1 = low)
   A) Market share
   B) Return on assets
   C) Overall product quality
   D) Overall competitive position
   E) Overall customer service levels
References


Table 1: Correlation Matrix of Latent Variables

<table>
<thead>
<tr>
<th>Research Constructs</th>
<th>EDI</th>
<th>INFO</th>
<th>REL</th>
<th>PERF</th>
</tr>
</thead>
<tbody>
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<td>EDI in Supplier Management (EDI)</td>
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<td></td>
<td></td>
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<tr>
<td>Supply Chain Information Alignment (INFO)</td>
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<tr>
<td>Supply Chain Relational Alignment (REL)</td>
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<td>.475</td>
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<td></td>
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<tr>
<td>Firm Performance (PERF)</td>
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<td>.201</td>
<td>.370</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: all correlation coefficients are significant at p < .01

Figure 1: Research Model and Hypotheses
(A) Consideration of EDI Capability in Supplier Management

(B) Supply Chain Information Alignment

(C) Supply Chain Relational Alignment

(D) Firm Performance

Figure 2: Measurement Models

Figure 3: Structural Equation Model

* indicates insignificant path