Information sharing and supply chain performance: the role of connectivity and willingness

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Abstract

Purpose – The purpose of this paper is to understand how information technology (IT) is used to enhance supply chain performance.

Design/methodology/approach – A large-scale survey and semi-structured interviews were used to collect industry data.

Findings – Two distinct dimensions to information sharing – connectivity and willingness – are identified and analyzed. Both dimensions are found to impact operational performance and to be critical to the development of a real information sharing capability. However, many companies are found to have placed most of their emphasis on connectivity, often overlooking the willingness construct. As a result, information sharing seldom delivers on its promise to enable the creation of the cohesive supply chain team.

Research limitations – Despite the extensive data collection, the research represents a snapshot of practice. Replication from a longitudinal perspective would help define how IT is evolving to enable supply chain management.

Practical implications – A roadmap is presented to help guide IT development and investment decisions.

Originality/value – The research presents a two-by-two matrix to help managers and academics understand the related nature of connectivity and willingness. A roadmap is presented to help guide IT development and investment decisions.

Keywords Supply chain management, Information management, Communication technologies, Quality improvement

Paper type Research paper

Introduction

Advances in information technology have changed modern business practice, making collaborative supply chain management (SCM) possible (Cachon and Fisher, 2000; Chatfield et al., 2004; Lee et al., 2000; Li, 2002). Information’s competitive value is widely heralded – it substitutes for inventory, speeds new product design, shortens order fulfillment cycles, drives process reengineering, and coordinates SC activities (Cachon and Fisher, 1997; Clark and Hammond, 1997; Hammer, 1990; Hult et al., 2004, Kulp et al., 2004; Kurt Salmon Associates Inc., 1993; Lee et al., 1997, 2000). Information sharing is at the core of collaborative, supply-chain based business models. Think Dell and Wal-Mart, two companies that depend on information exchange to help diverse members of a supply chain to work together efficiently and effectively. Information sharing allows Wal-Mart to outsource much of its inventory planning to suppliers who become responsible for monitoring inventory levels, planning replenishment, and suggesting new ideas to improve throughout. At Dell, sales information cascades back several tiers to make the entire supply chain more efficient and responsive, enabling Dell to operate with only four days inventory supply. Information-enabled collaboration reduces costs across the chain while enhancing customer service and value. Unfortunately, few companies have fully harnessed information’s ability to enhance SC performance.

One of the challenges confronting companies in their quest to leverage information as a viable enabler is a misperception regarding the nature of a valid information sharing capability. Many managers define and manage information sharing as a technology issue (Cachon and Fisher, 2000; Chatfield et al., 2004; Constant et al., 1994; Fiala, 2005; Frohlich, 2002; Hongtao, 2002; Lee et al., 2000; Robinson et al., 2005; Strader and Lin, 1999). They tend to believe that by investing in technology, people and companies can be meaningfully
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connected. This perception leads to a reliance on the power of technological innovation to drive collaboration. The result: technology is bought and sold as the solution to a company's information sharing deficiencies. Yet, for many companies, the sought after information sharing capabilities and higher levels of cross-enterprise collaboration never materialize (Fawcett and Magnan, 2001).

A few companies, however, appear to treat information sharing quite differently. They act as if sharing is a behavior embedded in organizational cultures. For example, companies like Deere and Honda send engineers to work on site at suppliers in an effort to improve suppliers’ processes. They also bring supplier design engineers into their R&D centers to work on new product teams. In both cases, sensitive information regarding cost and technology plans is shared. These face-to-face commitments augment their investments in technology to create better relationships and raise the level of information sharing. Only when companies are willing and able to share vital – and often proprietary – decision-making information can trust be established and collaboration promoted. Technology becomes a tool to augment and promote information sharing and real collaboration. These companies seem to recognize that a substantial gap separates technological connectivity and SC collaboration. The cultural construct of willingness appears to be critical to bridging this gap.

Experience suggests that while willingness is vital to information sharing, connectivity is the better-understood and more-invested-in capability. Two questions thus arise:

1. How do companies perceive connectivity and willingness and what are they doing to build each of these capabilities?
2. How important are connectivity and willingness to enhanced collaboration and higher levels of SC performance?

The nature and role of an information-sharing capability

Much has been written about SCM in recent years. While the discussion typically revolves around closer collaboration among members of the chain, the perspectives and prescriptions vary greatly. However, one tenet appears as a common thread tying the discussion together: success depends on managers’ ability to identify changes in the competitive environment and then to structure SC resources to help the company compete more effectively. This contingent response determines how well the firm, and the entire chain, adapts to the dynamics of an evolving and intensely competitive market (Hofer, 1975).

Of all the resources a company manages, information has perhaps received the greatest attention as critical to the implementation of the company’s strategic SC response. To respond productively to rapid change, a company must “be aware of new information generated in its environment and adopt structures that enable fast decision making … and practices that reduce information overload” (Mendelson, 2000, p. 515; Tushman and Nadler, 1978). For this reason, companies are investing heavily in information technologies to enhance their ability to manage information and knowledge across the supply chain (Ofek and Sarvary, 2001).

Figure 1 captures this sequential relationship, emphasizing the fact that managers are seeking to improve operational and competitive performance by developing a more comprehensive and effective information sharing capability. To date, most of the managerial and theoretical focus has been the technological side of the information sharing capability. Yet, many organizations have been “disappointed with the returns from these investments” (Jap et al., 2002). One possible reason for the disappointment is that the technologies have not been supported by commensurate investments in organizational cultures that promote open sharing of information (Fawcett and Magnan, 2001). Common sense suggests that the technological ability and the willingness to share information should work supportively together to enhance the quality and impact of SC decision making. Each of these two distinct dimensions – connectivity and willingness – of an information-sharing capability is therefore discussed in the following paragraphs.

The role and impact of connectivity

Information technologies play a central role in SCM. They enable companies to collect, analyze, and disseminate information among members of the chain to improve decision making (Sprague and Watson, 1979). Connecting managers across functional and organizational boundaries and providing them with relevant, accurate, and timely information reduces temporal and spatial distance enabling them to make better, more collaborative decisions. Recent technological advancements have dramatically increased companies’ ability to connect. The goal of enabling individuals anywhere in the chain to seamlessly interact with one another is becoming a technological possibility (Chesbrough and Teece, 2002).

Enhanced connectivity promises to change competitive capabilities. The most readily apparent change is seen in information’s ability to substitute for inventory in the chain (Constand et al., 1994). Enhanced connectivity is also shortening new product development cycles and order fulfillment lead times (Erhun and Tayur, 2003; Sahin and Robinson, 2002; Sanders and Premus, 2002). Real-time connectivity also provides less-tangible benefits such as empowering managers to detect environmental trends and inflection points earlier, helping companies respond to changing competitive rules (McGee, 2004). Further, real-time connectivity helps companies monitor customer behavior on a continuous basis. Immediate feedback to members of the chain can be used to drive learning and the development of “smart services.” The ability to dynamically optimize chain performance to meet emerging customer needs may provide unparalleled competitive advantage (Allmendinger, 2005). The belief that enhanced connectivity facilitates better decision making, improved capabilities and higher performance levels leads to our first hypothesis: H1. Connectivity is positively correlated to a company’s performance.

The role and impact of willingness

Connectivity creates the capability to share information. However, people make the decisions regarding what will be shared and when. The old saying, “information is power” holds true in today’s business world. As a result, many individuals are unwilling to share information that they perceive may place their organizations at a competitive disadvantage. Regardless of whether these perceptions are accurate, tremendous amounts of potentially useful

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Figure 1 A contingency perspective of information sharing capability as a strategic enabler

Strategic Management Initiative

Driving Forces

- More Demanding Customers
- Greater Competitive Intensity
- Shifting Channel Power
- Economic Globalization
- Tighter Alliance Relationships
- Compressed Product Cycles
- Continued Merger Activity
- Need for Better Information
- New Information Technologies
- Shifting Competitive Focus; i.e., Companies to Supply Chains

Information Sharing Capability

Connectivity

Willingness

Performance Outcomes

- Unique Products & Services
- Faster R&D Cycle Times
- Superior Quality
- Cost Competitiveness
- Shorter Order Cycles
- Flexible Customer Response
- Enhanced Delivery Performance
- Better Asset Management
- Increased Cash-to-Cash Velocity
- Superior Channel Relationships

Methodology

To understand the nature and role of information sharing in today’s SC decision-making environment, it was necessary to tap the managerial experience of companies that have undertaken SCM initiatives. Thus, a multi-method empirical approach involving both surveys and interviews was used to gain insight into how managers perceive and develop information sharing capabilities. This triangulation approach – literature review, survey, and company interviews – provided an opportunity to benchmark current practice while identifying facilitators and stumbling blocks to best practice.

Cross-functional mail survey

Numerous informal discussions with materials managers confirmed that a wide variety of opinions exist regarding the nature, role, and adequacy of information sharing. To document how materials managers view information sharing in the SC context, a mail survey methodology was adopted and targeted to three different groups of managers: purchasers, logisticians, and manufacturing managers. A mail survey is generally a cost-effective approach to gathering substantial quantities of data from a large number of managers and generating broad-based, generalizable findings.

Based on the literature and the pre-survey interviews, a four-page instrument consisting of 16 questions with 169 separate data points was developed to explore a variety of SC issues. An advisory board consisting of practitioners and academics reviewed the survey. Their feedback was used to modify the instrument to improve its ability to capture relevant information and make it more user friendly. The survey process followed Dillman’s Total Design Method and included three mailings of a cover letter, an instruction sheet, and the survey instrument. The mailing list was compiled from three professional associations: the Institute for Supply Management, APICS, and the Council of Supply Chain Management Professionals. A total of 588 usable responses were received for a 12 percent response rate. Approximately 100 non-respondents from each group were telephoned to obtain basic demographic data so that respondent and non-respondent profiles could be compared. No differences were found.
Company interviews

Company interviews emphasize qualitative analysis and are useful for answering questions regarding what, why, and how. Interviews provide an opportunity to contextualize survey findings and explore issues of interest in greater detail. They are ideal for identifying best or unique practices. Interviews were conducted with companies at four different positions along the supply chain: retailers, finished goods assemblers, suppliers, and service providers. Most of the interview companies were selected because they had a reputation as SC leaders. Others were included because they were suppliers or customers of the SC leaders.

Once a company agreed to participate, a letter of introduction and a brief overview of the research objectives were mailed together with a copy of the interview protocol to the appropriate manager(s). This information was sent before the interview so that the manager could adequately prepare for the discussion. The typical interview lasted four to six hours, with the longest taking over ten hours. Where appropriate, a facility tour was included as part of the visit. Interviews generally involved multiple managers from the host organization, depending on the company's organizational structure. Supporting documents were also collected whenever possible.

A total of 144 interviews were completed. To assure comparability of approach and results, a semi-structured protocol was developed (this also provided for flexibility in pursuing greater insight into unique practices and programs). Further, the core research team conducted the initial interviews together to establish a common approach. Periodic meetings were then held to compare results and resolve any issues. Finally, a standardized write-up procedure was established to help the research team content analyze and understand the key findings.

Analysis and findings

To evaluate information sharing’s influence on performance requires the development of appropriate measurement constructs. In addition to the measures of connectivity and willingness, performance was measured from two perspectives. First, managers were asked to indicate the extent SC collaboration has improved the firm’s operational – cost and service – performance. Second, managers were asked to evaluate their company’s overall performance vis-à-vis leading industry rivals. A variant of Dess and Robinson’s (1984) perceptual measure of firm performance was used. Research has shown that a well-designed perceptual measure is an appropriate surrogate for financial performance data (Vickery et al., 1993; Ward et al., 1994).

Assessing the reliability and validity of the measures

Table I contains a listing of the items used to measure the four constructs. Each of these measures consists of multi-item scales, which were summed to form the respective construct. Following Gefen (2003), we examine our constructs for: scale reliability; convergent validity; discriminant validity; and unidimensionality. Cronbach’s coefficient alpha, a measure of internal consistency, is also shown for each measure (Churchill, 1979). Each of the alpha coefficients exceeds 0.7, indicating a satisfactory degree of reliability (Nunnally, 1978).

Convergent validity measures the extent that the items proposed for a construct are actually correlated. Discriminant validity, by contrast, measures the degree that variables that

<table>
<thead>
<tr>
<th>Table I Constructs and measures used</th>
<th>Mean</th>
<th>SD</th>
<th>Alpha</th>
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<tbody>
<tr>
<td><strong>Construct</strong></td>
<td>Mean</td>
<td>SD</td>
<td>Alpha</td>
</tr>
<tr>
<td>Connectivity&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.47</td>
<td>1.24</td>
<td>0.86</td>
</tr>
<tr>
<td>Information systems are highly integrated throughout the supply chain</td>
<td>4.90</td>
<td>1.76</td>
<td></td>
</tr>
<tr>
<td>Information applications are highly integrated within the firm</td>
<td>4.83</td>
<td>1.65</td>
<td></td>
</tr>
<tr>
<td>Adequate information systems linkages exist with customers</td>
<td>3.69</td>
<td>1.60</td>
<td></td>
</tr>
<tr>
<td>Adequate information systems linkages exist with suppliers</td>
<td>4.56</td>
<td>1.59</td>
<td></td>
</tr>
<tr>
<td>Current information systems satisfy supply chain communication requirements</td>
<td>3.26</td>
<td>1.57</td>
<td></td>
</tr>
<tr>
<td>Willingness&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4.23</td>
<td>1.23</td>
<td>0.88</td>
</tr>
<tr>
<td>Frequent and regular communication among supply chain members</td>
<td>4.64</td>
<td>1.58</td>
<td></td>
</tr>
<tr>
<td>A willingness to share information among supply chain members</td>
<td>4.58</td>
<td>1.57</td>
<td></td>
</tr>
<tr>
<td>Use of cross-functional teams</td>
<td>4.37</td>
<td>1.64</td>
<td></td>
</tr>
<tr>
<td>Sharing of technical expertise with suppliers</td>
<td>4.33</td>
<td>1.53</td>
<td></td>
</tr>
<tr>
<td>Senior level managerial interaction among supply chain members</td>
<td>4.22</td>
<td>1.65</td>
<td></td>
</tr>
<tr>
<td>Sharing of technical expertise with customers</td>
<td>4.15</td>
<td>1.56</td>
<td></td>
</tr>
<tr>
<td>Use of supply chain teams with members from multiple firms</td>
<td>3.30</td>
<td>1.70</td>
<td></td>
</tr>
<tr>
<td>Operational performance&lt;sup&gt;c&lt;/sup&gt;</td>
<td>4.26</td>
<td>1.07</td>
<td>0.94</td>
</tr>
<tr>
<td>Responsiveness to customer requests</td>
<td>4.69</td>
<td>1.39</td>
<td></td>
</tr>
<tr>
<td>On-time delivery/due-date performance</td>
<td>4.65</td>
<td>1.48</td>
<td></td>
</tr>
<tr>
<td>Overall customer satisfaction</td>
<td>4.62</td>
<td>1.36</td>
<td></td>
</tr>
<tr>
<td>Cost of purchased items</td>
<td>4.58</td>
<td>1.46</td>
<td></td>
</tr>
<tr>
<td>Profitability</td>
<td>4.51</td>
<td>1.36</td>
<td></td>
</tr>
<tr>
<td>Inventory costs</td>
<td>4.47</td>
<td>1.52</td>
<td></td>
</tr>
<tr>
<td>Order fulfillment lead times</td>
<td>4.47</td>
<td>1.51</td>
<td></td>
</tr>
<tr>
<td>Overall product cost</td>
<td>4.37</td>
<td>1.33</td>
<td></td>
</tr>
<tr>
<td>Productivity</td>
<td>4.32</td>
<td>1.38</td>
<td></td>
</tr>
<tr>
<td>Overall product quality</td>
<td>4.15</td>
<td>1.47</td>
<td></td>
</tr>
<tr>
<td>Transportation costs</td>
<td>3.88</td>
<td>1.56</td>
<td></td>
</tr>
<tr>
<td>Market penetration</td>
<td>3.85</td>
<td>1.43</td>
<td></td>
</tr>
<tr>
<td>Product innovation lead times</td>
<td>3.74</td>
<td>1.48</td>
<td></td>
</tr>
<tr>
<td>Cost of new product development</td>
<td>3.43</td>
<td>1.50</td>
<td></td>
</tr>
<tr>
<td>Competitive performance&lt;sup&gt;d&lt;/sup&gt;</td>
<td>4.91</td>
<td>1.07</td>
<td>0.87</td>
</tr>
<tr>
<td>Sales growth the last three years</td>
<td>4.96</td>
<td>1.31</td>
<td></td>
</tr>
<tr>
<td>Market share growth the last three years</td>
<td>4.85</td>
<td>1.28</td>
<td></td>
</tr>
<tr>
<td>Growth in return on assets (ROA) in the last three years</td>
<td>4.77</td>
<td>1.26</td>
<td></td>
</tr>
<tr>
<td>Overall competitive strength</td>
<td>5.06</td>
<td>1.19</td>
<td></td>
</tr>
</tbody>
</table>

Notes: <sup>a</sup> To what extent do you agree with the following statements as they relate to your firm’s SC? (7 = strongly agree, 1 = strongly disagree); <sup>b</sup> to what extent do the following improve collaboration between your firm and other SC members? (7 = greatly; 1 = does not); <sup>c</sup> to what extent has SC collaboration improved your firm’s performance in the following areas? (7 = greatly improved; 1 = not improved); <sup>d</sup> how does your firm’s performance compare to leading rivals in your primary industry? (7 = much greater; 1 = much less)
should not describe a construct actually do not correlate with the construct. A two-step principal components factor analysis was used to assess validity. First, the eigenvalues computed in the analysis are examined to determine the number of constructs supported by the data. Second, the factor loading pattern from a Varimax rotation is examined to determine if individual variables load properly on the proposed constructs. Table II demonstrates that the items load as predicted, suggesting acceptable levels of convergent and discriminant validity.

Finally, unidimensional validity connotes that the individual items do not correlate with some other missing construct. Again, following Gefen (2003) we test for unidimensionality by examining the correlation among pairs of residual variance. Shared residual variances above 2.58 indicate possible non-unidimensionality (Gerbing and Anderson, 1988; Segars, 1997). In unreported tests, none of the shared residual variances is above the threshold of 2.58.

Assessing information sharing’s impact on performance

To examine the impact Connectivity and Willingness have on organizational performance, we estimate the following two OLS regressions:

Operational performance = \( \beta_0 + \beta_1 \text{Size}_i + \beta_2 \text{Connectivity}_i + \beta_3 \text{Willingness}_i + \epsilon_i \)

Competitive performance = \( \beta_0 + \beta_1 \text{Size}_i + \beta_2 \text{Connectivity}_i + \beta_3 \text{Willingness}_i + \epsilon_i \)

Figure 2 reports the regression results complete with White’s (1980) corrected \( t \)-statistics for heteroskedasticity and variance inflation factors to test for multicollinearity. The variable Size (measured as number of employees) was included in the regression to control for possible scale effects that might confound the relationship between information sharing and performance.

Focusing first on the impact of Connectivity and Willingness on Operational Performance, we find that the overall model \( F \)-statistic is 85.8, which is significant at the \( p = 0.0001 \) level. More important, perhaps, is the fact that the parameter estimates for both Connectivity (\( \beta_2 = 0.27 \)) and Willingness (\( \beta_3 = 0.35 \)) are significant at the \( p = 0.001 \) level while the parameter estimate for Size is not significant (\( p = 0.25 \)). Interestingly, Willingness has a somewhat stronger influence on Operational Performance than Connectivity. These results provide strong support for the first two hypotheses – that connectivity and willingness are important antecedents to improved performance in the SC context. In fact, the adjusted \( R^2 \) of 35.5 percent suggests that Connectivity and Willingness account for over one third of the variance in Operational Performance. Given the number of factors that affect operational performance, this is a notable finding. Clearly, the regression results reveal a strong relationship a between a company’s information-sharing capability and its ability to reduce costs and increase service levels.

Turning to the impact of Connectivity and Willingness on Competitive Performance, we find that the overall model \( F \)-statistic is 7.6, which is significant at the \( p = 0.0001 \) level. However, despite statistically significant parameter estimates...
for both Connectivity ($\beta_2 = 0.09, p = 0.04$) and Willingness ($\beta_3 = 12, p = 0.006$), the $R^2$ is relatively small 3.9 percent. Nonetheless, higher levels of information sharing do lead to slightly enhanced competitive position. Thus, while the first two hypotheses are again supported, Connectivity and Willingness do not translate automatically to dramatically higher levels of financial and market performance.

Figure 3 introduces a two-by-two connectivity-willingness matrix. The idea underlying the matrix emerged from the interviews. Specifically, managers frequently expressed frustration that despite large investments in technology, information that was needed to make important tactical and strategic decisions was unavailable. Companies were simply unwilling to share certain types of information. The lack of willingness was particularly evident in relationships that had at some point in the past acted opportunistically. Over time, it became apparent that interview companies could be placed in one of four quadrants based on their stance regarding: information technology investments; and willingness to share needed decision-making information. For information technology investments; and willingness to share needed decision-making information. Four issues are described briefly in each quadrant: the nature of the SC relationship, the state of connectivity, the state of willingness, and the expected outcome. For example, Quadrant IV represents strategic, trust-based relationships that have implemented state-of-the-art information technologies and inculcated high levels of willingness to share information. Companies in this quadrant possess both the ability and culture for information sharing to support high levels of unique, value-added collaboration. $H_3$ suggests that these companies will outperform companies in the other three quadrants.

To test this hypothesis, the surveyed companies were split into four groups corresponding to the four quadrants in the matrix:

1. low-connectivity/low-willingness;
2. high-connectivity/low willingness;
3. low-connectivity/high willingness; and
4. high-connectivity/high-willingness.

Various splits on the data were performed, including a median split, a tercile split, and a quartile split. Analysis of variance procedures were then performed to determine if performance differences were significant. The performance patterns for the different data splits were consistent; therefore, only the results for the tercile split are reported (see Table III).

Again, we focus first on the results for Operational Performance. The overall model $F$-statistic is 42.99, which is significant at the $p = 0.0001$ level, The model explains 37.6 percent of the variance in performance. Using Tukey’s Studentized Range Test to compare differences in means we see that companies in Quadrant IV: High-Connectivity/High Willingness do achieve higher levels of performance than their counterparts in the other three quadrants. While there is no difference in performance between companies in Quadrants II and III, they both outperform companies that have established neither Connectivity nor Willingness.
When Competitive Performance is evaluated, the overall \( F \)-statistic is 4.20, which is significant at the \( p = 0.0064 \) level. The model only explains 5.4 percent of the variance in performance. Looking at the means reveals that the only companies to perform at statistically higher levels are those in Quadrant IV: High-Connectivity/High Willingness. Companies in the other three quadrants achieve comparable levels of financial and market performance. The message: to distinguish themselves from rivals, companies must establish both high levels of connectivity and willingness. One final point deserves emphasis – a comprehensive information-sharing capability is more critical to improving Operational than Competitive Performance.

### Building an information-sharing capability

The finding that superior information-sharing capabilities enable better operational performance and higher levels of competitiveness raises the question, “What are SC leaders doing to improve collaboration through more effective information sharing?” The interviews help answer this question by benchmarking the status of industry practice and providing insight into the barriers and the bridges to a stronger information-sharing capability.

### Status of connectivity and willingness

If the question were asked, “Where are companies investing their time and money to gain competitive advantage?” the

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**Figure 3** The connectivity-willingness matrix

<table>
<thead>
<tr>
<th>Quadrant</th>
<th>Connectivity</th>
<th>Willingness</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>II</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>III</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>IV</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>

- **I (Low Connectivity, Low Willingness)**: Relationship is arm’s length, lacks trust, and share’s informationreactively. Insufficient resources are available or dedicated to information technology. History of opportunistic behavior limits the willingness to share more information than is necessary. Minimal information is shared, leading to missed opportunities to improve efficiencies and collaboration.

- **II (High Connectivity, Low Willingness)**: While closer relationship exists, partners resist open information sharing for fear of opportunistic behavior. Technology links are in place to enhance coordination, but the information shared is incomplete or insufficient to support collaboration. Order and inventory information is shared; however, partners hold closely more sensitive information including new product development plans, technology roadmaps, and market entry objectives. Opportunities for high levels of unique collaboration are overlooked.

- **III (High Connectivity, High Willingness)**: Strategic relationship is desired, trust has been established, but information sharing does not yet support relationship goals. Insufficient resources are available to create adequate technology linkages. An effort is made to share information, however, information is often processed and communicated slowly and may be inaccurate. Decision makers may have difficulty making sense of the shared information. Opportunities for high levels of unique collaboration are not readily identifiable and are not fully supported by the needed information.

- **IV (High Connectivity, High Willingness)**: Relationship is strategic, built on high levels of trust and shared information. Technology integration has been a high priority in the relationship, enabling high levels of connectivity. All relevant decision-making information is shared on a frequent and timely basis. Information is accurate, honest, and open. Opportunities for high levels of unique collaboration are identified and leveraged via a strong information-sharing capability.
answer would likely be, “information technology.” Managers are fully aware of the powerful role of connectivity – and they do not want to be left behind in the battle for the best information technologies. After all, both cross-functional process integration and SC collaboration depend heavily on high levels of connectivity. Recognizing this, leading companies have invested vast financial resources to build information systems capable of collecting, analyzing, and disseminating accurate, real-time information regarding forecasts, inventory, delivery, quality, and just about anything else a manager could ask for.

Specifically, companies are investing in a variety of software. Most of the investment is targeted at the following applications: enterprise resource planning (ERP) systems, warehouse management systems (WMS), transportation management systems, advanced planning and scheduling (APS) systems, satellite tracking systems, database management and mining, intranets and extranets, point of sales tracking systems, and web-based catalogues. These applications affect every aspect of the order fulfillment process from tracking inventory status to ordering to picking and packing to shipping to receiving to storing. Information systems help eliminate uncertainty, reduce inventory, and increase responsiveness to customer requests. Interviewed managers emphasized the following roles of their information systems:

- automated order placement;
- electronic funds transfer (payment);
- facility design;
- SKU management;
- shipment consolidation;
- point of sales data capture;
- shipment tracking;
- customer profiling;
- share best practices;
- supplier performance monitoring;
- computer aided design;
- advanced shipment notices;

- facility location;
- inventory control;
- transportation routing;
- warehouse management;
- automatic replenishment;
- product flow-through analysis;
- on-line bidding/auctions;
- purchasing compliance to policy;
- creation of global consortiums/exchanges; and
- share strategic information (e.g. technology plans).

While the need for better connectivity is readily seen, few companies have fully grasped the importance of the willingness dimension of information sharing. During the interviews, the typical complaint was, “Our systems are inadequate to handle our SC needs.” Further discussion almost always revealed that a lack of willingness kept managers from obtaining the information they needed to make more collaborative SC decisions. In fact, SC partners indicated that the companies with the most capable systems often rely excessively on their systems. Believing that they have solved the communication challenge by making inventory, order, and sales information easily available, they do not share strategic information in a timely manner.

The fact that the willingness side of sharing often goes overlooked is debilitating. High levels of SC collaboration are intimately tied to a willingness culture. It is willingness that builds trust among decision makers, enhances SC understanding, leads to more creative collaboration, and establishes the culture needed for managers to feel comfortable sharing sensitive information.

**Barriers to sharing information**

The interviews identified four barriers to better information sharing. The most noted challenge is the cost and complexity of implementing advanced systems. Without the new “enterprise” systems, companies struggle to keep everyone on the same page, making decisions from the same high-quality information. Despite large investments in these

<table>
<thead>
<tr>
<th>Quadrant IV: high connectivity/high willingness</th>
<th>Mean operational performance</th>
<th>Mean competitive performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadrant III: low connectivity/high willingness</td>
<td>4.23^b</td>
<td>4.68</td>
</tr>
<tr>
<td>Quadrant II: high connectivity/low willingness</td>
<td>4.14^b</td>
<td>4.62</td>
</tr>
<tr>
<td>Quadrant I: Low connectivity/low willingness</td>
<td>3.31</td>
<td>4.66</td>
</tr>
</tbody>
</table>

Notes: ^a operational performance for companies in Q IV is higher than counterparts at \( p < 0.05 \) level; ^b operational performance for companies in Q II and Q III is higher than for those in Q I at \( p < 0.05 \) level; ^c competitive performance for companies in Q IV is higher than Q I at \( p < 0.05 \) level, Q II at \( p=0.14 \), Q III at \( p < 0.10 \)

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Table III ANOVA results: the impact of information sharing on organizational performance

<table>
<thead>
<tr>
<th>ANOVA results</th>
<th>DF</th>
<th>Sum of squares</th>
<th>Mean square</th>
<th>F-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operational performance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model</td>
<td>3</td>
<td>126.24</td>
<td>42.08</td>
<td>42.99</td>
<td>0.0001</td>
</tr>
<tr>
<td>Error</td>
<td>214</td>
<td>209.49</td>
<td>0.98</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( R^2 ): 37.6 percent</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Competitive performance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model</td>
<td>3</td>
<td>14.75</td>
<td>4.92</td>
<td>4.20</td>
<td>0.0064</td>
</tr>
<tr>
<td>Error</td>
<td>221</td>
<td>258.35</td>
<td>1.16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( R^2 ): 5.4 percent</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

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**Tukey’s studentized range test**

<table>
<thead>
<tr>
<th>Quadrant</th>
<th>Mean operational performance</th>
<th>Mean competitive performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadrant IV: high connectivity/high willingness</td>
<td>5.07^a</td>
<td>5.19^c</td>
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<tr>
<td>Quadrant III: low connectivity/high willingness</td>
<td>4.23^b</td>
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<td>3.31</td>
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</tr>
</tbody>
</table>
systems, most interview companies have experienced difficulty in installing them. Time and money budgets are often exceeded by 50 to 100 percent. And the systems often do not perform as advertised. Some managers therefore describe the implementation process as an endless nightmare. Even so, most managers agree that despite the pain of implementation, no realistic option exists.

A second barrier is found in systems incompatibility. It is not unheard of for a company to receive customer orders through EDI only to end up manually reentering the information into its own systems. This happens because the systems do not talk to each other. Incompatibility is particularly painful among companies involved in mergers and acquisitions. Incompatibility also challenges smaller firms. That is, when industry standards do not exist, or are not used, expensive systems cannot connect seamlessly with each other. Many smaller firms simply do not have the resources to invest in multiple connectivity systems. Faced with the challenge of selecting among diverse standards used by different customers, these cash-poor companies opt out of the new technologies altogether.

Systems incompatibility exacerbates the cost of connectivity, creating the third barrier – different levels of connectivity exist up and down the chain. This is the SC version of the “island of automation.” A company cannot leverage the full benefits of connectivity when it receives 100 percent of its orders electronically and transmits 80 percent or more of its orders to suppliers using fax or phone. Until all the key players in the chain are connected, the ability to drive collaboration through shared information will be limited.

The final barrier can be stated simply, “Managers do not understand the willingness dimension of information sharing!” As a result, they do not invest in a culture conducive to sharing information. Thus, it is not surprising that many managers are simply unwilling to share valued information. Viewed as power, information is tightly controlled, especially in the absence of trusting relationships. This reality not only impedes SC collaboration but also makes the implementation of advanced information systems more difficult. Several managers quietly noted that their greatest problems in implementing “enterprise” systems were rooted in people, not technical impasses. These managers emphasize that it is often easier to resolve technical problems than it is to manage behavioral issues. Interviewed managers made it very clear that achieving needed levels of willingness to spur SC collaboration is perhaps the most intractable challenge to better information sharing.

Bridges to a world-class information-sharing capability

Anecdotal evidence suggests that few companies understand how to turn information sharing into a competitive advantage. The interviews confirmed that most companies have yet to figure out how to leverage a combined connectivity/willingness strategy. They did, however, identify a few common threads that bind the practice of SC leaders into a prescriptive formula.

Maintain a balanced perspective

Technology should enhance managerial decision making, not replace it. When human and technology systems work well together, higher levels of performance become possible. The Director of SCM at a leading consumer goods company commented on the link between people and technology, saying, “Technology is just an enabler, people are the bridge or the barrier to process integration.” This mindset prevails at SC leaders, helping them invest for the long haul and from a holistic perspective.

Avoid technology traps

Companies often buy technology for the wrong reason. Some view it as a panacea — the answer to a problem that has not been fully understood or correctly diagnosed. Technology by itself is often the wrong prescription. Others get caught up in either a “follow-the-leader” or “shiny-hardware” syndrome. The fact that other companies are “buying it” is seldom justification for a technology implementation. It is likewise important not to overspend to acquire the most advanced “shiny hardware” on the market, especially when more modest expenditures can better meet existing needs. The final pitfall to avoid is the “island of automation” described previously. One manager summed up this challenge, saying, “There are no silver bullets, but plenty of people willing to sell you one.”

Match technologies to specific value-added capabilities

The few interview companies firmly encamped in Quadrant IV: High-Connectivity/High-Willingness tie every technology investment to a real, documented capability need. Specific process improvements drive technology expenditures. By directly tying investments to specific needs, these companies are able to better define actual needs and standards. They also achieve higher levels of buy-in among those affected by the new technology.

Understand the 3Ps of technology implementation

Technology investments that simply automate existing processes add only marginal value. Processes should be redesigned to take advantage of new capabilities made possible by technology. The issue is one of sequence — understand the technologies capabilities, redesign the process, and then implement the changes. Adopting appropriate performance measures that support the process change is a vital part of the process redesign. Likewise, draw on people’s expertise from the beginning of the redesign sets the stage for leveraging their passion. Focusing on the 3Ps – Processes, Performance measures, and People – increases understanding and buy-in. The result: resistance is mitigated and technology implementations go more smoothly.

Invest proactively in a culture of willingness

The willingness to share information requires trusting relationships. Achieving trust is something best done face-to-face. Several managers noted the need to increase one-on-one time even though they were in the midst of large technology investments. Building a culture of willingness takes multifaceted efforts. Senior-level executives must spend a significant amount of their time — often in excess of 20 percent — meeting with counterparts at key customers and suppliers. Customer and supplier visits are made by cross-functional account management and supplier management teams. Advisory councils are used to assure more cohesive and meaningful information exchange up and down the chain. Supplier conferences bring companies together to improve relationships, share expectations, and disseminate best practices. These practices do more than help achieve harmonious relationships; they provide insights into real needs and unique opportunities to work collaboratively together.

To summarize, leading companies realize that implementing advanced technologies to achieve high levels
of connectivity is just the beginning. Technologies must be tied to specific capabilities and the human dimension of information sharing must be recognized as every bit as critical as the technologies themselves. The key word is sharing – sharing happens only when managers are comfortable with relationships and confident that any shared information will be used appropriately to drive collaborative improvement.

**Conclusion**

Most managers we spoke with credit new information technologies for propelling SCM to the forefront of strategic thinking. Shared information is the conduit that fosters process redesign and facilitates collaborative relationships. Yet, in the minds of SC managers, information deficiencies rank second only to counterproductive measurement as a barrier to creative and competitive SC collaboration. Improvement is needed. Unfortunately, our experience suggests that this will require the adoption of a new mindset regarding technology. The connectivity-willingness matrix can provide the perspective needed to refocus information technology strategies.

The good news: companies are intently focused on upgrading their information-sharing capabilities. They view connective technologies as attractive and are actively investing in them. The bad news: companies struggle to implement and leverage technologies. Technology is too often viewed as the answer rather than as an enabler. Implementation initiatives are poorly scoped and groundwork for success is seldom established. The bridges to world-class information sharing are never built and neither the structure nor the culture needed to share information is established. When this occurs, time and money budgets are overrun, technology solutions under perform, and technology providers are blamed for over promising and under delivering. Managers ask, “What happened to all of the investment? Where are the results?”

To summarize, getting connectivity right is a serious challenge. And for now, despite tremendous progress, current information systems fall short of providing the seamless connectivity SC managers want. The connectivity challenge is exacerbated by organizational cultures and structures that reduce managers’ willingness to share the information needed to improve overall SC performance. Willingness as a key to information sharing is often overlooked and frequently misunderstood. It receives little attention and even less investment. This must change if companies are to obtain the “full” return on their technology investments. Fortunately, SC leaders are beginning to break this mold. They are demonstrating that when connectivity and willingness come together companies can achieve the dramatic information-sharing benefits that attract the managerial attention and financial investment in the first place.

**References**


Information sharing and supply chain performance

Stanley E. Fawcett et al.


**Further reading**


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