

BENCHMARKING INFORMATION INTEGRATION IN SUPPLY CHAIN MANAGEMENT: A MULTI-CHANNEL APPROACH

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Abstract

Information integration is a leading aim for many supply-chain managers. Although the benefits of successful information integration are desirable, the barriers are quite daunting. Our study benchmarks the current status of information integration in supply chain management using indepth case study methodology at five channel positions. The study reveals two main dimensions to information integration: connectivity and willingness. We discuss both of these dimensions' implications for managers and academics and provide prescriptive direction where research and development should be channeled to facilitate information integration success.

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ABSTRACT

Information integration is a leading aim for many supply-chain managers. Although the benefits of successful information integration are desirable, the barriers are quite daunting. Our study benchmarks the current status of information integration in supply chain management using in-depth case study methodology at five channel positions. The study reveals two main dimensions to information integration: connectivity and willingness. We discuss both of these dimensions' implications for managers and academics and provide prescriptive direction where research and development should be channeled to facilitate information integration success.

Keywords: Supply chain management, information integration, information technology, people management

Type of Paper: Research Paper

BACKGROUND OF SUPPLY CHAIN INFORMATION INTEGRATION

Between 60 to 80 percent of the value-added we generate is linked directly to knowledge—and that proportion is growing.

—Heinrich von Pierer, CEO of Siemens

The ability for a firm to transfer knowledge across department, company, and global boundaries is a competitive advantage for many organizations in the 21st century marketplace (Fink and Holden 2005; Phan 2003). In particular, advances in information integration have enabled supply chains to reap significant returns to investment—some which include decreased order cycle times, increased agility to respond to customer demand, and increased firm profitability (Gavirneni 2002; Hult *et al.* 2004; Kulp *et al.* 2004; Lee 2004; Li 2002; Liu *et al.* 2005; Soliman and Janz 2004). For example, using information integration, 7-Eleven in Japan captured point-of-sale data and basic shopper demographics to help managers understand what drives demand for its stock-keeping units. Combining this information with reactive supply chain partners enabled 7-Eleven Japan to continually satisfy changing customer preferences, achieve the highest sales per square foot in Japan's convenience-store industry, and to attain 55 times inventory turnovers per year (Gottfredson *et al.* 2005; Lee and Whang 2001).

However, despite “elegant technological solutions, an agile, adaptive supply chain remains an elusive goal” (Harvard Business Review 2003:64). Managers continue to face hindrances to information integration. Some of the most mentioned hindrances are unwillingness to share information, inadequate technology and information systems, misinterpretation of feedback among chain partners, and lack of trust (Barratt 2004; Bender 2000; Janssen 2004; Kwon and Shu 2004; Lee *et al.* 1997; McCarter *et al.* forthcoming; Sterman 1989). For example, General Motors, Ford Motor, and DaimlerChrysler created Covisint, an online auto-parts market intended to provide an information bridge between suppliers and automakers. Soon after its creation Covisint began falling short of expectations. Specifically, Covisint was unable to broker the projected \$500 billion in annual sales between automakers and suppliers because the companies could not agree on what software to use and how to use it (Fahey 2004). The result was the three large automakers, having invested \$350 million into the venture, having to sell the information-trading portal.

The significant benefits countered by the daunting barriers lead to the question “How far has information integration really progressed in facilitating supply chain management?” There is likely a gap existing between the rhetoric surrounding supply-chain information integration and actual practice. Our study benchmarks the status of supply-chain information integration using in-depth case study methodology. Furthermore, in an attempt “to tell the world something it did not know before,” we conclude our study with a prescription for supply-chain managers and scholars regarding where research and development should be channeled to facilitate information integration (Bazerman 2005:29; Ferraro et al. 2005).

METHODOLOGY

Because supply-chain management is intrinsically collaborative (Bowersox et al. 1999), a cross-channel, in-depth case study allows analysis at multiple layers within the chain and provide insight into human behavior in the natural environment (Scandura and Williams 2000). Case study research has grown in interest among business scholars as a “research strategy” that allows in-depth qualitative analysis for answering the questions what, why, and how to provide description and theory (Yin 1981:59; Ellram 1996; Gersick 1988; Harris and Sutton 1986; Hudson et al. 2004; Kidder 1982; Liu *et al.* 2005; McLutcheon and Meredith 1993; Meredith et al. 1989; Shah forthcoming; Yin 1994).

Five chain positions were pre-determined to allow cross-channel analysis (Eisenhardt 1989). Such case variety across chain channels “fosters the development of a more creative and generalizable theory” (Lewis 1998:460). Fifty-one in-depth interviews were conducted, surpassing Yin’s (1981) recommended sample size of 25 to provide compelling evidence in support of theory. The average interview lasted from four to six hours with the shortest interview lasting a little over an hour and the longest taking over 10 hours. The break down by channel category is as follows: fourteen retailers, thirteen finished goods assemblers, twelve first-tier suppliers, three lower-tier suppliers, and nine service providers.

All interviews were conducted face-to-face, and confidentiality was promised to facilitate candid responses. Case-study participants were senior-level managers initially identified based on their participation at annual meetings of leading professional associations where they were presenting cutting-edge findings in supply-chain management. Such a non-randomized selection method allows us to “transparently observe” extreme chain-member practices and shed light as to why some supply-chain firms succeed in information integration while others do not (Pettigrew 1990:275; Eisenhardt 1989). In most instances, the interviews were conducted with

multiple managers from the host organization (the number of company representatives ranged from one to eight).

During each interview, a semi-structured interview guide was used. The guide was subdivided into general questions, questions on collaboration among the interviewed company's customers and suppliers, and key practices with particular chain members. The guide questionnaire consisted of both open ended or rating scale questions, enabling a clearer perspective of each interviewee's responses (Spradley 1979).

Following each interview, structured case write-ups were created. Such an approach avoids "data asphyxiation" where enormous volumes of data overwhelm the analysis process (Pettigrew 1990:281). Furthermore, being familiar with each case as a "stand-alone entity" allows for unique patterns from each case to become visible, and for more generalized theory in cross-case comparisons to be formed (Eisenhardt 1989:540).

RESULTS AND DISCUSSION

The interview findings suggest that companies are intently focused on enhancing their information-sharing capabilities. Commentary by chain position is listed in Table 1. While the most visible efforts are in information systems, interviewed managers made it very clear that people management's connection to information sharing is of equal or greater importance. That is, new technologies allow information to be gathered, manipulated, and disseminated more quickly and in larger quantities than ever before, and enable a new level of communication and decision making. By contrast, the people-management side of information exchange brings with it misunderstanding of supply chain needs, lack of trust among decision makers, and a lack of willingness that is needed for managers to feel comfortable sharing sensitive information. Only when the technology and people issues of information sharing come together can companies

achieve the benefits that attract the managerial attention and financial investment in the first place.

Insert Table 1 here

Technology and Information Integration

Companies are investing heavily in a variety of software. Most of the investment is targeted at one of the following applications: enterprise resource planning (ERP) systems, warehouse management systems (WMS), transportation management systems, advanced planning and scheduling (APS) systems, satellite tracking systems, computer-assisted ordering systems, database management and mining, electronic data interchange (EDI), intranets and extranets, point of sales tracking systems, and Web-based catalogues. These new information applications have impacted 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 are used to eliminate uncertainty, reduce inventory, and increase responsiveness to customer requests. In fact, the interviewed managers specifically emphasized the following roles of the new information technologies:

- Automated order placement
- Electronic funds transfer (payment)
- Facility location
- Stock keeping unit 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 design
- 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
- Share strategic information (e.g., technology plans)

The more advanced and more optimistic information technology companies have established policies designed to phase out non-electronic orders (from customers and to suppliers). Most of these companies have been heavily invested in EDI for several years and are transitioning as quickly as possible to Web-based systems. Of course, some managers are skeptical and suggest that existing investments combined with limited bandwidth and security concerns will limit the Web's attractiveness. Three of the information technology best practices encountered in the interviews include the following:

- The development of Web catalogues for all standard purchases that occur within a company. The purchasing department's role is to select the best suppliers, negotiate beneficial relationships, and then work with the systems people to help design the Web catalogue. Once the relationships and the catalogue are in place, purchasing gets out of the way and focuses its time on strategic purchasing issues. Individual end users access the catalogue and make purchases with a simple point and click. Web catalogues have improved service, reduced cost, empowered end users, and increased compliance with respect to the use of preferred suppliers.
- The development of Web-based systems that enable suppliers to obtain the latest sales data and up-to-date rolling forecasts. One of the participants has created a "Web-pull" system, which has essentially placed the data found in a material requirements planning (MRP) system on the Web for suppliers to use as needed. Suppliers can see real-time inventory levels as well as the timing of expected demand. They can use this information to plan their own production schedules. Another company shares three years of sales history with its suppliers together with an 18-month rolling forecast of demand. Again, this information helps suppliers better utilize their own production capacities while providing higher levels of service to the buying company.
- The establishment of proactive supplier selection policies regarding technology adoption. One senior manager emphasized that even to be considered as a source, a supplier had to be connected electronically. To achieve preferred status, a supplier had to implement EDI at least one tier backward. As a result of this policy, EDI linkages cascade backwards two tiers for almost 100 percent of the strategic purchases made by the company. This type of policy helps close the gaps that often develop between the first and second-tier suppliers and facilitates greater chain-wide connectivity.

Despite the huge investments in advanced information systems, a tremendous amount of communication still takes place the old fashioned way; that is, via fax and telephone. Several managers noted that they are constantly on the phone with colleagues, customers, or suppliers.

For many companies, over half of all communication occurs using these older technologies. At other companies, an interesting technology divergence has occurred—they receive 100 percent of their orders electronically (Web or EDI) and transmit 80 percent or more of their orders to suppliers using fax or phone. The emphasis on traditional communication back to suppliers is often a result of the supplier's lack of technology. Many suppliers simply have not had the resources needed to invest in EDI and Web systems. Further, they are often faced with the challenge of selecting among multiple standards used by different customers. Rather than make the tough choice, they forgo the investment altogether.

Interestingly, several of the interviewed companies that receive customer orders through EDI end up retyping the information into their own computer systems. This reality highlights the challenge of system incompatibility. The lack of compatibility not only deters many supply-chain integrative initiatives but confounds companies that have been involved in the recent spate of mergers and acquisitions. Bringing diverse information systems together can be difficult from both technological and political standpoints. For example, one of the interviewed companies decided to phase out the use of an acquired company's superior costing system in favor of its own in-house, weaker system.

People and Information Integration

On the people-management side, astute managers recognize that the best technology in the world does not build solid and synergistic relationships where information is not shared frequently and openly. For example, at one retailer, the point of sale (POS) system captures all relevant sales data on a real time basis. However, the retailer does not share any of this data with its suppliers. More bewildering is the fact that this same retailer shares complete shipping data with its third-party logistics providers to help them more efficiently plan their vehicle utilization.

Other companies are more than happy to share forecasts with suppliers but hold tenaciously onto actual production plans and strategic information. The willingness to share information is based largely on trust and expected mutual benefit. Achieving trust is something best done face-to-face. Indeed, several managers emphasized the need to increase one-on-one time even though they were in the midst of significant technology investments.

Common approaches to relationship building are multifaceted. First, senior-level executives are charged with spending a significant amount of their time—often in excess of 20 percent—meeting with counterparts at key customers and suppliers. Customer and supplier visits made by cross-functional account management and supplier management teams respectively support the high-level contact. These visits do more than help achieve harmonious relationships; they provide key insights into real needs and real opportunities to work together in innovative ways.

Teaming is another common approach to enhancing information sharing. Cross-functional teams are widely used for internal coordination while advisory councils are increasingly used to assure more cohesive and meaningful information exchange up and down the supply chain. Along the same lines, more leading companies are adopting dedicated account management teams to provide a consistent and comfortable interface with their best customers. Looking upstream, supplier conferences are bringing companies together on a more frequent basis to improve relationships, share expectations, and disseminate best practices.

Three Caveats of Information Integration

Enterprise Resource Planning

At least three caveats regarding modern information sharing should be mentioned. First, although ERP systems have become extremely popular in the past several years, most of the

interviewed companies have experienced some difficulty in installing these systems. Time and money budgets are often exceeded by 50 to 100 percent. Several managers commented on the endless challenges they had endured during the implementation process. Other managers questioned the value of the ERP systems while a few spoke highly of the benefits their companies had attained. Perhaps the most positive report came from a company that had left its existing systems in place, running them in parallel with the newly installed ERP system until all of the bugs had been worked out. A feeling shared by several managers who have been through the process is that while the implementation is painful, they believe there is no realistic option. There were, however, a couple of managers who feel that the best-of-breed philosophy is superior to the integrated ERP approach. Their challenge is getting all of the disparate, functional systems to talk to each other. Thus, the best-of-breed approach is not without problems. Most of the managers hope that Web-based systems will emerge in the not too distant future to relegate current, complicated systems to the annals of history. Ultimately, a valid concern voiced on occasion is that these expensive, hard-to-implement systems are not the silver-bullet or panacea to the companies' information dilemma. Too many companies seem to be caught in either a shiny-hardware syndrome or a follow-the-competition mentality. Either philosophy hampers the successful implementation of a capable information system.

Global Net Exchanges

Second, global net exchanges—such as the ones instituted by Ford, General Motors, and DaimlerChrysler as well as Carrefours and Sears—were often perceived as the wave of the future; however, have not measured up to expectation. Several of the interviewed companies are active participants in these exchanges. Two of the greatest concerns are that 1) the mechanics (technical and philosophical) are much more complicated than they initially appear, and 2) the

shared leverage will eliminate cross-profit subsidization, threatening the lead company's overall competitive advantage. Both of these concerns turned out not only to be true, but hindering to global net exchange success (Fahey 2004; Luening 2001; Meta Group 2000). This issue, once rarely considered in the trade press, is now gaining more attention.

The bottom line is that large companies often are able to utilize their market positions to extract lower prices from their suppliers. In order to maintain some semblance of a profit margin, the suppliers invariably charge other customers slightly higher prices. When all of the key finished goods assemblers and their best suppliers are pooling their purchases to achieve maximum buying leverage, there is no one left to charge the higher prices. The supplier either has to live on an incredibly thin margin or go out of business. At the same time, all of the members of the exchange end up paying the same basic price for components, eliminating any competitive advantage that comes from superior purchasing practice. One fewer weapon is left available for use in tomorrow's competitive battle. These realities increase the political rhetoric and jockeying for position that is taking place as these net exchanges are being developed. Companies with adequate market power and efficient technological and purchasing practices are likely to continue to opt out of the net exchanges.

The World Wide Web

Third, the advent of the World Wide Web (Web) has created opportunities to alter the dynamics of channel power. Power has consistently shifted downstream toward the end consumer over the past 20 years. For example, whereas Procter & Gamble once dominated its supply chain, Wal-Mart is the new channel captain. However, with the Web, finished goods assemblers and packaged goods producers can take their products directly to the end users of their products. This ability creates the opportunity to develop alternative, parallel channels. Of

course, this option comes with plenty of risk. Few companies are willing to alienate current channel partners to experiment with an unproven technology. For example, one company interviewed was betting on this inherent fear when it sent out letters to its suppliers warning them not to use the Web to take their products directly to consumers. This company's threat was straightforward—if you use the Web to bypass us, we will stop carrying your product; therefore, make a careful choice as to which channel you want to sell through. One of the participant companies was emphatic in its response to the potential for its suppliers to bypass it and go directly to the consumer. The manager stated, “We hold the hammer and will use it if necessary. We will not tolerate our suppliers using the Web to bypass us.”

Another risk encountered by a participant company involves alienating internal sales people who are likely to lose commissions if products are sold directly to customers via the Web. Despite these inherent risks, several managers commented that their companies are exploring role shifting and complete disintermediation strategies. All of the interviewed companies look forward to a future where seamless information exchange is possible. Each is pursuing its own unique course in its quest to obtain this goal ahead of the competition.

IMPLICATIONS FOR DEVELOPING INFORMATION INTEGRATION CAPABILITY

The research suggests two dimensions of information integration exist. The first dimension is *connectivity* or technological capability to extract, quantify, and share information. For the supply-chain manager, a key to success is to carefully evaluate and adopt new technologies based on their own merits and their implicit fit with the company's specific needs and situation. “Me-too” technology strategies tend to be expensive and seldom deliver as hoped for or as promised by the software providers and the installation consultants. In fact, a consistent disappointment expressed by the interviewed managers was the challenge of truly gauging a

system's installed performance since the consultants constantly "oversold and under delivered." The bottom line is there is no "silver bullet" for solving information integration problems in supply chains, but there are plenty of people willing to sell you one.

Unfortunately scholarly research is still falling short in enlightening the supply-chain manager. Specifically, the current information integration scholarship is not answering the basic questions asked by supply-chain managers, "What are the bottom line benefits and drawbacks of *such-and-such* information practice? What should I do in *such-and-such* situation to generate useful information? How can I get my managers to share useful information willingly? What information is truly useful for me and my company?" This position echoes Bazerman's (2005) warning to management scholars of the dangers of conducting only descriptive research while failing to provide managers with tools and solutions to resolve managerial problems.

The second dimension is *willingness* to share necessary information. Willingness to share information is directly connected to individual and group behavioral patterns. Aside from information technology management, another key to a manager's success is to find and cultivate receptive workers who are comfortable with the new technologies and are disposed to sharing information openly. The best of the best companies realize that the human aspect of information sharing is every bit as important as implementing advanced technologies and achieving high levels of connectivity. The key word here is sharing—sharing happens only when managers are comfortable with relationships and confident that any shared information will be used appropriately. People's willingness to communicate openly and honestly is either the bridge or the barrier to seamless information sharing. In short, connectivity and willingness must come together for information to bridge the gaps that currently exist in modern supply chains.

Interestingly, the current information integration research for supply chains is not adequately taking into consideration human behavioral issues. The research analyzing issues of technology, process, design, and mapping of information sharing in supply chains is vast. However, little has been studied regarding human issues, such as relationship management, people management, and reward allocation in relation to information integration. Although these softer issues of information integration appear less rigorous in nature, they still loom over managers in supply chain management. Scholars must not forget that behind quantitative models and advanced technological innovation, behavioral issues are still prevalent (Ghoshal 2005).

Some pedagogical and empirical research has begun analyzing certain behavioral patterns' relation to information integration in supply chains (Brau *et al.* 2005; Dejonckheere *et al.* 2004; Fawcett and McCarter forthcoming; Rafaeli and Ravid 2003). However, this research is only the tip of the iceberg. Future empirical, experimental, and case-study research remains to be tapped by business scholars to provide insight and remedies to supply-chain managers as to how to better implement and maintain successful information integration.

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Table 1: Current Status of Information Integration

Retailer Perspective:

- EDI and WMS provide info back to first-tier suppliers. Significant face-to-face, fax, and phone. Collaborative promotions.
- 95% POs sent via EDI. Some EFT and ASN. Minimal CAO. Considered Web, but waiting and watching. A little adversarial.
- IS systems focus on “seamless transitions and handoffs.” Supplier orders via phone, fax, and EDI. Customer orders via Web.
- Share forecast data with key suppliers. Demand data sketchy at best. System visibility “not there yet.”
- Extensive POS feeds automated inv. mgmt. system. 100% EDI connection with suppliers. Web in infancy. Constant phone.
- Use in-house EDI system to share production data. Moving to Web. Know where product is at all times. 99.9% accuracy.
- EDI cascades back two tiers. Web interface for customers. Cross-functional teams coordinate internally. SAP in progress.
- 90%+ EDI communication with first tier. Web conversations. Limited CAO. Integrating merged systems.
- IT is decision making and learning enabler. Best-of-breed mindset. Share forecasts/production plans. Moving to Web.
- EDI with 5-yr “dream” of Web. Member of net exchange. Vendor advisory council as sounding board & meets vendors.
- EDI systems combined with Web connects all retail stores, DCs, and key suppliers. Information is the lifeblood of SCM.
- “All the IT needed”—daily POS by item and store (do not share with suppliers). POs via EDI, but do not share strategic info.
- EDI and extranet to share 3-yr history and 18-month forecast. CPFAR pilot test. A lot of face-to-face time with key partners.

Finished Goods Assembler Perspective:

- Implementing ERP and engineering systems. Moving to Web linkage with suppliers. Lack willingness to share complete info.
- EDI up/downstream. Goal is Web catalogue in place within 18 months. Shared forecasts. Joint promotion planning. SAP.
- Belief that all info sharing will be Web-based. Working on Web-based VMI. Some Web sales directly to end customers.
- 75% of suppliers are EDI connected. Production plans shared on 3-month rolling horizon. Intra and extranets are being used.
- Replicated systems led to an emphasis on IT cost reduction. 80%+ of suppliers are EDI or Web capable. SAP adoption.
- 85% orders via EDI. Building Web capability using AIAG XML standard. Share quarterly forecasts with key suppliers.
- Orders—80% inbound EDI vs. 15% outbound EDI (fax, phone). Web not immediate solution. ASN and EFT. Software enables.
- EDI, fax, phone, and Web are all used. Rely on best-of-breed. SAP experimentation. Extranet and CPFAR are new vehicles.
- Total SAP adoption tied to Oracle database for better customer analysis. EDI used and Web is envisioned to connect the SC.
- Industry standards have made EDI preferred info-sharing mechanism up/downstream customers. Some fax and telephone.
- SAP too inflexible/difficult to install. Adding APS software. Internet buying exchange. Some Web; mostly EDI.

First-Tier Supplier Perspective:

- Orders received/placed via fax and some EDI. Some VMI and ESI in NPD projects. On-site info sharing. New ERP.
- Mix of EDI and auto-fax. Do not like EDI because lack standards. Half IT staff building intra/extranet. Key is personal contact.
- Limited EDI; mostly phone and fax. Experimenting with Web. Annual SC top mgmt meetings. Account mgrs know customers.
- 80% of orders via EDI. Migrate to Web with new ERP and database technologies. Share forecasts but not actual sales data.
- EDI and Web connect up/downstream. Annual supplier conference. Supplier brainstorming. Quarterly business reviews. SAP.
- Annual supplier conference emphasizes shared learning. Phone, fax, EDI, Web, and face to face. Web-pull MRP info.
- Face-to-face, phone, fax and EDI. Rolling schedule shared with top suppliers. Moving to Web in next year. Electronic catalog
- Phone, fax, and EDI. Executives meet with key customers and suppliers. Feedback to drives CIP. Systems are limiting factor.
- Installing SAP. Forecasts shared on rolling monthly basis. Best practice sharing across organization via quarterly meetings.

Lower-Tier Supplier Perspective:

- Acquisitions have led to disparate systems. Adopting SAP. Orders come/go by phone and fax. Partnership review meetings.
- Personal, face-to-face and phone to build trust. Extranet to share production & customer plans. Weekly technical exchange.

Service Provider Perspective:

- EDI, linked computer systems, and tailored WMS metrics. Key account mgmt and personal relationships. IT investments.
 - Orders—95% customer EDI; 90% supplier EDI. Phasing out non-electronic orders. Link IS with “key” partners. SAP.
 - Fax, phone, Web coupled with face-to-face business reviews. Use customer surveys. Willingness is a challenge.
 - Quarterly reviews with customers. Proprietary system documents savings. Fax and phone. Web catalogue for 15% of orders.
 - Info sharing vital to volume aggregation. Use Web catalog. Web system impeded by culture/processes/policies/people.
 - Customer visits are critical to knowing customers real needs. Day-to-day via phone, fax, and WMS system. Web in future.
 - Phone, fax, EDI, and Web. Constant personal communication/frequent performance reviews. Willingness and systems needed.
 - Phone, fax, EDI, and face-to-face. Developing a Web strategy. IT is key to 3PL success. Satellite tracking and ASNs.
 - Phone, EDI, and auto-fax. Implementing Web-based catalogue for customers. Face-to-face very important. Lack willingness.
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