The Role of the Internet in Supply Chain Management

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The Internet has grown rapidly over the last 5 years. It is predicted that more than 100 million households will be connected to the World Wide Web by 2002. But what about the use of the Internet in business-to-business supply chain applications? Here, the greatest potential of the Internet is being realized by speeding up communication between customers and their suppliers, improving service levels, and reducing logistics costs. In this article, the authors discuss for the first time how the Internet is being used in managing the major components of supply chains including transportation, purchasing, inventory management, customer service, production scheduling, warehousing, and vendor relations. The study breaks down each area and describes to what extent and how the Internet is being applied. The study also looks at the development of Intranets and Extranets in supply chains.   © 2000 Elsevier Science Inc. All rights reserved.

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INTRODUCTION

The development of supply chains over the years has been slow. Companies developed individual parts of their supply chains beginning first with the transportation component and moving on to include warehousing, finished goods inventory, materials handling, packaging, customer service, purchasing, and finally, raw materials inventory. The goals of supply chain systems are multidimensional and include cost minimization, increased levels of service, improved communication among supply chain companies, and increased flexibility in terms of delivery and response time.

Usage of Internet provides numerous cost-saving opportunities for supply chains.

Throughout the 1960s, 1970s, and 1980s the ability of firms to achieve these goals was limited, since the communication and knowledge links in the existing supply chains did not bring together all of the key databases. Also, there was the reluctance on the part of firms in the supply chain to share data with each other. This hesitancy was due to a variety of factors, including the perceived threat of giving away competitive advantage to other firms, the sharing of sensitive information such as inventory levels and production schedules with other channel members, and the potential of loosing customers to other competitors.

Today, much of the reluctance to interface with other firms in supply chains is breaking down. The change in attitude is due to variety of factors including just-in-time (JIT) programs, electronic data interchange, and point-of-sale data sharing programs. Each factor made traditional logistics managers realize that there is more to be gained by working with other supply chain firms than there is to lose. For example, one of the greatest barriers to JIT was the fear that sharing production information with vendors would hurt a company by revealing its production-plan-

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ning schedule to the competition. The fear was groundless, because what mattered most was keeping inventories low and reducing the resulting administrative costs of carrying inventory at manufacturing, plant, and dealer locations.

Electronic data interchange (EDI) had the same effect on the fears of the data sharing in the supply chain. Here, firms were actually linking up their companies with computer-to-computer ordering and data exchange. The fear was greatest among small companies. Implementation of EDI required an investment in computers and software, on the parts of both the vendor and the buyer. Standardization was also a requirement that made the switch to EDI a lot slower than with JIT.

Point-of-sale information programs were a major influence in altering among logistics managers the thinking that data exchange in the supply chain can be beneficial to all parties involved. This was dramatically demonstrated by the results experienced by large mega-discounters such as Wal-Mart and Kmart, which were the first retailers to link their point-of-sale information with the computers of their vendors. Here, the vendors were informed immediately of the stock levels of their respective products sold through the stores of the buyers. If the stock levels required replenishment, then the vendors were immediately informed by the point-of-sale systems, which were direct links from the cash register scanners at the respective store outlets. If any item fell to its minimum level of stock, an order was issued for replenishment. The order was electronically transmitted to the vendor. It was filled by the vendor and sent directly to the store or central warehouse.

The Challenge of the Internet

The growth of the Internet has presented supply chains with many significant opportunities for cost reduction and service improvements. These opportunities include:

1. On-line vendor catalogs from which buyers can find,

select, and order items directly from suppliers without any human contact

2. The ability to track shipments using a wide variety of modes including truck, rail, and air transport
3. The ability to contact vendors or buyers regarding customer service problems from late deliveries, stock-outs, alterations in scheduled shipment dates, late arrivals, and a wide variety of other service issues
4. The ability to reserve space in public warehouses for anticipated deliveries to market locations
5. The ability to schedule outbound shipments from private and public distribution centers on a 24-hour basis
6. The ability to provide 7-day/24-hour worldwide customer service
7. The ability to receive orders from international customers
8. The ability to check the status of orders placed with vendors
9. The ability to place bids on projects issued by government and industry buyers
10. The ability to notify vendors of changes in configurations in products that are produced to order
11. The ability to pay invoices electronically and to check outstanding debit balances
12. The ability to track equipment locations including rail cars, trucks, and material handling equipment
13. The ability to directly communicate with vendors, customers, etc. regarding supply issues on a 7-day/24-hour basis via E-mail
14. The ability to schedule pickups and deliveries
15. Theability to be more responsive to customer service problems
16. The ability to reduce service costs and response time.

Traditional Logistics Practices

The development of the Internet has created innumerable opportunities for companies and their supply chains.

While there are significant cost reduction opportunities, companies are in a quandary as to how to take advantage of them. Traditional logistics practices are "slow to die" among vendors, carriers, and shippers. For example, the face-to-face negotiation that had always taken place between carriers and shippers over rate negotiation is no longer needed. Rate negotiation can now be carried out over the Internet quickly and at a cost lower than before.

Inventory management can be made more accurate with the use of bar code readers that can transmit stock levels to computers. The data can be accessed by the Internet and transmitted directly to logistics managers responsible for the inventory. This system is quicker and more accurate, since stock levels can be reviewed frequently. It is still common practice, however, for logistics managers to plow through long inventory status reports to check for out-of-stock situations.

LITERATURE REVIEW

The use of the Internet in supply chain management (SCM) is a relatively recent phenomenon. Its principal applications have been in the areas of procurement, transportation scheduling, vehicle tracking, and customer service. There have been few, if any, studies done on the use of the Internet in SCM. The principal literature support comes from the descriptions of projects of companies, on how they have utilized the Internet in the management of their individual supply chains. For example, General Electric, in its appliance division, uses the Internet to schedule shipments out of centrally located warehouses in metropolitan areas. The goal is to allow the company to more accurately and cost effectively deliver its products on time. The numbers of deliveries per hour has increased significantly while transportation costs per order have dropped dramatically.

Fisher Scientific effectively used the Internet in its supply chain by increasing build-to-order production. The firm is experiencing lower inventory costs and some-

Order processing and transportation enjoy widespread application of the Internet.

what higher production costs. With the use of the Internet to more accurately track inventory, Fisher Scientific is building to order and configuring to order all of the products it sells to its customers.

The Ford Motor Company uses the Internet to track small quantities of spare parts shipped to customers on a daily basis. PPG Industries, Inc. utilizes the Internet to monitor the weekly route performance of carriers from its main production plants. The company also uses the Internet to track long-haul deliveries across the country. Air Products and Chemicals Inc. uses the Internet in its global sourcing process. The Internet informs the firm of which delivery terminal and which plant is the best for servicing the customer. Weyerhauser uses the Internet to monitor vessel-shipping while taking into consideration the stop-off costs for the sites.

For Rollins Leasing Inc., the Internet has helped it reduce its supply chain costs by 5% to 15% through increased partnering with its suppliers. The partnership made implementing an automated routing system faster and easier and led to a routing system that would save money and time while increasing asset utilization. Using maps for routing method no longer met the company's needs, and as the company's customer base grew, the time and effort to route manually became unmanageable. The Internet enabled the firm to track shipments and supplier schedules more accurately. For Emery Worldwide Logistics, the use of the Internet enabled the company to determine the efficiency of its private fleet versus its previous outsourcing of transportation by monitoring its own shipments on a daily basis.

Waste Management, Inc. uses the Internet to augment its customer service center. Customers can register complaints and request product update information through the company's Web site by means of E-mail. The firm has found that customers who once would only talk to a Waste Management service representative are now happy with the information and problem resolutions they receive through the Web. Huffy Service, a technical service company, uses the Internet to keep in touch with its field technicians. The firm has learned to use the data it obtains from the Internet to more efficiently schedule its field personnel and to be more responsive to customer needs.

Objectives of the Study

In order to determine to what extent U.S. firms have been using the Internet in the operation and management of their supply chains, the Department of Marketing at Temple University conducted a nationwide survey of firms that are members of the Council of Logistics Management (CLM). The objectives of the study were to determine:

1. Whether firms use the Internet in their supply chains
2. How and to what extent the Internet is used in customer service
3. How and to what extent the Internet is used in purchasing
4. How and to what extent the Internet is used in transportation operations
5. How and to what extent the Internet is used in material handling systems
6. How and to what extent the Internet is used in the management of transportation fleets
7. How and to what extent the Internet is used in private warehouse operations
8. How and to what extent the Internet is used in the management of relations with "for hire" carriers
9. How and to what extent the Internet is used in the provision of customer service
10. How and to what extent the Internet is used in the packaging of products
11. How and to what extent the Internet is used in negotiating with carriers over transportation rates.

Inventory management is being revolutionized by the Internet.

METHODOLOGY

Sample

The study was conducted using a random sample of respondents drawn from attendees at the 1998 CLM Conference in Los Angeles, California. One thousand conference participants were sent an E-mail questionnaire. The research questionnaire was four pages in length, covering all aspects of SCM (see Appendix A for a listing of the issues that were covered). One hundred and eighty-one completed questionnaires were returned via E-mail, a response rate of 18.1%. Although this is a relatively low response rate, the number of returns may be compensated by the extreme heterogeneity of the industries and companies represented by the respondents (see Appendix B for a listing of respondent industries and companies). Furthermore, the method of selecting potential respondents, in conjunction with the purely exploratory and descriptive nature of this research, makes this an acceptable sample for our research.

Aside from the seven substantive supply chain decision areas (see Appendix A), the questionnaire also addressed Extranet and Intranet usage. All of the supply chain dimensions addressed in the questionnaire were analyzed using student T-test, multiple response, and cross-tab analyses. Internet, Extranet, and Intranet usage was also explored by contrasting the size of the firm (measured in both terms of sales and number of employees) and involvement with international operations.

FINDINGS

A total of 90.1% of the respondents indicated using the Internet in some part of their SCM program. This result should be viewed with caution due to the self-selection bias inherent in this type of survey. It may also account for the lower response rate, as queried respondents may be unaware of their firms Internet usage. Furthermore, the result also may reflect the firms' lack of Internet participation. In light of those firms who do use the Internet for SCM, the most popular application (Table 1) was for the management of their transportation systems. The area in which the Internet was least used in SCM was production scheduling. Tables 2 through 8 provide results for how and to what extent the Internet is used in each of the logistics functional areas (1 = little usage; 5 = high usage).

Supply Chain Management (SCM)

The research revealed that the most popular use of the Internet for SCM is in transportation, followed next by order processing, managing vendor relations, purchasing procurement, and customer service (see Table 1). The ranking is explained by the level of operating activity in each area, i.e., shipment frequency, the number of orders received, and the level of expenditures made by firms to support each one. In addition, the use of the Internet in each of these areas is based on the real-time information

TABLE 1
Internet Applications by Logistics Decision Area

Application	% Using	Rank
Purchasing/procurement	45.2	3
Inventory management	30.1	5
Transportation	56.2	1
Order processing	50.7	2
Customer service	42.5	4
Production scheduling	12.3	6
Relations with vendors	45.2	3

TABLE 2
Purchasing/Procurement Applications

	% Using	Rate of usage
EDI with vendors	37.0	2.44
Purchase from catalogs	39.4	2.57
Communicate with vendors	52.1	2.95
Negotiate with vendors	36.0	2.26
Check vendor price quotes	32.9	2.71
Damaged products to vendors	21.9	1.94
Vendor warranty issues	21.9	1.88

EDI = Electronic Data Interchange.

requirements needed to manage them effectively. The use of the Internet in customer service, inventory management, and production planning and scheduling will become more popular as the technology develops.

Purchasing and the Internet

The use of the Internet in managing purchasing in the supply chains has developed rapidly over the last 10 years. The research demonstrates that the Internet is utilized in a variety of procurement applications including the communication with vendors, checking vendor price quotes, and making purchases from vendor catalogs (Table 2). The purchasing function in U.S. firms has been streamlined through the use of the Internet. General Electric, for example, has reduced its purchasing staff by more than 50 percent and permits on-line purchasing from vendor catalogs by each department. The paperwork flows have been reduced, and order-cycle times—the time from when the order is purchased to the time it is delivered to the company—has decreased by 40 percent.

Vendor negotiation has also been streamlined through the use of the Internet.

Face-to-face negotiations are not used as frequently because the negotiations can conducted through the Internet. This includes the bargaining, re-negotiation, price, and term agreements.

The study showed that product-damage issues are also managed through the use of the Internet. This has lowered the costs of handling returned or damaged goods by improving the tracking of the items and by being notified by vendors beforehand when damaged goods can be shipped. The financial aspects of returned goods are also handled more efficiently, including notification as to when credits are posted by vendors. Warranty issues are likewise handled on the Internet. Notifications of warranty termination dates, new types of warranties, procedures for processing claims, and the actual handling of warranty claim matters are also handled through the Internet.

Inventory Management and the Internet

One of the most costly aspects of supply chains is the management of inventory. The research has shown that the most popular use of the Internet in this area is the communication of stock-outs by customers to vendors, or the notification of stock-outs by companies to their customers. The Internet has enabled companies to more quickly institute EDI information programs with their customers. Prior to the development of the Internet, EDI took a long time to implement in a supply chain. Each channel member had to invest heavily in equipment, software, and training before EDI systems could be made operational. This is similar to the situation with JIT delivery programs. Ever since the introduction of the Internet, JIT and EDI systems take only half of the needed time to develop and to be put into operation.

The Internet has affected inventory management most dramatically in the ability of firms to be proactive in the

TABLE 3
Inventory Management Applications

	% Using	Rate of usage
EDI programs with vendors	27.4	3.55
JIT delivery programs	27.4	3.50
Communicate out-of-stock	31.5	3.65
Order ship date delays	37.0	3.00
Raw material inventory levels	24.7	3.17
Emergencies affecting inventory	31.1	3.05
Finished goods inventory levels	27.4	3.20
Field warehouses/depots inventory levels	32.9	3.17
Field depots on out-of-stock	26.0	3.05

EDI = Electronic Data Interchange; JIT = Just-in-Time.

TABLE 4
Transportation Applications

	% Using	Rate of usage
Pickups, regional distribution centers	22.3	3.18
Drop-offs, regional distribution centers	21.9	2.94
Monitor on-time arrivals of carriers	41.1	3.07
Managing claims, overall performance	26.0	2.43

management of inventory systems. This is demonstrated in the ability of firms to notify customers of order-shipping delays and inventory emergencies. The research showed that the information available to inventory managers is becoming more readily available because of the reporting systems that can be used through the Internet. This includes finished-goods inventory levels at manufacturing and field level depots along with raw material levels at central and regional assembly locations. The Internet also provides managers with the ability to track out-of-stock inventory items in field depots. The overall benefit of the Internet to firms in managing inventory in their supply chains is to keep inventory levels low, reduce overall holding costs, and still provide high levels of customer service.

Transportation and the Internet

The most popular use of the Internet in supply chains is in the management of transport. Transportation typically is the second highest cost component in a supply chain, accounting for approximately 25% of the overall operating costs (see Table 4). The research showed that the monitoring of pickups at regional distribution centers by carriers is the most popular application of the Internet in this area. This is particularly important for a company, since tracking shipments to regional depots provides the firm with data on the reliability performance of the carriers it is using. This enables transportation managers to

make sure that the motor carriers they use are meeting their promised arrival times. It also provides managers with the information they need to inform carriers of shipment delays as they occur, and to not have to wait for days before the information becomes available for corrective measures to be taken. The research revealed that claims management (26.0%) is also being tracked through the Internet. Claims reporting, processing, and settlement are more easily handled through the use of Internet tracking-system applications.

Order Processing and the Internet

The second most popular use of the Internet in supply chains is in order processing applications (see Table 5). The most frequent use of the Internet here is in order placement and order status. Over half of the firms use the Internet for this purpose. This has dramatically reduced the costs of order processing, which before the Internet accounted for approximately 18% to 20% of the total cost of managing a supply chain system. A major component of this cost saving is the reduction of paperwork involved in traditional order processing systems because of the Internet. Another large advantage of the Internet in order processing is the speed at which orders can be processed. The reduction in order-cycle time, or the time between the order is placed and the time it is received by a customer, has been reduced by as much as one-half.

The use of the Internet in order processing has reduced the error rate involved in order processing. Errors now can be detected more easily and corrected more quickly. The research showed that the most frequent rate of usage

TABLE 5
Order Processing Applications

	% Using	Rate of usage
Customer order status/placement	52.1	3.26
Vendor order efforts	27.3	3.05
Customer on out-of-stock	28.8	3.33
Check customer credit	22.3	2.88
Check vendor credit	21.5	2.53
Returned customer merchandise	21.5	3.67
Total customer order cycle performance	22.4	3.30
Credit processing status to customers	21.5	2.00
Obtain price quotes from vendors	19.2	2.36
Provide price quotes to customers	31.1	3.00

TABLE 6
Customer Service Applications

	% Using	Rate of usage
Receive customer complaints	43.8	2.59
Provide technical service	29.8	2.81
Notify customers of emergencies	33.9	2.79
Sell to customers	47.9	2.63
Manage outsourcing of service	15.1	2.36

Vendor relations improved.

of the Internet in order processing was in the handling of return goods (3.67%) followed by out-of-stock notification of the customer (3.33%). Of course, the greatest usage of the Internet here is in order placement and order status (52.1%). The accuracy of pricing is of utmost importance in order processing, and the Internet provides companies with the ability to check vendor prices on-line before an order is placed. The research showed that nearly one-third of firms (31.1%) are using the Internet in this area (Table 5).

Customer Service and the Internet

The Internet has provided firms with the ability to offer their customers another way to contact the firm regarding service issues. The research shows that 43.8% of the companies use the Internet to receive customer complaints, while 33.9% utilize it for emergency notifications (see Table 6). The Internet also gives customers 24-hour access to a company's service department, enabling customers to immediately notify companies of any service issues or problems that may arise. The overall effect has led to reduced response times and resolutions of customer service problems.

The Internet has improved the two-way flow of communication between firms and their customers. This is demonstrated by the results of the research that show that U.S. companies are using the Internet not only for service issues, but for selling their products and services as well (47.9%). This two-way communication capability can

have a profound effect on cementing customer-firm relationships. Experience with Internet service systems shows that customers whose service issues are dealt with quickly and to their satisfaction, are more likely to want to purchase the firm's products again. The Internet can build strong product and service loyalty if used appropriately in the customer service area.

The Internet and Vendor Relationships

The Internet has proven itself to be an important communication link with vendors. The research showed that the most widespread use of the Internet here is in purchasing from on-line catalogs (41.1%). As discussed above with the application of the Internet to purchasing, the Internet has caused dramatic changes in the traditional methods of procurement in U.S. firms. An example of this is shown in the results of the research in Table 7. The receipt of queries from vendors (38.4%), providing vendors with information (28.8 %), and the processing of returns and damaged goods (24.7%) were all handled by the Internet. Again, the Internet enables vendors and their customers to handle these functions on a 7-day/24-hour basis.

An important factor in vendor relations is the ability of a company to rate the performance of its vendors based on the elements agreed to in their negotiated contracts. These performances include such factors as deliveries to company warehouses and depots, the on-time performance of the carriers used by the vendors, and vendor raw material inventory and general stock levels. The re-

TABLE 7
Vendor Relations Applications

	% Using	Rate of usage
Vendor deliveries to depots	26.0	2.95
Vendor raw material stock levels	13.7	1.40
Purchase from on-line catalogs	41.1	2.17
Receive queries from vendors	38.4	2.00
Provide vendor information from queries	28.8	2.05
Vendor ratings on overall performance	23.3	2.24
Process returns/damaged products	24.7	3.00
Ratings of on-time performance of carriers	20.5	1.80

TABLE 8
Production Scheduling Applications

	% Using	Rate of usage
Coordinate schedules with vendors	21.9	2.63
Coordinate schedules with field depots	13.7	2.50
Coordinate with JIT of vendors	20.5	3.00
Coordinate schedules with multiple U.S. sites	19.1	2.07
Coordinate schedules with multiple international sites	16.4	1.92

JIT = just-in-time.

No limit to the application of the Internet in supply chains.

search showed that the Internet is being utilized to monitor these areas. According to the study, 26% of the firms are using the Internet to monitor vendor deliveries to their field depots. Over 20% are using the Internet to monitor the on-time performance of vendor transportation carriers. Surprisingly, 23% are using the Internet to develop comprehensive performance-vendor ratings that conclude everything from service response to the processing and return of damaged goods to stock availability. The benefits of these evaluating systems improve the overall quality of vendor performance, lower purchasing costs, and improve the productivity of vendor operations. This information enables companies to form strategic vendor alliances based on solid informational bases developed from Internet monitoring systems.

The Internet and Production Scheduling

Production scheduling has traditionally been the most difficult aspect of SCM. The reasons for this include: (1)the high level of inaccuracy of sales forecasts; (2)the lack of raw material information from vendors; and (3)the general paucity of information regarding fluctuations in vendor-stock levels and customer demand. The Internet has enabled U.S. firms to minimize the difficulty in their production scheduling by improving the communication between vendors, firms, and customers. The research showed that 20.5% of the firms in the study use the Internet to coordinate their JIT programs with vendors. In addition, the study showed that 21.9% of the firms are beginning to use the Internet to coordinate their production schedules with their vendors (see Table 8). This communication is not only being done domestically, but internationally as well, with over 16.4% of the firms coordinating their production schedules with multiple overseas sites.

While the research did not address the issue of customer demand analysis using the Internet, the application of the Internet to order processing (discussed above) provides firms with real-time information on the sales of their products and services. This has resulted in more accurate sales forecasting, which in turn has greatly improved production scheduling.

Intranet Usage

The research explored the usage of Intranets in SCM. The research showed that 70.4% of the firms indicated the use an Intranet. Only six of the nine firms who use an Intranet indicated that they utilized it in he management of their supply chains. The principal use of an Intranet was for communication (59%). A series of statistical contrasts across Intranet users and nonusers are not reported here due to the very small sample size of the non-Intranet users.

Extranet Usage

The use of an Extranet was also explored, with 30.1% of those using the Internet for SCM indicating that they also use an Extranet; 45.2% of those using the Internet did not report using an Extranet. Significant results for those using an Extranet included those in inventory management decisions where Extranet users were more likely to use EDI programs with vendors ($t = 3.96; p < .001$); those who were more likely to use the Internet to communication with customers on out-of-stock ($t = 2.43; p < .024$); those who were more likely to notify customers on order shipping delays ($t = 2.40; p < .025$); and those who were more likely to use the Internet to communicate with field warehouses and depots on inventory levels ($t = 2.49; p < .023$). Those who used the Extranet were also more likely to use the Internet for scheduling pickups at regional distribution centers ($t = 2.31; p < .036$); receive customer complaints ($t = 2.26; p < .033$); and receive information queries from vendors ($t = 3.05; p < .006$).

Company Size and the Internet

Internet usage was also explored in the context of the size of the firm with two measures—*the number of employees and sales volume*. A median split was used to dichotomize the size of the firms based on employees into those with employees of 500 or less and those with over

500 employees; and by sales into groups of those under $250 million and those over $250 million. As measured by the number of employees, larger firms were more likely to use the Internet to communicate with customers on order status ($t = -3.65$; $p < .001$) and to manage the outsourcing of customer service functions ($t = -4.44$; $p < .003$). Conversely, smaller firms were more likely to use the Internet to coordinate production scheduling for field depots ($t = 4.74$; $p < .001$) and to coordinate production schedules of multiple manufacturing sites in the United States ($t = 2.47$; $p < .030$) and internationally ($t = 3.06$; $p < .012$).

The results for the size of firm determined by sales indicate that smaller firms use the Internet more (1) to communicate with vendors on finished-goods inventory levels ($t = 2.09$; $p < .059$); (2) to communicate with customers on out-of-stocks ($t = 2.11$; $p < .049$); (3) to check the credit status of customers ($t = 2.56$; $p < .022$) and of vendors ($t = 2.75$; $p < .016$); (4) to obtain price quotes from vendors ($t = 5.92$; $p < .001$); and (5) to provide technical service ($t = 2.95$; $p < .008$). Conversely, larger firms use the Internet more for to purchase items from vendor on-line catalogs and supply lists ($t = -2.02$; $p < .053$) and to provide vendors with ratings for the on-time performance of their carriers ($t = -2.25$; $p < .043$).

Management Implications

The use of the Internet in SCM is rapidly increasing. The key ingredient for success in managing a supply chain is fast, accurate information from a wide range of operating areas including transportation, inventory, purchasing, customer service, production scheduling, order processing, and vendor operations. The ability to react quickly to market changes and to adjust inventory, production, and transportation systems accordingly is necessary for cost efficiency and for the improved utilization of assets. The Internet has and will continue to provide logistics managers with this information and enable them to improve the profitability of their supply chains. On a continuing basis, the Internet will enable logistics managers to monitor their supply chain operations and reduce costs when inefficiencies arise. The effects of this are and will continue to affect the profitability of firms dramatically [1–15]. The Internet will enable companies to achieve the true efficiencies embodied in supply chain cost reductions, which is based on the axiom that "a 1-cent reduction in supply chain costs can have as much as a 5-cent improvement on operating profits."

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APPENDIX A

Supply Chain Management Decision Areas

Purchasing/procurement
Inventory management
Transportation
Order processing
Customer service
Production scheduling
Relations with vendors

Purchase/Procurement Decision Areas

EDI programs with vendors
On-line purchasing from vendor catalogs

Communicating with vendors
Negotiation with vendors
Checking price quotations of vendors
Arranging for returned/damaged products to vendors
Dealing with warranty issues of vendors

Inventory Management Decision Areas

EDI programs with vendors
Coordination of JIT delivery programs
Communication with customers on out-of-stocks, etc.
Notification of delays in order ship dates to customers
Communication with vendors on raw-material inventory levels
Communication with customers on emergency situations affecting inventory levels
Communication with vendors on finished-goods inventory levels
Communication with field warehouses and depots on field inventory levels
Communication with field depots on out-of-stock situations, emergencies, etc.

Transportation Management Decision Areas

Scheduling pickups at regional distribution centers
Scheduling drop-offs at regional distribution centers
Monitoring on-time arrivals of carriers
Managing claims status and processing communication with carriers on overall performance

Order Processing Management Decision Areas

Communication with customers on order status
Communication with vendors on order efforts
Communication with customers on out-of-stocks
Check credit status of customers
Check credit status of vendors
Communication with customers on returned merchandise
Providing total order-cycle performance for customers
Providing credit processing status to customers
Obtaining price quotes from vendors
Providing price quotes to customers

Customer Service Management Decision Areas

Receipt of customer complaints
Providing technical service
Notifying customers of emergencies in the supply chain—strikes, fires, etc.

Use of Internet to sell to customers
Manage the outsourcing of customer service functions

Production Scheduling Decision Areas

Coordination of production schedules with vendors
Coordination of production schedules with field depots
Coordination of production schedules with JIT schedules of vendors
Coordination of production schedules of multiple manufacturing sites in the United States
Coordination of production schedules of multiple manufacturing sites at international locations

Vendor Relations Decision Areas

Coordination of deliveries of vendors to field warehouses and depots
Communication with vendors regarding raw-material stock levels at their plant sites
Purchasing of items from vendor on-line catalogs–supply lists
Receipt of information queries from vendors
Provision of information regarding vendor queries
Providing vendors with service ratings on their overall performance
Processing of returned materials, damaged products to vendors
Providing vendors with ratings of the on-time performance of their carriers

APPENDIX B

Respondent Industries

- Pharmaceuticals
- Snack Foods
- Software products and solutions consulting
- Paper and building products; gypsum; and chemicals
- Consumer products
- Transportation services
- Software and hardware
- Food processors
- Forest products
- Electronic computing and test equipment
- Retail apparel
- The marketing and brokering of private-label and branded grocery items
- Personal care products, nutritional supplements
- Mobile communication devices

- Manufactures of kitchen products
- Food and beverages
- Cookies/cracker sales and distribution
- Outboard engines, boats, after-market parts and accessories
- Vitamins
- Paper and corrugated packaging
- Chemicals, plastics, and fibers
- Retail grocery sales
- Material logistics centers, E-commerce order fulfillment
- Office equipment, photographic equipment, electronics, computer peripherals
- Personal computing products, technology training, and technical services
- Pharmaceuticals and medical devices
- Medical supplies products
- Integrated circuits manufacturing
- Packaged meats
- Steel
- Depot outsourcing
- Logistics services
- Specialty chemicals
- Software and implementation services
- Global logistics management
- Home care, nutrition, cosmetics, and personal care products
- Third-party logistics providers
- Automotive
- Processed foods
- Warehouse logistics
- Third-party logistics repair