

PB98-130958

Transportation Research, Public Service & Education

MPC REPORT NO. 98-71

**Supply Chain Management: Issues and Practices
for Small and Rural Manufacturers**

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February 1998

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SUPPLY CHAIN MANAGEMENT: ISSUES AND PRACTICES
FOR SMALL AND RURAL MANUFACTURERS

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(Final Report to MPC 97-71A)

February 1998

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ABSTRACT

As the business environment becomes increasingly competitive, companies continuously look for ways to distinguish themselves from their competitors. Adopting integrated logistics policies is a method that many companies have used to improve their competitive edge. Companies have implemented an integrative philosophy known as supply chain management (SCM), which minimizes inventory, by reducing uncertainty, and increases customer service and competitiveness. It has become important to understand how to successfully manage a supply chain to realize these benefits. As SCM becomes more visible, new demands will be placed on everyone in the supply chain, particularly small and rural companies to implement these strategies.

This report presents the results from expert interviews with Minneapolis/St. Paul companies and North Dakota manufacturing companies. The Minneapolis expert interviews helped to identify the minimal logistical capabilities a supplier must have in order to do business with the Minneapolis companies. Ten firms with membership in the Council of Logistics Management participated in these interviews. The North Dakota expert interviews identified the capabilities of small and rural manufacturers to apply logistical practices to their companies. These companies were chosen on the basis that they were likely to have business partnerships with the Minneapolis companies or to compete in similar markets.

Companies adopt a SCM philosophy to achieve the following three strategic goals: 1) reduce inventory levels, 2) increase customer service, and 3) build a competitive advantage. To reach these goals, three operational strategies companies can implement include 1) information technology, 2) core carriers, and 3) third party logistics. "Leading edge" companies focus on the strategic goals of SCM while small, rural companies focus on the day-to-day operational activities. The different focus by each set of companies could cause some difficulties when trying to do business with each other.

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INTRODUCTION

In response to competitive market pressures, companies are using logistics-based strategies to distinguish themselves from their competitors. Although, these strategies are initiated to reduce inventory levels (resulting in reduced costs), they include other issues such as transportation and information technology. A company's understanding of these logistics issues allows them to become more competitive which may lead to improved customer service. "Leading edge" companies are primarily the leaders in the implementation of competitive logistical practices and use them as competitive weapons to secure and maintain customer loyalty (Bowersox et al., 1989). Small and rural manufacturers many times are required to adopt such practices simply to do business with these "leading edge" companies.

As companies develop and implement sophisticated logistics policies, new and innovative management practices emerge. In response to the challenges faced by companies in maintaining a competitive advantage, supply chain management (SCM) has come to the forefront of business practice today. SCM is a philosophy that strives to actively manage the supply chain. The supply chain for a product consists of all companies involved in production and distribution from the raw material stage to the final customer. It has become increasingly important to understand the benefits of managing the supply chain.

Objective

The objective of this study was to assess whether the logistical practices of small and rural manufacturers permit their participation in an integrated SCM system. The study examines and compares the current logistical practices of selected Minneapolis and North Dakota companies. Companies can use the information to better understand current SCM practices and the importance of

developing integrated SCM practices in the future. Better understanding will enable or assist companies to be more competitive and extend their markets with larger companies.

Justification

Supply chain management is an issue in many industries as companies realize the importance of creating an integrated relationship with their suppliers and customers. Managing the supply chain has become a way of improving competitiveness by reducing uncertainty and improving service. The objective of SCM is “to improve a company’s competitive position in the global marketplace and to sustain that position despite competitive forces and rapidly changing consumer needs” (Coyle, Bardi, and Langley, 1996). In addition, SCM aids in the development and management of a coordinated flow of goods and services from the raw material stage to the final customer. One important aspect of successfully managing the supply chain requires that a company understands its own logistical strategies and practices, in addition to those of its buyers and suppliers. Underlying this concept is the belief that SCM will place new demands on the logistical capabilities of suppliers.

Considerable research has been undertaken to identify what it means to be “world class” or “leading edge” in logistical management. A Council of Logistics Management textbook, *World Class Logistics*, (Bowersox et al., 1995) states to be “world class” means that a “firm has successfully envisioned and realized a combination of logistical practices capable of serving selected customers better than competitors.” Although, many firms may not realize the importance of logistical management to their competitiveness. This project addresses the issues that should be understood and implemented in order to be a “leading edge” logistical company.

Firms in the Midwest will be able to use the information from this research to develop SCM strategies based on the future logistical requirements of their customers. In addition, this research will provide valuable information on current SCM practices of firms in the Midwest. By identifying any discrepancies in perceptions of service and actual services provided, opportunities for improvement will

be discovered. The opportunity to make changes in business practices could result in more efficient supply chain partnerships.

Research Procedure

This research project consisted of two main parts. First, expert interviews with “leading edge” Minneapolis companies helped to identify minimal logistical capabilities a supplier (whether large or small) must have in order to do business with “leading edge” companies. The second step of the project identified the current logistical practices of small and rural North Dakota manufacturers. This was accomplished through expert interviews with leading North Dakota manufacturers.

Expert interviews are used to obtain information through unstructured personal interviews, without administering a formal questionnaire (Malhotra, 1996). Prior to the interviews, a list of topics was prepared, but the order in which these topics were to be addressed was not predetermined. Instead, the topics were addressed using an unstructured, open-ended format. This allowed greater flexibility in capturing the insights of the experts. The purpose of interviewing experts is to help define the research problem rather than to develop a conclusive solution (Malhotra, 1996).

Minneapolis Expert Interviews

The goal of the expert interviews with these companies was to obtain opinions on various issues about SCM. Individual companies are not identified in this study because of assurances of confidentiality. Twelve firms with membership in the Council of Logistics Management (CLM) were selected to be interviewed. The participants were chosen on the basis of their company and job title. In July 1996, 16 people from 10 firms participated in the expert interviews. Titles of individuals ranged from president, director of distribution, director of total supply chain management, to vendor compliance manager. Three companies were manufacturing-based (combinations of original equipment manufacturers (OEM) and component), three were food processors, one company was warehousing

based, one was a retailer, and two were consultants. Although a set of six questions guided the interviews, the discussions were unstructured, with many diversions (Appendix A). The results were compiled into a “white paper” and sent to the participants for their comments or additions.

Table 1.1 contains company profiles for the “leading edge” firms participating in the expert interviews. The estimated sales range from \$14.23 billion to \$16 million and the number of employees range from 74,000 to 150. This demonstrates a significant range in the size of the “leading edge” companies. The consultants are not included in the table.

Table 1.1. “Leading Edge” Company Profiles by Estimated Sales and Number of Employees, 1996

Firm	Type	Two-digit SIC Codes	Estimated Sales (in million \$)	Number of Employees
1	Public	26, 36, 38	14,230	74,289
2	Public	36, 38	7,311	53,000
3	Public	20	5,410	9,800
4	Co-op	20,28	3,014	5,000
5	Public	59, 67	2,110	9,500
6	Public	35	931	3,280
7	Private	20	160	900
8	Private	42	16	150

Source: “Company Profiles Database.” [WebPALS Online Catalog and Reference Database.](http://www.pals.msus.edu/cgi-bin/pals-cgi) <<http://www.pals.msus.edu/cgi-bin/pals-cgi>> (Sept 30, 1997).

North Dakota Expert Interviews

The second step of the project identified the capabilities of small and rural manufacturers to apply logistical practices to their companies. This was accomplished through expert interviews with North Dakota firms likely to have business partnerships with “leading edge” companies or to compete in similar markets. The goal of the expert interviews with these companies was to gain insights and perceptions into current logistical practices, future logistics trends, and impacts of these trends. In addition, the results gained from the Minneapolis and St. Paul interviews were shared with the North Dakota companies.

In May 1997, ten people from eight firms participated in the North Dakota expert interviews. The titles of these people ranged from vice president, transportation manager, logistics manager, to master scheduler. The companies were primarily manufacturing based. Three of the companies were original equipment manufacturers (OEM), three were food processors, and two were component manufacturers. Although a set of seven questions similar to the Minneapolis interview questions were used, the discussions were unstructured (Appendix B).

Table 1.2 shows company profiles for the North Dakota firms included in the study. Information was not available (N/A) from one company.

Table 1.2. North Dakota Company Profiles by Estimated Sales and Number of Employees, 1996

Firm	Type	Two-digit SIC Codes	Estimated Sales (in million \$)	Number of Employees
1	Private	37	88	449
2	Co-op	20	41	200
3	Private	37	30	270
4	Private	25	29	310
5	Private	35	22	145
6	Co-op	20	11	38
7	Private	38	6	65
8	Private	N/A	N/A	75

Sources: "Company Profiles Database." WebPALS Online Catalog and Reference Database. <<http://www.pals.msus.edu/cgi-bin/pals-cgi>> (Sept 30, 1997) and personal company contact, October 3, 1997.

The similarities and differences between "leading edge" firms and North Dakota manufacturing firms were addressed and used to develop conclusions and apparent trends related to SCM. In addition, recommendations for small and rural manufacturers were addressed. These can help to develop a successful SCM philosophy in a small or rural manufacturing company.

Report Organization

The remainder of this report is organized into five chapters. Chapter II, the literature review, discusses the concepts of a SCM philosophy and how it affects business practice. The expert interview results from the “leading edge” Minneapolis and St. Paul companies are presented in Chapter III. Chapter IV presents the interview results from the North Dakota manufacturing companies. A discussion of the similarities and differences between the interview comments is presented in Chapter V. A summary and the conclusions of the study are presented in Chapter VI.

LITERATURE REVIEW

In this chapter, a brief history of logistics is presented, including how SCM has come to the forefront of business practice today. In addition, this chapter identifies three goals of SCM and the operational changes a company must make to achieve these goals.

The idea of logistics and its associated concepts is not new. The logistics evolution consists of three main stages, dating back to the 1960s. During the 1960s and 1970s, many companies focused their main attention on the physical distribution or outbound logistics system (Coyle, Bardi, and Langley, 1996). “The channel discipline was primarily manufacturer push” (LaLonde and Powers, 1993). This meant that goods were pushed through the supply chain toward customers. This type of system did not consider what customer demand was, but rather tried to predict what it would be and supply the system accordingly. As a result, large levels of inventory accumulated in the supply chain (Coyle, Bardi, and Langley, 1996). Companies attempted to manage the interrelated outbound activities, including (but not limited to) transportation, warehousing, and packaging, to ensure efficient product delivery to the final customer.

The second stage was evident during the late 1970s and 1980s. Companies realized they could lower costs more by combining the inbound side (materials management) with the outbound side (physical distribution) (Coyle, Bardi, and Langley, 1996). Firms broadened their logistical view to look at “efficient material flow through the entire business firm” (LaLonde and Powers, 1993). This combination evolved into what is now called the logistics system. Companies began to “view the whole process, from raw materials to finished goods, as a continuum that, managed from a systems perspective, could lead to a more efficient operation” (Coyle, Bardi, and Langley, 1996).

The third stage, observed during the 1980s and 1990s, is characterized by five external factors which caused companies to further expand their outlook about logistics. These five factors are:

- consumers are more knowledgeable about products and more demanding about price and quality,
- changing channel structures and relationships resulted in trends involving the size, scope, and distribution for goods and services,
- globalization of the economy and markets caused companies to respond to increasing competitive pressures by copying some foreign business practices, including just-in-time,
- technological changes resulted in massive data processing and information systems improvements using electronic data interchange (EDI) and bar coding, and
- government policy and deregulation resulted in lower costs and higher quality transportation services (Coyle, Bardi, and Langley, 1996).

These five factors caused a new focus involving all firms in the production and distribution system to ensure that “the final customer received the right product, at the right cost, at the right time, in the right condition, and in the right quantity” (Coyle, Bardi, and Langley, 1996). This concept developed into what is referred to the supply chain or logistics pipeline. Logistics involves both information management and the physical movement of inbound raw materials and outbound finished goods. In addition, logistics is “the mechanism allowing a supply chain of multiple entities to be managed as a single, profit maximizing firm” (Titus, 1996). Ellram and Cooper (1990) define supply chain management (SCM) as an “integrative philosophy to manage the total flow of a distribution channel from supplier to the ultimate user.” This includes partnerships and alliances among vendors/suppliers, manufacturers, and transportation and public warehousing companies, in addition to customers.

The three major reasons for establishing a SCM philosophy are 1) to reduce inventory investment in the chain, 2) to increase customer service, and 3) to help build a competitive advantage for the channel (Cooper and Ellram, 1993). Firms implement SCM by improving customer service through increased frequency of reliable product deliveries and reducing costs associated with holding large

inventory levels. According to Carter and Ferrin (1995), “the goal of SCM is to meet customer service objectives while simultaneously minimizing inventory and associated costs.” “In its broadest context SCM is a strategic management tool used to enhance overall customer satisfaction that is intended to improve a firm’s competitiveness and flexibility” (Giunipero and Brand, 1996).

Major Reasons to Establish a Supply Chain Management Philosophy

Reduce Inventory Investment in the Chain

In the past, holding large amounts of inventory was a typical business practice. This was due to the uncertainty involved in dealing with many suppliers. The current business trend is to reduce or eliminate inventory wherever possible, but it is important to understand the balance between customer service and inventory.

Ballou (1992) states that increased customer service is a reason to hold inventory. “Inventories provide a level of product or service availability, which, when located in the proximity of the customer, can meet a high customer service requirement” (Ballou, 1992). Inventory close to the customer can also reduce cost of lost sales and result in repeat customers.

Holding any amount of inventory results in some form of expense, particularly carrying costs. On the other hand, the reasons for holding inventory can indirectly reduce operating costs realized in other company activities (Ballou, 1992). These cost reductions can be price-quantity discounts, lower transportation rates, or holding safety stock to insure against stockouts (Coyle, Bardi, and Langley, 1996). Safety stock is held to buffer uncertainty or variability involving external factors, including supplier relations, economic conditions, and raw material supply. Many firms hold safety stock due to the time variance during product delivery and unknown demand requirements.

Uncertainty has traditionally been buffered with inventory (Ellram and Cooper, 1990). SCM strives to minimize the uncertainty involved in business transactions among firms in the supply chain which leads to building safety stock inventory (Coyle, Bardi, and Langley, 1996). Reducing uncertainty

can lower inventory levels held within the chain by reducing the number of suppliers a firm deals with and enhancing the relationships with the remaining firms. Sharing information about anticipated demand, orders, and production schedules reduces uncertainty and can lead to lower safety stock inventory (Coyle, Bardi, and Langley, 1996). Inventory is not necessarily eliminated completely from the channel, but rather only the redundant inventory levels (Cooper and Ellram, 1993). For example, Xerox took over \$700 million of inventory out of its operation within two years by applying SCM techniques (Stenger, 1994).

Information sharing helps to reduce uncertainty and leads to lower inventory levels. “It is not necessary that all channel members have access to the same information, but only the information which is needed for them to better manage their supply chain linkages” (Cooper and Ellram, 1993). During the 1980s, “the idea of reducing uncertainty by exchanging information for inventory, received widespread recognition as a means of reducing costs and increasing effectiveness among trading partners” (Ellram and Cooper, 1990). Information sharing is an essential characteristic of the SCM philosophy.

A broken supply chain could occur if firms do not communicate. “A broken supply chain has substantial stock at one point to enable another node in the supply chain to skate by with minimal stock” (Davis, 1993). This is an inefficient supply chain because there is more inventory being held than is required. The SCM concept focuses on holding inventory where it is optimal for the entire chain (Ellram and Cooper, 1990). “Each player in the supply chain optimizes its own position by holding all of the inventory it needs or requiring other supply chain members to hold additional inventory” (Ellram and Cooper, 1990). There will always be some level of inventory within the supply chain, but “the real difficulty is knowing how much to hold and where to hold it” (Davis, 1993). Coordination is the reason that SCM exists and has become increasingly popular within firms.

Increase Customer Service

Companies have recognized that customer service can increase revenue and customer satisfaction. The driving force behind the emergence of SCM is pressure from the customer for improved service (Giunipero and Brand, 1996). Coyle, Bardi, and Langley (1996) define customer service as a “process for providing competitive advantage and adding benefits to the supply chain to maximize the total value to the ultimate customer.” Customer satisfaction is referred to as the “cumulative level of satisfaction based on the total purchase and consumption experience with a good or service over time” (Sharma, Grewal, and Levy, 1995). SCM is instrumental in delivering high customer satisfaction with reduced lead times and costs.

Customer service affects company performance in two ways: 1) customer satisfaction and 2) cost expenditures (Dresner and Xu, 1995). An increase in customer service levels will increase costs, but also will increase customer satisfaction that in turn increases revenues. In other words, a satisfied customer will return and be willing to pay a premium for high customer service levels, resulting in higher profits.

When implementing a customer service program, each level of service is associated with some transportation and inventory costs. For example, inventory levels (and carrying costs) can be lowered if air transportation is used, but transportation costs will be higher (Coyle, Bardi, and Langley, 1996). These costs can be justified if higher customer service levels result in a higher profit. A company needs to find a customer service level that balances total benefits and total costs.

Langley and Holcomb (1992) identified several trends in customer service including: 1) the ability to effectively manage information, 2) longer-term relationships, and 3) sustainable competitive advantage. Understanding and implementing these trends are important because customer service becomes the link between logistics and marketing activities (Langley and Holcomb, 1992). A company with a logistics and marketing advantage will be an industry leader.

Companies that can effectively manage and share information within the supply chain have a significant customer service tool. Information is key to a company's ability to provide excellent service. An open communication channel between buyers and suppliers is necessary to receive feedback on customer service. Information must be accessible and usable by the entire supply chain to ensure proper customer service levels. In the traditional system, companies control all inbound and outbound information flows so they feel much more comfortable. "The information exchanged is limited to the needs of the current transaction" (Cooper and Ellram, 1993). According to Luis Fsolis, vice president of business development, GE Capital Logistics, "information has to capture the needs of customers better and most companies have been capturing and managing information that only pertains to themselves" (Meachum, 1996).

A shift from transactual to contractual relationships has resulted in longer-term relationships (or partnerships) with buyers and suppliers. Partnerships evolve "from a relationship between suppliers and satisfied customers who have become repeat purchasers and loyal to a particular firm" (Sharma, Grewal, and Levy, 1995). Close buyer-supplier relationships have come to the forefront of today's business world as a result of companies' working to improve their levels of customer satisfaction. Customers experience service improvements through reduced inventory levels, shorter cycle times, and more timely and accurate information (Lambert, Emmelhainz, and Gardner, 1996).

Enhanced customer service levels give companies a competitive advantage over competitors by ensuring customers that service is a priority. A successful customer service program can become a "strategic tool for a company to differentiate itself from its competitors" (Coyle, Bardi, and Langley, 1996). The total focus of SCM is to satisfy the customer which enhances the competitiveness and profitability of a firm (Giunipero and Brand, 1996). "Effective management of the goods flow, from the supply of raw materials to the distribution and delivery of the finished product to the customer, is the basis of effective customer service" (van Amstel and Starreveld, 1993). Competitive advantage is not only a trend in customer service, but also a reason to establish an entire SCM philosophy.

Build Competitive Advantage

As the market environment becomes more competitive, firms must develop a strategic long-term (versus a traditional adversarial approach) competitive advantage to remain in business. Strategic capabilities needed for a firm's success and competitive advantage include being responsive to target markets, having low total distribution cost, and speedy, reliable delivery (Morash, Droge, and Vickery, 1996). Companies use strategic alliances to achieve these capabilities. An alliance is defined as "a contractual relationship between two independent entities in the logistics channel to achieve specific objectives and benefits" (LaLonde and Cooper, 1989). Partnerships are the most informal and most common type of strategic alliance (Rogers and Daugherty, 1995).

LaLonde and Cooper (1989) define partnership as "a relationship between two entities in the logistics channel that entails a sharing of benefits and burdens over some agreed upon time horizon." According to Ellram and Hendrick (1995), a partnership is "an ongoing relationship involving a commitment over an extended period of time, and a sharing of information and the risks and rewards of the relationship." The common characteristics from these definitions include long-term agreements and sharing benefits, costs, and information.

Successful partnerships have the following dimensions: 1) long-term commitment, 2) information sharing, 3) cost reduction and increased quality, and 4) sharing risk and rewards (Ellram and Hendrick, 1995; Gentry, 1996). Benefits include improved quality, reduced cycle time, lower total cost/price, order completeness, and improved communications (Ellram and Krause, 1994). The management of risk and uncertainty through cooperation is a key motivation bringing partners together (Gardner and Cooper, 1988).

Despite the difficulty of forming strong effective partnerships, it is necessary to supply a product within specifications at the right price. "Companies that know how to manage alliance relationships will have a competitive advantage over those companies that are not comfortable with alliances" (Soucie, 1997).

SCM is an incentive to establish partnerships among parties in the chain and implies that most or all members of the channel coordinate their efforts (Giunipero and Brand, 1996; Cooper and Ellram, 1993). Recently, the traditional adversarial approach to supply chain members, is being replaced by a much different stance - one in which the firms position themselves as partners (Carter and Ferrin, 1995). A key difference between adversarial and partnership relationships is that a partnership involves trust and information sharing (Ellram and Cooper, 1990). "An effective SCM system is made up of a series of partnerships, working together and mutually sharing information and channel risks and rewards" (Ellram and Cooper, 1990).

SCM planning is focused on a long-term, ongoing approach (Ellram, 1991). Proper implementation allows everyone in the supply chain, suppliers through customers, to get more involved in production planning. Involvement from all supply chain participants allows for better products to be marketed because everyone has input. "Input to decisions and goal formulation are important aspects of participation that help partnerships succeed" (Mohr and Spekman, 1994). Group participation is an important aspect of joint planning and, if not achieved, could produce a product that does not serve the needs of the customer. "If the channel is to be more closely coordinated, then joint planning of such activities as material flows and development of new products is in order" (Cooper and Ellram, 1993).

Risk sharing is an important aspect of partnerships and maintaining a competitive advantage. Ellram (1991) suggests that the degree of risk should be managed and shared among the business partners. Firms are relying on partnerships within; therefore, they share the risk of not being able to fulfill an order requirement which delays production. Some examples of risk sharing include "joint investment in assets and third party companies guaranteeing certain volumes of business over a certain period of time" (Coyle, Bardi, and Langley, 1996). Information sharing allows the reduction of risk through 1) detection of deviance from expectations, 2) faster, more accurate operational instruction exchange, and 3) easy, speedy managerial information flow among firms (Gardner and Cooper, 1988). A successful supply chain needs information and risk sharing to achieve the highest possible rewards.

Operational Changes of Supply Chain Management

To achieve the three goals of SCM, a company can implement three operational changes: 1) information technology, 2) reduction of core carriers, and 3) third party logistics. Table 2.1 shows the relationship between the goals of SCM and these operational changes.

Table 2.1. Relationship Between Goals and Operational Changes of SCM

Reasons for and Goals of SCM	Operational Changes with SCM		
	Information Technology	Core Carriers	Third Party Logistics
Reduce Inventory Investment	EDI and Bar Coding	JIT and On-time Delivery	Vendor Managed Inventory
Increase Customer Service	EDI and Bar Coding	Satellite Tracking	Exposure to Innovative Logistical Services
Build Competitive Advantage	Integrated Systems	Services Tailored to Shipper's Needs	Focus on Core Competency

Information Technology

Information technology (IT) is essential to develop and maintain a successful SCM philosophy. Companies implement information systems to monitor inventory levels and schedule production, to provide high levels of customer service, and to enhance their competitive position through partnerships. SCM is concerned with product flows and information flows. Information flows in both directions through the supply chain. “The current emphasis on supply chain re-engineering essentially means changing an organization from the flow of things to the flow of information” (LaLonde and Powers, 1993).

The two applications of IT on which companies have focused are electronic data interchange (EDI) and bar coding. EDI is essentially a “paperless” computer to computer exchange. “The purpose of EDI is to eliminate duplicate data entry and to improve the speed and accuracy of the information flow by linking computer applications between companies” (Emmelhainz, 1994). The key element of EDI is

the elimination of human interaction which reduces or eliminates data entry and minimizes the time required for data entry (Emmelhainz, 1994). For example, Super-Value Stores, Inc. saved \$5,000 to \$6,000 per week by eliminating manual processing of invoices and other documents, and expected yearly savings of \$600,000 by reducing clerical staff that validates purchase orders against invoices (Coyle, Bardi, and Langley, 1996).

EDI improves product flow coordination and allows companies to share product information, particularly inventory levels. A major benefit of EDI is decreased inventory levels through the availability of more current data (Harrington, 1990). For example, Volvo Transport AB of Sweden estimates that it avoids carrying over \$28 million in excess inventory stocks each year through its EDI based information network” (Coyle, Bardi, and Langley, 1996).

Like EDI, bar coding removes the human element in checking and tracking inventory (Cooke, 1994). No technology is more crucial to update and upgrade IT quality than bar codes (Cooke, 1994). Bar coding is a popular and cost effective technology that captures data in real-time at the point of origin (Sadhvani and Tyson, 1990). It provides the means to track products from the point of manufacture to the point of sale. Bar coding increases stock check-in accuracy to better than 99 percent and one food industry supplier virtually eliminated customer claims for mis-shipments by using bar coding (Cooke, 1994).

Bar coding is used most in product movement activities such as inventory tracking, shipping, and receiving (Sadhvani and Tyson, 1990). “When inventories are the lifeline of a business, bar coding puts controls around inventory management, pinpoints the cause of any losses, and becomes a necessity” (Sadhvani and Tyson, 1990). In addition, bar codes can lead to a 99 percent level of inventory accuracy and allow the stock of certain slow moving items to be greatly reduced (Sadhvani and Tyson, 1990).

The real payoff of IT can be realized when a company uses a bar coding and EDI combination which can improve service and lower costs (Coyle, Bardi, and Langley, 1996). Bar coding and EDI reduce data entry error and improve accuracy of information which results in lower order cycle time and

better overall business practices. For example, using a combination of EDI with product coding and point-of-sale (POS) scanning, Levi Strauss in cooperation with JC Penney, has been able to reduce inventory over 24 percent while improving customer service over 20 percent (Emmelhainz, 1994). A company can realize a significant competitive advantage by using these technologies and making a commitment to integrate IT systems with their buyers and suppliers. Information technology has improved competitive advantage by “improving on-time performance, lowering error rates, and reducing damage rates” (Cooke, 1994). McKesson Corporation, a major drug distributor, uses an order process with EDI and bar code scanning and has reduced ordering time for a typical drugstore 50 to 75 percent (Coyle, Bardi, and Langley, 1996).

Bowersox and Daugherty (1995) state that information technology will encourage firms to develop more extensive external relationships. The nature of SCM entails the exchange of substantial quantities of information, sometimes confidential, between business partners (Carter and Ferrin, 1995). A successful partnership requires communication concerning the standards required from both parties. “It has been suggested that the success of any given supply chain depends on an increase in the level, quality and timing of information exchanged between participants” (Giunipero and Brand, 1996). Information should be provided as required for planning output, processes, and technology (Ellram, 1991). “By sharing information and being knowledgeable about each other's business, partners are able to act independently in maintaining the relationship over time” (Mohr and Spekman, 1994). Information sharing between buyers and suppliers is important to develop and maintain trust. Exchanging information between firms has become an increasingly important aspect of business.

Core Carriers

Companies have formed partnerships to improve competitiveness and customer service. In many cases, companies are reducing the number of suppliers they do business with, particularly transportation carriers. “The major apparent trend in distribution and transportation management over the past two

decades has been the shift from transactional to relational exchange between shippers and carriers” (Boyson, 1995). Companies state several reasons for this shift including:

- long-term commitment,
- reliable transportation service,
- consistently better service,
- demand responsive,
- accurate, available information, and
- partnerships allow access to information and sharing of risks and rewards.

The shift to close carrier partnerships has resulted in more long-term agreements and thus an overall reduction of carriers used by a company. The decreased number of carriers has been dramatic in some cases, with companies going from 1,000 to fewer than 100 (Coyle, Bardi, and Langley, 1996). Core carrier strategies affect inventory investment, customer service, and the ability of a company to build a competitive advantage.

Just-in-time (JIT) is an inventory management system which has arisen from companies’ reducing their total inventory investment. With the increasing use of (JIT), the reliability of transportation carriers has become an essential business tool. Companies using JIT place a premium on and have demanding requirements for high-quality transportation services (Crum and Holcomb, 1994). These companies usually require smaller, more frequent shipments that must be on-time and damage free. “In response to JIT, shippers have adopted strategies designed to increase their control over truck transportation services” (Crum and Holcomb, 1994). Specifically, shippers have reduced the number of carriers with which they do business.

If a company’s core carriers demonstrate the ability to consistently deliver on-time, inventory investment can be significantly reduced. For example, MicroAge Computer Centers reduced freight costs by 10 percent and improved on-time delivery by using only 10 LTL carriers for all shipments east of the Mississippi River. Detroit Diesel reduced its carrier base from 131 carriers to 14, and the high

service provided by these carriers resulted in a \$30 million inventory reduction (Coyle, Bardi, and Langley, 1996).

As companies reduce their carrier base, customer service and satisfaction become essential decision factors. Carriers can offer several customer service tools, but a popular one is the use of satellite tracking. Satellite tracking is a form of IT that is fast becoming a trend in transportation management. "Orbiting satellites can send and receive radio signals, linking truckers to a dispatcher and can pinpoint a truck's location within 1,000 feet anywhere in the United States" (Cooke, 1994). This tracking ability allows the customer to know exactly where the shipment is and the expected arrival date and time. This is an excellent customer service tool for the shipper and all supply chain members. Each company that has a stake in the shipment can know the exact location and can prepare sufficiently for any delays that may occur.

Developing partnerships is a trend in maintaining a competitive advantage. In response to reducing carriers, shippers have increased the amount of contracting with carriers. This enables a shipper to "eliminate the uncertainties in rates and services" and "allow the shipper to specify the rate and level of service" (Coyle, Bardi, and Langley, 1996). Contracts provide the shipper the opportunity to tailor the services to its operation and rely on a carrier that can perform these services. The benefits of contracting include better financial and operating performance for the carriers, carrier services tailored to the shippers' needs, and a better, closer relationship between carriers and shipper (Crum and Holcomb, 1994). Long-term contracts minimize risk for both parties. The carriers can be assured that investments in specialized equipment will be justified, and the shippers have greater influence over carrier performance and receive premium service (Crum and Holcomb, 1994). A negative risk of long-term contracting is a firm's increased dependency on the carriers it uses. This dependency makes the company more vulnerable to shipment disruptions. For example, if a transportation provider has an employee strike, it might not be able to provide the service guidelines in the contract.

Third Party Logistics

Rogers and Daugherty (1995) classify third party agreements as a type of strategic alliance. In literature and business material, third party can also be referred to as contract logistics and outsourcing (Coyle, Bardi, and Langley, 1996). The literature defines third party logistics in various ways. Coyle, Bardi, and Langley (1996) defined a third party provider as an “external supplier that performs all or part of a company’s logistics functions.” Ellram and Cooper (1990) define them as “outside parties who provide functions not performed by the firm.” The common theme across most definitions is third party providers are external partners which perform various logistical functions that the buyer/seller might be capable of, but may not have the resources to do efficiently. Third party logistics can help a company to reduce inventory, increase customer service, and build a competitive advantage.

A third party company can provide warehousing or storage for and manage inventory levels. A third party company may better manage inventory resources, including information technology, warehouse equipment, and transportation services. The third party usually does not take an interest or position in the inventory (Coyle, Bardi, and Langley, 1996). “Third party providers take possession of the goods but do not take title of them and provide services for a price” (McGinnis, Kochunny, and Ackerman, 1995). An example of this method is vendor managed inventory (VMI) where the vendor manages inventory for the customer. “One of the major reasons for VMI is the reduction in inventory that both parties are able to achieve” (Coyle, Bardi, and Langley, 1996). The products can be in a warehouse, in transit, or in the customer’s store, but the vendor manages, monitors, and replenishes the inventory.

Utilizing VMI allows a company to focus on making the product and reduces the investment required to do the management function within the company. Proctor & Gamble (P&G) and Wal-Mart have received the most press for a VMI relationship. In essence, P&G manages the level of inventory of its products in Wal-Mart’s stores and monitors the movement through Wal-Mart’s distribution cross

docking facility. For each product, P&G determines when to ship and how much to ship to Wal-Mart (Coyle, Bardi, and Langley, 1996).

A major benefit of using third party logistics services is the improved customer service levels (Coyle, Bardi, and Langley, 1996; Lieb and Randall, 1996). “The best third party providers maintain they can substantially improve service while reducing cost” (Boyson, 1995). But decreasing costs is not the primary reason companies use third party services. Exposure to innovative methods of doing business, including information systems, shipping, transportation, and warehousing, allows companies to increase their customer service levels. Timeliness, accuracy, and availability of information are the most important customer service dimensions in the shipper/third party relationship and will allow them to coordinate inter-organizational activities (LaLonde and Cooper, 1989; Bowersox and Daugherty, 1995). Third parties often can provide logistical services that a company cannot afford to implement.

Companies also use third party logistics providers to perform activities that the company could do, but that someone else can do better, cheaper, or easier. This allows the company to focus on its core competency as a “strategy to operate more effectively and efficiently” (Coyle, Bardi, and Langley, 1996). A company that can focus on its core competency in addition to offering third party logistical services can develop and maintain a significant competitive advantage. “Third party logistics providers have emerged as major players, providing superior management to firms whose core competencies do not include a logistics function” (Boyson, 1995). A benefit of using third party providers is the ability to focus on core competencies, reduction of capital costs, and access to greater or specialized logistics expertise (Coyle, Bardi, and Langley, 1996). Opponents to third parties claim they lead to a loss of control, less direct contact with customers, substantial costs related to reducing internal operations, and reduced internal logistics expertise (Lieb, 1992).

LOGISTICAL PRACTICES OF MINNEAPOLIS-ST. PAUL COMPANIES

This chapter reports the results of the expert interviews with the Minneapolis and St. Paul “leading edge” companies. Leading edge companies have three characteristics. First, they “seek to use logistical competency to gain and maintain competitive superiority” (Bowersox et al., 1989). Second, they “seek to add value to the products and services they market by operating a cost-effective logistics system” (Bowersox et al., 1989). Third, they “leverage their assets by forming strategic alliances with service suppliers” (Bowersox et al., 1989).

Ten firms participated in the Minneapolis expert interviews. A list of six questions was sent to the respondents before the interview (Appendix A) and this chapter summarizes their responses. The respondents were allowed to review this information for corrections or additions before being included in the study. This procedure ensured that the information presented here is accurate and has the respondents approval.

Importance of Supply Chain Management

The respondents agreed that SCM is a fundamental change within industry. While some seemed to say it was dramatic, others were more reserved on the effects it had on their business.

Supply chain excellence is a major element within most of the companies. While it is a business practice, it is also a mind set for some of them. The fundamental idea behind SCM is the management of information instead of the management of inventory. SCM has also helped companies to make the transition from an organizational structure based on functional silos to a process-orientated structure. This transition can lead to confusion and conflict among firms, and SCM has helped to buffer these effects.

Some companies began implementing SCM policies about three years ago. Others feel it is the most current buzzword for something that has been occurring for a long time. Many companies are still struggling with the question of what is SCM and what the future will be. The future of SCM will probably depend on what the industry demands. SCM appears the right thing to do and will remain important.

Major Reasons for Establishing Supply Chains

The respondents identified three reasons to establish supply chains, which were consistent with the literature review: 1) to reduce inventory investment in the chain, 2) to increase customer service, and 3) to build a competitive advantage. These reasons are discussed in the following sections.

Reduce Inventory Investment in the Chain

In the past, holding large amounts of inventory was a normal business practice to guard against risk. Today many companies find holding inventory costly and try to push the inventory onto someone else within the supply chain. Where inventory is held is a challenge in most chains. One reason for SCM is to reduce inventory levels by deleting the inventory redundancies in the chain. In most situations, the distributor wants less inventory and tries to push it back to the manufacturer. Some companies are demanding the manufacturer to deliver the inventory to private customer warehouses in smaller lots more frequently. As a result, the concept of vendor managed inventory (VMI) has become a trend in inventory management. This system allows the inventory to be pushed back to the vendor and, as a result, lowers the investment and risk for the other chain members.

As product life cycles shorten, reducing inventory investment in the chain has become important. Cycle times, the time between a customer order and the time it is received by the customer, are being reduced as a result of the quick response (QR) inventory system. QR is “a method of maximizing the efficiency of the supply chain by reducing inventory investment” (Coyle, Bardi, and Langley, 1996).

The QR system improves customer service because the customer gets the right amount of product when and where it is needed. In addition, the move to faster order placement and shorter lead times will help to reduce cycle stock and safety stock.

Some important inventory issues for SCM include

- shorter delivery times (as part of cycle time reduction),
- just-in-time (JIT) (a shift from batch ordering),
- bar coding and point of sales (POS) data,
- vendor managed inventory (VMI), and
- consignment inventory.

The first three issues are complementary. To utilize a JIT system, shorter delivery times are needed. To know what products need to be quickly replenished, POS data are required. These three issues rely on information sharing to succeed. Vendor managed and consignment inventory are emerging management strategies designed to efficiently place inventory in the supply chain.

Increase Customer Service

The respondents stressed that customer service is important to remain competitive. Firms implement SCM to improve customer service through increased frequency of reliable product deliveries. Some respondents stated that increasing demands on customer service levels are driving partnerships with vendors and suppliers. The ability to serve customers with higher levels of service, including faster delivery of products, is an important concept that results in partnering. Having a close relationship with a supplier or vendor results in common trust and enables firms to achieve the desired customer service levels.

Build Competitive Advantage

Achieving and maintaining competitive advantage within an industry is difficult. Numerous competitive pressures force a company to remain efficient. Companies that employ the resources to implement SCM may be able to achieve a competitive advantage within the supply chain.

Attaining competitive advantage within the channel results from top management support for decreased costs and waste. Many companies want to push costs back to their suppliers and remove labor costs from the system. These cost-reducing strategies tend to initiate the competitive efficiency of the entire chain. SCM must be able to quantify a bottom line impact. A concern, however, is that some supply chains will quickly realize the "low hanging fruit" and neglect long-term investments required to acquire the more difficult, but potentially larger gains.

Companies have become more market-channel focused. In other words, they are looking at how the entire channel's activities affect how the system operates. The channel power has shifted to the retailer (Norek, 1997), as a result of the business practices of some large retail companies (e.g., Target, Wal-Mart, K-Mart). The large size of these retailers gives them power to dictate exactly how they want their suppliers to do business with them. The use of point of sales (POS) data and increased efficiency of distribution have also been instrumental in improving channel power and competitive advantage.

Characteristics of Current Supply Chain Management Philosophy

Common characteristics of SCM identified by the respondents were consistent with factors identified by Coyle, Bardi, and Langley (1996) and included: 1) shared information, 2) organizational relationships, 3) total pipeline coordination, and 4) firm flexibility. At some point during every interview, the firms mentioned that information sharing is probably the most important characteristic in a successful supply chain.

Shared Information

Respondents unanimously felt that information is crucial and drives the entire supply chain system. The concept that moving information is as important as moving product is an essential part of the growth and improvement in information technology (IT) capabilities. Information sharing is necessary to reduce uncertainty and lower inventory levels. The respondents stressed that the willingness to share information must extend within the firm and across the supply chain (suppliers and buyers). Communication within the company is important to decide who the customer is and what the company's goals are and to make sure that these two match.

One long-term goal of logistics is to increase information sharing in the supply chain. Communicating the following types of information is essential for a successful relationship: product development (new products and improvements), costs, demand schedules (including point of sale data), material quantities, and production schedules. It is also crucial to get information about end-use consumers back through the supply chain to manufacturers. This results in better product information about what the customer wants, improves production operations, and minimizes the lag time in the supply chain.

The overall goal of an information technology (IT) system is to improve a company's communication capability. IT has been, and will continue to be, the catalyst for change, but some respondents believe there is a "limit" to what technology can do. This limit could result from the problem with information system incompatibility associated with numerous systems. The respondents stated that a fundamental goal for their companies is to improve IT systems. Improved IT has the potential to reduce the manual drudgery of extensive paperwork and data entry.

One company is working to effectively implement IT, but is finding it difficult because 80 percent of the shipments handled are not labeled with bar codes. These shipments seem to represent products of Fortune 100 companies. Bar code technology is only one part of the IT puzzle. This

company's inventory and shipment control systems and financial control system are state of the art and provide information to customers and management.

It was also stated that an effective and productive IT system integrates with the human element. IT will play a greater role in controlling the order selection process in the future, but the human mind is still better at some functions and needs to remain in the system. Key benefits of human input include flexibility, adaptability, and decision making ability.

Electronic data interchange (EDI) is the standard communication system used in many industries. It links business processes with business partners and increases the accuracy of information exchanged. EDI will continue to grow in importance, and some respondents believe eventually everyone will implement it. In the future, a company should not need management information systems (MIS) personnel to run EDI. In theory, the system will get easier to use, and any employee should be able to install and run the program.

While EDI systems may not be hard to implement, some company policies make implementation troublesome. One problem has been how to actually define EDI. Because of this, some respondents said there were problems with several types of EDI systems being used and their compatibility with their suppliers. Most companies do not have good application systems and may need to focus more on interfacing their programs.

In response to the concern of integration, the respondents stated that the EDI system should be kept simple, yet efficient. This would allow all suppliers to communicate more effectively. Respondents that stated there were no problems with coordination among systems and emphasized the need to stick to basic EDI standards for it to work. While some companies are making major capital investments in electronic commerce, others feel that expensive equipment does not payoff because the systems are always changing.

Retail companies are the most frequent users of EDI in order processing. If the manufacturer knows what is going on in the retail sector, inventory can be reduced and service increased. The

inventory turnover ratio is also improved because key accounts can share information about the product in the distribution centers. In contrast to the retailers, it was found that the food service industry is less familiar with EDI. One company (non food service) stated that most of its information received is not transmitted electronically, but rather through a fax machine.

Organizational Relationships

Strategic alliances and partnerships are important for a successful supply chain. They encourage firms to focus their attention on the entire supply chain and reduce the number of suppliers with whom they deal. Most of the companies participating in this study, have developed preferred vendor (supplier) programs, as well as core carriers. This is to ensure that a quality product is received in the quantity required and where and when it is needed. A successful strategic alliance has the following characteristics: 1) extreme trust, 2) win/win relationship, 3) team building, 4) common goals, and 5) cooperation (willingness to assist, better negotiations, less money driven). Most companies are aggressively developing strategic alliances. In contrast, one company in this study is not actively seeking partnerships, but partnering only with the customers who request it.

Third party firms are external partners and perform various functions that the buyer/seller might be capable of, but may not have the resources to do efficiently. The respondents stated that third parties are becoming very popular and will continue to be important for having a cost-effective business.

Third party logistics or outsourcing has become popular because most companies, even Fortune 500 businesses, cannot do everything. There seems to be undefined opportunities for third party suppliers, especially on the outbound side. Many companies are outsourcing the distribution process and can track all deliveries through the third party provider.

Third party providers are valuable if they can perform a function cheaply or meet a need that the company cannot fulfill itself. Some respondents felt that many third party companies oversell their capabilities, and their systems cannot deliver what is needed. Third party outsourcing is not right for

every company or function within a company. Some companies would prefer not to do it, but feel it is a necessity. A company needs to have great trust in the outsourced process provided by the third party, and this seems to be a hurdle that many companies cannot overcome.

All of the companies interviewed use and will continue to use third party suppliers at different levels within the individual company. Some drawbacks experienced with third party suppliers include: 1) high cost of service, 2) additional processing time, and 3) lack of concern about the user company. Some problems can stem from the users (of the third party) lack of understanding and knowledge as to how the relationship is to work. Because of these reasons, the transition to using an outside provider can be difficult. In contrast, some companies found their experiences with third party providers very valuable.

Total Pipeline Coordination

Each company has multiple supply chains with different needs. It can be difficult to serve every supply chain with one logistical system, so cross-channel coordination is crucial. This coordination allows supply chains within a company to integrate with each other.

Creating supply chain value is important for successful coordination. The most important single factor in creating supply chain value is the ability to predict/forecast demand. The goal for total coordination is to be demand driven, not lot size driven. Suppliers should supply products according to customer demand, not according to production quotas. One company has a complete demand management program consisting of product demand, sales and operations, manufacturing, and supply planning. Information from these functions is shared with suppliers to improve their operational efficiency.

In the past, forecasting was done primarily using historical data. Companies are moving away from this method and beginning to use point of sale (POS) data which can be used to find out the exact number of a product purchased by the customer during a certain time interval. As a product's bar code is

scanned, the purchase is recorded and is readily accessible by the supplier of the particular product. This allows the supplier to know both the quantity sold and current inventory at the store and then the supplier can supply the customer in a timely manner.

Firm Flexibility

Large manufacturers stressed that an important attribute for all suppliers will be flexibility or agility to respond to demand or market changes. An agile company modifies plant and distribution networks by

- operational efficiency (quick line changeovers),
- productivity savings (back hauling),
- speed of new product introduction,
- standardized packaging machines (quick changeover), and
- accelerated product development.

As firms move to SCM, they are concerned with internal plant efficiency and the supplier's efficiency. The key to supply chain operational efficiency seems to be agility rather than economies of size and investments in plant and distribution equipment can contribute to a company's agility.

Minimum Logistical Requirements for Suppliers

As the supply chain becomes increasingly competitive, companies may demand specific requirements from their suppliers. The Minneapolis companies identified minimum requirements that their suppliers need to follow. The most important concept of a successful business partnership is the ability to deliver a top quality product. This ability was the most common issue addressed when discussing minimum logistical capabilities. Many respondents use the term "perfect order" to describe this ability. This concept consists of a product order being 100 percent complete, on-time, and damage

free. A strong quality and inspection program, for example ISO 9000 certification, can help to ensure the perfect order concept is realized.

The remaining logistical issues discussed have been categorized into six areas, including: 1) long-term relationships, 2) marketing, 3) flexibility, 4) communication, 5) shipment requirements, and 6) transportation.

Long-term Relationships

Strategic partnerships with suppliers are important for a successful supply chain. Companies have started to limit the number of suppliers with whom they do business by implementing vendor review programs. Buyers use these programs to find suppliers with operational excellence. Small and rural suppliers must be willing to sign long-term agreements with their buyers. This allows the suppliers to have a continuous revenue for their products. In addition, it shows they are committed to excellence and are willing to go through extra efforts for the buyer. With the evolution toward a sole supplier relationship, companies need full disclosure of financial information, gain sharing, joint design work, and a compatible business culture.

Many respondents mentioned that their companies use suppliers that use or are willing to implement the same forecasting techniques and information systems. This is because their suppliers need the ability to link electronically into the buyer's system to get shipping and production schedules. The compatibility of these information systems is vital to the success of the electronic link.

The respondents felt that small and rural suppliers do a good job and should not have too many problems working with large buyers. A few even stated that these suppliers play a key role in their business. Small suppliers have the advantage of being hungry for expanded business and continued growth. This hunger encourages them to do whatever is in their power to ensure they satisfactorily supply their large customers.

Marketing

Small and rural suppliers need to continue to find and carve out niche markets. The respondents stressed that small suppliers need to focus on better service offerings, such as door-to-door delivery service. Larger competitors have become more concerned about reducing costs and have lost sight of offering special services. However, it was also mentioned that the small suppliers might not be able to afford these special services.

An innovative suggestion for small and rural suppliers to remain competitive is to form a cooperative relationship between certain departments (for example, management information systems (MIS) or research and development (R&D)) among various companies. This would allow these smaller companies to be more competitive and increase their service offerings. A cooperative of special services within companies could be a way to reduce costs. Small and rural suppliers could also have a third party company perform the marketing activities.

Flexibility

A smaller supplier can be more flexible in manufacturing and production than its larger counterparts. A small supplier is flexible when it is willing to look at new programs, in addition to being more responsive and agile in productivity and competitive pressures. The respondents stressed that small suppliers will have to stay close to batch manufacturing at a good price.

The ability to hold inventory closer to the markets was also discussed. If small suppliers cannot transport the product quickly to the destination, then alternative methods of storage and transportation might have to be implemented. By building or leasing a warehouse close to the market, a company could attain an advantage by providing products to their buyers more quickly and efficiently.

Communication

The ability to communicate with buyers is an essential part of doing business. The respondents stated the need to build an interface to communicate with their suppliers. To do this, many companies are helping their small suppliers set up an EDI communication system in addition to implementing other technical capabilities needed to communicate efficiently. These large companies predict that EDI usage will increase for both transmittal and verification of orders. As IT improves, it will be easier for all companies to get involved and implement these programs.

Even with the advancements to make IT easier to use, updates and advances are still critical for companies. Being informed allows everyone to remain competitive and up to date on new avenues of communicating information between buyers and suppliers. Satellite and computer capabilities are essential for small companies. One respondent said that the advent of the computer makes the idea of being “rural” irrelevant. Technological advances have allowed many so-called rural companies to become more competitive with the larger companies.

Shipment Requirements

Having and supplying the correct shipment information could be the most important aspect of having a “perfect order.” Implementing proper shipping procedures was discussed by the respondents. The product must be received in the required condition, so the buyer does not experience production or shipping delays. For example, if a company requires a 1" screw for an assembly and receives a 1.5" screw, the production line could be delayed until the correct screws are shipped. A complete, correct, on-time order is especially essential in a just-in-time environment.

A good supplier must ship products in a reliable, timely manner. This requires that the supplier has an efficient ordering and distribution process. Most respondents stressed the need for electronic ordering, and this is where the EDI system is almost a necessity. A successful supplier should also have creditworthiness with no signs of defaulting in the past.

The packaging and palleting requirements most frequently mentioned were

- carton markings (UPC codes on product package and detailed product description),
- bar coded palletizing (UPC codes on pallet),
- uniform pallets (same size pallets),
- one item per pallet, and
- uniform packaging requirements.

Uniformity in packaging requirements is an important issue, especially for warehousing companies. Some companies have less strict, more lenient packaging requirements, and this can cause their packages to become damaged more easily. Consequently, the warehousing company could ultimately deliver a faulty product, but rarely is it their fault. Implementing stronger packaging requirements for certain products would alleviate this problem.

Transportation

There was a basic consensus among the respondents that having access to low cost, reliable transportation is essential. Securing loads for backhaul trips can help to ensure transportation is more efficient and less costly. The respondents also seemed to feel that rural areas will always suffer from transportation disadvantages, and it will get worse. One respondent stated that SCM cannot help a company to resolve distance issues. Each company chooses where it wants to locate, and if distance is a detriment, it is the company's own fault. Other respondents said that rural suppliers will need other assets to overcome the distance disadvantage.

LOGISTICAL PRACTICES OF NORTH DAKOTA MANUFACTURERS

In this chapter, the results from the expert interviews with eight North Dakota manufacturing companies are presented. A list of seven questions was sent to each respondent (Appendix B) prior to the interview. The respondents' comments to the questions are summarized and compared with relevant literature.

Importance of Supply Chain Management

Views concerning the importance of SCM to a company varied. Two respondents were not familiar with the concept until a definition was given. They agreed that it was important for a company to understand the concept.

The other companies have just started looking at SCM and see it as important for their future. Two respondents think it is simply a new headline for something their companies have been doing for a long time.

Major Reasons for Establishing Supply Chains

The three major reasons for establishing supply chains addressed by the respondents were consistent with the literature review: 1) to reduce inventory investment in the chain, 2) to increase customer service, and 3) to build a competitive advantage.

Reduce Inventory Investment in the Chain

Half of the respondents talked about or referred to a just-in-time (JIT) inventory management system. The others may be using this inventory system as well, but may not call it JIT. Coyle, Bardi, and Langley (1996) address four elements in a JIT system: 1) short lead times, 2) small, frequent replenishment quantities, 3) high quality, and 4) zero inventories. The JIT system refers to the concept

that inventories should be available when and where a firm needs them, thereby minimizing inventory costs. "Experience indicates that efficiently implementing the JIT concept can dramatically reduce parts and materials inventories, work in progress, and finished product" (Coyle, Bardi, and Langley, 1996).

In general, most North Dakota companies participating in this study have reduced inventory levels (both raw materials and finished goods) in the last three years. Even with the reductions and increased use of the JIT inventory management system, there are still large quantities of inventory being stored by the North Dakota firms. One company holds about 90 days worth of inventory, while two others are design-to-order companies which hold between 6,000 and 7,000 items in inventory. But it is important to note that the number of stock-keeping units (SKUs) is not quite as important as is the stock level quantity of each SKU. Companies need to analyze and determine the quantity needed on hand for each SKU. This will allow for more accurate inventory stocking levels.

In addition, two of the companies buy four times a year for shipping and purchase discounts, yet still call their inventory system JIT. This results in them holding both raw material and finished goods inventory which could be costly. On the other hand, holding inventory could allow for raw material purchase quantity discounts or better customer service response time for the finished goods. There seems to be some conflicting perceptions about inventory reduction and JIT.

Increase Customer Service

The respondents stressed the importance of excellent customer service and discussed some of the methods they implement to ensure continuing business with buyers and suppliers. One company tailors its operations to be customer driven by encouraging communication concerning what the customer requires of each product. To achieve this, policies are designed for each customer's needs and followed up with personal interviews or satisfaction surveys to ensure that specifications are met.

One company stated it has achieved customer loyalty because some of its products have been in the market for 25-30 years and never required service. It also has great customer trust because its

product testing results are posted on the internet for anyone to analyze. This gives customers the opportunity to see the product durability and results before a purchase is made. Other ways to improve customer service include taking costs out of the system to serve customers better and smoothing relationships with vendors.

Build Competitive Advantage

Many companies have formed strategic alliances to develop a competitive advantage. All eight companies participate in partnerships or realize the importance of developing a relationship with a buyer or supplier. Partnerships allow these small, rural manufacturers to pool resources to help them compete against their larger, urban counterparts. Another way a company can build a competitive advantage is to implement an information technology (IT) system which will result in a more efficient business process. The participants realized the importance of IT for their companies, but some did not know how to implement an IT system in a cost-effective way.

Logistical Characteristics of North Dakota Companies

Logistics initiatives were started about three years ago in one company, four companies are just beginning to develop strategies, and three have been looking at logistics as a competitive advantage for years. Logistical activities are handled differently in each firm. One company has logistics meetings twice a week, involving the production, transportation, and merchandising departments. These meetings address the process flow of what needs to be done for key products. Another company has production scheduling meetings once a month. During these meetings, safety stock levels are set, in addition to minimum and maximum order quantities.

The remaining companies did not discuss having logistics planning meetings, but this should not be a sign that there are no logistics meetings. Instead, it is more likely that the topic was not addressed in all the interview sessions. It is also important to point out that many small firms have limited office

space, so employees interact continuously. During this interaction, business brainstorming may occur on a more informal basis.

One company focuses on essential logistics activities because of the detailed procedures for individual products due to the differences in delivery dates and customer requirements. Proper knowledge of logistics aids in more accurate product planning and as a result, a better product. They are also working to bring all divisions together and break down “silos” by creating cross-divisional teams. The importance of getting top management support was stressed. This is essential before moving toward logistics initiatives and allows the same ideas and concerns to be relayed across all departments.

Inventory Management

Three companies have started to collect data and develop historical inventory records to track inventory and determine on-hand stock levels. One company plans to implement an inventory tracking computer system to determine turnover ratios. Half of the companies use Materials Requirements Planning (MRP) to control inventory levels. MRP is a “dependent demand inventory planning and control system that schedules the exact amount of all materials required to support the desired end product” (Daft, 1991). “It is an inventory ordering and time-phased scheduling technique, which uses bill of material, inventory data, and the master production schedule to calculate requirements for material and determine when to release the material replenishment order” (Torkzadeh and Sharma, 1991).

Materials Resource Planning called MRP II was also mentioned by two companies. It is more advanced than MRP by reaching “into every company operation to control all resources” (Daft, 1991). It is usually used by larger companies as a strategic planning tool for management and strives to combine all activities and produce a computer-based model of the company’s operations (Daft, 1991). Benefits derived from the MRP II system include improved customer service levels, optimized production scheduling, reduced component stockouts, refined stocks, and increased plant throughput (Hartley, 1991).

The companies that are using the MRP system felt that it was the centerpiece of their business. It seems small firms believe MRP is the key logistics tool to reduce inventory and insure efficiency. Coyle, Bardi, and Langley (1996) feel a principal advantage of MRP is the ability to maintain reasonable safety stock levels and minimize or eliminate inventories wherever possible. In addition, other advantages include the following: identify process problems long before they occur, base production schedules on actual demand, and coordinate materials ordering across the firm. MRP is most suitable for batch production or assembly processes. But they also list several disadvantages, including computer-intensive applications which make changes difficult once the system is in operation, increased ordering and transportation costs as inventory is reduced, sensitivity to short-term fluctuations in demand, and complexity.

One company stated it will not implement a new information system, but rather stay with the MRP system and utilize it to the fullest. Another respondent felt that MRP inflates inventory, resulting in a company holding too much safety stock. One company has outgrown its current MRP II system and feels the planning capacity of the system is weak. The companies felt it is important to share the MRP information with their suppliers.

One company is moving away from MRP and switching to a new system called Enterprise Resource Planning (ERP). This system will tell it how many people are needed for each manual product assembly in addition to reducing machine bottlenecks. The new system will include EDI capabilities which the company has not had. A full company integration, including accounting, should reduce repeat transactions. The software company does the program installation and employee training in approximately 2 ½ weeks. The program is designed and programmed so it performs functions the company wants it to. To be successful, a company must understand the entire business well enough to program the appropriate data into the system. A sophisticated system such as ERP needs the proper data and information to produce the results a company wants.

One company talked about a trace and recall system. In the case of product defects or customer complaints, this system allows it to trace the product back to the raw material input through production tickets attached to the pallets. These tickets contain information such as when the product was made and where the inputs came from. The companies also discussed bar coding their products. The companies are in different stages of implementing bar coding. The companies (with one exception) will have complete bar coding capabilities within the next year. One company does not use bar coding and did not express any hurry to implement the process.

Vendor managed inventory (VMI) management systems were discussed with two of the companies in the study. With VMI, the supplier or vendor manages and monitors the level of inventory of its products in-transit and in the buyer's warehouse or store. For each product, the supplier decides when to ship and how much to ship. One of the major reasons for VMI is the reduction in inventory that both parties can achieve. The supplier owns the product until the buyer pulls it out of the warehouse or the customer pulls it off the shelf.

Small buyers using VMI can essentially outsource certain logistical requirements that they cannot afford or that are not financially feasible to implement. VMI would allow a small buyer to push the inventory management task onto a supplier that may have the resources to do the task efficiently at a lower cost.

Transportation Management

Every company in today's competitive business environment relies on reliable transportation. Rural companies sometimes have difficulty finding carriers to haul goods largely because they tend to ship in smaller quantities. Therefore, they may not be able to fill a truckload of products and must use more costly methods such as less-than-truckload (LTL) carriers. The LTL carrier "consolidates numerous smaller shipments into truckload quantities for the line haul (intercity) movement and

disaggregates the full truckloads at the destination city for delivery in smaller quantities” (Coyle, Bardi, and Novack, 1994).

Most of the larger LTL carriers do not service rural companies. Rural areas many times are not profitable accounts for the trucking industry because costs per unit are too high due to low volume and longer distances. One respondent stated it is hard getting trucks to come to rural North Dakota. This problem exists even though the company, which does business nationally and internationally, is located on an interstate highway. This company has service from two only carriers.

One respondent stated that many companies look at transportation as a cost instead of an opportunity. A company can either throw away money on costly transportation or look for a cost effective, efficient method to move goods. One company has done this through a transportation initiative that has assigned people to analyze ways of reducing costs. The selection of a transportation carrier should not be based only on low cost, but also on performance, including on-time delivery and zero defects. In addition, companies may want to do business with a carrier that utilizes compatible, up-to-date information technology systems. Therefore, strategic alliances may have to be formed with transportation carriers.

Most respondents try to use as many local carriers as possible, which extends better relations to the local companies. One company does extensive routing and scheduling to give each trucking company the best route according to the trucker’s backhauls. This technique conflicts with the trend in transportation management, using core carriers. Companies may have to make some tough decisions concerning transportation management to develop a competitive position. One respondent stated that rural manufacturers spend more money on transportation and less on employee wages. This is probably due to the costly transportation rates incurred by rural manufacturers.

The eight companies handle inbound transportation in various ways. Inbound traffic is controlled by the purchasing department or bid out with contracts. Another company arranges and pays

for all inbound traffic for their larger suppliers. United Parcel Service (UPS) was also mentioned as an important inbound carrier for smaller packages.

Outbound traffic also is managed differently by the companies. In two companies, the buyer dictates the carrier used for outbound transportation. One customer does this by contracting its own transportation and paying for all outbound shipments. The other customer has the option to contract its own transportation, but may ask the company to do it. In another company, sales managers manage their own outbound traffic.

One company has a private trucking line. “The primary reasons for a firm having a private truck fleet are improved service and lower costs” (Coyle, Bardi, and Novack, 1994). The company feels it gains a competitive advantage, especially with customer service requirements. The drivers are employed by the company, so they know how to handle the product and understand what the customer requirements are. A drawback to a private fleet is that the company could manage it poorly and end up paying too much for transportation.

One company expressed interest in developing contracts with core carriers in the future. It has some concern about higher rates at first, but over time, it hopes the rates would decrease or be written into contracts. The justification of using core carriers lies in the company’s desire to reduce or consolidate the base of truck suppliers. North Dakota companies using many local carriers are far from adapting to the core carrier trend. One company discussed the ability to track truck shipments. “Satellite tracking systems allow carriers to determine the exact location of a shipment and relay this information to the customer” (Barber, Honeyman, and Lantz, 1997).

Rail transportation is used by two North Dakota companies. Each company uses varying levels of rail traffic. One company found that rail was a very inefficient means of transportation with a variable in-transit time of 8-20 days. Although rail was a lower cost transportation method, they switched to trucks. Another respondent also stated that the reliability of the railroad was too sporadic. These responses point to the realization that railroads still have poor on-time performance which is essential for

a successful JIT inventory system. In addition, poor rail service could hinder a company's ability to implement a good customer service program, since on-time delivery is a major aspect.

In general, most North Dakota companies use trucks as their primary transportation mode due to the flexibility and reliability. Companies that ship bulk commodities seem to use more railroad transportation due to the lower cost.

Strategic Partnerships

All the companies stated they participate in or are looking at developing some form of strategic partnership with a buyer or supplier. A strategic partnership is defined as "a mutual, ongoing relationship involving a commitment over an extended period, and a sharing of information and the risks and rewards of the relationship" (Ellram, 1991).

Third party logistics is a type of strategic alliance and is increasingly becoming an essential aspect of competitive companies. It "involves the use of external companies to perform logistical functions that have traditionally been performed within an organization" (Lieb, 1992). The number of firms offering third party services has increased at a rapid rate over the past few years, including larger companies such as United Parcel Services, Federal Express, and Roadway Express (Lieb, 1992).

Companies seem to have mixed reviews on the importance and value of third party logistics. Those that say it is valuable feel that the manufacturing company should focus on its core competency and allow other companies to manage the logistics function. This results in a competitive advantage and lower costs. Opponents say that using third parties leads to less control, less contact with customers, and increased costs (Lieb, 1992). The companies in this study seemed to agree with the opponents, since none of them currently participate in third party relationships.

Most North Dakota companies have been approached by third party providers, but do not use them due to many reasons, including the loss of control, too much variance in quality, and high costs. One company stated that third party providers would not work for it because its suppliers are too far

away and it preferred to own its truck line and benefit from the backhauls. Another company stated it will not use third party services because it would lose control over the product, and it wants to maintain as much control as possible.

Gentry (1996) identified four common dimensions among buyer-supplier relationships: 1) long-term commitments, 2) open communication and information sharing, 3) cooperative continuous improvement on cost reductions and increased quality, and 4) sharing of risks and rewards. Table 4.1 categorizes the companies according to how they meet these four dimensions.

Table 4.1. How North Dakota Manufacturers Meet Strategic Partnerships

Firm	Long-term Commitments	Information Sharing	Continuous Improvement			Shared Risk
			Monitor	Certification	Inspection	
1	X	X	X	X	X	X
2		X	X			
3	X		X		X	X
4	X	X	X	X	X	X
5	X		X		X	X
6	X		X		X	X
7	X	X	X		X	X
8		X	X		X	

Long-term Commitments

All companies have reduced or are analyzing ways to reduce their supplier base. One company has already reduced its supplier base from 500 to 200, two other companies are looking to reduce the supplier base by approximately 50 percent. The companies that have reduced the number of suppliers are asking their suppliers to do more and are offering them a greater percentage of the business. Most companies feel it is important not to rely on a single supplier due to the high vulnerability. To offset this problem, six of the companies are developing long-term contracts with suppliers.

Open Communication and Information Sharing

All respondents stated that the amount of information sharing with suppliers has increased and is essential to a good buyer-supplier relationship. It was stated that large suppliers are fairly sophisticated in communication capabilities, but the small buyers do not have extensive information technology (IT). Two fundamental types of IT used in companies are electronic data interchange (EDI) and bar coding. These are basic forms of IT which may imply that North Dakota companies have a long way to go before implementing more sophisticated IT programs.

Electronic data interchange (EDI) is a paperless method for companies to communicate such things as purchase orders and bills of lading. Most respondents said EDI is important in maintaining business with many of their customers. Some companies have been using EDI since the early 1980s, while others still do not use an EDI. Five companies are using EDI within the company or will be within the next few months. One company communicates with its buyers and suppliers extensively through e-mail and the internet. Three companies do not use EDI primarily because their suppliers and customers do not require it. One company that does not use EDI will begin to use it with the new ERP system. It hopes this will allow its customers to use EDI to place orders. Another company that does not have EDI right now is looking at starting the process with one supplier and then work on adding others.

Order processing varies in the companies from EDI to receiving orders over the phone and/or fax machine. In addition, an order could go through various departments, including contracting, purchasing, engineering, accounting and finance, shipping, and production control. Even with EDI, most companies agreed there is still plenty of paperwork because people “trust” paper documents. One respondent said an order is retyped at least four times before it goes out the door, while another said that the human element will never disappear from the order process. Yet, an important requirement to be “leading edge” in logistical practices is the ability to use EDI. Therefore, the companies that are not implementing EDI may be limiting themselves from doing business with “leading edge” companies such as the Minneapolis firms.

Four companies use bar coding or will be by the end of the year. One company uses bar coding for labor tracking. One company stated that bar coding is used in the loading area and will be implemented extensively in other areas as well. Bar coding removes the element of human error in checking and tracking inventory and reduces costs, improves timeliness, and allows for greater inventory control (Sadhvani and Tyson, 1990). Companies that do not use bar coding stated they find it difficult to track product problems when they occur because there is little or no good documentation. Two companies do not use bar coding, but one is planning to start next year.

Cooperative Continuous Improvement on Cost Reductions and Increased Quality

Three aspects to cooperative continuous improvement include 1) monitor supplier performance, 2) vendor certification, and 3) inspection.

First, monitoring supplier performance varied from extensive to none at all. The companies that monitor supplier performance analyze on-time delivery, defect rates, product quality, the ability to follow company specifications, and the costs associated with maintaining the specifications. In one company, purchasing measures the supplier's on-time reliability and defect rates of the inbound product. Records are kept of each vendor and analyzed to evaluate supplier's performance.

Another company spoke of a former supplier. The supplier could not do what was promised and was unable to deliver on-time. As a result, that supplier lost the manufacturing company's business. Now the manufacturing company uses one overseas supplier that manufactures parts to specifications.

Second, buyers may certify suppliers if they consistently follow and meet product specifications. Certification allows the supplier's products to bypass inbound inspection because it has an extended record of consistent quality. One company started certifying its suppliers five years ago, but has no more than two dozen suppliers certified. Inbound materials from these suppliers are marked with a large red-and-white sticker stating they are certified and no inspection is required. Another company is beginning

to certify one supplier. However, it is a long process (6-12 months) because of the documentation that is necessary.

Some companies have certain specifications (or criteria) that must be met by each supplier. These criteria are often passed from the buyer (particularly government agencies) on to everyone else along the supply line. If a supplier can demonstrate the ability to meet the criteria, then the company will use it. Companies feel it is important to be able to rely on their suppliers and have them back up their product. Some suppliers will take back the product if it does not meet the criteria. One company stated it would like to see the inbound product more consistent and feel it needs to educate the inbound supplier on five specific criteria that need to be met.

Third, when companies do not implement a vendor certification program, they usually have to go through an inspection process. Product inspection is important because of the high costs associated with a bad product. Miller (1995) discusses the trade-off between the level of a supplier's inspection and a buyer's costs. As the supplier increases the number of units inspected, the defect rate falls; therefore, the buyer's inbound inventory has fewer defects, lowering the buyer's costs. Buyers are willing to pay for quality and dock the price paid to suppliers for poor quality products.

A poor outbound inspection program could result in a less-than-desirable (defective) product, leading to dissatisfied customers and possibly the loss of an account. A company that does not have inbound inspection might have to carry higher levels of inventory to balance out problems with poor or unusable raw material. There are obviously costs associated with not having an inspection program. Manufacturing companies that require inbound material with certain specifications need to set up an intensive inspection program if they do not have one.

The companies in this study strive for high quality products and have or are implementing processes to ensure quality throughout the company. The inspection programs in the companies varied from none at all to ISO 9000 certification. There seems to be some inconsistency here. The companies that do not have any inspection realize that quality is important, but probably do not know how to ensure

product consistency. These companies need to implement quality inspection programs that will reduce costs and increase customer satisfaction. One company does not inspect inbound material because there are no product specifications, while another company feels it should inspect the product to a greater extent. This company would like to put some safeguards in and will be moving toward an inspection initiative.

Companies that do not inspect their inbound and outbound shipments frequently discussed ISO 9000 as a quality program many of them are implementing. “A company that has achieved ISO 9000 registration can attest that it has a documented quality system that is fully deployed and consistently followed. This does not necessarily imply, however, that the company produces better quality products than those of its competitors” (Peach, 1997). The key of ISO 9000 is the documentation of a specific process. It does not matter whether the process is good or bad, but rather that it is consistently performed in a certain way. ISO 9000 requires that a company operate in a manner set by the company itself while meeting certain basic requirements (Rabbitt and Bergh, 1993). “ISO 9000 certification demonstrates the capability of a supplier to control the processes that determine the acceptability of the product or service being supplied” (Rabbitt and Bergh, 1993).

One company specifically stated it does not inspect product from two suppliers because they are ISO 9000 certified suppliers and there have not been any problems with their products. One respondent stated that ISO 9000 is becoming more popular because companies are more comfortable using a supplier that is certified. It also provides both the buyer and supplier with more confidence internally and shows qualification of a quality program. The important thing in an ISO 9000 program is to document the exact processes performed in the manufacturing process.

Companies that do inspect materials go about it in different ways. In one company, the quality department inspects both the raw materials and the finished goods. The department has product specifications that each product must pass before coming in or leaving the company. Another company

that is close to achieving ISO 9000 certification inspects products through a skip lot (every four products). This process gives it about 98-99 percent accuracy, and it would like to get 100 percent.

Sharing Risks and Rewards

Firms which have formed strategic partnerships find that sharing risks and rewards are necessary for successful relationships. A partner's unwillingness to share the benefits and costs of doing business may be detrimental to the relationship. A firm's sincere concern can be expressed by mutual loyalty and the willingness to help in difficult situations, in addition to negotiating instead of litigation (Ellram and Hendrick, 1995). The North Dakota companies that have formed partnerships with suppliers seemed to be happy with their supplier relationships, probably because of the feeling of mutual risks and rewards.

Origin of Recent Logistical Changes

There has been a shift in channel power from manufacturers to retailers (Norek, 1997). Retailers are driving logistics changes which traditionally had been initiated by manufacturers. Manufacturers are still leading the implementation of logistics changes. However, the motivation comes from their customers (Norek, 1997).

With retailers exerting pressure on manufacturers, it would be seem appropriate for these manufacturers to push some functions back to their suppliers. Norek (1997) found that 52.4 percent of the manufacturing firms shifted functions back to their suppliers. Norek (1997) discusses four common tasks that are transferred back to the supplier by the manufacturer: 1) hold raw material inventory or vendor managed inventory (VMI) with raw materials, 2) labeling and bar coding, 3) packaging and pallet specifications, and 4) electronic data interchange (EDI). These criteria are similar to initiatives discussed with the "leading edge" companies.

Logistics Functions Pushed from Buyer

The North Dakota companies that participated in this study stated they feel the pressure from their buyers to adapt to certain standards. Vendor managed inventory was discussed on page 48. Two companies are managing their vendor's inventory.

One company had just received word from its major buyer that bar codes needed to be on every product within a few months. Regardless of the costs to the company, it must adopt the technology to keep the buyer as a customer. The buyer will provide it with software and equipment needed to implement the bar coding. The buyer may also send personnel to help with the setup and implementation of the program. Another company must have EDI capabilities to work with one buyer.

The criteria passed down from the buyer are often passed further up the supply chain to the suppliers of these manufacturing companies. The logistics initiatives which occasionally start with the retailer are pushed back up the chain, sometime even as far back as the initial supplier. Few suppliers have the power or resources to push back or question the logistics initiatives required by large retailers. Norek (1997) stated that of the 100 firms participating, only one or two had the ability to push back the requirements. "We tend to forget the thousands of medium and small suppliers who are having difficulty even keeping up with past demands let alone push back on new ones" (Norek, 1997).

Logistics Functions Shifted Back to Suppliers

Two North Dakota companies are initiating logistics changes and pushing them onto their suppliers. One company initiates the decision to change and then funnels these changes down to its suppliers. There is an internal decision to improve the supply process, and this company takes the necessary steps to achieve efficiency. Another company talked about developing a bar coding system and requiring its suppliers to also implement bar codes on all inbound material. This company also talked about how its vendors will add the services the company needs. It is easier for the vendor to add the service than for the company to find a separate supplier that can provide it.

These companies's realize that rather than doing everything internally, it is efficient to have their suppliers perform certain logistics functions as well. The two companies have experienced their customers' pushing functions back to them, so they have found it necessary to require the same abilities from their suppliers.

Past and Present Trends in Information Technology

Information technology (IT) has exploded over the past few years to become an essential competitive tool. The companies agreed that IT is becoming increasingly important. Companies must develop an IT program that will allow a competitive advantage and reduce costs.

One company has hired many IT people over the last four years to work on getting every employee updated to the same programs and to develop company-wide standards. One respondent stated that the increased use of information systems will reduce or eliminate the amount of clerical work to be done. In the future, another company hopes to implement a computer system to track inventory in addition to better scheduling programs, better records of inputs, and customer follow-up procedures. The increased use of IT will allow companies to grow and increase output without adding new employees.

One respondent felt that the level of automation and technology employed within the company has allowed it to grow while keeping the same number of employees. It believes that employees need to support and understand EDI technology. This company is undergoing a \$9 million re-engineering project which it calls SCORE (Serving Customers in Option Rich Environment). It is installing a new computer system that will integrate all processes within the company. There is a six-week lead time for orders (four in the office, one in manufacturing, and one in transit), and it hopes to cut down lead time by integrating department functions together. This company needs high tech IT because this competitive edge is sometimes required to do business with other companies. But, not every firm can implement IT because of the costs involved.

Sales Forecasting Techniques

Sales forecasting is essential to know how much inventory needs to be ordered or held in storage. All but one of the companies participating in the study perform some form of forecasting.

How often the companies perform forecasts differs depending on the type of product produced or manufactured. One company holds production scheduling meetings once a month. In these meetings, safety stock is set, and minimum and maximum order quantities are determined. The product it sells is somewhat seasonal, so it forecasts on seasonal requirements. Another company forecasts sales weekly, monthly, quarterly, and yearly. It has monthly meetings to discuss forecast levels and forecast accuracy. One company's forecasts are updated monthly and are usually 85-90 percent accurate.

The information used to forecast future sales differs for each company. Sales, both past and future, drive the forecasts in some companies. Future sales levels are found by asking the buyers what they plan on buying or by attaining materials resource planning (MRP) results from them. One company's sales are driven by supply, the demand is greater than supply. This company does not forecast, but rather schedules production in relation to backlog levels. A new software system will schedule the engineering process better to avoid backlogs and allow for better forecasts. One company does a market analysis focused on the short term. It is concerned with how much it needs to ship within a short period.

Many companies use computer spreadsheets to estimate their forecasts. There are numerous uncertainty factors in forecasting, and programs that simulate risk would be good tools for these companies to use.

COMPARISON OF LOGISTICAL PRACTICES

In this chapter, similarities and differences about SCM between the “leading edge” Minneapolis firms and the North Dakota manufacturing firms are discussed. These factors form the basis for conclusions and recommendations for small and rural manufacturers. In addition, the results of this chapter can be used to further develop strategic plans within companies.

Respondents from both groups agreed that SCM is an important philosophy for companies to adopt. The “leading edge” firms seem to have more completely adopted SCM and have entire departments dedicated to its implementation. In addition, there are dedicated positions, such as director of supply chain management and director of supply chain industrial markets. The “leading edge” companies implement SCM as part of their strategic plan. These companies are continually looking for methods to strategically position themselves within their respective industries.

Two of the companies participating in this study were implementing strategies similar to those of “leading edge” Minneapolis companies. These companies realize the importance of and are able to implement SCM practices. On the other hand, the remainder of North Dakota companies seem to struggle with the adoption of these strategic trends.¹ The majority of North Dakota companies are primarily focused on day-to-day operational activities. This focus could be necessary because key employees may participate in multiple tasks within the company. This may minimize the time and the resources needed to recognize and implement strategic trends. In addition, North Dakota firms seem to be more “lean.” In other words, they do not have entire departments dedicated to strategic plans, but rather departments which focus on operational efficiency.

¹ This study is not intended to criticize North Dakota firms, but rather is designed to interpret and evaluate the actions of these firms. These results and conclusions should be used to aid firms in developing a SCM strategy.

Respondents from both groups agreed that the strategic goals for a SCM philosophy are to reduce inventory investment, increase customer service, and attain a competitive advantage. Companies use various operational strategies to achieve these strategic goals. Table 5.1 shows a comparison of the importance of these activities to North Dakota and “leading edge” firms.

Table 5.1. Importance of Strategic Goals and Operational Strategies for SCM

Strategic Goals	Operational Strategies	North Dakota	"Leading Edge"
Inventory Management		◆	◆
	JIT	◆	○
	VMI	□	○
	MRP	◆	□
	Sales Forecasting	○	○
Information Technology		◆	◆
	Compatibility of Systems	□	◆
	EDI	○	◆
	Bar Coding	◆	◆
Strategic Partnerships		◆	◆
	Monitor & Certify Suppliers	○	◆
	Reduce Supplier Base	◆	◆
	Third Party Logistics	□	◆
Legend			
◆ Very Important ○ Somewhat Important □ Not Important			

The very important rating indicates that most companies feel the factor is essential in implementing a SCM philosophy. A somewhat important rating indicates a varying level of importance, depending on business practices. A not important rating shows the factor is minimally important for a SCM philosophy. The ratings were developed by the author after reviewing the comments from individual interviews. The results are subjective, but are intended for use in future research.

Inventory Management Policies

Both sets of respondents agreed that reducing inventory levels is an important operating strategy of a successful SCM philosophy. Except for VMI, North Dakota firms ranked inventory management operational strategies higher than the “leading edge” firms.

The North Dakota companies stressed that they utilize a JIT system. Over the last three years, inventory levels have fallen in some companies, which would indicate they are using JIT successfully. However, some companies stated their inventory levels have actually increased. It would seem these companies do not use a true JIT inventory system, but rather a system based on volume. These companies need to determine whether the savings from volume purchases are enough to balance out higher inventory carrying costs. If the costs are higher than the savings, the companies may want to consider changing their buying and inventory strategies. The “leading edge” companies discussed inventory management systems, including JIT, quick response (QR), and Efficient Consumer Response (ECR) which are entrenched operating strategies in these firms.

Vendor managed inventory (VMI) was also discussed by both groups. VMI essentially aids in determining where to efficiently place inventory in the supply chain. The “leading edge” firms utilize this system. The important issue is whether the North Dakota companies have the resources to manage inventory if a buyer required them to do so. This issue was not discussed with all North Dakota companies. However, by evaluating their inventory management philosophies, it could be concluded that most of them do not have the appropriate resources or channel power to manage a VMI system.

North Dakota companies discussed the use of materials resource planning (MRP) systems to control inventory levels. Most use MRP as the basis of their inventory management systems and have the perception that it is the best system for controlling inventory levels. In essence, this illustrates their operational perspective on inventory management activities. They need to integrate MRP with new, innovative methods of managing inventory and scheduling production processes. The MRP system need not be eliminated, but rather used as a complement to new systems. In contrast, the Minneapolis

companies did not discuss MRP systems. Their focus is strategically based and may rely on a combination of other computer production planning systems and point-of-sale (POS) data.

Sales forecasting is used to determine both raw material and finished good inventory levels. Accurate sales forecasts can help to reduce inventory and eliminate obsolete items which are no longer in the production or distribution process. Traditionally, historical data were used to forecast product demand. The Minneapolis companies are using point of sales (POS) data to monitor when products need to be replenished. This allows companies to know exactly when an item leaves the store, and the companies can plan their production processes. In contrast, North Dakota companies are using historical inventory data, production scheduling meetings, and MRP outputs from buyers to forecast sales. But, the “leading edge” companies anticipated sharing POS data with their suppliers, so the North Dakota firms should expect to use POS data in the future. The strategic focus of “leading edge” companies requires some type of forecasting, while the operational activities of the North Dakota companies may not.

Information Technology

Information sharing is essential to attain and maintain a successful supply chain management philosophy. North Dakota firms trail “leading edge” firms with respect to IT compatibility, EDI, and bar coding. Most “leading edge” Minneapolis companies and a few North Dakota manufacturing companies use sophisticated IT systems. Some smaller companies may realize the importance of IT, but think they cannot afford it. In general, many North Dakota companies have a long way to go before having “cutting edge” IT systems.

The “leading edge” companies stated that EDI is an essential IT tool and will become increasingly important, particularly for transmitting and verifying orders. Most of these companies require their suppliers to use EDI and will help them to implement the system. The “leading edge” companies stated that their suppliers must be able to electronically link into all aspects of the company. IT compatibility is essential to the success of this link. The largest obstacle to complete adoption of IT

systems in a supply chain may be the incompatibility of systems. This is because companies use several different software packages, and these may not be compatible with those buyers and suppliers use. For example, one company has several computers dedicated to EDI linkages with buyers and suppliers. Some companies must have different computers for each customer because none of them are using the same systems. There seems to be a lack of standardization and communication within and outside of industries. This obstacle will have to be reduced or eliminated before all companies can participate in a successful and useful IT system.

The North Dakota suppliers feel the pressure from their larger buyers, and many are working to implement EDI either with help from their customers or on their own. In many companies, it will be used for order processing and will allow for increased amounts of shared information. Even with the advent of EDI, these companies rely on paper documents simply because of the trust and reassurance of seeing something on paper. The “leading edge” firms stated that the ability to use EDI is a factor of growing importance in determining which suppliers they use. Companies that do not implement EDI may lose business with “leading edge” customers.

The North Dakota companies are beginning to extensively implement bar coding in all business areas. One company uses bar code labor tracking to determine the employee who assembled each product. Bar coding can also enhance production and distribution channels, in addition to accurate POS data. As North Dakota companies use bar coding more extensively across all areas, they will realize the increased ability to share and disseminate information interdepartmentally and with buyers and suppliers. The “leading edge” firms already use bar coding extensively which allows them to use POS data to forecast sales.

The “leading edge” companies felt that the explosion of IT and computers makes the term “rural” irrelevant. This means that when rural companies utilize IT systems, they can have access to the same information as the “leading edge” companies. The development of sophisticated IT systems allows

small and rural companies to compete against as well as have business relationships with “leading edge” companies.

Strategic Partnerships

The companies in this study are actively pursuing partnerships with both their buyers and suppliers. The “leading edge” companies put more emphasis on monitoring and reducing the supplier base and third party logistics. They stated that the most important outcome of a successful partnership is the ability to deliver a top quality product. This means a quality product needs to be delivered on-time and damage free. These factors are becoming increasingly important as shorter delivery times are required as part of cycle time reduction. They also stated their suppliers must have a strong quality and inspection program, which may include ISO 9000 certification.

Some of the manufacturing companies have implemented extensive inspection and review programs. These companies monitor suppliers according to on-time delivery, defect rates, quality, ability to meet specifications, and costs. Suppliers that continually meet buyer standards are certified, and their products bypass inbound inspection. In addition, a few of the companies are working to get ISO 9000 certification to assure both their buyers and suppliers that they can deliver a consistent product. The importance of a high quality product and monitoring suppliers was evident for both groups of respondents.

“Leading edge” companies said rural suppliers must be willing to undertake long-term agreements between buyers and suppliers as a minimum requirement. This can ensure a customer base for rural suppliers. Product specifications and minimum IT capabilities can be included in a contract to ensure that the relationship is valuable for all parties involved. In response to this trend, “leading edge” companies and North Dakota manufacturers are reducing the number of suppliers with whom they do business. In general, all companies in this study are reducing their supplier base and placing more responsibility on the remaining suppliers. Only one North Dakota company tries to use as many

transportation companies as possible and has an employee who schedules and routes all the vehicles. They seem to be afraid of reducing suppliers and causing hard feelings among local carriers.

The “leading edge” companies stated that rural suppliers must have access to low cost, reliable transportation. The North Dakota companies agree with this, but find it difficult to find transportation carriers willing to service them. To resolve this issue, companies may need to form shipper associations and cooperate with other rural companies in the area to consolidate loads of products to fill truckloads. Shipper associations are “nonprofit cooperative consolidators or distributors of shipments owned or shipped by member firms” (Coyle, Bardi, and Novack, 1994). Their primary purpose is to group members’ shipments for line haul, allowing shippers to benefit through better service and lower total transportation cost (Coyle, Bardi, and Novack, 1994). A growing number of small and mid-size shippers are looking at cooperating through shippers’ associations.

Third party agreements are a specific type of strategic alliance. All the companies participating in the study have been solicited by third party companies. The “leading edge” companies use third party providers fairly extensively, while the rural companies do not use the service. The “leading edge” companies use third party logistics primarily in the distribution process, particularly for tracking deliveries. This might be something for which North Dakota companies could consider using third party providers. Most importantly, rural companies could use third party providers to enhance IT capabilities. The drawbacks of using third party logistics stated by the “leading edge” companies were similar to the reasons that the rural manufacturers do not use them. The primary disadvantages are loss of control, high costs, and variance in quality. The North Dakota companies seemed more concerned about the loss of control, whereas the “leading edge” companies seemed less concerned about this aspect of third party logistics.

There is general agreement between North Dakota and “leading edge” firms that the strategic goals of SCM are important. However, there is considerable difference at the firm level about the importance of the operational strategies. North Dakota firms place a greater emphasis on inventory

management, while “leading edge” firms focus more on information technology and strategic partnerships. It is important for North Dakota firms to realize their strategic goals and initiatives are largely driven by the “leading edge” firms. As a result, they must adopt strategic goals and operational activities based on their buyer’s expectations. “Leading edge” firms also need to recognize that small and rural suppliers focus on day-to-day operational activities and may not be aware of strategic and technical trends.

SUMMARY AND CONCLUSIONS

This chapter summarizes the results of this study and presents recommendations for small and rural manufacturers. Study limitations and the need for further research are also addressed.

Summary and Findings

As companies strive to remain competitive in an increasingly sophisticated business environment, they have adopted a management philosophy known as supply chain management (SCM). This philosophy has placed new demands on everyone within the supply chain, including small and rural companies. The objective of this study was to assess whether the logistical practices of small and rural manufacturers permit their participation in an integrated SCM system. There were two elements to this project: expert interviews with “leading edge” Minneapolis and St. Paul companies and interviews with selected North Dakota manufacturing companies. These interviews aided in obtaining and identifying SCM strategies used within both sets of companies. In preparation for the expert interviews, an extensive literature review was done on SCM. This helped to develop interview questions. The issues raised by the respondents echoed many issues addressed in the literature, which confirm the relevance of this study.

Companies adopt the SCM philosophy to achieve the following three strategic goals: 1) reduce inventory levels, 2) increase customer service, and 3) build a competitive advantage. To realize these goals, companies implement three operational strategies, including 1) information technology, 2) core carriers, and 3) third party logistics. The study found that “leading edge” companies tend to focus on strategic activities while the North Dakota companies have a day-to-day operational outlook. The business structure of the firms seemed to dictate what type of IT systems used and the attitude toward third party providers and partnerships.

Recommendations to Small and Rural Manufacturers

Rural companies may need to adopt additional strategies to position themselves as supply chain participants. This list is not exclusive, but can be used as a starting point for company decision-making concerning strategic SCM policies. These recommendations should be attuned to the company's own strategic goals, as well as to those of its customers. The recommendations are categorized as strategic and tactical.

Strategic

“Strategic goals are broad statements of where the organization wants to be in the future. They pertain to the organization as a whole rather than to specific divisions or departments” (Daft, 1991). The following recommendations are strategic issues that small and rural companies should be aware of when developing a SCM philosophy.

1. Continue to pursue long-term partnerships with suppliers.
2. Perform a cost/benefit analysis of inventory carrying costs versus volume purchases.
3. Investigate alternative and innovative ways of managing inventory including VMI and IT systems designed to reduce on-hand levels.
4. Look at the possibility of pushing logistical requirements back to suppliers.
5. Analyze the benefits of using third party logistics for transportation, IT systems, or distribution.

Tactical

“The results that major divisions and departments within the organization intend to achieve are defined as tactical objectives” (Daft, 1991). The following are tactical issues that small and rural companies could use to develop and support a SCM philosophy.

1. Hold logistics meetings once a month. This will allow all departments to understand the entire system and break down interdepartmental barriers.
2. Complement MRP systems with other inventory management computer programs.
3. Develop shipper associations to consolidate inbound and outbound shipments with other local companies to gain access to a cost efficient and reliable transportation.
4. Use a transportation carrier that utilizes compatible, up-to-date IT systems.
5. Further develop bar coding technology.
6. Implement quality inspection programs.

In addition, the flow chart (Figure 6.1) shows an example decision tree. Companies can use this to decide whether to establish a SCM philosophy. The sole focus of this flow chart is whether SCM is important to the buyer(s) of a company's products and how to develop an integrated SCM philosophy. If SCM is not important, then a company may not need to worry about implementing it right now. But, a company should continue to be aware of what is happening in the business environment and be prepared to take any necessary actions. When SCM is important, the process can become difficult and time consuming. A company can be proactive or reactive to business trends. A proactive firm initiates changes to establish a SCM philosophy and then encourages its suppliers to adopt similar practices. These are the beginning steps to establishing an integrated supply chain management philosophy. Once all companies in the supply chain are successfully using SCM, then a total integration is realized.

Reactive firms face a more complicated decision process. Some firms may be willing to adopt while others may be resistant for certain reasons. The companies that are willing to adopt SCM as an integrative philosophy within their companies should also encourage their suppliers to establish SCM practices. Some companies may resist new management techniques, fearing they will be outdated by the time the company can fully adopt them. Therefore, companies should perform analysis to determine pros and cons of adopting SCM. This analysis should help them make a decision whether or not to adopt SCM. If the firm makes the decision to adopt SCM, it should encourage its supplier base to do so as

well. The key to developing an integrated SCM philosophy is to encourage all members of the chain to adopt SCM.

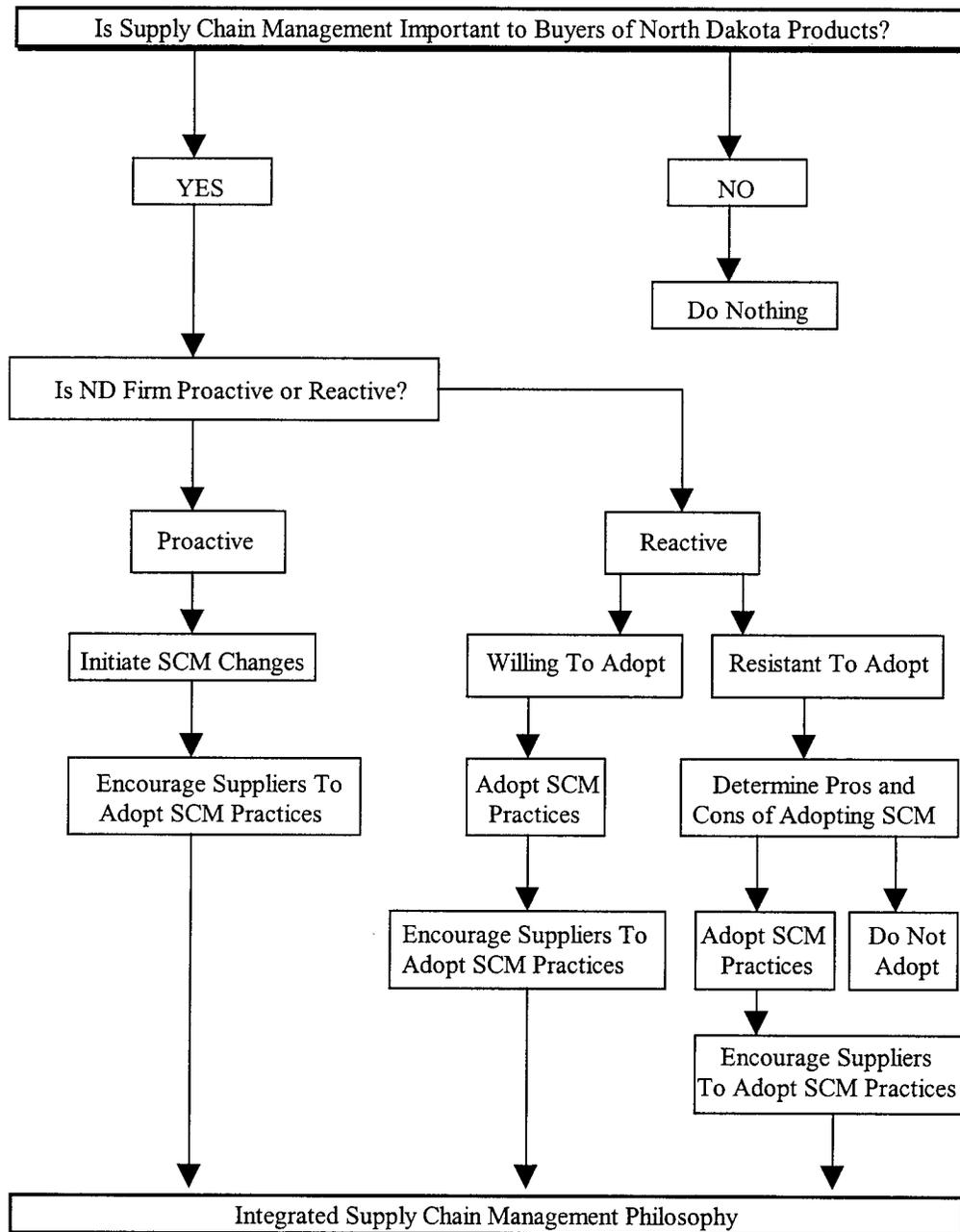


Figure 6.1 A Decision Tree for Establishing an Integrated SCM Philosophy

Limitations of the Study

Expert interviews were used to gain more information about SCM and how companies are approaching it. Participants in the study were chosen based on their job titles and companies. Particular companies were asked to participate in this study because the author believed they represented what other companies in their industry were doing. In addition, the author also believed they would be more willing to participate than their counterparts. Most companies chosen to participate actually did so. A mail survey was not developed because the author felt better results would be achieved from expert interviews.

The primary limitation of this study was the limited number of participants. But since this study was exploratory, a large number may not be needed. Two potential difficulties may arise when using expert interviews (Malhotra, 1996). First, individuals may claim to be knowledgeable and seem eager to participate, but may not really possess expertise. Second, it may be difficult to locate and obtain help from experts outside the organization conducting the study.

Implications for Further Study

The goal of this study was to determine the important factors for an integrated SCM philosophy and to assess whether small and rural manufacturers can participate. This study was exploratory, and the results can be used to develop future surveys concerning SCM issues. Furthermore, the extensive literature review can be used as a starting point for developing background on this topic.

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APPENDIX A

MINNEAPOLIS-ST. PAUL INQUIRY LETTER AND QUESTIONS

June 27, 1996

The logistics program at North Dakota State University needs your assistance. We would like to evaluate how trends identified in the Council of Logistics Management's "world class" and "leading edge" research translates into strategies and policies for manufacturing firms and their raw material suppliers. You are part of a select group of individuals from the Twin Cities area who we are approaching to assist us with this research project.

Specifically, we envision a three-pronged approach to address this research problem. First, we need to identify, from both firms and literature, what logistics trends manufacturing and processing firms confront today. Second, we would like to evaluate how firms will respond to these trends in terms of their specific business processes. In addition, we are interested in how these changes in business processes will impact the firm's suppliers. What will firms expect as minimum logistics capabilities and how will this capability be evaluated? Third, given the trends and what we learn from manufacturing/processing firms, what are smaller firms and firms located in rural areas thinking of in terms of future logistics capabilities.

This project has been endorsed by the Twin Cities CLM Roundtable. Our team which includes Frank Dooley, Joel Honeyman, Matt Titus, and myself will be working with the Twin Cities Roundtable to complete this project and insure it is of value to the logistics community. We would like to meet with you for an hour or so during the next month to discuss this project in more detail. Your insight and perceptions into future logistics trends and their impact on your firm, your suppliers, or your clients would be of extreme value to this project. I will be contacting you within the next week or so to determine your interest in this project. For your information, a list of the individuals contacted for this project is enclosed. If you have any questions or concerns, please feel free to contact me at 701-231-1087.

Sincerely,

Christine M. Geiger
Graduate Research Assistant

Enclosure

SUPPLY CHAIN MANAGEMENT
LOGISTICS RESEARCH PROJECT ISSUES
JULY 23-25, 1996

These questions will give you an idea of what we would like to discuss. Additional issues may also be addressed by either the research team or by your company depending on the format of conversation.

1. Many sessions at the 1996 CLM annual conference focus on supply chain management (SCM). From your experience, is SCM a passing fad or a fundamental change? Alternatively or in addition, how important is SCM to your firm and industry?
2. What characteristics define your company's current supply chain management philosophy?
3. What do you believe is the major reason(s) for establishing supply chains?
4. What role can information technology play to improve supply chain performance?
5. What are the **minimum** logistical capabilities your suppliers must have to do business with your company? What types of logistical capabilities do your suppliers currently provide and do they meet your company standards? How important is it to your company that suppliers employ up to date technological and informational advances?
6. What will be the role of third party logistics in supply chain management?

** A reminder that the research team consists of four people: Frank Dooley, Joel Honeyman, Matt Titus and Christy Geiger. We will all be attending the meeting with you, so if you feel the need to ask other people within your company to join us please do so.

APPENDIX B
NORTH DAKOTA INQUIRY LETTER AND QUESTIONS

April 17, 1997.

The logistics program at North Dakota State University needs your assistance in a research project evaluating the trends in logistics and transportation management. This research project is part of a Master's thesis in Agricultural Economics by Christy Geiger and has been endorsed by the Twin Cities Council of Logistics Management Roundtable. You are part of a select group of companies in North Dakota that we are asking to participate in this research project. We recognize you as being representative of "leading edge" firms in North Dakota.

Specifically, we want to evaluate the differences between logistics trends for firms in North Dakota and larger firms located outside of North Dakota. First, we have already interviewed ten "leading edge" firms from the Minneapolis area (see attached page). Issues addressed during these interviews included: supply chain management, technological advances, strategic alliances, and fundamental changes in business. Additionally, we asked them how firms in North Dakota can increase their efficiency in supplying the larger firms. Our objective in meeting with you is to ask similar questions and compare the responses from the Minneapolis firms.

The research team which consists of Frank Dooley, Joel Honeyman and myself would like to meet with you for an hour or so during the next month. The objective of the meeting is to discuss this project and gain your insight and perceptions into future logistics trends and their impact on your firm. Additionally, we would like to share the results gained from the Minneapolis interviews. I will be calling you within the next week to determine your interest in this project. For your information, a list of individuals and firms contacted for this project is enclosed. If you have any questions or concerns, please feel free to contact me at 701-231-1087.

Sincerely,

Christy Geiger
Graduate Research Assistant

Enclosure

SUPPLY CHAIN MANAGEMENT
LOGISTICS RESEARCH PROJECT ISSUES
MAY 19-21, 1997

These questions will give you an idea of what we would like to discuss. Additional issues may also be addressed by either the research team or by your company depending on the format of conversation.

1. Supply chain management (SCM) is a current industry “buzzword”. How important is SCM to your firm and industry?
 - A. What do you believe are the major reasons for establishing supply chains?
2. Please describe the logistical characteristics of your company (inventory policies, shipping, warehousing and information technology).
3. Does your company participate in any strategic partnerships or preferred buyer/supplier relationships in which you are contracted with certain suppliers?
 - A. Please describe any recent changes in logistics (in particular, inventory control systems or information technology) that have originated with your buyers or suppliers?
 - B. If changes have been made, please describe sources for assistance in implementing the changes.
4. Have inventory levels (raw materials and finished goods) increased, fallen or stayed the same over the past three years?
 - A. What do you think will happen to inventory levels in the next three years?
5. Please describe the computer systems and software used to track inventory.
 - A. What role does information technology play to improve your company’s performance?
 - B. Has the use of information technology changed in the past three years?
 - C. What do you think will happen with information technology in the next three years?
6. Describe sales forecasting techniques used by your company.
 - A. How have they changed?
 - B. What types of changes would improve the accuracy of your forecasts?
7. What role has third party logistics and/or outsourcing had in your company in the past three years?
 - A. What will happen to third party logistics in your company in the next three years?

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Avenue, Washington, DC 20540, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.



PB98-130958

2. REPORT DATE
February 1998

3. REPORT TYPE AND DATES COVERED
project technical

4. TITLE AND SUBTITLE
Supply Chain Management: Issues and Practices for Small and Rural Manufacturers

5. FUNDING NUMBERS

6. AUTHOR(S)
Christine M. Geiger and Frank J. Dooley
North Dakota State University

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Mountain-Plains Consortium
North Dakota State University
Fargo, ND

8. PERFORMING ORGANIZATION REPORT NUMBER

MPC 98-71

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Department of Transportation
University Transportation Centers Program
Washington, DC

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION AVAILABILITY STATEMENT

12b. DISTRIBUTION CODE

As the business environment becomes increasingly competitive, companies continuously look for ways to distinguish themselves from their competitors. Adopting integrated logistics policies is a method that many companies have used to improve their competitive edge. Companies have implemented an integrative philosophy known as supply chain management (SCM), which minimizes inventory, by reducing uncertainty, and increases customer service and competitiveness. It has become important to understand how to successfully manage a supply chain to realize these benefits. As SCM becomes more visible, new demands will be placed on everyone in the supply chain, particularly small and rural companies to implement these strategies.

This report presents the results from expert interviews with Minneapolis/St. Paul companies and North Dakota manufacturing companies. The Minneapolis expert interviews helped to identify the minimal logistical capabilities a supplier must have in order to do business with the Minneapolis companies. Ten firms with membership in the Council of Logistics Management participated in these interviews. The North Dakota expert interviews identified the capabilities of small and rural manufacturers to apply

14. SUBJECT TERMS logistical practices to their companies.

logistics, supply chain management, manufacturing

15. NUMBER OF PAGES
80
16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT

18. SECURITY CLASSIFICATION OF THIS PAGE

19. SECURITY CLASSIFICATION OF ABSTRACT

20. LIMITATION OF ABSTRACT

UL

