LOGISTICAL CAPABILITIES OF TRUCKING FIRMS

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Table of Contents

CHAPTER 1. INTRODUCTION 1
Research Objectives 2
Report Organization 3

CHAPTER 2. LITERATURE REVIEW 3
The Trucking Industry After Deregulation 3
Logistics in the Trucking Industry 6
Information Systems and Technology 7
Electronic Data Interchange 7
Computer Software Used in Information Systems 9
Barcoding 10
Satellite Tracking Systems 10

CHAPTER 3. RESEARCH METHODS 13
Data Collection 13
Survey Group Selection 13
Mailings 14
Survey Design 14
Data Analysis 15

CHAPTER 4. EMPIRICAL RESULTS 18
Overall Survey Results 18
Respondent Characteristics 18
Table 4.1. Percent of Respondents Based on Number of Power Units 19
Table 4.2. Percent of Respondents Based on Equipment Usage 19
Table 4.3. Percent of Respondents based on Region(s) they Serve 20
Figure 1. Federal Regions (Department of Transportation). 21
Scope of Logistical Services Offered 21
Table 4.4. Logistical Services Being Offered by Trucking Firms 22
Technology Characteristics 24
Table 4.5. Overall Ranking of Features for Firms Using EDI 24
Opinions on Current Policies and Trends 26
Table 4.6. Responses to Opinion Questions Concerning Industry Trends 27
Survey Results Based on Company Size 27
Table 4.7. Percent of Respondents Using EDI, Satellite Technology, and Close Partnerships with Shippers Based on Firm Size 28
Table 4.8. Opinion Question Results Based on Number of Power Units 30

CHAPTER 5. SUMMARY AND CONCLUSIONS 33
Discussion 35

BIBLIOGRAPHY 38

APPENDIX A: Actual Survey Sent to Trucking Firms 40

CHAPTER 1. INTRODUCTION

Logistics and value-added services are becoming increasingly important in the trucking industry. Shippers are not only looking for reliable transportation of their products, but often are interested in other related services that add value to their products. Not surprisingly, many trucking companies are positioning themselves to take advantage of opportunities to better serve their customers. Some of these firms are beginning to offer a variety of services beyond their traditional transportation business (Bigness, 1995).

There are a variety of reasons for the trend of trucking firms providing logistical services. First, deregulation of the trucking industry has allowed motor carriers greater freedom in choosing which markets and routes they serve, and has allowed them to negotiate long-term contracts with shippers. These changes have enabled carriers and shippers to develop close relationships, which encourage cooperation and sharing of information. As a result, many shippers have enjoyed improved service levels and greater efficiency in their supply chain, improving their competitive position.

A second reason can be traced to recent philosophical changes regarding manufacturing in the U.S. To remain competitive in the domestic and global environment, U.S. firms have been forced to improve the efficiency of their operations and the quality of their products. This has resulted in Just-In-Time (JIT) inventory management practices and quick response replenishment programs, similar to programs used in Japan for many years (Bigness, 1995). With an emphasis on JIT and other programs, the importance of logistics management has increased. These reasons have contributed to a demand for third-party logistics services by manufacturing firms. Due to their core competencies in transportation and related services, trucking firms have begun to fill the niche of providing these logistics services.

According to industry experts, the outsourcing of logistics has enormous growth potential. Currently, U.S. manufacturers "hire third-party companies for only about 12 percent of their logistics," however "with the increased competition in a global economy, companies will find it more efficient to outsource as much as 25 percent to 30 percent" (Bigness, 1995). An indication of this trend is that 16 of the largest 23 logistics companies have been created in the past eight years (Bigness, 1995).

While large trucking firms such as Schneider, J.B. Hunt, Ryder, and Roadway have led the way in developing logistics management services, many smaller trucking companies also are offering value-added services for their customers. Examples of these services include light subassembly, packaging, warehousing, as well as inventory and supply chain management.

Research Objectives

The objectives of this research are to determine how regional trucking firms are incorporating logistical services into their business, show some of the current trends regarding logistics in the trucking business, and allow firms to evaluate themselves against the rest of the industry. The specific objectives are:

1. Describe how the trucking industry has evolved since deregulation, and how the industry is responding to the demand for logistical services.
2. Survey a random sample of firms from Minnesota, South Dakota, North Dakota, Colorado, Montana, Wyoming, Utah, Iowa, and Nebraska to gather information on the industry.
3. Evaluate how firms in the trucking industry are responding to current trends.

Report Organization

The report is divided into four remaining chapters. A literature review is presented in Chapter 2, which summarizes a brief history of the trucking industry after deregulation, current technologies used in the trucking industry, and a background description of logistics management. The survey instrument is described in Chapter 3. Empirical results to the study are presented in Chapter 4. Finally, a summary and conclusions are presented in Chapter 5.

CHAPTER 2. LITERATURE REVIEW

In this chapter, a brief history of the trucking industry after deregulation is described. This section provides a historical background for the introduction of logistics services in the industry. In addition, some logistics services are described, which are currently popular in the trucking industry. Finally, current technologies such as satellite tracking and EDI are described.

The Trucking Industry After Deregulation

The Motor Carrier Act of 1980 substantially changed how motor carriers operate in the U.S. The purpose of this legislation was to relax some of the federal regulations that had controlled the trucking industry since 1935. Some of the important characteristics of the act included easing of criteria for common carrier certification, creating a "fitness only" criterion for certain kinds of transportation. The new criterions curtail the ability of existing carriers to protest entry, easing of restrictions on commodities transported, points served, or routes traversed, and the establishment of a "zone of reasonableness" for adjusting rates (Felton and Anderson, 1989).

The Motor Carrier Act of 1935, which regulated the industry, was mainly a product of the Great Depression (Felton and Anderson, 1989). Due to the extreme economic hardship that affected all sectors of the economy, the federal government was willing to try drastic measures to end the crisis. In addition, regulating motor carriers was considered to be maintaining fair competition because the railroads were already regulated. However, once the Great Depression ended, very little change occurred in motor carrier legislation until the Motor Carrier Act of 1980. Changes that finally occurred were due to changing political and economic environments, in addition to the regulatory experience

itself. Similar to the motor carrier industry, rail and air transportation modes underwent deregulatory changes during the same time (Felton and Anderson, 1989).

Since deregulation, there have been some major changes in the industry that have contributed to the development of trucking firms' involvement in offering logistical services and the third party logistics industry. One of the most important changes caused by deregulation has been the shippers' ability to reduce the number of carriers with whom they do business (Glaskowsky, 1986). In addition, deregulation has allowed "route rationalization" so carriers can serve any markets they wish. Route rationalization was not allowed under regulation when motor carriers had very restrictive operating certificates, which limited operating routes. Reducing the number of carriers allows shippers to develop close relationships, resulting in improved service (Thomas, 1994).

Detroit Diesel is an excellent example of the development of close relationships between carriers and shippers. In 1986 Detroit Diesel began its quality transportation program, reducing the number of carriers from 131 to 14. Detroit Diesel had increased service levels and productivity by reducing the number of carriers used in its operation and developing close relationships with those remaining (Thomas, 1994).

Another change in the motor carrier industry resulting from deregulation is that carriers are now free to negotiate long-term contracts with customers. Contracts allow manufacturing companies to eliminate their private carrier fleets, resulting in cost savings and freeing up capital for other ventures (Cullen, 1996). Also, long-term contracts between carriers and shippers stimulate the development of close partnerships. These close partnerships encourage the partnering firms to work as a team focusing on quality, rather than as adversaries who negotiate service based strictly on price. Deregulation has

created more market opportunities for contract carriers and allowed carriers to develop "tailored" service for their shipping customers (Glaskowsky, 1986).

Similar to motor carriers, other modes in the transportation industry have undergone changes following deregulation. It has been argued that since deregulation, "largely artificial boundaries among transportation modes (LTL, TL, air freight, railroads, barges, and so forth) have been vanishing. Without the arbitrary restrictions imposed by regulatory systems, the transportation services sector is becoming one market rather than separate markets. In fact, largely as a result of deregulation, shippers are increasingly oriented toward a total, integrated logistics operation (including inventory management, handling, and warehousing) rather than simply purchasing transportation" (Elzinga, 1994). With changes in the economic environment, motor carriers are not only competing among themselves, but also with other modes. Offering logistics services is one area where trucking firms can gain a competitive advantage over rival firms in today's market.

Logistics in the Trucking Industry

Logistics covers a broad spectrum of activities that businesses have been carrying out for many years. These activities include transportation, inventory management, order processing, purchasing, warehousing, materials handling, packaging, customer service, and scheduling (Balou, 1992). Traditionally, logistical functions were carried out by the companies that needed them to produce and/or deliver products. However, over the past two decades this practice has begun to change. Increased global competition and changing market conditions have forced firms to become more efficient and responsive to customer needs. This has opened up many opportunities for outside firms, or "third-party" providers, to offer logistical services (Cullen, 1996).

Manufacturers and producers are outsourcing logistical functions for many reasons. First, outsourcing allows firms to reduce costs and liabilities, or cost centers. Industry experts believe outsourcing is necessary for firms to concentrate on their "core competencies," or those activities firms engage in to make money (Cullen, 1996). Second, outsourced logistics generally cost less than doing it in-house (Cullen, 1996). Companies with large fleets or warehouse space usually can contract with shippers at a reduced cost. Executives and managers often look to outsourcing logistics to reduce physical assets and to reduce the costs of liability and government compliance (Cullen, 1996). Finally, firms can gain flexibility by outsourcing logistics activities. "When business is down, you still own the private fleet or warehouse. But if you're using a public or contract warehouser and for-hire carriers, you don't pay when you don't have inventory" (Cullen, 1996).

Many firms in the trucking industry have recognized the potential business that exists by offering logistical activities and providing greater value to their customers. One estimate has the market for outsourced logistics services worth $374 billion, with $278 billion going to transportation. However, providers of outsourced logistics have only realized 2.5 percent, or $10 billion, of the total opportunities (Cullen, 1996). Not surprisingly, the trucking industry has taken the lead in this initiative. In 1994, motor carrier freight costs were estimated to account for more than 50 percent of the total logistics costs in the U.S. (Delaney, 1995). Initiatives such as Just-In-Time (JIT), Electronic Consumer Response (ECR), Quick Response, and Materials Requirements Planning (MRP) depend on accurate and timely shipments, which motor carriers can provide. However, carriers must have access to information and be involved in close relationships with their shipping customers for these and other logistics initiatives to succeed (Cullen, 1996).

Information Systems and Technology

The flow of information has become vitally important in today's business environment.[1] In recent years, new information technology has made initiatives such as JIT and MRP II possible, and has made outsourcing of logistics activities possible (Cullen, 1996). These new technologies have greatly impacted many industry sectors, including transportation and logistics, by improving information flows throughout the entire supply chain. This has allowed for the reduction of inventories and more accurate tracking of the flow of materials (Robeson and Copacino, 1994). This substitution of information for inventory is occurring because "the cost of information has been declining relative to other expenses such as land, labor, and capital" (Robeson and Copacino, 1994).

Electronic Data Interchange

An important component of information systems is electronic data interchange (EDI). Electronic data interchange is a format that links organizations and computer systems. 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" (Robeson and Copacino, 1994). A key characteristic of EDI is that it is intended to be a computer-to-computer link that does not require human interpretation, thereby reducing data entry errors and time caused by multiple entry (Robeson and Copacino, 1994).

EDI is used for two primary purposes: to improve customer service and to improve the efficiency of the logistical system (Robeson and Copacino, 1994). Examples of EDI usage include the processing of freight bills, purchase order processing, and to enhance Just-In-Time (JIT) systems. In

[1]Portions of this section were largely adapted from Barber and Dooley (1996).

addition, inventory reduction is often possible with the use of EDI (Robeson and Copacino, 1994). EDI and other systems are so important that they are becoming "the key to taking costs out of a supply chain operation without compromising the needs of the customer's customer" (Cullen, 1996).

Similar to other industries, EDI is becoming more prevalent in the trucking industry. In fact, the use of EDI may become extensive in the trucking industry because of the importance of transportation in the supply chain (Crum, Premkumar, and Ramamurthy, 1996). A study recently completed by Crum, Premkumar, and Ramamurthy (1996) looked exclusively at EDI in the trucking industry. The study focused on Class I and II carriers with respect to annual revenues. Revenues of firms in the study ranged from $5 million to greater than $1 billion.

This study showed that on average, trucking firms currently using EDI (i.e., adopters) are more than twice as large as those not using EDI (i.e., non-adopters), suggesting that a firm's size affects its ability or willingness to implement EDI. However, it also should be noted that there were a number of EDI adopters in the smallest size category. In addition to size, several environmental and organizational factors were found to be different between adopters and non-adopters. Interestingly, most adopters in the study implemented EDI because of initiatives from their large shipping customers. It appears that most carriers feel the greatest benefits of EDI relate to customer service and marketing. Finally, one of the study's conclusions suggests "that non-adopters need to be educated about the benefits of EDI relative to their current way of doing business" (Crum, Premkumar, Ramamurthy).

Computer Software Used in Information Systems

Computer software is a key component in any information system. Many types of software exist for virtually all business functions. Areas that have grown rapidly in recent years are MRP and

computer integrated manufacturing (CIM) software. This market segment was predicted to generate revenue of more than $2 billion in 1995 (Industrial Engineering, 1991). While most MRP II systems are essentially similar, software has to be tailored to each individual firm. Types of hardware, size of the system, and functionality determine what software package is needed. As more firms continue to implement MRP II and better information systems, the demand for better software packages will grow.

Four factors will influence information system software development in the future (Industrial Engineering, 1991). First is the continued integration of business functions throughout an organization and the supply chain. The growing importance of JIT is the second factor influencing software development. The third factor is hardware compatibility. Finally, shifts in hardware usage from mainframes to mini and microcomputers as smaller machines become more powerful will influence software development of information systems. While computers will continue to become an even more important component of inventory management, the costs of these systems should drop and the capabilities improve (Industrial Engineering, 1991).

A new type of software is finite-capacity-scheduling (FCS), which is used to enhance MRP systems with regard to scheduling. Many managers do not understand how to fix scheduling problems, but FCS software helps production planners solve problems by coordinating resources such as manpower, machinery, and materials. While MRP tells a manager what is needed, it assumes there is infinite capacity and does not recognize constraints. Finite-capacity-scheduling software is a planning tool that is designed to handle some of these problems. Many companies have noticed significant cost savings after they have implemented FCS software. For example, Crescent Manufacturing Company, a firm in Ohio that produces 600 different products, already operated in a JIT system, but they scheduled

manually. Benefits of adding an FCS package included "reducing lead time from 60 to 30 days, reducing inventory by 30 percent, and cutting setup time by at least 20 percent" (Stevens, 1994). Other benefits that firms noticed with FCS were improved customer service and increased production capacity (Stevens, 1994).

Barcoding

Barcoding has become popular due to its accuracy and speed. It entails the use of a scanner to "scan" the universal product code (UPC) symbols on products. Data are then recorded automatically for inventory purposes. Trends have shown that nearly 80 percent of companies are now using barcoding for almost all products that move through their system (Robeson and Copacino, 1994).

Satellite Tracking Systems

Satellite technology is having a major impact on the trucking industry (Coyle, Bardi, and Novack, 1994). Satellite tracking systems allow carriers to determine the exact location of a shipment and relay this information to the customer. In addition, these systems can be used to route drivers to loads or advise them of road and weather conditions. A home-based computer can transmit this information to individual drivers through onboard computers. Satellite technology will continue to evolve and become more important in the motor carrier industry (Coyle, Bardi, and Novack, 1994).

In this chapter, changes in the trucking industry since deregulation were summarized, including how relationships between carriers and shippers have changed. Logistics in the trucking industry also was discussed. This included how the demand for logistics services is increasing and some of the

opportunities that exist for third-party providers. Finally, the impacts of information systems and technology on logistics and the trucking industry were examined.

CHAPTER 3. RESEARCH METHODS

In this chapter, the survey used in the study is discussed, as is data collection and data analysis procedures. The section on data collection includes a discussion of the survey group selection and mailings. A summary of the response rate to the survey also is shown in this chapter.

Data Collection

To better understand how trucking firms are responding to the demand for third-party logistics services, a mail survey was sent to a sample of regional firms (Appendix A). This survey was used to determine current capabilities regarding technology such as EDI and satellite systems, in addition to logistics services that firms currently are offering. The survey also queried managers about their opinions on specific topics, such as the impacts of technology and logistics on their business. Analysis and results of collected data are presented in the next chapter. The survey and analysis techniques are further described in this chapter.

Survey Group Selection

Surveys were mailed to a random sample of regional truckload (TL) firms operating more than three power units. The sample was drawn from the National Motor Carrier Directory compiled by Transportation Technical Services. Companies from the following states were included in the study: Minnesota, South Dakota, North Dakota, Colorado, Montana, Wyoming, Utah, Iowa, and Nebraska. Only truckload (TL) carriers were included in the study, but some firms indicated they also offered less-than-truckload (LTL) services. Companies of varying sizes were sent the survey.

Mailings

A total of 1,035 surveys was mailed during the week of February 3, 1997. Two weeks later, a reminder postcard was mailed to every firm in the original mailing. Ten surveys were returned as undeliverable. In addition, approximately 20 firms responded either in writing or with a telephone call that the survey did not pertain to them and they were not interested in filling it out. Of the surveys returned, 116 contained usable information for a usable response rate of 11 percent.

Survey Design

The survey was a mail questionnaire consisting of 23 questions. It contained a combination of open-ended and forced answer questions (see Appendix A for the complete survey). The survey was separated into four main topic areas. The first section, containing four questions, was designed to determine the scope of logistics services currently offered by the firm. The first question listed some logistics services and asked respondents to indicate which services they currently offer and what percentage of their customers use the service. The remaining questions asked when the firm began offering logistics services and if these services are offered to clients other than their trucking customers.

The second section queried respondents about the use of technology in their firm. Included were a number of questions about EDI. Respondents were asked to indicate the percent of their customers that use each listed EDI function. This section also questioned respondents about their use of satellite tracking and communication systems.

The next section contained questions concerning managers' opinions about current logistics related policies and trends in the trucking industry. These questions were presented in a scaled format and included a range of five choices for each particular question. The purpose of this section was to

determine how trucking managers perceive the value of logistics services, technology, and close partnerships with customers.

Firm characteristics was the topic of the final section of the survey. The first question in this section queried respondents about close relationships, or preferred transportation provider programs, their firm may be developing with its shipping customers. A close relationship is one where both parties engage in cooperative practices, such as sharing information and negotiating service rates based on overall value rather than lowest price. The goal of these programs is to create a win/win situation for both parties involved in the partnership and eliminate traditional adversarial relationships.

This section also included questions about regions of the country the firm regularly serves, the number of power units, and types of equipment operated. In addition, a question was asked that ascertained the revenue contributions of logistics operations and trucking operations in percentage terms to the firm's total revenue. The primary purpose of this section was to categorize firms for further analysis.

The last page of the survey provided respondents the opportunity to provide any additional comments they had. A cover letter was included with the mailings to outline the objectives of the study. A postage paid return envelope also was enclosed with each mailed survey.

Data Analysis

Data were entered into a Microsoft Access database as surveys were returned. Once the data were ready to be analyzed, they were converted into a spreadsheet format in Microsoft Excel. Excel was used to compute relevant statistics such as means, variations, and frequencies. The SAS (Statistical Analysis Software) system also was used to compute more advanced statistics. In addition, the overall

data set was split into groups determined by firm size for analysis. The following chapter describes the results of this analysis.

CHAPTER 4. EMPIRICAL RESULTS

Included in this chapter is a discussion of the results of the survey. Overall results are presented, in addition to analysis based on firm size.

Overall Survey Results

A mail survey was used to gather data about logistical practices in the trucking industry (Appendix A). Results are reflective of many different sized firms in the industry. However, many small trucking firms, especially those in specific niche markets, indicated that many questions in the survey did not apply to their operation.

Respondent Characteristics

A wide range of firms, based on the number of power units, responded to the survey (Table 4.1). Approximately 12.3 percent of respondents were very small firms with five or fewer power units, 25.4 percent indicated between six and 15 power units, 30.7 percent had 16 to 50 power units, 21.1 percent had 51 to 100 power units, and 10.5 percent of the sample consisted of large firms with more than 100 power units. A following section of this chapter describes results based on firm size.

Table 4.1. Percent of Respondents Based on Number of Power Units

Number of Power Units	*Number of Respondents*	*Percent of Respondents*
1-5	14	12.3%
6-15	29	25.4%
16-50	35	30.7%
51-100	24	21.1%
More than 100	12	10.5%
Total	114	100.0%

Respondents also were categorized based on equipment operated (Table 4.2). Dry van was the most popular type of equipment used, followed by refrigerated van, flatbed, tanker, and intermodal. Other types of equipment that were listed as used by firms included hoppers, various dump trailers, heavy haul equipment, car carriers, livestock carriers, and mail trailers.

Table 4.2. Percent of Respondents Based on Equipment Usage

Equipment Type	*Number of Respondents*	*Percent of Respondents*
Dry van	45	39.1%
Refrigerated van	34	29.6%
Flatbed	27	23.5%
Tanker	22	19.1%
Intermodal	7	6.1%
Other	30	26.1%

* Percentages in Table 4.2 do not add up to 100 percent because some firms operate multiple types of equipment.

Respondents also were asked for the region(s) of the country their firm regularly serves (Table 4.3). These correspond to the nine federal regions set by the Department of Transportation as shown in Figure 1. Not surprisingly, the most common areas served were regions 5, 7, and 8 since these regions were where the firms targeted for the study were drawn. The other regions in the country had approximately the same level of service.

Table 4.3. Percent of Respondents based on Region(s) they Serve

Region	*Number of Respondents*	*Percent of Respondents*
Region 1	24	21.4%
Region 3	31	27.7%
Region 4	37	33.0%
Region 5	78	69.6%
Region 6	50	44.6%
Region 7	84	75.0%
Region 8	70	62.5%
Region 9	43	38.4%
Region 10	38	33.9%

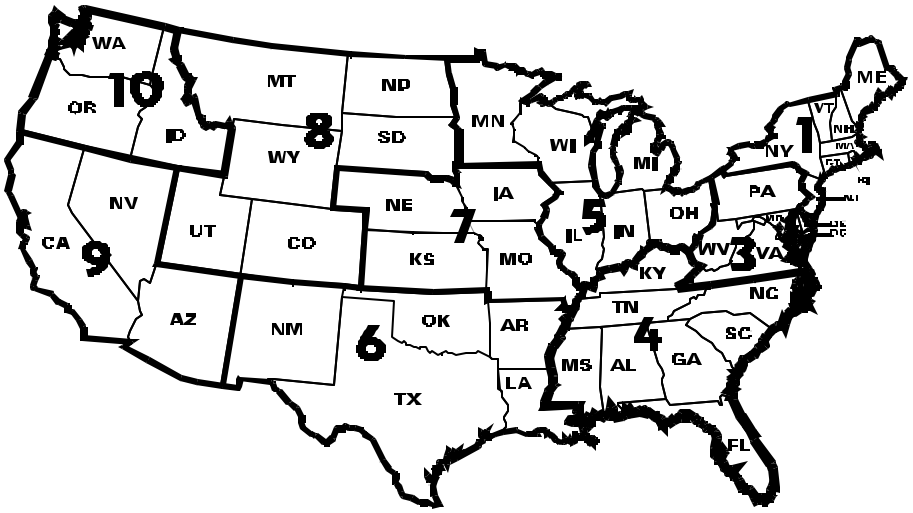

Figure 1. Federal Regions (Department of Transportation).

Scope of Logistical Services Offered

The first question in the survey concerned logistical services offered by firms. Eleven services were listed in a table. For each service, a five-point scale was used to measure the usage of that service. A value of "1" indicated the service was not offered by the firm, and a value of "5" indicated more than 75 percent of customers used the service. A mean value was generated for each logistical service, in addition to the percent of respondents for each number (Table 4.4).

Table 4.4. Logistical Services Being Offered by Trucking Firms
(Actual question: What percentage of your customers are currently using the following services, if offered by your firm?)

			Percentages				
			Not Offered	*Under 25%*	*25-50%*	*51-75%*	*Over 75%*
Item		*Mean*	*1*	*2*	*3*	*4*	*5*
1.	Routing and scheduling (n=107)	2.22	47.7	15.0	15.9	10.3	11.2
2.	Carrier selection (n=104)	1.97	56.7	15.4	12.5	4.8	10.6
3.	Determine least cost mode (n=102)	1.83	62.7	12.7	11.8	3.9	8.8
4.	Palletization (n=105)	1.63	65.7	21.0	2.9	5.7	4.8
5.	Warehousing (n=105)	1.62	63.8	22.9	5.7	2.9	4.8
6.	Inventory management (n=104)	1.50	76.0	9.6	7.7	1.9	4.8
7.	Demand forecasting (n=101)	1.27	88.1	5.0	2.0	2.0	3.0
8.	Packaging (n=103)	1.21	88.3	5.8	2.9	1.9	1.0
9.	Supply chain management (n=102)	1.17	90.2	5.9	1.0	2.9	0.0
10.	Light subassembly (n=103)	1.16	86.4	11.7	1.9	0.0	0.0
11.	Process reengineering (n=102)	1.08	95.1	2.9	1.0	1.0	0.0

The results show that routing and scheduling is the most popular logistical service offered by responding firms. This was the only service that was offered by more than 50 percent of firms. Additional services offered by close to 50 percent of firms included carrier selection, determination of least cost mode, palletization, and warehousing. The other services listed in the question, including inventory management, demand forecasting, packaging, supply chain management, light subassembly, and process reengineering, were offered by a small minority of trucking firms.

The second question in the survey asked firms to add any other services they may be offering. Some of these services include cross-docking, consolidation and distribution functions, contract warehousing, and traffic management activities.

Approximately 50 percent of responding firms indicated offering logistics services. The average number of logistics customers these firms have is nearly 20. However, almost 80 percent indicated having 10 or fewer customers. The average revenue contribution of logistics for these firms was more than 18 percent of their total revenue. In fact, nearly 30 percent of firms that reported logistics revenues indicated it accounted for more than 25 percent of their total revenue.

Close partnerships, or preferred transportation provider programs, with carriers and shippers were common among respondents. Approximately 64 percent of firms indicated they are involved with close partnerships with their shipping customers. In addition, the trucking firms involved with these programs are doing so with more than 50 percent of their customers on average.

More than 75 percent of firms currently offering logistics services indicated they began offering these services after 1980. This indicates that offering logistics services is a relatively new concept for most firms in the industry. It also indicates that many firms are looking toward logistics to give them a competitive advantage and add value for their customers. In addition, more than 30 percent of firms indicated offering these services to clients other than their trucking customers. Finally, approximately 24 percent of respondents indicated that they consider their logistics operations to be a separate department or business unit from their regular trucking business.

Technology Characteristics

Nearly 25 percent of respondents are currently using Electronic Data Interchange (EDI). This is comparable to the findings of other recent studies of the trucking industry (Crum, Premkumar, and Ramamurthy, 1996). However, most trucking firms (80 percent) in this sample indicated using EDI with less than 25 percent of their customers. This can be explained by the fact that currently, EDI usage is most prominent among larger shippers.

Question nine in the survey examined how trucking firms and their customers are using EDI data. Six common EDI features were listed and respondents were asked to identify the percent usage for each feature. A response of "1" indicated the feature was not in use, while a response of "5" indicated the feature was used by more than 75 percent of customers (Table 4.5). Information in Table 4.2 is only from those firms who indicated using EDI. Therefore, the "Not in use" column reflects firms who have EDI but are not using that particular feature.

Currently, invoices and freight bills are the most popular EDI features being used by trucking firms and their customers (Table 4.5). This is not surprising as invoices are typically one of the first items used by EDI in other industries. However, a surprising result is the low usage of purchase orders because purchase orders are the most common type of EDI transaction for all industries (Petrosky, 1997). This result may be due to variable demand for many trucking firms with their customers. EDI works best for high volume, low variation type transactions (Petrosky, 1997). The other features listed were used by approximately 50 percent of respondents.

Table 4.5. Overall Ranking of Features for Firms Using EDI
(Actual question: What percentage of your customers are currently using the following services, if offered by your firm?)

			Percentages				
			Not In Use	*Under 25%*	*25-50%*	*51-75%*	*Over 75%*
Item		*Mean*	*1*	*2*	*3*	*4*	*5*
1.	Invoices (n=23)	2.48	26.1	43.5	4.3	8.7	17.4
2.	Freight Bills (n=24)	2.46	25.0	41.7	12.5	4.2	16.7
3.	Purchase Orders (n=23)	2.09	43.5	30.4	13.0	0.0	13.0
4.	Quick Response Initiatives or JIT (n=23)	2.09	47.8	26.1	8.7	4.3	13.0
5.	Forecasts (n=20)	1.75	55.0	30.0	5.0	5.0	5.0
6.	Production Schedules (n=22)	1.73	54.5	27.3	13.6	0.0	4.5

Some of the EDI software packages used by firms in the industry include Harbinger, Kleinschmidt, and Sterling. Also, a number of firms indicated they have developed their own EDI software. Most firms appear to be using EDI on a mainframe or minicomputer with a network.

Question 11 in the survey queried firms about their use of satellite tracking and communication systems. Approximately 15 percent of responding firms indicated using satellite systems. However, of those firms using satellite technology, 75 percent also indicated using EDI. This indicates that those firms who are integrating technology are doing so throughout their entire operation.

Opinions on Current Policies and Trends

The third section in the survey contained six questions that measured opinions about the influences of technology and logistics on the trucking industry. Each question used a five-point scale to

measure the relative importance of the question being asked. In each case, a response of "1" indicated strong disagreement or unimportance while a response of "5" indicated strong agreement or importance. A mean value was generated for each question, along with a summary of responses (Table 4.6).

Most of the respondents believed EDI will continue to become a greater influence in the industry (Table 4.6). In fact, less than 10 percent indicated a response of "1" or "2," which represent decreased influence. This is an interesting result in that many smaller trucking firms were included in the study that may not yet have considered implementing EDI due to cost considerations. While larger firms may be more proactive in implementing EDI, most firms in the industry are aware of the future importance of EDI. Respondents also thought that close relationships between themselves and their shipping customers will increase in the future.

The remaining four questions in this section concerned logistics services in the industry. Interestingly, most respondents thought that providing logistical services adds value to customers, but were undecided if providing logistical services is necessary to remaining competitive. However, there appeared to some agreement that firms offering logistical services will become more prevalent in the future. Finally, most respondents do not consider themselves to be a third-party logistics company (Table 4.6). Only approximately 15 percent indicated that they consider themselves a third-party provider.

Table 4.6. Responses to Opinion Questions Concerning Industry Trends

		Percentages				
		Decrease Influence				*Increase Influence*
Question	*Mean*	*1*	*2*	*3*	*4*	*5*
Do you feel EDI will become a greater or lesser influence in the future? (n=112)	3.80	5.4	3.6	26.8	33.9	30.4
		Less Firms				*More Firms*
Do you think more or less firms will establish closer relationships between shippers and carriers in the future? (n=111)	3.75	3.6	6.3	28.8	34.2	27.0
		Does not Add Value				*Does Add Value*
Do you feel providing logistical services adds value or does not add value to customers of the trucking industry? (n=111)	3.45	7.2	9.0	29.7	39.6	14.4
		Less Prevalent				*More Prevalent*
Do you feel firms providing logistical services will become more or less prevalent in the trucking industry? (n=110)	3.41	6.4	7.3	36.4	39.1	10.9
		Strongly Disagree				*Strongly Agree*
Do you feel providing logistical services is necessary to remaining competitive in the trucking industry? (n=113)	3.09	13.3	14.2	33.6	28.3	10.6
		Strongly Disagree				*Strongly Agree*
Do you consider yourself a third-party logistics company? (n=111)	2.25	36.0	20.7	29.7	9.0	4.5

Survey Results Based on Company Size

In this section, comparisons are made based on the number of power units a firm operates to determine if a firm's size impacts its use of technology and logistical capabilities. Statistical differences in

firms' logistics practices are examined. Specifically, comparisons are made on firms' technology usage, such as EDI, ad on their logistics service offerings.

Not surprisingly, a greater percentage of larger firms in the sample are using EDI and satellite technology, as well as engaging in close partnerships with their shipping customers (Table 4.7).

Table 4.7. Percent of Respondents Using EDI, Satellite Technology, and Close Partnerships with Shippers Based on Firm Size

Number of Power Units	*Percent of Respondents Using EDI*	*Percent of Respondents Using Satellite Technology*	*Percent of Respondents with Close Partnerships*
1-5	0.0%	0.0%	38.5%
6-15	7.4%	3.7%	48.3%
16-50	20.6%	16.1%	65.7%
51-100	47.6%	30.4%	79.2%
More than 100	58.3%	16.7%	91.7%

Examining the results, EDI is being used by 20.6 percent of firms with 16 to 50 power units, by 47.6 percent of firms with 51 to 100 power units, and by more than 58 percent of firms with more than 100 power units. Conversely, no respondents in the one to five power units group indicated EDI usage, and only 7.4 percent in the six to 15 power units group use EDI. A chi-square test indicates significance at the $p<.001$ level.

Satellite technology usage also is more prominent among larger firms, 30.4 percent for the 51 to 100 power units group versus 3.7 percent for the six to 15 power units group and 0.0 percent for the one to five power units group. However, the percent usage was only 16.7 percent for the more than 100 power units group in this sample. The chi-square test here is significant at the $p<.05$ level.

In addition, a significant number of the companies in the more than 100 power units group (91.7 percent) are engaging in close partnerships with their shipping customers. This compares to about 38.5 percent in the one to five power units group that do so. The chi-square test reveals significance at the $p<.01$ level.

Questions from the section concerning opinions on current policies and trends were also examined based on firm size (Table 4.8). For all six questions in this section, a mean value was computed for the five firm size categories as defined in Table 4.1. A larger mean value indicates stronger agreement to the question (the actual scales for each question were given in Table 4.6).

Performing an ANOVA analysis reveals that only in the first and fourth questions, regarding the future influence of EDI and closer relationships between shippers and carriers, were there any statistically significant differences at the $p<.05$ level (Table 4.8). Duncan's Multiple Range Test was used to determine whether or not mean differences existed.

However, for each question, the mid- to large-sized firms agreed more strongly than did the smaller firms. These are expected results because larger firms are undoubtedly more pro active in implementing new technologies due to cost considerations. In addition, larger trucking firms appear to be more involved in providing logistical services to their customers than smaller trucking firms. Most of the smaller trucking firms may be providing niche transportation services, which do not require additional logistical services. However, it is still necessary for firms in the trucking industry, regardless of size, to keep abreast of changes in technologies and services.

Table 4.8. Opinion Question Results Based on Number of Power Units

	Mean Values by Power Unit Group				
Question	*1-5*	*6-15*	*16-50*	*51-100*	*More than 100*
1. Do you feel EDI will become a greater or lesser influence in the future?	3.17[b]	3.61[a,b]	3.80[a,b]	4.33[a]	3.92[a]
2. Do you feel firms providing logistical services will become more or less prevalent in the future?	3.17	3.25	3.51	3.54	3.50
3. Do you feel providing logistical services adds value or does not add value to customers of the trucking industry?	3.08	3.21	3.57	3.75	3.50
4. Do you think more or less firms will establish closer relationships between shippers and carriers in the future?	3.92[a,b]	3.41[b]	3.57[a,b]	4.09[a,b]	4.18[a]
5. Do you feel providing logistical services is necessary to remaining competitive in the trucking industry?	2.83	2.97	3.26	3.13	3.08
6. Do you consider yourself a third-party logistics provider?	1.82	2.28	2.29	2.22	2.50

[a,b] Significant differences present where letters are shown. Means with the same letter are *not* significantly different.

In this chapter, results of the survey were presented. These included overall results and results based on firm size (number of power units). In the next chapter, conclusions are drawn from these results, in addition to conclusions to the study.

CHAPTER 5. SUMMARY AND CONCLUSIONS

This study examined logistical policies and related trends that are occurring in the trucking industry. Logistics is becoming increasingly important in the trucking industry for many reasons. Many carriers are looking for ways to add value to their customers, such as offering logistical services (Bigness, 1995). Also, many shippers are looking to outsource logistics activities to reduce costs and focus on their core competencies.

Factors that contributed to the trucking industry's ability to offer logistical services to better serve their customers were examined. Deregulation of the trucking industry allowed close relationships and long-term contracts to develop between carriers and shippers, which in turn create better service and efficiency. Indeed, the need to maintain competitiveness and perhaps gain a competitive advantage has encouraged companies to look toward logistical services.

Several types of logistical information systems and technology were explored. These included EDI, various computer software packages, barcoding, and satellite tracking systems. These technologies are primarily used to improve information flow through the supply chain and thus increase tracking ability and decrease the amount of inventory needed.

A survey was introduced to better understand how well trucking companies are responding to the demand for logistical services. The survey group selection, mailings, survey design, and data analysis techniques were described.

Chapter 4 presented the overall results of the survey in addition to analyses based on company size. Some of the findings and conclusions of the survey included the following.

Respondents were approximately evenly distributed across five different size categories and operated a broad range of equipment including dry and refrigerated vans, flatbeds, tankers, hoppers, car and livestock carriers, as well as intermodal. Respondents served every region of the country with the most common regions in the upper Midwest.

Approximately 50 percent of responding firms indicated offering logistical services. The average revenue contribution of logistics for these companies was more than 18 percent of their total revenue, with nearly 30 percent indicating logistics accounted for more than 25 percent of their total revenue.

Out of 11 services listed, routing and scheduling was the only one offered by more than 50 percent of the responding companies. The other most common services offered were carrier selection, determination of least cost mode, palletization, and warehousing.

About 64 percent of the respondents are involved with close partnerships with their shipping customers, and more than 75 percent of companies that offer logistic services began offering them after 1980.

Almost 25 percent of respondents are using EDI; invoices and freight bills are the most common feature followed by purchase orders. Approximately 15 percent of the respondents indicated using satellite systems.

The majority of the respondents believed EDI would continue to become a greater influence in the industry, that more firms will develop closer relationships between shippers and carriers, and that firms providing logistical services will become more prevalent.

Respondents also believed strongly that providing logistical services adds value to their customers, but were undecided if providing logistical services is necessary to remain competitive.

Significantly greater percentages of larger firms (based on number of power units) are using EDI and satellite technology, and are engaging in close partnerships with their shipping customers.

Companies of all sizes tended to agree that providing logistical services will become more prevalent and that logistical services add value to customers.

Larger firms tended to agree more with the statements that EDI will become a greater influence and that more firms will establish close relationships between shippers and carriers, although smaller companies also agreed somewhat.

Companies of all sizes were undecided if logistical services were necessary to remain competitive, with larger firms agreeing slightly more than smaller ones.

Discussion

This study helped to determine how trucking companies are responding to current trends and the demand for logistical services. The results showed that many companies are responding to the demand in a variety of areas, and are realizing the value both to themselves and to their customers. Larger companies are developing their logistical services more extensively than smaller companies. However, there is evidence that smaller companies are starting to progress and see the value of doing so.

From the survey, it is clear that technology and changes in business are driving the trucking industry into the 21st century. Survey comments clearly demonstrate some firms are on a more progressive path with their customers in order to add logistical value. This evolution is leading to a small number of larger trucking firms, which handle the bulk of the cross country freight market, while smaller firms remain in the regional and city-to-city markets. A lesson in why this may occur can be taken from

the other industries where firms are actively attempting to reduce the number of suppliers they work with. The same can be said in the trucking industry.

Companies are moving towards preferred provider programs. This is evident by the response in Question 18, where even the smallest of firms are involved in preferred provider programs. Not surprisingly, 91 percent of the largest firms in terms of power units (100 or more) are involved in some type of preferred provider program. In terms of technology, 58 percent of these same firms also are using EDI. It is this combination of technology and partnering that will drive the trucking industry into the 21st century.

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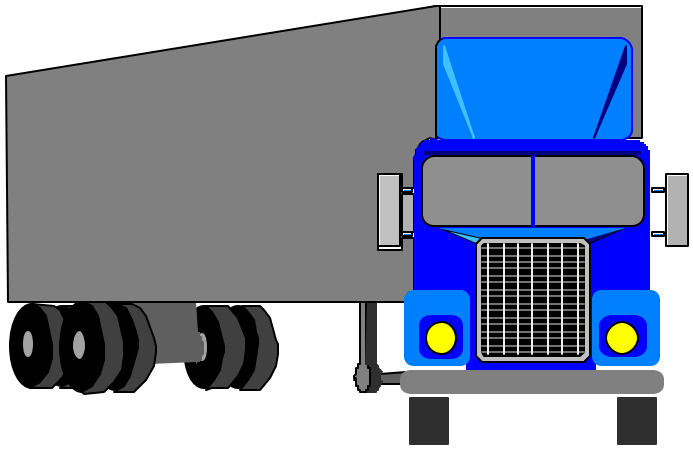
APPENDIX A

Actual Survey Sent to Trucking Firms

LOGISTICAL CAPABILITIES OF TRUCKING FIRMS



February 1997

The Upper Great Plains Transportation Institute
North Dakota State University
Fargo, North Dakota

Instructions

1. Please read and answer all questions carefully.

2. Select the response that best represents your feelings. There is no right or wrong answer.

3. When you have finished, place this survey in the business reply envelope. You do not need a stamp to mail this.

4. Please **return this survey within one week.**

5. Feel free to use any white space as well as the back of this survey for any comments you may have.

ALL RESPONSES AND COMMENTS ARE ANONYMOUS

WE WILL NOT REPORT AN INDIVIDUAL FIRM'S RESPONSES

THANK YOU FOR YOUR HELP

If you have any questions or concerns regarding this survey, please call Jason Barber with the Upper Great Plains Transportation Institute at NDSU, phone number (701) 231-1086. E-mail address *jbarber@badlands.nodak.edu* is checked daily.

SCOPE OF SERVICES OFFERED

This section asks you to please provide some basic information on logistical services offered by your firm. Logistical services include transportation related activities which provide value to customers.

Q-1. **What percentage of your customers are currently using the following services, if offered by your firm?** (Circle number)

		Not Offered	Under 25 percent	25-50 percent	51-75 percent	Over 75 percent
1	Light subassembly	1	2	3	4	5
2	Packaging	1	2	3	4	5
3	Warehousing	1	2	3	4	5
4	Inventory management	1	2	3	4	5
5	Supply chain management	1	2	3	4	5
6	Process reengineering	1	2	3	4	5
7	Palletization	1	2	3	4	5
8	Demand forecasting	1	2	3	4	5
9	Routing and scheduling	1	2	3	4	5
10	Determine least cost mode	1	2	3	4	5
11	Carrier selection	1	2	3	4	5

Q-2. **Does your firm offer any other type of logistics services?** (Circle number)

1. Yes (please list)

   _____

2. No

Q-3. **If your firm offers any of the services listed in Q-1 or Q-2, what year did you begin offering these services?**

_____

Q-4. **If you answered yes to any part of Q-1 or Q-2, are these services offered to clients other than your trucking customers?** (Circle number)

1. Yes
2. No

TECHNOLOGY CHARACTERISTICS

This section asks you to please provide some information on technology used by your firm.

Q-5. Do you use Electronic Data Interchange (EDI)? (Circle number)

1. Yes
2. No

If you answered YES to Q-5, please continue to Q-6. If you answered NO to Q-5, please go on to Q-10 on page 3.

Q-6. With what percentage of your customers do you use EDI?

_____ Percent

Q-7. What type of hardware are you using for your EDI system?
(Circle all that apply)

1. Mainframe
2. Minicomputer
3. Microcomputer
4. Network

Q-8. What software packages are you using for your EDI system?

_____

_____

Q-9. What percentage of your customers use the following features in their EDI data. (Circle number)

		Not in use	Under 25 percent	25-50 percent	51-75 percent	Over 75 percent
1	Forecasts	1	2	3	4	5
2	Invoices	1	2	3	4	5
3	Purchase Orders	1	2	3	4	5
4	Freight Bills	1	2	3	4	5
5	Production Schedules	1	2	3	4	5
6	Quick Response Initiatives or JIT	1	2	3	4	5

Q-10. **Do you consider your logistics services to be a separate department or business unit from your trucking company?** (Circle number)

1. Yes
2. No

Q-11. **Do you use satellite tracking and communication systems?** (Circle number)

1. Yes
2. No

OPINIONS ON CURRENT POLICIES AND FUTURE TRENDS

This section asks you to provide opinions about some trends affecting logistics and the trucking industry.

Q-12. **Do you feel EDI will become a greater or lesser influence in the future?** (Circle number)

Influence will Diminish				Influence will Increase
1	2	3	4	5

Q-13. **Do you feel firms providing logistical services will become more or less prevalent in the trucking industry?** (Circle number)

Will become less Prevalent				Will become more Prevalent
1	2	3	4	5

Q-14. **Do you feel providing logistical services adds value or does not add value to customers of the trucking industry?** (Circle number)

Does not provide Value				Does provide Value
1	2	3	4	5

Q-15. **Do you think more or less firms will establish closer relationships between shippers and carriers in the future?** (Circle number)

Less Firms				More Firms
1	2	3	4	5

Q-16. **Do you feel providing logistical services is necessary to remaining competitive in the trucking industry?** (Circle number)

Strongly Disagree				Strongly Agree
1	2	3	4	5

Q-17. **Do you consider yourself a third-party logistics company?** (Circle number)

Strongly Disagree				Strongly Agree
1	2	3	4	5

BUSINESS CHARACTERISTICS

This section asks you to provide some brief information to assist in categorizing your firm.

Q-18. **Is your firm engaging in close partnerships (preferred transportation provider programs) with your shipping customers?** (Circle number)

1. Yes
   With what percentage? _____ Percent
2. No

Q-19. **Approximately how many power units (tractors and straight trucks) does your firm operate?**

_____ Power units

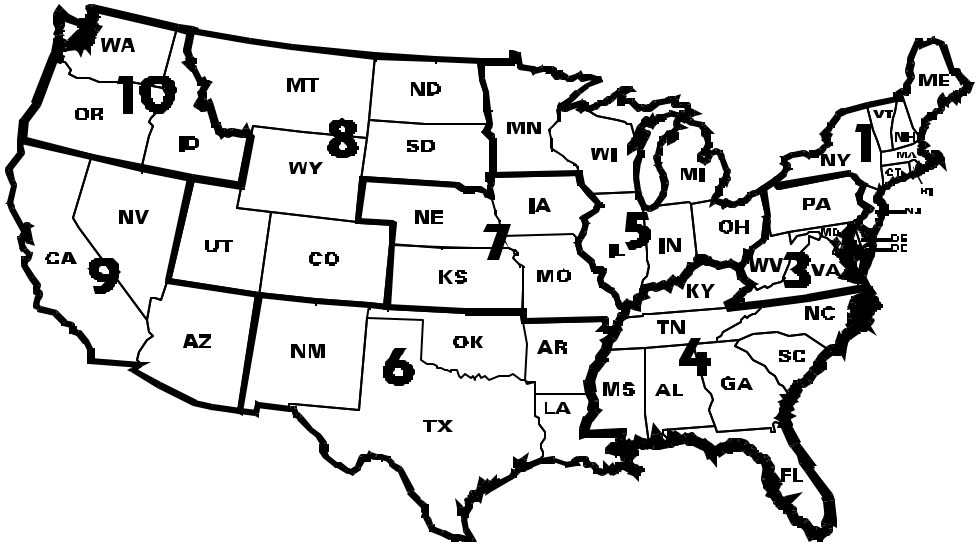
Q-20. **What most characterizes your type of operation?** (Circle all that apply)

1. Dry van
2. Flatbed
3. Refrigerated van
4. Tanker
5. Intermodal
6. Other (specify):

Q-21. If you are currently providing logistics services for customers, approximately how many logistics customers do you currently have?

_____Customers

Q-22. Please indicate which regions of the country your firm regularly serves.
(Circle numbers)



Q-23. Please indicate the relative percentages of logistics and trucking operations which contribute to total revenue for your firm.

_____% Revenue contributed by *logistics* operations.
_____% Revenue contributed by *trucking* operations.

= 100 % Total Revenue

Do you have any other comments?