Procurement of Motor Carrier Services and the Impact of Surges in Demand

by

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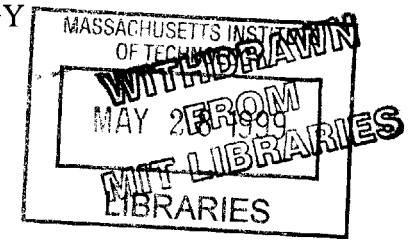

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ABSTRACT

This thesis addresses how shippers adjust their procurement of motor carrier services for lanes that experience surges in demand. A distinction between surges in the truckload (TL) and less-than-truckload (LTL) industry is made. LTL firms are typically more flexible in their ability to expand capacity, taking advantage of economies of density (or scale). Therefore surges often improve their cost structure. However, for TL firms, economies of scale have not convincingly been shown to exist. When faced with seasonal surges in demand, TL carriers are forced to reallocate limited resources with little impact on the cost structure of operations. On the other hand, specific surges incongruent with those of the general industry change the repositioning activities of empty TL equipment. Therefore, the cost of providing service in these lanes changes as well.

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1 Introduction

Changes across the transportation landscape have been monumental since the reign of deregulation began nearly twenty years ago. In such an environment, changes in the roles of and relationships between shippers and motor carriers have been required. New players like third party logistics providers have added expertise in technology and management to catapult shippers into new dimensions for the procurement of transportation as well as other logistics services. The importance of viewing cost over entire supply chains has led many companies to revise the previously narrow focus of minimizing transportation costs to minimizing total logistics costs in and across organizations. However, transportation costs alone, primarily trucking, make up the majority of logistics costs within many organizations.

Shippers have designed the management of their transportation and distribution networks in a variety of different ways, hoping to take advantage of the most effective tools at their disposal. Although private fleets are still the dominant management structure, many shippers have disintegrated this function in favor of outside operations from specialized transportation and logistics companies. In fact, contracting has steadily been growing in popularity since deregulation began.

Many pressures on both shippers and carriers have led to this increase in partnerships and contracting in transportation. Economic incentives for carriers to improve the structure of their networks and the continual cost pressure on shippers have brought new ideas to the arena. Bidding has begun to incorporate more complex structures made practical by the increased speed of computing power. Conditional rates in the truckload market are gaining use due to the efficiencies gained by both shippers and carriers. Further developments in bidding and contracting for transportation will continue to bring additional benefits to both shippers and carriers.

1.1 Motivation for Thesis

The focus of the thesis is on reviewing current practices of shippers and carriers that procure motor carrier transportation during periods of significantly surging or seasonal demand. Fluctuations in demand for transportation service often place a high burden on carriers to provide sufficient equipment during peak periods. In some cases carriers are able to meet surging demand with the repositioning of equipment, but, at other times capacity is simply unavailable to meet all shippers' needs. Consequently, the burden often shifts to shippers to find satisfactory transportation services on short notice.

To provide a framework for understanding the problem, the remainder of this chapter gives an overview of the motor carrier industry and its functions. Chapter 2 describes the current procurement practices of shippers and carriers for both truckload and less-than-truckload services. Chapter 3 describes the practice of managing surges in demand. As a precursor to the remaining analysis of the impact on rates caused by surges in demand, a general description of factors that influence rate levels is included. Finally, Chapter 4 concludes with a summary of findings and suggestions for future research.

1.2 The Motor Carrier Industry

The benefits to shippers of well managed transportation functions in a company stem from two sources. First, a company may increase its product's value to the customer by providing high levels of service through an efficient transportation network. Second, the firm may seek to minimize the transportation expenditure required to provide this service. The challenges to carriers are to understand the service needs of the shipper and to meet them with a price that is attractive to both parties.

As a practical matter, most shippers consider the movement of goods a secondary function. Inbound movements serve only to procure inputs for the firm's processes and outbound shipments simply finalize sale transactions. Although the relative importance of transportation certainly falls below the shipper's primary function, be it manufacturing, retailing or another area, transportation activities often have a very large impact on total cost. For some industries transportation costs rise as high as 8 percent of the total cost of

goods sold (Bureau of Transportation Statistics 1998). Because of the large cost of transportation, particularly in manufacturing, shippers often focus only on minimizing these costs. Other shippers, in part due to the general quality movement, have recognized the importance of transportation in providing a high level of service quality to their customers, also leveraging quality service to differentiate their products from others in their market.

As discussed in more detail in Chapter 2 on procurement practices, a shipper that concerns itself with the evaluation of service quality must determine the appropriate tradeoff between costs and service. Transportation in itself is not a valuable commodity. The demand for transportation services is derived only from the shipper's need to move goods from one location to another. Therefore, the importance of service characteristics that are required in transportation stem primarily from the needs of the shipper as they relate to its customer and its commodity.

Transportation providers have responded to the increased service demands of shippers since deregulation. Motor carriers, in particular, have made great strides to extend the value of their product from strictly physical transportation of freight to more developed and sophisticated logistics services. Under the highly regulated environment prior to 1980 little differentiation was seen among services provided by motor carriers. Modal selection was the primary decision made by firms, a choice among rail, water, air or highway. However, due to the wave of deregulation and a focus on improved services, the landscape of transportation has changed dramatically over the last twenty years.

This section narrows the focus of the thesis to the procurement of motor carrier transportation. First, a brief description of regulation in the trucking industry will be reviewed. A summary of each industry segment follows, grouping firms by the type of consolidation activities performed by each. Finally, the basic economic factors that influence motor carrier operations are discussed.

1.2.1 Regulation

From their early stages until 1980, motor carrier operations were highly regulated by the federal government's Interstate Commerce Commission (ICC). The ICC was established prior to the rise of motor carriers to protect shippers from monopoly power

abuses by the railroads. Most of the restrictions enacted upon carriers were aimed at controlling market entry and the prescription of minimum rates. With the advent of motor vehicles, motor carriers had been required to abide by similar standards since 1935. Authority for hauling freight by both commodity and route was required for every for-hire carrier, a motor carrier that receives a fee from another company for providing services. The administrative process was very costly, difficult and time consuming. Regulation provided a large barrier to entry for any carrier who sought to begin a competing service in an area new to their operations.

Under regulation, all aspects of motor carrier transportation were affected. For-hire carriers were allowed to haul freight only under one type of federal status: either contract or common carrier. Each common carrier was required to serve any shipper in its authorized lanes with a common tariff known to the public. Contract carriers were only allowed to serve specific customers and were unable to make contracts with more than eight customers in total, also known as the "rule of eight". Even shippers using their own private fleets were restricted, unable to haul freight for another shipper.

With the Motor Carrier Act of 1980, many of these barriers were removed. The lengthy authorization process was reduced to include only insurance coverage and safety standards. Restrictions for granting authority by lane were lifted; once authorized, carriers were allowed to operate in any area. For-hire motor carriers could serve as both common and contract carriers with no "rule of eight" to limit the number of shipper relationships. Contracts could be signed with rates specific to a given customer as long as they were filed with the ICC. With similar authority private fleets began hauling freight for other shippers. Further reforms occurred in 1994 when the Trucking Industry Regulatory Reform Act (TIRRA) repealed the need for carriers to file rates with the ICC at all.

While these federal reforms applied to all inter-state commerce, intra-state movements were still heavily regulated in over 40 states in 1994. Under these regulations, however, ground networks of air carriers were unaffected by state laws governing motor carriers. As a result, air carriers were able to price ground transportation services below that of competing trucking firms. In 1995, intra-state regulations were removed by the Airline Improvement Act (AIA). Motor carriers and air

carriers alike were then allowed to carry ground freight freely, as in the deregulated inter-state movements.

The results of deregulation have been many faceted. Shippers have seized the opportunity to demand differentiated services, with most carriers speeding to meet the challenge, making great strides since deregulation. Several carriers have evolved from mere transporters of products to logistics service organizations, taking advantage of the greater flexibility in operations and pricing. A detailed description of shipper-carrier interaction since deregulation follows in Chapter 2.

1.2.2 Market Structure of the Motor Carrier Industry

Motor carriers dominate the transportation industry in the United States when viewed by the amount of revenue accumulated by each mode. According to the Standard and Poor's Corporation, motor carriers collected 79 percent of all transportation industry revenues in 1997. The motor carrier industry is segmented by several characteristics of the firm: private or for-hire, types of consolidation activities, and firm size. Figure 1-1 shows a breakdown of the motor carrier industry in 1997 by these characteristics, reporting total revenues and the approximate number of firms in each segment.

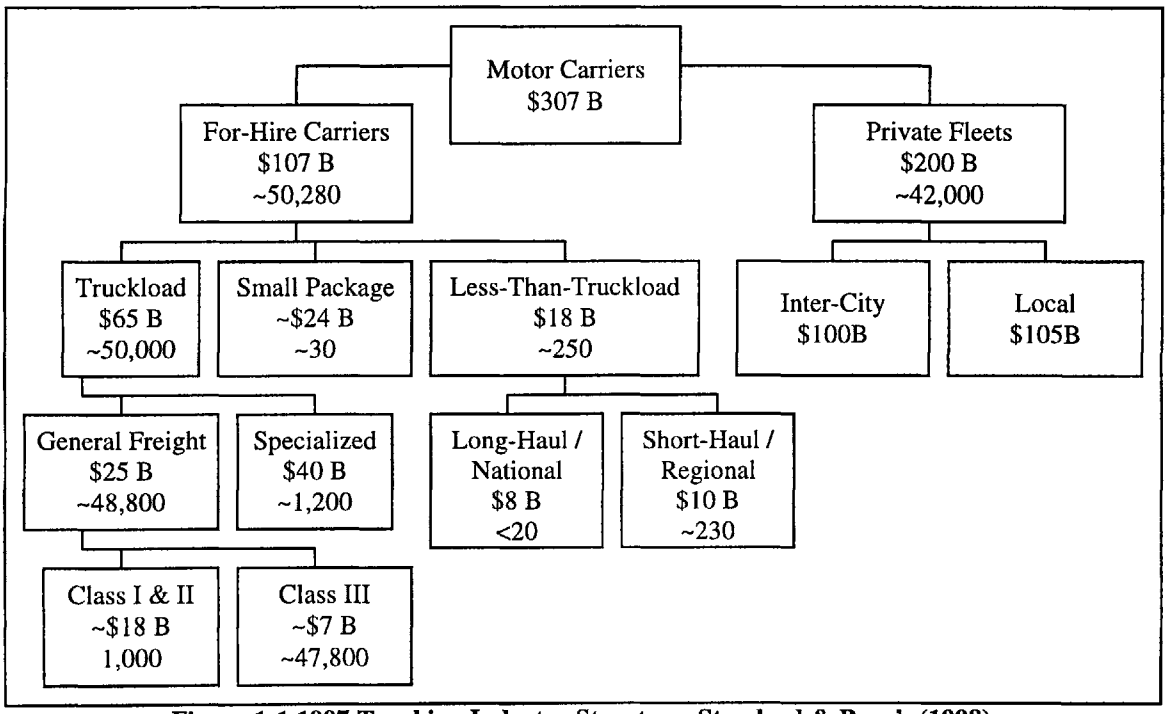

Figure 1-1 1997 Trucking Industry Structure, Standard & Poor's (1998)

Freight Consolidation

Consolidation refers to activities that involve the accumulation and segregation of freight. For shippers that have enough freight to fill an entire truck, a direct operation is typically used from the origin to the destination. However, if a shipment is too small to fill an entire truck, consolidated operations may be a more efficient mode of transportation. The three primary types of consolidation used by motor carriers are *time*, *vehicle* and *terminal consolidation* (adapted from Caplice 1996, pp. 21 and Sheffi 1998).

Time consolidation occurs when a shipper holds items at a particular location for some amount of time until a sufficient amount of volume is accumulated. Once there is enough freight for a shipment, the items are sent in one conveyance to their destination. This improves the efficiency of the transportation network by decreasing the total number of required shipments at the expense of holding products for shipment. In some cases, all accumulated items may not have the same destination. Here time consolidation simply reduces the number of pickups by a single carrier who will then deliver to multiple destinations using vehicle consolidation.

Vehicle consolidation is the use of a single vehicle that makes multiple stops to pickup (deliver) shipments having the same origin (destination). During transit, multiple shipments are effectively combined for a time into one shipment within the vehicle. The postal service provides an example of vehicle consolidation when performing regularly scheduled pickup and delivery runs. A postal worker begins at one central location with all the mail of a given day in one truck. Along the route, each destination receives its mail from the delivery person who deconsolidates the individual shipments for delivery to each local address.

Terminal consolidation involves the use of freight processing centers or terminals operated by the carrier. Shipments from multiple origins arrive at a common terminal. Upon arrival the freight is unloaded, sorted and reloaded onto a single conveyance to a common destination. The destination need not be the final destination for all pieces of freight. In fact, a shipment may pass through several intermediate terminals before being delivered to its final destination.

A transportation system may use more than one form of consolidation or no consolidation at all. For example, a shipment of one very large item may require an

entire truck to transport it from one location to another. No consolidation is used in this movement. However, the postal service uses all three forms of consolidation. Letters accumulate every day in a drop box near the local post office for pickup one time each day (*time consolidation*). A vehicle on one route makes pickups from several drop boxes in a small city for delivery to the local post office (*vehicle consolidation*). Once delivered to the local post office, individual letters are sorted and reloaded on several trucks headed to different destinations for potentially more sorting and eventual delivery (*terminal consolidation*).

Motor carriers that perform terminal consolidation are known as consolidated operations. These include the less-than-truckload (LTL) and small package carriers. LTL carriers typically have relatively regular routes and schedules. In fact, the network of terminals that is owned by an LTL carrier is the primary definition of its operating capability or geographic coverage. Carriers that pickup and deliver shipments without terminal consolidation are known as direct operations, a prime example being the truckload (TL) segment of the motor carrier industry. Note that direct operations do not preclude the use of time or vehicle consolidation activities.

As previously mentioned, one of the primary differences between direct and consolidated operations is the size of the shipment carried. However, the critical nature of service (for example, time sensitivity or concerns about freight damage) may drive shipments otherwise likely to travel via a potentially lengthy and handling-intensive LTL network to move on a truckload directly to the destination. Shippers face a tradeoff between service and cost when determining the use of direct or consolidated carriers for the transportation of their shipments.

Truckload: Direct, Irregular-Route Carriers

TL carriers operate direct, often irregular, routes moving products with the use of one conveyance from the origin to destination. Truckload carriers often distinguish themselves by commodity type or by the specialized equipment that is required to haul certain commodities. For example, refrigerated van carriers handle temperature sensitive commodities, while flat bed carriers often move large, finished equipment or other bulky items. Dry van truckload carriers haul general freight that requires no special handling.

With truckload carriers, transit time between points is typically minimized. Shippers have the ability to schedule individual shipments as necessary without the requirement of following a predetermined schedule. Although these benefits may be very strong for shippers, the direct movement of goods from origin to destination leaves carriers with the added responsibility of returning the truck to its origin. As a result, TL carriers consistently search for network configurations that minimize the amount of empty miles hauled.

Small carriers often choose to serve specific lanes where volumes allow principally headhaul-backhaul networks. Most large carriers, however, are unable to combine all movements from their large network so simply. Repositioning to nearby locations is used to build tours that reduce overall empty miles. A tour includes two or more loaded movements connected by repositioning time and miles such that a "round-trip" is eventually constructed. The ability to construct attractive tours has a large impact on the rate structure offered to shippers. In general, the ability to minimize empty miles and connection time between loads is the largest single concern of the truckload industry.

Very large barriers to entry exist at the top end of the market due to shippers' needs for wide geographic coverage, high service requirements and a high level of technical investment in carrier information systems. Larger TL carriers are therefore able to serve shippers with high requirements for geographic coverage and information accessibility, while the ability of small carriers to compete is reduced by their lack of capabilities. As a result, small carriers such as the owner-operator are left to serve the smaller businesses and those less sensitive to such issues. At times, however, the lines are blurred as some larger trucking firms employ owner-operators instead of hiring company drivers.

Less-Than-Truckload: Consolidated, Regular-Route Carriers

Geographical consolidation is the primary characteristic of LTL operations. For shippers wanting to move freight that does not fill an entire truckload, an LTL carrier consolidates several shipments into one truckload. Although shipments are commonly defined to be less than 10,000 pounds, LTL carriers are flexible in the size shipment they allow. The primary distinction among LTL firms is the relative geographic coverage

provided by each. National carriers are predominately long-haul and unionized while regional carriers are primarily short-haul and non-unionized.

National carriers typically operate a large hub-and-spoke network, which relies on dispatching policies and schedules to efficiently consolidate and distribute freight from multiple origin points to a single destination and from single origin points to multiple destinations. Main sorting hubs or break-bulk facilities are used as the primary consolidation centers. Shipments typically are picked up and dropped off by scheduled delivery runs to and from end-of-line terminals. Instead of extensive hub-and-spoke networks, regional LTL carriers send more shipments directly between end-of-line terminals with potentially one intermediate sorting terminal. Regional carriers tend to concentrate on very short-haul markets, often less than 300 miles in length.

1.2.3 Motor Carrier Economics

Shippers are interested in understanding carrier economics in order to influence the motor carrier's cost structure effectively. Carriers are faced with quite a challenge due to their heavy dependence on consolidation and load balancing. The result is an extremely high level of interdependence throughout the system that sometimes changes drastically within short periods of time. Therefore the cost analysis of any single lane becomes extremely difficult (Sheffi, 1986). Particularly in the LTL industry, costs are joint or common across several service offerings and require discriminatory pricing by the carrier to recover costs in some lanes (Phillips, 1991).

Further complicating the cost structure, carriers produce transportation services that are multi-dimensional in their output. Jara Díaz (1981) describes motor carrier services as a function of the origin, destination, commodity and time of the movement. Therefore if a shipper seeks to change the way carriers manage its network, these output dimensions must be influenced. Most shippers have little ability to change the commodity being shipped or the timing of most shipments. Therefore shippers may control two things offered to each carrier: (1) the total volume of traffic and (2) the placement of traffic on the network of each carrier (Caplice 1996, pp. 26).

The result is that a shipper must determine if a certain set of volumes or lanes may be handled more efficiently by one or more than one carrier. To understand to what

extent these aspects impact motor carrier economics, three factors will be reviewed: economies of scale, economies of scope (balance), and economies of density.

Economies of scale assume that some level of fixed cost can be more efficiently allocated over a large base to lower the unit cost. Thus, economies of scale are present if the unit costs for serving a network decrease when the volume on all lanes increases in the same proportion. For example, in two lanes:

$$C(\lambda X_1, \lambda X_2) < \lambda C(X_1, X_2)$$

where

X_i: Number of shipments on lane *i*,

$C(X_1, X_2)$: Total cost of a carrier to serve X_i shipments on lane *i*, and

λ: Scale parameter.

Several studies have been conducted over the last twenty years to determine if economies of scale exist in the motor carrier industry. These studies overwhelmingly state that either constant or decreasing returns to scale exist (Grimm, Corsi and Jarrell, 1989). Alone, these studies imply that simply increasing volume supplied to a carrier would have little impact on the carrier's ability to improve its cost structure. However, several firms in the LTL industry merged immediately after the restrictions of regulation were lifted. This apparent contradiction in theory and practice, argues Jara Díaz (1981), was due to inaccurate model specifications that did not fully account for the multi-attribute production of LTL transportation firm outputs, masking the importance of other factors.

In fact, economies of scale would seem more likely to exist in the national LTL industry due to the need for a large, efficient network of break-bulk facilities which is a large barrier to entry for new firms. The specialized break-bulk facilities have little value outside LTL carriage and are therefore highly fixed and industry-specific costs (Silverman, Nickerson, and Freeman 1997). As volume increases, the utilization of these facilities and the network improves.

Economies of scope exist when the cost per unit shipped on two distinct lanes is less when served by only one carrier (A or B) rather than by one carrier on each lane (A and B), that is:

$$C_A(X_1, X_2) < C_A(X_1, 0) + C_B(0, X_2)$$

also: $C_B(X_1, X_2) < C_A(X_1, 0) + C_B(0, X_2)$

Because economies of scope are restrictive in that each carrier must fully serve a subset of lanes in the network, two more general definitions are also given: subadditivity and cost complimentarity. Subadditivity simply implies that the cost of one carrier serving two lanes will be less than two carriers serving the same two lanes. As stated in this definition, lanes may be shared among carriers:

$$C_A(X_1, X_2) < C_A(X_{1A}, X_{2A}) + C_B(X_{1B}, X_{2B})$$

also: $C_B(X_1, X_2) < C_A(X_{1A}, X_{2A}) + C_B(X_{1B}, X_{2B})$

where: $X_1 = X_{1A} + X_{1B}$ $\quad X_2 = X_{2A} + X_{2B}$

Cost complimentarity is the effect that an additional unit of flow on a specific lane has on the cost of serving that lane (or some other lane). In fact, this is the most common impact seen in the truckload industry, influencing the empty repositioning problem. Due to the fine differences in each of these points, economies of scale or balance has been used in practice to describe subadditivity and cost complimentarity as well.

Jara Díaz (1981) demonstrated that economies of scope are exhibited by trucking firms. The cost of serving a particular lane is contingent on the ability to secure a complimentary lane or set of lanes. Although it may appear that because of the interactions among lanes the best economies may be gained by giving all business to one carrier, several issues limit those benefits. One carrier is seldom able to give a high level of service in every lane or geography where a shipper does business. The existing network of one carrier may match better with a subset of the shipper's lanes than the network of another. As a result, economies of scope often make the cost of a serving a particular lane different for each carrier. Therefore, the best allocation of lanes would result when each carrier is allowed to choose the sets of lanes that are most attractive from its own perspective, each maximizing its own benefit.

Economies of density are used to refer to the density of shipments in two situations: the density per customer and per geographic area. Economies of density are present if increasing either the customer location density or the number of shipments per customer location, while holding the total number of shipments constant, results in the reduction of per unit shipment costs. Economies of density with respect to customer are

often also thought of as economies of scale. On the other hand, an increase in shipment density per geographic area is purely economies of density.

Friedlander and Spady (1980) have shown the existence of economies of density in the TL industry while Keaton (1983) found them in the LTL industry as well. The conclusion is that shippers should limit the number of carriers to maximize their own densities (both location and shipment) per carrier (Sheffi 1998). However, as described above, reliance on a single carrier is seldom deemed wise by shippers. In addition to the reasons mentioned earlier, most national LTL carriers have another risk factor - unionized labor. A strike would immediately shut down all shipments into or out of their facilities. As a result, shippers are more likely to employ the strategy of using a small number of carriers than to rely solely on one carrier.

In addition to the formal economic definitions above, Rakowski (1988) and Kling (1990) both discuss the issue of marketing economies. Marketing economies, or network economies, are defined as the ability of a carrier to gain more business by providing shippers with wide geographic coverage. The shipper is able to reduce the number of carriers with which it maintains relationships because fewer carriers may be used to gain network coverage, assuming each carrier meets the required service level. Although it is not proven by empirical analysis, the perception that bigger carriers gain business due simply to their size is common across the motor carrier industry. In fact, marketing economies and economies of density complement each other, as reducing the number of carriers per customer inherently improves the density of shipments per carrier.

1.3 Governance Structures

Shippers and carriers enter into relationships of varying levels of commitment to accomplish the transportation of goods. In the trucking industry, many shippers enter into contracts with carriers for transportation services, while others choose to integrate internally by operating private fleets. Williamson (1985) makes use of the term governance structure to define the mechanism used by buyers and sellers to ensure that an exchange is carried out successfully. In choosing a specific governance structure, shippers (and carriers) seek to ensure the lowest possible cost of the transaction, given a

desired level of service. Transaction cost analysis will be reviewed in the next section as a basis for understanding governance structure selection. The range of structures used in the trucking industry follows, with an in-depth consideration of contracting.

1.3.1 Transaction Cost Analysis

Transaction cost analysis is commonly used in economic theory to explain the choice of governance structures in a market. In the transaction cost analysis of the trucking industry, three components are reviewed: *ex ante* costs, transportation costs, and *ex post* costs. The cost of the transportation itself is typically the largest portion of the transaction cost. Included are the direct costs associated with movement of the freight. Such costs may be the cost per mile or cost per pound in addition to any accessorials charged as a result of special services required in association with the movement of the shipment.

Ex ante costs include costs incurred prior to the transportation of goods such as the cost associated with planning and negotiating for the purpose of "safeguarding the agreement" (Williamson 1985, pp. 20). Conversely *ex post* costs occur after the movement of goods is complete. These costs typically are a result of a disagreement between the shipper and carrier due to a deviation from plans made during the *ex ante* phase of the transaction. The result is a need to correct the outcome and assign responsibility.

The costs associated with *ex ante* planning and *ex post* correction are inversely related. For example, organizations often choose to negotiate very detailed contracts that require a large amount of time and cost to complete in hopes that few unplanned scenarios will result after the freight has been moved. Such contracts may include penalties for unfulfilled obligations and arbitration procedures used to settle disputes. Alternatively, the transportation of freight with little prior planning or contingencies can lead to great difficulty in resolving *ex post* issues that arise. Therefore each firm must weigh the cost of *ex ante* planning versus the potential risks of *ex post* action.

If either *ex ante* or *ex post* costs are high for a transaction, the spot market will be less likely to handle the risk associated with these costs. Typically, increased *ex ante* or *ex post* costs occur when the service becomes specific to either the supplier or buyer, an

occurrence also known as specificity. With specificity, vertical integration or contracting becomes increasingly important to protect the seller or buyer as the ability of one party to extract monopoly rents increases (Caplice 1996, pp. 62). Due to the absence of a competitive market in this situation, a more clearly defined relationship is created to protect both parties. Examples of specificity include specialized assets, special timing requirements of shippers, and the carrier's uncertainty of future transactions with a shipper. With these issues in mind, governance structures in the trucking industry will be reviewed.

1.3.2 Governance Structures in Trucking

In the trucking industry, governance structures range from transactions performed at an arm's length in the spot market to complete vertical integration within the firm by the use of private fleets. The range of potential agreements between these extremes is a continuum, depicted by Figure 1-2. Although this continuum is fully spanned by the TL market, the LTL market is limited primarily to the spot market and contracting.

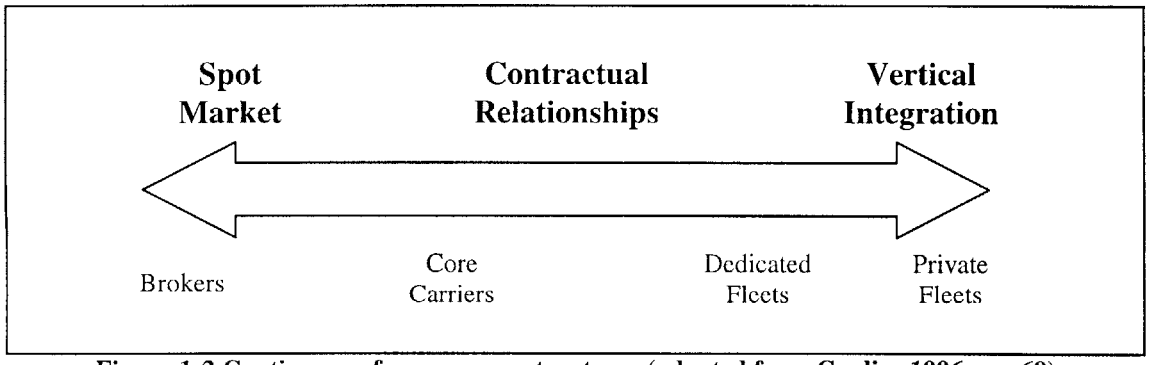

Figure 1-2 Continuum of governance structures (adapted from Caplice 1996, pp. 69)

Vertical integration is the most common governance structure in the trucking industry. Companies such as retailers and manufacturers, which are not primarily involved in the transportation industry, own these fleets. Many shippers consider private carriage the only way to guarantee premium service. Internal control of operations, drivers and equipment availability forces the shipper to rely only on itself from pickup to delivery, and everything in between. Some shippers believe that a lower cost of operation is gained with private fleets, regarding their private fleets as a benchmark for any for-hire carriers used to supplement their transportation services.

Even though most shippers that own fleets believe that their choice of governance structure is better than any other, private carriage is generally recognized by the trucking industry as less cost efficient than for-hire carriers. In the tradeoff between cost minimization and high service levels, vertically integrated shippers prefer operational control to transportation cost minimization, either implicitly or explicitly. In cases where high service levels are required, outstanding service provided in-house may indeed outweigh the additional price paid for transportation. However, for those not seeking extremely high levels of service or special equipment, the use of a company owned fleet may be a protection of personal management "turf" or simple misinformation.

For example, the transportation cost to privately serve only those lanes that can be combined to eliminate empty miles in the shipper's network is very low. If these costs are compared to the contracted transportation cost on the remaining lanes served by outside carriers, private fleets appear much more efficient. Similarly, if overhead costs within a firm are not fully allocated to the management of a private fleet, private costs again appear lower than they actually are.

A classic example of a private fleet that is used appropriately to ensure extremely high levels of service, as well as value-added service, is that of Frito Lay. Company drivers do not simply deliver product to the customer dock. They replenish in-store stock to reduce damage, ensure product freshness, and maintain cleanliness of the display. It is unknown whether contracted services would consistently be able to provide such services, which are considered essential by Frito Lay to its continued success.

At the other end of the spectrum, an arm's length relationship represents a governance structure where all expectations are spelled out. The pure competitive or spot market often characterizes these transactions, where communication between shippers and carriers exists only to complete one transaction at a time. The market itself enforces the terms of an exchange through the threat of alternative sellers and buyers. For this to take place effectively, the exchange must be well defined and uniform across all participants. An atmosphere similar to perfect competition is required.

In addition to shippers seeking carriers directly in the spot market, the use of traditional and electronic brokers is widespread. Brokers reduce the cost of "spot searching" for loads by carriers and for trucks by shippers. Shippers may contact a single

broker to avoid calling several carriers before locating an available truck. In the shipper's eyes, the broker acts like a single trucking firm with a large fleet, albeit made up of several carriers. On the other hand, brokers may find loads for carriers' idle truck capacity that otherwise would require substantial empty miles to reposition for its next move.

The last general type of governance structure is the use of contracts, which spans a wide range of alternatives. Contracts serve the purpose of modifying or adding to existing market practices when the spot market may be unable to achieve the desired outcome. Contracts range from basic rate agreements, which are very similar to the spot market, to partnerships in which dedicated equipment and employees supplied by a carrier are operated as if they were part of the shipper's organization.

The truckload market truly spans the continuum of governance structures. In fact, many individual shippers using TL services span several governance structures for differing parts of their businesses. It is not uncommon for a large shipper to assign specific lanes of its business to its private fleet prior to contracting out the remaining business. This shipper may then rely on the spot market for "odds and ends" shipments where contracts are not in place to meet the particular requirements for a load.

On the other hand, the LTL market primarily makes use of contractual agreements and the spot market. Most LTL carriers maintain published tariffs, or rates for their networks. These tariffs represent the rate at which carriers are willing to take any shipment in the spot market. In effect, these published tariffs serve as a baseline for negotiating contracts with customers. Shippers with private fleets do not typically engage in terminal consolidation activities on a large scale. Therefore, these fleets are considered within the truckload industry.

1.3.3 Contracting

As described in the previous section, contracts serve a wide variety of purposes. For shippers, contracts are used to stipulate service requirements, the availability of equipment, and rate stability while carriers typically receive fewer guaranteed benefits. Less than one-third of contracts stipulate realistic volume guarantees for carriers (statistic from the MIT shipper survey described in Chapter 2). This imbalance of guarantees

suggests that shippers have the upper hand in negotiations, particularly in light of the fact that contracts are often used to reduce rates. However, carriers are able to construct more efficient networks across many shippers with the use of contracts, taking advantage of economies of scope to provide lower rates than in the spot market.

Transaction cost analysis states that the need for a contract often arises when part of the transaction becomes specific to one of the parties. Trucking contracts become useful in providing safeguards for transactions involving specialized assets or timing requirements. However, contracts are also widespread for general freight (dry-van movements) with little specificity involved for either shippers or carriers. Transaction cost analysis fails to address the purpose for contracting in such an environment.

Caplice (1996, pp. 83) states that the use of contracts in dry-van TL movements is primarily due to the desire of carriers to take advantage of economies of scope. For economies of scope to exist with an individual shipper, the probability of matching a connection with a follow-on load must be high. This is true in relatively few cases, especially when a shipper only controls outbound freight movements at a particular location. However, contracts also help to guarantee several lanes of traffic across many shippers, improving the carrier's probability that a connection with a follow-on load will be made between shippers. By developing a well-established network, carriers are consistently able to generate efficiencies by maximizing equipment and driver utilization, and reducing excess operating costs.

Caplice also suggests two lesser reasons for contracting from the shippers' perspective: bundling of lanes and coverage. Shippers may be unable to find attractive rates on some lanes in the spot market. With the use of contracting, lanes may be bundled to effectively subsidize "poor" lanes with "good" lanes. Secondly, shippers seek the guarantee of a list of carriers that are able to provide service for their entire networks. As such the shipper avoids the spot market and brokers and gains the ability to more accurately predict its transportation budget.

In addition to the aforementioned benefits, Cavinato (1984) states that shippers gain rate stability through the use of contracts. Instead of being subject to the potential rate fluctuations in the spot market, contracts typically provide consistent rates over yearlong and sometimes multi-year periods if escalation clauses are included. This

aspect of contracting provides shippers more certainty in planning budgets, product sourcing and vendor selection. Beier (1989) states that in addition to rate reductions and improved service quality, shippers and carriers benefit from the impact of a more efficient transaction. The regular interaction between carrier and shipper, stemming from the ability to contract, improves the efficiency of the logistics transaction. In effect, this experience effect is a simple externality of a contracting process with recurring transactions.

Several individuals have surveyed contracting practices in recent years (Crum and Allen 1991 and 1997; Minahan 1997; Rinehart 1989; La Londe and Cooper 1989). These statistics serve to shed some light on contracting in general.

- The use of contracts has increased through the 1980s and into the 1990s, with approximately 80 percent of shippers and carriers involved in contracting.
- The number of requirements included in contracts, such as minimum performance levels and equipment guarantees, has also increased during the 1990s.
- Based on the concentration of carrier revenues with contracted shippers, the depth of partnershipping in the TL industry appears to be relatively high.
- The typical length of contracts in the trucking industry is anywhere from seven months to two years.

1.4 Procurement of For-Hire Transportation

Shippers and carriers must interact to bring about the movement of freight. However, the effectiveness of their communication and of the ensuing relationships has been the subject of many debates. Shippers desire a high level of service from carriers at competitive prices. In addition, many shippers want to be ensured that the carriers with which they do business will have sufficient capacity to move their loads for the next day, the next week and the next month. Carriers, on one hand, are seeking to meet many of these desires of shippers, but at the same time are trying to maximize their own profits by running efficient operations and taking advantage of the economies of scope and density that exist in their networks of customers.

At the most basic level of communication, similar to the spot market, shippers notify carriers of the availability of a load and carriers provide a rate at which that load is moved. In most cases, further coordination with carriers is required before the decision to assign lanes is made. The success had by shippers and carriers have in communicating with each other directly impacts the kind of service and future relationships that will exist.

This section discusses a general model of procurement practices. In addition, several strategies used by shippers to procure motor carrier services are reviewed, with examples of each.

1.4.1 Procurement Process

Figure 1-4 below represents the framework used by most shippers to purchase motor carrier services. Although shippers differ in their application of each step, the model captures the whole of shipper activities. The practice of procuring transportation follows three stages of decision-making: strategic, tactical and operational. Whether for spot market or contractual business, shippers must pass through these steps. Each step is reviewed in turn [adapted from Caplice 1996, pp. 30-31].

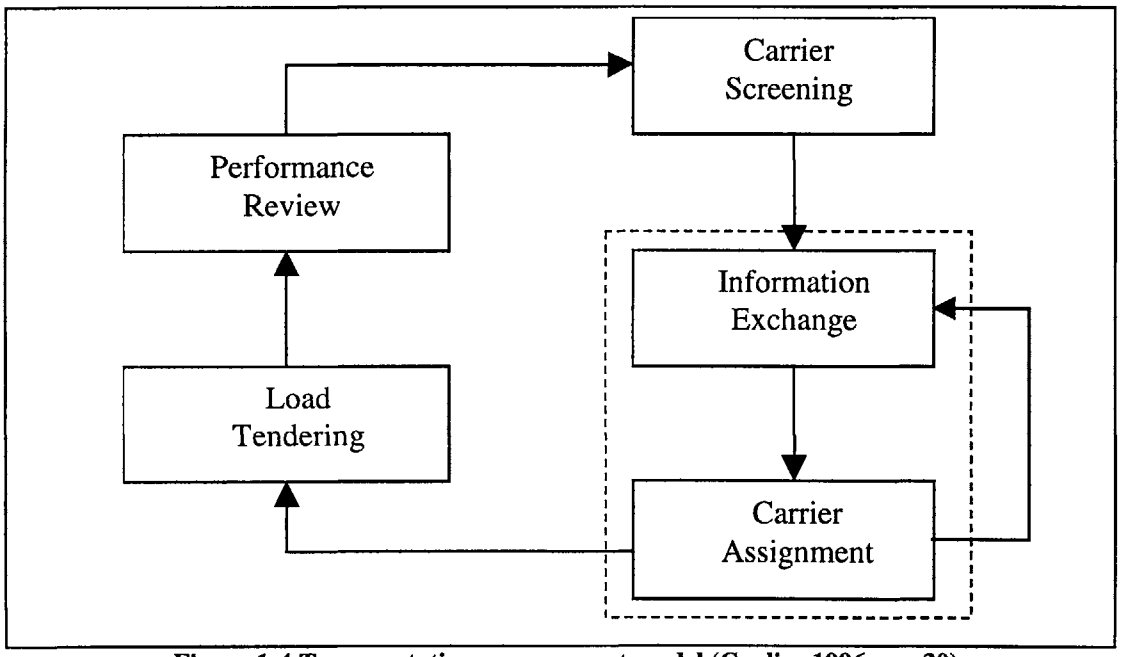

Figure 1-4 Transportation procurement model (Caplice 1996, pp. 30)

Shippers begin the procurement process with a strategic decision of selecting the carrier base. Carriers are screened to reduce the sheer size of the process, seeking those firms of higher quality in the eyes of the shipper. Criteria often used to screen carriers include financial stability, geographic capability, technological capability, and equipment availability.

Following the screening process, shippers begin the tactical process, starting with the exchange of information with carriers. Specific details are provided to the carriers regarding the nature of the network to be served. The amount and detail of information provided to carriers varies significantly from shipper to shipper. There are no standards across the industry for this process nor is there agreement among shippers or carriers about the appropriate information to be exchanged. In part this is due to the differing requirements of each shipper. This poses a particularly difficult problem for carriers, which must respond with prices and potentially other commitments for each shipper, regardless of information. This exchange of information, including prices, between shippers and carriers is often iterative, be it a formal or informal process.

The second tactical step is to assign carriers to specific lanes until the shipper's network is fully covered. One or more carriers may serve each lane, typically with more than one carrier across the network. Many shippers assign their networks to a combination of carriers to provide the minimum cost of transportation services. This process most often occurs through a bidding process if contracts are involved, or in the spot market.

After carriers have been assigned to the network, the operational steps remain. Loads are tendered to each carrier for movement to their final destinations. In some lanes, the shipper only allows a single carrier for a particular shipment. Other times, a decision must be made to choose from among several carriers. The assignment process may provide guidelines for choosing carriers, but in most cases a real-time decision is required.

Finally, the performance of each carrier is reviewed, primarily to ensure that each transaction was carried out effectively. Many shippers also track specific measurements to assess whether the agreements with each carrier were fulfilled. Typical measures include tracking on-time performance, prices, and refusal rates. Furthermore, a

performance review often aids in future decisions to screen and potentially assign carriers in future bids.

1.4.2 Case Studies in Procurement Strategy

Prior to beginning the procurement process, shippers typically determine the expected relationship style and governance structures to be used for the transportation activities under bid. As discussed earlier, this decision is a function of the shipper's requirements, resulting both from the commodity to be moved and from the customer receiving the product. In general, as the shipper's requirements increase, the depth of the relationship also increases. Shippers with few requirements are more likely to use the spot market, while shippers that must depend heavily on high service or specialized transportation providers are more likely to develop stronger ties through contracts with the carrier.

These attitudes of shippers in contract negotiation and enforcement are often as important as the true requirements necessary to move their freight. Marcus (1987) discussed two basic approaches: market dominance and credible commitments. Shippers who seek to dominate their carriers by intimidation or threats are typically trying to reach cost minimization targets. On the other hand, credible commitments involve sustaining long-term relationships based on the efficiency advantage that arises from co-specialization of assets between firms. Commitments, often by contract, are made in the context of partnerships where risks and rewards are shared (Gentry 1993), typically found in markets where factors other than price are important to shippers. Marcus argues that most markets evolve from an initial strategy of market dominance to one of credible commitments as a market matures, once both parties discover and begin to take advantage of the full range of co-specialization benefits.

Several examples of procurement strategies and governance structures typically employed across industries are described below. Their purpose is simply to give a more detailed description of how firms have chosen to conduct business under each governance structure.

Spot Market

Few large shippers rely on this method to move the entirety of their shipments. Instead, the spot market is generally used for shipments that do not recur or are relatively unimportant in terms of cost and service in comparison to the rest of a shipper's freight. The cause may be that freight is shipped through other modes or that a special shipment must be made that does not fit the parameters of any existing governance structure already in place.

Basic Rate and Service Contracts, US Postal Service

Many shippers contract basic transportation services in order to obtain guaranteed rates and, in some cases, special service requirements. The United States Postal Service (USPS) follows this method, specifying all requirements in the contract. Motor carrier transportation is contracted primarily for movement between post offices, accounting for $1.6 billion in expenses during 1996. Over 15,500 contracts with highway transportation companies were in force. Due to the number of contracts signed with trucking firms, bidding and transportation procurement for these activities are handled at the local level. With local control, smaller businesses are allowed much greater access to bid on the traffic, encouraging greater diversity in the supplier base. Continuing relationships with carriers are encouraged, with every area having the final say in contracting within the overall budgetary limits.

Every highway contract is based on a standard format, including strict service requirements, delivery times from point to point, frequency of service and size of truck. The commitment of the USPS to guarantee that mail remains private and protected is different than many industries where general freight is shipped. Loss and damage is not acceptable from carriers, nor is tampering with the security of any shipment. Carriers with non-compliance problems must eliminate the problem or the contract is terminated. Because each lane is contracted with only one carrier responsible for handling all the business stipulated in the contract, any termination results in a new bidding process.

This basic strategy works well for the USPS in that such a decentralized process can be managed relatively easily due to the strict service requirements in every case. As

long as the carrier meets all service requirements, decisions only need to be made on a cost basis, limiting the variables that must be weighed during carrier selection.

Core Carriers, Gillette

Gillette has been very successful in establishing long-standing relationships with its base of core carriers. Over 90% of all business is handled by only 40 core carriers, not a very large number considering the high use of local LTL carriers. The remaining business is handled by other carriers because of special requirements or lanes inconsistent with the geographic coverage of the core carrier base. Carrier relationships have been relatively easy to maintain due to consistency in the sources for raw material as well as relatively stable demand from customers. Gillette's consistent requirements and expectations have also benefited carriers by allowing them to recognize and take advantage of lane balancing and backhaul opportunities. The strength of these relationships is reflected in the high level of service provided and the fact that carriers refuse an extremely low number of loads during the tendering process.

Another reason that core carriers have worked very well for Gillette is that it has somewhat specialized LTL service requirements for transportation from its regional distributors to its customers. A core group of local LTL carriers originating from each pool distribution center was initially selected based on their familiarity with delivering personal care products. Gillette believes that the stability of business attracts and keeps carriers so that a core of dependable carriers has been maintained. Another key to Gillette's success is its ability to communicate effectively with the carrier base, enabling it to depend on core carriers for responsiveness to new service opportunities.

A more thorough discussion of core carriers and their uses can be found in section 2.1.3 under the section of carrier screening.

Dedicated Transportation, Toyota

Toyota operates a parts consolidation center whose inbound routes are served by dedicated personnel and equipment provided by Schneider National. Due to the consistency of volumes and pickup locations, the same drivers and trucks are regularly scheduled to pickup parts and deliver them to the consolidation facility, allowing the drivers to become familiar with the routes and pickup locations. Toyota benefits in many

ways. Toyota gains the Schneider's expertise in drivers and equipment maintenance, while keeping the responsibility for managing the routing and scheduling of the service. Furthermore, Toyota no longer has the responsibility of managing a private fleet for this business. Schneider efficiently operates the fleet, while Toyota has flexibility to add or change routes without needing to invest its own capital and time into equipment and employees.

Third Parties, Ryder

The use of third party logistics providers (3PLs) varies drastically in the amount of control delegated by the shipper to the 3PL. In some cases, third parties manage only the billing and administrative matters related to transportation. In other cases, third parties, in effect, take over the management of a firm's transportation activities by planning, bidding, tendering loads and monitoring carrier performance. Ryder Integrated Logistics provides shippers with several levels of involvement in managing their transportation services.

As a third party, Ryder must manage multiple carriers and meet the needs of several shippers simultaneously. Ryder's strength in carrier management is leveraged by the size of its customer base and carrier relationships. Pricing and reporting issues may be provided by Ryder while day-to-day operations are still handled separately by each shipper and carrier. Ryder also manages operationally intensive functions for some shippers. In this way Ryder improves the shipper's negotiating power as well as operating efficiencies.

The general process by which a new shipper begins tendering loads through Ryder typically takes between six and eight months from initial contact to full implementation. All shippers must go through a qualifying process prior to signing a contract with Ryder. First, three to four months of historic shipment data is acquired. The rates and network structure are then evaluated and a strategic summary of proposed improvements is offered. This initial evaluation of the shipper's network is critical for both parties to determine what type of relationship each shipper will continue with Ryder.

After the strategic evaluation is completed, detailed traffic forecasts are required including delivery requirements for each facility, operating times and locations, as well as

any formal goals to be achieved. It is typically difficult, however, to gather all the necessary information at the onset of the relationship. With the available information, Ryder develops a proposed solution and reviews all operations in detail with the shipper. If the relationship is formalized, one of three options is typically chosen: a traditional bid is let, pricing is solicited from target carriers preferred by the shipper or the existing pricing structure is temporarily rolled over. Once the solution is implemented, shippers receive weekly details about shipments by mode, transportation costs and compliance along with other accounting information to monitor performance.

Shippers often seek third party services to be relieved of the technological burden of managing mode optimization, tendering, freight payments and a host of other technical issues. As a result, the 3PL typically brings a much higher level of visibility of traffic management to a shipper who may not have the appropriate systems to properly understand its own business. In doing so the shipper not only avoids the upfront expense of upgrading old systems, but eliminates the need to remain on the cutting edge of new developments in transportation and logistics software and systems.

Mixed Structures, A Large Retailer

Many companies employ a mix of several governance structures to handle the varying requirements of their businesses. For example, a large retailer uses two distinct transportation methods heavily: a private fleet and contracted transportation. The private fleet primarily makes store deliveries from its distribution centers. It is the largest private fleet in the United States, including 3,700 drivers, 3,500 trucks and 22,000 trailers. Drivers are given routes that, at a maximum, require one night on the road and then allow one night at home. Routes are selected to minimize the transportation costs for the private fleet, often combining moves to make closed (or nearly closed) tours. This retailer views the service provided to their retail stores by their own drivers as a very important reason for maintaining a private fleet, encouraging professional standards from each employee.

For inbound traffic to the distribution centers, the retailer uses both contracted transportation and its own private fleet. Over half of all goods are purchased collect from the vendor. In doing so, it takes ownership of the goods at the vendor's docks and

manages inbound transportation to their distribution centers (DCs). As a result, many inbound loads to the DC can be moved as a backhaul using the private fleet as the trucks return from their retail store routes to the DC. The corporate traffic department contracts the remaining transportation required, approximately 1.1 million loads in 1998. Two methods are used to select contract carriers. About 40% of the business is contracted through the use of an optimization-based decision support system for bidding, which includes service factors in addition to price to award traffic to the best carriers. The remaining 60% of contracts are strictly based on lowest cost, subject to a minimum level of service requirements. For these contracts, bidding is typically not required because of the attractiveness of doing business with this large company. Instead, interested carriers provide a 48-state matrix of rates that is loaded into a transportation management software program that selects the lowest priced carrier for each load during the tendering process.

Steps have been made in the last year to move toward improving relationships with carriers. In the past this shipper has used its size to command the service and rates it desired from carriers. Although the top 25 carriers of all modes carry 85% of all its business, this shipper has just begun to move toward shared forecasting and contingency planning with a few key carriers, its "Strategic Transportation Partners." In fact, one of its goals during 1998 and 1999 is to reduce the current number of total carriers from 515 to 125 in order to improve relationships with the companies with which it works. In general, this shipper's experience is very similar to many other companies across the transportation industry.

1.5 Summary

Carriers are faced with quite a challenge as a result of such dependence on consolidation and load balancing, causing high interdependence throughout the system. For LTL firms, economies of density encourage larger volumes concentrated in pockets across the network. TL firms, on the other hand, rely on balancing loads and economies of scope to improve their economics. Contracting allows carriers to construct more

efficient networks. The power of contracting, however, typically lies with the shipper, which can demand special service requirements or other terms.

Shippers are motivated by efficiency to choose the governance structure that minimizes total costs to their firms. However, even under similar circumstances, shippers will choose different structures due to the priorities of each firm or its managers. Firms with an intermediate or short term focus will be more likely to limit the bounds of their relationships with carriers in order to focus strictly on cost reductions. Firms with a long-range outlook are more likely to seek efficiencies that can be gained jointly with a carrier, forcing a more interdependent relationship. In either case, the strategy of the transportation function must support the overall strategy and goals of the shipper.

An overview of the procurement process was described, showing the cyclical nature of strategic, tactical and operational decisions. Several examples from industry were provided to introduce the varying procurement strategies employed by shippers. These brief introductions are further elaborated on in the following chapter, describing each of the five procurement steps in more detail.

2 Procurement Activity in the For-Hire Trucking Industry

This chapter focuses on the transportation procurement practices of shippers and third party providers as well as carrier response in the trucking industry. Each stage of the transportation procurement model shown in Figure 1-4 will be reviewed in turn. Information has been collected from three primary sources: past research described in literature, in-depth interviews with transportation managers, and survey results from shippers, carriers and third party logistics providers, conducted by MIT.

Benchmarking Sources

The survey and interview process is described below.

Surveys

Three separate surveys were conducted, one each for carriers, third parties and shippers in December of 1997. The specific questions asked and the summarized responses are found in the Appendices. These surveys were conducted at the request of the Defense Logistics Agency (DLA). Although the carrier survey contained some questions applicable only to government practices, eighty percent of the questions were generalized to capture the practices of all carriers, regardless of their relationships with DLA. The 3PL and shipper surveys were designed to capture industry-wide motor carrier procurement practices without regard to specific DLA practices.

The carrier survey was sent to 840 motor carriers. Surveys were mailed to all carriers conducting business with DLA, representing approximately half of the total number mailed. In addition, US carriers affiliated with the American Trucking Asoociations were included that operated over 175 trucks and tractors, excluding household goods carriers, munitions carriers and motor vehicle haulers. A response rate of 10 percent (86 returned surveys) was achieved. Of those returned, 37 (40 percent) did business with DLA at the time of the survey. Carriers are categorized as TL or LTL if

more than 70 percent of the revenue was listed in that category; otherwise the carrier was listed as Other. These categories are used to understand differing carrier practices between modes, as well as for comparison with shipper responses for either TL or LTL activities. Based on this distinction, nearly 70 percent of carriers primarily hauled TL freight, 17 percent LTL freight, and the remaining carriers were mixed or did not respond.

The third-party-logistics provider survey was mailed to 114 companies. Responses were received from 27 3PLs, constituting a response rate of 24 percent. Because 3PLs primarily handled TL freight their responses apply only to TL practices.

Shipper surveys were mailed to 831 individuals within 402 companies. The shipper recipient list was developed by selecting individuals from the Council of Logistics Management directory if their companies were listed as Fortune 1000 companies. Responses were received from 98 companies for a response rate of 24 percent at the company level. On average, shippers responded that 54 percent of transportation purchases were for TL shipments, 17 percent for LTL freight and the remaining were mixed or did not respond.

All sizes and revenue ranges responded to the carrier and 3PL surveys, indicating that the sample is representative of a wide group of firms in these two industries. Carrier revenues ranged from under $3 million to over $500 million annually. Similarly, 3PL revenues ranged from under $10 million to over $100 million annually. On the other hand, over 80 percent of shipper responses were received from companies with over $1 billion in annual revenues. This concentration of large shippers was part of the design of the survey with the use of the Fortune 1000 list. As such, survey results are likely to represent leading industry practices for transportation procurement. In fact, shippers that responded managed more than half of both inbound (two-thirds) and outbound (three-fourths) freight activities, leaving the remainder to be handled by their suppliers and customers. Their control of freight activities indicates an active role in transportation management.

The structure of the three surveys does not allow direct comparison of perceptions between specific carriers, 3PLs or shippers who currently are engaged in business together. Nonetheless, the perceptions of the roles of each industry segment have

grounds for general comparisons in that overarching perceptions in an industry have a basis regardless of the immediate partner with which business is transacted. Also, not every topic was addressed in all three surveys. Comparisons are drawn only between those responses that are relevant to one another.

Throughout this thesis the three surveys of shippers, carriers and third parties will be referred to as the MIT surveys to distinguish them from surveys reviewed from the literature.

Interviews

Interviews were conducted with transportation managers from seven firms. The intent of the interviews was to understand the general network of the firms as well as the strategies used to procure transportation. In each interview, the manager responded to a common list of questions. While these questions were the basis for discussion, each participant provided further information and additional perspectives on the business issues faced by the firm.

Among the interviewees were shippers: AmeriServe, Gillette, AlliedSignal, the United States Postal Service, and a large retailer. Of carriers and third parties, JB Hunt and Ryder Integrated Logistics participated in the interview process. These discussions occurred during the months of February and March of 1998. Changes in business practices since that time are not reflected below.

2.1 Carrier Screening

Although every shipper and third party develops its own standards and internal requirements, in general carrier screening seeks to reduce the unstable or unproven carriers from participating in the initial bidding process. This step is strategic in nature and requires a clear understanding of the overall transportation strategy of the shipper to determine the most appropriate strategy and carrier attributes. Because the procurement of transportation services is typically cyclical, the screening process includes the decision of adding new carriers to an existing base as well as eliminating current carriers.

The criteria used to initially screen carriers are typically used to select carriers during the assignment process as well. In most cases the two sets of criteria are not

identical, but do overlap in many areas. For example, overall on-time performance is likely to be used as an initial screening component. A shipper may once again use service components like on-time performance to aid in the decision of carrier assignment. Therefore, a review of assignment criteria is included here rather than with the discussion of the tactical decision of carrier assignment in section 2.3.

Because of the prevalent use of core carrier programs, which is an outgrowth of the screening process, a detailed description of these programs is included. Shippers increasingly depend on fewer relationships with partners that share strategic vision. Stronger shipper-carrier relationships allow improved sharing of information and opportunities to jointly reduce costs. Typically, participants in core carrier programs expect higher standards, better responsiveness and greater commitments to one another. In this type of market, some carriers are able to differentiate their products by including more specialized service components in addition to on-time performance and price.

This section focuses on the strategic level of carrier screening that occurs prior to a detailed exchange of information between shippers and carriers. Screening methods and criteria are reviewed, followed by a discussion of the use of core carriers in the industry.

2.1.1 Screening Process

Shippers screen carriers to ensure the quality of transportation services as well as to reduce the total number of carriers with which bidding activities are performed. Initially, some shippers use a formal certification process to select carriers for bidding. Others screen carriers by allowing only known carriers or only carriers above a certain size to bid. Once the initial screening process is complete, shippers continue the procurement process until carriers have been assigned and the network is covered. In many cases, however, additional carriers must be added or eliminated from the base prior to a full-blown bid. Alternatively, a third party may be used to provide this entire service. These issues are discussed in turn.

The clearest definition of a screening program can be seen in the certification process, a tool used by companies to manage the purchase of both goods and services. The ISO quality initiative that has been so well accepted in manufacturing is an example

of this type of activity. Initially, certification programs were developed by manufacturers to reduce the need for inspection of goods upon receipt. Certification allowed buyers to accept product only from partners who maintained high quality standards. More recently, purchasers of services have also used certification as a part of an overall quality management system. However, the implementation of certification processes for transportation services has only recently gained widespread popularity.

Gibson, Mundy and Sink (1995) discuss three general business approaches to the process of certification: in-house development of standards by buyers, standardized systems, and supplier self-certification. Proprietary certification systems are developed in-house to meet the exact requirements of the buyers. However, this precise level of information can only be gained using extensive development time and capital. Standardized certification programs eliminate the need for redundant certifications by suppliers, but cannot address the variable requirements of buyers. Supplier self-certification on the other hand may not meet the requirements of shippers due to the fact that an internal process may be seen as less reliable than one initiated and conducted from outside the firm.

Shippers seeking transportation services have been forced to rely upon in-house certification due to a lack of industry standards available to develop any standardized programs. 3M was one of the first shippers to develop a carrier certification process in 1983. The core of its program included setting proprietary standards, measuring and reviewing performance and taking corrective action as needed. Its focus was on operations and administrative relations. As certification programs became more developed many companies included supplier technological capabilities and financial stability in their criteria. In addition to traditional carrier selection criteria, the most innovative programs now include benchmarking, performance monitoring and a structured scoring system to rate and rank carriers.

In a survey of a wide variety of industries, Gibson, Mundy and Sink (1995) found that organizations are using certification for transportation services at an increasing rate. Almost 40 percent of respondents were using formal carrier certification programs, with only 20 percent of these programs being more than five years old. Gibson, Sink and Mundy (1993) also found that the purpose for selection and evaluation programs was

primarily to ensure carrier conformance to performance standards and to promote the safe transport of goods. However, shippers in their study stated that the most significant benefit gained from certification programs was cost improvement, with over half stating that a cost reduction of five percent or more was gained. On-time performance improvement was the second most important benefit from such programs.

While certification programs seem to be driven primarily by shippers, carriers have found that doing business with shippers using such programs provided benefits to them as well. Carriers were more often given long-term contracts and automatic renewal of contract by shippers with formal evaluation programs.

As mentioned in section 1.4, the procurement process is cyclical, often using information from the previous cycle to influence the decisions to procure transportation again. When a new carrier is added to the existing carrier base, say in a second round of procurement, the three most important criteria identified by Gibson, Sink and Mundy to make such a decision were on-time performance history, quality of service, and equipment availability. Over 75 percent of the respondents in their survey recognized these factors as the most important criteria for supplementing an existing carrier base. These factors exclude the consideration of rates, and suggest that the purpose for selecting additional carriers may be to secure additional capacity or to replace carriers with unacceptable service levels. In addition to these factors, Gibson, Sink and Mundy found that shippers preferred carriers that exhibited a willingness to focus on continuous improvement.

Baker (1984) reviewed the way in which shippers eliminate carriers from their existing base. Failure in the areas of transit time reliability, pickup service reliability and financial stability were the primary causes for elimination. She states that carriers are initially selected based on maximizing total potential gains to the shipper, however, carriers are eliminated (and simultaneously replaced) based on minimizing total shipper losses. Her theory states that decision-makers weigh the threat of a potential loss more heavily than an equivalent potential gain. As a result, Baker proposes that a carrier must high standards including superior service and price to be included in the process, but are easily eliminated. In some cases, this may be the reason that many carriers feel they

receive "mixed messages" from shippers about the relative importance of various service and price attributes.

Because of the nature of third party logistics providers, shippers using their services often have the advantage to preview several carriers based on recent performance with other shippers managed by the 3PL. Thus, a large fact-finding portion of the screening process is eliminated for shippers using 3PLs. Furthermore, the information collected by 3PLs is often standardized across their carrier base for easy and appropriate comparison during the screening process.

AmeriServe

AmeriServe distributes food to several restaurant chains across the United States with an annual transportation cost of approximately $400 million. In 1998 AmeriServe performed the certification process with 125 carriers, chosen from the highest revenue and best carriers from the current system's base. A diskette with 226 questions was sent to each carrier. Carriers were given approximately 2 months to return the diskettes for certification. Each question corresponded to one of four functional areas: customer service, fleet, financial stability and operations. Figure 2-1 shows the weighting applied to each area and a sampling of the topics.

Area	Weight	Sample Measures
Operations	40%	geographic coverage, safety, on time performance, claims ratio, EDI capability
Financial Stability	25%	sales, income, operating ratios from last 3 years
Customer Service	20%	single point of contact, problem resolution
Fleet	15%	size, age, number of equipment

Figure 2-1 Performance factors and weights used by AmeriServe for carrier certification

Based on the information provided, carriers are compared against a set of standard requirements in each area to be certified. Once a carrier is certified, each receives ratings compared to a given standard for each area. This information is used to aid in the carrier assignment process. If a carrier rates above the standard overall, the rates per mile of that carrier are reduced to reflect the relative attractiveness of its service. On the other hand, below average carriers have their rates increased. The range of increase or decrease for the final selection of carriers in each lane is bounded by a 5% change in the rate. The

effect of such maneuvering of rates is that a dollar value is actually assigned to each of the measured characteristics from the certification process.

This certification process is a very quantitative initial approach to rank bids, taking into account service factors as well as the base price. Prior to awarding lanes, a subjective review of the rankings with input from operations personnel allows carriers to be selected to meet both financial and service needs. Once the review of each carrier's rates and rankings is complete, carriers with the lowest adjusted rate per mile for each lane are awarded the business. The process is static, with carriers expected to be re-certified every one or two years if any significant changes occur.

2.1.2 Selection Criteria

Several surveys have been conducted to understand which criteria are important to shippers in the screening and selection of carriers. In most cases, service requirements and price ranked highly. Abshire and Premeaux (1991) found that shippers primarily sought carriers that met high service standards including reliability of on-time delivery and pickup, and total transit time for the shipment. Following these factors, shippers desired responsiveness in emergency situations, financial stability, handling expedited shipments, and flexibility in rates. A study by Minahan (1997) noted that rates and on-time pickup/delivery were most important, with geographic coverage and transit time also among the principle factors considered by shippers. In Gentry's (1991) survey, on-time delivery was clearly ranked the most influential factor with rates ranked second. The remaining factors important to carrier selection were geographic coverage, transit time, care in handling, shipment tracing, and financial condition of the carrier.

Moskal (1989) stated that core carriers should be measured by factors indicating that a successful and productive relationship with the carrier can be sustained. He noted the importance of a strong financial position, well-maintained and "market-responsive" equipment, a sufficient quantity of quality drivers, equipment density in required markets and EDI capabilities.

Earlier studies show that the criteria for carrier selection have not changed significantly over time. Bardi, Bagchi and Raghunathan (1989) found that transit time reliability, rates, total transit time, willingness of the carrier to negotiate rates, and

financial stability of the carrier were most important to shippers. Chow and Poist (1984) found the most important factors in carrier selection included transit time reliability, total door-to-door transit time, equipment availability at shipment date, quality of pickup and delivery service, and door-to-door transportation rates.

A study conducted by Foster and Strasser (1991) distinguished between shippers having a formal carrier selection and evaluation program and those without one. Respondents without a formal program were found to value freight rates above other criteria for selection, while shippers with a formal program ranked price below the importance of service reliability, consistency, and responsiveness. The result suggests that shippers with more pressing service requirements may seek to meet those requirements formally, while shippers with less critical service issues may simply rely on price signals to acquire the best carriers. Another interpretation is that shippers that are less sophisticated in procuring transportation are more focused on price than on other issues.

Other surveys have focused on determining how well carriers understand the importance of selection criteria to shippers. Crum and Allen (1997) compared carrier perceptions from similar surveys conducted in 1990 and 1996. The five criteria that were perceived to be the most important remained unchanged over the time period: transit time reliability, pickup and delivery reliability, quality of carrier personnel, willingness to negotiate price and carrier reputation. These factors are very similar to those noted by shippers. In this respect, shipper and carrier expectations have generally remained unchanged since deregulation. The remaining studies discuss the direct matching of shipper and carrier expectations.

Foster and Strasser (1989) found that shippers and motor carriers agreed on four of the top five carrier selection criteria variables: schedule reliability, door-to-door transportation costs, willingness to negotiate rates, and door-to-door transit time. While motor carriers perceived that transit time was the most important criteria, shippers ranked schedule reliability first. The study sought to further determine if shippers and motor carriers have internal reward systems that work in opposition to the most important carrier selection criteria. Shippers were rewarded internally by improving consistency of service and reducing costs, factors that match the top ranked selection criteria. Motor

carriers, however, were rewarded most for meeting the needs of shippers, increasing the number of new accounts, and increasing contacts with shippers. Carrier representatives must find a balance between meeting internal performance requirements and shipper standards.

Other studies that directly compare the perceptions of shippers and carriers typically allow each respondent to provide an absolute value for the importance of each criterion. These absolute values are then aggregated by shipper and carrier respondents and compared, determining whether a statistical difference exists between the absolute values. Abshire and Premaux's study found that in most cases, carriers typically over-emphasized the absolute importance of carrier selection criteria in comparison to shippers' preferences. Out of thirty-five possible criteria, nineteen exhibited differences in perceived importance. However, their conclusion was that overall carrier understanding of shipper desires was fairly good. Assuming that carriers did not place too much additional weight on the over-rated criteria, shippers would be satisfied with the performance of carriers based on the common perceptions.

Lambert, Lewis and Stock (1993) found the top selection criteria of LTL carriers included the honesty of dispatchers, on-time pickup, on-time delivery and competitive rates. Shippers perceived the performance of carriers to be fair to poor on these important selection criteria. However, the carriers' performance was rate better than desired for criteria ranked less important to shippers. Based on this survey, carriers have an opportunity to reallocate resources to the more important issues to better serve the LTL shipping community. Interestingly, the study also found that the five carriers most commonly evaluated by shippers in the survey were largely undifferentiated in price and performance rankings.

Similar to previous studies, Murphy, Daley and Hall (1997) found that *absolute* ratings of individual selection criteria were significantly different between carriers and shippers for over half of the factors reviewed. However, a review of the *relative* rankings of each factor by shippers and carriers showed only two criteria were found to differ: rates and negotiated service. Shippers ranked rates much more highly than carriers, while carriers considered negotiated service to be more important than rates. This reveals that carriers and shippers view the relative importance of attributes rather similarly, although

the absolute importance of several individual criteria may vary. Therefore the question of whether shippers and carriers truly agree on these criteria or not remains unanswered.

Results of the MIT surveys revealed some differences of the use of pre-bid selection criteria among groups. In general, shippers and third parties agreed on the relative importance of each criterion. Figure 2-2 shows the items that were requested by more than half of shippers and 3PLs.

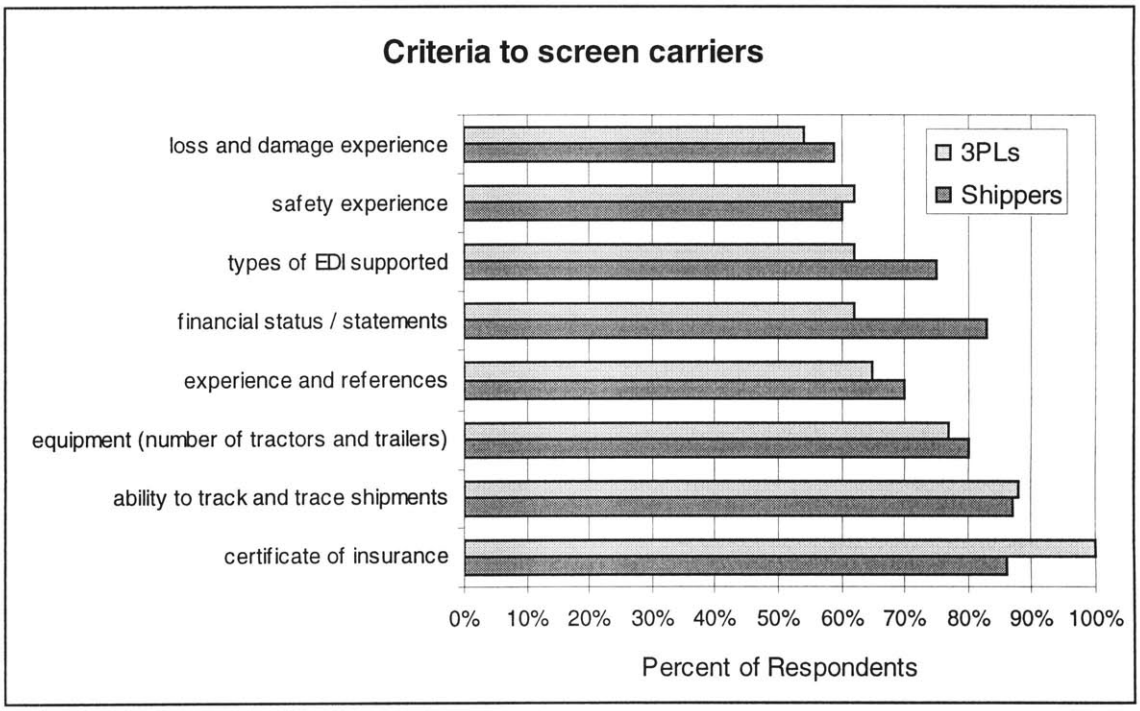

Figure 2-2 Criteria for carrier screening

Carriers were also asked to respond with the percent of customers requiring each criterion prior to selection. Truckload and LTL carriers differed significantly in the requests made of them. With the exception of the criterion of experience and references, LTL carriers stated similar requirements to the shippers and third parties. For TL carriers, however, only three items were requested by more than half of their customers, including a certificate of insurance, equipment information and experience and references. This shows the large variability of truckload requirements across customers. Also larger shippers have come to an agreement on key carrier requirements, while the bidding practices of smaller firms not captured in the MIT shipper survey may vary significantly as indicated by the carrier survey.

2.1.3 Core Carriers

Porter (1987) explains that if one party has greater power in the market than another, it is likely to use that power to improve its bargaining position. For example, a large shipper can increase its bargaining power in purchasing transportation by keeping the number of carriers large enough to ensure competition, but small enough to be an important buyer to each one. With this incentive along with a focus on quality relationships, many core carrier programs were developed throughout the 1980s.

Core carrier programs take on many different characteristics depending on the shipper involved. Shippers expect that by concentrating the volume among a smaller number of core carriers their power will be greater to demand both lower prices and higher service. In general, shippers state that the benefits of core carrier programs include reduced transaction costs and tailored services, while providing a few carriers more financial stability in the form of more business. In some cases the loads may become more stable and reliable as the volumes increase for the carrier. These benefits may improve the carrier's economics and, in turn, result in lower rates for the shipper, especially in the LTL industry.

Carriers that participate in these programs expect, and often receive, better information from the shipper, allowing prices to more accurately reflect the service provided. This aspect of information exchange will be discussed in section 2.2. Another benefit of core carrier relationships is found in the improvement of communication for operational activities. Core carrier programs provide carriers benefits by linking shippers to the technology resources used to administer tendering, which reduces response time to tenders and increases switching costs for shippers if a new carrier is considered for their businesses.

In a study by Crum and Allen (1990) over half of the respondents stated that a carrier reduction strategy was employed from 1984 to 1988. In 1984 the average number of carriers was 158 while in 1988 it was near 100, a drop of approximately one-third. At the time of the study, two-thirds of the respondents expected the decrease to continue over the next five years, with only 3 percent expecting an increase. Baker's (1984) survey showed that 34 percent of respondents used 10 or fewer total motor carriers and another 24 percent using only 11 to 20 carriers. The primary reason given for the use of a

limited number of carriers was that more control over transportation activities could be achieved. This mimics the popular concept of core carrier programs.

In the MIT surveys, shippers' and third parties' use of core carrier programs was compared to the total number of carriers used for both TL and LTL services. Both segments tendered to many more TL carriers than to LTL carriers on an annual basis, as shown in Figure 2-3. The extreme difference in the number of TL carriers between shippers and third parties could be a result of many factors. As 3PL providers serve customers with varied needs, more specialized TL carriers are required. Similarly, 3PL customers may have existing relationships with TL carriers that cannot easily be broken upon entering into an agreement with a 3PL, therefore causing more carriers to be added to the 3PL base. In general, capacity is more fixed with TL carriers, while LTL carriers have greater flexibility to add capacity by reoptimizing the consolidated trucking network.

	TL (Average / Median)	LTL (Average / Median)
Total Carriers		
Shippers	73 / 30	27 / 10
Third Parties	694 / 200	27 / 20
Core Carriers		
Shippers	24 / 10	10 / 5
Third Parties	35 / 18 (combined TL and LTL)	

Figure 2-3 Number of carriers to which loads were tendered

Core carrier programs were used to reduce the number of carriers by almost 87 percent of shippers and 64 percent of 3PLs. The table shows that core carriers consist of at most 50 percent of the total number of both TL and LTL carriers used by shippers. This average is much lower for 3PLs due to the larger number of total carriers in the system. Although the core carriers constituted one half or fewer of the total number of carriers used, they handled nearly 80 percent of shippers' business, and nearly 60 percent of the business for 3PLs. Carriers were also asked what percent of business they handled under core carrier programs. For both TL and LTL carriers, just over one third of all carrier revenue was generated through a core carrier program. Clearly core carrier programs are widely used across the trucking industry.

AlliedSignal

The initial goal of AlliedSignal's core carrier program is to provide a core network of carriers that would initially handle approximately 80 percent of all transportation requirements for its business units, understanding that customized solutions may be needed for the remaining business. Upon reaching the goal of 80 percent, the measure will be evaluated to determine its appropriateness. Currently the strategic business units (SBUs) have about 85 percent compliance with the core carrier program. An example of the success of this program is the dramatic reduction in LTL carriers used by AlliedSignal's automotive product group. In 1997, 220 carriers were tendered to, only one third of the total carriers from the previous year. By bringing each SBU together under one contract for each carrier and mode, purchasing power and more attractive business opportunities for carriers have been gained.

With a better focus on the LTL carriers with which AlliedSignal does business, a cooperative model of operations has been possible. In the past, carriers were only concerned about gaining as much volume as possible, while AlliedSignal simply chose the carrier with the lowest rate. During the first six months of the program, AlliedSignal made efforts to match business requirements to the capabilities of its core carriers. For example, LTL cut-off times for pick ups and set offs were reviewed as well as operations at local LTL consolidation locations. This information was matched to AlliedSignal's business requirements to provide a better scheduling and a better mix of freight for each carrier's network.

JB Hunt

From a carrier's perspective, JB Hunt views core carrier programs as an attractive way to serve customers more effectively. Fewer relationships must be developed by both shippers and carriers, and administrative burdens are reduced as business with core carriers increases. This allows JB Hunt to get to know each shipper's business better as a result of the improved relationships. Almost all bids received by JB Hunt focus on a core carrier strategy. Between 60 and 80 percent of all business is gained from shippers using core carrier programs.

Efficiencies are primarily gained by sharing information about operations and requirements. For example, surge capacity is much easier to manage under this

environment. Well-managed shippers are likely to notify JB Hunt several weeks in advance of increased demand. This allows JB Hunt time to better reposition equipment and schedule loads appropriately when capacity is constrained. Another way JB Hunt and its shippers benefit from core carrier relationships is that JB Hunt typically knows in advance when a bid is coming up. Even though the shipper does not typically allow a longer time frame for a response once the bid is received, JB Hunt is able to prepare prior to the bid receipt and to better respond to the request.

JB Hunt takes advantage of this information by providing more creative, "engineered solutions" for top shippers. As a result, JB Hunt improves utilization, generating cost efficiencies that are then shared between the carrier, through lower costs, and the shipper, through reduced rates. Success in this area has been reached with shippers like Wal-Mart, Procter & Gamble, and Ford. Without this coordination, JB Hunt would have been forced to hedge the rates for contingencies that were not disclosed, or perhaps not known, by the shipper.

2.2 Information Exchange

Shippers have the responsibility of providing an initial picture of their network to the carrier. A distinctive feature of each shipper's operation is the method by which this information is exchanged. Some shippers choose to send out a single paper request for rates while others rely on electronic communication and require multiple rounds of bidding with the carriers.

This section focuses on the interaction between shippers, 3PLs and carriers during the bidding process prior to awarding (assigning) business to the carriers. Two primary issues will be discussed: the methods used by shippers and 3PLs to solicit rates from carriers and the level of detail in the information changed. Research on bidding methods exists, but little has been done in the area of detailed information exchange.

2.2.1 Bidding Process

Caplice (1996, pp. 236) discusses the method of auctions and competitive bids in the truckload industry. The most prevalent form of bidding is the single round, sealed bid

auction that selects the low cost carrier in each individual lane. Rinehart (1989) found that two-thirds of shippers use a formal bidding process to acquire carrier services. The effect of this design on shippers and carriers is that shippers may actually increase the amount of hedging from carriers and that the advantages of economies of scope cannot be gained through such a method. Carriers are forced to hedge their prices because of uncertainty in the information provided by shippers and in the ability to make follow-on connections with another load.

Although core carrier programs may reduce the number of carriers involved in the bidding process, making it more likely that a carrier will gain multiple lanes, the carrier is still unsure as to the specific lanes that it will gain. As a result, prices must be hedged to guard against, for example, winning only one of two lanes that form a continuous move if combined. Furthermore, the empirical observation of the "winner's curse" describes that carriers are most likely to win the lanes which they most over-valued and consequently under-priced. The result is minimal profits, or potentially even losses. Carriers therefore find hedging the only way to protect against inefficient operations when lane by lane bidding exists.

Both shippers and carriers were asked in the MIT surveys what methods were used to solicit rates. For both TL and LTL modes competitive bids and/or face to face negotiation are the most common. Nearly 75 percent of all shippers use both methods. Both TL and LTL carriers agreed that 80 to 90 percent of their business was obtained through these methods. Solicitation of single loads at a time, either through brokers or the spot market, was used by one-fourth of shippers, while trucking companies in particular stated that only 13 percent of revenues were generated in this way. This leads to the conclusion that although a relatively large number of shippers solicit single loads at a time, very little business moves with rates negotiated in this manner.

Sophistication in the exchange of information has a long way to go. Although electronic communication is extensive in the transportation industry, less than 25 percent of shippers and third parties stated that electronic communication methods were the only communication of pre-bid information. Instead, 40 percent of shippers provided all pre-bid information to carriers by paper, compared to 28 percent of third parties. Electronic communication was conducted almost exclusively by sharing diskettes of information.

Ryder Integrated Logistics

Ryder has been innovative in its LTL and TL bidding procedures. In 1997 Ryder began using a two-tiered bidding system for TL carriers. In the first step, Ryder selects a group of core carriers based on the quality measures that appear to match well with the customer's business requirements. These carriers each submit a bid based on the initial shipment information provided. When the first bids are received, each carrier is given the lowest bid from each lane. The second step allows each carrier to submit a second bid that will be used to award the traffic.

This method has some very distinct benefits. The second set of bids tends to be highly concentrated in the same range. With this information, the market price is determined roughly by the average of the second round, and any bids outside an upper or lower limit (+/- 0.3 sigma) are eliminated. Ryder believes that bids below the range are a result of underbidding the requirements and would result in a later renegotiation of rates to protect the carrier. Another benefit of a tight range of bids is that if a secondary carrier must be used in any lane, it is not likely to have a significant negative impact on the overall cost. In 1998, this process was handled electronically with spreadsheets and databases, but specific software packages wer under review to automate the process.

2.2.2 Information Detail

In defining the method of communication with carriers, shippers and third parties also define the time lines, rate structures and processes required from carriers. Initially, shippers provide information about the origins, destinations, commodity types, and volumes to be bid. Given this information, the carrier weighs the predictive value of the information, often compares this data to its own network and historical information about the shipper (if available), and determines prices for these lanes. Additional communication often occurs between these two steps for clarification or to allow carriers to revise their bids.

Many shippers find it very difficult to maintain accurate, useful information for bidding. Their shipping or receiving clerks may not keep electronic information. Billing records often leave out important details regarding the transportation information required by carriers. Therefore, carriers are forced to hedge their rates based on

incomplete network information. Those carriers with existing relationships benefit from the information they retain about historical movements by using its predictive value for ongoing bidding.

Traffic Flow

As described earlier, no standards exist among shippers and carriers regarding the appropriate information needed during the bidding process. In fact, only three types of traffic flow information were provided to carriers by more than one third of all shippers, with third parties adding a fourth. Shipper information provided to LTL and TL carriers, shown as LTL and TL in Figure 2-4, was primarily related to the amount of freight. In addition to these items, 3PLs included frequency of stop-offs per lane. Any other information was reported by one-third or fewer respondents. Third parties in general were more likely to provide traffic flow information to carriers. It is possible that due to the third party understanding of carrier needs, more information is initially gathered to reduce hedging in the returned bids.

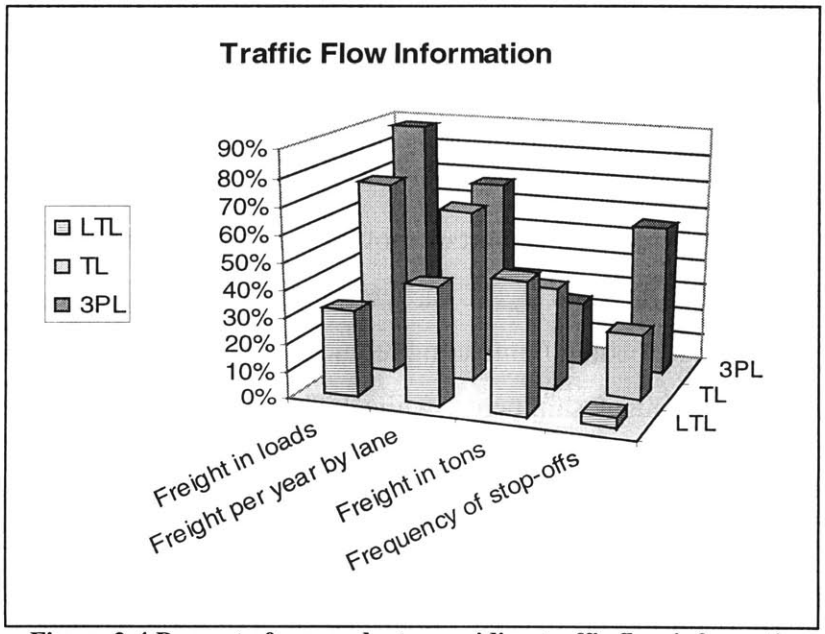

Figure 2-4 Percent of respondents providing traffic flow information

Carriers were asked to rate the importance of each piece of traffic flow information on a five-point scale. TL carriers stated that the two most important factors were amount of freight in loads and per year by lane, but included several other criteria which were unmet by most shippers. The lack of shipper information deemed important

by carriers suggests that a significant amount of hedging is required in the bidding process for carriers to ensure profitable rate levels. LTL carriers agreed that the amount of freight per year by lane was important, but ranked only one other issue as very important: weight by commodity, which is not typically provided by shippers. Through the fewer requirements for LTL carriers, we see that their consolidation activities are able to handle more variability in service requests than those of the TL industry.

Each respondent was also asked to describe the facility information provided to carriers during the bidding process. Much of the information provided by shippers was similar for TL and LTL shipments, as seen in Figure 2-5. Again, third parties included more information than shippers in their bids.

	TL Shippers	LTL Shippers	3PLs
Location	88%	79%	100%
Operating hours	77%	71%	88%
Scheduling requirements	71%	53%	83%
Point of contact	70%	63%	38%
Live load/unload requirements	61%	39%	79%
Average weight of shipment	56%	47%	75%
Average loading/unloading time	31%	23%	63%
Pallet exchange	33%	24%	63%
Average lead time for tender	34%	24%	63%

Figure 2-5 Percent of respondents providing information related to the facility

Carriers also provided the importance of each piece of facility information on a five-point scale. Both TL and LTL carriers ranked location, live load / unload requirements and average loading / unloading requirements most highly. TL carriers also desired the average weight of shipments, while LTL carriers included operating hours among the top four. From this we see that third parties again were much better at providing carriers with the information they needed to appropriately develop rates for their customers. Shippers provided much less information which carriers use to make decisions.

Rate Structures

Although rate structures may differ between contracts, rates primarily reflect the cost of the direct transportation while accessorial charges account for additional services provided by the carrier. The direct transportation services for an LTL carrier typically

include loading and unloading (handling), local movements to and from terminals, sorting activities at terminals, and line-haul movements between terminals. TL carriers are usually engaged only in handling activities and line-haul movements between the origin and destination. Accessorials may include waiting time, intermediate stops, pallet returns and many other items.

There is no consensus across carriers, shippers and 3PLs about the most appropriate way to structure rates. This causes a large amount of inefficiency for carriers in making and maintaining differing rate structures for separate customers. No single TL rate structure is used more often than another by shippers or third parties. In order of most frequent, the rate structures used by TL carriers were rate per mile with a minimum charge, flat rate and rate per mile.

Similarly, for LTL rate structures, no one structure was clearly used more than others across respondents. Almost 50 percent of the shippers surveyed stated that they used freight all kind (FAK) rates. For third party providers, both rates per hundredweight (CWT) and FAK rates were the most common. Carriers responded that they primarily used NMFC (National Motor Freight Classification) based rate structures. The NMFC determines which standard classification a carrier uses to identify and rate each shipment for transport. From this classification, carriers offer discounted prices based on a set rate structure determined by the shipment's weight and the distance it will travel.

In addition to the basic structure of rates, some shippers seek flexibility by allowing carriers to offer rates in a single lane that differ based on special circumstances. In most cases, multiple rates are used to more accurately reflect the cost of the service provided. Again, third parties were more flexible and responsive to carriers than shippers. The use of multiple rates for TL shipments was allowed by more nearly 70 percent of third parties under four circumstances: differences in trailer length, if a previous load was inbound to the facility, intermodal movements and differences in the transit time. More than half of all shippers did not allow multiple rates under any circumstance. The most likely case for shippers to warrant multiple TL rates was with intermodal moves, used by 46 percent of respondents. Based on carrier responses to the MIT survey, multiple rates were not typically allowed for TL shipments, except if a previous load was inbound to the facility.

For LTL shipments, carriers stated that they were allowed multiple rates depending on the mix of commodities (64 percent) and the annual volume of total shipments (77 percent). Shippers, however, stated they were even less flexible with LTL rates, with no more than 20 percent of respondents allowing multiple rates in a single lane for any particular circumstance.

Instead of the using multiple rates, shippers of TL freight were more likely to pay for accessorials to account for special carrier services. More than 70 percent of shippers paid accessorials for TL shipments with stop-offs, for detention or waiting time, and under fuel surcharge programs. Similarly, more than 70 percent of third party providers paid for these accessorials as well as for loading or unloading charges and for equipment furnished but not used. For LTL shipments, however, fuel surcharges were the only accessorial paid by more than half of all shippers.

Lane Definition

When providing carriers with information, the shipper or third party must determine the way in which the network is defined. For example, shippers define the size of origins and destinations for each lane. An origin can consist of a specific address or a broader definition such as a zip code or even a state. These definitions were relatively similar for TL and LTL shippers, as well as for 3PLs. Five digit zip codes and city-state locations are the most common identifier for locations. To a lesser degree, shippers also use three digit zip codes, statewide and multi-state regions.

It is typical for TL shippers to request rates for point to point locations, region to region locations, or a combination of the two for rate coverage. Lanes with the largest volume and cost are often managed at a detailed level, while the remaining lanes are covered by rates with widely defined geographies in place for their limited use. Theoretically, the larger the region of the areas bid, the higher the rate per load quoted. This is due to the fact that carriers must hedge against an abundance of movements from the farthest edges of each region compared to a move from the relative centers of one region to the other. In the regression analysis of section 3.3.1, lanes that are defined by regions rather than points are shown to have a significantly higher cost.

For LTL shipments, a larger region may not necessarily mean higher prices due to the uncertainty of destinations, distance and volume. Because of the nature of LTL consolidation activities, greater volumes to larger regions will potentially have lower rates than smaller volumes to more narrowly defined regions. As a result, shippers may be able to leverage relatively high volume shipments into a particular site to also gain better rates to other locations defined within the same region (rather than separating high volume from the rest of the rates). This strategy also simplifies the administrative work to maintain rates for "incidental shipments" by providing wide geographic coverage in the rate structure.

JB Hunt

Preparing a response to shipper bids is very challenging, particularly when little information is provided. The best shippers of JB Hunt provide summary level data by 5 digit zip origins and destinations, number of loads, times and dates, with shipment detail available if needed. In addition, all required accessorial activities are important to know as well as the operating hours and loading/unloading times at both the shipper and receiver. Once this information has been processed, JB Hunt seeks to schedule a face to face meeting with the shipper to review the assumptions used to generate rates and any other outstanding issues.

With the appropriate preparation lead time, approximately two full weeks, JB Hunt analyzes each bid for potential opportunities of synergy with existing business. Depending on the benefit that can be gained with this business "in the mix", lanes are basically grouped into one of three categories with respect to the form of pricing offered. For the lanes best suited to the JB Hunt network, aggressive (lower) pricing is offered. Average pricing compared to the market is provided on lanes to which JB Hunt is unaffected positively or negatively, and an appropriate level of profitability is ensured on the remaining lanes.

Figure 2-6 shows the factors that JB Hunt considers to make a difference in its economics. Each of these circumstances is considered valuable enough to offer multiple rates in the same lane to more accurately reflect operating costs. However, in some cases the customer does not allow multiple rates to be offered. Based on the needs of shippers,

multiple rates can reduce the amount of hedging required by JB Hunt in the bidding process.

Multiple rates are offered by JB Hunt	Multiple rates are not allowed by shipper, but would be preferred by JB Hunt
• Depending on whether it is a continuous move • Depending on whether it is Over-the-Road or Intermodal • Depending on transit time	• If consistent weekly volumes are offered • Depending on the number of loads already tendered on a lane that week • Depending on attaining certain annual freight volumes • Depending on the day of the week • Depending on different trailer lengths

Figure 2-6 Situations where multiple rates are used or preferred by JB Hunt.

JB Hunt has maintained a database of all bids, both formal and informal, received from shippers since 1997. The information received from shippers is logged as well as a summary of the information returned to the shipper. With the use of this system, JB Hunt is able to quickly determine the current status of any bid, in addition to all past bid information requested by every shipper. Furthermore, future solicitations can be anticipated without notice from the shipper. Prior to this system, spreadsheets and hard copies were the only historical source of bidding information. In this way JB Hunt has improved the information available to make the most accurate predictions of costs for the rate-making process. In addition to these benefits, lanes with backhaul opportunities can be identified and solicited after reviewing the network generated through the bidding process.

2.3 Carrier Assignment and Award Methods

In making carrier selection decisions, a shipper must determine 1) the relevant quantitative cost factors as well as less tangible qualitative factors and 2) how to weight all of these factors together to select the carrier best able to meet the shipper's needs. The determination of the quantitative and qualitative factors to assign carriers was discussed in section 2.1.2. This section describes the methods used by shippers and third parties to evaluate those factors, weighing the advantages of one carrier over another.

Carrier selection methods vary among shippers as much as the criteria by which carriers are measured. In general, two approaches may be taken. Many shippers select carriers with the lowest rates subject to a set of minimum service requirements, often a less formal approach. Other shippers choose several criteria, weight their importance, and select carriers based on maximizing the benefits (or minimizing the costs) provided by each carrier. This approach is more difficult to implement, requiring relatively sophisticated software to aid in the decision-making for large problems. Literature on this subject includes two examples of optimization approaches.

Moore, Warmke and Gorban (1991) discuss an optimization and simulation model that is used to assign carriers to the transportation network at Reynolds Metal Company. The optimization model first assigns carriers on a lane by lane basis with the objective of minimizing total freight costs. Only the bids from those carriers meeting minimum service requirements are considered in the optimization model. Requirements set by Reynolds for the number of total carriers in the system, maximum carriers at a location, and volume commitments are met in this model. Several iterations of the model are solved to review the impacts of changing these constraints.

Using the results of the optimization, a simulation model is used to evaluate the potential for continuous moves and the effects of variable shipping patterns. This model incorporates the penalties of under-utilization of fixed equipment commitments as well as the benefits of inbound shipments for continuous moves. The simulation model does not revise the set of carriers chosen in the optimization model. Instead, it changes the assignment of lanes to carriers to take advantage of cost improvements provided by continuous moves. The simulation results are then used as the basis for making the final lane assignments.

Caplice (1996, pp. 197) discusses the use of optimization models that incorporate the ability of carriers to submit conditional rates, explicitly allowing carriers to take advantage of economies of scope when possible. In these models carriers are allowed to submit rates for lanes independently or conditioned on the acceptance of rates in other lanes. For example, a rate of $1.10 per mile for lane A may be given independently, but if the carrier also wins lane B, the rate in lane A would be reduced to $1.00 per mile. The conditional bid increases the attractiveness of bidding for carriers by producing more

efficient aggregations of lanes (discussed below), that when taken together increase the probability of finding a follow-on load for the carrier and reduce the need for deadheading and / or dwell time. Shippers and carriers both benefit from the carrier's ability to win multiple lanes that complement their network, exploiting economies of scope.

Efficient aggregations can be categorized into four types: reloads, open tours, closed tours, and local tours. Reloads are opportunities for matching inbound and outbound loads at a specific location. An open tour is a collection of lanes that form a chain that begins and ends at different locations and may contain deadhead movements. Closed tours are similar to open tours except that they begin and end at the same location. Local tours were identified as a collection of lanes with a common origin or destination that require less than half a day's travel (Caplice 1996, pp. 237).

Different formulations of these models were distinguished by the selection of carriers by load and by lane. Assignment of carriers by load apportions the traffic on each lane, allowing multiple carriers to win the same lane. The by lane formulation ranks winning carriers without assigning a specific number of loads to each one. A second distinction was made between models using bid-sets and carrier-sets, both allowing the use of conditional bids. The bid-set model treats conditional bids as unique, in addition to other bids for individual lanes. Furthermore, the bid-set model assigns lanes only to one primary carrier, but identifies secondary carriers if desired. The carrier-set model treats each possible lane allocation to a carrier as a single decision variable, assigning a number of loads per lane. Although the carrier-set model allows the use of volume based pricing, its implementation is not computationally practical (Caplice 1996, pp. 231).

2.4 Load Tendering and Performance Review

Once the strategic and tactical steps of procurement are complete, only the operational steps of load tendering and performance review remain.

2.4.1 Load Tendering

For most shippers, tendering of shipments is a relatively mundane, time intensive task. As a result, some shippers have chosen to adapt technologies that improve its efficiency. Load tendering may involve selecting the appropriate carrier from a list, contacting that carrier, providing shipment details and requirements to the carrier, and receiving a confirmation that the carrier will, in fact, move the shipment. The tendering process may take days or hours to complete, depending on the situation. The more rapidly this exchange takes place, the shorter length of time passes while the freight waits to be shipped.

Some shippers using electronic data interchange (EDI) have adopted processes for automatic load tendering and confirmation with this technology, hoping that nonproductive time can be eliminated from the tendering process. Carriers receive the transmission and send the confirmation electronically, in some cases immediately or within a few hours. If a carrier turns down a load, the shipper can automatically send another EDI transmission to the secondary carrier with little loss in time. AmeriServe has successfully implemented such a program with its core carriers. However, most shippers still rely on the mediums of fax and telephone to tender loads to carriers.

The technology used for tendering gives an indication of the sophistication of the transportation consumer. The responses of shippers in the MIT survey show similar practices for tendering of TL loads and LTL shipments, with between half and 60 percent of tendering completed by telephone. Fax tenders were the second most common mode of tendering for shippers, ranging from 16 percent to 32 percent. Most shippers thus rely on old technology to complete this time-intensive function.

Third party providers are different from shippers and carriers in that approximately 30 percent of all 3PL tenders are given by EDI, almost as many as by telephone (39 percent). This difference may be explained by the fact that 3PLs often provide shippers with technological solutions to functions otherwise performed manually by the shipper. This technology provides the efficiency that allows third parties to serve their shippers effectively.

For carriers however, the tendering process can be extremely complex. Each decision to accept a load tendered to them involves a core profitability decision. Several

computer models have been developed to aid in this process. For example, Powell, et al. (1988) describe a model used to determine optimal dispatching policies for truckload operations given high levels of demand uncertainty. An optimization model incorporating stochastic elements is used to provide the most profitable real-time decision whether to accept or reject a load tendered to it, as well as understanding from where each truck will be dispatched to haul those loads that are accepted.

2.4.2 Performance Review

Transportation cannot be inventoried, verified in advance, or counted. Therefore this service is intangible in many ways. In fact, some elements of performance are compared only to an expectation of the customer, rather than to a formal standard. This stems from the fact that services are performances rather than objects. As a result, the evaluation of transportation service includes both the process as well as the final outcome (Parasuraman, Zeithaml and Berry 1985). With so many complications and relatively undefined factors, carriers often find it difficult to understand how buyers truly perceive their services (Bowersox 1990).

Variation in the "production" of transportation services is typically much greater than that of an object. Although all processes have some natural variation, the performance of transportation services is subject to more variation than a typical repetitive process on a single piece of equipment. Transportation has many more uncontrollable factors that can influence the final outcome: the carrier faces unavoidable disruptions on the road; the duration of the service generally covers a long time span; and additional variation is produced by the human element involved (Gentry, 1993).

In spite of these factors, or perhaps as a result of them, shippers have begun tracking performance rather seriously. This can be seen by comparing the results of the MIT survey in Figure 2-7 to the research done by Chow and Poist (1984) in the early 1980s. In the Chow and Poist survey, only five carrier measurements were formally tracked by as many as 25 percent of respondents. At that time the important measures were freight loss and damage, claims processing, transit time reliability, negotiating rate changes and shipment tracing. In fact, they are not dissimilar from today.

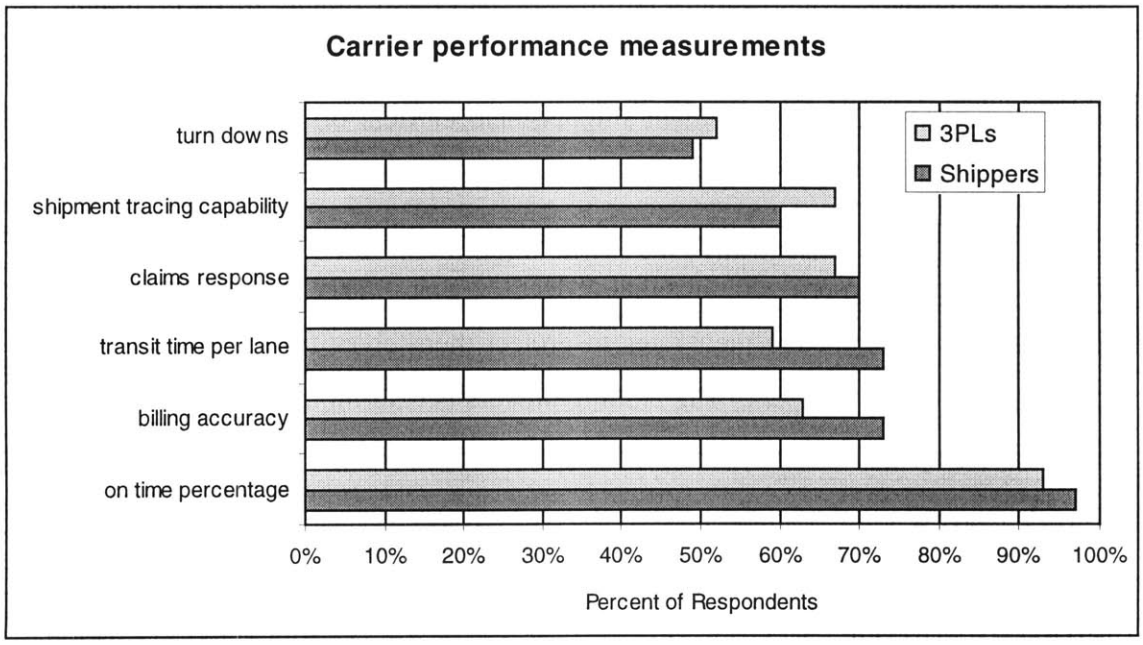

Figure 2-7 Carrier performance measurements

Most shippers and 3PLs store these performance measures in a central location, collecting the information primarily by a manual process. Carriers provide much of the information as a service to their customers, even though they are, in fact, measuring themselves. Practically all shippers from the MIT survey include the use of performance measurements in their decision to assign carriers. However, barely 10 percent of the respondents assign a specific dollar value to each measure in the assignment process. Therefore, the use of these measures remains somewhat of a question. It is possible that their primary function is preventative, kept by shippers as "insurance" to discourage poor performance. On the other hand, this information is also used by some shippers to give quality awards to their best carriers. As such, the improved use of performance measurements remains a potential opportunity from which shippers will be able to reap benefits in the future.

2.5 Summary

The overall process for procuring motor carrier transportation was discussed in detail. Shippers and third parties vary significantly in the methods and criteria used to screen carriers. This variability maintains a high cost of screening for each party because

the dissimilarities do not allow the effort of multiple shippers to be combined. In an effort to improve communications with carriers, many shippers follow a strategy of using core carriers. In this environment shippers and carriers often share more information, working towards a partnership rather than an adversarial relationship.

The quality of information exchanged during the bidding process determines the ability of carriers to provide rates that reflect the cost of service. Poor information often requires carriers to hedge their rates to protect themselves from unexpected costs once they begin serving shippers. The bidding process is determined by shippers and typically is based on a single round, sealed bid auction to identify the low cost carrier in each lane. Some shippers are moving to the use of conditional bids, allowing carriers to reduce hedging by taking advantage of economies of scope.

Carrier assignment and award methods used by shippers are typically based on the selection of carriers that minimizes total freight transportation costs. Some shippers attempt to solve this problem by choosing carriers with the lowest cost in each lane. Other shippers use more sophisticated models to incorporate service criteria and administrative considerations into the decision.

Load tendering is primarily a routine task for shippers. However, for carriers the decision to accept load tenders is an extremely difficult problem and requires extensive forecasting and probabilistic modeling to determine the most optimal decisions. Performance measurement primarily allows shippers to monitor carrier conformance to contracts, but is leveraged by some shippers for greater use in the continuing carrier selection processes. Although most shippers state that performance factors are used in carrier selection, many such decisions are based on shipper perceptions rather than explicit analysis.

3 Contracting for Surges in Demand

Surges in customer demand often have extreme impacts across the entire supply chain, affecting purchasing, manufacturing and retailing actions. Firms must meet these surges to remain competitive in the market. Shippers rely on transportation to ensure product delivery. However, under the circumstances of a surge, many shippers find it difficult to retain sufficient capacity for all shipments, often competing against other firms seeking to move shipments during a surge of their own. Furthermore, carriers face more complexity in planning and operating issues as a result of a surge.

This chapter reviews the impact of surges in demand on transportation procurement, with a focus on its effect on rate levels. First, surges in demand are defined and described with an example. Next, a distinction is made between the impact of surges on TL and LTL firms. Then, several strategies for addressing this issue in the TL market are reviewed. Finally, truckload data is analyzed from several shippers as well as from a firm that experiences large surges in demand.

3.1 The Impact of Surges in Demand

A surge in demand is viewed differently by each entity that is affected. A shipper may determine that a surge in demand for transportation occurs when the number of weekly movements exceeds the average by more than 20 percent. On the other hand, a carrier may be relatively unaffected by a small shipper with a surge in demand defined as such. In fact, some surges may impact carrier economics positively. However, seasonal surges across several industries may not appear large to an individual shipper but when aggregated can have an extreme impact on one carrier, and thus, in turn on shippers.

These issues are discussed in more detail below from both a shipper and carrier perspective.

3.1.1 Shipper Demand

A surge in demand may occur either as a direct result of end consumer behavior or indirectly due to "artificial" factors within or between firms. In some cases, each factor influences the other, creating a larger effect on demand. Principally, firms seek to reduce the magnitude of these surges in demand. Each shipper, however, faces difficulties in managing the behavior of three parties: end consumers, internal decision-makers and business partners. The remainder of this chapter discusses how shippers interact with these three parties. Because shippers cannot always influence their parties effectively, surges in demand remain to be managed in the transportation of goods.

The challenges faced by shippers in understanding and managing end customer demand are difficult to overcome. The following two examples illustrate the inherent nature of surge in the demand for some products, resulting in a surge in transportation requirements. First, weekend consumer purchases often force a surge in transportation needs on Friday and Monday to stock and restock shelves at retailers. Although several efforts have been made by retailers to adjust this pattern, consumers remain steadfast in their purchasing habits. Second, seasonal sales due to weather, holidays or other factors are similarly uncontrollable by the shipper. For example the US Postal Service experiences a huge increase in demand for services during the Christmas season due to an increased number of packages and personal correspondence.

Most shippers internally cause surges in customer demand by providing incentives to purchase their product inconsistently. Demand is manipulated by internal decisions made by the shipper. Some examples include special promotions and advertisement campaigns or advertised price increases. When consumers realize a price increase is on the horizon, an immediate surge in the demand for the product takes place before the price goes up. This surge is typically followed by a lull in demand until the consumer has depleted the stock of items purchased at the lower price. Finally, many shippers compensate their salespersons based on a quota system. When customers are aware of these practices, they may delay purchasing products from the shipper until the end of the measured period when they are able to obtain better prices from anxious salespersons.

In addition to surges that occur due to changes in end customer demand, "artificial" factors also come into play. For instance, the end of financial reporting periods often brings with it large surges in demand for the sake of improving period sales volumes, meeting bonus targets, and reducing inventory. These surges occur at month-end, quarter-end and year-end for most shippers. As a result of the common time frame, practically every carrier has limited excess capacity during these times. To complicate the problem, shippers may have special requirements that cannot be met by every carrier with available capacity (Mottley 1999).

In many cases, poor cross-functional communication and inter-company collaboration further complicate the true demand, causing unnecessary surges in demand for transportation services in order to meet the needs of the end consumer (Copacino 1998). One party may misinterpret the true requirements early in the process, causing emergency correction later and a surge in demand. The cause may be poor forecasting or limited visibility of information across the supply chain, as demonstrated by the MIT beer game (Sterman 1989). The game shows how product flow is conditioned by information which, along with any distortion in that information, is passed along the supply chain. This can create variations in production as well as inventory holding. As distortions increase, the variance of the replenishment orders becomes higher than the variance of the demand for each connection between a buyer and its suppliers. The result is a "bullwhip effect" of increasingly large fluctuations in ordering patterns throughout the supply chain. The number and size of orders placed during this process directly affect transportation requirements.

Surges are also experienced in trucking when another mode like rail is unable to handle the business offered to it. For example, when business is low, railroads typically reduce the frequency of service to a shipper to reduce their operating costs. When a surge in demand occurs, the railroad may find it difficult to increase operating frequency quickly. Until the frequency of service can once again be increased, truck may be the only alternative for a shipper to meet delivery commitments to its customers[1].

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[1] Conversation with Mark O'Donnell of AmeriSteel on March 25, 1999.

Similarly, when a shortage of trucks exists in the truckload industry, an LTL carrier may be called upon to carry loads that would otherwise move by truckload. In such an environment, the LTL is likely to be nearing its capacity as well. If the shipment is moving in a direction that follows a typical backhaul for the LTL carrier, the shipper will likely be well served. However, a carrier's capacity problem will only be exacerbated if the shipment follows the main flow of traffic already being handled.

Company PQR, the disguised name of a firm, provided shipment data for a year, beginning in January, 1998. The following graphs show examples of Company PQR's overall shipping patterns to illustrate a surge in demand. Further details about this data can be found in section 3.3. As seen in Figure 3-1, the overall business for this shipper begins to rise substantially around the 30th week and peaks around the 44th week (where week 1 represents the first week of January).

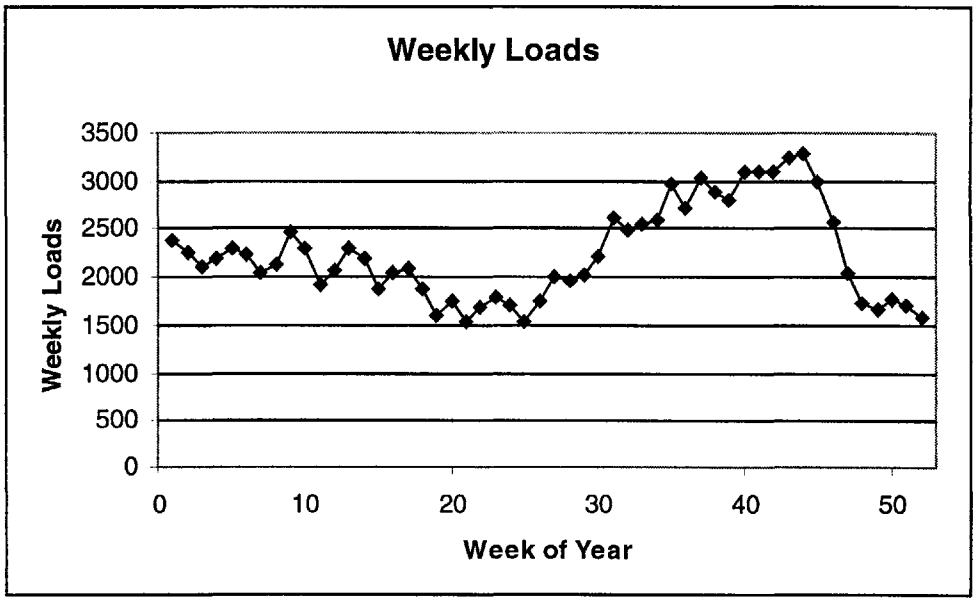

Figure 3-1 Summary of all weekly loads for a shipper demonstrate a general surge in demand

This same pattern of surge may also be seen in the loading patterns summarized by month of year in Figure 3-2. A level loading across months would result in an 8.3 percent average in monthly loadings as a percent of the annual total. The month of October exhibits almost a 50 percent increase over the level load.

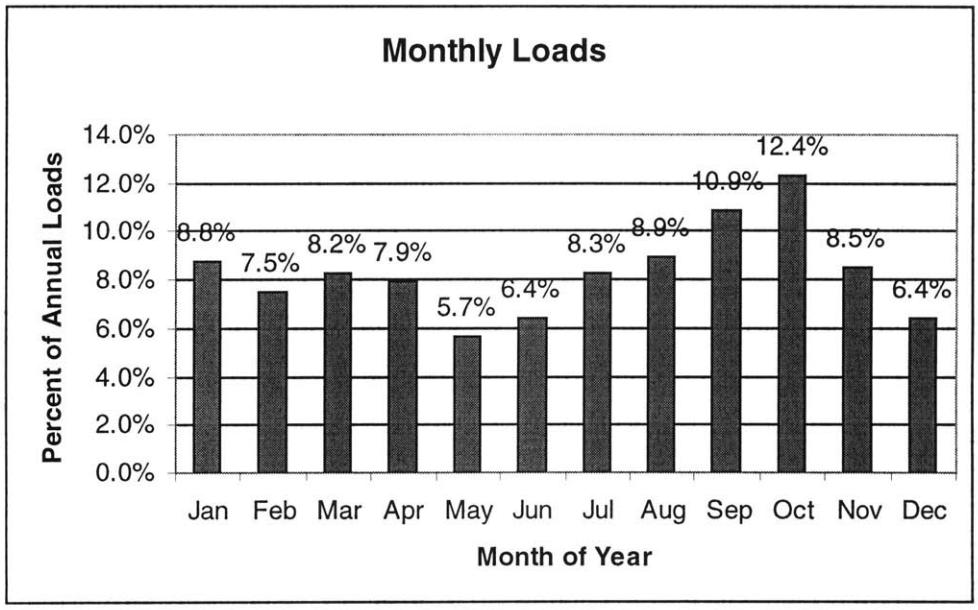

Figure 3-2 Summary of all monthly loadings for a shipper

The increase in demand does not exist in every lane. Both lanes graphed in Figure 3-3 have an average of a little more than five loadings per week.

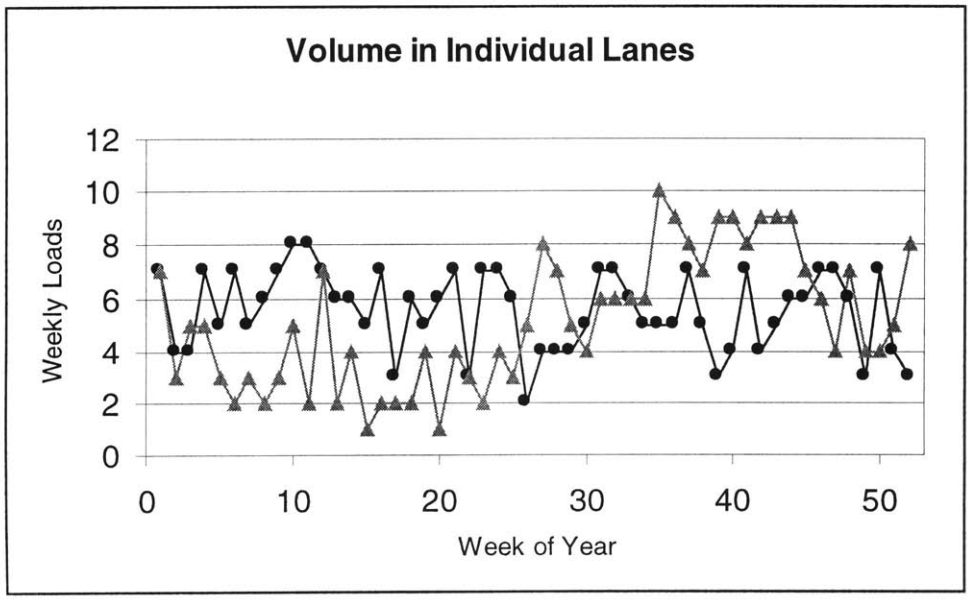

Figure 3-3 Weekly loads for two lanes with and without a surge

The lane represented with triangles has a relatively low demand at first with a large surge in demand during the second half of the year. On the other hand, the lane represented with circles demonstrates comparatively level loadings throughout the year, seldom moving above 7 or below 3 loads per week.

3.1.2 Impact on Carriers Economics

Carriers must face the issue of surge by attempting to meet the transportation demand of several customers while managing the scarce resources of equipment, drivers and facilities. As mentioned above, surges often occur simultaneously among several shippers due to seasonal or end-of-period demand. Carriers are forced to choose among customers, making decisions to serve some and refuse others. In this process, a carrier's resources are often reallocated based on contractual commitments and internal decision rules of the firm. The difficult result is that smaller customers and those without commitments often are turned away during periods of surge.

Many practitioners believe that only the "real partners" win in the end, allowing those shippers that have a close relationship with their carriers to fully depend on the service provided by carriers even during periods of "allocation" of carrier resources. During a surge in demand from many shippers, a carrier will be unable to provide the appropriate level of service to shippers with which little relationship time has been invested. Therefore, a concern of carriers is to determine the strategies of relationship building and contracting that best maximize profit for the firm. In fact, the alienation of smaller customers during periods of surge demand represents a very difficult issue for carriers to address.

Because the surges in demand affect truckload and less-than-truckload carriers differently, each industry is discussed in turn.

TL Impact

Adding more volume in every lane, as occurs in a general surge across all traffic, has not been shown to significantly change the cost structure of TL firms because of their relatively constant returns to scale. As a result, general surges in demand across the truckload industry primarily result in a decision to allocate capacity rather than an opportunity to gain significant efficiencies due to a change in cost structure. The primary impact is in lost good will from customers with unmet demand. Surges occurring only in specific lanes, however, could have a very different effect on the costs of a TL carrier due to economies of scope, described as the primary economic influence on truckload carriers

in section 1.2.3. The key factor is the impact of empty repositioning costs on carriers as a result of the surge.

As for any bid, when a carrier initially reviews lanes with high levels of surge, it must determine how the business fits into its existing network. Due to economies of scope faced by the carrier, a surge in one lane may provide a great compliment to the business, while additional volumes on another lane may exacerbate the shortage typically found in that region. Due to the specificity of this situation to each carrier's network, a general understanding a priori is unknown when considering a shipper's potential cost of bidding in a lane. It must be left to each carrier bidding for the business to determine how a surge in traffic will affect its cost of operation. Ideally, truckload firms seek to acquire business that has complimentary surges that offset one another, both in timing and directionality. However, carriers have had little success with this strategy in practice[1].

The simple example in Figure 3-4 demonstrates the effect of surge in demand on a sample TL operation. The initial network of one carrier consists of two points, A and B. The lane from A to B requires 10 trucks daily while the return trip from B to A requires 5 trucks daily. In effect, the carrier must provide 10 trucks for this system daily, with five of them returning to point A empty each day. If a surge of 20 percent occurs in both directions, the result for the carrier is an increase in truck requirements by 20 percent. Although the total costs of operation increase, the average shipment cost is unchanged

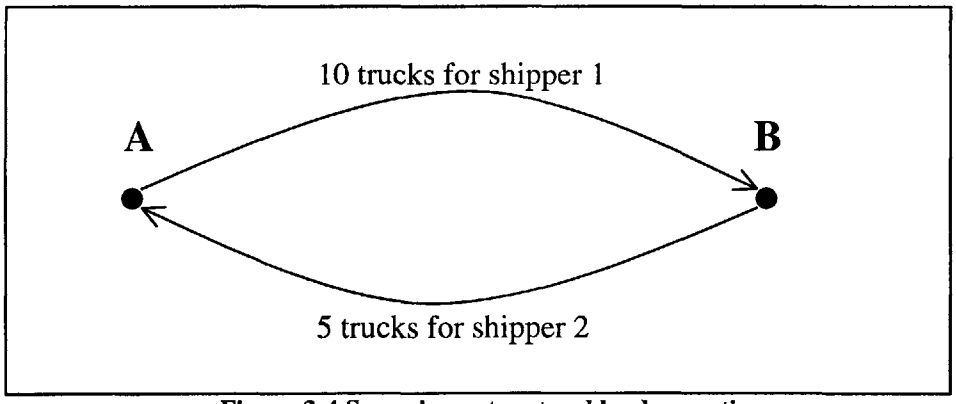

Figure 3-4 Surge impact on truckload operations

[1] Based on conversations with Gary Whicker, JB Hunt and John Lanigan, Schneider National.

because half of the carrier's round trips remain empty. However, if a surge occurs only in one direction, the cost structure of the carrier is changed. For example, if shipments from A to B increases by 20 percent, an additional 20 percent of capacity is required to meet this demand. However, if shipper 2 increases demand by 20 percent, empty capacity from the headhaul of A to B can be used without increasing total costs significantly. The result is lower costs per shipment, potentially improving carrier profits as well as reducing the rates offered to the shipper.

Though it has been generalized that shortages and surpluses of resources in a particular lane are different for each carrier, some similarities do exist. Most carriers that serve the states of Florida, Arizona and the northeastern United States experience an imbalance in the flow of goods. Carriers typically have a surplus of empty equipment in these regions because more goods are brought in from elsewhere by truck than are produced for export. As a result, the cost of moving goods to these regions is typically higher than for similar moves to other regions. Conversely, the cost of moving goods out of these regions is typically lower than from other locations because of the excess amount of capacity that terminates in the area. This pattern is reinforced by the rate analysis performed in section 3.3.

LTL Impact

Surges in the LTL industry effect carrier operations very differently than in the TL industry. Unlike TL carriers that are mainly affected by economies of scope, consolidated carriers like the LTL industry are sensitive to economies of density. Therefore increases, including most surges, in the volume of freight from a specific shipper often improve the cost structure of an LTL firm. In this situation, the carrier is able to take advantage of efficiencies in pickup and delivery during surge periods, and in some cases the ability to bypass break-bulk terminals. The improvements result from reduced stop times per item and improved load capacities over the network.

Consolidated carriers generally have a large degree of flexibility in operations, enabling them to shift resources to accommodate surges in capacity. For example, LTL pickup and delivery routes can be scheduled with some flexibility. As a surge in demand occurs at a shipper on one route, the route of a nearby truck can be rescheduled to provide

additional capacity for the first. In another example, cross docking may be eliminated if a shipper generates enough volume to single destinations and can by-pass a break-bulk terminal. Large shipments may also remain in the nose of the trailer, a practice known as nose-loading or head-loading, to continue on to the final destination without intermediate handling, even if shipments loaded on the middle and back of the trailer must be removed and replaced with other shipments to the same final destination. Reducing the handling of shipments also reduces the average shipment cost for an LTL carrier.

Certainly there are situations, primarily at the end of financial periods, where a surge in demand across the network causes problems due to a shortage of capacity[1]. Typically, shippers provide relatively little information about surges prior to their occurrence. The most detailed information often amounts to a phrase as general as "30 percent of the monthly volume occurs during the last 5 days of the month." Based on this level of information, pricing decisions as well as operating plans must be made to handle these situations. In the high tech industry in particular, surges in demand occur at the end of each quarter. During such periods, Viking has special operating procedures designed to use all available labor and equipment to its full capacity.

3.2 Strategic Procurement for Truckload Surges

Although review of scheduling and routing issues in the LTL industry may provide additional insights into efficiencies that can be gained during periods of surge, the basic impact on the LTL industry of increased demand is positive. For truckload carriers, however, surges primarily bring with them unfavorable effects. The remainder of the discussion on surges in demand will therefore focus on the process of procuring TL transportation services in the presence of surge. Also, as shippers primarily determine the choice of transportation procurement strategies, this section focuses on the shipper's perspective, with insights on the potential effects on carrier economics.

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[1] Based on a conversation with Karen Bittner-Childers of Viking Freight, a regional LTL carrier, on March 19, 1999.

As in governance structures, the decision to manage procurement for periods of surge may combine many strategies. In some cases, many carriers are contracted, each providing a guaranteed number of trucks. In other instances one carrier is responsible for handling all shipments, but is allowed to broker loads to other carriers to supplement capacity during periods of surge. In most cases, shippers must decide to make a tradeoff between the opportunity for better service and the lure of potentially lower transportation costs. Better service may be guaranteed at a higher cost. On the other hand potentially lower costs may be gained at the risk of sacrificing service when a low cost provider is unable to meet the shippers needs.

The following is a summary of several of the individual procurement strategies, some of which may be combined by the shipper, used to achieve the transportation needs during periods of surge.

3.2.1 Use of the Spot Market

As described in section 1.3.2, large shippers do not typically use the spot market as the only method for procuring transportation. Some shippers choose to rely on the spot market, either with their own efforts or through the services of a broker, to find loads during surge periods when previously contracted carriers are unable to accommodate their load. Here, the issue of cost versus service applies. Shippers that depend on the spot market make a tradeoff, risking a loss in service quality from spot carriers in return for the lower costs of contracted services that do not guarantee capacity during a surge.

Although shippers are not guaranteed capacity or specific service levels in the spot market, this structure allows carriers to reveal their true costs of moving the freight. When it is not economical or feasible for a contracted carrier to handle the business, the shipper is forced to find another carrier that is willing to move the shipment at the market rate (plus potentially a premium for surge conditions and the use of a broker). Therefore contracted carriers have more freedom to reduce hedging that might otherwise be required to guarantee equipment in lanes with highly fluctuating demand. Unfortunately, a carrier also has the incentive to promise more than it can perform if no consequences exist. Therefore shippers may be forced to rely on brokers or the spot market more than

anticipated, putting a strain on the relationship between shippers and their contracted carriers.

Company XYZ

Company XYZ is in the process of integrating a relatively decentralized network with a goal that a core of approximately ten carriers would be used to handle at least 80 percent of the business. A broker or third party would be used to find equipment for the overflow, particularly during periods of surge. Under this scenario, core carriers would be encouraged to participate in the volume increase during periods of surge, however, XYZ would rely primarily on brokers to ensure capacity was available for all loads.

3.2.2 Contractual Equipment Guarantees

Some shippers require carriers to make guarantees regarding the capacity that will be provided in a lane. These guarantees from carriers can be absolute, e.g. 10 trucks per week, or relative, e.g. one-third of all traffic in a lane. In return, shippers typically offer carriers only relative commitments, such as a percent of loads outbound from a particular facility or within a lane. In most cases, no absolute guarantee is in place for the carrier's benefit. When shippers do make absolute guarantees, they are typically so low that the carrier would not have made a different decision in their absence.

The shipper's primary objective for equipment guarantees is to ensure that needed capacity is available for periods of surge in their business that coincide with surges across the truckload industry. As described in section 3.1.2 on carrier economics, this does not change the carrier's cost structure. Instead, it is simply a safeguard for shippers at the risk of their carriers. The guarantee forces carriers to prioritize these shippers over others, resulting in dissatisfaction from shippers without guarantees when their loads cannot be covered during periods of surge. As a result, carriers may charge a premium in rates to ensure the profitability of maintaining these commitments at the risk of losing other business.

In the case where absolute guarantees are made on both sides, both shippers and carriers must carefully plan for the surge. Such guarantees can be made for year-round capacity as well as for short-term periods, such as a seasonal increase in demand. The shipper must determine carefully the need for equipment, knowing that underestimating

demand may put at risk the ability to acquire transportation during a surge while overestimating has an increased cost associated with it. This contract may be based on the carrier's guaranteed acceptance of a certain number of tendered loads or the carrier could physically dedicate a certain amount of resources to be used by the shipper as necessary.

Reynolds Metals Company

Reynolds Metals Company (Moore, Warmke, and Gorban 1991) makes use of both absolute and relative guarantees in their bidding process. For each lane with high volume as well as high variability, Reynolds sets an absolute guarantee expressed in terms of a number of trucks per week. Carriers must supply these locations with the guaranteed number of trucks. For absolute guarantees, both parties face penalties for unmet expectations. If the truck is not provided the carrier is penalized, while trucks furnished by the carrier but not used by Reynolds receive the guaranteed compensation. In addition to absolute guarantees, Reynolds also sets a variable number of trucks to be provided at every location, up to a weekly maximum. Carriers are penalized for not meeting at least 95 percent of any variable commitment. In return for the variable commitment, Reynolds makes no guarantees.

Although carriers often receive better information about lane volumes in this scenario, the relative commitment still relieves the shipper from accurately predicting volumes and surges in each lane. Carriers can understand the core volume of business, but fluctuations are masked with the variable commitments. In fact, carriers are punished for not meeting 95 percent of variable demand in each lane.

3.2.3 Carrier Density per Lane

Shippers must choose to source lanes to only one carrier or to split the lane assignment between several carriers. "Single sourcing" puts the responsibility for providing capacity for a lane entirely on one carrier. To relieve the pressure on a carrier, many shippers give this carrier the right to broker some portion of its loads to other carriers. Instead of allowing brokering, another option that has been exercised by shippers is the conscious selection of carriers that use a high percent of owner-operators. Carriers that employ owner-operators typically have more flexible capacity than other

carriers, but in some cases the quality and consistency of service may suffer. The use of owner-operators also allows these carriers to maintain lower fixed costs, another potential benefit of this strategy.

On the other hand, splitting lanes between carriers provides the shipper some insurance that if one carrier is unable to handle all the volume, another carrier may be able to pick up the slack. However, since no single carrier "owns" the lane, the potential exists for each carrier to give it a low priority during periods of surge, putting the shipper's ability to ensure capacity and service requirements in jeopardy. When splitting lanes between carriers, the shipper must determine the appropriate number of carriers assigned to each lane and the way in which carriers share the assignment of loads.

Company ABC

ABC combines two strategies, relative volume commitments and single sourcing. ABC faces surges on two levels, a weekly surge on Mondays and Fridays due to weekend replenishment at retailers and periodic surges caused by promotions and end of fiscal period sales. Its definition of a surge is when the number of shipments in a lane exceeds 20 percent above the average shipment level in that lane. Carriers are typically given forecasted information prior to the shipment date. No penalties are paid, however, to carriers if equipment is furnished but not used. Rather, ABC views this risk simply as a "cost of doing business."

ABC's strategy is to choose for each lane one primary carrier that is required to handle a relative commitment of at least 92 percent of all volume in that lane. Several secondary carriers are also selected to choose from in the event that a primary carrier rejects a load. During the bidding process carriers are allowed to submit two bids for consideration, one as the primary the other as a secondary carrier in the lane. In this way, their structure is similar to single sourcing, with something like a brokering system built in by maintaining a contracted list of several secondary carriers.

3.2.4 Variable Pricing

Most shippers do not allow multiple rates in a single lane. Therefore carriers are forced to hedge the rates provided to shippers for many reasons, one of which is the variability of volume in a lane. An alternative for shippers and carriers is the use of

multiple rates that are dependent on seasonal periods or volume levels, allowing carriers the potential to offer rates that better reflect the cost of service that is provided on a particular lane. Rates could be based on normal periods of demand and changed during certain time periods like the end of the month, or if the volume in a particular lane exceeds, or also goes below, a given amount.

In this scenario, several variables must be determined. First, the number of permissible rates that a carrier can submit may be limited. If seasonal rates are used, the effective time periods for each rate must be set. For volume dependent rates, volume thresholds must be used to apply the rate differential. Furthermore, the shipper must decide whether it will fix these parameters prior to the bidding process or allow carriers to determine them based on their own needs.

Sears Logistics Services

Sears Logistics Services (SLS) is one of few shippers that has implemented a tiered rate structure based on volume levels. The purpose is to allow carriers the option of pricing based on their cost structure. SLS recognizes that as volumes in a particular lane increase, carriers are likely to find it more difficult and more costly to handle all loads in a given lane. As equipment in a particularly region becomes scarce, more empty miles are required to reposition each additional truck.

In 1993, a three-tiered rate strategy was initiated with carriers. However, few gains were made in bidding and the resulting performance, as many carriers sought to win the bid by under-pricing the high volumes that would occur during surges in demand. Following some revisions of the program, a two-tiered strategy was adopted in late 1998 under the same principles as before. The benefits from this approach have yet to be evaluated.

The two-tiered strategy requires carriers to submit two prices along with a weekly volume threshold that must be met before the second tier price becomes effective. This scenario allows carriers a large degree of flexibility. A carrier could choose to set the threshold infinitely high to avoid ever reaching the higher price, essentially ignoring any impacts from increased volumes. On the contrary, a smaller number of loads could be stated before the threshold was reached, allowing the rate change to be effected weekly.

The revised method requires a minimum difference of 15 percent between tier rates, forcing carriers to closely evaluate their pricing decisions and volume thresholds. Under the previous method with three tiers and no minimum differences, some carriers had difficulty setting prices appropriately during periods of high volume, finding their rate to be low with respect to their own costs.

The use of a tiered rate program is not considered the "answer" to the problem of surge. Rather, SLS relies heavily on their relationships with key carriers to perform during a surge. "Guaranteed service lanes" are awarded jointly to two carriers with each provide a relative commitment to handle 50 percent of loads in that lane. These lanes have the largest volumes in the system. Other lanes are bid with the tiered system, but SLS relies on a single carrier to serve each one, allowing carriers to broker a small amount of loads. SLS believes the combination of these strategies provides the service they require while offering carriers the flexibility to accurately price their services[1].

3.3 Rate Analysis of Traffic with Surges in Demand

Before presenting the rate analysis, the two sets of data used for the analysis are briefly described.

Data Sources

The first set of data contains information from twelve shippers and is used to explain general factors that influence rates in the truckload industry. Only valid contract rates generated from bidding processes conducted in 1998 are included. Actual freight information was not collected from these shippers. The network consists of 152,626 lanes, where approximately 50 percent of the lanes account for over 90 percent of the cost. Each record contains information about a lane: origin, destination, miles, rate, trailer type, and annual expected volume. The average length of haul for the combined network was near 450 miles.

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[1] Jim Burns, Council of Logistics Management Annual Conference, October 12, 1998

The second data set is from PQR, the disguised name of a firm with a significant amount of surge in its demand for transportation. This data set is used to review the potential impact on rates due to surges in demand. Actual freight bills from PQR were used to generate this data set. The network consists of 8,316 lanes and 3,712 distinct shipping points (origins and/or destinations) with an average length of haul of over 600 miles. In this data set, less than 20 percent of the lanes accounted for over 80 percent of the annual freight bill. The traffic in this network is much more concentrated than the average represented in the first data set. The shipments for this firm are consumer goods from manufacturing facilities to both distribution centers and retailers.

3.3.1 Truckload Rate Factors

This section provides a general overview of the relevant factors that influence carrier rate levels provided to shippers. The analysis focuses on factors that were obtained by reviewing the origin, destination, lane miles, expected annual volumes and trailer type. Although several additional factors influence rates, such as specific service requirements, complete information related to other factors was not available. The data elements are described as follows in the models:

CPL	Cost per truckload in dollars
Miles	Distance traveled for each shipment in miles
Annual Volume	Estimated annual loads
Trailer Type	Type of trailer required; specialized or not
Origin	Origin of load, described as a city, 5-3-or-2 digit zip
Destination	Destination of load, described as a city, 5-3-or-2 digit zip

Ordinary least squares regression analysis was used to identify the statistically significant factors that impact rates. The five models reviewed are shown below. The validity of each model was evaluated prior to the testing of the successive models. For example, if a variable included in Model 2 was not significant, it was not included in Models 3 through 5. As a result, only those factors that proved significant were carried to the following models.

$$CPL = \beta_0 + \beta_1 * Miles \qquad \text{[Model 1]}$$

$$CPL = \beta_0 + \beta_1 * Miles + \beta_2 * Annual\ Volume + \beta_3 * (Annual\ Volume)^2 \qquad \text{[Model 2]}$$

$$CPL = \beta_0 + \beta_1 * Miles + \beta_2 * Annual\ Volume + \beta_3 * (Annual\ Volume)^2 + \beta_4 * Trailer\ Type \qquad \text{[Model 3]}$$

$$CPL = \beta_0 + \beta_1 * Miles + \beta_2 * Annual\ Volume + \beta_3 * (Annual\ Volume)^2 + \beta_4 * Trailer\ Type + \beta_5 * NotZip5 \quad [Model\ 4]$$

$$CPL = \beta_0 + \beta_1 * Miles + \beta_2 * Annual\ Volume + \beta_3 * (Annual\ Volume)^2 + \beta_4 * Trailer\ Type + \beta_5 * OrigZip3 + \beta_6 * DestZip3 + \beta_7 * DestZip2 \quad [Model\ 5]$$

$$CPL = \beta_0 + \beta_1 * Miles + \beta_2 * Annual\ Volume + \beta_3 * (Annual\ Volume)^2 + \beta_4 * Trailer\ Type + \beta_6 * DestZip3 + \beta_7 * DestZip2 + \beta_i * Region_i + \beta_j * Region_j \quad [Model\ 6]$$

where $Region_i$ = 1 if the lane begins in region i,
= -1 if the lane ends in region i,
= 0 if both

Distance

Model 1 captures the fixed and variable components of the truckload rate. The fixed cost is represented by β_0 while the variation in rates as a result of distance is captured by β_1. This most basic regression model explains almost 86 percent of the variation in cost per load, as seen in the adjusted R square in Figure 3-5. The estimate of fixed costs per load is $213 with the mileage component contributing $1.12 per mile.

SUMMARY OUTPUT - 12 Shippers, Model 1

Regression Statistics	
R Square	0.8597
Adjusted R Square	0.8597
Observations	152626

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	213.0870			
Average Miles	1.1231	0.0012	967.2349	-

Figure 3-5 Regression output for twelve shippers, Model 1

Volume

In addition to lane miles, Model 2 captures variation as a result of the annual volume with the coefficients β_2 and β_3. The first coefficient of volume, β_2, is expected to be negative. As volumes increase, the stability of the lane typically improves allowing carriers to better plan their networks. The second coefficient of volume, β_3, was included to determine if changes in volume impact rates non-linearly.

SUMMARY OUTPUT - 12 Shippers, Model 2

Regression Statistics	
R Square	0.8599
Adjusted R Square	0.8599
Observations	152626

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	217.9150			
Average Miles	1.1212	0.0012	959.3860	-
Annual Volume	(0.0253)	0.0020	(12.9233)	0.0000
(Annual Volume) ^ 2	0.00000113	0.00000013	8.4593	0.0000

Figure 3-6 Regression output for twelve shippers, Model 2

All coefficients are significantly different from 0. This indicates that all factors in Model 2 are significant in their effect on cost per load. Although all factors are statistically significant, the adjusted R square is not substantially improved in Model 2. In fact, it only rose from 0.8597 to 0.8598 with the addition of volume information. The coefficient was negative for β_2 and positive for β_3, thus cost per load decreases at a slightly decreasing rate as volume increases.

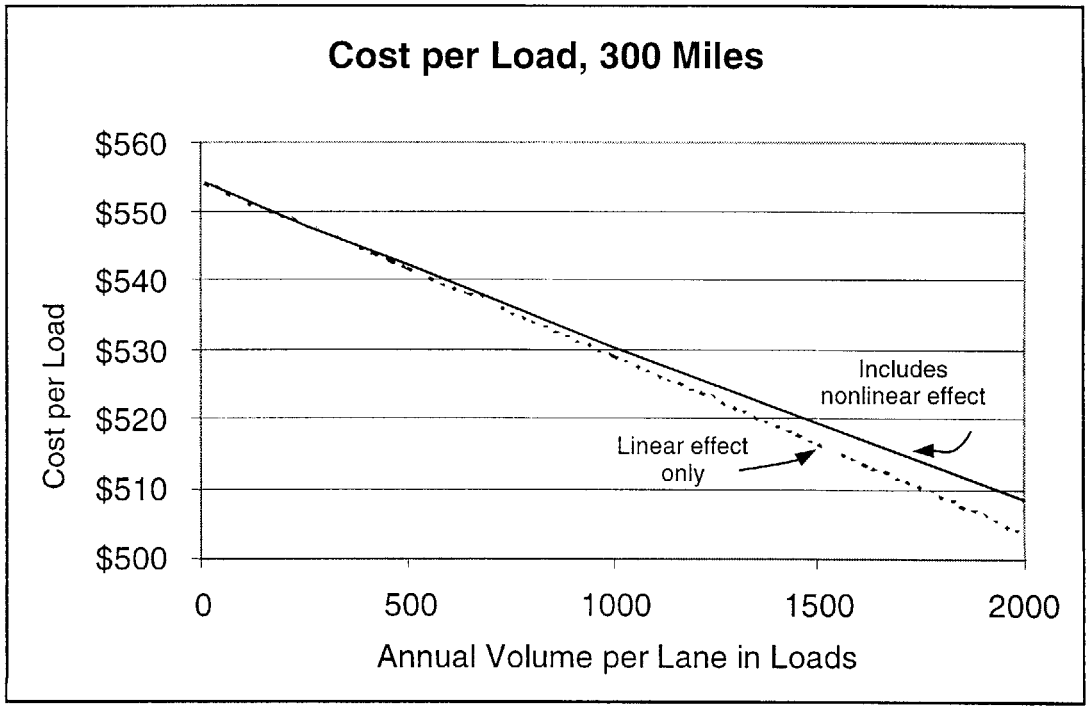

Figure 3-7 Effect of annual volume in loads on cost per load, Model 2

For example, Figure 3-7 shows the expected cost per load for a 300 mile move over several potential annual volume levels. The dotted line represents only the linear effect of volume, while the solid line includes its non-linear effect. It is rather obvious from the figure that, although the non-linear effect on rates is statistically significant, the overall impact is quite small (less than $5 per load difference between the annual volumes of 1 and 2000 loads).

Trailer Type

Model 3 includes a dummy variable that indicates if a special trailer is required for the load. It was expected that a requirement for special services would increase the price of the load. In fact, the estimated cost of special equipment was almost $65 per load as shown in Figure 3-8. This coefficient β_4, is statistically significant at the 1 percent level. All other coefficients remain significant in this model as well.

SUMMARY OUTPUT - 12 Shippers, Model 3

Regression Statistics	
R Square	0.8606
Adjusted R Square	0.8606
Observations	152626

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	213.3610			
Average Miles	1.1197	0.0012	959.2281	-
Annual Volume	(0.0231)	0.0020	(11.7938)	0.0000
(Annual Volume) ^ 2	0.00000102	0.00000013	7.6679	0.0000
Trailer Type	64.9282	2.4356	26.6585	0.0000

Figure 3-8 Regression output for twelve shippers, Model 3

Lane Definition

Models 4 and 5 review the potential effect of the differing geographic definition of origins and destinations on rate levels. For example, some shipping points in the data were identified by the first two or three digits of the zip code rather than a specific city or five digit zip code. Dummy variables were included to identify origins or destinations defined by either two or three digit zip codes. For each dummy variable, each coefficient was expected to be positive because carriers are expected to hedge their rates when

shipping points are less specifically defined. The potential for shipping a longer distance than to the mid-point of a region would cause this increased cost. No data was available for origins defined only by a two digit zip code.

Model 4 reviews the general impact of the origin and/or the destination being defined at a level less detailed than a five digit zip code, represented by the variable NOTZIP5. As seen in fig XX the coefficient is statistically significant at 1 percent. As the coefficient is positive, the model indicates that increasing the size of the origin and destination areas used to represent a lane increases the rate per load.

SUMMARY OUTPUT - 12 Shippers, Model 4

Regression Statistics	
R Square	0.8619
Adjusted R Square	0.8619
Observations	152626

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	206.3890			
Average Miles	1.1132	0.0012	947.9880	-
Annual Volume	(0.0162)	0.0020	(8.2884)	0.0000
(Annual Volume) ^ 2	0.00000067	0.00000013	4.9964	0.0000
Trailer Type	65.5638	2.4241	27.0463	0.0000
NotZip5	73.5329	1.9315	38.0702	0.0000

Figure 3-9 Regression output for twelve shippers, Model 4

Model 5 further separates the effects of origin and destination. The results of this regression were mixed. The coefficient for origins defined by three digit zip codes was not statistically significant. However, the cost was in fact higher for those destinations identified only within a region defined by two or three digit zip codes. Interestingly, the less defined destination regions of two digit zip codes were estimated to be less costly than the smaller destination regions defined by three digit zip codes. In part, this may be due to the relatively smaller number of lanes defined at the level of two digit zip codes within the data set. More importantly, as expected, the results indicate that defining larger regions for the purpose of rate making, at least in terms of destinations, inflates the rate levels in the truckload industry.

SUMMARY OUTPUT - 12 Shippers, Model 5

Regression Statistics	
R Square	0.8643
Adjusted R Square	0.8642
Observations	152626

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	207.3020			
Average Miles	1.1125	0.0012	955.6024	-
Annual Volume	(0.0167)	0.0019	(8.6157)	0.0000
(Annual Volume) ^ 2	0.00000069	0.00000013	5.2210	0.0000
Trailer Type	60.4262	2.4052	25.1231	0.0000
Destination Zip 3	515.3670	8.7502	58.8977	-
Destination Zip 2	55.1756	1.9479	28.3263	0.0000
Origin Zip 3	(46.3605)	90.0434	(0.5149)	0.6066

Figure 3-10 Regression output for twelve shippers, Model 5

Geographic Location

Finally, Model 6 defines broad geographic regions to identify whether certain regions of the United States, on average, are more or less costly to purchase transportation services. The concept is based on the opportunity cost of service in both the origin and destination region. That is, the cost of moving from the origin to the destination is affected by the follow on loads that are available at the destination as well as the loads leading into the origin. The regression method uses an arbitrary sign rule for each lane and each region. The value associated with the origin zone is added to the cost of the move while the value from the destination zone is subtracted to the cost. The individual coefficients generated by the regression have no meaning. Rather, the relative cost between regions is significant. For those shipments originating and terminating in the same region, the effect is captured in the intercept term, β_0.

The results of this regression in Figure 3-11 show that 88.54 percent of the variation is explained in Model 6. All coefficients are significant at the 1 percent level.

SUMMARY OUTPUT - 12 Shippers, Model 6

Regression Statistics	
R Square	0.8854
Adjusted R Square	0.8854
Observations	152626

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	219.7200			
Average Miles	1.0728	0.0012	929.3912	-
Annual Volume	(0.0188)	0.0018	(10.5466)	0.0000
(Annual Volume) ^ 2	0.00000079	0.00000012	6.4892	0.0000
Trailer Type	61.5817	2.2165	27.7833	0.0000
Destination Zip 3	541.5260	8.0445	67.3166	-
Destination Zip 2	17.8284	1.8230	9.7796	0.0000
Mid Atlantic	253.4860	32.9164	7.7009	0.0000
Mississippi Valley	413.9910	32.9601	12.5604	0.0000
North Central	446.8560	32.9091	13.5785	0.0000
North East	128.7510	32.7818	3.9275	0.0001
North West	103.2950	33.0669	3.1238	0.0018
Ohio Valley	439.1270	32.9106	13.3430	0.0000
South Central	372.6360	32.9184	11.3200	0.0000
South East	357.0870	32.9276	10.8446	0.0000
South West	243.3790	32.9632	7.3834	0.0000

Figure 3-11 Regression output for twelve shippers, Model 6

Since the absolute values of each regional coefficient are meaningless on their own, the relative values are shown in Figure 3-12. The intersection of two regions calculates the addition of the origin coefficient and the subtraction of the destination coefficient. For those results with a positive number, the cost of the load is increased by this amount while a negative number indicates the cost is decreased. For example, all loads originating in the North East have a negative sign, indicating that there is likely a surplus of trailers that terminate in this region. This follows conventional thought that the North East typical consumes more than it exports out of the region. Therefore carriers are willing to charge less to move trucks out of this region.

	Origin -->	MidAtlantic	MissValley	NorthCentral	NorthEast	NorthWest	OhioValley	SouthCentral	SouthEast	SouthWest
Destination		$ 253	$ 414	$ 447	$ 129	$ 103	$ 439	$ 373	$ 357	$ 243
Mid Atlantic	$ 253	$ -	$ 161	$ 193	$ (125)	$ (150)	$ 186	$ 119	$ 104	$ (10)
Miss Valley	$ 414	$ (161)	$ -	$ 33	$ (285)	$ (311)	$ 25	$ (41)	$ (57)	$ (171)
North Central	$ 447	$ (193)	$ (33)	$ -	$ (318)	$ (344)	$ (8)	$ (74)	$ (90)	$ (203)
North East	$ 129	$ 125	$ 285	$ 318	$ -	$ (25)	$ 310	$ 244	$ 228	$ 115
North West	$ 103	$ 150	$ 311	$ 344	$ 25	$ -	$ 336	$ 269	$ 254	$ 140
Ohio Valley	$ 439	$ (186)	$ (25)	$ 8	$ (310)	$ (336)	$ -	$ (66)	$ (82)	$ (196)
South Central	$ 373	$ (119)	$ 41	$ 74	$ (244)	$ (269)	$ 66	$ -	$ (16)	$ (129)
South East	$ 357	$ (104)	$ 57	$ 90	$ (228)	$ (254)	$ 82	$ 16	$ -	$ (114)
South West	$ 243	$ 10	$ 171	$ 203	$ (115)	$ (140)	$ 196	$ 129	$ 114	$ -

Figure 3-12 Cost differential for loads originating and terminating in different regions of the country

3.3.2 Influence of Surges on Rate Factors

Due to the relatively minor importance of volume levels in rate factors examined in the previous section, another approach to estimating rate levels is taken below. Data from a shipper with particularly strong surges in demand is reviewed with the use of regression analysis to determine whether rate levels vary depending on the extreme nature of surges faced in each lane. The hypothesis being tested is that greater amounts of surge, or even variation, in weekly or monthly volume levels cause increased costs for the carrier. Rates are used as a surrogate for carrier costs due to the competitive nature of the truckload industry, driving price near average cost.

Similar variables to those defined in the previous data set were defined for this shipper as well. Only miles and volumes were available at the lane level, geographic factors were not included. In order to determine which lanes have surges, only lanes with an average of at least one load per week are examined. This reduces the total of 8316 available data records to 426 lanes. The following variables are defined within this data to identify lanes that exhibit surges during the year:

Var/Mean	Variance of monthly loads / average monthly loads
Max/Min	Maximum monthly loads / minimum monthly loads
Surge Weeks	Number of weeks in which more than 20 percent of the average weekly loads were moved

The following models were formulated to estimate the impact of volume variations and of surges in demand on rate levels:

$$CPL = \beta_0 + \beta_1 * Miles \quad \text{[Model 1]}$$

$$CPL = \beta_0 + \beta_1 * Miles + \beta_2 * Annual\ Volume + \beta_3 * (Annual\ Volume)^2 \quad \text{[Model 2]}$$

$$CPL = \beta_0 + \beta_1 * Miles + \beta_4 * Var/Mean \quad \text{[Model 3]}$$

$CPL = \beta_0 + \beta_1 * Miles + \beta_5 * Max/Min$ [Model 4]

$CPL = \beta_0 + \beta_1 * Miles + \beta_6 * Surge\ Weeks$ [Model 5]

Model 1 shows results somewhat similar to those of the previous data set. As shown in Figure 3-13, mileage alone can be used to explain 92.48 percent of the variation in rates. For this shipper, however, the rates appear to be a little lower than the average rates from the 12 shippers. The intercept is near 190, well below 213, and the average cost per mile is 92 cents, also below the cost of $1.12 per mile for the other data. Perhaps these differences in cost are due to the longer average length of haul for the surge data. Another explanation could involve differences in the geography of this shipper when compared to the network of the 12 shippers combined. Unfortunately, information about the geography of the surge data was not available to test this hypothesis. This model provides the basis for comparing the other models described below.

SUMMARY OUTPUT - Surge Data, Model 1

Regression Statistics	
Multiple R	0.9618
R Square	0.9250
Adjusted R Square	0.9248
Standard Error	145.8224
Observations	426

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	190.8911	10.0457	19.0023	0.0000
Average Miles	0.9184	0.0127	72.3031	0.0000

Figure 3-13 Regression output for surge data, Model 1

Model 2 is used to compare the impact of annual volume levels on rate levels. As seen in Figure 3-14, the inclusion of annual volume decreases the adjusted R square and is not significant at the 5 percent level. Unlike the previous data, annual volume levels cannot be seen to influence rate levels in the surge data. As a result, annual volumes are not included in the following models that include variables to represent lanes with large variations in volume such as surges.

SUMMARY OUTPUT - Surge Data, Model 2

Regression Statistics	
Multiple R	0.9618
R Square	0.9250
Adjusted R Square	0.9245
Standard Error	146.1214
Observations	426

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	191.9358	13.9433	13.7654	0.0000
Average Miles	0.9182	0.0128	71.9207	0.0000
Annual Volume	(0.0002)	0.0743	(0.0033)	0.9974
(Annual Volume) ^ 2	(0.0000)	0.0001	(0.2366)	0.8131

Figure 3-14 Regression output for surge data, Model 2

Model 3 uses the variable Var/Mean to represent lanes with extreme variations in monthly demand over the period. This variable is defined as the variance in volume divided by the average volume. The expectation is that as the variance in monthly volume increases with respect to the average, the carrier faces higher costs to account for the uncertainty. Based on the significance of the coefficient β_4, this variable has no impact on the rate levels. This indicates that for lanes with high fluctuations in monthly volume, carriers do not adjust the rate higher or lower.

SUMMARY OUTPUT - Surge Data, Model 3

Regression Statistics	
Multiple R	0.9618
R Square	0.9250
Adjusted R Square	0.9246
Standard Error	145.9943
Observations	426

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	191.1275	11.2731	16.9543	0.0000
Average Miles	0.9183	0.0127	72.0963	0.0000
Var/Mean	(0.0582)	1.2542	(0.0464)	0.9630

Figure 3-15 Regression output for surge data, Model 3

Model 4 includes the variable Max/Min, which is defined by taking the ratio of the maximum monthly volume over the minimum monthly volume (for those months with volumes strictly greater than zero). The expectation is that as the difference between volumes in months increases, the cost of serving that lane increases as well. As a result, the coefficient β_5 is expected to be positive. Quite to the contrary, Figure 3-16 shows that the coefficient is negative, although it is not significant until the 10 percent level. The regression implies that as monthly volumes are more dispersed, rate levels appear to decrease. As there is no economic explanation for this, it appears to be simply a spurious correlation.

SUMMARY OUTPUT - Surge Data, Model 4

Regression Statistics	
Multiple R	0.9621
R Square	0.9256
Adjusted R Square	0.9252
Standard Error	145.4262
Observations	426

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	198.7438	10.9078	18.2204	0.0000
Average Miles	0.9185	0.0127	72.5118	0.0000
Max/Min	(0.8125)	0.4464	(1.8203)	0.0694

Figure 3-16 Regression output for surge data, Model 4

Finally, Model 5 was estimated using a variable that represents the total number of weeks that volume levels exceeded an amount more than 20 percent above the average. Once again, an increase in the number of weeks in which a surge occurs is expected to increase the relative cost of serving such a lane. As in the previous regression, the coefficient was again negative, the opposite of our expectation. However, the coefficient was not significant, as shown in Figure 3-17, indicating that in fact the number of weeks in which surges occurred was not useful in explaining the variation in rate levels.

SUMMARY OUTPUT - Surge Data, Model 5

Regression Statistics	
Multiple R	0.9618
R Square	0.9251
Adjusted R Square	0.9247
Standard Error	145.9135
Observations	426

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	207.9202	26.7877	7.7618	0.0000
Average Miles	0.9185	0.0127	72.2588	0.0000
Surge Weeks	(1.0452)	1.5240	(0.6858)	0.4932

Figure 3-17 Regression output for surge data, Model 5

Several other models for the surge data were developed, using dummy variables to create variations on Models 3, 4 and 5. In every case, the coefficient for the dummy variable displayed less significance than in the models described above.

3.3.3 Discussion of Rate Analysis

In summary, lane mileage is the most important factor in determining the cost per load, explaining approximately 85 to 92 percent of the variation in rates. This supports the idea that most truckload costs are variable. The next most important factors appear to be geographic location as well as the definition of the destination region. Both factors are heavily influenced by the ability to find follow-on loads, and the impact of economies of scope. Following these are equipment issues and volume related impacts. However, all factors identified beyond mileage explain, at most, another 2.5 percent of the variation in rates.

Based on the rate models evaluated in section 3.3.1, it appears that volume is important in determining rates. However, rate levels appear unchanged as a result of variation in volume levels discovered in section 3.3.2. This finding seems to contradict the theory that carriers cost change significantly based on the volume levels in a lane.

Several potential reasons could be used to explain the reason why the variability of volumes in a lane do not have much predictive value for rates. In practice, carriers may have difficulty predicting the change in costs as volume levels increase in a lane.

Due to the unpredictability of demand across their network, carriers find it difficult to estimate repositioning costs for a particular origin as volume levels change. Not only are the volumes unpredictable in the lane being evaluated, but also in all other lanes that are complementary to it. As such, rates may not be adjusted to account for the variation in volume.

Another potential explanation of the minimal predictive value of volume variability is that carriers do not incur substantially different costs for lanes with higher fluctuations than for others. On the other hand carriers do not always receive the appropriate information regarding fluctuations in volume levels by the shipper when information is exchanged for the bid, forcing. As a result, carriers may choose to spread this risk across the rates in all lanes, hedging against the likelihood of increased costs.

3.4 Summary

Surges are a result of many factors, both internal and external to each shipper. For the LTL carrier, surges often result in efficiencies due to economies of density. However, during periods of surge common to several shippers, little economic impact may be made on TL carriers, rather than to reallocate resources. For specific lanes that have increased demands opposite surge periods, economies of scope predict that carriers cost will be influenced either positively or negatively. Participants in the industry generally agree with these statements.

Shippers use several strategies to ensure that surges in the demand for transportation are met. The use of spot markets is consistently a "backup" plan to find transportation for demand unmet by contracted carriers. In contracting, equipment guarantees primarily safeguard the shipper with little benefit to carriers. Variable pricing, however, allows carriers to provide rates that more accurately reflect the cost of service. The ultimate success of variable pricing strategies has yet to be determined.

After a review of the rate structure of the TL industry, the common conception that rates are mileage based, with some affects from geography, was confirmed. However, the perception that surges in the demand for transportation cause generally higher rates was not affirmed by empirical analysis.

4 Conclusions

Carriers in the motor carrier industry have made many changes since deregulation to take advantage of the economic drivers in their operations. LTL firms have leveraged their flexibility to take advantage of economies of density, increasing the number of shipments in their network to reduce average costs. TL carriers have made use of contracting to shape their networks by improving lane balancing to generate economies of scope. However, carriers face the challenge of taking full advantage of these opportunities when negotiating with shippers who typically have the upper hand in defining their relationships.

Shippers choose their governance structures to minimize total costs to their firm. The successful accomplishment of this task includes balancing transportation costs, service requirements and their impact on other operations. Firms with higher service requirements often seek more complex governance structures to meet their needs, moving away from the spot market and towards contracting and vertical integration. However, even firms with relatively similar requirements may choose different governance structures. There still remains a high degree of subjective decision-making in strategically positioning transportation to support each shipper's goals.

As the choice of governance structures is relatively subjective, so is the much of the decision-making to procure transportation services. Although the general steps of procurement for each shipper are similar, the actual decisions made during the process vary significantly based each shipper's service requirements. While some shippers choose to formalize certification and detail information communicated with carriers, others minimize the interaction and force carriers to surmise details of the transportation network. In general, shippers benefit from improved communication by reducing the need for carriers to hedge the rates they provide. In addition, the service promised by carriers is more often able to meet the expectations of the shipper when steps are taken by both parties prior to operations to understand the shipper's requirements. In addition to

certification, ongoing core carrier programs and the use of performance measurements have encouraged communication between shippers and carriers.

Although shippers have many technologically advanced tools at their disposal, many strategic decisions and transactions in transportation rely on old techniques that seek only to minimize the cost of transportation in individual lanes. This ignores the opportunity to reduce total logistics costs by incorporating carrier economics and the benefits of improved service in the carrier assignment decision. Although most shippers explain that performance factors are used in carrier selection, these decisions are primarily made based on general perceptions of performance benefits rather than explicit analysis.

Surges in demand have a large impact on shippers and carriers, often forcing both parties to scramble to ensure that demand is met for transportation services. Although some factors that cause surge can be controlled or mitigated, the inherent surge in customer demand due to behavioral and seasonal effects cannot be changed. As a result, methods of contracting for surges in demand must be addressed. After a review of the rate structure of the TL industry, the common theme that rates are mileage based at around one dollar per mile, with some affects from geography was confirmed. However, the perception that surges the demand for transportation cause generally higher rates was not confirmed by empirical analysis. Carriers may find it difficult to predict these costs, and therefore are forced to hedge rates overall to protect themselves in the event of cost-increasing surges.

Future research would be useful to better understand the impacts of surge on the LTL industry. Review of economies of scope relative to short term changes in volume could provide insights to their true cost or benefit. In the TL industry, the ability of carriers to predict repositioning costs for lanes with high variability in volumes is poor. Improving the estimation of costs in this environment may prove useful in understanding the true profitability of both existing business and potential opportunities.

Appendix I - Shipper Survey

Number of Valid Surveys Returned

In December 1997, 831 surveys were sent to individuals at 402 shippers. Of the 98 companies returning surveys, 15 returned one for inbound and one for outbound practices, making a total of 113 surveys returned.

		Practice(s) Reflected in Response			
		Inbound	*Outbound*	*Both*	*Totals*
Surveys	*One*	11	23	49	83
Returned	*Two*	15	15		30
	Totals	26	38	49	113

Commercial Shipper Rules

Question 1. On average, how much advance notice do you give to carriers when tendering a load / shipment?

	Percent Response
0 to 12 hours	31.5
13 to 24 hours	36.0
25 to 48 hours	18.9
3 to 6 days	9.9
1 week or more	3.6
Total	**100.0**

Note: Data based on 111 valid responses.

Question 2. What percentage of your loads / shipments are tendered using the following technologies?

	Average	
	TL	LTL
Phone	53.6	60.3
Fax Machine	27.1	16.1
Email	1.5	1.1
Websites	1.6	1.7
EDI	9.2	6.7
Other	7.1	14.0
Total	**100.0**	**100.0**

Note: Data based on 103 valid TL responses and 93 valid LTL responses.

Question 3. From where is your tendering conducted?

	Percent Response
A centralized location	29.1
Each shipping location	64.5
Both locations	6.4
Total	**100.0**

Note: Data based on 110 valid responses.

Question 4. Do you use any electronic or computerized freight payment system or third party service?

	Percent Response
Yes	82.3
No	17.7
Total	**100.0**

Note: Data based on 113 valid responses.

Question 5. What percentage of your loads / shipments do you allow carriers to broker?

	Percent Response
0 - Not allowed	53.2
1 to 25%	38.7
26 to 50%	.9
No limit	7.2
Total	**100.0**

Note: Data based on 111 valid responses.

Rate Structures

Question 6a - Inbound traffic only. What percentage of your freight is paid for under the following terms?

	Average	
	TL	LTL
You pay for transport directly	65.2	63.9
Vendor pays for transport and bills you separately	8.5	12.0
Vendor pays for transport and includes it in purchase price	24.0	21.5
Other	2.3	2.6
Total	**100.0**	**100.0**

Note: Data based on 74 valid TL responses and 72 valid LTL responses.

Question 6b - Outbound traffic only. What percentage of your freight is paid for under the following terms?

	Average	
	TL	LTL
Customer pays for transport directly	18.4	20.6
You pay for transport and bill customer separately	17.7	18.1
You pay for transport and include it in sale price	58.6	57.5
Other	5.3	3.8
Total	**100.0**	**100.0**

Note: Data based on 83 valid TL responses and 75 valid LTL responses.

Question 7. How are your rates structured for TL service?

	Percent Response
Rate per mile	56.4
Flat rate	54.6
Rate per mile with a minimum	37.3
Other	9.1

Note: Data based on 110 valid responses.

Question 8. How are your rates structured for LTL service?

	Percent Response
FAK	46.6
Discounted NMFC class based	32.0
Rate per CWT for each lane	26.2
Discounted carrier scale	19.4
Discounted weight / distance rate scale	12.6
Other	14.6

Note: Data based on 103 valid responses.

Question 9. Can carriers submit multiple rates for a single lane in the following situations?

	Percent Response	
	TL	LTL
Depending on whether it is an Over-the-Road or Intermodal move	46.0	3.5
Average lead time for tendering	5.3	1.8
Depending on the transit time provided	23.0	16.8
If a different trailer length is used	23.0	1.8
If previous load was inbound to this facility	23.0	1.8
Depending on attaining certain annual freight volumes	15.0	15.0
Depending on day of week	5.3	3.5
Depending on the mix of commodities	2.7	9.7
If a certain number of loads have already been tendered on this lane this week	0.9	0.9
Under any circumstance	0.9	0.0
Other	11.5	4.4

Note: Data based on 113 valid responses.

Question 10. What accessorials do you pay to carriers?

	Percent Response	
	TL	LTL
Stop off charges	88.5	15.0
Fuel surcharge program	71.7	54.0
Detention	69.0	23.9
Equipment furnished but not used	42.5	9.7
Loading / unloading charges	38.1	13.3
Residential delivery	5.3	15.9
Appointment delivery	4.4	10.6
Other	3.5	4.4

Note: Data based on 113 valid responses.

Question 11. What limits on liability do you require carriers to provide on shipments?

	Percent Response	
	TL	LTL
Actual value of cargo	56.1	61.1
Minimum of actual cargo value and $____	15.3	10.0
Other	28.6	28.9
Total	**100.0**	**100.0**

Note: Data based on 98 valid TL responses and 90 valid LTL responses.

Solicitation and Award Program

Question 12. How do you determine which carriers to use in your system?

	Percent Response
Competitive bid	77.3
Face to face negotiation	73.6
Solicitation for a single load at a time	23.6
Multiple round bid	15.5
Use of brokers	15.5
Other	5.5

Note: Data based on 110 valid responses.

Question 13. What do you ask for prior to selection (beyond price and service standards)?

	Percent Response
Ability to track and trace shipments	86.6
Certificate of insurance	85.7
Financial status / statements	83.0
Equipment (# tractors & trailers)	80.4
Types of EDI supported	75.0
Experience / references	69.6
Safety experience	59.8
Loss & damage experience	58.9
Management qualifications	41.1
Quality control / ISO 9000 certification	33.0
Other	20.5

Note: Data based on 112 valid responses.

Question 14. On average, how much preparation lead time do you give to carriers in your bids?

	Percent Response
Less than 30 days	29.2
31 to 60 days	59.4
61 to 90 days	9.4
91 days or more	1.9
Total	**100.0**

Note: Data based on 106 valid responses.

Question 15. How many total carriers did you tender to in the last 12 months?

	TL	LTL
Mean	73.6	27.3
Median	30.0	10.0

Note: Data based on 104 valid TL responses and 93 valid LTL responses.

Question 16a. What percentage of your loads / shipments are tendered to contract carriers?

	TL	LTL
Mean	80.1	76.1
Median	95.0	95.0

Note: Data based on 101 valid TL responses and 88 valid LTL responses.

Question 16b. If greater than 0%, what is the average length of these contracts?

	Percent Response	
	TL	LTL
7 - 12 months	28.6	26.7
13 months to 2 years	37.8	44.2
Over 2 years	33.7	29.1
Total	**100.0**	**100.0**

Note: Data based on 98 valid TL responses and 86 valid LTL responses.

Question 17. How many loads do you guarantee to a contract carrier on an annual basis?

	Percent Response	
	TL	LTL
No guarantee	44.1	47.2
Nominal amount (e.g., 3 lds / yr)	28.4	23.6
Realistic volume	27.5	29.2
Total	**100.0**	**100.0**

Note: Data based on 102 valid TL responses and 89 valid LTL responses.

Question 18. How do you contract with your carriers?

	Percent Response	
	TL	LTL
By lane	50.5	32.2
By facility (originating)	45.5	33.3
By region	37.6	56.3
By facility (destining)	20.8	19.5
Carriers are not contracted	5.9	8.1

Note: Data based on 101 valid TL responses and 87 valid LTL responses.

Question 19. Of the total, approximately how many carriers handled 80% of your traffic?

	Percent Response
Less than 5	28.8
6 - 10	26.1
11 - 15	15.3
16 - 20	5.4
21 - 25	8.1
More than 25	16.2
Total	**100.0**

Note: Data based on 111 valid responses.

Question 20. Do you have a core carrier program?

	Percent Response
Yes	86.6
No	13.4
Total	**100.0**

Note: Data based on 112 valid responses.

Question 20a. If yes, how many carriers are in the system?

	TL	LTL
Mean	23.5	6.7
Median	10.0	5.0

Note: Data based on 89 valid TL responses and 74 valid LTL responses.

Question 20b. What percentage of your business ($) do the core carriers handle?

	Percent Response	
	TL	LTL
Less than 20%	1.1	3.8
21% to 40%	2.3	1.3
41% to 60%	5.7	7.5
61% to 80%	31.8	28.8
81% or more	59.1	58.8
Total	**100.0**	**100.0**

Note: Data based on 88 valid TL responses and 80 valid LTL responses.

Question 21. Do you use a routing guide?

	Percent Response
Yes	82.1
No	17.9
Total	**100.0**

Note: Data based on 112 valid responses.

Question 21a. If yes, is it:

	Percent Response
Paper based	52.2
Electronic	36.7
Both	11.1
Total	**100.0**

Note: Data based on 90 valid responses.

Question 21b. If electronic, where is the routing guide maintained?

	Percent Response
Centrally	81.3
At each location	12.5
Both	6.3
Total	**100.0**

Note: Data based on 48 valid responses.

Lane Configuration

Question 22. Do you operate trailer pool / drop and hook facilities?

	Percent Response	
	TL	LTL
Yes	62.6	42.4
No	37.4	57.6
Total	**100.0**	**100.0**

Note: Data based on 107 valid TL responses and 99 valid LTL responses.

Question 23. How do you identify a location for a carrier?

	Percent Response	
	TL	LTL
City - state	31.9	24.8
5 digit zip code	28.3	32.7
3 digit zip code	15.0	16.8
Statewide	13.3	8.0
Multi-state regions	9.7	11.5
Standardized Point Location Codes (SPLC's)	7.1	5.3
9 digit zip code	3.5	3.5
2 digit zip code	1.0	0.0
Other	8.9	6.2

Note: Data based on 113 valid responses.

Data Provided to Carriers

Question 24. What traffic flow information do you provide to carriers within your bidding process?

	Percent Response	
	TL	LTL
Amount of freight in loads	71.7	31.9
Amount of freight per year by lane	63.7	44.3
Amount of freight in tons	37.5	48.7
Frequency of stop-offs per lane	23.9	4.4
Lane mileage and source of miles	21.2	5.3
Day of week distribution of loads	19.5	9.7
Amount of freight by week for a year	17.7	13.3
Maximum # of daily loads / shipments	15.9	8.9
Target, goal, or benchmark rates	15.9	6.2
Detailed flow breakdown of 5 digit zip to 5 digit zip	13.3	20.4
Other	3.5	3.5

Note: Data based on 113 valid responses.

Question 25. How do you provide traffic flow information to the carriers?

	Percent Response
Hard copy on paper	75.9
Electronically on diskette	51.9
Electronically via email	16.7
Electronically via a website	0.9
Other	1.9

Note: Data based on 108 valid responses.

Question 26. What facility information do you provide to carriers within your bidding process?

	Percent Response	
	TL	LTL
Location	87.6	78.8
Operating hours	77.0	70.8
Scheduling requirements	70.8	53.1
Point of contact	69.9	62.8
Live load / unload requirements	61.1	38.9
Average weight of shipment	55.8	46.9
Trailer pool availability / size	37.2	19.5
Average lead time for tendering	33.6	23.9
Pallet exchange	32.4	23.9
Product packaging	31.9	38.9
Average loading / unloading time	31.0	23.0
Dock information (# doors etc.)	27.4	23.0
Ability to reschedule appointments	27.4	18.6
Other	2.7	2.7

Note: Data based on 113 valid responses.

Performance Measurement

Question 27a. Do you track the following performance factors on carriers?

Performance factor	Frequency of carriers tracking	Percent of carriers tracking
On-time percentage	102	97.1
Billing accuracy	77	73.3
Transit time per lane	77	73.3
Claims response	73	69.5
Shipment tracing capability	63	60.0
Number / % of turn downs	51	48.6
Response time	35	33.3
Surge capability	19	18.1
Other	7	6.7

Note: Data based on 105 valid responses.

Question 27b. If so, who provides the data?

On-time percentage	Frequency of responses	Percent of responses
Shipper	22	21.6
Carrier	56	54.9
3PL	4	3.9
Shipper & Carrier	11	10.8
Shipper & 3PL	1	1.0
Carrier & 3PL	1	1.0
Shipper, Carrier & 3PL	1	1.0
Not Specified	6	5.9
Total	**102**	**100.0**

Transit time per lane	Frequency of responses	Percent of responses
Shipper	18	23.4
Carrier	50	64.9
3PL	3	3.9
Shipper & Carrier	3	3.9
Shipper & 3PL	1	1.3
Not Specified	2	2.6
Total	**77**	**100.0**

Billing accuracy	Frequency of responses	Percent of responses
Shipper	45	58.4
Carrier	5	6.5
3PL	20	26.0
Shipper & Carrier	2	2.6
Shipper & 3PL	3	3.9
Shipper, Carrier & 3PL	1	1.3
Not Specified	1	1.3
Total	**77**	**100.0**

Claims Response	Frequency of responses	Percent of responses
Shipper	50	71.4
Carrier	11	15.7
3PL	6	8.6
Shipper & Carrier	3	4.3
Not Specified	3	4.3
Total	**73**	**100.0**

Shipment tracing capability	Frequency of responses	Percent of responses
Shipper	11	17.5
Carrier	45	71.4
3PL	1	1.6
Shipper & Carrier	4	6.3
Not Specified	2	3.2
Total	**63**	**100.0**

Number / % of turn downs	Frequency of responses	Percent of responses
Shipper	31	60.8
Carrier	10	19.6
3PL	5	9.8
Shipper & Carrier	2	3.9
Shipper & 3PL	1	2.0
Not Specified	2	3.9
Total	**51**	**100.0**

Response Time	Frequency of responses	Percent of responses
Shipper	23	65.7
Carrier	4	11.4
3PL	1	2.9
Shipper & Carrier	4	11.4
Shipper & 3PL	1	2.9
Not Specified	2	5.7
Total	**35**	**100.0**

Surge capability	Frequency of responses	Percent of responses
Shipper	10	52.6
Carrier	5	26.3
3PL	1	5.3
Shipper & 3PL	2	10.5
Not Specified	1	5.3
Total	**19**	**100.0**

Other	Frequency of responses	Percent of responses
Shipper	4	57.1
Carrier	1	14.3
Shipper & Carrier	1	14.3
Not Specified	1	14.3
Total	**7**	**100.0**

Question 28. Are these data collected and maintained in a central location?

	Percent Response
Yes	86.0
No	14.0
Total	**100.0**

Note: Data based on 107 valid responses.

Question 29a. Are performance factors included in the carrier assignment decision?

	Percent Response
Yes	94.6
No	5.6
Total	**100.0**

Note: Data based on 111 valid responses.

Question 29b. If yes, is a dollar value assigned to each performance factor?

	Percent Response
Yes	11.2
No	88.8
Total	**100.0**

Note: Data based on 102 valid responses.

Question 30. How is compliance to the routing guide monitored?

	Percent Response
Manual process	53.0
Automated process compares routing guide to tenders and is used	40.0
Routing guide compliance is not monitored	14.0
Automated process exists but is not used	0.0

Note: Data based on 100 valid responses.

Question 31. How is carrier performance monitored?

	Percent Response
Manual process	63.1
Reliance on carrier reports	39.6
Automated process monitors aspects of carrier performance and is used	29.7
Automated process exists but is not used	3.6
Carrier performance is not monitored	0.9

Note: Data based on 111 valid responses.

Question 32. Is the volume of traffic awarded to each carrier monitored throughout the year?

	Percent Response
Yes	80.9
No	19.1
Total	**100.0**

Note: Data based on 110 valid responses.

Respondent Information

Question 33. What is your total annual revenue (estimated gross revenues for 1997)?

	Percent Response
Under $50 million	4.1
$50 to $100 million	1.0
$101 to $250 million	4.1
$251 to $500 million	5.2
$501 million to $1 billion	5.2
Over $1 billion	80.4
Total	**100.0**

Note: Data based on 97 valid shipper responses

Question 34 (TL). What is your total annual transportation purchase (of TL)?

	Percent Response
Under $1 million	12.9
$1 to $4 million	11.8
$5 to $10 million	7.5
$11 to $25 million	16.1
$26 to $50 million	12.9
$51 to $100 million	12.9
Over $100 million	25.8
Total	**100.0**

Note: Data based on 93 valid shipper responses.

Question 34 (LTL). What is your total annual transportation purchase (of LTL)?

	Percent Response
Under $1 million	9.1
$1 to $4 million	17.0
$5 to $10 million	23.9
$11 to $25 million	14.8
$26 to $50 million	21.6
$51 to $100 million	5.7
Over $100 million	8.0
Total	**100.0**

Note: Data based on 88 valid shipper responses.

Question 35. How many TL loads to you ship per year?

	Percent Response
Less than 500	10.5
501 to 1,000	12.6
1,001 to 5,000	14.7
5,001 to 10,000	4.2
10,000 to 50,000	26.3
50,001 to 100,000	11.6
Over 100,000	20.0
Total	**100.0**

Note: Data based on 95 valid shipper responses.

Question 36. How many LTL loads to you ship per year?

	Percent Response
Less than 500	7.4
501 to 1,000	8.5
1,001 to 5,000	12.8
5,001 to 10,000	18.1
10,000 to 50,000	12.8
50,001 to 100,000	19.1
Over 100,000	21.3
Total	**100.0**

Note: Data based on 94 valid shipper responses.

Question 37. Approximately what percentage of your purchased transportation ($) is hauled by the following modes?

	Average
Rail	11.5
TL	45.4
LTL	24.6
Package	11.5
Other	6.9
Total	**100.0**

Note: Data based on 95 valid shipper responses.

Question 38. Approximately what percentage of your purchased transportation ($) is moved?

	Average
Inbound	33.1
Interplant	11.5
Outbound	55.0
Other	0.4
Total	**100.0**

Note: Data based on 89 valid shipper responses.

Appendix II - Third Party Survey

Number of Valid Surveys Returned

In December 1997, 114 surveys were sent to third party logistics providers (3PLs). A total of 27 surveys were returned, making the response rate near 24 percent.

3PL's Shipper / Carrier Rules

Question 1. On average, how much advanced notice do you receive from shippers when being tendering a load / shipment?

	Percent Response
0 to 12 hours	25.9
13 to 24 hours	29.6
25 to 48 hours	33.3
3 to 6 days	11.1
1 week or more	0.0
Total	**100.0**

Note: Data based on 27 valid responses.

Question 2. What percentage of your loads / shipments are tendered using the following technologies?

	Average
Phone	39.1
Fax Machine	21.6
Email	6.3
Websites	2.6
EDI	30.2
Other	0.2
Total	**100.0**

Note: Data based on 25 valid responses.

Question 3. What percentage of your loads / shipments do you allow your carrier partners to broker?

	Percent Response
0 - Not allowed	51.9
1 to 25%	33.3
26 to 50%	0.0
51 to 75%	0.0
76 to 100%	0.0
No limit	14.8
Total	**100.0**

Note: Data based on 27 valid responses.

Rate Structures

Question 4a. How are your rates structure for TL service?

	Percent Response
Rate per mile	65.4
Flat rate	57.7
Rate per mile with a minimum	53.8
Other	15.4

Note: Data based on 26 valid responses.

Question 4b. How are your rates structure for LTL service?

	Percent Response
Rate per CWT	66.7
FAK	57.1
NMFC class based	33.3
Discounted weight / distance rate scale	33.3
Other	9.5

Note: Data based on 21 valid responses.

Question 5. Can your carrier partners submit multiple rates for a single lane in the following situations? (check all that apply)

	Percent Response
If a different trailer length is used	68.2
If the previous load was inbound to the facility	68.2
If a certain number of loads have already been tendered on this lane this week	31.8
Depending on whether it is an over-the-road or intermodal move	72.7
Depending on transit time provided	68.2
Depending on the amount of lead time offered to the carrier	27.3
Depending on attaining certain annual freight volumes	31.8
Depending on the mix of commodities	18.2
Depending on day of week	36.4
Other	9.1

Note: Data based on 22 valid responses.

Question 6. What accessorials do you pay to carriers?

	Percent Response
Stop off charges	92.3
Detention	80.8
Loading / unloading charges	80.8
Appointment delivery	3.8
Residential delivery	30.8
Fuel surcharge program	73.1
Equipment furnished but not used	69.2
Other	15.4

Note: Data based on 26 valid responses.

Solicitation and Award Process

Question 7. What do you ask for prior to selection of your carrier partners (beyond price and service standards)?

	Percent Response
Experience / references	65.4
Equipment (# tractors & trailers)	76.9
Types of EDI supported	61.5
Ability to track and trace shipments	88.5
Management qualifications	23.1
Financial status / statements	61.5
Quality control / ISO9000 certification	15.4
Loss & damage experience	53.8
Safety experience	61.5
Certificate of insurance	100.0
Other	15.4

Note: Data based on 26 valid responses.

Question 8. On average, how much preparation lead time do you give your carrier partners in your bids?

	Percent Response
Less than 30 days	96.2
31 to 60 days	3.8
61 to 90 days	0.0
91 days or more	0.0
Total	**100.0**

Note: Data based on 26 valid responses.

Question 9a. What percentage of your loads / shipments are tendered to carriers under a contract?

Mean	76.8%

Note: Data based on 24 valid responses

Question 9b. If greater than 0%, what is the average length of your typical contract?

	Percent Response
On month or less	4.5
2 to 6 months	40.9
7 to 12 months	36.4
13 months to 2 years	18.2
Over 2 years	0.0
Total	**100.0**

Note: Data based on 22 valid responses.

Question 10. How many carriers do you use in each mode?

	TL	LTL	Other
Mean	694	27	53
Median	200	20	28

Note: Data based on 23, 19, and 6 valid responses, respectively.

Question 11. For TL, 80% of your TL traffic is handled by how many carriers?

	Percent Response
Less than 5	7.7
6 to 10	15.4
11 to 15	7.7
16 to 20	23.1
21 or more	46.1
Total	**100.0**

Note: Data based on 26 valid responses.

Question 12a. Do you have a core carrier program?

	Percent Response
Yes	64.0
No	36.0
Total	**100.0**

Note: Data based on 25 valid responses.

Question 12b. If yes, how many carriers are in the system?

Mean	35
Median	18

Note: Data based on 15 valid responses.

Question 12c. What percentage of your business ($) do the core carriers handle?

	Percent Response
Less than 20%	5.9
21 to 40%	11.7
41 to 60%	29.4
61 to 80%	35.3
81% or more	17.7
Total	**100.0**

Note: Data based on 17 valid responses.

Question 13a. Do you use a routing guide?

	Percent Response
Yes	44.0
No	56.0
Total	**100.0**

Note: Data based on 25 valid responses.

Question 13b. If yes, is it:

	Percent Response
Electronic	50.0
Paper	41.7
Both	8.3
Total	**100.0**

Note: Data based on 12 valid responses.

Question 13c. Who has control over the routing of the business you handle?

	Percent Response
You have control	68.8
Dictated by shipper	18.8
Shared	12.4
Total	**100.0**

Note: Data based on 16 valid responses.

Lane Configuration

Question 14. How do you identify a location for a carrier?

	Percent Response
Standardized point location codes (SPLC's)	12.0
9 digit zip code	0.0
5 digit zip code	60.0
3 digit zip code	24.0
2 digit zip code	0.0
City, state	40.0
Statewide	32.0
Multi-state regions	20.0
Other	4.0

Note: Data based on 25 valid responses.

Data Provided to Carriers

Question 15. What traffic flow information do you provide to carriers within your bidding process?

	Percent Response
Amount of freight in tons	24.0
Amount of freight in loads	88.0
Amount of freight per year by lane	68.0
Amount of freight by week for a year	32.0
Day of week distribution of loads	36.0
Maximum # of daily loads / shipments	20.0
Frequency of stop-offs per lane	56.0
Lane mileage and source of miles	36.0
Detailed flow breakdown of 5 digit zip to 5 digit zip	24.0
Target, goal, or benchmark rates	32.0
Other	4.0

Note: Data based on 25 valid responses.

Question 16. How do you provide thee data to the carriers?

	Percent Response
Hard copy on paper	80.0
Electronically on diskette	64.0
Electronically via email	20.0
Electronically via website	4.0
Other	8.0

Note: Data based on 25 valid responses.

Question 17. What facility information do you provide to carriers within your bidding process?

	Percent Response
Location	100.0
Operating hours	87.5
Point of contact	37.5
Pallet exchange	62.5
Product packaging	29.2
Trailer pool availability / size	45.8
Dock information (# doors, etc.)	29.2
Scheduling requirements	83.3
Ability to reschedule appointments	12.5
Live load / unload requirements	79.2
Average loading / unloading time	62.5
Average weight of shipment	75.0
Average lead time for tendering	62.5
Other	8.3

Note: Data based on 24 valid responses.

Performance Measurement

Question 18a. Do you track the following performance factors on carriers?

	Percent Response
On-time percentage	92.6
Number / percent of turn downs	51.9
Transit time per lane	59.3
Shipment tracing capability	66.7
Surge capability	22.2
Claims response	66.7
Billing accuracy	63.0
Response time	40.7
Other	3.7

Note: Data based on 24 valid responses.

Question 18b. If so, who provides the data?

On-time percentage	**Frequency of responses**	**Percent of responses**
Shipper	1	4.5
Carrier	5.0	22.7
3PL	16	72.7
Total	**22**	**100.0**

Number / percent of turndowns	**Frequency of responses**	**Percent of responses**
Shipper	1	7.7
Carrier	3	23.1
3PL	9	69.2
Total	**13**	**100.0**

Transit time per lane	Frequency of responses	Percent of responses
Shipper	1	6.7
Carrier	2	13.3
3PL	12	80.0
Total	**15**	**100.0**

Shipment tracing capability	Frequency of responses	Percent of responses
Shipper	1	6.3
Carrier	5	31.3
3PL	10	62.5
Total	**16**	**100.0**

Surge capability	Frequency of responses	Percent of responses
Shipper	1	20.0
Carrier	1	20.0
3PL	3	60.0
Total	**5**	**100.0**

Claims response	Frequency of responses	Percent of responses
Shipper	1	6.7
Carrier	4	26.7
3PL	10	66.7
Total	**15**	**100.0**

Billing accuracy	Frequency of responses	Percent of responses
Shipper	1	5.9
Carrier	2	11.8
3PL	14	82.4
Total	**17**	**100.0**

Response time	Frequency of responses	Percent of responses
Shipper	1	10.0
Carrier	2	20.0
3PL	7	70.0
Total	**10**	**100.0**

Question 19. Are these data collected and maintained in a central location?

	Percent Response
Yes	92.6
No	7.4
Total	**100.0**

Note: Data based on 25 valid responses.

Question 20. Do you provide carriers additional incentive (e.g., a bonus) for each performance factor?

	Percent Response
Yes	11.1
No	88.9
Total	**100.0**

Note: Data based on 25 valid responses.

Question 21. How is carrier performance monitored?

	Percent Response
Automated process monitors aspects of carrier performance, and it is used	57.7
Automated process exists, but is not used	3.8
Manual process	50.0
Carrier performance is not monitored	0.0
Other	3.8

Note: Data based on 24 valid responses.

Question 22. Is the volume of traffic awarded to each carrier monitored throughout the year?

	Percent Response
Yes	92.0
No	8.0
Total	**100.0**

Note: Data based on 25 valid responses.

Respondent Information

Question 23. What is your annual revenue (estimated gross revenues for 1997)?

	Percent Response
Under $5 million	16.0
$5 to $10 million	20.0
$11 to $25 million	8.0
$26 to $50 million	4.0
$51 to $100 million	20.0
Over $100 million	32.0
Total	**100.0**

Note: Data based on 25 valid responses.

Question 24. What is your annual transportation purchase?

	Percent Response
Under $1 million	4.0
$1 to $4 million	12.0
$5 to $10 million	20.0
$11 to $25 million	12.0
$26 to $50 million	0.0
$51 to $100 million	28.0
Over $100 million	24.0
Total	**100.0**

Note: Data based on 25 valid responses.

Question 25. How many TL loads do you ship per year?

	Percent Response
Less than 500	4.0
501 to 1,000	8.0
1,001 to 5,000	4.0
5,001 to 10,000	12.0
10,001 to 50,000	36.0
50,001 to 100,000	12.0
100,001 and over	24.0
Total	**100.0**

Note: Data based on 25 valid responses.

Question 26. Approximately what percentage of your purchased transportation ($) is hauled by the following modes?

	Average
Rail	9.5
Truckload	68.0
Less-than-truckload	13.7
Package	3.8
Other	5.0
Total	**100.0**

Note: Data based on 25 valid responses.

Appendix III - Carrier Survey

Number of Valid Surveys Returned

In December 1997, 840 surveys were sent to carriers. A total of 86 surveys were returned, making the response rate near 10 percent.

Load / Shipment Tendering

Question 1. On average, how much advanced notice do you receive from shippers when being tendering a load / shipment?

	Percent Response
0 to 12 hours	32.5
13 to 24 hours	37.4
25 to 48 hours	25.3
3 to 6 days	3.6
1 week or more	1.2
Total	**100.0**

Note: Data based on 83 valid responses.

Question 2. What percentage of your loads / shipments are tendered using the following technologies?

	Average
Phone	64.4
Fax Machine	26.9
Email	0.7
Websites	0.3
EDI	5.5
Other	2.2
Total	**100.0**

Note: Data based on 79 valid responses.

Question 3a. For TL carriers, do shippers allow you to broker a certain percentage of their loads / shipments?

	Percent Response
Yes	61.2
No	38.8
Total	**100.0**

Note: Data based on 67 valid responses.

Question 3b. If yes, what is the typical maximum percentage?

	Percent Response
up to 20%	34.1
21 to 40%	17.1
41 to 60%	2.4
61 to 80%	0.0
81% or more	4.9
Varies widely	41.5
Total	**100.0**

Note: Data based on 41 valid responses.

Question 4. What percentage of your business is received from brokers / third parties?

	Percent Response
none	9.0
1 to 5%	50.0
6 to 10%	16.7
11 to 20%	15.4
21 to 50%	6.4
over 50%	2.6
Total	**100.0**

Note: Data based on 78 valid responses.

Contractual Relationships

Question 5. How much of your business is through a core carrier program?

	Percent Response
less than 10%	21.8
11 to 20%	16.7
21 to 40%	16.7
41 to 60%	24.3
61 to 80%	14.1
81 % or more	6.4
Total	**100.0**

Note: Data based on 78 valid responses.

Question 6. How much of your business is under contract?

	Percent Response
none	2.4
1 to 20%	12.2
21 to 40%	12.2
41 to 60%	22.0
61 to 80%	20.7
81% or more	30.5
Total	**100.0**

Note: Data based on 82 valid responses.

Question 7. What is the average length of your contracts?

	Percent Response
1 month or less	6.2
2-6 months	0.0
7-12 months	48.1
13 months to 2 years	34.6
over 2 years	11.1
Total	**100.0**

Note: Data based on 81 valid responses.

Question 8. What percentage of your contracts offer volume guarantees of the following form?

	Average
No volume guarantees	31.9
Nominal volume guarantee (e.g. 3/yr)	47.6
Realistic volume guarantee	19.2
Other	1.3
Total	**100.0**

Note: Data based on 79 valid responses.

Question 9. What percentage of your contract customers contract in the following manner?

	Average
Lane	19.9
Facility (originating)	53.1
Facility (destining)	7.8
Region	15.0
Other	4.2
Total	**100.0**

Note: Data based on 79 valid responses.

Question 10. What percentage of your contracts include a rate freeze of:

	Average
One year, but less than two years	70.5
Two years	4.4
Longer than two years	1.8
Other	23.3
Total	**100.0**

Note: Data based on 76 valid responses.

Question 11. What percentage of your contracts have a 30 day cancellation clause?

	Percent Response
Yes	90.9
No	9.1
Total	**100.0**

Note: Data based on 82 valid responses.

Question 12. What percentage of your contracts have a fuel surcharge clause?

	Percent Response
Yes	67.3
No	32.7
Total	**100.0**

Note: Data based on 78 valid responses.

Rate Structures

Question 13. For TL carriers, what are the most common rate structures that you use (rank from 1 = most common)?

	Average Rank
Flat rate	2.1
Rate per mile with NO minimum	3.1
Rate per mile with a minimum	1.7
Other	3.1

Note: Data based on 66 valid responses.

Question 13a. Indicate whether you currently offer multiple rates for customers based on the following situations.

	Percent Response
If a different trailer length is used	19.4
If previous load was inbound to this facility (continuous move	68.7
If a certain number of loads have already been tendered on this lane this week	10.4
Depending on whether it is over-the-road or intermodal	21.9
Depending on transit time provided	37.3
Depending on the amount of lead time offered to the carrier	7.5
Depending on attaining certain annual freight volumes	29.9
Depending on day of week	19.7
Other	8.3

Note: Data based on 64 to 67 valid responses.

Question 14. For LTL carriers, what are the most common rate structures that you use (rank from 1 = most common)?

	Average Rank
Rate per CWT	2.4
FAK	3.2
NMFC class based	2.3
Discounted weight/distance rate scale	3.6
Other	3.4

Note: Data based on 20 valid responses.

Question 14a. Indicate whether you currently offer multiple rates for customers based on the following situations.

	Percent Response
Depending on the mix of commodities	45.8
Depending on transit time provided	26.1
Depending on the amount of lead time offered to the carrier	0.0
Depending on attaining certain annual freight volumes	56.5
Depending on day of week	4.5
Other	0.0

Note: Data based on 21 to 24 valid responses.

Solicitation and Award Methods

Question 15. What percentage of your current customers were obtained under the following methods?

	Average
Competitive bid	32.0
Face to face negotiation	50.7
Multiple round bid	3.0
Solicitation for a single load at a time	11.2
Other	3.1
Total	**100.0**

Note: Data based on 83 valid responses.

Question 16. Approximately how many competitive bids did you participate in over the past year?

Mean	174
Median	40

Note: Data based on 76 valid responses.

Question 17. What percentage of your potential customers ask for the following information prior to their selection (beyond price and service standards)?

	Percent Response
Experience / references	49.5
Equipment (# tractors & trailers)	71.4
Types of EDI supported	46.0
Ability to track and trace shipments	48.9
Management qualifications	23.9
Financial status / statements	51.9
Quality control / ISO9000 certification	19.5
Loss & damage experience	31.0
Safety experience	53.7
Certificate of insurance	92.1
Other	0.0

Note: Data based on 59 to 74 valid responses.

Question 18. What percentage of the competitive bids that you have participated in over the last year provided the following preparation lead times (from bid receipt to bid submission)?

	Average
Less than 7 days	14.4
8 to 15 days	25.3
16 to 30 days	33.6
31 to 60 days	20.1
61 days or more	6.6
Total	**100.0**

Note: Data based on 78 valid responses.

Question 19. What percentage of the competitive bids that you have participated in over the last year provided the following notification lead time (from bid submission to award notification)?

	Average
Less than 7 days	4.6
8 to 15 days	11.4
16 to 30 days	30.9
31 to 60 days	29.4
61 days or more	18.8
Never notified	4.9
Total	**100.0**

Note: Data based on 78 valid responses.

Question 20. What percentage of the bids were conducted in the following manner?

	Average
Paper based	67.3
DOS based bid tool	9.4
Spreadsheet based bid tool	19.7
Internet or website based application	0.6
Other	3.0
Total	**100.0**

Note: Data based on 78 valid responses.

Question 21. What percentage of the competitive bids that you have participated in over the last year provided you the following traffic flow information and how do you rank the importance (rank 1 = very important, 5 = least important)?

	Percent Response	Average Rank
Amount of freight in tons	47.6	2.7
Amount of freight in loads	64.5	1.7
Amount of freight per year by lane	58.8	1.6
Amount of freight by week for a year	28.4	2.0
Day of week distribution of loads	19.8	2.3
Maximum # of loads / shipments per day	33.7	1.9
Frequency of stop-offs per lane	36.1	2.2
Lane mileage and source of miles	42.4	2.4
Distribution of shipments / weight by commodity	29.1	2.2
Detailed flow breakdown of 5 digit zip to 5 digit zip	18.7	3.3
Target, goal, or benchmark rates	17.0	2.8
Other	4.0	2.8

Note: Data based on 52 to 68 valid responses.

Question 22. What percentage of the bids give you the following facility information and how do you rank the importance (rank 1 = very important, 5 = least important)?

	Percent Response	Average Rank
Location	95.7	1.1
Operating hours	56.9	1.8
Point of contact	66.4	1.9
Pallet exchange	40.2	2.8
Product packaging	31.4	2.7
Trailer pool availability / size	38.7	2.5
Dock information (# doors, etc.)	9.9	3.6
Scheduling requirements	48.1	1.7
Ability to reschedule appointments	26.6	2.2
Live load / unload requirements	50.8	1.5
Average loading / unloading time	30.7	1.6
Average weight of shipment	52.4	1.9
Average lead time for tendering	38.4	2.0
Other	0.0	-

Note: Data based on 53 to 71 valid responses.

Question 24. How reliable do you feel the information you receive is?

	Percent Response
Very reliable	10.7
Somewhat reliable	77.3
Somewhat unreliable	12.0
Very unreliable	0.0
Total	100.0

Note: Data based on 75 valid responses.

Related only to Defense Logistics Agency Practices

Questions 23 and 25 through 31. (Omitted)

Respondent Information

Question 32. Your motor carrier operations are broken out as follows (total should equal 100%):

	Average
Nationwide less-than-truckload	3.0
Regional less-than-truckload	14.5
Nationwide truckload	43.8
Regional truckload	30.3
Other	8.4
Total	**100.0**

Note: Data based on 82 valid responses.

Question 33. What is your estimated gross annual revenue from motor carrier operations for 1997?

	Percent Response
Under $3 million	3.6
$3 to $9.9 million	13.3
$10 to $24.9 million	13.3
$25 to $99.9 million	43.4
$100 to $249.9 million	10.8
$250 to $499.9 million	7.2
$500 million and over	8.4
Total	**100.0**

Note: Data based on 83 valid responses.

Question 34. What type of carrier are you?

	Percent Response
General freight	63.9
Heavy specialized (e.g., heavy machinery, building material)	7.2
Munitions	1.2
Refrigerated solids	4.8
Motor vehicle hauler	7.2
Other	15.7
Total	**100.0**

Note: Data based on 83 valid responses.

Question 35. What is your average length of haul?

	Percent Response
Less than 300 miles	22.0
300-499 miles	25.6
500-699 miles	20.7
700-999 miles	17.1
1000 miles or more	14.6
Total	**100.0**

Note: Data based on 83 valid responses.

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