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Determining the Value of Real-Time Congestion Information for Commercial Vehicle Operators

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In this project, researchers sent mail surveys to commercial vehicle operators (CVOs)--for-hire carriers and private fleet operations--in the Twin Cities to determine their use of congestion information and their ability to attach specific values to congestion costs. The project also assessed the ability of CVOs to avoid congestion.

The report presents survey findings. Despite the fact that a vast majority of respondents indicated congestion information would be useful, CVOs do not rely currently on available congestion information to any significant extent. The reasons may include lack of awareness and/or an inability of CVOs to effectively use the form and content of the information. For-hire carriers also are not well-equipped to estimate congestion costs with any degree of confidence. This results from apparently inadequate costing systems and/or technology to capture costs at the vehicle level. Further, respondents said that they had very little flexibility to adjust schedules to avoid congestion. Also, shippers without private fleets feel significantly less strongly about congestion as a problem than their counterparts with such fleets. Thus carriers may be constrained in their ability to use congestion information. The report also contains a demographic profile of CVOs operating in the Twin Cities and recommendations for further research.

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Final Report

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Executive Summary

This project attempts to measure the value of congestion information for three classes of firms doing business in the Twin Cities Metropolitan Area (TCMA); a) for-hire motor carriers, b) shippers who operate private fleets, and c) shippers who do not operate private fleets. Further, it attempts to determine whether for-hire carriers operating in the TCMA can assign a specific value to congestion costs. Surveys were administered to carriers operating in the TCMA as well as shippers operating facilities in a 22 county area surrounding and including the Twin Cities. For convention, the term commercial vehicle operator (CVO) refers to both for-hire motor carriers and private fleets operated by shippers. Essential findings of the report are as follows;

- Approximately 68% of for-hire carriers and 40% of shippers view congestion as a problem in terms of delivering service to their respective customers. For both groups, normal rush hour congestion was the dominant cause followed by weather and construction. Shippers who do not operate private fleets were significantly less concerned with congestion as a problem than those that did operate such fleets.

- Approximately 75% of motor carriers and 65% of private fleet operators indicated that they would find it of some value to have access to a real-time congestion information system.

- A majority of carriers and private fleet operators do not currently use the congestion information that is already available to them. The combination of this and the above

bullet suggests a need toward building awareness of the existing congestion information that is currently available.

- While respondents indicate congestion information would be of value, the data suggest that motor carriers are not able to place a specific value on congestion, i.e., their costing systems do not identify congestion as a cost driver. Expressed differently, because their costing systems do not measure such costs, they do not have the ability to attribute specific savings to such systems. This makes it difficult for carriers to justify investments needed to acquire such information.

- Carriers indicate a preference for congestion information to be delivered to dispatchers while operators of private fleets are split between delivering the data to the dispatcher or the vehicle. One of the explanations for this split is that carriers wish to avoid specific investments which would need to be made to equip each tractor with some sort of communication device. Private fleet operators are split because not all of them use dispatchers.

- While congestion appears to be predictable by season, day of week, as well as time of day, a number of factors suggest that carriers and private fleet operators may not be able to avoid it. Shippers in general are less concerned about congestion as a problem than are CVOs. Consignors and consignees also rely on appointments and stress reliability as a service characteristic of their carriers. In fact, reliability is the dominant service characteristic for both groups of respondents. Thus, truck operators are expected to perform whether it is a congested period or not. For example, the data

reveal only 28% of carriers and 39% of private fleet operators feel they have the flexibility to change schedules.

- All CVOs represented in the survey face the same seasonal demand patterns for their services. This is true across seasons and days of the week. Thus, congestion will affect the capacity of all segments of the industry similarly. The data clearly show that the effects of congestion on CVOs will be greatest in the buildup toward the December holidays and on Mondays and Fridays.

- The primary flexibility of truck operators is to change routes when the normal route is congested. Such flexibility may be limited, however, in that alternative routes may be restricted. Further, congestion information is available only on major highways and interstates all of which tend to become congested at once.

- It is difficult to conclude which type of firm is most sensitive to the costs of congestion. There is no significant difference between how manufacturers, distributors or retailers view congestion as a problem. There is also no difference regarding the perception of congestion when firms are compared by their most important product. The conclusion is that competitive pressures will continue to mount in all industries and all products will be considered time sensitive by their owners.

- The perception of the carriers is that congestion is increasing their operating costs and they are not able to pass these costs onto their clients. As a group they are mixed in terms of their ability to plan for congestion.

CHAPTER 1

INTRODUCTION

This project is an outgrowth of a project entitled Logistics 20/20, a freight transportation planning program developed by the Minnesota Department of Transportation (Mn/DOT) Metro Division. During the course of the study, Mn/DOT Metro division conducted several studies. The first process Mn/DOT used to engage the freight community by was one-to-one interviews with 12 food shippers and 12 construction industry carriers to identify key issues with shippers and carriers in the Twin Cities Metropolitan Area (TCMA). The interview data identified highway congestion as an important element in the ability of respondents to maintain customer service. For example, congestion was among the top three concerns by respondents in terms of future trends. Respondents also identified reliability, which could be affected by congestion, as one of the most important elements of their services to their customers. These responses were consistent across both industries. Finally, congestion was viewed as the most important highway trend for the food industry respondents and one of the most important for the construction industry.(1)

The results of the Logistics 20/20 project has encouraged the hypothesis that operators of truck fleets, both private fleet operators and motor carriers, would find value in real time congestion information. For convenience, the combined group of motor carriers and private fleet operators are referred to as commercial vehicle operators or CVOs. In theory, having real time information on congestion could result in increased asset productivity and improved customer service for truck operators. For example, being able to avoid congestion would allow CVOs to increase revenue per vehicle and/or decrease operating costs as well as improve customer service. It could also lead to increased

capacity without any additional investment. In order to actually avoid congestion, however, the CVO must have some flexibility to alter its operations and/or schedules. In addition, if the CVO is expected to make any investments, e.g., buy technology in order to receive real-time congestion information, it should be able to place a value on congestion costs and estimate the potential savings from avoiding congestion. This project addresses a number of these issues as well as expands the scope of Logistics 20/20 by including for-hire motor carriers and a sampling of shippers not operating private fleets. Specifically, this study measures whether congestion information would be of value to truck operators in the TCMA, the ability of motor carriers to place a value on congestion and, if so, what that value may be. It also attempts to determine how much flexibility the carriers may have in order to avoid congestion, i.e., either to change operations or schedules. The study also defines the nature of CVO operations in the TCMA more precisely than has been done previously.

After a brief literature review and definition of the objectives and scope of the project, the survey methodology is discussed. Two surveys were administered—one to motor carriers and one to shippers, some of whom also operated private fleets. Survey results from for-hire carriers are discussed first and then compared with the results from shippers. In addition to conclusions relative to congestion information, descriptive statistics of both groups are discussed. The final section of the report contains recommendations and suggestions for further research.

Literature Review

Much of the available literature focuses on intelligent transportation systems (ITS) and congestion pricing which, in turn, focuses on passenger vehicles. A subsection of the ITS literature includes advanced travel information systems or (ATIS). These are systems similar to the one being studied in this report where traffic information is conveyed to the driver either before the trip or en-route. Most of this literature focuses on the value and use of such systems as used by passenger vehicles and how it may be delivered. An example of a cross-section of such literature is contained in a collection of papers edited by Benekohal.(2) Those articles that are slightly related to the current study focus on different ways in which ATIS information can be delivered to the vehicle, e.g., en-route or pre-trip and the value of travel time, albeit in Korea.(3) Unfortunately, the articles do not reveal specific references about the value of a real-time congestion information system for commercial vehicle operators in the United States. The most directly applicable literature deals with the human factors aspect of delivering ATIS systems to commercial vehicle operators. These are two studies sponsored by the Office of Safety and Traffic Operations R&D of the Federal Highway Administration which are cited below. The focus of the first study is to evaluate 7 different ATIS systems in terms of the human factors issues presented by each.(4) The second study analyzes the influence of using ATIS on driving tasks for both private and commercial vehicle operators.(5) Relevant conclusions of this study are as follows and assume the ATIS system is installed in the vehicle;

> Introduction of ATIS technology should first be made using less complex systems.

Driver acceptance will depend on the driver's trust of automation.

Use of sophisticated ATIS/CVO functions to replace existing technology (e.g., cellular phone) is considered unnecessary. That is, ATIS systems are not merely a communication device.

Drivers have been shown to be resistant to diverting from their present route to avoid congestion.

Subjects using complex navigational devices drove more slowly than those using less complex devices. The effects are more prevalent in older drivers.

CVOs rated economic productivity of such systems as the most important criteria.

Aside from the literature on ATIS, there are a number of web sites dealing with congestion that are available in select cities. These are somewhat similar to the system being studied in this report. One of these is "Traffic Online Freeware" which is currently serving Chicago, Houston, Milwaukee, San Francisco, and Seattle. The company is planning to open a site in Minneapolis and St. Paul.(6) Rather than showing a map of the area, this system identifies specific segments of highway and reports estimated speeds on the segment and estimated travel times. A similar system is "Smartraveler" which operates in Boston, Cincinnati, Philadelphia and Washington D.C.(7) By clicking on the segment of interest, a report identifies any traffic delays. That is, the display is segment-specific rather than being comprehensive. These systems are designed to provide information prior to the trip rather than en-route and are driven by reported data rather than cameras, as in the Mn/DOT site. A general listing of similar sites can be found in Transport Topics which is a publication of the American Trucking Association.(8)

Finally, the American Trucking Association (ATA) reports on a survey concerning the use of congestion information by CVOs in the Boston area.(9) The conclusions of the report, which are of interest, are as follows;

> Most respondents were small fleets, e.g., 65% of respondents had fewer than 20 power units.
>
> Approximately 40% indicated they saw benefit to real-time traffic information.
>
> The larger the fleet the greater the interest.
>
> Only 6% of larger fleets, i.e., over 100 power units, use a traffic information system. One conclusion is that they are not aware of the services.
>
> The longer the haul the greater the perceived benefit.
>
> There is some correlation between time-sensitive loads and a fleet's perceived benefit from real-time information.

The study being discussed here corroborates many of the ATA's conclusions above. As noted in the Executive Summary, few carriers currently use the congestion information available to them although many see value to such systems. Many carriers cannot place a value on such information and therefore their use is limited. The results discussed here suggest that the above conclusions can be extended to operators of large fleets as well. This study also goes further in that it analyzes differences between different types of carriers as well as shippers who operate private fleets.

CHAPTER 2

ORGANIZATION OF THE PROJECT

Objective

The objective of this study is to produce conclusions and recommendations relative to the following issues;

- What is the extent to which CVOs currently use any form of congestion information?
- Is the carrier able to place a specific value on congestion costs? What is the specific value?
- What are the necessary features of a real-time congestion information system and how must it be delivered? What are the various factors which affect a carrier's congestion costs e.g., operational constraints such as work rules, costs of assets, and customer service expectations, e.g., client requirements?
- How much flexibility does the carrier have in order to avoid congestion?
- Which industries or type of firm, i.e., CVO client firms, are most affected by congestion costs?

Scope

One limitation of the study relates to the development of names and addresses of targeted firms, i.e., motor carriers and industrial firms. No single source of information was available to identify potential respondents. Thus, a variety of sources were used with some overlap and probably some omissions. This is discussed further in the methodology section.

The second limitation relates to defining the different segments of the motor carrier industry. The study is limited to the following segments of CVO;

Truckload Carriers (TL)
    For-Hire
    Private (as part of shippers survey)
Less Than Truckload Carriers (LTL)
Cartage Companies
Courier Companies

Because carriers often participate in both TL and LTL operations, these carriers were grouped as "intercity" carriers for some portions of the following analysis. Data was collected from those firms, in the above segments, having some presence in the TCMA. The significance of this limitation is that other carriers, e.g., package express firms are not included.

General Methodology

The methodology included secondary research, interviews and survey data from both carriers and shippers. A review of the data collected by the Mn/DOT Metro Division Freight Transportation Planners (Logistics 20/20 project) provided background about shipper perspectives on the costs of congestion. They provided a format for interviews with shipper and carrier segments which were translated into survey instruments for both groups. For example, the same description of service and road issues that were used in Logistics 20/20 were also used in this study. The surveys were then pre-tested with telephone interviews and sample mailings. Carriers used in the pre-test were excluded from the general survey.

Carrier Survey

The intent was to identify all carriers which were domiciled or had an office or other presence in the Twin Cities Metropolitan Area (TCMA) area, no matter where they operated. The geographic definition of the TCMA is a function of the source documents used to identify carriers. These were the two major telephone directories and a commercial directory identifying TCMA carriers. It was originally thought such groups as the Minnesota Trucking Association (MTA) would provide names and addresses. However, the MTA does not share its membership lists. Perhaps because of deregulation at both the state and national levels, information such as the identity of carriers and the nature of their operation is no longer collected in any organized way. For example, the Mn/DOT Office of Motor Carrier Services also does not maintain such lists. Consequently, the carriers targeted for the study were identified by two primary sources; the "Twin Cities Official Shippers Guide," and local telephone directories.(10) Two separate lists were developed from each source and then merged. The total population of each carrier segment is estimated in Table 1 under the column of "Surveys Issued." The for-hire motor carrier survey is in Appendix A.

Shipper Survey

A shipper survey was pre-tested and developed parallel to the carrier survey. Shipper names were drawn from a commercial database of freight shippers, i.e., "The Directory of Shippers."(11) This list of shipper names represented firms in a wider area than simply the TCMA. As is discussed below, the names covered an area of approximately 22 counties surrounding the metropolitan area. The shipper survey is in Appendix B.

The data for both surveys was analyzed using descriptive statistics as well as tests of independence between two different sets of responses. Where possible, data was collected into two categories depending on the nature of response, e.g., yes/no to a particular question. One group was considered a control group and the other the "application" group. The analysis then compares whether there are any meaningful differences in the responses to other questions.(12) For example, shipper respondents were separated into two distinct groups on the basis of whether they did or did not operate a private fleet. That group not operating a private fleet is considered the control group, while the private fleet shippers are considered the application group. The responses for these two groups were compared in terms of whether any meaningful differences existed between the answers of these two groups. Such comparisons were made between both carrier and shipper respondents.

Survey Characteristics

Table 1 contains the vital statistics of the two surveys that were administered to shippers and carriers in the Twin Cities metropolitan area. The response rate from both the

TABLE 1

Characteristics of Survey Sampling Frame and Response Rates

	Surveys Issued	Surveys Un-deliverable	Survey Base	No. of Responses	Response Rate
Cartage	41	5	36	19	52.8%
Courier	62	2	60	14	23.3%
Intercity	175	11	164	61	37.2%
Shipper	320	33	287	71	24.7%
Total	598	51	547	165	27.59%

cartage and intercity segments exceeded expectations. The initial response from the courier and shipper segments were somewhat below expectations. Consequently, a second wave of questionnaires were applied to these groups which improved the response rate to more acceptable levels.(13) Table 1 includes data from the second wave of surveys.

It is of interest to estimate the size of the populations of the targeted respondents, i.e., carriers with a presence in the TCMA. By developing combined lists of carriers from the respective telephone directories of the Twin Cities and the "Shippers Guide," an attempt was made to identify all carriers with a presence in the TCMA. Thus, from Table 1, the respondents represent approximately 23%, 37% and 53% of the populations for courier, cartage and intercity carriers respectively.

The issue of shipper population is a little more complex. As noted, the names from the "Directory of Shippers" included firms that were located in an approximate 22 county area. According to the Minnesota Directory of Manufacturers, there are approximately 9,000 manufacturing firms operating statewide.(14) Approximately 5,230 of these firms operate in zip codes 55000-55488. These zip codes generally cover 22 counties including the immediate metropolitan area. The sample of 320 surveys issued represents approximately 6.1% of the population in the "expanded metropolitan area," and responses represent 1.4% of that population. While this may appear to be a low number, the absolute number of responses, i.e., 71 data points, does provide a basis for statistically valid conclusions.(15) Further, there is only a small amount of variation in shipper

responses, indicating that the aggregate data is representative. For example, there was little difference between the nature of responses in the first wave of questionnaires and those of the second wave.

Both the shipper and intercity carrier segments were analyzed for non-response bias. That is, do the non-respondents have any significantly different characteristics than respondents, and do these differences influence the interpretation of the results? An accepted method for testing for non-response bias is to compare the late respondents with early respondents.(16) The logic of this approach is that late respondents are more likely to resemble non-respondents. Because they represented the larger group, inter-city carriers were divided into early and late groups and the responses were compared. Areas of possible non-response bias include the following;

> While there is no significant difference in the size of respondents, as measured by either revenue and employees, early respondents have smaller tractor fleets and larger van fleets. That is, early respondents appear to be more oriented toward an urban operation than an intercity one.
>
> Early respondents are significantly more concerned about the "problem" of congestion than are late respondents (p=. 043).(17)
>
> Early responders see more value in congestion information than do late responders (p=.054).

While it is important to recognize non-response bias, it would appear that the survey has sampled those carriers who are most concerned with congestion. In regard to such bias from shippers, the most significant difference is that late responders are larger and have a greater tendency to have private fleets (p=.089).

CHAPTER 3

SURVEY RESULTS: FOR-HIRE CARRIERS

Carrier Demographics

Demographic data were collected from each respondent in order to categorize respondents and provide a basis of comparison between groups. Demographic variables include type of operation, size as measured by revenue and employees, fleet size and commodities carried.

Carrier Type: Each questionnaire was pre-coded to determine which carrier segment the respondent belonged to. In addition, each respondent was asked to indicate the primary nature of its operations, e.g., cartage, courier, intercity, etc. In general, the self-assessment agreed with the pre-coded estimates. This suggests that the assumptions

Table 2

Self Assessment of Carrier Classification

Carrier Type	Number
Cartage	15
Courier	13
TL (General Merchandise.)	20
TL (Other)	14
LTL	27
Other	5
Total	94

used in constructing the mailing lists were reasonable. In addition, the self-assessment data provided an additional breakdown of information. For example, Table 2 provides a

more detailed description of carrier type. Of the 61 intercity carriers, from Table 1, 27 or 44% were LTL carriers and 34 (56%) were TL carriers. Of the 34 TL carriers, 20 or almost 59% were general merchandise carriers while the others are more specialized.

Scope of Operations: One way of looking at the for-hire carrier data is by scope of operations. Respondents were asked to specify their geographic scope of operations such as metro area, greater Minnesota, etc. This question is designed to reveal those carriers who spend most of their operations in the metro area and therefore, may be in the greatest need of congestion information. The data is presented in Table 3 and Figure 1.

Table 3

Scope of Operations for Carrier Respondents

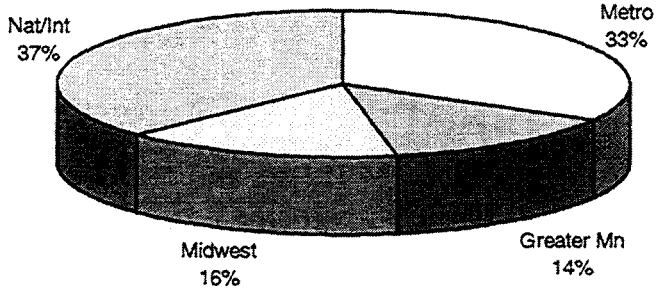
Scope of Operations	Number of Respondents	% of Responses
Metro Area	31	32.9%
Metro Area and Greater MN	13	13.8%
Throughout Midwest	15	16.0%
National/International	35	37.2%
Total	94	100%

It turns out that "scope of operations" may be a better predictor of which carriers operate in the TCMA than "carrier type". For example, only 53.3% (8/15) of cartage companies have their operations confined to the metro area. Similarly, only 18% (5/27) of LTL carriers operate exclusively within the metro area. On the other hand, couriers are predictably confined to the metro area and TL carriers generally have a much wider scope of operation than other carriers. One implication of this finding is that, with the exception of couriers who spend all of their time in the TCMA, the amount of congestion

faced by the carriers may be a function of how they schedule their work. Further, for purposes of statistical analysis between groups, "scope of operations" is used as well as type of carrier.

Figure 1

Scope of Operations for Respondents



Fleet Size: Carriers were asked to indicate the size of fleet in terms of either tractor units or trucks or vans. The responses indicate a large number of responses at both the low and high end of the scale. For example, 58.3% (42/72) of the respondents have fleets of less than 50 tractor units, while 20.8% (15/72) have fleets in excess of 300 units. For those respondents with tractor fleets under 300 units, the average fleet size is estimated to be 54.8 units.(18) For those respondents with straight trucks or vans, the overall average was 48.6 units. Thus, respondent firms were of substantial size when compared with the smallest fleets registered in Minnesota, which may contain only a handful of vehicles. The intuitive prediction at this point is that carriers with larger fleets would be more sensitive to congestion and therefore perceives it as a greater problem. This is discussed later in the report.

Size of Firm: Respondents were also asked to classify their firm in terms of both revenue and employees. Approximately 71.4% (65/91) of respondents report revenues of less than $25 million and 53.8% (49/91) report firms of less than 50 employees. For those firms with revenue of less than $350 million, the average revenue is $35.7 million. Those firms with less than 500 employees have an average of 71 employees. A summary of the size of respondent is presented in Tables 4 and 5. Some categories have been consolidated in the interest of space. See also Figures 2 and 3. Total responses do not add up to 94 since not all respondents answered every question.

Table 4

Revenue for Carrier Respondents

Revenue	n	%
<$25mil	65	71.4
$25-50mil	7	7.7
$50-200mil	8	8.8
>$200mil	11	12.1
Total	91	100

The size variables of fleet, revenue and employees reveal that motor carriers tend to be either large or small organizations. In fact, most of them tend to be smaller firms. The implication here is that many carriers operate on a small budget and are resource constrained.

Figure 2

Distribution of Revenue for Carrier Respondents

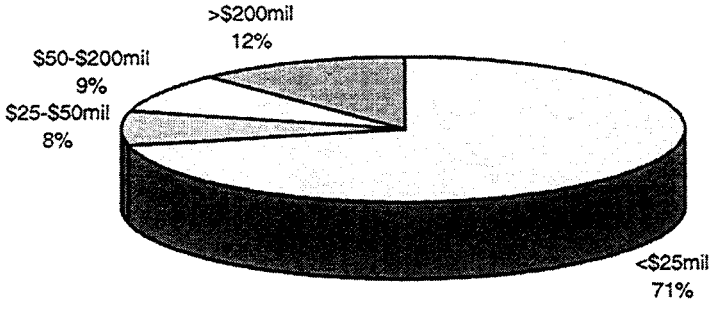


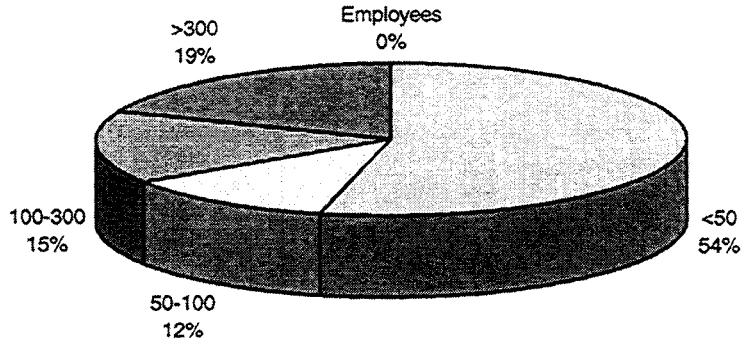
Table 5

Employees for Carrier Respondents

Employees	n	%
<50	49	53.8
50-100	11	12.1
100-300	14	15.4
>300	17	18.7
Total	91	100

Figure 3

Distribution of Employees by Carrier Respondents



Top Four Commodities: Respondents were asked to indicate the top four commodities that they carried. These were tabulated in terms of the number of times a particular commodity was chosen as one of the top four.(19) Using this methodology, the commodities were ranked according to their importance to the carrier. The data is presented in Table 6.

Table 6

Ranking of Most Important Commodities For-Hire Carriers

Product Class	No. Of Responses
Consumer Goods (for Retail Distribution)	58
Pulp and Paper	46
Other (variety of other commodities)	29
Food (Dry)	28
Metal Products	25
Machinery	23
Lumber	20
Electrical Equipment	19

It could be argued that most of these commodities are time sensitive, with the possible exception of lumber. The significance of consumer goods as the most important commodity is that it is time sensitive freight with high value. Paper products include packages delivered by couriers and are also obviously time sensitive. Food products are becoming more time sensitive, not only because of perishibility, but of the desire by the grocery industry to minimize inventory through such supply chain management strategies as just in time and efficient consumer response.(20) In general, manufactured products, such as machinery, metal products and electrical equipment are also becoming more time sensitive because of just in time inventory strategies that attempt to minimize inventory in the supply chain. The list of "other" commodities also reflected time sensitivity. A number of the items suggested as "other" by survey respondents could be placed in other classes, e.g., computers to electrical equipment. However, the list did contain items that are unique and represent time sensitivity. Examples of such products include auto parts, air freight, cigarettes, computer paper, live animals, newspapers and store fixtures.

The ranking appears to confirm a trend toward increased time sensitivity by shippers of all types of products. For example, there were no statistically significant differences between the perception of congestion as a problem by the carriers and their primary commodities. That is, the commodity does not affect the carrier's view of congestion. It is also the case that this trend is likely to increase over time. Management strategies, at all levels of the supply chain, will continue to focus on minimizing inventories. For example, between 1980 and 1997, the average inventory-turns have increased 57%.(21)

Operational Characteristics

Approximately 26.6% (21/79) of respondents operate on a route basis and the balance operate primarily on an origin-destination (O-D) basis. The average length of a route was 124 miles per day. It was originally speculated that route carriers would have more difficulty with congestion than O-D carriers. That is, route carriers would have less flexibility in avoiding congestion depending on the sequence of material loaded on the truck. On the other hand, O-D operators may be able to reschedule certain stops if they would otherwise occur in a congested period. For example, the grocery industry uses night deliveries to avoid such difficulties. The data, however, does not reveal any significant differences between the two groups relative to their view of congestion as a problem.

It is interesting to speculate relative to the relationship between congestion and carrier capacity. For example, if the route carrier's average distance of 124 miles/day can be considered a benchmark of daily capacity, then such a figure could be used as a barometer of whether congestion was having an impact on the carrier's capacity over time. This should be considered for future research and will be discussed later in this report. Such research would also test the question whether daily miles were a good measure of capacity in the TCMA.

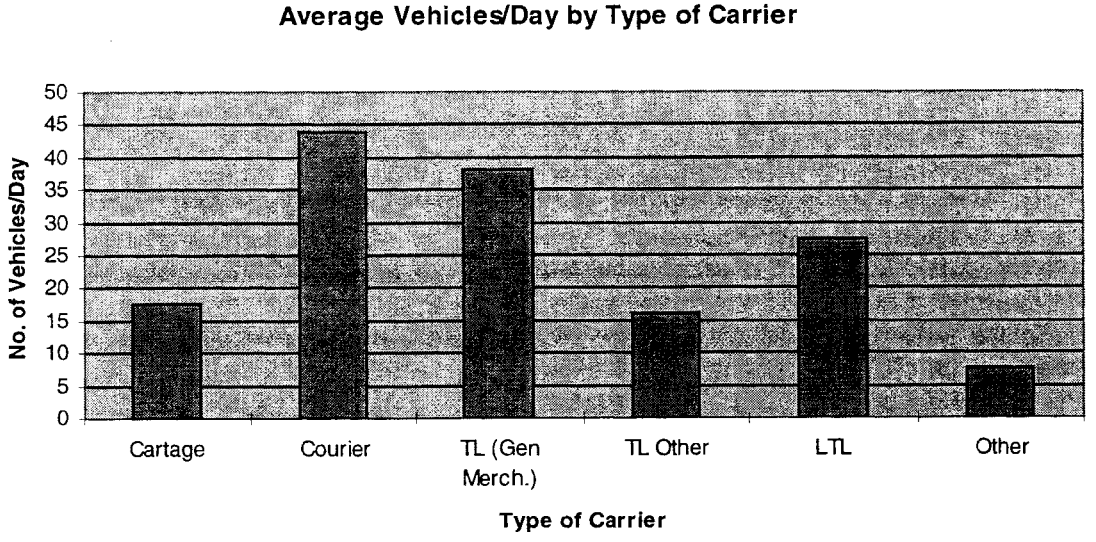
The overall average number of vehicles on the road in the Twin Cities Metropolitan area represented by all respondents, i.e., all types of for-hire carriers, is 27.9 units. A breakdown of the number of vehicles by carrier is presented in Table 7 and Figure 4.

Table 7

Average Number of Vehicles per Respondent by Type of Carrier

Carrier	Avg. Vehicles/Day	n	% of response
Cartage	17.6	15	16.1%
Courier	44.0	13	14.0%
TL (Gen Mrchdse)	38.2	20	21.5%
TL (Other)	16.1	14	15.1%
LTL	27.4	27	29.0%
Other	7.7	4	4.3%

Figure 4



Note that even though truckload carriers are passing through the Twin Cities on the way to an origin or destination, according to Figure 4, the combination of general merchandise and other truckload carriers represent a significant number of vehicles in the metro area. Expressed differently, despite the fact that other carriers, such as cartage, couriers and LTL carriers spend much of their operations in the metro area, in terms of sheer numbers of vehicles, TL carriers also have a great deal at stake relative to congestion. As discussed above, it is unclear at this point which class of carrier, TL or LTL, has the most

time sensitive freight. The fact is that the LTL carriers have been loosing market share to TL carriers since 1986.(22) For example, between 1986 and 1996 the market share of LTL carriers fell from 10% of the total market to 7%. At the same time, the market share for TL carriers moved from 18% to 23%. Intermodal carriers gained 1% of share, parcel carriers gained 4% and air freight gained 2%. All other carriers lost share. The reason is a change in supply chain strategy. As industrial firms establish distribution centers at inventory consolidation points near the market, shipments into those distribution centers are now moved in TL quantities at the expense of LTL carriers. Thus, the observation is that both types of carriers can be judged to carry time sensitive freight.

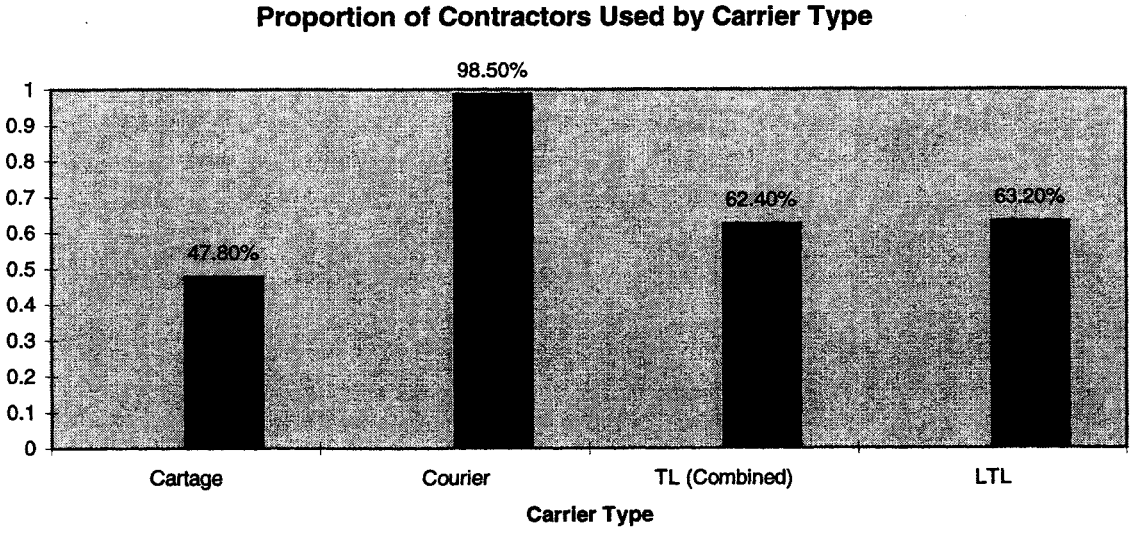
Carriers were asked about their use of contractors in their operations. Based on responses, all types of carriers use contract drivers. The lowest rate of use is in the LTL industry where only 37% (10/27) indicated use of contractors. The highest use is by couriers where over 92% of respondents use them. Approximately 78% (11/14) of "other TL" carriers used contractors and 65% (13/20) of truckload carriers of general merchandise used contractors. The rate of contractor use by cartage carriers is 40% (6/15). Of those carriers using contractors, 44.4% (24/54) use them 100%, i.e., the fleet is all contractors. Table 8 indicates the average proportion of carriers using contractors and the proportion of contractors in the fleet when they are used. In the case of LTL carriers, note that while the proportion of carriers using contractors is relatively low, when they are used they represent a majority of the fleet. The explanation for this is that many national LTL carriers are unionized where the percent of contractors will be low. Where LTL carriers are not organized, the proportion of use will be high.

Table 8

Distribution of Contractor Use

Type of Carrier	Proportion of Carriers Using Contractors	Overall % of Contractors in Fleet
Cartage	40%	47.8%
Courier	92.3%	98.5%
TL (combined)	70.5%	62.4%
LTL	37.0%	63.2%

Figure 5



The purpose of probing the use of contractors was to test the proposition that carriers who used contractors would have a different perception of the congestion problem than those who did not. For example, because contractors assume the cost of operations, the contractor and not the management would assume congestion costs. On the other hand, contractors have the ultimate judgment in determining how the work will actually be performed, i.e., the selected route of delivery. Thus, contractors are a means of shifting congestion costs from management to the actual operators of the vehicles. The data

suggest however, that there is no statistical difference between the use of contractors and how a carrier perceives the congestion problem. That is, management does not view contractors as a means of avoiding congestion costs. The survey did not test whether contractors perceive congestion differently than management. This remains an issue for further research.

Seasonality

Carriers were asked to weight both the months of the year and the days of the week in order to measure the seasonality of their traffic volumes. That is, they were asked to allocate 120 points across all 12 months, and 70 points across all days of the week, to reflect differences in demand. There are a number of reasons why this information is useful. First, it provides the ability to project traffic volumes for different seasons of the year as well as different parts of the week. Second, the data provides a basis for determining if all of the carriers experience similar patterns or whether there are some leads and lags which may offset the peak periods. These annual and weekly patterns are presented in Figures 6 and 7 respectively. The figures are organized according to the various scopes of operation used by the carriers and the indices for each segment are simply added together. That is, the left-hand scale is the sum of the four segments. In both the monthly and weekly variations, all of the carriers appear to have the same

Figure 6

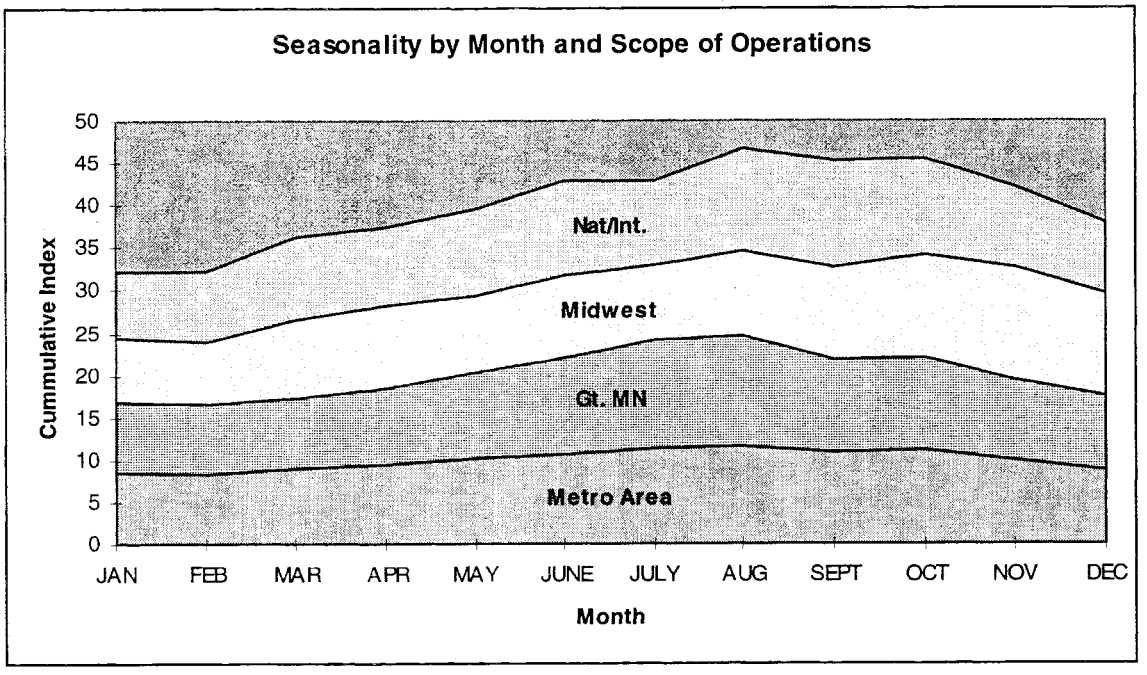
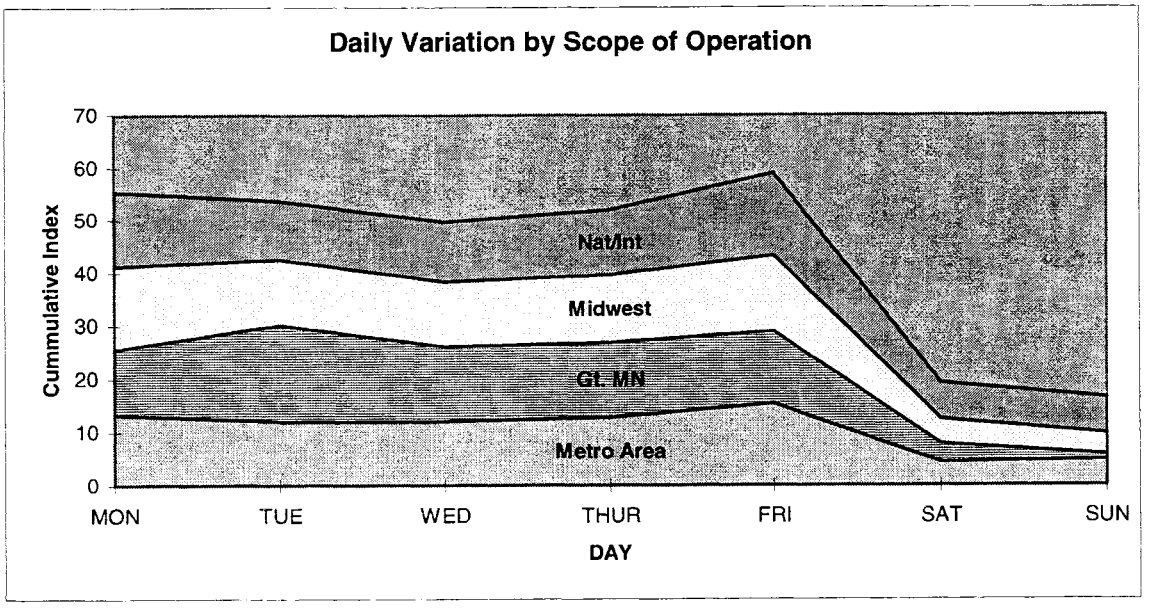


Figure 7



pattern. There is a large build-up of volume in March and again in August, approximately 15% and11% increases respectively. Volume holds at that level through September and October, before declining the last two months of the year. Table 9 maps the average monthly index for the entire for-hire carrier sample.

Table 9

Average Monthly Volume Index
For All Types of For-Hire Carriers

	Average Index	% Change
January	8.05	-
February	8.08	0.33%
March	9.28	14.82%
April	9.37	1.00%
May	10.01	6.88%
June	10.72	7.10%
July	10.55	-1.60%
August	11.68	10.72%
September	11.46	-1.91%
October	11.37	0.76%
November	10.30	-9.41%
December	9.20	-10.77%

The conclusion from Figures 6 and 7 is that all carriers experience very similar demand patterns during the year and also during the week. The annual pattern appears to follow a build-up to the winter holiday season with a lead-time of approximately two months. The weekly pattern is very consistent in terms of heavy traffic on Monday and then a higher peak on Friday as firms make an effort to move shipments before the weekend. For example, there is a 17.66% increase in estimated volume between Thursday and Friday. See Table 10. Very little traffic is shifted to Saturday or Sunday probably because of the

costs. It should be noted, however, that a substantial number of respondents appear to be active on Saturday and Sunday, 36 and 31 respondents respectively. Of these, approximately 50% were either TL or LTL carriers, 20% were couriers and 14% were cartage carriers. This could signal a move to more flexible operations by shippers and receivers.

Table 10

Average Daily Volume Index
For All For-Hire Carriers

Day	Average Index	No. of Responses	% Change
Monday	13.94	78	
Tuesday	12.57	78	-9.83%
Wednesday	12.12	78	-3.58%
Thursday	12.80	78	5.61%
Friday	15.06	77	17.66%
Saturday	5.44	36	-63.88%
Sunday	5.44	31	0%

Service Characteristics

Carriers were asked to rank a menu of service characteristics, including such descriptors as reliability and transit time from the perspective of their customer. In general, the shipper is considered the customer in this scenario i.e., the carrier works for the shipper. If the receiver, i.e., consignee, does not receive adequate service from the carrier, the normal process is to notify the shipper who will deal with the carrier.(23) The purpose here was to test the importance of factors that could be affected by congestion--such as reliability or on-time deliveries. Table 11 presents a summary of this ranking. The menu of service characteristics is based on the menu developed in Logistics 20/20. The values assigned are the average of the rank which were assigned by each of the respondents.

The standard deviation and the number of responses are also reported in order to provide information on the uniformity of the ranking. Figure 8 contains a graphic picture of the rankings.

Table 11

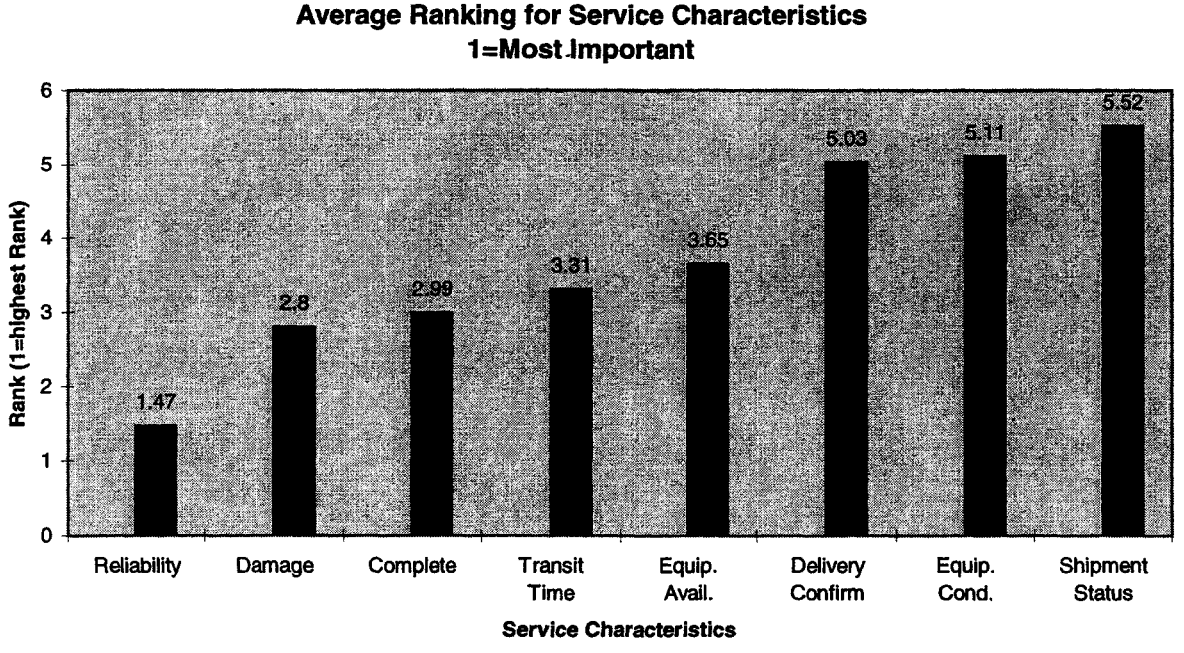
Average Ranking of Service Characteristics
All For-Hire Carriers (1 = most important)

	Average Rank	Std. Deviation	No. of Responses
Reliability	1.47	1.02	93
Damage	2.80	1.39	80
Complete Shipment	2.99	1.60	77
Transit Time	3.31	1.98	71
Equip. Availability	3.65	1.97	78
Delivery Confirm	5.03	2.19	62
Equip. Condition	5.11	2.24	65
Shipment Status	5.52	2.23	56

There appear to be three distinct groupings of service items. Reliability appears to dominate the list by being ranked first more consistently. The standard deviation indicates that there is little dispersion around the average, i.e., respondents generally agree reliability should be ranked first. Also of note is the fact that reliability was chosen as an important service factor by all of the respondents. The second group consists of damage, completeness, transit time, and equipment availability. These appear to be important as a group with no element standing out as significant from the others. Of this group, damage and completeness appear more important because of the expense of special handling orders when these situations occur. Transit time is an interesting situation. It appears substantially less important than reliability. The implication of the data is that it may be of no moment how long the shipment takes as long as it arrives when it is supposed to.

Factors such as equipment condition, delivery confirmation, and shipment status appear to be relatively unimportant in the carriers' perception of service. While there was an opportunity for respondents to indicate other service characteristics, only two were reported. These were safety and price. The conclusion is that the list of service characteristics was sufficiently complete and inclusive. Further, there are only minor differences as to how the various carriers ranked different service characteristics. All carrier segments ranked reliability as most important. Couriers ranked delivery reports and equipment availability substantially higher than other types of carriers. However, there are no significant differences in these ratings by scope of operation.

Figure 8



Congestion as a Problem for For-Hire Carriers

Approximately 68.5% of respondents (63/92) indicated that they considered traffic congestion or the condition of the highways as a barrier to maintaining their service

standards. Related to the discussion earlier concerning the identification of time sensitive products, there were no statistically significant differences between the perception of congestion as a problem by the CVOs and their primary commodity. That is, the commodity does not affect the carrier's view of congestion. All carriers, across all commodities, appear to have a similar view of congestion as a problem. There is also no difference between carriers who use contractors and those who do not. Further, as the scope of operation widens, e.g., Midwest or national motor carriers, the perception of congestion as a problem in the TCMA appears to decline. However, the differences are not statistically significant. These results appear to differ somewhat from the results cited earlier from the American Trucking Association.(9) That study found some evidence that the longer the haul, the more concern with congestion. These results suggest there is no difference.

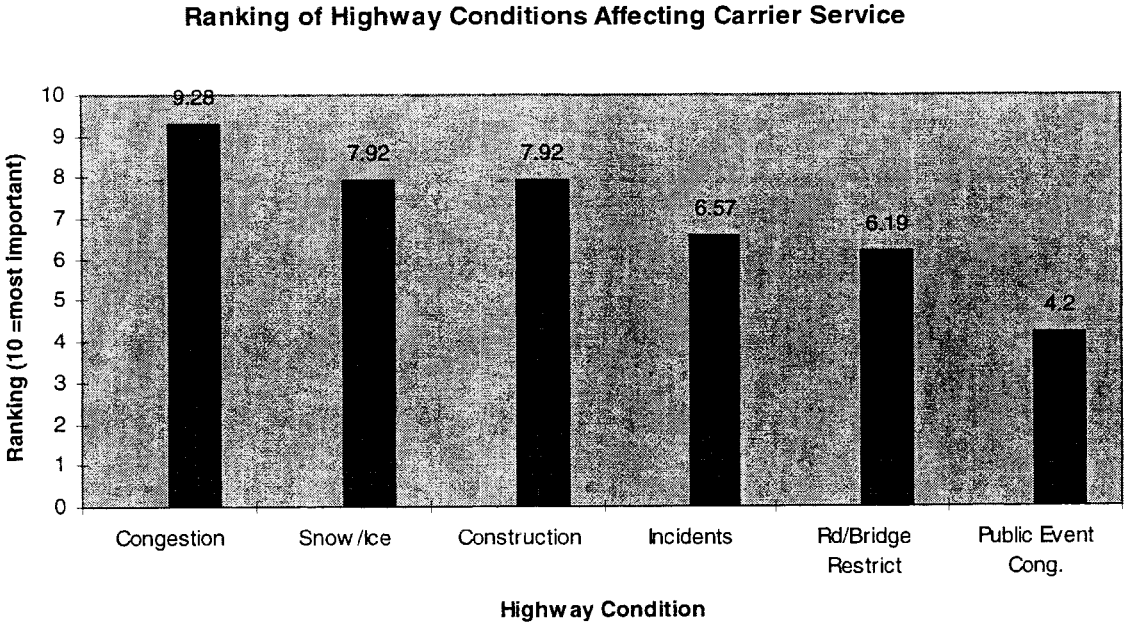
Those CVOs who did view congestion as a problem were asked to assign from 1-10 points (10 being very important) to those factors which would have the greatest impact on their ability to provide high levels of customer service. Table 12 and Figure 9 summarize this data. The higher the value, the greater the importance of the factor.

Table 12

Importance of Highway Conditions Impacting on Carrier Service (10 = very important)

Factor	Average Index	Std. Deviation
Rush Hour Congestion	9.28	1.55
Snow/Ice/Water on Road	7.92	2.11
Road & Bridge Construct.	7.92	2.03
Accidents & Incidents	6.57	2.63
Bridge/Road Restrictions	6.19	3.04
Public Event Congestion	4.20	2.77

Figure 9



There were only 4 responses suggesting "other" causes, indicating the menu of highway conditions were reasonably complete. The data confirms that rush hour congestion is the primary factor that impacts the carrier's ability to provide service. Winter conditions, road construction projects, traffic incidents, and road restrictions also have an impact, but are all dominated by rush hour congestion. Public event congestion does not have a

strong impact—likely because it is scheduled and predictable. Comparisons were made between the different types of carries but no significant differences were found. All of the carrier segments are in agreement on the importance of rush hour congestion. The primary difference between carriers is that couriers tend to rate incidents and road construction as more important and road restrictions as less important than other carriers. This is obviously because of the small vehicles normally used by couriers.

CVOs were asked a series of questions relative to who bears the costs of congestion. On a 5 point scale, where 5=strongly agree and 1=strongly disagree, carriers disagreed with the statement suggesting they were successful in passing the costs of congestion to their customers (3.84 on a scale of 5). Carriers appeared to slightly disagree or remain neutral to the question of whether they can recover congestion costs. Carrier responses averaged 2.40 out of a 5-point scale in response to the question of "congestion adds significant cost which (the carrier) cannot recover." Carriers appear to agree slightly or are neutral relative to the question whether they can plan for congestion and adjust to it. The question of whether they can plan for congestion scored 2.77 on a 5-point scale, i.e., close to the midpoint of 2.5. In summary, the perception of the carriers appears to be that they are bearing the burden of congestion costs and, as a group, are uncertain relative to their ability to recapture or prevent such costs.

Approximately 14.7% of respondents (11/75) indicated their costing system was sensitive to work performed during congested periods. Only 19.8% (18/91) indicated the ability to monitor the non-productive time of the vehicle. There were only 9 respondents who

indicated the ability to identify the differences in cost between congested and non-congested periods for different types of equipment. Because of the small number of responses in each category, the data are inconclusive. However, it indicates the difficulty carriers may have in estimating such costs and/or their unwillingness to share such information. See Table 13.

Table 13

Difference in Cost per Hour Between Congested and Non-Congested Work by Type of Truck

	Type of Equipment		
	Semi-Tractor/Trailer	Straight Truck	Van
Number of Respondents*	6	4	3
$ Cost Difference/hr.	$55.33	$22.25	$21.67
Range of Responses	$12-$125/hr	$9-$50/hr	$20-$25/hr

*Some respondents estimated costs for more than one type of equipment.

For example, given the available data, the average difference in cost for performing work with a semi-tractor trailer in a congested period compared to a non-congested period is $55.33 per hour. Similar estimates for straight trucks and vans are $22.25 and $21.67 respectively. The lack of response suggests that most carriers are unable to estimate the cost premium caused by congestion and are unable to measure such costs at the vehicle level. For example, 79.1% (72/91) were able to communicate with the vehicle at any time rather than waiting for the driver to check in. However, only 23.6% of carriers (22/93) indicate they had GPS capability in some or all of the vehicles that would allow them to locate the vehicle in real time. Further, only 19.7 % (18/91) of respondents indicated they had technology that would allow them to monitor the non-productive time of the vehicle. The probable case is that costing is still a difficult and imprecise process

for carriers. That is, they may take congestion into consideration implicitly when preparing price quotes but it is difficult for them to measure precisely. This presents somewhat of a dilemma. For example, 74.7% of carriers (68/91) indicate it would be of value to have a real-time congestion information system but the absence of a costing methodology makes it difficult for the carriers to place a precise value on such a system.

A related point concerns where real time traffic information should be delivered. Of those respondents indicating a value in such information, 73.4% (47/64) would want the system to be delivered to the dispatcher rather than the vehicle. The reason for this choice may be that carriers are aware of the cost implications associated with such systems. Delivering such systems to the vehicle, while perhaps being the preferred choice, has cost implications in that each vehicle must be equipped with some receiving device.

Use of Existing Information

The prototype for any kind of real time congestion information system is the current Mn/DOT website, www.dot.state.mn.us/tmc/, which demonstrates the current speeds and incidents on a significant portion of the metro area freeway system. Carriers were asked whether they regularly refer to Mn/DOT's website. Only 4 of 93 respondents (4.3%) indicated yes. Much of this can be attributed to a lack of promotion on the part of Mn/DOT to CVOs as a targeted constituency or the possibility that the system does not interface well with the carrier's operation. On the other hand, and testifying to the fact

that road construction is a major concern of the carriers, 43.0% (40/93) of the respondents regularly use Mn/DOT's advisory service which alerts them about construction projects.

The value of real-time congestion information may be limited by the constraints imposed on the carrier by either the consignee or consignor. As will be discussed later, approximately 47.8% (33/69) of shippers use a scheduled appointment system. Thus, there is the need for some carriers to make a commitment in advance and be held accountable to it. Only 28.3% of respondent carriers (26/92) indicated they had the flexibility to reschedule appointments. On the other hand, 91.3% of the respondents (84/92) indicated that they had the flexibility to seek alternative routes in order to avoid congestion. This flexibility may have limited use, however, since there are fewer routes available for operators of large trucks.

CHAPTER 4

SURVEY RESULTS: SHIPPERS

As reported in Table 1, 71 shippers responded to the questionnaire for a response rate of 24.74%. As noted earlier under "Survey Characteristics," the responses represent approximately 1.4% of the population of all shippers in the relevant area. Shipper questionnaires were sent out in two waves. A total of 44 responses were received after the first wave. After Labor Day of 1998 a second wave was sent to the same mailing list with a cover letter asking non-respondents to complete the questionnaire. Returns of the second wave were controlled to eliminate duplication.

Shipper Demographics

The primary business of respondents are tabulated below:

64.3% Manufacturing
17.1% Distributor
14.3% Retailing
4.3% Other

There are no statistical differences between the type of firm and their perception of congestion as a problem.

The commodity orientation of the respondents include consumer retail goods, dry and refrigerated foods, pulp/paper, and machinery. This is similar to the commodity orientation of the carrier sample. In addition there is a large "other" category (23.4% of responses) which indicates a wide variety of specific products, e.g., boats, magazines and ammunition.

The revenue characteristics of the shipper sample is contained in Table 14, and Figure 10 demonstrates that shipper respondents are generally larger organizations than surveyed carriers (from Table 4).

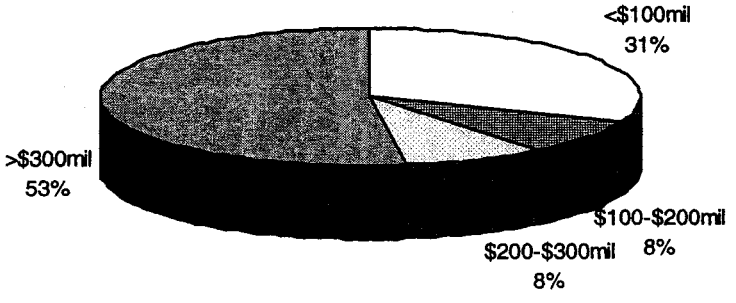
Table 14

Revenue Characteristics of Shipper Sample

	No. of Responses	%
<$100 mil	22	31.0%
$100-200 mil	6	8.5%
$200-300 mil	6	8.5%
>$300	37	52.0%
Totals	71	100%

Figure 10

Distribution of Revenue for Shipper Respondents



Facilities

Respondents operate an average of 4.77 facilities in the metropolitan area which have an average of 2.28 shifts. Manufacturers tend to operate the most shifts (2.5/day) while distributors operate 2.0 and retailers 1.75. Multiple shifts suggest that retailers and

distributors may indeed have some capability to reschedule shipments in terms of resupplying the day's sales. For example, the grocery industry will schedule deliveries at odd hours to avoid congestion and other problems. Manufacturers, on the other hand, may not be as able to reschedule shipments since their production schedules may be shift specific. The ability of both carriers and shippers to reschedule appointments is discussed later in this report.

These facilities also appear to be busy. Average responses were 125 vehicles per week for manufacturing facilities, 123 vehicles per week for distribution centers, and 127 vehicles for retailing facilities. The retail data appears to be driven by a small number of large respondents skewing the data. Approximately 47.8% (33/69) of respondents indicated they operate on an scheduled appointment basis. The appointment window averaged 4.4 hours. On the issue of the consequences of a carrier missing a scheduled appointment, 50% of respondents indicated the primary consequence was the carrier had to wait (22/44). Other sanctions included adjusting the carrier's service record [7], making another appointment [7], financial loss of future business [10], and charging any extra costs back to the carrier [5]. Multiple responses were possible. In the final analysis, it appears to be somewhat unrealistic that shippers could enforce a more stringent penalty than waiting, although this can have a significant cost to the carrier nevertheless.

Seasonality

The seasonal characteristics of shipper activities mirror those of the carriers, as might be expected. In effect the shipper responses verify the seasonal patterns indicated by the carriers. The monthly and daily variations are presented in Tables 15 and 16. Weekly data is almost identical to carrier data.

Table 15

Average Monthly Volume Index
All Shippers

Month	Average Carrier Volume Index (from Table 9)	Average Shipper Volume Index
January	8.05	8.31
February	8.08	8.45
March	9.28	10. 09
April	9.37	9.48
May	10.01	10.01
June	10.72	10.73
July	10.55	10.39
August	11.68	10.09
September	11.46	10.72
October	11.37	11.30
November	10.30	10.01
December	9.20	10.39

Table 16

Average Daily Volume Index
All For-Hire Carriers versus All Shippers

	Average Carrier Volume Index (from Table 10)	Average Shipper Volume Index
Monday	13.94	13.40
Tuesday	12.57	13.30
Wednesday	12.12	12.50
Thursday	12.80	13.10
Friday	15.06	14.9
Saturday	5.44	8.45
Sunday	5.44	5.82

Service Characteristics

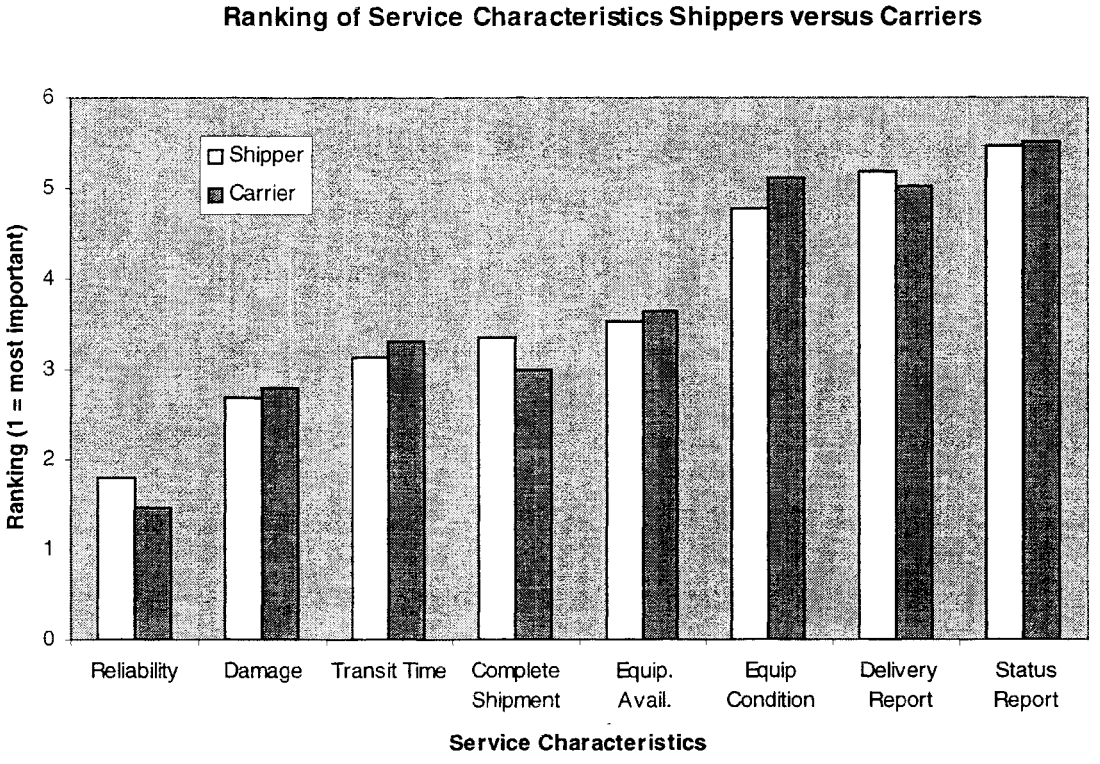
Shippers rank service characteristics almost identically with carriers. As Table 17 demonstrates, there is only one minor change between how shippers rank transit time versus that of the carriers. Carriers show a preference for completeness. Reliability remains the most important service factor from both perspectives. In fact it dominates the other characteristics. Figure 11 compares the data graphically.

Table 17

Ranking of Service Characteristics
Shipper versus Carriers
(1=most important)

Shipper Ranking of Service Items	Average	Carrier Rankings of Service Items	Average (from Table 10)
Reliability	1.80	Reliability	1.47
Damage	2.68	Damage	2.80
Transit Time	3.13	Complete Shipment	2.99
Complete Shipment	3.36	Transit Time	3.31
Equip. Availability	3.54	Equip. Availability	3.65
Equip Condition	4.78	Equip. Condition	5.11
Delivery Report	5.17	Delivery Report	5.03
Status Report	5.46	Status Report	5.52

Figure 11



The data were further analyzed to compare the ranking of service characteristics by the primary commodity classification of the shipper. Based on the Chi-square results, there were no significant differences between important product categories. This supports the observation made earlier that virtually all product categories consider their cargo time sensitive.

Congestion as a Problem for Shippers

In contrast to carriers, only 39.7% (27/68) of all shippers indicated that congestion or the condition of the highways was a problem in their operations. (Approximately 68% of carriers viewed congestion as a problem.) Further, rush hour congestion and road construction are viewed as equally important problems as far as shippers are concerned.

See Table 18 and Figure 12. Notice that carriers assign more weight to rush hour congestion than shippers do, despite the fact that both groups rank it as most important. Carriers also rank road and bridge restrictions and incidents higher than shippers do. Both groups view public event congestion similarly, i.e., as relatively unimportant. This latter factor was included as a consistency item since it can be anticipated in many situations and may occur primarily on weekends.

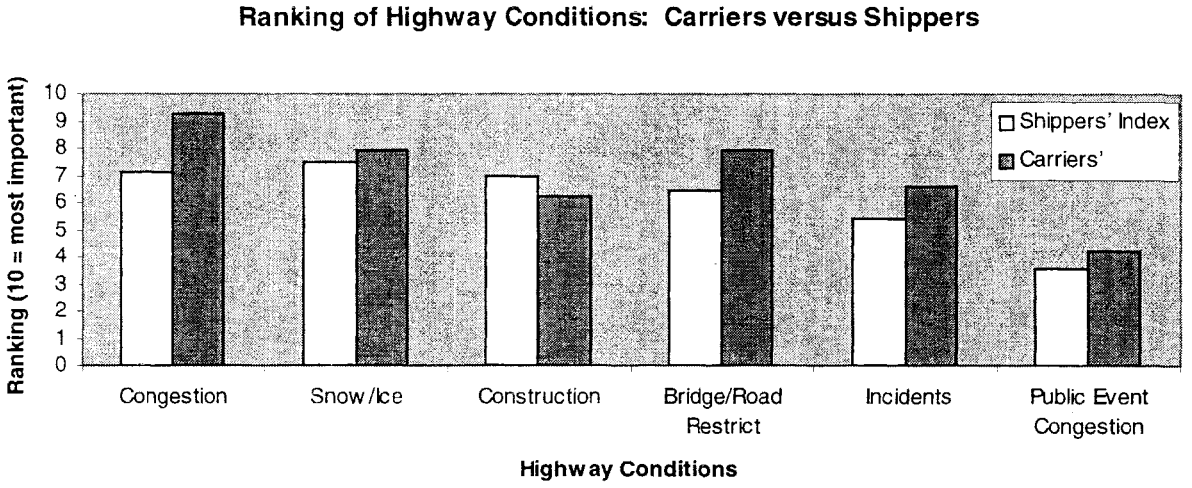
Table 18

Importance of Highway Conditions
Comparison of Shipper and Carrier Responses
(Assign up to 10 points where 10 = very important)

	Average Shippers' Index	Average Carriers' Index (from Table 12)
Rush Hour Congestion	7.10	9.28
Snow/Ice/Water on Road	7.45	7.92
Road & Bridge Construct.	7.00	6.19
Bridge/Road Restrictions	6.42	7.92
Accidents & Incidents	5.38	6.57
Public Event Congestion	3.59	4.20

As is discussed in the next section, the presence of a private fleet does make a statistically significant difference relative to a shipper's view of congestion as a problem. That is, private fleets do increase the importance of congestion to the shipper.

Figure 12



Private Fleets

Approximately 48.4% (31/64) of shipper respondents indicated they operated a private fleet. Surprisingly, only 11.4% (4/35) of those operating private fleets outsource them to a 3rd party.(24) The size of such fleets is substantial, e.g., 50 tractor units with a range of 25-225 units. For delivery trucks, the average was approximately 42.3 units. These results are very similar to the fleets operated by the for-hire carriers discussed in the early part of this report. Approximately 54.3% (19/35) of the respondents operating private fleets had both tractors and delivery trucks in their fleets. A total of 72.7% (24/33) of private fleet operators were evaluated as a cost center and only 27.3% (9/33) as a profit center. The orientation of the cost center approach is to minimize the cost of the operation rather than, for example, maximize service to internal clients. There is no difference between the two groups in their perception of congestion as a problem. There is, however, a statistically significant difference on how shippers that do not operate

private fleets view congestion relative to those that do. Shippers with fleets perceive congestion as a significantly greater problem than those without. (p=.04)

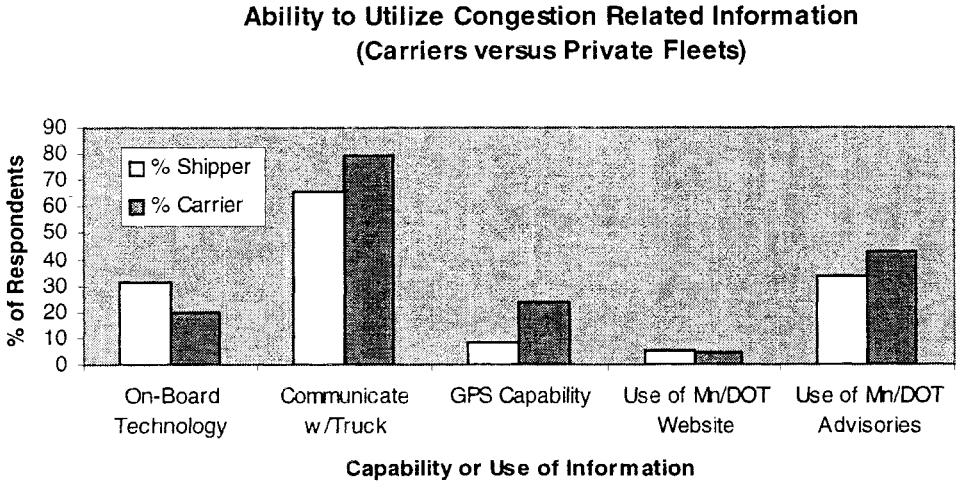
Table 19 contains a comparison between private fleets and for-hire carriers relative to their respective use of technology. In general, the conclusion is that private fleet operators are no better equipped to use real-time congestion information than are carriers. Private fleets do have somewhat more technology on-board which allows them to

Table 19

Technology and Use of Congestion Information
Private Fleets vs. For-Hire Carriers

	% Shipper Response	% Carrier Response
On-Board Technology	31.4	19.8
Communicate w/Truck	65.7	79.1
GPS Capability	8.6	23.7
Use of Mn/DOT Website	5.6	4.3
Use of Mn/DOT Advisories	33.3	43.0

Figure13



monitor non-productive time for the vehicle. However, their use of existing information relative to congestion is no better than for-hire carriers. See Figure 13.

Shippers with private fleets were asked whether they would find value in real-time congestion information. The same question was put to the carriers. Table 20 suggests shippers view the value of congestion information as somewhat less valuable than carriers although the difference is not significant. In response to the question whether congestion information would have value, almost 63% of shippers and 75% of carriers indicated yes. The choice for those shippers that do value such information, (62%) would be to have it delivered directly to the vehicle. This is in direct contrast to carriers who want to see it delivered to dispatchers (74%). A reason for this difference is that private fleet operators may not rely on a dispatcher to the same extent as for-hire carriers.

Table 20
Value of Congestion Information
All Shippers vs. All For-Hire Carrier

	% of Shipper Response Yes	% of Carrier Response Yes
Value in Congestion Information?	62.9%	74.7%
Deliver to Dispatcher?	48.0	74.2
Deliver to Vehicle?	52.0	25.8

Finally, private fleet operators have the same degree of flexibility in seeking alternative routes or rescheduling appointments as for-hire carriers do. Approximately 38.7% (12/31) of shippers with private fleets think they may be able to reschedule appointments while 28.3% (26/92) of carriers thought so. Both private fleets and carriers enjoy flexibility where drivers can reroute vehicles to avoid congestion, 96.8% (30/31) and 90.6% (84/92) respectively. However, as noted earlier, such flexibility may be difficult to implement considering load limits and roads that totally prohibit truck traffic.

Firms not operating private fleets were organized as a control group and compared to those shipper respondents who do operate such fleets. There were no significant statistical differences between these two groups relative to their use of appointments or the size of appointment windows. There is little difference between these two groups in terms of their perception of important service dimensions. One exception is that private fleet operators do consider completeness of the order as more important than those shipper respondents who do not have private fleets. Construction is also ranked substantially higher for fleet operators, e.g., average rankings of 7.81 for fleet operators and 6.19 for non-fleet operators, again on a 10-point scale.

CHAPTER 5

CONCLUSIONS

This study has compared for-hire carriers and shippers across a number of characteristics relative to congestion. The most significant difference is that those shippers operating private fleets view congestion as a significantly greater problem than those who do not operate such fleets. In other words, shippers not operating private fleets do not view congestion as an issue that interferes with their operation or their ability to provide customer service. By the same token, shippers with private fleets and for-hire carriers have the same view of congestion as a problem. There are other similarities between private fleet operators and carriers as well. Both groups face similar issues in terms of seasonality or demand, desired customer service characteristics, how the fleet is equipped with technology, and the flexibility each group has to rearrange schedules and avoid congestion.

The specific conclusions of this report are organized according to the list of objectives at the beginning of this document.

- What is the extent to which the carriers currently use any form of congestion information?

  Carriers, as well as private fleet owners, have demonstrated that they do not currently use much of the congestion information that is available to them. Only 4 of 93 carrier respondents and 2 shipper respondents who operated a private fleet indicated they used Mn/DOT's website. Less than half of the carriers avail themselves of the advisories concerning construction projects while 50% of private fleet operators do.

To a certain extent these results suggest greater awareness than the ATA findings in the Boston study cited earlier.(9) This finding suggests a course of action that should be aimed at building CVO awareness of the existing program at TMC.

There appear to be a combination of factors that would explain why carriers do not use congestion information more. Perhaps the easiest to address is that CVOs are uninformed about the availability of such information. A second issue is that the existing information does not integrate with the current operations of the CVO. That is, the existing system was designed independently of how dispatchers work. While it is an Internet based system, it represents a separate focus from whatever dispatching system is currently being used. A third factor relates to how the information is delivered. Where the delivery point is the dispatcher, an Internet connection would be all that was required as long as it was organized in such a way to effectively interface with the dispatcher. It is a different matter when the information is to be delivered to the vehicle. In this case, CVOs face investment cost necessary to equip the fleet as well as the acquisition cost of the information. Such resistance is increased by the inability of carriers to precisely measure cost differences between congestion and non-congestion work. Thus, they are not able to measure the return such investments would generate and will find it difficult to measure such trade-offs. Finally, carriers may simply not have the flexibility of either changing their routes or their schedules in order to avoid congestion. Because trucks may be limited to specific highways, or are route carriers, their options are limited. Also, few carriers feel they have the ability to alter schedules that are dictated by their clients. Thus,

even when armed with congestion information, carriers may not have any degrees of freedom to use it.

- Is the carrier able to place a specific value on congestion costs? What is the specific value?

  The results of this survey would suggest that carriers are not able to place a specific value on congestion costs. Some may use a waiting charge as a surrogate for such costs, but generally the data suggests carriers would be hard pressed to place a value on such costs. For example, only 14.8% of carrier respondents indicated that they had a cost system that can measure congestion costs. Also, only 9 respondents out of 75 were able to estimate cost differentials of congested versus non-congested work. Average estimates of the cost difference between congested and non-congested work are approximately $53/hr. for tractor trailers, $22/hr. for straight trucks, and $22/hr. for vans. However, the small number of data points suggests that further research is needed in this area.

The issue of not being able to specify congestion costs has a number of sources. One is the lack of sophisticated cost systems that allow congestion costs to be identified and analyzed. The second is an inability of the carriers to capture such costs because of the lack of technology at the vehicle level. The vehicle is the critical unit of analysis in this regard, and carriers as well as private fleet operators, do not appear to be equipped to capture data at that level. Less than 20% of carriers were able to measure the productivity of the vehicle and only 24% were equipped with GPS

capability. Approximately 31% of private fleet operators have technology available to monitor productivity, but only 9% are equipped with GPS.

- What are the necessary features of a real-time congestion information system and how must it be delivered?

  The preferred format of a congestion information system is not clear based on the results of the analysis. The fact that a majority of respondents do not currently avail themselves of such information makes it difficult for respondents to specify a preferred system. It is clear from the carriers' perspective, that such data is better delivered to dispatchers – probably on the basis that it avoids the costs of equipping each vehicle. The data verifies that carriers can easily communicate with vehicles. Making congestion information available to the dispatcher avoids the cost of distributing all information to the vehicle for the driver to sort out.

  To a certain extent, the inability of the carriers to measure congestion costs contributes ambiguity to what type of system will deliver value. Such a system should exhibit either average speeds or transit time by segment. Whether the segments are analyzed comprehensively, such as in the current TMC model, or individually as in some of the systems available in other cities, is of no great moment. The critical information is how long will it take the vehicle to get through the segment. While the survey does not contain any data to support it, pretest interviews also suggest the hypothesis that the length of waiting lines at freeway entry points is a useful piece of data. The reason for this is that many route vehicles have to reenter the freeway many times during the course of their route.

The fact that there is a lack of consensus of where such information should be delivered suggests that two different formats may be required to satisfy both segments of the market. For example, carriers generally want the information delivered to the dispatcher (74% of carriers) while private fleet operators are evenly split whether information should go to the dispatcher or vehicle. Under the dispatcher scenario, the current model of the Traffic Management Center seems appropriate. It is comprehensive and allows the dispatcher to view it periodically and relay the information to the driver. Recall that CVOs are equipped to communicate with drivers on demand. The most straightforward scenario is to provide the dispatcher with an internet connection which would allow them to monitor Mn/DOT's website. A useful feature of the system would be the ability to make it area specific. That is, monitoring the system becomes difficult if it covers a wide geographic area.

If the information is delivered to the vehicle, then it needs to be specific relative to the location of the vehicle. That is, if the driver is en-route then the driver needs to be alerted to the congestion. This is a rather sophisticated system. An alternative scenario is that the driver queries the system about the next segment needed to reach the next stop before departing. In this case, the format of the system could resemble the systems described as available in other cities. Finally, the system would have to be inexpensive.

- What are the various factors which affect a carrier's congestion costs, e.g., operational constraints such as work rules, costs of assets, and customer service expectations, e.g., client requirements?

  Some of the costs associated with congestion may not be under the carrier's control, but simply a part of its environment. Seasonality is an issue where all of the carrier segments experience the same demand patterns during the year and week. The impact is that when one member of the industry has limited capacity, the entire industry is affected. It further means that the costs of congestion are seasonal and a function of the day of the week. Considering lost opportunity costs, a carrier's cost of congestion increases in the fall season and on Mondays and Fridays.

  There is close agreement between shippers and carriers relative to service. Reliability is not only number one on both lists, it dominates the list. Carriers view rush hour congestion as the primary threat to reliability while shippers view rush hour congestion as one of a number of equally important threats. These include road construction and weather. Recall also that, according to the data in this survey, shippers view the congestion problem with somewhat less urgency than do the carriers. From a practical standpoint, reliability can be enforced through a combination of appointments and sanctions. Approximately 48% of shipper respondents indicated use of appointments, and the average appointment window was 4.4 hours. The primary sanction against missed appointments is to make the carrier wait. While this can be a significant cost for the carrier, such costs may not be identified as a cost of non-reliable service or a congestion cost. Thus, the way costs are handled by the CVO may be masking some of the true costs of the problem. On

the other hand, it simply may not be efficient for the shipper to impose any stronger sanctions than waiting.

As noted earlier in this report, it was hypothesized that the use of contractors was one way for carrier organizations to shift the costs of congestion to the driver, i.e., contractor. The data suggest this is not the case. The perception of congestion as a problem does not differ depending on the use of contractors. Instead, the use of contractors is driven by a variety of other reasons, including cost and flexibility. Contractors are used in all of the carrier segments to varying degrees. The LTL industry, which tends to be unionized, uses them the least, 37% of respondents, while couriers use them the most with 92.3% of respondents. Approximately 70% of truckload carriers use contractors. (See Table 8.) The key to the use of contractors is that the route used to deliver the product must be left to the discretion of the contractor. This explains why most CVOs have substantial flexibility to seek alternative routes.

- How much flexibility does the carrier have in order to avoid congestion?

  Not very much. While there is a great deal of flexibility in seeking new routes in order to avoid congestion, the implementation is limited. When the freeways become congested, city streets may not be an alternative for CVOs. Further, both shippers and carriers feel the same pressures from their customers to maintain appointments. Only 30% of carriers and 27% of shippers felt they had the flexibility to change appointments. This represents a severe constraint in the form of the need for all

firms, carriers and shippers to deliver customer service. And, as the data here suggest, reliability is the most important element of customer service.

- Which industries or type of firm, i.e., CVO client firms, are the most sensitive to congestion costs?

  There is no statistical difference between the type of shipper firm, e.g., manufacturer, distributor or retailer, and their perception of congestion as a problem. Further, there is no difference between shippers' view of congestion by type of product. According to the available data, the best predictor of whether shippers will be concerned with congestion is whether they operate a private fleet.

Recommendations for Further Action and Research

This survey has been a first step in defining the value of congestion information for the CVO. The results of the study suggest that the users of the information are not well prepared to exploit such information to the fullest extent possible. Thus, further research is needed in a number of areas in order to continue making progress toward the goal of better defining and measuring the impacts of congestion on CVOs and how Mn/DOT may be able to ameliorate those impacts. In addition, this study reveals that survey research has limitations as an effective means of gaining insight into the relationship between congestion and the CVO. Future work should try to focus more on field and longitudinal studies. The reason is that respondents may not be well prepared to provide answers to the relevant questions posed by surveys.

- Mn/DOT should develop an information program relative to the availability of current congestion information aimed at CVOs. Informational pamphlets should be developed indicating the location of Mn/DOT's website and the type of information that is available. These should be distributed as a direct mail campaign to commercial vehicle operators with any kind of presence in the Twin Cities Metropolitan Area. The information should also be disseminated through those media that cater to a trucking audience, e.g. specialized magazines.

- Being aware of the information is one thing, but it is important to demonstrate how the information may effectively be used. Therefore, Mn/DOT should develop a demonstration project that evaluates, over time, how the TMC's current presentation of congestion information interfaces with motor carriers and dispatchers. Carriers from different segments of the industry should be selected, e.g., two each from the cartage, courier, LTL and TL segments. The reason for selecting different segments is to be able to detect differences between different carriers. A free Internet connection and terminal, where necessary, would be provided to each. In exchange, the carrier would agree to cooperate for a period of at least three months. Cooperation in this sense means that Mn/DOT would monitor how the information was being used. Data could be collected in some type of journal or diary kept by the dispatcher and focus on such elements as how many times the system was referred to, when did it come into play in the dispatcher's daily decision making, and what is the perceived impact on the dispatcher. In addition, there should be regular consultation between the project manager at Mn/DOT and the dispatcher(s) in terms of how the

service could be better designed in order to integrate the system into the daily routine. There are two important outputs from this type of project. One is to gather field-test data relative to the ease with which the current system can be integrated into the carrier's dispatch operation. The second is to capture the views of the user as to how the display should be designed. Up to this point there appears to be limited user input toward the design of the current TMC display.

- There remains a central question relative to the ability of the CVO to use congestion information effectively. In order to measure these effects, a longitudinal study should be conducted which would attempt to quantify and measure the impacts of such a system on the CVO's costs and service. A demonstration project could be established that focuses on measuring the effectiveness of real-time congestion information for both carriers and shippers. A group of shippers with private fleets as well as a group of carriers should be selected as pilots in a long-term program to cooperatively measure the value of such information. While it is premature to suggest the methodology for such a project, it should be over the long term, e.g., 6 months to a year. A baseline of operating measurements should be established in order to have a basis for comparison over the period of the project. That is, a measure of effectiveness for current operations should be taken on both a time and cost dimension. For example, miles per day could be used as a measure of capacity as well as cost information. Congestion information would then be introduced into the pilot firm's operation as an experimental variable. A measurement system must be devised in order to measure changes between baseline measurements and those

resulting after the introduction of congestion information. The difference is an estimate of the value of congestion information. Care in selecting the participants in such a study will facilitate the extrapolation of the results to the general population.

- There are a number of other studies that could focus on the decision-making process of interested parties dealing with congestion. For example, is there a difference between how independent contractors, i.e., the drivers, view congestion and the perception of the carrier management? Would contractors be able to measure the value of congestion information sufficiently to justify paying for such information themselves?

- In a similar vein to the above bullet, does congestion enter into the pricing decision of the carrier even though they may not have a specific costing system to precisely measure such costs? For example, is there an implied process that the carrier uses to compensate for congestion when they know it will be involved? If true, then it may be the case that the carrier is more interested in being able to plan for congestion rather than avoiding it.

- The impact of congestion on the service and costs of the shipping firm is an important and complex area. The costs of poor transport services, e.g., lost sales and customer ill will, are very difficult for firms to define and capture. Further, such information is generally kept in the sales or marketing departments as opposed to the transportation department. That is, there is a separation between the transportation decision-maker

and the relevant information. It would be an area of fruitful research to focus on how industrial firms, regardless if they operate private fleets, measure the effects of unreliable transportation service.

References

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2. Ray Benekohal, (ed.) Traffic Congestion and Traffic Safety in the 21st Century, (New York, NY: American Society of Civil Engineers, 1997)

3. T.C.Sutaria, "Santa Ana Integrated Traveler Information Sharing System," pp. 354-360 and Yoo et. Al. "Analysis of the Effectiveness of FTMS: A Korean Case, pp. 146-152 in Benekohal (ed) Traffic Congestion and Traffic Safety in the 21st Century, (New York, NY: American Society of Civil Engineers, 1997)

4. D. L. Clarke et. al, Development of Human Factors Guidelines For Advanced Traveler Information Systems (ATIS) and Commercial Vehicle Operations (CVO): Comparable System Analysis, (McLean, VA: Office of Safety and Traffic Operations R&D, Federal Highway Administration, 1996) Report FHWA-RD-95-197.

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6. The web site address is www.trafficonline.com.

7. The web site is www.smartraveler.com.

8. James M. Galligan, "Avoiding Gridlock: Check the Monitor for Traffic," Transport Topics, September 7, 1998, pp. 30-32 and p. 80.

9. "Most Fleets Don't Clamor for Real-Time Traffic Reports," Transport Topics, The American Trucking Association, September 7, 1998, p. 33.

10. "Twin Cities Official Shippers guide," (Chicago, IL: Official Motor Freight guide, Inc. 1997, Issue 126)

11. "The Directory of Shippers," (Fredericksburg, VA: Transportation Technical Services, Inc., 1998).

12. The statistical test which was performed was the Chi Square test which returns a value indicating the probability that the relationship between the two variables would occur by chance. Thus, the lower the value returned by Chi Square the smaller the probability that the association could occur by chance.
A probability of <.05 is normally considered a significant difference under conventional probability rules. The p value here is the probability that the association between the two variables would occur by chance. See Taro Yamane, Statistics, (New York: Harper and Row, 1973, pp. 762-764)

13. The second wave of surveys was screened to eliminate duplicate responses.

14. "The 1995 Minnesota Directory of Manufacturers," K&G Publishing, Inc, P. O. Box 444058, Eden Prairie, MN, 1995.

15. A formula was used to determine the sample size of surveys aimed primarily at estimating proportions, i.e., yes and no type questions. The formula is n=[(z/h)**2*p(1-p)] where n is the sample size, z is the confidence interval, e.g., 1.64 for 90%, h is the upper limit on the error of the confidence interval and in this case .10, and p is the expected proportion the variable will appear in the population. The most conservative assumption for the value of p is .5 since that

will maximize the value of n. The evaluation of this equation yields a value of 67. The shipper sample has 71 data points. See Taro Yamane, Reference 12, p. 206.

16. J. Scott Armstrong and Terry S. Overton, "Estimating Non-Response Bias in Mail Surveys," Journal of Marketing Research, Vol. 14, August 1977, pp. 396-402. See also Douglas M. Lambert and Thomas C. Harrington, "Measuring Non-response Bias in Customer Service Mail Surveys," Journal of Business Logistics, Vol. 11, No. 2, 1990, pp. 5-25.

17. See reference 12. The p value reported here is the probability that the association between the two variables would occur by chance. For example, there is less than a 5% chance that the differences in how the way late respondents and early respondents consider congestion a problem could be explained by chance.

18. Carriers were presented with a menu of ranges from which to indicate fleet size. The last choice was open ended, i.e., >300 units, while other choices presented a range, e.g., 1-50. In order to calculate an average, the open ended choice was dropped and the remaining responses assumed the midpoint of the range. The same type of calculation was done for trucks and vans, revenues and employees.

19. The survey asked to identify the top 4 most important commodities. The number of times a particular commodity was identified were tabulated and placed in Table 6. A subsequent analysis was performed where each response was weighted, e.g., a ranking of #1 would receive a weight of 4, #2 would receive a weight of 3 and so on. No statistical difference exists between the two rankings. The major difference was that lumber was replaced on the list by refrigerated food.

20. Efficient Consumer Response (ECR) is an industry wide initiative in the grocery industry aimed at reducing inventories and delivering value to the retail consumer. The backbone of the initiative is the sharing of sales information among supply chain trading partners. See "ECR 1995, Progress Report," Joint Industry Project on Efficient Consumer Response. Contact Industry Relations Department of the Grocery Manufacturers of America 202-337-9400.

21. Robert V. Delaney, "9th Annual State of Logistics Report," (St. Louis, MO: Cass Logistics, June 1998)

22. American Trucking Trends, Washington, D.C: American Trucking Association, 1997.

23. The general rule is that the party that holds title to the product pays the freight bill and has the choice of carriers. When damage occurs the shipper, i.e., owner will file the claim.

24. Since the transportation industry was deregulated in the 1980s, many industrial firms have either eliminated their private fleets or assigned them to be operated by specialized logistics firms, known as 3rd. party logistics providers, or to be operated by carriers. The logic is that 3rd party providers or carriers are more expert at operating truck fleets and the firm is able to eliminate assets from its balance sheet.

Appendix A

For-Hire Motor Carrier Survey

For-Hire Carrier Survey

1. Of the following descriptions, which one best describes you as a carrier? (check the one most appropriate box based on revenue):

__	Auto Transport	__	Tank	__	Household Goods
__	Cartage	__	TL (General Merchandise)		
__	Freight Forwarder	__	Dry Bulk	__	Waste Hauling
__	Refrigerated	__	LTL	__	Flat Bed
__	Small Package/Parcel Delivery/Courier			__	Other

2. Which description best fits the scope of your operation (Please check only one):

__ Twin Cities Metro Area
__ Between Twin Cities and Greater Minnesota
__ Greater Minnesota
__ Between Points in Greater Minnesota and Throughout the Midwest
__ Throughout the Midwest
__ National
__ International (Either Mexico or Canada)

3. Please indicate your tractor fleet size?

__	none	__	1-50	__	51-100	__	101-150
__	151-200	__	201-250	__	251-300	__	over 300

4. Please indicate your delivery truck or van fleet size?

__	none	__	1-50	__	51-100	__	101-150
__	151-200	__	201-250	__	251-300	__	over 300

<u>If you are a courier/small package carrier, go directly to question 5c.</u>

5a. Please indicate whether the vehicles making pick-ups and/or deliveries operate on the basis of; _____ Route pattern or _____ Origin-Destination pattern. (<u>choose one</u>)

5b. For your particular response in 5a, indicate either the average length of route or the average distance between origin and destination. (in Miles)

__	less than 100	__	101-200	__	201-300	__	301-400
__	401-500	__	501-600	__	601-700	__	701-800
__	over 800						

(go to reverse side)

5c. If a courier/small package carrier, indicate average number of:

_____ Daily miles/vehicle _____ Shipments/vehicle

6. How many vehicles do you have on the road in the Twin Cities Metropolitan Area in an average day? _____

7. What % of the vehicles are operated by contractors or owner-operators? _____%

8. Indicate the annual revenues for the entire firm.

__ 0-$25 million	__ 25-$50 million	__ 50-$75 million
__ 75-$100 million	__ 100-$125 million	__ 125-$150 million
__ 150-$175 million	__ 175-$200 million	__ 200-$225 million
__ 225-$250 million	__ $250-275 million	__ 275-$300 million
__ 300-$325 million	__ 325-$350 million	__ over $350 million

9. Please indicate the approximate number of employees for the entire firm:

__ 0-50	__ 51-100	__ 101-150	__ 151-200
__ 201-250	__ 251-300	__ 301-350	__ 351-400
__ 401-450	__ 451-500	__ over 500	

10. What is your heaviest volume by month in terms of the number of vehicles in the Twin Cities metro area? Please allocate 120 total points among choices in proportion to the volume per month, e.g., if all months were the same each would receive 10 points.

__ January	__ February	__ March
__ April	__ May	__ June
__ July	__ August	__ September
__ October	__ November	__ December

11. What is your heaviest volume by day in terms of the number of vehicles in the Twin Cities metro area? Please allocate 70 points in proportion to the total number of vehicles per day which are operating within the Twin Cities Metropolitan Area, e.g. if all days were the same, then 10 points each. Include vehicles that are making local deliveries or pick-ups as well as inter-city vehicles making either pick-ups or deliveries.

__ Monday	__ Tuesday	__ Wednesday	__ Thursday
__ Friday	__ Saturday	__ Sunday	

12. Indicate the top four commodities which you transport: 1=most important, 2 for next most important...etc.

__	Agricultural/Farm products	__	Chemicals
__	Clay, Concrete, Glass	__	Electrical Equipment
__	Food (dry)	__	Food (refrigerated)
__	Household goods (furniture)	__	Instruments
__	Lumber, Wood Products	__	Machinery
__	Petroleum	__	Primary Metal Products
__	Pulp, Paper, Products	__	Transportation Equipment
__	Appliances	__	Consumer Goods for Retail Distribution
__	Other (describe) _____		

13. Please rank the importance of each of the following service issues from the perspective of your customers: 1=most important, 2 for next most important, etc., blank for unimportant

__ Completeness: No shortages or overages
__ Damage: Product arrives in condition requested
__ Delivery Reports: Confirmation of shipment arrival
__ Equipment Availability: Equipment available for shipment
__ Equipment Condition: Equipment is mechanically sound
__ Reliability: Shipment arrives on time/pick up on time
__ Speed: Length of in-transit time
__ Status Report: En route location of shipments
__ Other (describe)_____

14. Do you consider congestion and/or the condition of the highways in Minnesota as a barrier to maintaining your service standards? __ Yes __ No (if "No", please go to question 17a)

15. On a scale of 1-10 (10=very important, 1=not important) please rate those highway factors which have the greatest negative impact on your ability to consistently provide high service levels to your clients. (Note; more than one item may receive the same score if they are "equally" important.)

__	Bridge or Road Restrictions	__	Rush Hour Congestion
__	Snow, Ice, Water on Road	__	Traffic Accidents or Incidents
__	Road and Bridge Construction	__	Public Event Congestion
__	Other (describe)_____		

16a. Does your costing system distinguish between pick-ups and deliveries performed during congested periods as opposed to non-congested periods?

__ Yes __ No (If No go to Question 17a)
(go to reverse side)

16b. If "Yes" to 16a, estimate the difference between the cost per vehicle hour for congestion and non-congestion periods for each of the following vehicles which apply.

Tractor/trailer $_____/hr Straight truck $_____/hr Van %_____/hr

17a. Do you have on-board technology which allows you to monitor the non-productive time of the vehicle? ____ Yes ____ No

17b. Are you able to communicate with your trucks at will as opposed to waiting for drivers to check-in? _____ Yes _____ No

17c. Are your trucks equipped with GPS capability, i.e., can you locate the vehicle on a real time basis? ____ Yes ____ No

18a. Does your firm refer to Mn/Dot's website which displays current average speeds on the Twin Cities Metro Area freeway system? _____ Yes _____ No

18b. Does your firm utilize any of Mn/Dot's advisories about planned construction and other hot-spots on the highway system? _____ Yes _____ No

19a. Would you find it of value if real-time congestion information were available to your organization? _____ Yes _____ No (If No go to Question 20.)

19b. If Yes to 19a, please indicate whether you would prefer to provide such information directly to the dispatchers in your organization or to the vehicles/drivers. (Check one)

_____ Delivered to Dispatchers _____ Delivered Directly to Vehicles/Drivers

20. Considering the nature of your operation and the requirements of your customers, do you feel your firm would have the flexibility to schedule deliveries and pick-ups during non-congestion times? _____ Yes _____ No

21. Do your drivers have the flexibility to seek alternative routes in order to avoid congestion? _____ Yes _____ No

22. Indicate the extent to which you agree with the following statements;

	Strongly Agree				Strongly Disagree
We have passed the cost of congestion. to our customers. . . .	1	2	3	4	5
We have learned to plan for the uncertainty of congestion . .	1	2	3	4	5
Congestion adds significant cost which we cannot recover . . .	1	2	3	4	5

Appendix B

Shipper Survey

Shipper Survey

Instructions: Responses should reflect truck movements to and from a specific facility located within the Twin Cities metropolitan. The facility could be a manufacturing plant, warehouse/distribution center, or any other fixed facility located in the Twin Cities Metropolitan area which receives or ships freight. If the firm has divisions, please use the division as the base of reference. Additional research may not be necessary since your first thinking is normally best.

1. Which of the following best describes the primary business function of your firm?
___ Manufacturer ___ Distributor ___ Retailer _____ Other

2. Please indicate the approximate annual revenues for your entire firm or division:

__	0-$25 million	__	151-$175 million	__	301-$325 million
__	26-$50 million	__	176-$200 million	__	326-$350 million
__	50-$75 million	__	225-$250 million	__	351-$375 million
__	76-$100 million	__	$251-275 million	__	376-$400 million
__	125-$150 million	__	276-$300 million	__	over $400 million

3. Please indicate the top 4 commodity descriptions for outbound shipments from your manufacturing or warehouse facilities to either customers or your own retail stores (1=most important, 2=next most important, etc.)

Product Characteristics:

__	Agricultural/Farm products	__	Chemicals
__	Clay, Concrete, Glass	__	Electrical Equipment
__	Food (dry)	__	Food (refrigerated)
__	Household goods (furniture)	__	Instruments
__	Lumber, Wood Products	__	Machinery
__	Petroleum	__	Primary Metal Products
__	Pulp, Paper, Products	__	Transportation Equipment
__	Appliances	__	Consumer Goods for Retail Distribution
__	Other (describe) _____		

4. Please indicate the number of facilities controlled by your firm (or division) which are located within the seven county metropolitan area of Minneapolis/St. Paul and which ship and receive product on a regular basis. Also indicate the number of shifts typically operated by the facility.

Number of Facilities		Number of Shifts Operated
___	Manufacturing Facilities	_____
___	Distribution Centers or Warehouses	_____
___	Retail Outlets	_____

(go to reverse side)

5. Please indicate the approximate number of vehicles making deliveries and/or pick-ups of freight to the facility in an average week:

Manufacturing Facilities	_____ vehicles/week
Distribution Centers or Warehouses	_____ vehicles/week
Retail Outlets	_____ vehicles/week

6a. Do these facilities operate on an appointment basis for arriving trucks? (If "No," please go to question 7) __ Yes __ No

6b. How big of a window does the carrier have in order to be considered "on time?"
_____ hours

6c. Are carriers penalized for missing appointments? __ Yes __ No

6d. What is the nature of the penalty? (select all that apply)

__ Financial (loss of future business)
__ Carrier Service Record is Adjusted
__ Carrier must wait
__ Carrier must redeliver at another appointment
__ Carrier is charged back for any extra costs
__ Other _____

7. What is the heaviest volume by month in terms of trucks (not courier traffic) arriving at your facilities to either pick-up or deliver shipments? (Please allocate 120 total points among the months in proportion to the volume per month, e.g., if all months were the same each would receive 10 points.)

__ January	__ February	__ March
__ April	__ May	__ June
__ July	__ August	__ September
__ October	__ November	__ December

8. What is the heaviest volume by day of the week in terms of trucks (not courier) arriving at your facilities to either pick-up or deliver shipments? (Please allocate 70 points in proportion to the volume of vehicles per day during an average business week, e.g. if all days were the same, then 10 points each.)

__ Monday	__ Tuesday	__ Wednesday
__ Thursday	__ Friday	__ Saturday
__ Sunday		

9. Please rank each of the following transportation service characteristics which you use to evaluate your transportation vendors: 1=most important, 2 for next most important, etc., blank for unimportant

__ Completeness: No shortages or overages
__ Damage: Product arrives in condition requested
__ Delivery Reports: Confirmation of shipment arrival
__ Equipment Availability: Equipment available for shipment
__ Equipment Condition: Equipment is mechanically sound
__ Reliability: Shipment arrives on time
__ Speed: Length of in-transit time
__ Status Report: En-route location of shipments

10. Do you consider congestion and/or the condition of the highways in Minnesota as a factor affecting the transportation service you receive from your carriers?
__ Yes __ No (if "No", please go to question 12a)

11. On a scale of 1-10 (10=very important, 1=not important) please rate those highway factors which have the greatest negative impact on your ability to consistently provide high service levels to your clients. (Note; more than one item may receive the same score if they are "equally" important.)

__	Bridge or Road Restrictions	__	Rush Hour Congestion
__	Snow, Ice, Water on Road	__	Traffic Accidents or Incidents
__	Road and Bridge Construction	__	Public Event Congestion
__	Other (describe)_____		

12a. Does your firm operate a private truck fleet? (If "No," please go to question 19)
__ Yes __ No

12b. Is the operation of the private fleet managed by a 3rd party or commercial carrier?
__ Yes __ No

12c. Indicate the approximate size of the tractor fleet.

__	none	__	1-50	__	51-100	__	101-150
__	151-200	__	201-250	__	251-300	__	over 300

12d. Indicate the approximate number of delivery trucks in the fleet.

__	none	__	1-50	__	51-100	__	101-150
__	151-200	__	201-250	__	251-300	__	over 300

13. Please indicate how the private fleet is evaluated;
_____ cost center, e.g., minimize cost
_____ profit or contribution center. e.g., estimated revenue minus cost.

(go to reverse side)

14a. Do your trucks have on-board technology which allows you to monitor the non-productive time of the vehicle? ____ Yes ____ No

14b. Are you able to communicate with your trucks at will as opposed to waiting for drivers to check-in? _____ Yes _____ No

14c. Are your trucks equipped with GPS capability, i.e., can you locate the vehicle on a real time basis? ____ Yes ____ No

15a. Does your firm refer to Mn/Dot's website which displays current average speeds on the Twin Cities Metro Area freeway system? _____ Yes _____ No

15b. Does your firm utilize any of Mn/Dot's advisories about planned construction and other hot-spots on the highway system? _____ Yes _____ No

16a. Would you find it of value if real-time congestion information were available to your organization? _____ Yes _____ No (If "No," go to Question 17.)

16b. <u>If Yes to 16a</u>, please indicate whether you would prefer to provide such information directly to the dispatchers in your organization or to the vehicles/drivers. (Check one)

_____ Delivered to Dispatchers _____ Delivered Directly to Vehicles/Drivers

17. Considering the nature of your operation and the requirements of your customers, do you feel your firm would have the flexibility to schedule deliveries and pick-ups during non-congestion times? _____ Yes _____ No

18. Do your drivers have the flexibility to seek alternative routes on their own judgment in order to avoid congestion? _____ Yes _____ No

19. Please staple your business card to the survey if you wish a copy of the tabulated results of our survey.

20. Please use the following space to provide any comments on your operation and the impact of congestion which you consider important.