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TEXAS TRUCK DATA COLLECTION GUIDEBOOK

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Abstract: In August 2003, the Texas Department of Transportation (TxDOT) contracted with the Center for Transportation Research at The University of Texas at Austin to recommend a robust methodology to TxDOT planners for collecting and maintaining inter-county and interstate truck travel data in a format required for the Statewide Analysis Model (SAM). This guidebook discusses two data collection approaches — roadside intercept surveys and truck carrier participation — that showed the most promise of providing TxDOT with statistically reliable and verifiable truck travel data over the next three to five years.	Keywords: Truck travel data, statewide planning, roadside intercept surveys, truck carrier participation.	No. of Pages: 36

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Introduction

Primary freight data collection efforts involve collecting truck travel data directly from the freight community (i.e., shippers, carriers, receivers, and freight forwarders) through surveys, including roadside intercept surveys, mail-out/mail-back questionnaires, combined telephone-mail-out/mail-back questionnaires or telephone interviews. Done correctly, these survey methods are, in general, the most reliable and accurate methods of obtaining truck travel data for statewide freight planning programs. This guidebook discusses two data collection approaches - roadside intercept surveys and truck carrier participation - that showed the most promise of providing TxDOT with statistically reliable and verifiable truck travel data to be used in the freight model of the Statewide Analysis Model (SAM). For a detailed discussion of the short term and intermediate long term options for collecting truck travel data available to TxDOT, the reader is referred to Research Report 0-4713-1 entitled "Securing Truck Data for Texas."

Roadside Intercept Surveys

Few states have relied on collecting primary truck travel data for statewide modeling or planning, partly because this can be costly and time-consuming at the state level. The exception has been Washington State's Eastern Washington Intermodal Transportation Study (EWITS) and the subsequent Strategic Freight Transportation Analysis (SFTA) study. The objective of both these studies has been to provide Washington with useful freight movement data and statistically reliable information on truck characteristics and commodity

flows for all major Washington highways through an extensive program of statewide origin-destination truck intercept surveys of truck drivers. Valuable lessons learned and innovative practices employed in both these studies are highlighted in text boxes throughout this section of the guidebook to illustrate or emphasize certain aspects of this approach.

Finally, it has to be mentioned that TxDOT has detailed specifications for conducting external station surveys (see Specification No.: TxDOT 968-85-20*). The external station survey specification *"describes service to conduct interviews, surveys, geocode and report data, provide traffic control and automatic vehicle classification counts in the study area..."* (TxDOT, 2003). The objective of this section of the document is thus not to replace, contradict or replicate the specifications used by TxDOT. Rather it is anticipated that the information provided in this section of the guidebook can be used as a framework to modify the specifications in the future when a decision is made to collect truck travel data for the SAM through roadside intercept surveys.

Data Collection and Sampling

Since it is impossible to intercept every single truck that travels to, from, in or through Texas, inferences or predictions about the population of trucks are typically made from an appropriately selected sample. Sampling results in savings in resources, money, and time. Incorrect sampling procedures or human judgment may, however, cause bias and result in the collection of unreliable data (Snedecor, 1989). The objective of this section is

National Transportation Analysis Regions (NTARs) have been defined by the U.S. Department of Transportation (DOT) to collect interregional freight movement data for the Commodity Flow Survey (CFS). These NTARs were designed considering, among other factors, functional geography and size. Functional geography attempts to include population or economic activity centers to ensure that most of the origins, destinations, or transfers of long distance commodity movements are captured. Size attempts to ensure that more long distance movements to and from other regions than within the region are captured. Ultimately, the NTARs were decided by combining and adjusting the BEA Economic Area boundaries before the changes to the BEA boundaries in 1995.
(Source: BTS, 1996)

The...EWITS study outlined a goal of stopping one out of ten trucks on the I-5 corridor, one out of five trucks on the other major corridors and one out of two trucks at the sites with the lowest truck traffic volumes. However, the SFTA goal was to maximize the number of vehicles surveyed at each site; therefore, trucks were stopped and interviewed if there was a) space available to safely park them and b) there was an interview person available to immediately interview the driver. At the lower volume sites, this approach (Continued... gray box next page)

to provide insight into answering three questions:

- Where to sample? In other words, how to select appropriate sites and roadways where roadside intercept surveys can be conducted.
- Who to sample? In other words, which trucks at the sites.
- When to sample? In other words, which days of the week and seasons to account day-of-the-week and seasonal variation.

Site Selection: Identification of Geographically Dispersed Sites

The optimal sample size is not only influenced by the level of reliability that is required, but also the total cost of implementing the survey. The latter would be largely a function of the degree of geographical coverage and the number of days surveyed. In identifying the physical roadway sections for the roadside intercept surveys the following should thus be considered:

- Texas's eight National Transportation Analysis Regions (NTARs) to ensure geographical coverage;
- Non-urban roadway sections to capture county-to-county movements;
- Roadway functional system to capture truck movements on all major road classes, and
- Traffic volume and vehicle classification to ensure a significant volume of daily truck traffic traverses the roadway section.

To ensure geographical coverage of the state of Texas and to account for variations in the characteristics of trucks that use different roadways, it is recommended that a total of 96 sites be identified: three sites per major highway type (i.e., interstate, state highway, Texas highway, and farm-to-market/ranch-to-market) in each of the eight NTARs in Texas. In selecting the location of the survey stations, care should be taken to ensure that a significant proportion of the inter-urban freight trips can be captured in an average week.

The vendors should visit each of the roadway sections to determine an appropriate site where surveys can be conducted, i.e., weigh stations, truck rest stops, etc. Attention should be paid to existing roadway conditions, sight distances, prevailing vehicle speeds, and the presence of shoulders and auxiliary lanes. After determining the feasibility of the sites as interview sites, it is important to obtain the required permission for collecting data at these sites. The necessary permits to conduct surveys at public right-of-way locations can be obtained from TxDOT districts having jurisdiction over the roadways at each station site. Finally, Traffic Control Plans should be prepared, detailing the existing roadway geometry, the types of traffic control devices that will be used, and areas of refuge for the interviewers at roadside locations.

Who to Sample?

Although it seems reasonable to follow a systematic sampling approach where every *n*th vehicle is sampled, the objective should be to interview as many trucks as possible given available space and an interviewer to administer the survey.

enabled interviews to be completed for 60-80% of the trucks passing through the station during its open hours. The sites with a higher volume saw between 5% and 20% of the total trucks being surveyed. The lowest percentage of trucks interviewed were at those sites where there was a high volume of truck traffic at the weigh station, and additional trucks were utilizing WSDOT's Commercial Vehicle Information System Network (CVISN) bypass program" (Jessup, Casavant, and Lawson, 2004).

The truck roadside intercept surveys conducted by Washington State University were conducted at weigh stations and ports of entry (Casavant, Gillis, Blankenship, and Howard, Jr. 1995).

Targets can be set, for example to have an objective of surveying 10 percent of all trucks on Interstate facilities, 5 percent of all trucks on major corridors (i.e., U.S. highways and state highways), and 50 percent of all trucks at sites with low truck traffic volumes.

When to Sample?

To account for seasonal variation, day-of-the-week variation, and time-of-day variation, it is recommended that roadside intercept surveys be conducted at a minimum every season (four times a year) ideally, over a one week period for 24 hours per day at each site. Using the bid prices by surveying companies for 2004 as a guideline it is, however, foreseen that the costs of conducting roadside intercept surveys seven days a week for 24 hours each day will be prohibitive. The option thus exists to collect truck data on fewer days. Wednesdays are typically chosen to collect truck travel data, because truck flows tend to be higher/lower towards the beginning and end of the week. Most holidays or observances of holidays also typically occur on Mondays or Fridays. It is, however, strongly recommended that intercept surveys be conducted at a minimum on one weekday and one weekend day to account for day of the week variations as truck flows are typically lower on the weekends than on weekdays.

Given the number of sites proposed for Texas (i.e., 96 sites), TxDOT is advised to schedule the seasonal surveys over a two month period. In scheduling the surveys, considerable care should also be taken to reduce the probability of surveying the same flow of trucks at more than one site.

Recruiting Survey Personnel

The SFTA study found that approximately 15 to 18 people were required at each site over a 24-hour period for conducting the interviews. This translates into an average of four to five people per interview shift per site (Clark, Jessup, and Casavant, 2002). The finding and hiring of a large number of short-term employees represents a major cost when performing roadside intercept interviews (Gillis, 1994). In the past, TxDOT has entered into a contract with vendors, such as Graham Traffic or Alliance Texas, to conduct external station surveys for both passengers and commercial vehicles. These vendors have access to trained surveyors and supervisors, although the extent of the proposed effort might require the recruiting and training of additional surveyors and supervisors.

To reduce costs, it is possible to recruit volunteers from local organizations or educational institutions that are interested in performing community service. Recruiting volunteers who reside close to the interview sites will reduce transportation costs and their familiarity with the area will result in better knowledge and an understanding of the regions where the interviews will be conducted (Gillis, 1994). Assuming there are no groups that are willing to provide volunteer labor, the option exists to allow groups to use the roadside intercept surveys as a fundraising opportunity. This could translate into significant cost savings compared to hiring trained surveyors or a large number of short-term employees.

“... Washington State service organizations (Lions and Kiwanis Clubs) were offered the opportunity to conduct truck driver interviews as a club fund- raising activity... As a result of initial recruitment efforts, eight Lions Clubs and one Kiwanis Club agreed to provide members to serve as local interview teams. All clubs were based in the regions surrounding the selected interview sites. Their close proximity minimized travel costs for the interview team. Club member’s personal knowledge of local roads and industries also proved to be a major advantage in communicating and understanding responses provided by truck drivers” (Clark, Jessup, and Casavant, 2002).

!! SAFETY, SAFETY, SAFETY!!

- 1) *Wait until trucks are completely stopped before approaching them.*
- 2) *Make sure survey set-up site is conducive to the safe flow of survey and non-survey truck traffic.*
- 3) *Be mindful of passing trucks.*
- 4) *Individuals not conducting surveys should remain clear of all traffic and trucks.*
- 5) *Never engage in arguments with truck drivers.*
- 6) *Wear reflective safety vest at all times!*
- 7) *Wear headlamps during nighttime hours*
- 8) *Always cooperate with Commercial Vehicle Enforcement Officers, especially in regard to safe traffic flows.*
- 9) *Never step onto the running board of the truck.*
- 10) *Always speak clearly and loudly, while looking at the driver. Be courteous and finish the survey by thanking them for their time.*

Source: Extracted from Strategic Freight Transportation Analysis, 2002–2003

Training Survey Personnel

Both classroom and on-site instruction of survey personnel is crucial to ensure that the data collected is ultimately reliable. The following points should be reviewed at the training sessions even if trained surveyors are used to conduct the roadside intercept surveys:

- project goals and objectives to enable surveyors to answer questions from truck drivers about the purpose of the data collected,
- the interview questionnaire,
- identification and familiarization with truck and trailer configurations

-
- personal interview techniques, including, greeting, etiquette and proper behavior, and asking and phrasing of survey questions,
 - personal safety, including, letters of release of liability, and
 - personal conduct, including, on-time performance, acceptable attire, writing legibly, and items to bring on-site (Clark, Jessup, and Casavant, 2002 and Gillis, 1994).

Survey Equipment Needs

Equipment needs will vary depending on the volume of truck traffic at the site and when the surveys are conducted. Besides general office supplies, equipment, such as cones and safety vests, are required to ensure the safety of the survey crew. In addition, it is recommended that the surveyors be provided with attire (i.e., hat) that will enable truck drivers to identify the survey crew. The following materials checklist was used in the SFTA study:

- enough surveys for each site,
- pens, highlighters, pencils, staplers and staples,
- clipboards,
- reflective orange safety vests,
- traffic cones,
- "Survey Team Ahead" sign,
- hats,
- plastic containers for storing surveys,
- headlamps for nighttime survey shifts,
- two-way radios, and
- tally counters (Clark, Jessup, and Casavant, 2002).

Commercial Vehicle Enforcement Officers and Public Notification

The presence of uniformed officers at the interview site may prove to be beneficial. Cooperation from uniformed vehicle enforcement officers, employees of the Department of Public Safety, or police officers will, most importantly, ensure the safety of the survey crew. Secondly, many truck drivers may be intimidated by the presence of a uniformed officer in the area. They may be concerned that they were being pulled over for a violation. After learning about the survey, these drivers might be relieved and more than willing to participate. This will enhance participation and result in more data (Gillis, 1994).

The public also needs to be notified about the goals and purpose of the data collection effort (Jessup, Casavant, and Lawson, 2004). Public awareness campaigns should be designed and implemented to inform the trucking community about the purpose of the survey and the potential benefits of participating well in advance of the actual survey dates.

Survey Design

Survey instruments have to be developed in a manner that ensures that participants are not burdened or overwhelmed by the interview process. Also, questions have to be worded appropriately to ensure correct responses and improve response rates. For the SAM truck travel database, data is required regarding the commodity county/state/province origin and destination, cargo/commodity type, cargo weight, commodity value, and operational characteristics (i.e., full truckload, less than

full, or empty).

When developing survey questions, it is important to keep in mind that truck driver cooperation is crucial to the success of the survey. To minimize the inconvenience to the truck driver, it is important to keep the survey instrument as brief as possible. This also allows for more trucks to be surveyed. Some questions could thus be completed by the surveyor through observation. Examples of such questions include the date, time of day, and the vehicle configuration (see survey instrument). This will reduce the amount of time spent conducting the actual interview with the participating truck driver.














All questions should avoid wording bias. Examples of wording bias would be "loaded" questions or structuring questions in a way to elicit a certain response. Answers to questions should be kept as simple as possible by minimizing the amount of writing necessary to complete the survey. Checkboxes for frequently appearing answer choices can be used to save time.

Texas's close proximity to Mexico and its large Spanish-speaking population would require the use of bilingual interviewers to prevent any confusion caused by language barriers. It is recommended that the entire survey should be completed in approximately two to three minutes (Jessup, Casavant, and Lawson, 2004). A longer questionnaire may result in impatience and fatigue in the participant, which could compromise the integrity of the collected data.

The proposed survey on page 14 and 15, *Truck Travel Questionnaire* and the table, *Explanation of the Data Fields* on page 16, provide an example of

Truck Travel Questionnaire

Survey Location:			
Surveyor ID: <input style="width: 150px;" type="text"/>		Time: <input style="width: 30px;" type="text"/> <input style="width: 30px;" type="text"/> <input style="width: 30px;" type="text"/> <input style="width: 30px;" type="text"/>	

5. Single Units 3-Axle 	6. Single Units 4- or more Axles 	7. Single Trailers 3-Axles 	8. Single Trailers 4-Axles  
9. Single Trailers 5-Axles  	10. Single Trailers 6- or more Axles  	11. Multi-Trailers 5- or less Axles 	12. Multi-Trailers 6-Axles  
13. Multi-Trailers 7- or more Axles 			

Q2. Information on driver's door (optional, if time permits).

Company Name: _____

City, State: _____

Telephone Number: _____

Q3. State/province of license plate registration.

Tractor: ₁ ☐ TX ₂ ☐ Other _____

Trailer: ₁ ☐ TX ₂ ☐ Other _____

Q4. What type of cargo do you carry? If more than one type, select type that make up largest percentage of shipment weight.

₁ <input type="checkbox"/> Agriculture	₂ <input type="checkbox"/> Food	₃ <input type="checkbox"/> Building materials
₄ <input type="checkbox"/> Raw material	₅ <input type="checkbox"/> Wood	₆ <input type="checkbox"/> Chemicals/Petroleum
₇ <input type="checkbox"/> Textiles	₈ <input type="checkbox"/> Machinery	₉ <input type="checkbox"/> Miscellaneous
₁₀ <input type="checkbox"/> Secondary	₁₁ <input type="checkbox"/> Hazardous	₁₂ <input type="checkbox"/> Refused
		₁₃ <input type="checkbox"/> Don't know

Date:			
Direction Surveyed (check one): ₁ <input type="checkbox"/> NB/EB ₂ <input type="checkbox"/> SB/WB			
Q5. Is this a truckload or less-than-truckload shipment?			
₁ <input type="checkbox"/> Truckload	₂ <input type="checkbox"/> Less-than-truckload	₃ <input type="checkbox"/> Refused	₄ <input type="checkbox"/> Don't know
Q6. Total weight or volume of all cargo on board.			
_____ ₁ <input type="checkbox"/> Pounds	₃ <input type="checkbox"/> Gallons	₄ <input type="checkbox"/> Empty	
	₆ <input type="checkbox"/> Refused	₇ <input type="checkbox"/> Don't know	
Q7. Total value of all cargo on board.			
\$ _____ ₁ <input type="checkbox"/>		₆ <input type="checkbox"/> Refused	
Q8. Where did you pick the cargo up?			
City, State: _____			
If in Texas,			
Address (county): _____			

₃ <input type="checkbox"/> Refused			
Q9. Where will you deliver this cargo to?			
City, State: _____			
If in Texas,			
Address (county): _____			

₃ <input type="checkbox"/> Refused			

Explanation of the Data Fields

Field Name	Description
Survey Location	A unique number assigned to each survey site
Date	Survey date
Surveyor ID	A unique number assigned to each surveyor
Time	Time survey is conducted
Direction Surveyed	Direction in which truck traffic is surveyed
Vehicle Classification	Truck and trailer configuration
Company Name	Name of trucking company as printed on the driver's door
City	City as printed on the driver's door
State	State as printed on the driver's door
Telephone Number	Telephone number on the driver's door
Tractor License Plate Registration	License plate registration number of the tractor
Trailer License Plate Registration	License plate registration number of the trailer
Commodity	The major commodity carried
Shipment Type	Whether shipment is a truckload or less-than-truckload*
Payload Weight	The weight of the cargo that is carried
Cargo Value	The value of the cargo that is carried
Cargo Origin City	City where the cargo was picked up
Cargo Origin State	State/province where the cargo was picked up
Cargo Origin Address	Address where the cargo was picked up
Cargo Destination City	City where the cargo will be dropped off
Cargo Destination State	State where the cargo will be dropped off
Cargo Destination Address	Address where the cargo will be dropped off

* A truckload shipment weighs either in excess of 10,000 pounds or does not allow a truck operator to carry any other load.

A less-than-truckload shipment weighs less than 10,000 pounds and does allow a truck operator to carry other loads on the same truck. Usually package carriers, such as FedEx, UPS, and the US Postal Service are not considered less-than-truckload carriers (Federal Highway Administration, 1996)

a proposed truck travel questionnaire that can be used in roadside intercept surveys.

Interview Procedure

Trucks selected for an interview should be directed to a designated area. As the selected truck is parking, the interviewer should record information, such as the time of day, the truck configuration, and the company information, that is available through visual observation to minimize the amount of time and inconvenience to the truck driver.

Once the truck is safely parked, the interviewer should approach the truck driver in a friendly and polite manner and request cooperation in the survey. The driver should be informed that participation in the survey is voluntary. Once a driver agrees to participate, the interviewer should go through the questions as quickly as possible while maintaining proper quality control. If, for any reason, there is inadequate space for trucks to park safely and an interviewer is not available, a truck driver who would have participated should be allowed to leave (Gillis, 1994). It is thus very important to have an adequate number of surveyors available to collect data.

“The truck drivers were provided with a coupon for a free cup of coffee as a token of thanks for their participation” (Casavant, Gillis, Blankenship, and Howard, 1995).

Data Quality Control

Errors are inevitable when collecting data. Some examples of errors that could occur during data collection include:

- systematic errors caused by inappropriate interview procedures, inappropriate site selection, or ambiguous questions,
- inaccurate responses given by the truck drivers, and
- inaccurate recording of vehicle data or driver responses by the surveyor (Jessup, Casavant, and Lawson, 2004).

Effective data management will help to reduce errors from mistakes in data collection or database entry. The number of systematic errors that may result from ambiguous questions can be reduced by conducting pilot tests of survey instruments to identify problems with questionnaire wording. Any inappropriately worded or ambiguous questions should be addressed appropriately in updated versions of the survey. In addition, ongoing improvements to survey instruments should be encouraged. Feedback from both the survey crew and supervisors involved in the data collection process should be collected and considered. By improving the clarity of the interview questions, drivers are also less likely to provide inaccurate responses, which will reduce potential errors further (Gillis, 1994).

As an incentive to perform work of the highest quality, incentives may be awarded to those groups who provide surveyors with complete, accurate, and legible questionnaires (Gillis, 1994).

An informative training program is a form of data quality control that is established well before the actual surveying takes place. Training should, however, not end once the surveying begins.

Ongoing training and supervision provide an opportunity for answering questions that came up and will remind the survey crew of the interview procedures, which will reduce the number of errors caused by inaccurate data recording. Supervisors should also check completed questionnaires immediately for accuracy and completion. Any problems identified can thus be immediately addressed.

Finally, logic checks should be performed on all questionnaires before being entered into a database. For example, a potential error that may occur is when the driver provides the gross vehicle weight of both the cargo and the truck instead of the weight of the cargo being transported. Certain assumptions thus need to be established for handling such errors before the data is entered into a database. For example, if the cargo weight provided exceeds the legal limit for that truck's particular axle configuration, the weight will be assumed to be the gross weight of the truck and cargo. Reference questions could also be included in the survey to facilitate the checking of answers that truck drivers are providing and surveyors are recording.

Data Entry and Clean Up

Capturing data electronically through the use of handheld computers or other devices may reduce data entry errors. Alternatively, data entry forms with numerous built in checks can be programmed to facilitate the accurate entry of data. For example, the data that can be entered in certain data entry boxes can be restricted. As an example, Question 4 in the survey has 13 possible choices, ranging numerically from 1 to 13. The software

can thus be coded to display an error message if the data entry person attempts to enter a value greater than 13. Also, entries can be restricted to those included in a drop down list. In this case, the data entry person will only be able to choose from the list. For example, state or province information can be limited to the U.S. states, Canadian and Mexican provinces that are included in the drop down list.

Once the data has been entered, it will still be required to visually inspect the data for missing or incorrect observations (Clark, Jessup, and Casavant, 2002). Sometimes an interviewer might not be able to obtain all the information needed to complete the survey or accidentally neglect to complete the survey. Instead of disposing valuable data, some information can be confidently inferred using responses from other questions on the survey. The importance of asking reference questions is also relevant here (Gillis, 1994). At times, however, a survey may be so incomplete that its data cannot be used. Guidelines should be established to define the minimum amount of information needed from a particular survey for it to be considered useful.

Finally, an effort should be made to reduce the effect of accidentally using data from one particular truck more than once. This may happen if data is collected on the same highway from the same truck at two or more interview sites (Gillis, 1994). One option is to compare the license plate registration numbers of the trailer and truck tractor in a specific geographic area to ensure that duplicate entries do not exist for the same truck.

Data Expansion

Since only a sample of trucks are interviewed to represent the characteristics of the population of trucks transporting cargo on Texas roads, it is necessary to develop statistical weights to expand the sample data to reflect the characteristics of the population. Two statistical weights, modeled after those used in Washington, can be used to expand sample data (Jessup, Casavant, and Lawson, 2004).

The objective of the first weight is to expand the sample data at each site for each season to reflect the characteristics of the population for that week, site, and season. The weight will be different for different seasons because the number of trucks sampled and the total number of trucks passing the site will be different for each season. The first weight can be calculated as follows: if 100 trucks are sampled for an interview and a total of 600 trucks pass the site in one week in any particular season, the site weight will be 6.0 for that specific season. This number can then be multiplied by any sample characteristic to provide a statistical estimate of the characteristics of the population. For example, if all the trucks reported a total cargo weight of 1,000 tons, the estimate of the total aggregate weight passing the site in one week from all trucks is $1,000 \text{ tons} \times 6.0 = 6,000 \text{ tons}$ each week for that season.

The objective of the second weight is to determine the characteristics of the population across seasons. In other words, to determine the characteristics of the Average Annual Weekly Truck Trips at a specific site. This is achieved by calcu-

To account for seasonal variation, Washington State University conducted truck intercept surveys during a four week period for each season: Spring (April), Summer (July), Fall (October), and Winter (January) (Clark, Jessup, and Casavant, 2002).

lating the weighted average factors across the four seasons and applying this factor to the expanded sample data. For example, assume the expanded trucks surveyed during each of the seasons at a specific site are as given in the table below, *Seasonal Weight Factor*.

Seasonal Weight Factor

Season	Total Trucks (Expanded Surveyed Sample)	Seasonal Weight Factor
Spring	2,500	.26
Summer	3,500	.36
Fall	2,000	.20
Winter	1,800	.18

Source: Adapted from Clark, Jessup, and Casavant, 2003

The seasonal weight factor is calculated by dividing the individual season totals by the total number of trucks surveyed during the four seasons (i.e., 2,500/9,800 to determine the spring seasonal weight factor). Thus to determine the Average Annual Weekly Truck Trips at a specific site, each of the seasonal weight factors are multiplied by the total trucks (i.e., expanded surveyed sample) and summed. These weight factors can subsequently be applied to other characteristics of interest captured in the survey (i.e., number of empty trucks, cargo tonnage, value etc.) and summed to arrive at the average annual weekly characteristics of truck trips passing a specific site.

Finally, since it is recommended to survey 12 sites in each NTAR in Texas, a weight factor to describe the characteristics of the population of truck movements in a specific NTAR can

be calculated. Since the Average Annual Weekly Truck Trips at each specific site will vary substantially, each site in the NTAR has to be assigned a weight. For example, assume the calculated Average Annual Weekly Truck Trips at the 12 sites in one of the NTARs are as summarized in the table below, *Site Specific Weight Factor*.

Site Specific Weight Factor

Site	Average Annual Total Daily Truck Trips	Site Weight Factor
1A	3,000	0.11
1B	4,500	0.17
1C	6,000	0.22
1D	1,300	0.05
1E	1,425	0.05
1F	1,480	0.05
1G	1,100	0.04
1H	1,590	0.06
1I	1,645	0.06
1J	1,700	0.06
1K	950	0.04
1L	450	0.02

The seasonal site factor is calculated by dividing the individual site totals by the total number of trucks over the 12 sites (i.e., 3,000/27,015 to determine the Site 1A weight factor). Thus to determine the Average Annual Weekly Truck Trips in the specific geographic region, each of the site weight factors are multiplied by the Average Annual Weekly Truck Trips at each site and summed. These weight factors can subsequently be applied to other characteristics of interest cap-

tured in the survey (i.e., number of empty trucks, cargo tonnage, value etc.) and summed to arrive at the average annual weekly characteristics of truck movements in a specific geographic region.

Unforeseen Circumstances

Harsh weather conditions, including severe thunderstorms or rain, may affect the quality of the data gathered. Any events that are out of the ordinary, such as construction, automobile collisions, or hazardous material spills, should be well documented (Gillis, 1994). Even where unforeseen circumstances may cease data collection temporarily in the case of extreme weather (e.g., tornadoes) or hazardous conditions (e.g., fuel leak), the interview site weight as defined in Section 2.2.10 can still be calculated. However, since fewer truck drivers will be interviewed, the value of the site weight will be much higher than normal. This will, however, assist in the statistical adjustment of the sample data that would otherwise be missing (Gillis, 1994). Good planning requires that alternate backup data collection days be scheduled in the event that unforeseen circumstances result in inadequate data collection.

Truck Carrier Participation

It has been recognized that effective partnerships are needed between government and the freight community to ensure adequate planning and funding of transportation infrastructure at the state and local levels. Despite this recognition, the transportation planning community struggles to understand the needs of the freight community partly due to the inferior freight data that is available to freight planners (Freight Stakeholders National Network, nd).

Enhanced freight mobility through infrastructure improvements is in the interest of both the private sector and the transportation planning community. In addition, reliable freight data can be valuable to the private sector in informing investment decisions relating to equipment utilization, new markets, and business opportunities (Transportation Research Board, 2003). This survey approach is based on the hypothesis that a statistically representative sample of truck carriers operating in, from, to, and through Texas can be convinced to share their operational data needed by TxDOT. This section of the guidebook discusses the anticipated components of such a data sharing partnership.

Identification and Recruitment of Trucking Companies

A number of databases exist from which a representative random sample of truck carriers operating on Texas roads can be identified in the table on the following page, *Potential Sources to Identify Trucking Companies Operating on Texas Roads*.

Potential Sources to Identify Trucking Companies Operating on Texas Roads

Data Source	No. Trucking Companies	Information Captured	Web Address
Texas Workforce Commission	Local trucking without storage – 1,669 Local trucking with storage – 1,485 Trucking, excluding local – 4,199	<ul style="list-style-type: none"> • Type of trucking company • Employer address (in some cases include mailing address) • Contact person and telephone number • Number of employees 	http://www.texasworkforce.org
TxDOT Motor Carrier Registration Database	37,312	<ul style="list-style-type: none"> • Type of carrier/facility • Customer information (name of business) • Telephone number • Mailing address (include city, state, zip) • Site address (include city, county, state, zip) • Number of vehicles covered under insurance policy 	
USA Data (Commercial data source)	100,000 prospects	<ul style="list-style-type: none"> • Business name • Address (city, state, zip code) • Contact name, title • Number of employees (range) • Phone/fax number • Year established 	http://mip.usadata.com/usapub/
Texas Vehicle Information & Computer Service, Inc. (Commercial data source)		<ul style="list-style-type: none"> • Address of the vehicle owner • Vehicle type • Gross vehicle weight 	http://www.tvics.com
US Census Bureau's Business Register	6 million U.S. employer establishments		http://www.census.gov/econ/overview/se0400.html

The research team obtained access to the TxDOT Motor Carrier Registration Database, which contains the company address and telephone numbers of truck carriers registered in Texas. It, however, seldom contains the name of a contact person in the company. When a random sample of these companies was approached, the research team found that "company operators" or company employees answering the telephone in most instances act as "gatekeepers". It was thus very difficult to (1) identify the appropriate company representative that can make a decision about entering into a data sharing partnership with TxDOT, and (2) to be transferred to that person. This type of "cold calling" was very time consuming and did not provide a satisfactory response.

The research team thus approached a number of trucking companies that have been exposed to transportation planning through their involvement with the North Central Texas Council of Government's Intermodal Freight and Safety Committee (IFS). The membership list of the IFS Committee was obtained and representatives of eight trucking companies were interviewed to determine whether:

- the company would consider participating in a truck data sharing initiative with TxDOT, and
- their conditions for participation.

All the trucking companies interviewed indicated their willingness to participate in a data sharing arrangement with TxDOT provided that certain conditions are met. The following list reflects the conditions for participation in descend-

"The Intermodal, Freight, and Safety Subcommittee's responsibility will focus on issues related to improving the flow and safety of goods movements in the region, as well as the use of existing rail freight corridors for commuter rail service. Representatives of the various private sector interests, including Intermodal and Freight, will be asked to meet with the Subcommittee to maintain a dialogue on issues of common interest and to identify opportunities for public/private sector partnerships."
Source: www.nctcog.org/trans/committees/ifs/

ing order of number of times mentioned:

- no information of the company will be included in the aggregate database that is compiled and used by TxDOT;
- the data will not be used for law enforcement or litigation against the company;
- the Texas Motor Transportation Association (TMTA) will be involved to protect the interests of those that participate;
- no severe cost burden will be imposed on the trucking company in compiling the data;
- TxDOT will demonstrate to the trucking companies that the data will be used for a worthwhile purpose;
- no shipper details will be requested, and
- the trucking company will have access to the aggregated database compiled by TxDOT.

Only one trucking company indicated that TxDOT will have to compensate the company for the costs of extracting the data and providing it to the agency as a condition of participation.

Given this positive response, the research team was encouraged that an extensive public outreach effort, including a news release, and the involvement of the TMTA, can result in a statistically representative sample of truck carriers being convinced to provide TxDOT with the required data. In addition, resources are available to TxDOT to assist in recruiting trucking companies. One such a resource is the Freight Stakeholders National Network. The Network can (a) recruit members from their constituencies, (b) provide policy support and technical sources to the group, (c) identi-

fy and support needed freight investments, and (d) share examples of best practices from other groups in other states (Freight Stakeholders National Network, nd).

Sampling

Sampling Trucking Companies

For data collected from a sample, sample size is a key determinant of data quality and reliability, but also of cost. Statistical formulas exist to determine the number of trucking companies that have to participate in a data sharing arrangement with TxDOT to ensure a statistically representative sample (see Text box). It is suggested that a random sample of trucking companies are selected and approached to participate in the data sharing initiative. Once the sampled list of trucking companies has been determined, TxDOT should involve, among others, the TMTA and Metropolitan Planning Organizations with freight committees to identify the appropriate contact person in each company.

According to the TxDOT Motor Carrier Registration Database, a large number of trucking companies in Texas (approximately 41 percent) have only a single truck insured. It is foreseen that these smaller companies will be particularly challenging to involve in a data sharing relationship, because the owner is frequently the driver of the truck.

Sampling Shipments

Similar to the approach adopted by the Commodity Flow Survey, it is recommended that the trucking companies are asked to provide TxDOT with data on the value, weight, commodity, origin,

Determining the Sample Size

The following statistical formula can be used to calculate the appropriate sample size:

$$n = \frac{[Z_{\infty/2}]^2 \times 0.25}{E^2}$$

Where,

n = Number of trucking companies to be included in the sample

$Z_{\infty/2}$ = Critical value corresponding to a specified confidence level

E = Margin of error

destination, and whether it is a truckload or less-than-truckload shipment for all their shipments in an assigned week four times a year. For shipments that include more than one commodity, the trucking company will be asked to report the major commodity in terms of shipment weight.

Data Collection

To minimize the data reporting cost burden imposed on participating trucking companies, electronic reporting options need to be explored. The 2002 Economic Census developed survey software that allowed for the importation of business data directly from company spreadsheets, thus reducing the burden on respondents in an effort to encourage participation in the survey (National Research Council of the National Academies, 2003). Electronic reporting will also reduce the cost of data entry for TxDOT and reduce reporting errors.

Since some larger trucking companies already use the internet to transmit manifest information among the shipper, carrier, and truck driver it is assumed that the internet can also be used to share relevant data with TxDOT. Options to transmit this information securely using Secure Socket Layers (SSL) and encryption are available.

During the discussions with the eight trucking company representatives it became apparent that it will be more difficult for smaller trucking companies to use electronic reporting options since their systems are not as sophisticated. To ensure participation, every effort should thus be made to ensure that the labor cost burden imposed on trucking companies in compiling the data, espe-

“For the 2002 CFS, each establishment was assigned a 1-week reporting period every quarter, for a total of 4 weeks in the calendar year. By assigning different reporting periods to different establishments, the sample covered all 52 weeks of the year” (National Research Council of the National Academies, 2003).

cially the smaller companies, is minimized. Most of the trucking companies, however, agreed that submitting the data electronically will enhance their participation. For the larger trucking companies with computerized systems, it will be relatively easy to run queries and provide TxDOT with the data needed as the requested data is readily available in their systems.

Data Expansion

The data expansion procedure would be similar as for the roadside intercept surveys. The sample data obtained can be expanded to reflect the truck travel characteristics for the population of trucking companies by using the inverse of the sampling rate. For example if 10 percent of the trucking companies of a particular size were surveyed the expansion factor would be $100/10$, which equals 10. This first weight is used to expand the sample data for each season to reflect the characteristics of the population for that week and season.

The objective of the second weight is to determine the characteristics of the population across seasons. In other words, to determine the characteristics of the Average Annual Weekly Truck Trips. This is achieved by calculating the weighted average factors across the four seasons and applying this factor to the expanded sample data (see ***Data Expansion***, page 21).

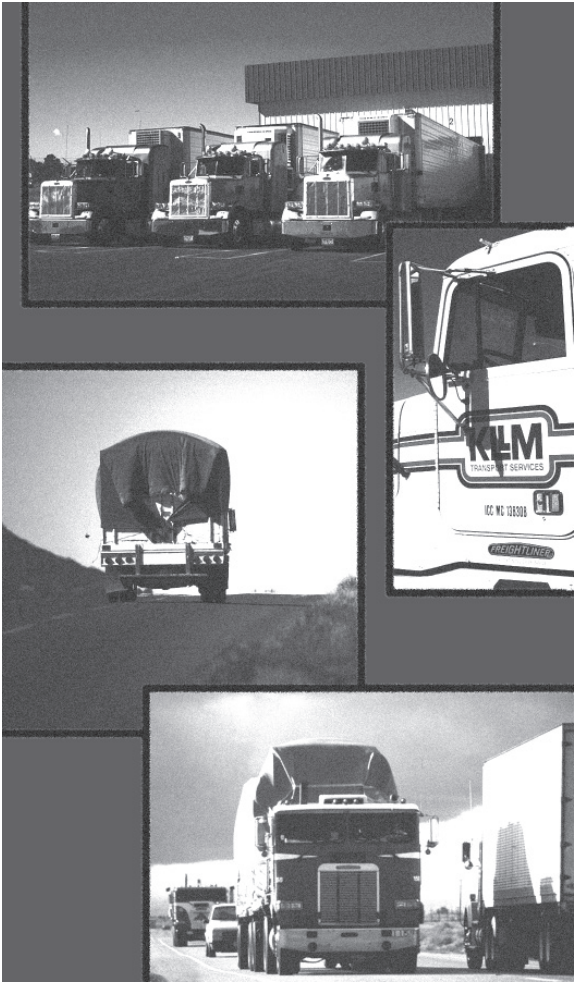
Concluding Remarks and Recommendations

Collecting primary truck travel data through either of these two approaches will inevitably be more costly than purchasing the Reebie TRANSEARCH database or estimating county-level truck travel data from publicly available data sources, such as the CFS. However, done correctly, both these approaches will provide TxDOT with more reliable and robust truck travel data for statewide planning.

It is estimated that surveying 96 sites one day per week four times per year would cost TxDOT in excess of \$5 million using the bid prices of surveying companies for 2004 as the benchmark. Since there is no precedent for collecting statewide truck travel data through a data sharing partnership with trucking companies, it is more difficult to estimate the costs associated with this approach. It is, however, foreseeable that this will entail a large upfront cost arising from the recruitment of trucking companies, the development of software to minimize the burden on trucking companies in submitting the data, and finally labor costs associated with compiling and managing the database. The recurring annual costs would, however, be limited to liaising with the companies, compiling and managing the database. Of the two approaches it is thus anticipated that a truck data sharing partnership with trucking companies will be more cost-effective than the truck intercept survey approach. Although still costly, this approach is worth further consideration by TxDOT.

Ultimately, higher truck travel data collection costs should be weighted against the benefits of reliable truck travel data that can be used to determine the impacts of truck traffic on mobility, sys-

tem performance, the safety of the road network, and the funding of the state-maintained road infrastructure.



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