Motor Carrier Data and Freight Modal Split

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Collection of commodity flow data from motor carriers is considered in the context of data requirements for freight modal-split models. A detailed examination of techniques for collecting motor carrier commodity flow data casts doubt as to whether collecting data from motor carriers can reasonably be accomplished and whether the data are really what is needed for freight modal-split models. The paper describes an ideal motor carrier commodity flow data set, compares it to data collected by loadometer studies, and describes alternative methods of collecting elements of the ideal data set. The analysis of motor carrier commodity flow data focuses on the State of Wisconsin, in terms of both existing loadometer study methods and regulation of motor carriers.

•ONE OBJECTIVE at the transportation planning and policy level is to use transportation as a means of enhancing economic growth as well as serving existing and anticipated transportation needs. In addition, there is a desire to equitably balance transportation modes and to provide for more efficient utilization of transportation resources. These objectives, however, are usually quite removed from capabilities to anticipate the consequences of alternative policies and plans. Usually these objectives are couched in terms of questions such as, How can transportation resources be effectively developed and efficiently utilized to direct a region's economic growth? How much, for what purposes, and between which points will people travel? Thus, more comprehensive transportation plans are sought to bring together highway, rail, mass transit, port, waterway, and airport development planning. The difficulties of integrating separate mode plans are only now being realized. On the one hand, there is little theory to provide a conceptual framework about commodity transportation; on the other hand, data are lacking about commodity and person flows and the reasons for those flows. Particularly lacking are detailed origin-destination commodity flow data.

With respect to planning for commodity transportation, there appears to be a gap between approaches. The model-builders make what appear to be impossible data demands, whereas data collectors obtain readily collected data rather than data that are useful for model-building.

The primary purpose of this paper is to describe an ideal motor carrier commodity flow data set, to compare it with data now collected by loadometer studies, and to describe alternative methods of collecting elements of the ideal data set. The ideal motor carrier commodity flow data set is one that serves for both modal planning and regulation of motor carriers. A secondary purpose of this paper is to relate the motor carrier commodity flow data to the data requirements for a freight modal-split model and to arrive at tentative conclusions regarding methods for meeting those data requirements.

Analysis of motor carrier commodity flows is used to relate to freight modal-split data requirements because the motor carrier mode would be the most difficult for which to obtain data. The large number and diverse types of motor carriers make it extremely difficult to collect representative flow data. The analysis of motor carrier commodity flows focuses on Wisconsin for specifics in terms of both existing loadometer study methods and regulation of motor carriers.

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FREIGHT MODAL SPLIT

This section explores the existing freight modal-split models to determine whether their data requirements can be attained by the various existing commodity flow data collection schemes.

Modal-split models are essential when performing multimodal planning efforts, which are especially important to state Departments of Transportation. The emerging Departments of Transportation (DOT's) should attempt to consider all modes of transport, even those in the experimental stage. The DOT's are attempting to go beyond treating individual modes as self-contained, independent systems and move toward "comprehensive," intermodal transportation planning. Existing methods of estimating the manner in which travel demand will allocate itself between the competing modes (i.e., modal split) have serious limitations.

This section describes two models proposed for freight mode choice estimation and attempts to determine the data requirements for each. The first model described is an abstract mode model developed by Mathematica for the Northeast Corridor Transportation Project (1). The second model was developed for the State of Pennsylvania (2). The Mathematica abstract mode approach predicts demand, by mode, for freight transportation between specified origin-destination pairs. This approach accomplishes the freight generation and distribution tasks as well as performs the modal split. The model predicts the tons of freight to be shipped from node i to node j by mode k in a specified time period T_{kij} by considering eleven variables:

$$T_{kij} = f\left(P_i, P_j, Y_i, Y_j, M_i, M_j, N_{ij}, H^b_{ij}, H^r_{kij}, C^b_{ij}, C^r_{kij}\right)$$

where

T_{kij} = tons shipped by mode k from node i to node j;

P_i, P_j = population of node i, node j;

Y_i, Y_j = gross regional product of node i, node j;

M_i, M_j = industrial character index for node i, node j;

N_{ij} = number of modes available for use between node i and node j;

H^b_{ij} = least time in transit of all available modes between node i and node j;

H^r_{kij} = relative time in transit $\left(\text{with respect to } H^b_{ij}\right)$ of mode k between node i and node j;

C^b_{ij} = least transportation cost of all available modes between node i and node j; and

C^r_{kij} = relative transportation cost $\left(\text{with respect to } C^b_{ij}\right)$ of mode k between node i and node j.

Using this approach a mode can be described by its characteristics rather than by its name, allowing for the examination of new modes by merely specifying the travel time and cost of using the mode without referring to its physical form. This mode choice procedure evaluates the effects of transportation time and cost on the modal-split decisions. Cost and time data are useful in evaluating the effects of future transportation investment decisions on the economy and transportation network of a region. The cost of transportation also can be used to predict the distribution of future freight flows.

A disadvantage of the Mathematica freight modal-split model is the lack of consideration given to commodity type. Because of commodity differences in perishability and value density, time and reliability are more important for some commodities than for others. Yet these characteristics are not considered in the model.

Apparently it is necessary to stratify data by commodity type and to develop separate estimating equations for different commodity groupings. Stratification by commodity type, however, requires more point-to-point commodity flow data for model calibration than is presently available.

The model proposed for Penn-DOT performs the modal-split decision using the output of an econometric model. This model provides the amount, in tons of commodity i, that will be shipped from node j to industry j in node X_{igjh}. The problem is to allocate the node-to-node flows of commodities provided by the econometric model to the various modes of transportation. The Penn-DOT model is similar to the Mathematica abstract mode model in mathematical formulation, except that the former has straight estimation of mode choice rather than generation and distribution of freight.

The Penn-DOT modal-split model requires data on the proportion of flow X_{ighj} using each mode. Equally difficult to collect are the data on the flows themselves needed to calibrate the econometric model, which provides the input X_{ighj} to the modal-split model.

For calibration purposes, it is necessary to collect data on commodity types flowing between nodes by the different modes under study. In addition to commodity data on origin to destination by mode, the Penn-DOT model requires stratification of data by shipping and receiving industry type. These requirements impose severe demands on any data collection scheme. An ambiguity in the Penn-DOT model is the distinction between commodity and industry. The model seems to require a one-to-one relationship; i.e., each industry type producing one predominant commodity. In input-output analysis, only dollars of sales between industries are desired. In commodity flow analyses, commodity flow data between these industries are required, which is much more complex. There are various methods of collecting commodity flow data, none of which is totally sufficient. Before the alternative collection methods are discussed, the data to be collected will be outlined.

AN IDEAL MOTOR CARRIER COMMODITY FLOW DATA SET

The ideal data set yields the maximum amount of useful information about commodity flows. It is thought that if the following information could be collected, the major regulatory and planning uses of commodity flow data would be attained.

Identification Requirements

An ideal commodity flow data set will identify the individual motor carrier, the shipper, and the consignee. Each will be identified by name, address, and, in the case of the consignees and shippers, industrial classification. One use of the names and addresses of the three parties will be to supply the means of contacting the parties at a later date if some of the information originally collected is incomplete or inaccurate. This follow-up capacity is necessary to ensure a comprehensive and complete study of all sampled movements. The address therefore must be a mailing one.

Another use of shipper and consignee names and addresses will be to identify the origins and destinations of the goods being transported. As such, the addresses also must indicate geographical groupings by states, cities, or smaller areas.

Transportation Characteristics

Vital to a commodity flow study is information pertaining to the vehicle load itself. An important load characteristic is the identification of the commodities being transported. A classification of commodities must be used that will give the appropriate degree of detail to yield useful information yet is capable of aggregation in various ways for analysis and publication and is precise enough to be collected readily. Various commodity classification systems exist, but quite often the breakdowns are not appropriate for the multiple-purpose objectives desired here.

The Standard Transportation Commodity Code (STCC) is recommended as the best means of classifying commodities (3). The code is revised constantly to keep it up to date. The first five digits of the STCC are identical to the Transportation Commodity Classification used by the Bureau of the Census in its 1963 Census of Transportation; and, as such, the use of the STCC will enable comparison of the collected data with Bureau of the Census transportation data.

The STCC is a rather lengthy document and contains both a numerical and an alphabetical listing of commodities. The great advantage of the code is the hierarchical form that groups the goods according to varying degrees of detail, the two-digit level being very general with greater detail accruing with each additional digit until at the seven-digit level the specific commodity is described. A study thus can choose the level of detail best suited to its needs and use just that level. Most alternative commodity classification schemes do not offer this ease of detail identification.

The initial commodity classification at the two-digit level breaks all commodities into 35 major industrial groups. The three-digit level lists minor industrial groups, such as jewelry, musical instruments, and toys. The STCC four-digit level differentiates between specific industries. This level divides toys into their various types; games, dolls, children's vehicles, etc. It introduces such items as sporting goods but goes into no further detail as to types of sporting goods. The five-digit level indicates a further breakdown, such as the difference between fishing, hunting, skiing, and football gear. Only the seven-digit level, however, yields a precise description of the many goods transported. For instance, the seven-digit level differentiates between such sporting goods as skis, ski boots, ski bindings, and other skiing equipment.

Because transportation rates and regulations apply directly to the specific commodities (e.g., ski boots) it is believed that any proposed goods movement study should entail commodity detail at the seven-digit STCC level. By utilizing this degree of detail, all commodities sampled will have an identification number. In many past studies, commodity groupings were quite general with the result that one observer would place a commodity in one general grouping whereas another observer would place the same commodity in a different grouping. This problem is minimized by using a very detailed commodity classification scheme such as the STCC.

Another advantage of using great detail in the recording of commodities is that anyone making subsequent use of the data can aggregate the data according to any level of detail desired.

The Standard Transportation Commodity Code is the desired classification because of its superior detail, organization, certainty, and the fact that more and more studies are now using it. A past problem with studies of this type was that two or more studies could not be compared because they used different commodity classification schemes. Wider usage of one system such as the STCC will be a step in eliminating this difficulty.

An ideal commodity flow data set will also collect rate information under which each commodity is being moved. The rates will lend insights into determining the reasons for certain commodity flow decisions; e.g., mode, route, and operating authority used. Rate data are especially useful to the regulatory bodies.

Summary of Ideal Commodity Flow Data

Table 1 gives the set of ideal commodity flow data, some of which have been discussed previously, and identifies the potential users of the data items. The data outlined in this section are the ideal data, and existing data collection techniques may not permit all of these data to be collected. An attempt should be made to collect as much of it as possible, and these ideal data should be the tool for determining which data collection technique is to be implemented. The collection technique producing the data that most closely approximate the ideal data set is the desired technique.

TABLE 1
IDEAL DATA SET

Ideal Data	Planning	Regulation
Identification requirements:		
Consignee name	O	O
Consignee address	X	O
Consignee industrial classification	X	—
Shipper name	O	O
Shipper address	X	O
Shipper industrial classification	X	—
Carrier name	O	X
Carrier address	O	O
Carrier operating authority	X	X
Carrier permit No.	—	X
Vehicle type	X	—
Vehicle identification data	O	O
Vehicle ownership	X	X
Document numbers	O	O
Transportation characteristics:		
Commodity	X	X
Commodity origin-destination	X	X
Vehicle origin-destination	X	X
Dates of flow	X	—
Timing of flow	X	—
Load weight	X	—
Gross weight	X	X
Rates	X	X
Routes taken	X	X

X = data will be used per se.
O = data will be used only to facilitate follow-up to obtain additional data.
— = data not used.

EXISTING LOADOMETER STUDIES

Loadometer studies carried out by state highway departments are the only existing internal studies conducted by states that classify loaded vehicles according to commodities carried. The basic problem with the existing loadometer studies is that the goals of the studies are not the same as the goals and uses of an ideal commodity flow data set. The loadometer studies exist to obtain truck dimension and weight data for highway design purposes, to collect origin-destination data for highway system planning, and to provide an indication of commodity flow data. Throughout the discussion of the existing loadometer studies, problems are presented that indicate why the existing procedures are inadequate to attain the ideal commodity flow data. The State of Wisconsin experience is cited to provide a specific framework.

Description

The Wisconsin loadometer program stops motor carriers at selected points on the highway network, weighs the vehicles, and interviews the drivers. Data are collected from roadside stations and are aggregated to yield information about the entire road network. The following data are obtained in each interview: type of operating authority, vehicle body type, whether or not vehicle is carrying freight, generalized description of commodity, axle spacings, fuel type, origin and destination by state, truck dimensions, axle weights, and operating permit.

Since its inception, the Wisconsin loadometer study has undergone constant expansion and revision from 12 roadside stations in 1942 to the present 39 stations. As seen by the following description, many problems exist with the present system and the ideal data set is not attained.

The existing loadometer study determines the origin and destination of the driver and sometimes the vehicle, neither of which are generally the same as the origin and destination of the commodities carried. Thus, the commodity origin and destination, important elements in the ideal data set, are not obtained.

The commodity carried is registered at the five-digit STCC level, not the more detailed seven-digit level. The source of the commodity identification is the driver, who in many instances does not know exactly what commodity is carried or who may be carrying a mixed load in which only one commodity or sometimes no commodity is identified.

The vehicle is registered as either full or empty, with no load factor given. Vehicle type, carrier operating authority, gross rate, and date of flow are collected in the loadometer study; the remainder of the ideal data set as given in Table 1 is not collected. The existing study thus does not nearly comply with the ideal data set.

Many other operational and practical problems exist with the present system.

With 39 fixed stations, many roads and road segments are never measured by the loadometer study. Statistical sampling of road segments is not employed, making it difficult to make inferences about total truck traffic on state roads.

A problem occurs at those loadometer study locations using Motor Vehicle Division weighing stations, which are used for overload enforcement. Each driver knows where each fixed Motor Vehicle Department weighing station is and will avoid the station if he has an overload or will go by it only when it is closed. Knowledge of whether the scales are open or closed can be obtained at the nearest truck stops, from other truckers, and even from the trucking companies themselves. Because many vehicles successfully avoid the scales (the exact proportion is unknown), the loadometer sample at the scale suffers. Consequently, the loadometer study, which does not prosecute overloads, is tied to the Division of Motor Vehicles, which does prosecute; and the sample is thus biased by the drivers that avoid the stations.

In 1968, the earliest loadometer station opened on June 10 and the last station closed on September 6. Because the loadometer stations are open only during the summer months, the data collected pertain only to that period. The volume of freight, however, and the types of commodities carried vary during the course of the year. The Wisconsin Department of Transportation recognizes these differing seasonal characteristics and volumes and consequently does not attempt to project a fall, winter, or spring commodity or vehicle flow figure from the summer data. Data are only available therefore for summer commodity movements.

The times and dates of operation of each loadometer station are also very limited. The vast majority of the stations collect loadometer data only 1 day per year, and the specific dates vary from year to year. The collection is further limited in that the stations are open only on weekdays, thereby collecting no weekend or holiday data. The majority of loadometer stations, furthermore, are open only 8 hours, from 6:00 a.m. to 2:00 p.m. Thirteen of the stations (one-third of the total) are also open from 2:00 p.m. to 10:00 p.m. Only four stations are open at night, 10:00 p.m. to 6:00 a.m., and these are all on the Interstate Highway System.

When a loadometer station is open, the crew attempts to stop, weigh, and interview 100 percent of the trucks going past the station. At many stations, however, during periods of high traffic volume, the physical facilities do not allow a great backup of vehicles. The average stoppage time for a truck is 2 minutes. When it is not possible to stop all trucks passing by, the vehicles are sampled according to a sampling model. The model surveys all five-axle vehicles and samples the smaller vehicles that pass by, thereby eliminating undue congestion. The use of the vehicle sampling plan adds an error factor to the data collected, but is justified by the roadside collection technique and the physical capacities of the stations.

Summary of Loadometer Study Analysis

As seen, the existing data collection technique does not nearly meet the requirements of the ideal data set. Most of the desired data are not collected, and some that are collected are not accurate or complete. The sparcity of stations, the lack of adequate sampling of times of operation, the inflexibility of operations, and the sole reliance on driver interviews all cause problems that require improved techniques to obtain the ideal data set.

ROADSIDE DATA COLLECTION TECHNIQUES

A roadside field survey requires a means of accumulating commodity vehicle flow data directly from vehicles on the roads. The existing loadometer study is an example of this technique. The information can be collected at the roadside by questioning the driver, by examining the documents carried on the vehicle, or by actually inspecting the load within the vehicle. The other roadside method is to identify specific vehicles passing given roadside stations, either with manual tabulation or an automatic device, and then to contact the carriers to obtain the desired information pertaining to the observed vehicle. Each of these techniques is described in the following paragraphs, and the advantages and problems of each are identified. Several problems common to all of the roadside techniques are described first, followed by the problems unique to each technique.

All roadside survey techniques require the establishment of observation or interview locations on road segments in the study area. It is impossible, however, to locate a roadside survey station on all highways and roads in the state. Further complicating the location problem is the ability of vehicles to use any combination of road links rather than staying on one specific identified road. Consequently, to obtain complete data on all highway commodity flows, observations must occur at a statistically significant number of randomly selected locations.

With probability as a technique, the statistician can strike an economic balance between (a) the cost of great precision and detail, e. g., cost of numerous stations, and (b) the losses that arise from insufficient information or precision, e.g., too few stations or poorly located stations. Given a confidence level and a desired degree of accuracy, the sampling theory is used to indicate the portion of the total universe needed to estimate the true commodity flow for a given area and commodity strata. In addition, it may be appropriate to stratify by road types, such as arterial, collector, and local roads. The length of each of these road types in total miles can be ascertained, and a probability sample for each can be developed that will locate the appropriate number of observation stations on each type.

Ideally, all observation stations will record the flows of all motor carriers passing when the station is in operation. Past experience, however, indicates that a study that stops motor carriers for even the simplest questions (e.g., the existing loadometer study) detains vehicles for an average of 2 minutes. If extensive commodity flow data are collected by driver interview, load inspection, or document investigation, the time is likely to be increased. When motor vehicle traffic is sparse, it is perhaps possible to stop and obtain data from all vehicles passing the station, and this should be done. Some stations, however, will be on heavily traveled routes; and during periods of peak flow it is physically impossible to stop all the vehicles. Consequently, vehicles will have to be sampled during these periods.

Load Inspection Method

One method of obtaining commodity information at a roadside survey is to actually open the trailer and examine the commodities being carried. This method, however, is an unlikely prospect. First, nearly all companies maintain a policy that all trailers be sealed and that the seal remain intact in transit. Second, it will take a prohibitive amount of time to enter the trailer and examine each load. Third, through visual inspection it is quite often impossible to identify commodities in a load, especially when the vehicle is carrying many different types of freight. Actually examining the load therefore is not a feasible method.

Vehicle Observation and Follow-Up Method—This technique is to record the license number or trailer identification number of vehicles passing the roadside station and to obtain the carrier's name and address by means of carrier license files. The desired data for each vehicle observed are then obtained from the carrier home office or terminal. No information other than vehicle identification data is obtained at roadside. All motor vehicles display a license and an identification number, and these can be observed readily by a camera or an observer situated along the road. Using this method facilitates a large sample size because of the ease in which the original data can be collected. Great problems exist in obtaining data, however, after the movement has occurred. (See the "Carrier-Contact Collection Techniques" section for a discussion of these problems.)

Driver Interview Method

This roadside survey method involves stopping the vehicles and interviewing the driver, as is now done in the loadometer studies. Many problems exist with this type of survey, some of which stem from the limited knowledge and sometimes uncooperativeness of the drivers themselves. Most drivers never see the commodities they are carrying, so that the only way the driver will be able to identify commodities carried is to look at the freight bills or to reiterate what the dispatcher or dock worker told him he is carrying. Quite often the driver's knowledge of what his vehicle is carrying is general and inaccurate. Unless he looks at the freight bills, a driver will never know what commodities are in the vehicle if the load is mixed, as is the case in one of every six loads in Wisconsin. Therefore, commodity data for these mixed loads will have to come from the freight bills carried with the load. Another problem is that the driver has no idea of the origin or destination of the commodities but rather only knows the origin of his particular trip and where his trip will end. This origin and destination may not be the actual origin or destination of either the vehicle or the commodity. Hence, any method of collecting commodity-flow data by merely questioning the driver of the vehicle must be examined critically, for the data received will be inexact and usually incomplete.

Document Examination Method

A roadside survey technique that does not seem to have been tried in any existing study is to obtain commodity information directly from documents carried in the motor vehicles. The obvious prerequisite for such a technique is the existence of documents containing the necessary information. The documents carried in motor carriers operating on highways depend on the type of carrier—common, contract, or private. According to the Wisconsin Administrative Code:

> (1) Freight bills for each shipment handled shall be made and kept by the carrier showing the name and address of the carrier, consignor, and consignee; the origin and destination; the date of receipt by the carrier; the description by number of packages and commodity name; and the weight, rate, and charge. (2) On traffic moving under joint rates, freight bills shall also show the point of interchange, the name of the connecting carrier, and the division of revenues between the joint carriers. (Public Service Commission, PSC 16, 02 Bills, freight.)

It appears from the regulations that intrastate common motor carriers need not carry the actual freight bills in the vehicle. Through extensive interviewing of common carriers, however, it is believed that most, if not all, common carriers do carry the appropriate freight bills in the vehicle carrying the freight.

Each interstate common carrier must also issue a document that will contain the following information, as required by the Interstate Commerce Commission (4): date of shipment; names of consignor and consignee; points of origin and destination; number of and description of packages; exact description of articles; and weight, volume, or measurement on which charges apply.

Again, all common carriers in interstate commerce seem to carry this document (either a freight bill or a bill of lading) in the vehicle that contains the freight.

All but the exempt contract carriers, both interstate and intrastate, must maintain bills of lading (which contain some of the ideal data for a commodity flow study) and must have these bills in the vehicle when carrying the commodities. The exempted contract carriers are those that carry farm and forest products directly from the point of growth or production. Although no bill of lading or freight bill need be carried on the exempted carriers, it appears that these carriers do carry a bill of sale that usually names the commodity and lists the weight, the origin and destination (shipper and purchaser), and the price paid. Hence, there appears to be little problem with contract carriers not carrying adequate documents from which commodity flow information can be obtained.

Private motor carriers by law must carry some document or have other means of proving that the commodities carried in the vehicle are actually owned by the carrier. They need not carry freight bills or bills of lading, although most private carriers do carry a bill of lading of sorts. The reason for this is that the company itself wants to know exactly what commodities are in each vehicle. Consequently, most companies (certainly the larger firms with more than one vehicle) do not allow a vehicle to leave a terminal or other place of origin without an appropriate bill of lading. Often the private vehicles are actually large delivery vehicles that deliver the commodities to the company's outlets; e.g., chain food or department stores. These carriers carry detailed documents enumerating the commodities within the vehicle.

Very few vehicles, therefore, move on the highway without bills of lading, freight bills, or receipts of sale from which commodity flow data can be obtained. When a vehicle does not have a document from which to derive the commodity information, the possible procedure is to obtain the carrier's name and address; record the license number and fleet number of the truck; and follow up by a mail questionnaire, phone call, or interview to the carrier home office or terminal to obtain the data about the particular vehicle.

Several problems, however, do exist with this method of examining documents in the vehicle. It is easy to deal with the documents of a load containing one or two commodities and therefore one or two freight bills, which can be manually copied or photostated. Many vehicles, however, carry mixed loads and many freight bills. In the case of common carriers, the number of freight bills on each vehicle can vary from one to well over 100. Consequently, either a large staff must be maintained at each station, the bills must be photostated, or the bills must only be sampled.

A problem in obtaining data directly from freight bills carried on the vehicle is the accuracy and nature of the data on the bills. Table 2 gives the data that can be obtained directly from the freight bill. From Table 2 it is apparent that almost all the ideal data can be obtained by using interviewer observation to supplement the freight bill data. Problems with the freight bill data that require clarification are of the following types: vehicle origin and destination are by company terminal number rather than address, no mailing address for consignee, and a typing error (which might state "ch supplies" instead of "sch supplies" for identifying the commodity). Arthur D. Little (5) found that the description of commodities on freight bills is also a major source of error; for example:

Commodity Shown on Freight Bill	Proper Commodity Description
1 crtn bolts	1 crtn bolts, iron or steel
10 bxs gloves	10 bxs gloves, leather
1 dr oil	1 dr peanut oil
1 box Autolite	1 bx spark plugs

Because of the sources of error on freight bills, follow-up may be required to yield all the ideal data set.

Summary of Roadside Data Collection Techniques

This section has identified the four basic types of roadside data collection: driver interview, inspection of the load, the recording of vehicle identification with a follow-up procedure, and document inspection. The last technique yields by far the most data, but in itself is insufficient to yield the complete ideal set. Hence, a combination of the methods will be required, the most probable being the driver interview and document inspection.

CARRIER-CONTACT COLLECTION TECHNIQUES

Another source of data is the motor carrier home office or terminal. Many problems exist, however, with obtaining information from carrier document files. First, no regulation states where the files are to be kept, thereby leaving the location to the discretion of the carriers. Small carriers will maintain the files at the home office or terminal. Large carriers may also do this, or the documents may be kept at the terminal if origin or destination. If the latter is done by a significant number of carriers, it will be extremely difficult to obtain the data from each terminal; a state study would have to contact every terminal in the country. It may be possible, however, to obtain cooperation from the carrier in easing this problem.

A second problem is that the method of filing the documents is up to the individual carrier. The filing systems vary between sophisticated cross-reference files to drawers filled with old documents. Generally, each carrier maintains its files alphabetically according to the consignee's or shipper's name. Such a filing system does not lend itself to yielding bills according to vehicle or shipment date because to supply such bills the entire alphabetical files would have to be paged through, as is the case with contacting shippers. This is possible for large carriers that make use of computers to record their

TABLE 2

DATA OBTAINED FROM FREIGHT BILLS IN ROADSIDE SURVEYS

Ideal Data	Collection Results
Identification requirements:	
Consignee name	A
Consignee address	B
Consignee industrial classification	B
Shipper name	A
Shipper address	A
Shipper industrial classification	B
Carrier name	A
Carrier address	C
Carrier operating authority	A
Vehicle type	D
Vehicle identification data	A
Vehicle ownership	C
Document numbers	A
Transportation characteristics:	
Commodity	B
Commodity origin-destination	A
Vehicle origin-destination	B
Dates of flow	D
Timing of flow	D
Load weight	D
Load factor	C
Gross weight	D
Rates	A
Routes taken	D

A = data completed on freight bill.
B = data on freight bill required clarification.
C = data not obtainable.
D = data obtained at roadside to complement document data.

data, but the small carriers would have to do the work manually. For this reason, carriers would have to be instructed in advance concerning the sampling procedure so that the bills could be intercepted prior to filing. The third problem with using carrier files is that some carriers, the exact proportion unknown, will not have files. This proportion, however, is not expected to be large, and obtaining the data prior to filing will eliminate the problem.

A very major problem with any technique that entails direct contact with the carriers themselves is the task of identifying the carriers that operate on Wisconsin roads. At present, no list exists of all motor carrier firms or motor vehicles that operate within the state. Such a list would have to be compiled prior to any study that would involve contacting the carriers.

SHIPPER-CONTACT COLLECTION TECHNIQUES

It is possible to contact shippers by means of a questionnaire, telephone call, personal interview, or by requesting that they send in a certain sampling of their shipping documents. Each of these contact techniques requires that data be collected from shipper documents; and, as such, the document mailing technique may be the least expensive and most accurate. Certain problems, however, cause great difficulty in requesting that sampled shippers send in copies of freight and shipping bills. Even though most commercial shippers maintain shipping document files from which the desired documents can be obtained, the files are usually kept alphabetically according to consignee's name. Because of such filing methods the desired documents cannot be gathered for all commodities shipped on a specific date or in a specific vehicle without first paging through the entire year's shipping documents. Such a document search would be most difficult for most shippers. Second, most small shippers keep very limited files and some, e.g., farmers and individual small firms, keep no useful files at all.

The greatest difficulty with any method of contacting shippers is the magnitude of the effort that would be involved in contacting all shippers of goods into, out of, within, or through a study region such as the State of Wisconsin. Industrial and commercial firms, the largest shippers, can be obtained from several different lists. These shippers, however, will have to be recorded for the entire United States because much of the freight carried on Wisconsin roads originates with out-of-state shippers. All shippers thus must be contacted; or, more likely, a sample must be taken of all shippers throughout the United States. Even if this were possible, many shippers do not know if the goods went through a given state or not. A commodity flow study for a single state or region must find a better source of data or be part of a national study.

If a universe of shippers can be established and sampled and if a means of intercepting a sample of shipment documents is developed, the shipper-contact collection technique should be extremely viable at the national level. An input-output study collects interindustry dollar flows. An extension of this would be to collect commodity and mode information. More importantly, data in this form are more suitable for direct input to freight modal-choice models.

SUMMARY OF DATA COLLECTION METHODS

Many methods of collecting commodity flow information exist that might be useful in a commodity flow study. Table 3 gives the types of data that can be obtained from each method. All the ideal data cannot be collected; however, several techniques are better than others. In selecting a final technique, the data each method is capable of collecting are very important. The wealth of data, however, will have to be balanced against the costs in time and money in obtaining the information. All the following methods should also play a role in selecting the data collection technique.

Any method must be statistically sound and the sampling method must be spread over the entire year, with all dates having an equal probability of being sampled, so as to isolate all possible adverse effects of sampling.

The least possible burden must be placed on the carriers or shippers. All data must be obtained in the first contact with the carrier or shipper, with follow-up procedures to be implemented only when absolutely necessary. Detailed step-by-step

TABLE 3

SUMMARY OF SOURCES AND DATA COLLECTED

Ideal Data	Data Sources: Contact Carriers: Documents Mailed In	Contact Carriers: Terminal Visits	Roadside Techniques: Inspect Documents	Roadside Techniques: Driver Interview	Roadside Techniques: Load Inspection	Roadside Techniques: Vehicle ID and Follow-Up
Follow-up data:						
Carrier name	X	X	X	X	X	X
Consignee mailing address	X	X	O	O	O	X
Consignee and shipper names	X	X	X	O	O	X
Consignee and shipper addresses	X	X	X	O	O	X
Document number	X	X	X	O	O	X
Vehicle number	X	X	X	X	X	X
Load information:						
Commodity description	X	X	X	O	O	X
Commodity origin-destination	X	X	X	O	O	X
Load weight	O	X	O	X	X	X
Load factor	O	X	O	X	X	O
Load type (mixed, straight)	O	X	X	X	X	X
Number of commodities	O	X	X	O	O	O
Commodity weight	X	X	X	O	O	X
Rate	X	X	X	O	O	X
Vehicle data:						
Route	O	X	O	X	O	O
Dates arrival, departure	O	X	O	X	O	X
Times in transit	O	X	O	X	O	X
Vehicle origin-destination	X	X	X	X	O	X
Carrier operating authority	X	X	X	X	X	X
Vehicle ownership	O	X	O	O	O	X
Interlining	X	X	X	X	O	X
Industrial classification of shipper-consignee	O	O	O	O	O	O

X = data can be collected. O = data cannot be collected.

instructions must be supplied to all sources of data, so that all necessary personnel can cope with every circumstance. A process of quality control to ensure accuracy and completeness of data must be implemented. Each carrier must also be guaranteed anonymity, with absolutely no adverse effects accruing on data sources.

CONCLUSIONS

In looking at the most difficult mode of collecting commodity flow data—surveying motor carriers—it can be concluded that collecting data from carriers is extremely complex and costly. The problems involved, as discussed in the analysis, are immense. Great difficulty is encountered in approximating the ideal motor carrier commodity flow data set because of the variety of carriers and commodities on the highways. These difficulties raise considerable doubt as to whether surveying carriers can provide a single data set useful for both planning and regulation.

For purposes of a freight modal split, it appears that contacting shippers should be investigated in greater detail. In a broader framework, such as a national or large regional study, the determination of a universe of shippers from which to sample might be less difficult.

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