Large-Truck Travel Estimates from the National Truck Trip Information Survey

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The methodology of the National Truck Trip Information Survey conducted by the Center for National Truck Statistics of the University of Michigan Transportation Research Institute is described in this paper. The survey was conducted to achieve the two main goals of estimating the registered large truck population of the continental United States and providing detailed data on its annual mileage. Travel in the file can be cross-classified by road type, area type, and time of day, and broken down according to truck configuration, cargo body style, cargo type and weight, gross weight, number of axles, and driver characteristics. This type of detail is useful in risk assessment, because the risk of accident involvement depends on the operating environment as well as the physical characteristics of the truck.

As part of its continuing studies on the safety of large trucks, the Center for National Truck Statistics of the University of Michigan Transportation Research Institute (UMTRI) carried out a national survey of medium and heavy truck usage over a 15-month period from November 1985 to February 1987. Termed the National Truck Trip Information Survey (NTTIS), the work produced a wealth of unique data on the travel patterns of different types of large trucks. Described in this paper are the methodology and some of the findings of the NTTIS survey, expanding on the results presented in an earlier paper (*1*).

LARGE-TRUCK TRAVEL DATA

Reliable estimates of large truck travel are needed for many purposes. Government agencies require travel data for regulatory and policy decisions. Highway finance determinations and pavement damage assessments rely on mileage estimates. The trucking industry uses travel information to guide operations and safety management. Cost-benefit analyses of proposed safety countermeasures require accurate travel estimates. The focus of this paper is on the need for exposure information suitable for calculating accident rates of different truck configurations under various operating conditions. With such information, areas for improvement in truck safety can be identified, and, if addressed, the effectiveness of accident-reducing measures monitored (*2*).

Although the need for data on the annual travel of the U.S. large truck population is well established, meeting this need is a difficult task. Travel data collection differs greatly from accident data collection. Accidents are discrete events, whereas travel is a continuous process. All state police maintain records of accidents, enabling reliable estimates to be made of the incidence of large truck involvements. However, no comparable data are collected for truck mileage.

States do supply the Federal Highway Administration (FHWA) with travel estimates based on traffic counts, as part of the Highway Performance Monitoring System established by FHWA in 1978. This program involves federal, state, and local governments. The states estimate travel based on traffic counts taken along selected road sections (*3*). National mileage figures are produced for different road classes and types of vehicles. Various criticisms have been made of the FHWA mileage figures, however. The classification system for large trucks is coarse, distinguishing only combination vehicles from single-unit trucks. More problematic are criticisms of the estimating procedure itself. Mingo (*4*) describes a series of inaccuracies and inconsistencies at both the state and federal levels in producing FHWA mileage figures. Greene et al. (*5*) argue that FHWA estimates are based on a nonrandom sample of vehicle counts and that traffic counts themselves do not represent vehicle travel but merely traffic density at one point on a road.

A different approach to estimating truck travel is taken by the Truck Inventory and Use Survey (TIUS), conducted every 5 years by the Bureau of the Census. This survey is conducted via questionnaires mailed to a random sample of truck owners. Except for vehicle registration data on which the samples are based, all TIUS information is self-reported. The questionnaires concern the "typical" configuration and operation of trucks over a 1-year period. Consequently, TIUS produces overall travel estimates, but travel cannot be broken down according to operating environment or specific features of truck configuration. TIUS estimates are based on a robust sample of truck owners. The 1987 TIUS collected data on a total of 104,606 trucks, including light trucks.

NTTIS shares some similarities with TIUS, but there are also important differences. Like TIUS, most of the information in NTTIS was obtained through interviews with truck owners. In contrast to TIUS, however, travel information in NTTIS is based on actual trips made by truck drivers, not their characterizations of "typical" trips. Another strength of NTTIS is that it offers many details concerning truck configuration and operating environment. Travel can be cross-classified by road type, area type, and time of day, and trucks can be classified according to configuration, number of trailers, carrier type, cab style, fuel type, cargo body style, cargo type and weight, and weight, length, and number of axles of trailers and power units. The file also includes information on driver age and experience.

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SURVEY DESIGN AND METHODOLOGY

The objective of the NTTIS was to estimate the number of large trucks in the United States and provide detailed data on their mileage. The survey was conducted through multiple telephone interviews with truck owners to collect data on the use of their vehicles on particular days. The resulting NTTIS file is a hierarchical data set consisting of three parts: a truck file, a truck-tractor trip file, and a straight truck trip file (*6*). The truck file contains vehicle, company (owner), and annual mileage information, with one record per vehicle. The tractor and straight truck trip files contain trip information, one record per trip, for each trip taken by a survey vehicle on a survey day. All three files include weight variables so that national truck population and travel estimates may be calculated.

Sampling Frame

The sampling frame for NTTIS was formed from the R.L. Polk files dated July 1, 1983. The Polk files describe all registered vehicles in the country, excluding pre-1973 model-year vehicles in California and all vehicles in Oklahoma. Hence, the NTTIS sampling frame reflected these omissions and excluded Alaska and Hawaii as well. The Polk files were extensively processed to eliminate duplicate registrations from state to state. Vehicles selected from the sampling frame were trucks with a gross vehicle weight rating (GVWR) greater than 10,000 lb. Excluded were all pick-up trucks (regardless of GVWR), all passenger vehicles (such as passenger vans, recreational vehicles, ambulances, and buses of any type), farm tractors, and government-owned trucks.

The sampling procedure treated each state as a separate stratum, and within each state, straight trucks were sampled separately from tractors. An UMTRI-developed algorithm was used to make power unit-type assignments for the sampling process. Sample sizes were specified for each state, roughly proportional to the size of its truck population, and an interval selection procedure was followed in each stratum. At least 30 straight trucks and 60 tractors were selected from each state, and California and Michigan were oversampled to increase the number of tractors that pull two trailers. A total of 8,144 trucks was selected from the Polk registration lists to form the sample for the survey.

Data Collection for the Truck File

Once the sample was drawn, the survey work was carried out in two phases (Figure 1). During the implementation phase, conducted from January to May of 1985, each truck selected in the sample was located and a description obtained. Survey interviewers tried to contact the most knowledgeable person available for implementation information. In the case of private persons, the best source was most often the owner. With large companies, contact people were typically fleet supervisors, dispatchers, mechanics, drivers, and so on. Once the initial contact was made, interviewers secured the owner's cooperation, confirmed the vehicle's identification, obtained descriptive information on the company and truck, including a recent odometer reading, and made arrangements for acquiring detailed mileage information on four random survey days. Survey interviewing was conducted by telephone whenever possible. Mail versions of the interview forms were used only when the interview could not be completed by phone.

Of the original sample of 8,144 vehicles, 564 or 6.9 percent were determined to be nonsample because they had either been destroyed, were no longer registered, had GVWRs under 10,000 lb, or were not trucks. Of the 7,580 remaining vehicles, interviews were completed for 6,305 cases, for a response rate of 83.2 percent. The other 1,275 cases were not completed, primarily because of problems in locating the owner. Refusals were encountered in only about 3 percent of the selected vehicles. Information on the 6,305 vehicles with completed interviews is contained in the NTTIS truck file, which includes 3,704 straight trucks and 2,601 tractors.

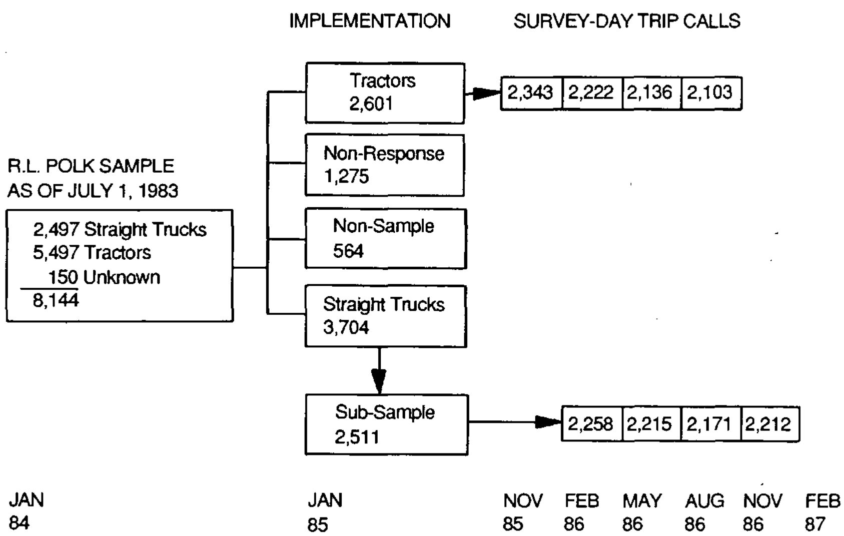

FIGURE 1 NTTIS case flow and timeline.

Data Collection for the Trip Files

After the implementation phase of the survey was complete, a sub-sample was drawn for the trip phase of 2,511 straight trucks and all 2,601 tractors. Most of the trip phase of the survey was devoted to collecting detailed information on the routes traveled by the selected vehicles and on the truck configuration, cargo, driver, and operating authority during these trips. Interviewers contacted truck owners quarterly over the course of a year to collect all trip information for a designated 24-hr period, usually the day before the phone call. Each "trip" lasted as long as the driver, operating authority, vehicle configuration, and cargo type and amount remained the same. Thus, if the driver changed, or cargo was loaded or unloaded, or one trailer type was exchanged for another, the interviewer began a new trip form to track the mileage put on by the new configuration. Tractor trip calls ran from November 3, 1985, through November 4, 1986, and straight truck calls were made from February 3, 1986, through February 5, 1987. A secondary goal of the trip phase was to collect a second odometer reading and usual or typical configuration data for all vehicles.

Vehicles selected for trip calls took a total of 13,097 trips, 4,966 by straight trucks and 8,131 by tractors. The trips were traced on specially prepared maps and the mileage broken down by road type, rural/urban, and day/night. The straight trucks traveled a combined sum of 206,276 mi, and the tractors logged 707,000 mi for an overall total of 913,276 mi. The value of the trip files lies in aggregating trip mileage across different travel categories for truck configurations of interest. The response rate for trip calls can be measured in two ways. Of the 5,112 vehicles selected for trip calls, some trip information was obtained, even if it was only that the vehicle was not in use, for 4,789 vehicles, for a response rate of 93.7 percent. It was hoped to complete four trip calls on each vehicle over the course of a year, for a total of 20,448 potential trip days. A total of 17,660 survey day cases was actually completed, for a survey day response rate of 86.4 percent. This rate was 88.2 percent for straight trucks and 84.6 percent for tractors. Overall, the in-use rate, that is, the percentage of vehicles that were actually used on the road on their survey date, was lower than anticipated. Straight trucks were in use on 27.0 percent of their survey days, and tractors were used at the slightly higher rate of 35.5 percent. The overall in-use rate was 31.3 percent, meaning that the typical vehicle was found to be in use on less than one-third of its survey days. In considering this apparently low usage, remember that NTTIS covered all registered trucks in the United States. This includes everything from trucks owned by Consolidated Freightways to farm trucks used mainly during the harvest season.

Mapping the Survey Trips

After a trip call was completed, research staff tracked the routes traveled on special maps prepared by UMTRI. The maps were based on the Rand McNally *Road Atlas* and followed its road type classification. Roads were divided into limited access highways, major arteries, and all other roads. Limited access roads include all U.S. Interstate highways, as well as state highways with fully controlled access. Major arteries include all U.S. and state routes that are not limited access, plus some other primary thoroughfares in large urban areas. All public roads that do not fall into the previous two categories make up the "other" road type group.

The special maps also included urban and rural zones. FHWA classifications were used to define three population categories: large urban areas (population of at least 50,000), small urban areas (population of 5,000 to 49,999), and rural areas. Local and county-wide maps showing the FHWA urban areas were obtained from each state so that exact boundaries could be marked on the *Road Atlas* maps. This made it possible to map the portion of the trip mileage in each of the three population areas precisely.

In addition to road type and population area, trips were broken down according to daytime and nighttime mileage. Because it was not feasible to ascertain the actual point on a trip where dawn or dusk came, "daytime" was arbitrarily set as 6 a.m. to 9 p.m. and "nighttime" as the 9 remaining hours. Therefore, nearly all of the travel classified as "night" was driven during darkness, but a small portion of the travel classified as "day" was actually driven in the dark, depending on the season of the year.

Adjustment Factors

A number of adjustment factors were calculated to correct for missing data encountered at several of the stages of data collection [for a full description, see Blower and Pettis (*6*)]. One important adjustment factor concerns mileage. As will be discussed in more detail later in this paper, total annual travel was estimated both from the information collected on the survey days and from two odometer readings obtained during the survey year. Estimates from odometer readings indicated greater annual travel than survey day estimates. Because odometer readings appear more accurate, an odometer adjustment factor inflates the mileages obtained from aggregating survey day travel to the mileages shown by odometer readings.

File Applications

NTTIS was designed to be a reliable sample of the real-world operating experience of trucks on the road. The data were collected on the basis of actual trips made by large trucks and can be used to produce national population and mileage estimates. A major application of the NTTIS travel file is to estimate the risk of large truck accident involvement under particular conditions. Large trucks are themselves a heterogeneous group, varying widely in size, configuration, and cargo, and they travel under many different circumstances. They operate on different classes of roads, in areas of varying population density, traveling at all hours of the day and night. All of these factors may influence the risk of accident involvement.

The NTTIS file allows truck travel to be cross-classified by many factors of interest. Every survey trip can be characterized in terms of day and night miles over three road types and three population types. By aggregating different types of travel across trips and survey days, annual mileage estimates can be produced for particular truck configurations. For example, mileage distributions can be compared between tractors hauling a van semitrailer and tractors with a flatbed trailer. The total annual mileage of these two configurations can be calculated, as can the proportion traveled on different road types or during the daytime versus the nighttime. By combining this information with the number of annual accident involvements for these configurations, the actual risk of accident involvement under the particular conditions may be estimated.

AVERAGE ANNUAL MILEAGE ESTIMATES IN NTTIS

The NTTIS file contains three independent estimates of average annual mileage. The first is the owner's estimate of annual travel, which is referred to here as "self-reported" annual mileage. The second is calculated from odometer readings supplied for specific dates near the beginning and end of the 1-year trip survey period. The third estimate is derived from travel reported on the individual survey days inflated by the selection weights for these dates. A comparison of the three estimates by power unit type (Figure 2) shows that the self-reported figures are the highest and the mileage from the survey days the lowest. An evaluation of these differences requires an understanding of the procedures used to obtain each measure of travel.

Deriving Average Annual Travel

When the truck owners were first contacted during the implementation phase of the survey, interviewers asked them to estimate how far they planned to drive the power unit over the following 12 months. An estimate based on the previous 12 months was acceptable if they planned to use the power unit in the same way. The self-reported figures are the highest of the three NTTIS travel estimates, averaging 55,149 mi for tractors and 12,547 mi for straight trucks. It is possible that owners sometimes overestimate the annual travel of their trucks. Because the estimate is made on the spot in the course of a telephone interview, the owner may not consider factors that lower a power unit's actual annual mileage from its planned use. Such factors include basing the estimate on high-mileage days instead of "average" days, not considering the time a power unit is out of service for maintenance and repairs, and not taking into account the rotating use of tractors in trucking operations.

The second means of deriving annual travel was to annualize the two odometer readings. The odometer-based derivations average 43,180 mi for tractors and 9,088 mi for straight trucks. Although these figures are about 20 to 25 percent lower than the self-reported mileage estimates, they might be expected to be more accurate simply because they are a more objective measure. The main problem with the use of the odometer figures in the NTTIS file is that two readings were not obtained for more than 40 percent of the trucks included in the trip survey. This reflects the difficulty involved in obtaining odometer readings. Accurate figures require contacting the respondent at two specific times during the year, and problems result if the power unit is not present when the calls are made or if the odometer has been broken or changed during the course of the year.

The third procedure for calculating average mileage was based on the travel information collected on the four survey days. Researchers tracked the actual routes followed by a vehicle for each 24-hr survey period and totaled and annualized the mileages. The mapped annual mileages turned out to be about one-third lower than the odometer readings, averaging 29,001 mi for tractors and 5,935 mi for straight trucks. Because the proportion of trucks reported not to be in use on the survey days was rather high, it is likely that sometimes trucks were reported incorrectly as not in use.

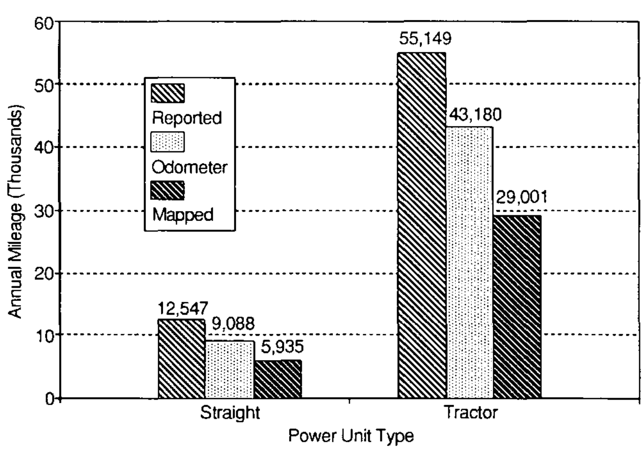

FIGURE 2 Average annual mileage in NTTIS by data source.

Discussion of Differences between Mileage Estimates

Part of the difference among the three types of mileage estimates in NTTIS is related to the timing in obtaining the estimates. Self-reported mileage estimates essentially pertain to the year 1985, whereas odometer and mapped miles roughly describe travel during 1986. Because truck mileage generally declines with the age of the truck, the self-reported estimates would be expected to be somewhat higher than the odometer and mapped estimates, because the former describe a population that is about a year younger than the latter.

It is possible to estimate the effect of the time lag between the self-reported and odometer miles. Average annual mileage was plotted by model year for self-reported miles, odometer miles, and odometer miles shifted by one year, to bring those estimates in line with self-reported estimates for time. Separate plots were prepared for straight trucks and tractors. Regression lines were plotted through each set of points, and the average distance between the lines for self-reported miles and unshifted odometer miles was calculated. The average distance between the lines for self-reported miles and shifted odometer miles was also calculated. The results indicated that the year's difference in timing explains 19.4 percent of the difference between self-reported and odometer estimates for straight trucks and 26.7 percent of the difference for tractors.

The self-reported average annual mileage figure for all straight trucks in NTTIS is 12,547 mi, and the odometer estimate is 9,088 mi, a difference of 3,459 mi. Assuming that 19.4 percent of this difference is caused by the time lag, the new odometer estimate would be raised to 9,760 mi , 2,787 mi below the self-reported figure. For NTTIS tractors, the average self-reported estimate is 55,149 mi and the average odometer estimate is 43,180 mi, a difference of 11,969 mi. Attributing 26.7 percent of this difference to the time delay results in a new odometer estimate of 46,375 mi, which is 8,774 mi under the self-reported figure.

Thus, the difference in time coverage probably accounts for about 20 to 25 percent of the difference between the self-reported and odometer estimates in NTTIS. Obviously other factors are also involved in the differences among the three types of estimates. The fact that three methods of calculating average annual mileage have yielded three different mileage estimates underscores the point that estimating truck travel is a very difficult task.

There is good reason to think that annual travel estimates by truck owners are too high. The owner is asked to provide an estimate for the entire year. It is unlikely that down time for repairs, accidents, or normal rotation of vehicles within a fleet will be considered. Travel estimates based on trip calls are almost certainly too low. Some travel was undoubtedly not reported, either inadvertently or to limit time spent on the interview. In any case, measurement error from trip calls is biased toward underreporting, because it is more likely that trips were overlooked than invented. Odometer readings provide a more objective, reliable means of estimating annual travel, although it is conceded that they too are subject to error. Despite extensive efforts, two odometer readings were obtained for just 58.6 percent of trucks selected for trip calls, a missing data rate significantly higher than for any other data element in NTTIS. It is possible that nonresponse bias affects the accuracy of the odometer estimates, although the direction of this effect is unknown. Trucks with high annual mileages may be more likely to be unavailable for odometer readings because they are on the road. Alternatively, little-used trucks may be inaccessible for different reasons, thereby raising the overall odometer estimates. Even with this uncertainty, odometer readings provide the best estimate of overall travel. Accordingly, mapped miles from survey calls are weighted by the odometer estimates.

TRAVEL DISTRIBUTIONS

Travel patterns of trucks, in terms of total travel and the distribution of road type, area type, and day/night, vary with respect to many of trucks' physical features. Power unit type, configuration, gross combination weight (GCW), and number of axles all are associated with different travel patterns. In this section, mileage distributions across the three travel categories will be examined for specific truck types of interest in order to illustrate some of the differences that exist. [For additional travel distributions based on NTTIS data, see Massie et al. (*7*).] The distributions in this section are based on mileage estimates from the mapped trips, inflated by the odometer adjustment factor.

Truck Configuration and Operating Environment

Large truck travel varies a great deal according to power unit type and configuration. Based on NTTIS estimates, straight trucks outnumber tractors in the national large-truck population by about 70 percent to 30 percent. NTTIS estimates a national population of 2,185,630 ± 26,063 straight trucks and 919,702 ± 26,736 tractors. The distribution nearly reverses for annual travel, however, with tractors logging 68 percent of the total miles and straight trucks only 32 percent (37,870 million mi ± 695 million for tractors and 17,990 million ± 513 million for straights). This is because the average annual mileage of a tractor is about five times that of a straight truck (41,176 to 8,231 mi). Trucks can also be broken down in NTTIS according to configuration, such as straight trucks alone, straight trucks hauling one or two trailers, bobtails (tractors alone), singles (tractors hauling one trailer), and doubles (tractors hauling two trailers). In this section, tractors with three trailers, or triples, will be included with doubles because they are made up of such a small category. NTTIS estimates that a total of about 55,560 million mi is logged annually by the five main large truck configurations. Singles accumulate 35,010 million mi ± 689 million each year (63 percent of the total), and straight trucks with no trailers are next with 16,680 million ± 485 million mi (30 percent). Bobtails, doubles, and straight trucks pulling trailers together account for only 7 percent of the total large-truck travel.

Breaking down truck travel by road class, there are marked differences among configuration types. The distribution of each configuration's miles over the three road classes is illustrated in Figure 3. The proportion of limited access travel ranges from less than 20 percent for straight trucks to more than 72 percent for doubles. Conversely, travel on major arteries drops from 42 percent for straight trucks to 20 percent for doubles, and mileage on all other types of roads ranges from 38 percent for straight trucks to less than 8 percent for singles and doubles. These distributions provide an example of the importance of considering factors in addition to total travel when calculating the risk of accident involvement. Limited access routes are generally much safer than other types of roads (*8*). Therefore, vehicles like singles and doubles that

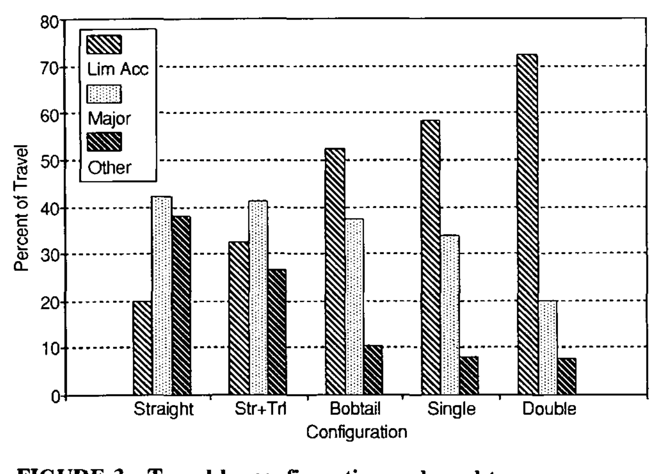

FIGURE 3 Travel by configuration and road type.

log a large proportion of their travel on the Interstates are exposed to less accident risk per mile than straight trucks, which travel much less frequently on limited access routes.

Considering travel on rural versus urban roads (following FHWA classifications), there are again substantial differences in the distributions among configurations (Figure 4). Single-unit straight trucks log approximately equal numbers of miles in rural and urban areas, whereas tractor-semitrailers put on more than twice as many rural as urban miles. Turning to the third main travel factor, time of day, this breakdown by configuration type can be seen in Figure 5. All five configurations put on far more miles during the day than at night, but again the proportions vary. Straight trucks accumulate less than 3 percent of their miles at night, whereas the nighttime portion is nearly 19 percent for singles and more than 34 percent for doubles. Just as for road class, area type and time of day are travel factors that affect a vehicle's risk of accident. As can be seen in Figures 3 to 5, mileage distributions over all three of these factors vary significantly from one truck configuration to another.

NTTIS also can be used to generate mileage estimates for combinations of the factors treated previously. Eight categories can be defined by generating all combinations of two road types (limited access versus all other roads), two light conditions (day versus night), and two area types (rural versus urban). If the aggregate travel distribution for the five truck configurations across the eight categories of travel is prepared, the category with the largest share of the mileage, at about 30 percent, is rural "other" roads during the daytime. The next largest is rural limited access roads during the daytime, with 22 percent. Urban limited access roads during the daytime represent 15 percent of travel, rural limited access roads at night 7 percent, and urban limited access roads at night 3 percent. Urban "other" roads during the day account for 18 percent of travel, rural "other" roads at night 3 percent, and urban "other" roads at night 1 percent. There is clearly more travel during the day than at night, particularly on "other" classes of roads. There is also more travel in rural compared with urban areas, and on "other" roads compared with limited access roads, although this last difference is not as great.

The travel distribution over the eight categories is shown separately for straight trucks with no trailers, singles, and doubles in Figure 6. Straight trucks accumulate much more travel on "other" roads, compared with singles and doubles, and put on very little nighttime mileage. Singles, on the other hand, accumulate substantial travel on limited access roads and have a higher proportion of night travel than straight trucks. Most of the doubles travel is on limited access roads, in part because of restrictions in some states, but a large share of their travel is also at night. Doubles are operated more uniformly around the clock and are used primarily in long-haul, general freight operations.

Gross Combination Weight (GCW)

The comparisons discussed so far have classified large trucks according to power unit type and configuration. NTTIS can also show travel by the actual GCW of the vehicle. Presented in Figure 7 are the travel distributions of straight trucks and tractors in 10,000-lb increments of GCW. The category labels for this and subsequent figures are for the lower bound of the GCW increment. So, for example, the bars labeled "20" rep-

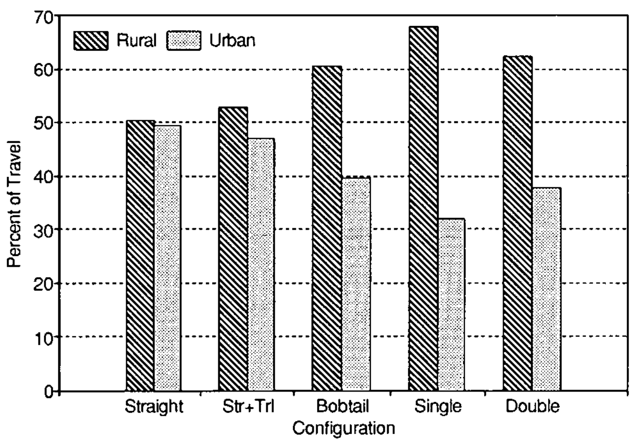

FIGURE 4 Travel by configuration and area type.

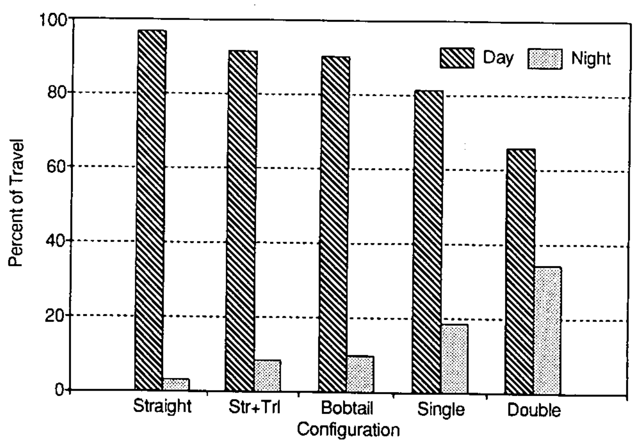

FIGURE 5 Travel by configuration and time of day.

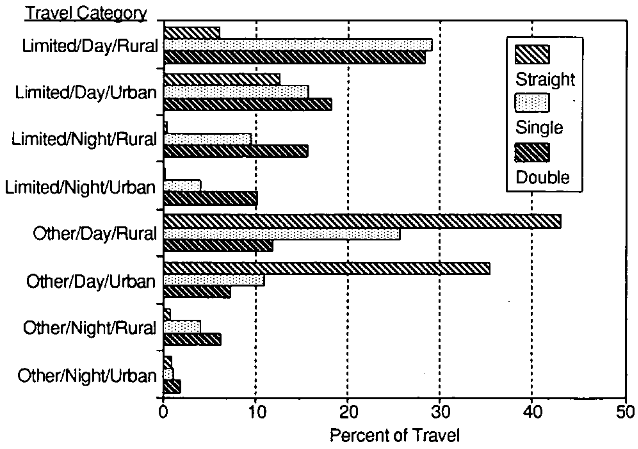

FIGURE 6 Travel by road type, time of day, and area type for straight trucks, singles, and doubles.

resent GCWs of 20,000 to 29,999 lb. Cases with missing data on GCW have been excluded from the distributions.

The operating characteristics of the two power unit types are quite different and the differences are reflected in their operating weights (Figure 7). Most straight trucks are Class 6 or below and operate without trailers. Accordingly, more than half of the travel of straight trucks is at weights under 20,000 lb, and more than three-quarters is at weights under 30,000 lb. The travel at higher weights reflects in large part the operations of loaded Class 7 and 8 straight trucks and straights with trailers. Tractors, in contrast, are primarily Class 7 and 8 and operate over 95 percent of the time with trailers, typically one. The empty weights of singles and doubles are roughly comparable, and the peaks of the bimodal distribution of tractor travel in Figure 7 reflect empty and loaded combinations.

Considering GCW for loaded vehicles only, the travel distributions naturally change, but the distinction between straight trucks and tractors remains clear. As a group, straight trucks travel slightly more without any cargo than do tractors. NTTIS estimates that about 36 percent of straight truck miles are in an unloaded condition, compared with only 30 percent for tractors (including bobtails). Illustrated in Figure 8 is travel

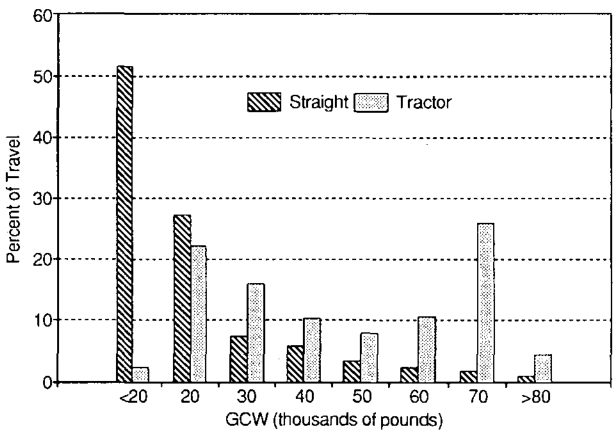

FIGURE 7 Travel by power unit type and gross combination weight.

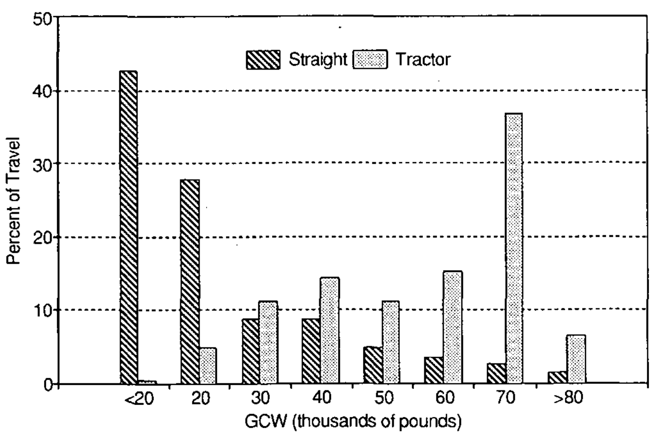

FIGURE 8 Travel by power unit type and gross combination weight, loaded trucks only.

according to GCW for large trucks that are at least partially loaded. This figure may be compared with Figure 7 to see the effect of excluding empty vehicles. The change in the GCW travel distribution for straight trucks is relatively minor. The under-20,000-lb class has dropped from 51 percent to 43 percent of the overall mileage, and all of the heavier categories show a slight rise as a result. This is evidence of the dominance among straights of weight classes up to Class 6, which are rated at no more than 26,000 lb. In contrast, the tractor distribution has changed substantially with the exclusion of the empty vehicles. The peak at the 20,999 to 29,999-lb category has disappeared, whereas the peak at the 70,999 to 79,999-lb class has risen. More than 58 percent of loaded tractor travel occurs at a GCW of 60,000 lb or greater, and 43 percent is conducted at a GCW of at least 70,000 lb. The comparable figures for loaded straight trucks are 7.5 percent and 4 percent, respectively.

Axle Configuration

Axle configuration is another large-truck characteristic that was considered in the NTTIS survey. The number of axles on each unit of a configuration was recorded, and if this number changed, as when a lift axle was raised or lowered, a new trip form was started. Thus, NTTIS contains the same detailed mileage information according to axle configuration as that already described for configuration type and GCW.

Provided in Figure 9 is an overview of tractor-trailer travel according to number of axles. The first six bars on the graph pertain to singles and the last two to doubles and triples. In each case, the first number indicates the number of axles on the tractor and the next one (or two) the number of axles on the trailer. Represented by "O/O" and "O/O/O" are "other" axle combinations for singles and doubles, respectively. By far the most common configuration for singles is a 3-axle tractor hauling a 2-axle trailer. This axle configuration accounts for nearly 74 percent of all tractor-trailer travel. The next most common configuration for singles is the 2/2 combination, which accounts for 11 percent of all tractor-trailer mileage. Among doubles, 2/1/2 is the most common configuration. This combination represents about 60 percent of all multi-trailer travel and 3 percent of overall tractor-trailer mileage.

In Figure 10, travel distributions are compared according to GCW for 3/2 and 2/1/2 axle configurations, which are the most common configurations for singles and doubles, respectively. The 3/2 singles have a greater share of travel at both ends of the GCW scale than do the 2/1/2 doubles. More than 37 percent of 3/2 singles travel occurs at a GCW of at least 70,000 lb. This compares with less than 27 percent of the 2/1/2 doubles travel. However, the doubles drive more of their miles in the very heaviest GCW class 80,000 lb and over than do the singles, 6.5 percent to 4 percent. Travel at GCWs under 40,000 lb accounts for more than one-third of the 3/2 singles mileage but only a quarter of the 2/1/2 doubles mileage. The higher proportion of travel at low GCWs for singles is likely caused by a typically lower empty weight compared with doubles. The greater share of travel at high GCWs may be caused by 3/2 singles frequently hauling higher-density cargo than 2/1/2 doubles, which are used for general freight.

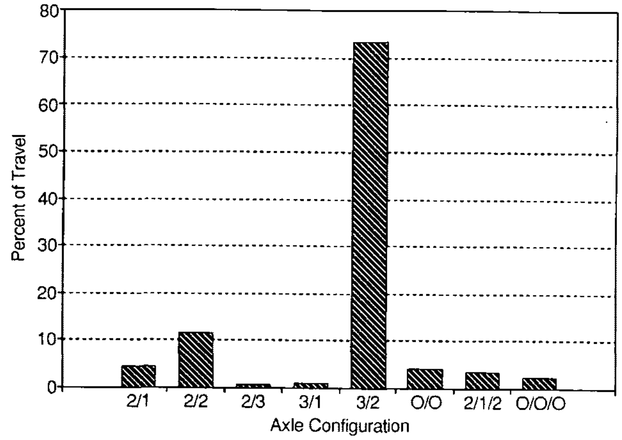

FIGURE 9 Tractor travel by axle configuration.

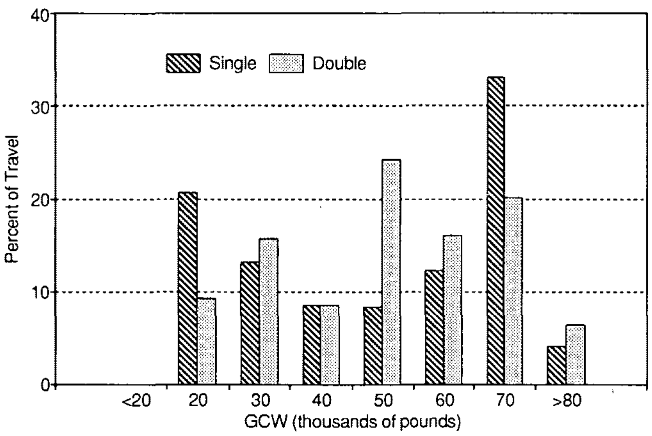

FIGURE 10 Travel by gross combination weight for 3/2 singles and 2/1/2 doubles.

CONCLUSIONS

The series of comparisons presented in the last section illustrate several important aspects of the national large-truck travel experience. The first is that different types of trucks have substantially different distributions of travel across categories defined by road class, time of day, and population area. Because these categories of travel are associated with different risks of accident involvement, the travel patterns of any given type of truck have a strong influence on the likelihood that a truck of that type will be involved in an accident. Second, large trucks form an extremely heterogeneous group. This is reflected in travel comparisons that consider power unit type, GCW, and axle configuration. Large trucks vary widely in their physical configuration, and this also has a bearing on the risk of accident involvement.

The diversity of trucking operations underscores the importance of reliable travel data in any analysis that seeks to determine the relative safety of one truck type versus another. To carry out the analysis, it is essential to have both accident data and travel data that can be cross-classified by the factors of interest, especially those categorizing the type of travel. It is not sufficient simply to know the total miles traveled. It must also be possible to classify the travel by factors related to accident risk, such as type of road and time of day.

NTTIS meets these criteria for reliable, detailed large-truck travel estimates, but the current file is already becoming outdated. Whereas UMTRI's Center for National Truck Statistics has been conducting a survey of large trucks involved in fatal accidents since 1980, NTTIS was a one-time project that surveyed truck use in 1985 to 1986. The U.S. trucking industry is a dynamic one that changes along with the economy, demographics, size and weight legislation, truck equipment and configurations, technology, traffic densities, as well as the nature of the highways on which trucks operate with other vehicles. Reliable truck travel information is a continuing need. Truck safety continues to be a matter of major national importance. To meet the demonstrated need of reliable, current estimates of heavy truck travel, NTTIS should be conducted on a regular basis, ideally once every 2 years.

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