UM-HSRI-79-89

ANALYSIS OF TRUCK ACCIDENT AND EXPOSURE INFORMATION

Phase I Report

by

James O'Day
Lyle Filkins
Kenneth Campbell
Arthur Wolfe
Robert Scott

University of Michigan

Highway Safety Research Institute
Ann Arbor, Michigan

November, 1979

The research reported herein was conducted under general research funds contributed by the Motor Vehicle Manufacturers Association and the Western Highway Institute. The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the MVMA or WHI.

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
UM-HSRI-79-89		

4. Title and Subtitle	5. Report Date
Analysis of Truck Accident and Exposure Information - Phase I Report	March 1980
	6. Performing Organization Code
	8. Performing Organization Report No.
7. Author(s) James O'Day, Lyle Filkins, Kenneth Campbell, Arthur Wolfe, and Robert Scott	UM-HSRI-79-89
9. Performing Organization Name and Address	10. Work Unit No.
Highway Safety Research Institute The University of Michigan Ann Arbor, Michigan 48105	11. Contract or Grant No.
	13. Type of Report and Period Covered
12. Sponsoring Agency Name and Address Motor Vehicle Manufacturers Association Detroit, Michigan 48202	Final - Phase I July 1979 - March 1980
	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

The present status of information regarding accidents involving heavy trucks, particularly with regard to existing accident and exposure data sources, is reviewed. Plans and schedules are developed for the collection of additional accident and exposure data, both at the national level and at the state level. Analytical issues deserving special consideration are discussed briefly in general terms, and it is noted that these issues have considerable influence on the subsequent collection of new data.

The case study and statistical inference approaches to determination of accident causation are also reviewed briefly and the latter is illustrated with examples involving heavy trucks.

17. Key Words	18. Distribution Statement
	Unlimited

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	46	

CONTENTS

SECTION 1

INTRODUCTION

This report considers the present state of information regarding accidents involving heavy trucks, particularly with regard to existing accident and exposure data sources, and then develops a plan for analysis and for collection of further data to answer questions posed by truck manufacturers and operators.

The impetus for the work reported here came originally from a list of information needs developed by a joint committee of interested persons from the Motor Vehicle Manufacturers Association and the Western Highway Institute. The document which resulted from these committee deliberations is referred to here as a prospectus, and is viewed as an expression of real need. The original prospectus is attached to this report as Appendix A, but a brief abstract of its contents follows:

* Determine the accident, injury, and fatality rates (in terms of events per vehicle-mile, ton-mile, and/or cube-mile) for a broad range of heavy trucks operating on U. S. highways. These should include at least comparisons between straight trucks, tractor-trailers, doubles, and triples; cabover vs. conventional designs; combinations of various lengths.

* Determine the causes of accidents involving heavy trucks.

* Get an understanding of the possible countermeasures which are likely to prevent or reduce the frequency of such accidents.

Of particular interest are accident rates and causes for the heavier (and longer) combinations, and it is clear that there will be a need for rather detailed identification of vehicle characteristics in the rate computations implied.

Organization of this report

The following section of the report discusses the general nature of the problem of drawing inferences about both rates and causes from accident and exposure data sources. In Section 3 there is a discussion of the quantity and quality of existing national and other accident data. Section 4 presents a discussion of the availability and quality of exposure data necessary for the rate computations desired. Section 5 reviews some present analytical efforts, and considers the problems of accident/injury/fatality rate determination using existing accident and exposure data.

Section 6 defines two general approaches to the determination of cause in accidents, explaining the advantages and limitations of each. The importance of accident rate in determination of accident cause is discussed.

Section 7 presents a plan aimed at meeting the needs of those who developed the original prospectus. The ability of any program to achieve precise answers to most of the questions posed is a function of the frequency of the events as well as the quantity and quality of the accident and exposure data. Events which are presently rather infrequent (say fatal collisions involving combination vehicles with more than one trailer) might not be quantified accurately without a census of all such cases in the country. But when the compared populations are both large (such as cabover vs. conventional tractors), comparisons will be easier. Where possible in Section 7, the degree of precision as a function of the effort required will be noted.

Section 8 contains a schedule for the recommended program, with individual tasks identified. Major subheadings in the schedule include the analytical activity, the acquisition and enhancement of the national data, and the individual state data acquisition work. The schedule is subject to revision as a function of budget availability, but is recommended in the form given in Section 8.

SECTION 2

GENERAL NATURE OF THE PROBLEM

The determination of a rate, such as accidents or injuries per mile traveled, implies the existence of both accident counts and mileage (or exposure) counts at comparable levels of detail. It should be clear that a comparison of, say, the injury accident rates for doubles vs. triples, must at the very least be based on the knowledge of the number of accidents and the number of miles travelled for each vehicle type. Further information to assure that the comparison is based on similar kinds of service very likely will also be required.

Figure 1 shows in block diagram form the necessary relationship. Three components are shown--the exposure data, the accident data, and some analytical method for combining the two. In the very grossest comparisons--for example, total accidents and total exposure in the country for passenger cars as compared with trucks--the analytical procedures are trivial: simply a division of the number of accidents by the number of miles. But since it is clear that truck miles are accumulated in a rather different environment than are car miles, a more reasonable comparison must account for such differences. The analytical "box" on the diagram represents the methods necessary to make the rate computations (and the comparisons) meaningful.

In a recent NHTSA report,[1] combination trucks were found to be involved in 5.6 fatal accidents per 100 million vehicle miles as compared with 3.6 fatal accidents per 100 million vehicle miles for passenger cars. However, the FHWA estimates of exposure provide the information that 81.0% of the combination vehicle-miles take place on rural roads compared with only 41.6% of the passenger car miles. It is clear that a comparison of injury or fatal accident rates should at least account for the road type on which the miles are aggregated. It is also known that more truck miles occur at night, so that accident causation factors such as limited visibility are more often present for trucks than cars, suggesting that a higher accident rate for trucks may not be so much related to the vehicle characteristic as to the environment under which that vehicle operates.

The availability and the nature of presently available accident and exposure information will be discussed in succeeding sections. But the fact is that at the present time our capability to make comparisons (i. e., calculate rates) in much detail is rather limited. The principal reason for this situation is the incompatibility of the existing accident and exposure data. This should become more clear after the characteristics of the available data are presented in Sections 3 and 4.

---

[1] NHTSA Undated Special Edition of "Highway Safety Facts"

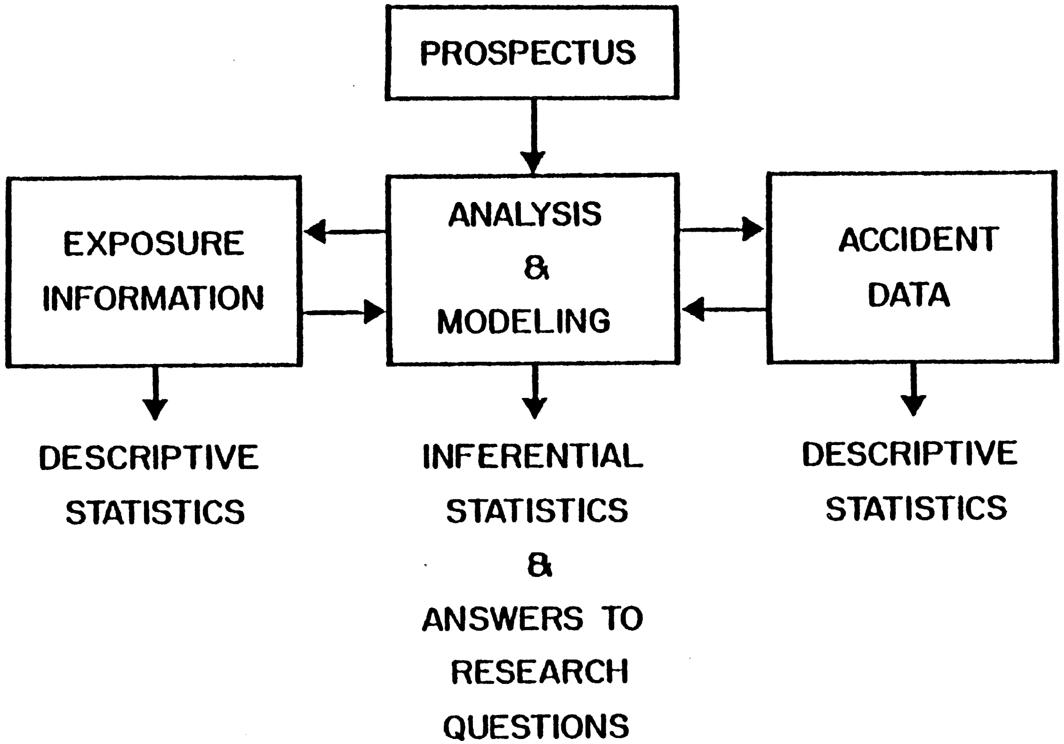


FIGURE 1
PROJECT OVERVIEW

SECTION 3

CHARACTERISTICS OF PRESENTLY AVAILABLE ACCIDENT DATA

Three rather different kinds of accident data are all likely to be useful in the present program. One kind is data which are more or less nationally representative--either a census of all of some kind of accident, a near census of accidents for some definable group of trucks, or a carefully designed sample of the nation's accidents. A second kind is a census (or possibly a sample) at the state rather than the national level--limiting any national inference from an analysis, but possibly richer in detail than the national data. The third type results from relatively detailed investigations conducted without any particular regard for sampling, so that, while they may provide some insight about how particular accidents happen, they do not provide the capability to estimate national frequencies or rates. This would include both the multi-disciplinary investigations conducted by various agencies, and special investigations and records kept by carriers. It is likely that such records will be of great value in the planned program in developing an understanding of causation.

National Accident Data Sources

The present national data sets include the Fatal Accident Reporting System (FARS), a compilation of essentially all police-reported fatal accidents from the nation. This is a relatively recent development, and is still changing and improving in quality. It contains moderate detail about location, environment, vehicle type, driver characteristics, casualties, and, to a limited extent, information about "contributing" or "causative" factors. Appendix B contains a listing of several factors reported in FARS. While it has the advantage of completeness, in the sense that nearly all fatal accidents have been included, it does not have the level of detail at present necessary to identify precisely the various truck body styles defined in the prospectus. Tractor-trailers are mostly identified in a single group; straight trucks are identified in several weight classes. Tractors or trucks in combination with more than one trailer are provided a separate classification, but there is no capability to differentiate doubles from triples, or to determine axle counts. Vehicle weight information, while reported, is apparently not the full weight of combinations at the time of the accident, but rather the license weight (derived from state revenue sources), and this information is of limited value in comparing various characteristics of heavy trucks.

BMCS data, by contrast, have rather detailed vehicle descriptions. This results from the submission of a form (MC-50) by the carrier for each accident involving certain classes of vehicles in which an injury occurred or in which there was $2000 in total property damage. For the most part, the BMCS has avoided asking questions which might relate to fault or causation, but rather has requested detailed factual data on cargo, vehicle configuration, date, time, objects struck, etc. The major problem with the present BMCS data in computing rates is that the reporting sources for entering data into this file are not very well defined. It is primarily made up of common carriers, although about 25% of the accidents reported are from sources other than the common carriers. Whether the coverage of common carriers is complete or not is not clear. A comparison of BMCS with FARS data (for fatal accidents only) indicates that only about half of the "large truck fatal accidents" (most of which involve combination vehicles) are contained in the BMCS files. A particular bias exists by state, with relatively more complete BMCS reporting of fatal accidents occurring in states in the mid-section of the U.S., less complete on the coasts and states bordering on Mexico and Canada. Appendix C contains excerpts from the recent BMCS file codebooks as used at HSRI, showing several distributions of truck accident involvements for 1976 and 1977.

A third set of national data is that emanating from the National Accident Sampling System (NASS). This is a recent program initiated by the National Highway Traffic Safety Administration (NHTSA) which will sample certain accidents occurring throughout the United States to collect quite detailed information. At the present time it is anticipated that the fully operational NASS will investigate something like 20,000 accidents per year, and they may oversample large truck accidents to produce a more useful sample of these than would be obtained from a strictly proportional sampling scheme. While the NASS is just now entering a phase of actual operation, it cannot be considered an "existing" data source at this time with respect to the questions asked in the prospectus. It is likely that NASS, in conjunction with future exposure data, will provide definitive information about accident rates by vehicle class for major groups of vehicles, as well as detailed information about injury mechanisms. It will probably not be able to provide much useful rate information about relatively rare populations, such as triples.

State Accident Data

Since the only national (census) accident data are provided for mostly serious accidents (BMCS and FARS), there is really no national source for information about the bulk of police-reported accidents. BMCS, for example, provides reports of about 1400 large commercial vehicle accidents in Texas for 1976; and FARS reports about 300 fatal accidents in Texas involving combination vehicles; but Texas police reports total about 14,000 accidents involving tractor-trailers in the same time period. Although the state accident files clearly contain many accidents of lower severity than do the national files, the quantity of accident reports available at the state level would permit much more meaningful comparisons of accident rates for different vehicle classes. Further, there are many vehicles unique to only one or a few states--the extremely heavy trucks in Michigan, triples in several of the Western states, and even doubles in a limited number of states. State sources of accident data, then, are attractive in spite of that fact that they do not fully represent the nation. Several states currently record Vehicle Identification Numbers (VIN's) on their accident reports. At least for recent model years, the VIN's can often be decoded from published information to provide better detail about truck style (cabover vs. conventional designs, for example). The State of Washington has, for the past several years, included VIN information in their digital accident files. Michigan police record the VIN, but it is unfortunately not subsequently coded for entry in the computer files. Nevertheless, with some difficulty, further information about truck style could be added to such data sets.

Also at the state level it has been possible in the past to establish supplementary data collection systems (usually called bi-level systems). An arrangement is made so that police officers prepare a second form for each accident satisfying certain conditions (for example, all accidents involving a tractor-trailer), and these data are added to that already available on the conventional report form. An alternative method, with some advantages, is to allow the original report form to serve as a prompting device, and to follow up by telephone or letter to acquire additional information. Both methods have been used in the past at HSRI, and the choice depends on a number of factors.

Other Accident Data Sources

While accident data collected by carriers are often of immediate use to that company, compilation of such data with that from other carriers is less useful. This results because no two companies view the need for accident information in exactly the same way, and adding the statistics from two different sources is a sort of apples and oranges problem. The same situation exists in combining information from two states, and, indeed, was a major impetus to the development of the National Accident Sampling System which should minimize the variable reporting problem. Carrier data may be of considerable interest in themselves in studying causation, but it is likely that rate information derived from a limited number of carriers will be of little value in making national inferences.

Other detailed accident information comes from the Multi-Disciplinary Accident Reports which have come from MVMA, NHTSA, and the Canadian Department of Transport-sponsored programs. Over the past ten years several hundred very detailed reports have been prepared. Also the BMCS field investigators perform a small number of detailed accident investigations each year, and these are published. A last major source, currently not in the public domain but potentially of great value, are the 2000 or so reports prepared under the FHWA-sponsored study conducted by Biotechnology, Inc. during 1977. These 15-page accident reports may provide further insight about how such accidents occur.

SECTION 4

CHARACTERISTICS OF PRESENTLY AVAILABLE EXPOSURE DATA

Exposure information is generally thought of in terms of vehicle miles travelled, or alternatively (for commercial vehicles) in terms of ton- or cube-miles, and should be determined for each class of vehicle to be analyzed.

There are also other factors which should be known rather precisely in comparing accident rates for various classes of vehicles, and these too can be considered in the exposure category. Included are information about time and location of travel, special characteristics of drivers associated with each class of vehicle, unique trip characteristics, vehicle physical condition, etc. In short, any factor which varies and may be recorded in the accident data may be sought in the exposure data too.

For each vehicle class of interest (and this includes large straight trucks, tractor-trailers, doubles, triples, by weight and length category, by number of axles, by fifth wheel position, etc.), desirable exposure information includes:

Travel quantity (in vehicle-miles, ton-miles, cube-miles)

Road class (for example, Interstate, primary, secondary, rural, urban)

Natural environment (rain, snow, mountain routes)

Trip characteristics (short-haul, long-haul, cargo, speed of travel)

Time (hour of the day, daylight or darkness, day of week, season, year)

Driver Characteristics (age, sex, experience, time driving this trip, experience with this company, violation history)

Carrier type (to permit subsetting for comparison with BMCS accident data)

Exposure data (and accident data too) are often available only in <u>aggregate</u> form. For example, presently reported mileage information from FHWA provides an estimate of total combination truck miles in the U.S., but (because it is aggregated) does not permit the analyst to break down mileage for more detailed kinds of trucks. Many accident data files now are available in disaggregated form, so that it is possible to subset into many of the categories of interest, but with few exceptions this is not true of the exposure data.

Existing exposure information has usually been collected for purposes other than comparison with accident data. Turnpikes, for example, have relatively complete counts of vehicles by weight class (for fee determination), but accident data from the same turnpikes typically categorize vehicles in an entirely different manner (for example, by type of trailer). FHWA mileage data groups all types of diesel users together, partly because their major source of data is fuel tax statistics, but partly because their intended use of the information is for highway planning rather than accident analysis.

The quintennial Truck Inventory and Use Surveys conducted by the Census Bureau are available in disaggregated form for national samples of almost 100,000 trucks. While not carried out primarily for accident rate analysis purposes, they do provide reliable annual mileage estimates for various truck configurations, cab types, etc., both nationally and (with reduced accuracy) for every state.

Since many (or most) of the questions posed involve rate computations--i.e., accidents, fatalities, or injuries per mile travelled under a variety of conditions--the exposure data for this study must be comparable with the accident data across as many levels as possible.

Present National Exposure Data

FHWA publishes annually an estimate of truck mileage nationally by road class. This has been used, for example, by the NHTSA in computing fatality rates for combination vehicles for the past four years, and in computing the same rates for various regions of the country. There is not sufficient detail to establish rates for most of the sub-classes (cabover vs. conventional, singles vs. doubles, etc.) of interest in the present study. FHWA does have long range plans for collecting data in more detail--indeed, several states already collect more detailed data themselves--but it is not likely that this will constitute a source of national data useful to the present study within the next several years.

As mentioned above, the Truck Inventory and Use (TIU) Survey provides the best existing exposure data for various types of large trucks. Data from the 1977 survey (earlier surveys were conducted in 1963, 1967, and 1972) have now been published in reports for 49 states, and the national summary will be published early in 1980. A public use tape containing data from the approximately 95,000 questionnaires returned by the sampled truck owners will also be available at that time.

The TIU Survey sampled all types of cargo vehicles in state motor vehicle registration files, but it used a stratification scheme to greatly oversample larger trucks. Consequently, three quarters of the sample consists of trucks over 16,000 pounds, a large proportion of which are combination vehicles. Copies of the 1972 and 1977 survey forms are attached as Appendix D. The 1977 form is considerably expanded in its vehicle description details (including five cab types, sleeper or not, brake type, etc.), and this data set should provide valuable overall exposure data for many vehicle configurations of interest.

As a part of the evaluation of the 121 brake system, HSRI collected fairly detailed exposure information on large air-braked trucks manufactured in 1974 and later. These data have been used to compare with both FARS and BMCS accident data, but are necessarily restricted to trucks of the model years studied. Further, although detailed with respect to factors important to brake system evaluation, there is not sufficient detail on such items as length, width, cargo, fifth wheel placement, etc. to satisfy the needs of this program.

State Exposure Measurements

Some states presently collect exposure data in considerable detail, using combinations of automatic traffic counters and periodic manual counts (the latter for more precise vehicle identification). FHWA considers that Tennessee, Georgia, Texas, Illinois, Iowa, and New Hampshire are among the more reliable sources of exposure information. Georgia, for example, has 61 permanent counting stations (30 rural and 31 urban), and supplements these by a periodic manual counting of vehicle classes and states of vehicle registration. Heavy trucks and tractor trailers are classified by axle count, but not by body style.

The states of Virginia and North Carolina record the odometer reading of all state-registered vehicles at the time of an annual inspection, thus providing at least aggregate mileage for all power units each year. This method, of course, does not account for road miles put on by out-of-state trucks. The state of Tennessee is probably unique in that truck styles are recorded in their counts using the FHWA (BMCS) classification system. For the most part each of the other states has chosen its own categories.

Vehicle counts in all states are the responsibility of the highway or transportation department, and the usual purpose of the counts is for highway planning and design. It is possible that additional data could be acquired in states that presently have satisfactory sampling systems, but no state presently collects data in sufficient detail to address the vehicle style questions posed in the prospectus.

Other Exposure Measurements

The FHWA heavy truck study conducted by Biotechnology has measured exposure on a sample of road segments in six states. For their particular purpose of comparing with accident statistics on the sampled road segments, the roadside survey method was ideal. These data are not likely to represent the nation well (and thus will not serve for comparison with national accident data sets), and also will not truly represent the states in which they were acquired (because of the small number of sample points). Their methods may prove useful, but since the reports are not yet available it is difficult to tell.

Alternative Methods for Acquiring Exposure Information

Presently available exposure data lack the capability to identify mileage for all of the various sub-classes of vehicles of interest in this study. This situation comes about mainly because the people who collected the exposure information were interested in matters other than comparison with accident data, and frequently have not collected the necessary information. The exceptions to this are the FHWA-Biotechnology data, which are available for comparison with a limited accident population collected under the same program, and the NHTSA-HSRI exposure data from the 121 study, which cover only recent model years, only two accident years, and were concerned primarily with factors important to the brake system evaluation.

The TIU survey should be of direct value in the present study with respect to factors which it does contain. For initial comparisons with the national accident data (FARS and perhaps BMCS) it should be useful.

Developing exposure data with more detail on travel environment (road type, weather, terrain), and on such vehicle details as fifth wheel placement may require a further survey. This might be accomplished by either a roadside survey (similar to that conducted by Biotechnology) or by truck owner survey concerning the truck's trips on predesignated days.

SECTION 5

ANALYSIS METHODS

Several major objectives are to be served by the analytical work undertaken in this project:

* To provide the overall methodological foundation on which the entire study will be conducted.

* To guide the identification of the accident data elements to be collected, the sampling plans for collecting them, and the procedures by which they are to be collected.

* To specify the accuracy and confidence intervals with which the accident data elements must be known to satisfy the project objectives.

* To guide, in a similar manner to that for the accident data, the collection of the exposure data elements.

* To provide a theoretical foundation--an analytical model--so that the accident and exposure data, both existing and newly-collected, may be correctly interpreted.

* To provide descriptive statistical information about new and existing accident and exposure data.

* To provide sound and defensible answers and interpretations and statistically correct inferences to the research questions under study.

Most of these objectives are self explanatory and do not require amplification for the present readership. Three aspects of these objectives, however, will require special care and deserve further emphasis: sample planning, modeling truck accident involvement, and multivariate analyses with data sets of limited size.

Sample planning. The first step in this activity is to translate the items given in the prospectus into statements of the comparisons which need to be made. It is clear that the acquisition of much exposure data is needed, and it is also clear that these data need to be acquired through sampling techniques since the gathering of a census of exposure information is not practicable. Issues of sample size will have to be addressed and resolved. The data elements to be collected must be detailed, and the accuracy and precision for each estimated. These considerations will also interact with the sample size issues.

Experience from the 121 study can be used to give an idea of the magnitude of the planning task. If we follow that general procedure and use the vehicle as the sampling point, then the exposure sample size should be on the order of 4000 vehicles, on the assumption that the missing-data rate can be kept in the vicinity of 20% or so. For example, an exposure survey of approximately 2000 vehicles conducted as part of the 121 study resulted in 95% confidence intervals for vehicle mileage which were 5-10% of the mean. Whether this sample should be stratified--and if so, how--has not been determined, of course. These and other sampling tasks of similar complexity and importance will have to be worked out before the field work is undertaken. It is clear that many organizations and agencies will have to take an active, supportive role in both the planning and the on-going data collection, and the required administrative and technical liaison also must be handled with care.

Similar issues pertain to the collection of the accident data. Both accident and exposure data need to be representative in a sense still to be defined, and both will have to be compatible in detail, in locale, and in time. Again it is clear that the administrative and technical liaison will occupy an important aspect of the overall planning, and this planning must occur in the context of the entire project analytical activities.

Modeling. A second major analytical topic involves the formulation of a theoretical and analytical foundation into which the accident and exposure data can be input and correctly analyzed. A preceding study concerned with turnpike accidents noted that the probability of truck-car crashes is a strong function of the times and places that both the passenger cars and the trucks travel. To be noted also is that with a given, constant level of truck-traffic exposure, an increase in the passenger car exposure level at the same times and places that trucks are traveling necessarily will increase the probability of car-truck accidents. Further, both the probability of the occurrence of a car-truck accident and the resulting severity given such an accident are as much a function of the car characteristics as they are of the truck characteristics. Without the additional contextual data and information in which car-truck collisions occur, it is certainly easy to come to grossly erroneous conclusions regarding truck involvement in these collisions. One of the most important of the analytical tasks to be undertaken is, therefore, the provision of an analytical structure--a model--so that the available data are correctly interpreted.

Multivariate analyses. The measures of truck-accident involvement discussed in the prospectus imply a number of simple rate calculations, for example, how many accidents (or injuries) divided by how many miles. It is clear, of course, that many other factors--from the vehicular, human, and environmental realms--interact with these. For example, large trucks tend to travel a majority of their mileage on rural roads, much of it at night, and much of it at relatively higher speeds than, say, passenger cars in urban areas during daylight. The assignment of low-seniority, less skilled drivers to unattractive runs may create an erroneous impression that the vehicle characteristics themselves are responsible for an unsatisfactory accident rate when in fact the driver characteristics are the more likely explanation. Conversely, the assignment of highly-skilled, accident-free drivers to more dangerous tractor/trailer/cargo configurations may mask inherently high-risk combinations. Interactions between variables of interest--and between variables of interest and those incorrectly thought by some persons not to be important--are one of the major problems confronting present-day accident-causation research.

An example, using 1973-1974 BMCS data, is provided by the findings of Herzog[2] and Hedlund[3] at NHTSA. Herzog initially found (p. 14) that: "1. The death rate for non-truck occupants in car-truck accidents increases with the weight of the truck. 2. There is no evidence to suggest that this fatality rate "levels off" at a loaded weight of 70,000-80,000 pounds."

Hedlund, in a more comprehensive analysis of the same data, subset the accident data into rural/two-lane, rural/four-lane, residential/ business two-lane, and residential/business four-lane groups. He concluded (p. 13) that "... the effects of truck weight are small compared to the the effect of district and roadway. In rural areas, weight appears to have no effect. In residential/business areas there is a slight increase in fatality odds with increasing weight."

The point of the preceding example, and the more general discussion in the earlier paragraph, is that it is exceptionally important that this entire research enterprise be sensitive to this "lurking variable" issue. These correlated, hidden variables can have two kinds of serious consequences: they can mask real, detrimental factors from any of the three realms--vehicular, human, or environmental--and they can also erroneously label as "causative factors" variables which have the misfortune of being correlated with a real problem factor. It is obvious that countermeasure efforts, if they are to be even partially effective, must be based on the real problem factors rather than on those confounded by lurking variables.

The simple and hard fact of research life is that there is no royal road which, if followed, will prevent erroneous conclusions because of lurking, unaccounted for variables. But the situation is far from hopeless. Multivariate statistical techniques are now in place--and are being refined continually--which can handle the analytical aspects of interactive variables. The central task of the research staff is to identify, before either the accident or exposure data collection activities start, those factors and variables that are likely to be associated with the study variables. Then the potential lurking variables can be found out before the fact and their effects compensated

---

[2] Herzog, Thomas N., Injury Rate As A Function Of Truck Weights In Car-Truck Accidents, Technical Note N43-31-7, DOT HS-801 870, National Highway Traffic Safety Administration, Research and Development, Office of Statistics and Analysis, Mathematical Analysis Division, Washington, D.C. Revised January 1976.

[3] Hedlund, James, The Severity of Large Truck Accidents, NHTSA Technical Note, DOT HS-802 332, U.S. Department of Transportation, National Highway Traffic Safety Administration, Research and Development, National Center for Statistics and Analysis, Washington, D.C. April 1977.

in the subsequent analyses. These activities will go a long way to assuring that sound, defensible inferences are drawn from the study.

While the multivariate techniques provide a basis for analysis when several potentially interactive variables are present, a caution is also in order. These techniques have a large appetite for data. Again, citing the experience gained in the 121 study, only four exposure variables, each limited to 2-3 levels, could be comfortably addressed in files containing 3000-4000 cases. These considerations must be carefully weighed in the selection of the variables and levels for inclusion and the development of the detailed design.

SECTION 6

ACCIDENT CAUSATION

Most people think of accident causation in terms of factors present in an accident _but for_ which that accident would not have occurred. This has, in fact, been called the "but for" test, and causes so identified may be candidates for change or countermeasure.

A second method for identifying causes of accidents involves statistical inferences drawn from a comparison of the accident data and parallel exposure data. If, in a large number of cases, a factor is present in the accident data relatively more often than it is in a control or exposure population, that factor may be identified as a "cause." In quite another field, the higher incidence of lung cancer among smokers than among non-smokers indicates that smoking is a "cause" of lung cancer.

In accident studies the "but for" method usually is applied by studying individual accidents; this is often called the case-study method. Experienced investigators who study an accident carefully look for departures from normal roadway, vehicle, or driver performance which are potentially correctable, and identify these as causes. It should be clear that such investigators must have some concept of what the normal situation is, and they may of course be aided by a checklist of possible factors prepared by others. The "statistical inference" method, on the other hand, is accomplished mainly by comparing groups of accident and exposed populations. It depends, of course, on the extent and detail of comparable data elements available in the two data sets.

Both methods are potentially useful, but some problem areas can be approached with only one. For example, there are factors which (in nearly everyone's opinion) really cause accidents, but which are not present or not measurable in a control (non-accident) population; and these can be discovered only by the case study method. A simple example would be a front wheel falling from the vehicle, clearly the cause of the ensuing accident, and essentially never present in a non-accident population. Another example is that of a driver falling asleep and getting into an accident. While there may be drivers in the non-accident population who are actually asleep, there seems to be no simple way to measure this reliably because the measurement process would require that the driver be disturbed.

On the statistical inference side, a recent example is the identification of drivers with short-term experience with a particular company as overrepresented in the BMCS accident files. Nearly half of the serious accidents reported in BMCS data for 1977 involved commercial vehicle drivers with less than two years experience with the company they were working for at the time of the accident. In this case there were no parallel exposure data available, and the inference that inexperienced drivers are an accident cause is based on someone's concept that most drivers have more experience than this. The availability of exposure information containing this factor would be helpful.[4] The point is that this overrepresentation of such inexperienced drivers could not easily be discovered in a single accident investigation, but may show up strongly in the statistical comparison of accident and exposure groups.

Within limits it is possible to use the accident data alone to make some statistical comparisons. In effect one may use a portion of the accident data to represent an exposed population--a sort of "induced" exposure method. In a recent study of BMCS data it was possible to compute the relative frequency of rollover for conventional box trailers as a function of the total vehicle weight (taken as a surrogate for the height of the center of gravity of the trailer). Rollovers were very infrequent for empty or lightly-loaded trailers, but occurred in about 15% of those cases in which the truck was fully loaded, leading to the inference that high centers of gravity may be a "cause" of that type of accident. By contrast the occurrence of jackknifes was nearly the inverse of this, occurring in lightly but not in heavily loaded trailers.

Both the case-study and statistical inference methods should be useful in determining causes of truck accident involvement. Fortunately there is a large set of detailed accident investigation material available from previous studies, and some reliance will be placed on this for the case study method. With respect to the inference method, exposure and accident data sets must be available with as much detail as possible (for example, the experience of the driver with the present firm).

---

[4] NHTSA has issued a request for proposal for further study of this finding, with the hope that some countermeasures might be developed if this cause can be better identified.

SECTION 7

PROGRAM PLANS

In this section several elements of a plan to acquire the exposure and accident data necessary to this program are presented. In addition, the nature of the analysis activity required will be discussed. The summary and schedule of the programs discussed will be presented in Section 8.

National Accident Data

As noted in Section 3, several sets of accident data drawn nationally are available. The FARS data have the advantage of rather complete coverage, but lack the detail implied by the prospectus. The BMCS data have the advantage of detail, but come from a poorly defined population and thus may not represent the nation well. The effort to acquire a new sample of national data would be very large, and in time the NASS program may provide this. But for the present it is appropriate to find ways to use the existing data.

The proposed method for doing this involves supplementing the FARS cases which are not duplicated in the BMCS files by a survey. During the past year FARS and BMCS data from 1976 and 1977 accident years have been merged. For the most recent year approximately half of the large truck fatal accident involvements in FARS are matched by a BMCS report; the remaining half either were not required to report to BMCS or failed to do so. As a part of HSRI's study of the 121 braking system, selected FARS truck accident cases were followed up by telephone and mail to add new data to the FARS file (in this case information concerning the brake system, the type of service, etc.). Contact was made through NHTSA with individual states, and the original accident report forms were retrieved.

For the present program we plan to use essentially the same process, but to complete as well as possible the information on the BMCS form for all of those (fatal accident) cases which are not presently available in the BMCS files. This would then form a rather complete set of fatal accident information with a high level of detail on vehicle configuration, cargo, etc. for comparison with national exposure data.

Additionally it is expected that followup of some FARS-identified cases can be done in the same manner. For example, FARS currently does not differentiate between doubles and triples (coding both as "multiple combinations"), but the total number of such cases is about 150 in a single year. For this subset or others retrieval of the original accident reports (and possibly telephone interviews) should provide the necessary detail to count triple vs. double involvement in fatal accidents at the national level.

In our 121 surveys we were able to obtain hard copy reports of accidents for about 90% of the cases sought, and this would make the combined BMCS-FARS data very useful in answering questions about fatal accident frequency relative to vehicle style. One option which should be noted is the possibility of limiting this task to combination vehicles. Straight trucks are less well defined (by size, etc.), and are involved in a relatively small proportion of the fatal accidents. The cost of getting data on these may be nearly as great as for the combination vehicles. Costs have been estimated from our previous experience in telephone followups as about $10.00 per case--based on an average $4.00 telephone call and an hour of telephonist's time. It should be noted that the followup process requires good cooperation from the NHTSA (which provides the initial FARS information), from the states, and ultimately from the vehicle owners. While this was achieved in the 121 study, it is necessary to spend some effort in making arrangements for such a program, and the total costs reflect our estimate of this.

National Exposure

The chief source of national exposure data (for commercial vehicles) will be the 1977 Truck Inventory and Use Survey, due to be released in computerized form by the Census Bureau early in 1980. These data, described briefly in Section 4 and in Appendix D, have more detail than did the 1972 or 1967 surveys, and should be more or less directly comparable with many elements of the combined BMCS-FARS data.

In addition to direct comparisons across variables in the accident and TIU data, the richness of the TIU file should permit the creation of many derived variables. For example, combinations of usual cargo class, weight class, and mileage may allow computation of an estimate of ton-miles for various vehicle categories. Such procedures will be a part of the analysis activities of the project, and will, of course, depend on the final quality of the data.

Cost of acquiring these data will be small, but it will be necessary to build it into a working file at the University of Michigan. As a part of this process codebooks will be published and the data will be generally available through the ADAAS system. Since this is quite a large set of data, analyses will be relatively expensive, but not prohibitive.

Of particular importance is the fact that the TIU data will be able to represent individual states with some precision. It will represent the larger states better--California and Texas, for example, had the largest sample size in the TIU survey. For those variables which are included, this will probably be the most useful data source for comparison with state accident files.

FHWA mileage data is another source of national exposure information which better reports mileage by road type, but is not as complete in vehicle type. Road type has been shown to be a major explanatory variable in previous studies (for example, in Hedlund's analysis of crash severity and truck weight), and the FHWA data should be useful in considering such factors. Printed FHWA reports contain less detail than must be available in the working files, and it will be helpful to this program to have the cooperation of FHWA in obtaining more detailed analyses of exposure with respect to road type, vehicle type, state or region of the country, etc.

Accident and Other Data at the State Level

While the FARS-BMCS data will provide adequate information to compute rates at the national level for fatal accidents, and for a limited population perhaps for BMCS-reported accidents, it will not be sufficient for some of the more detailed comparisons desired. This would include measurements of accident rate for triples, and perhaps even for doubles. For these reasons, it is intended that state-level accident data will be sought from several states.

The TIU exposure information has been collected in such a manner as to represent the individual states, and, for the variables covered, should be useful for comparison with state accident data files. On the other hand, states typically categorize commercial vehicles without fine detail, and such characteristics as cab style, trailer length, number of axles, etc., are not ordinarily found in police reports. The tentative plan is to augment existing state file by one or another kind of followup of reported accidents. Either of these might be considered "bilevel" activities, one being a police bilevel in which the reporting officer completes an additional form about the accident, the other a later followup by mail or telephone similar to that planned for the FARS/BMCS work discussed above.

The choice of states for such further investigations will depend on the sort of factors shown in Table 7.1. The presence of a sufficient number of truck types of interest, the completeness of the state accident report form, the potential for implementing a bilevel study, the size of the TIU sample of large trucks in that state, etc., are all important. HSRI presently has Michigan, Texas, and Washington police-level data in computerized form for at least the past five years, and is making arrangements under another program to acquire New York State data. Collection of additional accident or exposure data within these or other states, however, is not planned for fiscal year 1980 program, and actual selection of states for such work is not made at this time.

Analysis Methods

The discussion of analysis methods presented in Section 5 emphasized the need for more sophisticated analysis techniques than have typically been employed in the compilation of traffic accident statistics. The development and specification of the appropriate models and techniques must be a part of the design process. We propose to develop the models and analysis techniques described in Section 5 so as to maximize the validity and utility of the information produced by the data collection activities described above. This analytical work is seen as essential to an accurate interpretation of the complex interactions of the many exposure factors present.

Table 7.1

State Sources of Accident and Exposure Information

State or Jurisdiction	Special Vehicle Types	Exposure Data Available	Accident Data Form	Bilevel Potential	TIU Survey Useful	Size of State	FHWA Mileage Data	BMCS Reports Complete	Percent Accidents in State
Michigan .	Heavy	0	+	+	+	+	-	0	+
Texas . .	?	+	+	+	+	+	+	0	0
Washington	Triples	?	+	?	0	0	+	0	0
Utah . . .	Triples	?	?	+	0	0	?	+	0
Nevada . .	Triples	?	?	?	0	0	?	+	?
California	Doubles	?	?	?	++	+	?	0	+
New York .	Doubles	?	+	?	+	+	?	0	?
Tennessee	?	+	?	?	0	0	+	+	?
Turnpikes	Doubles	++	+	+	--	0	-	0	NA

Coded entries are:
+ Above Average
0 Average
- Below Average
? Status to be determined
NA Not applicable

Support from Various Agencies

The planned program needs the cooperation and support of many persons and agencies. In some instances this may be as simple as a willingness to talk and direct investigators to the right place. In other instances considerable effort may be required. In this subsection the major support needs will be discussed.

Among the federal agencies, the primary need is for early availability of data and assistance in interpreting information. The major effort in matching BMCS files with FARS would benefit greatly from periodic building of BMCS accident tapes, something which in the past has occurred only annually. If possible, quarterly updates of these would be desired. NHTSA's FARS data should also be acquired with the same frequency, and these are currently available. FHWA mileage estimates by road type and by state are not currently in published form, and we would hope to be able to get such information in greater detail from FHWA's Washington office. Case studies from NASS and BMCS will be necessary as a part of the accident causation analysis, and cooperation of those agencies in furnishing such reports to the project is necessary.

It is intended that this project produce frequent and usable reports. It is hoped that each of the agencies listed above will consider such reports important. Perhaps the promise of this will aid cooperation.

The heavy dependence on information from individual states will require good contact with persons in the states who control access to data. While we currently have good working agreements with regard to accident data in several major states, any new additions will be aided by making the proper contacts. In this regard it is expected that assistance from ATA (or state Trucking Associations) and WHI would be helpful. Support of the project conceptually by such organizations as the AAMVA would be important.

SECTION 8

SCHEDULE

For planning purposes the proposed program is divided into three time periods. The first of these is the last half of fiscal year 1980, beginning in December of 1979 or January of 1980 and continuing through June. Depending on availability of funds, efforts in this period will include (1) the acquisition of the major national data files, and preparation of them for use in analysis, (2) the design and startup of a followup survey to augment the FARS data with BMCS-like details, (3) formulation of final plans for state-level data acquisition, and consummation of agreements with selected states, (4) analysis of existing data sets and preparation of a major publication of descriptive statistics, and (5) publication and distribution of selected codebooks of truck accident information.

It is particularly important to begin the FARS followup work as soon as possible, since we have current contacts with most of the states which should not be allowed to cool. NHTSA cooperation will be necessary in providing access to the FARS data for case identification, but it will probably be better for actual arrangements with most of the states to be made directly between the University and the state. Overall it is intended that the BMCS/FARS data merge be accomplished for at least the 1977, 1978, and 1979 accident years, and these three years should be completed over a period of about two years in the schedule.

It is also important to make selections and agreements with particular states for acquisition of future data. The process of of contacting several states and many agencies within each state will be time-consuming, involve considerable travel, and will require the participation of senior staff. The process of getting such data from states means that state agencies will be providing much time and effort--often without full compensation. Support from a variety of agencies will be indispensable--including FHWA regional offices, state trucking associations (and the ATA), and perhaps insurance carriers and the AAMVA. Smooth operation in collection of state data should involve some quid pro quo, and the data produced within this program are expected to be published in a variety of forms which may be directly useful to state officials. There should be attention to this aspect of the arrangements.

During the second and third periods additional national accident data will be acquired, and further merges of the BMCS and FARS files will be accomplished. The major field effort during the middle period will be in collection of state accident and exposure information, but the exact nature of this activity cannot be defined until the cooperation of selected states is assured and funding limitations are known.

Tables 8.1, 8.2, and 8.3 show respectively the defined tasks. The analysis effort includes much of the early planning and sample designs, as well as the development of multivariate analysis techniques to be used in the study. The national accident data collection and enhancement has been discussed above, and will continue throughout most of the program. The state-level data will partly come from historical files of accident information currently available at HSRI, but the new or supplemental information is expected to cover some one-year period within each chosen state.

Table 8.1

TRUCK ACCIDENT ANALYSIS PROGRAM
Tasks and Schedules

Task	Schedule FY 1980 Q3	FY 1980 Q4	FY 1981 Q1	FY 1981 Q2	FY 1981 Q3	FY 1981 Q4	FY 1982 Q1	FY 1982 Q2	FY 1982 Q3	FY 1982 Q4
1. Develop Methodological Foundation										
a. Identify Variables and Interactions . .										
Accidents										
Exposure										
Traffic Models										
b. Extend Multivariate Techniques to the combination of accident and exposure data										
Identify Data requirements										
c. Develop and Implement Analysis Software										
2. Application to Data Collected										
a. National										
b. State										
3. Reports		+		+		+		+		+

Table 8.2

NATIONAL TRUCK ACCIDENT AND EXPOSURE DATA PROGRAM
Tasks and Schedules

Task	Schedule									
	FY 1980		FY 1981				FY 1982			
	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1. Maintain 1976-1978 FARS										
2. Maintain 1976-1977 BMCS										
3. Merge 1977 BMCS/1977 FARS . . .										
4a. Identify unmerged cases . . .										
4b. Acquire cases from states . .										
4c. Design/Print data forms . . .										
4d. Conduct telephone/mail survey										
4e. Merge with (3)										
5a. Acquire/build 1978 BMCS data .										
5b. Acquire/build 1979 BMCS data .										
6. Acquire/build 1979 FARS data .										
7. Repeat tasks 3,4 for new data .										
8. Maintain 121 exposure data . .										
9. Build 1972 TIU Digital File . .										
10a. Acquire 1977 TIU Tapes . . .										
10b. Build working files at HSRI .										
11a. Examine FHWA exposure methods										
11b. Acquire FHWA exposure data .										
12. Acquire NASS truck cases . . .										
13. Maintain Truck CPIR Files . .										

Table 8.3

STATE TRUCK ACCIDENT AND ANALYSIS PROGRAM
Tasks and Schedules

Task	Schedule									
	FY 1980		FY 1981				FY 1982			
	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1. Planning for State Data Acquisition	———	———								
2a. Continue acquisition of state accident data	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
2b. Acquire new state accident data			———	———	———	———				
3. Build (subset) TIU data for each state . . .			———	———	———	———				
4. Institute bilevel or followup procedures . .					———	———	———	———		
5. Conduct new exposure survey within states .					———	———	———	———		
6. Acquire passenger car exposure data					———	———	———	———		

APPENDIX A

Research Prospectus Prepared by MVMA/WHI Committee

SAFETY ASPECTS OF HEAVY TRUCKS

BACKGROUND

The key truck safety issues of concern to truck manufacturers and users are: the effect of weight, length, and configuration on safety; the incidence of, and countermeasures for, fires, underride, the potential benefit of enhanced conspicuity; and the available space, comfort and ride quality, and their effect on safety and driver health.

OBJECTIVE

To undertake a study which will determine the comparative accident experience (incidence in relation to total exposure) of trucks and single, double, and triple trailer combination vehicles.

PHASE I

APPROACH

A. The following questions need to be answered through collection and analysis of existing data to meet the objectives of the study:

1. What are the accident involvement rates per 100 million vehicle miles, and 100 million ton/volume-miles for the various vehicle configurations?

2. What are the fatality and injury rates per 100 million vehicle miles, and 100 million ton/volume-miles for the various vehicle configurations:
   a) by accident count?
   b) by vehicle count?
   c) by occupant count?

3. What portion of the population of classes 6, 7, and 8 does each configuration represent?

4. What portion of the overall vehicle population (all trucks and automobiles) does each configuration represent?

5. What are the accident causation factors for each vehicle configuration and accident situation?

6. What conclusions can be drawn concerning potentially effective countermeasures?

B. A reporting format to obtain data to support the answers shall be developed by the contractor. The data shall be reported in a matrix format for lay understanding (see examples). The data elements required shall be those contained on the conventional BMCS accident report form and supplemented by the following:

I. Vehicles - GVWR Classes 6, 7, and 8 ((>20,000 lbs.)
   a. Types or configurations:
      1. COE tractor and single trailer
      2. CBE tractor and single trailer
      3. COE tractor and twin 27-ft trailer combination
      4. CBE tractor and twin 27-ft trailer combination
      5. COE tractor and triple 27-ft trailer combination
      6. CBE tractor and triple 27-ft trailer combination
      7. COE straight truck
      8. CBE straight truck
      9. COE straight truck and full trailer
      10. CBE straight truck and full trailer
      11. Level 1 data on passenger car, light truck, MPV's and other vehicles
   b. Length
      1. Trailer length(s)
      2. Combination overall length
      3. Bumper to Back-of-Cab(BBC)
   c. Weight
      1. Tractor GVWR
      2. Truck GVWR
      3. Combination GCW
      4. Axles - GVWR actual
      5. Cargo weight at time of accident
         -truck
         -1st trailer
         -2nd trailer
         -3rd trailer
   d. Body Type
      1. Dry Box (a van box for carrying freight)
      2. Refrigerated Box
         a. Swinging Beef
         b. Other Movable Cargo
      3. Tank
         a. Baffled or Unbaffled
         b. Petroleum, Milk, Liquids of like Density and Viscosity
         c. Heavy Liquids, as Acids
         d. High Viscosity Liquids, as Asphalt
      4. Flat Beds
      5. Special, as Cattle or Car Hauler, etc.
   e. Location of 5th Wheel-inches forward/rearward of centerline of rear axle/tandem
   f. Combination of Axle Arrangements
   g. Local or Out-of-State

II. Causal Factors
   a. Highway
      1. System (i.e., Interstate, primary, secondary)
      2. Urban-rural

3. Number of lanes (each direction)
4. Highway route number
5. Type of surface
6. Dry, wet, icy

b. Environment
   1. Visibility factors
      a. night
      b. day
      c. fog
      d. rain
      e. snow
      f. clear
      g. etc.
   2. Terrain
      a. level
      b. uphill
      c. downhill
      d. curve
      e. straight

c. Equipment
   1. Was there evidence of a vehicle equipment related failure? What system? Component?
   2. Was vehicle overloaded?
   3. Was vehicle under special permit?
   4. Type of cargo?
   5. Was safety equipment in use (chains, etc.)?
   6. Was vehicle configurations a factor?
   7. Were lighting systems functioning? Effectiveness?
   8. Was vehicle conspicuity a factor?

d. Driver
   1. Proper license
   2. Medical card
   3. Fell asleep
   4. Judgment error
   5. Intoxicated
   6. Etc.

e. Accident
   1. Type of collision
   2. Type of non-collision
   3. Type of impact
      a. struck other vehicle
      b. struck by other vehicle
      c. struck fixed object (abutment, etc.)
   4. Jackknife
      a. tractor (truck)
      b. semitrailer
      c. full trailer
         1. first
         2. second
   5. Underride, Override - Side, Rear
   6. Fire

7. Area of damage to all vehicles in accident

f. Carrier
   1. ICC regulated
      a. for-hire
      b. private
      c. exempt
      d. owner-operator
   2. State regulated
      a. for-hire
      b. private
      c. exempt
      d. owner-operator
   3. Type of trip
      a. over-the-road
      b. pickup and delivery

In addition to the above, the truck version of the Collision Performance and Injury Report will be reviewed by MVMA/WHI to determine if the Report contains additional data elements which should be included.

C. An examination of existing data/reports will be required by the contractor. Sources could include: carriers, DOT, insurance companies, HSRI, Calspan, MVMA etc., States and the Truck Inventory and Use Survey.

Statistical information shall be compiled, using the following accident selection criteria: A fatality or injury requiring treatment away from accident scene, and/or property damage greater than $2,000, and/or other vehicle towaway:

1. Accident period - all applicable vehicles during 1975, 1976, and 1977
2. Accident rate - number/100 million miles and 100 million/ton/volume-miles
3. Fatality rate - number/100 million miles and 100 million ton/volume-miles
4. Injury/severity rates - number/100 million miles and 100 million ton/volume-miles
5. Sample size

D. A comparison shall be made of available data with that of the expressed needs of the sponsor. As an interim step, the Contractor will assess and report whether existing data are sufficient to answer the questions with statistical confidence.

E. A recommendation from the Contractor shall be included in the final report for further data collection and/or analyses based on the findings.

The report shall also include a summary of findings, conclusions, and a synopsis of the study.

APPENDIX B

Selected Variables for Accidents Involving
Tractor Trailers
in the 1976-1978 FARS Files

FARS Data for 1976-1978

The following Tables give the distribution in percent for several selected variables of the Fatal Accident Reporting System (FARS) files for 1976-1978. Only those accidents (fatal) which involve tractor-trailer combinations for 1976, or tractors only and tractor-trailer combinations for 1977 and 1978, are included.

Tables 1-4 are derived from accident files, hence they include one case for each fatal accident that involves at least one of the vehicle configurations described above.

Tables 5 and 6 contain one case for every such vehicle. Thus the numbers of vehicles in Tables 5 and 6 are greater than the numbers of accidents in Tables 1-4.

Tables 7 and 8 contain one case for each fatally injured occupant of the heavy vehicle described above. Since the fatalities in large-truck accidents are more often the occupants of passenger cars, the number of fatally injured passengers is much lower than the number of fatal accidents of Tables 1-4.

Note that while the number of fatal accidents involving heavy vehicles has risen from 3242 in 1976 to 3999 in 1978, there are relatively small differences in the proportionate distributions for the variables shown.

TABLE 1

FATAL ACCIDENTS BY TRAFFICWAY CLASS--1976-1978

TRAFFICWAY CLASS	1976	1977	1978
INTERSTATE	19.4%	22.6%	22.5%
OTHER LIMITED ACCESS	2.0%	1.1%	1.1%
OTHER U.S. ROUTE . .	31.6%	30.8%	30.4%
OTHER STATE ROUTE .	32.3%	31.6%	32.2%
OTHER MAJOR ARTERY .	0.8%	1.1%	1.4%
COUNTY ROAD	5.7%	4.9%	4.7%
LOCAL STREET	7.6%	6.7%	6.0%
OTHER ROAD	0.6%	0.4%	0.5%
UNKNOWN	0.1%	0.3%	1.2%
TOTAL NO. OF ACC. .	3242	3577	3999

TABLE 2

FATAL ACCIDENTS BY MANNER OF COLLISION--1976-1978

MANNER OF COLLISION	1976	1977	1978
NOT APPLICABLE .	27.7%	26.0%	26.9%
REAR-END	14.7%	17.8%	15.5%
HEAD-ON	19.3%	19.6%	19.5%
REAR-TO-REAR . .	0.1%	0.1%	0.3%
ANGLE	32.6%	30.3%	30.1%
SIDESWIPE	5.5%	6.1%	7.6%
UNKNOWN	0.2%	0.1%	0.2%
TOTAL NO. OF ACC.	3242	3577	3999

TABLE 3

FATAL ACCIDENTS BY LIGHT CONDITIONS--1976-1978

LIGHT CONDITIONS	1976	1977	1978
DAYLIGHT	55.2%	55.7%	53.4%
DARK	34.3%	33.6%	34.4%
DARK BUT LIGHTED	6.5%	7.2%	7.9%
DAWN OR DUSK . .	3.9%	3.5%	4.2%
UNKNOWN	0.1%	0.1%	0.1%
TOTAL NO. OF ACC.	3242	3577	3999

TABLE 4

FATAL ACCIDENTS BY WEATHER CONDITION--1976-1978

WEATHER/ATMOSPHERE	1976	1977	1978
CLEAR	78.7%	71.1%	71.1%
RAIN	10.1%	10.5%	10.9%
SLEET	0.4%	0.3%	0.6%
SNOW	3.0%	3.4%	3.2%
FOG,SMOKE,SAND,DUST	2.7%	2.8%	2.8%
HEAVY OVERCAST* . .	2.9%	10.7%	10.8%
OTHER	1.8%	0.4%	0.4%
UNKNOWN	0.2%	0.2%	0.3%
TOTAL NO. OF ACC. .	3242	3577	3999

* The coding definition for this item changed from "heavy overcast" to "cloudy" between 1976 and 1977.

TABLE 5

INITIAL IMPACT POINT FOR LARGE TRUCKS
INVOLVED IN FATAL ACCIDENTS--1976-1978

INITIAL IMPACT POINT	1976	1977	1978
NON-COLLISION . . .	5.6%	4.3%	3.2%
1 O'CLOCK	7.5%	7.1%	7..6%
2 O'CLOCK	1.6%	2.7%	2.3%
3 O'CLOCK	3.5%	4.0%:	4.2%
4 O'CLOCK	0.9%	0.9%	1.3%
5 O'CLOCK	1.0%	1.8%	1.6%
6 O'CLOCK	7.3%	9.1%	7.7%
7 O'CLOCK	2.0%	2.5%	2.3%
8 O'CLOCK	2.0%	2.0%	2.1%
9 O'CLOCK	4.2%	4.4%	4.5%
10 O'CLOCK	1.8%	1.8%	1.9%
11 O'CLOCK	8.5%	7.9%	9.9%
12 O'CLOCK	50.2%	48.1%	46.8%
TOP	0.6%	0.4%	0.7%
UNDERCARRIAGE . . .	2.2%	2.1%	2.6%
UNKNOWN	1.0%	1.1%	1.4%
TOTAL NO. OF TRUCKS	3418	3788	4231

TABLE 6

EXTENT OF DEFORMATION FOR LARGE TRUCKS
INVOLVED IN FATAL ACCIDENTS--1976-1978

EXTENT OF DEFORMATION	1976	1977	1978
NONE	7.0%	5.5%	6.6%
MINOR	15.7%	16.6%	15.8%
FUNCTIONAL(MODERATE)	17.8%	18.9%	21.6%
DISABLING(SEVERE) .	56.0%	57.7%	54.5%
UNKNOWN	3.2%	1.3%	1.5%
TOTAL NO. OF TRUCKS	3418	3788	4231

TABLE 7

SEATING POSITION FOR FATAL OCCUPANTS OF LARGE TRUCKS--1976-1978

SEATING POSITION	1976	1977	1978
DRIVER	82.8%	83.9%	83.8%
MIDDLE FRONT	1.3%	0.9%	0.4%
RIGHT FRONT	9.3%	8.0%	9.8%
SLEEPER	2.6%	3.3%	2.6%
OTHER PASSENGERS . . .	0.8%	0.3%	1.0%
RIDING ON EXTERIOR . .	0.6%	1.2%	0.7%
UNKNOWN	2.5%	2.4%	1.6%
TOTAL NO. OF OCCUPANTS	831	920	971

TABLE 8

EJECTION FOR FATAL OCCUPANTS OF LARGE TRUCKS--1976-1978

EJECTION	1976*	1977	1978
NOT EJECTED	50.4%	66.5%	64.7%
TOTALLY EJECTED . . .	25.6%	28.0%	29.5%
PARTIALLY EJECTED . .	4.3%	4.3%	4.5%
UNKNOWN	19.6%	1.1%	1.3%
TOTAL NO. OF OCCUPANTS	831	920	971

* The coding of this variable changed after 1976 from a combined ejection and extrication count to ejection alone. The unknown group in 1977 probably comes mainly from unknown extrications.

APPENDIX C

Selected Variables of the 1976-1977 BMCS Accident Files

The following tables give the distributions in percent for several selected variables of the BMCS data files. These tables are intended to be exemplary of the data in these files, and allow a brief comparison of distributions between 1976 and 1977.

TABLE 1

TYPE OF CARRIER FOR 1976-1977 BMCS-REPORTED ACCIDENTS

TYPE OF CARRIER	YEAR OF ACCIDENT	
	1976	1977
PRIVATE . . .	19.5%	19.1%
ICC AUTHORIZED	78.2%	79.6%
OTHER	1.8%	1.3%
MISSING DATA .	0.4%	0.0%
TOTAL NUMBER .	26,006	29,442

TABLE 2

TYPE OF DISTRICT FOR 1976-1977 BMCS-REPORTED ACCIDENTS

TYPE OF DISTRICT	1976	1977
RESIDENTIAL . . .	8.3%	7.7%
RURAL	58.8%	60.4%
PRIMARILY BUSINESS	32.7%	31.8%
MISSING DATA . . .	0.3%	0.1%
TOTAL NUMBER . . .	26,006	29,442

TABLE 3

WEATHER CONDITIONS FOR 1976-1977 BMCS-REPORTED ACCIDENTS

WEATHER	1976	1977
RAIN	14.0%	15.4%
CLEAR	67.6%	63.7%
SNOW	6.8%	8.3%
FOG/SMOG . . .	1.9%	1.9%
CLOUDY/OVERCAST	7.0%	7.2%
SLEET	0.6%	0.6%
OTHER	0.7%	0.8%
MISSING DATA .	1.5%	2.0%
TOTAL NUMBER .	26,006	29,442

TABLE 4

LIGHT CONDITIONS FOR 1976-1977 BMCS-REPORTED ACCIDENTS

LIGHT CONDITIONS	1976	1977
DAY	59.5%	59.4%
ARTIFICIAL LIGHTS	2.2%	3.0%
DAWN	4.2%	4.3%
OTHER	0.1%	0.1%
DUSK	3.3%	3.6%
DARK	29.8%	29.1%
MISSING DATA . .	0.8%	0.6%
TOTAL NUMBER . .	26,006	29,442

TABLE 5

COLLISION TYPE FOR 1976-1977 BMCS-REPORTED ACCIDENTS

COLLISION TYPE	1976	1977
NON-COLLISION	25.3%	25.3%
COLLISION WITH MOVING OBJECT	60.1%	58.8%
COLLISION WITH FIXED OBJECT	14.6%	15.9%
MISSING DATA	0.0%	0.0%
TOTAL NUMBER	26,006	29,442

TABLE 6

OTHER OBJECT INVOLVED FOR 1976-1977 BMCS-REPORTED ACCIDENTS

OTHER OBJECT	1976	1977
NOT APPLICABLE .	25.3%	25.3%
COMMERCIAL TRUCK	13.9%	14.6%
FIXED OBJECT . .	7.7%	7.4%
AUTOMOBILE . . .	43.4%	43.1%
PEDESTRIAN . . .	1.7%	1.4%
BUS	0.5%	0.5%
TRAIN	1.0%	1.0%
BICYCLE	0.5%	0.3%
ANIMAL	0.6%	0.5%
MOTORCYCLE . . .	0.8%	0.8%
OTHER	4.2%	5.1%
MISSING DATA . .	0.0%	0.0%
TOTAL NUMBER . .	26,006	29,442

TABLE 7

NON-COLLISION TYPE FOR 1976-1977 BMCS-REPORTED ACCIDENTS

NON-COLLISION TYPE	1976	1977
RAN-OFF-ROAD	12.7%	9.6%
JACKKNIFE	3.4%	4.7%
OVERTURN	7.0%	8.4%
SEPARATION OF UNITS . . .	0.3%	0.3%
FIRE	0.9%	0.8%
LOSS OR SPILLAGE OR CARGO	0.3%	0.4%
CARGO SHIFT	0.3%	0.3%
OTHER	0.4%	0.8%
NOT APPLICABLE(COLLISION)	74.6%	74.7%
MISSING DATA	0.1%	0.0%
TOTAL NUMBER	26,006	29,442

TABLE 8

VEHICLE COMBINATION FOR 1976-1977 BMCS-REPORTED ACCIDENTS

COMBINATION	1976	1977
STRAIGHT TRUCK	10.4%	9.7%
STRAIGHT TRUCK W. TRAILER	1.5%	1.6%
TRACTOR ONLY	3.3%	4.4%
TRACTOR, TRAILER	80.2%	79.7%
TRACTOR, TWO TRAILERS . .	2.8%	2.6%
TRACTOR, THREE TRAILERS .	1.5%	1.4%
OTHER, MISSING DATA . . .	0.2%	0.6%
TOTAL NUMBER	26,006	29,442

TABLE 9

NUMBER KILLED IN TRUCK FOR 1976-1977 BMCS-REPORTED ACCIDENTS

NUMBER KILLED	1976	1977
NONE	98.2%	98.1%
1	1.7%	1.7%
2	0.2%	0.2%
MORE THAN 2	0.0%	0.0%
TOTAL NUMBER KILLED	527	657

APPENDIX D

Truck Inventory and Use Survey Forms
for 1972 and 1977 Surveys

APPENDIX A. Facsimile of Questionnaire

O.M.B. No. 41-S71078; Approval Expires December 31, 1973

FORM TC-200 (9-29-71) U.S. DEPARTMENT OF COMMERCE BUREAU OF THE CENSUS

1972 CENSUS OF TRANSPORTATION TRUCK INVENTORY AND USE SURVEY

NOTICE – Response to this inquiry is required by law (Title 13, U.S. Code). By the same law, your report to the Census Bureau is confidential. It may be seen only by sworn Census employees and may be used only for statistical purposes. The law also provides that copies retained in your files are immune from legal process.

INSTRUCTIONS [1]

In correspondence pertaining to this report, please include State and license number.

Return the form in the enclosed pre-addressed postage-paid envelope not later than 15 days after receipt to:

Bureau of the Census
ATT: Transportation Division
Washington, D.C. 20233

(Please correct any error in name and address including ZIP code) [2]

Item 1 – VEHICLE IDENTIFICATION

Please correct any errors or omissions in the identification of the vehicle.

Make	Year model	Registered weight or capacity	State	License No.
[3]	[4]	[5]		

NOTE: Please complete this form whether or not you are still the owner of the vehicle identified in item 1.

Item 2 – OWNERSHIP OF VEHICLE [6]

Are you still the owner (or license holder) or lessee of this vehicle?

1 ☐ Yes

2 ☐ No
└ When did you sell, trade, or otherwise dispose of it? ...... Month and year ______

Item 3 – ACQUISITION OF VEHICLE [7]

How did you acquire this vehicle?

1 ☐ Purchased new

2 ☐ Purchased used – *Specify year purchased* → ______

3 ☐ Leased from someone else

Item 4 – BASE OF OPERATION

a. What was the principal place from which the vehicle was operated?

City or town ______

County [8] ______ State [9] ______

b. Was this vehicle operated almost entirely in the State named in 4a? [10]

1 ☐ Yes

2 ☐ No

Item 5 – VEHICLE MILES

ANNUAL MILES

a. What are the total miles this vehicle was driven during the past 12 months?. . . Miles [11] ______

If vehicle was idle for the year enter "None." If less than 12 months, estimate probable miles for a year.

LIFE TIME MILES

b. What are the total miles this vehicle has been driven since new? .... Miles [12] ______

Give speedometer (odometer) reading or if not indicated by speedometer, give your best estimate.

Item 6 – LEASED TO OTHERS WITHOUT DRIVER [13]

During the past 12 months, did you use this vehicle MOSTLY for leasing or renting (without driver) to others?

1 ☐ No – *Go to item 7 on page 2*

2 ☐ Yes – Was this vehicle usually leased or rented for: [14]

1 ☐ Less than 30 days? – *Go to item 9*

2 ☐ 30 days or longer? – *Go to item 7*

Please continue on page 2

Item 7 – MAJOR USE OF THE TRUCK OR COMBINATION 15

How was the vehicle mostly used during the past 12 months? *(Mark (X) one box)*

If the vehicle was leased to someone else (without driver) for periods of 30 days or more, mark (X) ONE box that describes the business of the person or company to whom you leased the vehicle the longest time.

01 ☐ Own farm or ranch or other agricultural activity
02 ☐ In forestry or lumbering
03 ☐ In mining or quarrying
04 ☐ In construction, buildings or roads
05 ☐ In manufacturing or processing
06 ☐ In wholesale and/or retail
07 ☐ For-hire transportation – Includes trucking services known as drayage, local cartage, household goods movers, common or contract motor carriers, commercial motor carriers, leased with driver, "owner-operators" under lease or contract.
08 ☐ For personal transportation – Used in place of an automobile to go from home to work; for outdoor recreation; camping; fishing; etc.
09 ☐ In utilities – telephone, electric, gas, etc.
10 ☐ In services – hotel, automobile repair, laundry, funeral services, advertising, plumbing repair, etc.

11 ☐ Other – If none of the above applies to the use you make of the vehicle, describe the main use of the vehicle here.

____

Item 8 – PRINCIPAL PRODUCTS CARRIED 16

Mark (X) ONE box which indicates product usually carried by this vehicle.

01 ☐ Farm products (fruit, grain, livestock, poultry, dairy products, florist and nursery products, etc.)
02 ☐ Mining products
03 ☐ Logs and other forest products
04 ☐ Processed foods (dressed meat, beverages, tobacco, etc.)
05 ☐ Textile mill products, including apparel and leather goods, etc.
06 ☐ Building materials (lumber, millwork, sand, gravel, glass, concrete, etc.)
07 ☐ Household goods (moving)
08 ☐ Furniture or hardware (not including household goods moving)
09 ☐ Paper products, including printing and publishing products
10 ☐ Chemicals or related products (including drugs, paints, fertilizers, etc.)
11 ☐ Petroleum or petroleum products
12 ☐ Primary metal products (ingot, billets, pipes, sheets, etc.)
13 ☐ Fabricated metal products except machinery and transportation equipment
14 ☐ Machinery except electrical
15 ☐ Electrical machinery, equipment, and supplies, including household appliances
16 ☐ Transportation equipment (motor vehicles, trailers, boats, motorcycles, etc.)
17 ☐ Scrap, refuse, and garbage
18 ☐ Mixed cargos
19 ☐ Used mainly for personal transportation or as a service vehicle such as a "traveling workshop" or is equipped with a crane, compressor, etc.)
20 ☐ Other – *Describe*

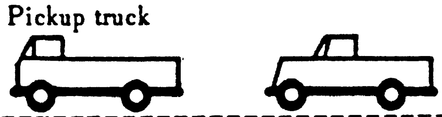
____

Item 9 – PICKUP, PANEL, MULTI-STOP OR WALK-IN

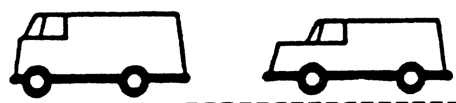
a. Does this truck have a pickup, panel, multi-stop or walk-in body? 17

1 ☐ No
2 ☐ Yes – *Mark (X) the box in front of illustration of type and answer "b" and "c"* 18

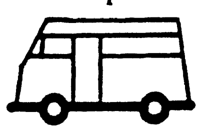
1 ☐ Pickup truck



2 ☐ Panel truck



3 ☐ Multi-stop or walk-in



b. Does this pickup, panel, multi-stop or walk-in truck have 4-wheel drive? 19

1 ☐ Yes
2 ☐ No

c. Is this pickup, panel, multi-stop or walk-in truck equipped with a camper body or other special camping equipment? 20

1 ☐ Yes
2 ☐ No

Please continue below

Item 10 – GROSS VEHICLE WEIGHT

21

Mark (X) ONE box that is nearest the maximum gross weight (empty weight of vehicle plus carried load) at which this truck or combination was operated during the past 12 months.

01 ☐ 6,000 or less	06 ☐ 19,501 to 26,000	11 ☐ 60,001 to 70,000
02 ☐ 6,001 to 10,000	07 ☐ 26,001 to 32,000	12 ☐ 70,001 to 80,000
03 ☐ 10,001 to 14,000	08 ☐ 32,001 to 40,000	13 ☐ 80,001 to 100,000
04 ☐ 14,001 to 16,000	09 ☐ 40,001 to 50,000	14 ☐ 100,001 to 130,000
05 ☐ 16,001 to 19,500	10 ☐ 50,001 to 60,000	15 ☐ 130,001 and over

Item 11 – TYPE AND SIZE OF BODY

Mark (X) ONE box to describe the type of body of the truck or combination. If the power unit is a truck-tractor, report body type of the combination most frequently used with the power unit.

Mark (X) ONE box to indicate length of load space or capacity. If two or more trailing units, (X) box for combined length or capacity.

BODY TYPE (22)	(23)
01 ☐ Pickup, panel, multi-stop, walk-in 02 ☐ Platform with added devices – such as feed, fertilizer, lime or water spreader; dumping device, etc. 03 ☐ Other platform – including stake, grain, flatbed, low bed, depressed center, etc. 04 ☐ Cattle rack (hogs, calves, and other livestock) 05 ☐ Insulated non-refrigerated van 06 ☐ Insulated refrigerated van 07 ☐ Furniture van 08 ☐ Open top van 09 ☐ All other enclosed vans 10 ☐ Beverage 11 ☐ Utility (body equipped for mobile repair and service, e.g., telephone line truck, electrical utility, etc.) →	Length of load space (feet) 01 ☐ Under 10 02 ☐ 10 and less than 13 03 ☐ 13 and less than 16 04 ☐ 16 and less than 20 05 ☐ 20 and less than 28 06 ☐ 28 and less than 36 07 ☐ 36 and less than 41 08 ☐ 41 or more
12 ☐ Garbage or refuse collector 13 ☐ Winch or crane, other than wrecker 14 ☐ Wrecker 15 ☐ Pole or logging 16 ☐ Auto transport →	*Do not specify body size for these types.*
20 ☐ Dump truck or combination →	Capacity of dump (water level without side boards) (cubic yards) 21 ☐ Under 5 · 24 ☐ 10 to 11.9 · 27 ☐ 18 to 19.9 22 ☐ 5 to 6.9 · 25 ☐ 12 to 14.9 · 28 ☐ 20 to 29.9 23 ☐ 7 to 9.9 · 26 ☐ 15 to 17.9 · 29 ☐ 30 or more
30 ☐ Tank truck or combination (for liquids) →	Liquid capacity of tank (gallons) 31 ☐ Less than 1,000 · 35 ☐ 4,000 to 5,999 32 ☐ 1,000 to 1,999 · 36 ☐ 6,000 to 7,999 33 ☐ 2,000 to 2,999 · 37 ☐ 8,000 to 11,999 34 ☐ 3,000 to 3,999 · 38 ☐ 12,000 or more
40 ☐ Tank truck or combination (for dry bulk) →	Dry bulk capacity (cubic feet) 41 ☐ Less than 300 · 44 ☐ 900 to 1,199 42 ☐ 300 to 599 · 45 ☐ 1,200 to 1,499 43 ☐ 600 to 899 · 46 ☐ 1,500 or more
50 ☐ Concrete mixer →	Capacity of mixer (cubic yards) 51 ☐ Less than 6 · 54 ☐ 8 to 8.9 · 57 ☐ 11 to 11.9 52 ☐ 6 to 6.9 · 55 ☐ 9 to 9.9 · 58 ☐ 12 or over 53 ☐ 7 to 7.9 · 56 ☐ 10 to 10.9
60 ☐ Other body types – (If the above descriptions do not satisfactorily describe your vehicle, please enter identifying body type and size or capacity.) →	

FORM TC-200 (9-29-71)

Please continue on page 4

APPENDIX A—Continued

Item 12 – VEHICLE TYPE 24

Is this vehicle a single unit truck or is it a truck-tractor?

1 ☐ Single unit truck 2 ☐ Truck-tractor

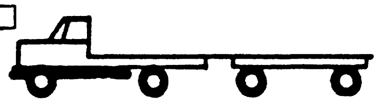
Item 13 – AXLE ARRANGEMENT 25

Mark (X) ONE box that illustrates the AXLE ARRANGEMENT of this truck or truck-tractor with the trailing unit most frequently used with the power unit.

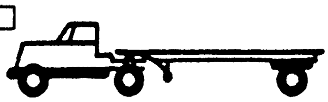
1 ☐

2 ☐

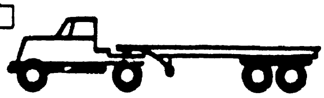
3 ☐



4 ☐

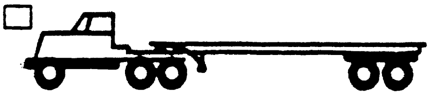


5 ☐

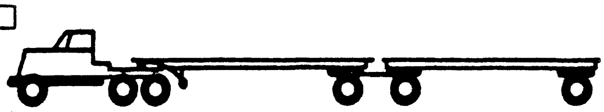


6 ☐

7 ☐



8 ☐



9 ☐ If none of the above applies, please indicate total number of axles on:

	Total axles
Truck or truck-tractor	
Trailing unit(s)	

Item 14 – POWERED AXLES 26

How many driving (powered) axles does this vehicle have? *Report tandem axles as two axles.*

1 ☐ One 3 ☐ Three
2 ☐ Two 4 ☐ Four or more

Item 15 – CAB TYPE 27

Does this vehicle have a tilt cab?

1 ☐ Yes 2 ☐ No

Item 16 – TYPE OF FUEL 28

What type of fuel is used with this vehicle?

1 ☐ Gasoline 2 ☐ Diesel 3 ☐ LPG or other

Item 17 – MAINTENANCE 29

When MAJOR repairs were needed on this vehicle, were they usually done by:

1 ☐ **Yourself?**
2 ☐ **Truck dealer or factory branch?**
3 ☐ **Own repair shop (set up specifically for maintenance)?**
4 ☐ **Independent garage?**
5 ☐ **Other?** – *Describe* ____________________

____

Item 18 – AREA OF OPERATION 30

Where was this vehicle MOSTLY operated?

Mark (X) ONE box only.

1 ☐ **Mostly in the local area** (in or around the city and suburbs, or within a short distance of the farm, factory, mine, or place vehicle is stationed).

2 ☐ **Mostly over-the-road** (beyond the local area) but usually not more than 200 miles one way to the most distant stop from the place vehicle is stationed.

3 ☐ **Mostly over-the-road trips** that usually are more than 200 miles one way to the most distant stop from place the vehicle is stationed.

Item 19 – NUMBER OF TRUCKS, TRUCK-TRACTORS AND TRAILERS OPERATED FROM "BASE OF OPERATIONS"

How many trucks, truck-tractors and trailers are you operating from the base named in item 4 on page 1? *Report total number including the vehicle which you described on this questionnaire.*

	Total	
Pickups, panels, multi-stops or walk-ins		31
Other trucks		32
Truck-tractors		33
Trailers (semi- and full trailers) .		34

Item 20 – Name of person to contact regarding this report	Address *(Number and street, city, State, ZIP code)*	Telephone *(Area code, number, extension)*

CERTIFICATION – This report is substantially accurate and has been prepared in accordance with instructions.

Item 21 – Signature of person preparing this report	Title	Date

APPENDIX E. Public-Use Computer Tape Contents

To accommodate data users, a special public-use tape has been prepared for the Truck Inventory and Use Survey—one of the surveys of the 1972 Census of Transportation. The tape contains essentially the complete detail for each truck in the sample, except that a few items of information were deleted in order not to reveal the identity or activities of an individual or firm. The tape contains a record for each of approximately 100,000 vehicles in the national sample, by State of registration, for each of the 50 States and the District of Columbia.

Detailed information contained in the public-use-tape layout is described below. Industry-compatible copies of this tape may be ordered through the Data User Services Office, Bureau of the Census, Washington, D.C. 20233. Inquiries relating to the tape contents and use should be directed to the Transportation Division, Bureau of the Census.

Item	Number of positions in layout	Item	Number of positions in layout
1. State of registration	2	15. Principal products carried	2
2. Census serial number (not license number of truck)	4	16. Small-truck description:	
3. Make-of-vehicle code	1	a. Pickup, panel, multistop, or walk-in	2
4. Year model	2	b. 4-wheel drive	1
5. Registered weight	6	c. Camper equipment	1
6. Ownership (owned or leased)	1	17. Gross-vehicle-weight code	2
7. Sold (if sold prior to survey):		18. Body-type code	2
a. Month	2	19. Body-size code	2
b. Year	2	20. Vehicle type (single unit or truck-tractor)	1
8. Acquisition (new or used)	1	21. Axle-arrangement code	1
		22. Number of powered axles	1
9. Year purchased if used	2	23. Tilt cab or not	1
10. Base of operations:		24. Fuel type	1
a. State operated	2	25. Maintenance source	1
b. Production area[1]	2	26. Area-of-operations code	1
c. Intrastate	1	27. Fleet size (at same base):	
11. Miles (thousands):		a. Number of pickups	3
a. Annual	3	b. Number of others	3
b. Lifetime	3	c. Number of truck-tractors	3
12. Leased or not	1	d. Number of trailers	3
13. Time leased if leased	1	28. Vehicle size class	1
14. Major use	2	29. Expansion factor (to universe level)	6

[1]These 27 areas were selected to represent relatively compact geographic concentration of manufacturing activity below the State level. Each consists of one Standard Metropolitan Statistical Area (SMSA) or more which makes possible comparisons between these data and economic and demographic statistics available from other sources.

☆ U. S. GOVERNMENT PRINTING OFFICE : 1974 O - 532-388

1977 TIU Questionnaire, Page 1

DUE DATE 15 D[illegible] AFTER RECEIPT OF FORM | Form Approved: O.M.B. Number [illegible] 075

FORM [illegible] | U.S. DEPARTMENT OF COMMERCE BUREAU OF THE CENSUS

TRUCK INVENTORY AND USE SURVEY

1977 CENSUS OF TRANSPORTATION

NOTICE – Response to this inquiry is required by law (title 13, U.S. Code). [illegible] your report to the Census Bureau is confidential. It may be seen only by [illegible] and may be used only for statistical purposes. The law also provides that copies retained in your files are immune from legal process.

In correspondence pertaining to this report, please refer to this control number

INSTRUCTIONS

In correspondence pertaining to this report, please include State and license number and the control number shown in the address label.

Return the form in the enclosed preaddressed envelope not later than 15 days after receipt.

RETURN TO: Bureau of the Census, 1201 East Tenth Street, Jeffersonville, Indiana 47132

(Please correct any error in name and address including ZIP code)

Section A – VEHICLE IDENTIFICATION AND USE

Item 1 – VEHICLE IDENTIFICATION *(Please correct any errors or omissions in the identification of the vehicle)*

Make	Year of model	Registered weight or capacity	State	License number	Vehicle identification number

NOTE: Please complete this form whether or not you are still the owner of the vehicle identified in item 1.

Item 2 – OWNERSHIP OF VEHICLE

Are you still the owner (or license holder) or lessee of this vehicle?

1 ☐ Yes

2 ☐ No → **When did you sell, trade, or otherwise dispose of it?** → Month ___ Year ___

Item 3 – ACQUISITION OF VEHICLE

a. How did you acquire this vehicle?

1 ☐ Purchased new

2 ☐ Purchased used

3 ☐ Leased from someone else

b. When did you acquire this vehicle? → Month ___ Year ___

c. During past 12 months was this vehicle leased or rented to others?

1 ☐ Yes

2 ☐ No

d. How was this vehicle leased or rented?

1 ☐ Without driver

2 ☐ With driver (or as owner operator)

Item 4 – LEASE CHARACTERISTICS

a. Was the lessee –

1 ☐ **Private (non-government)?**

2 ☐ **Unit of government?**

b. What is the length of lease or rental agreement?

1 ☐ Less than 30 days

2 ☐ 30 days to 1 year

3 ☐ 1–3 years

4 ☐ More than 3 years

c. Does your agreement include –

1 ☐ **Financing?**

2 ☐ **Maintenance?**

3 ☐ **Procurement and sale?**

Item 5 – CLASSIFICATION OF OPERATOR

Mark (X) the box which is the most appropriate for your type of operation

Not for hire –

1 ☐ **Private owner or an individual, or company** which just transports its own materials or merchandise. Includes an individual or a business such as a bakery, oil company, or soft drink bottler.

For hire –

2 ☐ **Interstate** – exempt carrier (not required to have an I.C.C. certificate because only exempt commodities are transported, such as: fresh agricultural products, fish, newspapers, or air freight haulage)

3 ☐ **Interstate** – I.C.C. certified contract carrier (carrying the goods of other than the owner by individual contract or agreement)

4 ☐ **Interstate** – I.C.C. certified common carrier (offering service to the general public, usually operating a regularly scheduled service between established terminals over a more or less regular route)

5 ☐ **Intrastate** – operating only within the State of registration (including local cartage, hauling between locations in the same town, city, or suburb)

Item 6 – MAJOR USE OF THE TRUCK OR COMBINATION

How was the vehicle mostly used during the past 12 months? *Mark (X) ONE box*

If the vehicle was leased to someone else mark (X) ONE box that describes the business of the person or company to whom you leased the vehicle the longest time.

01 ☐ On farm or ranch, or other agricultural activity

02 ☐ In forestry or lumbering

03 ☐ In mining or quarrying

04 ☐ In construction – buildings, or roads

05 ☐ In manufacturing, refining, or processing

06 ☐ In wholesale trade

07 ☐ In retail trade

08 ☐ For hire transportation – mixed or general cargo

09 ☐ In utilities – telephone, electric, gas, etc.

10 ☐ In services – hotel, automobile repair, laundry, funeral services, advertising, plumbing, refuse collection, repair, etc.

11 ☐ Daily rental or short term lease, without driver

12 ☐ For personal transportation – used in place of an automobile to go from home to work, for outdoor recreation, camping, etc.

13 ☐ Other – If none of the above [illegible] the [illegible] use of the vehicle, describe the main use of the vehicle here

Item 7 – PRODUCTS CARRIED

a. Principal products carried during past 12 months

Mark (X) ONE box which indicates products usually carried by this vehicle

01 ☐ Farm products (crops and fruits, raw milk, etc.)

02 ☐ Live animals (horses, livestock, poultry or other animals)

03 ☐ Mining products

04 ☐ Logs and other forest products

05 ☐ Processed foods (dressed meat, beverages, dairy products, etc.) or tobacco

06 ☐ Textile mill products including apparel and leather goods, etc.

07 ☐ Building materials (lumber, millwork, sand, gravel, glass, concrete, etc.)

08 ☐ Household goods (moving)

09 ☐ Furniture or hardware (not including household goods moving)

10 ☐ Paper products, including printing and publishing products

11 ☐ Chemicals or related products, including drugs, paints, fertilizers, etc.

12 ☐ Petroleum or petroleum products

13 ☐ Primary metal products (ingots, billets, pipes, sheets, etc.)

14 ☐ Fabricated metal products (except machinery and transportation equipment)

15 ☐ Machinery, except electrical

16 ☐ Electrical machinery, equipment, and supplies, including household appliances

17 ☐ Transportation equipment (motor vehicles, trailers, boats, motorcycles, etc.)

18 ☐ Scrap, refuse, or garbage

19 ☐ Mixed cargoes

20 ☐ Craftsman's vehicle, such as plumbers, carpenters, "traveling workshops," etc.

21 ☐ Special equipment such as a crane, compressor, winch, drilling rigs, etc.

22 ☐ No products carried (personal transportation)

23 ☐ Other – *Describe*

b. Secondary product carried (if applicable)

Of the list above, what would you consider to be the secondary product most carried by this vehicle? → Code No. ___

Item 8 – HAZARDOUS MATERIALS

a. Was this truck (or combination) used to haul hazardous materials during the past 12 months in quantities large enough to require a placard under the Code of Federal Regulations, Title 49, Transportation?

2 ☐ No – *SKIP to item 9*

1 ☐ Yes – *Continue with b*

b. Approximately what percent of the time was this unit used to haul hazardous materials?

1 ☐ Less than 25%

2 ☐ 25–49%

3 ☐ 50–74%

4 ☐ 75–100%

Section B – OPERATIONAL CHARACTERISTICS

Item 9 – BASE OF OPERATION

a. What was the principal place from which this vehicle was operated?

City or town ___

County ___ State ___

b. What percentage of the miles traveled by this vehicle was within the State named in item 9a?

1 ☐ Below 25%

2 ☐ 25–49%

3 ☐ 50–74%

4 ☐ 75–100%

Item 10 – NUMBER OF TRUCKS, TRUCK-TRACTORS AND TRAILERS OPERATED FROM "BASE OF OPERATION"

How many trucks, truck-tractors and trailers are you operating from base named in item 9a?

	Total number
a. Pickups, vans (panels), multi-stops	
b. Other straight trucks	
c. Truck tractors	
d. Trailers (semi- and full trailers)	

CONTINUE ON REVERSE SIDE

Section B – OPERATIONAL CHARACTERISTICS – Con.

Item 11 – AREA OF OPERATION

Where was this vehicle mostly operated?
Mark (X) ONE box only

1 ☐ Mostly in the local area (in or around the city and suburbs or within a short distance of the farm, factory, mine, or place vehicle is stationed)
2 ☐ Mostly over-the-road (beyond the local area) but not usually more than 200 miles one way to the most distant stop from the place vehicle is stationed
3 ☐ Mostly over-the-road trips that are usually more than 200 miles one way to the most distant stop from the place the vehicle is stationed
4 ☐ Mostly off-the-road operations as is usually associated with construction and farming operations

Item 12 – VEHICLE MILES AND MILES PER GALLON

ANNUAL MILES

a. What are the total miles this vehicle was driven during the past 12 months? *(If vehicle was idle for the year, enter "None." If owned less than 12 months, estimate probable miles for a year.)* .... Miles

LIFETIME MILES

b. What are the total miles this vehicle has been driven since new? *(Give speedometer (odometer) reading or, if not indicated by speedometer, give your best estimate.)* ..... Miles

MILES PER GALLON

c. What was the average miles per gallon you received from this vehicle? .... Miles per gallon

d. Is the figure entered in 12c above measured or estimated?
1 ☐ Measured from records 2 ☐ Estimated

Item 13 – MAINTENANCE

a. Was major maintenance (nonroutine) performed on the following equipment of this vehicle during the past 12 months?
1 ☐ Engine
2 ☐ Transmission
3 ☐ Braking system
4 ☐ Rear axle and differential
5 ☐ None of the above

b. By whom was this major maintenance performed –
1 ☐ Yourself or own repair shop (set up specifically for maintenance)?
2 ☐ Truck dealer?
3 ☐ Factory branch?
4 ☐ Leasing company?
5 ☐ Independent garage?
6 ☐ Other – Describe

Section C – PHYSICAL CHARACTERISTICS

Item 14 – GROSS WEIGHT
Mark (X) ONE box that is nearest the maximum gross weight in pounds (empty weight of vehicle plus carried load) at which this truck or combination was operated during the past 12 months. (If straight truck report GVW, if combination, report GCW.)

01 ☐ 6,000 or less	08 ☐ 33,001 to 40,000
02 ☐ 6,001 to 10,000	09 ☐ 40,001 to 50,000
03 ☐ 10,001 to 14,000	10 ☐ 50,001 to 60,000
04 ☐ 14,001 to 16,000	11 ☐ 60,001 to 80,000
05 ☐ 16,001 to 19,500	12 ☐ 80,001 to 100,000
06 ☐ 19,501 to 26,000	13 ☐ 100,001 to 130,000
07 ☐ 26,001 to 33,000	14 ☐ 130,001 and over

Item 15 – TYPE AND SIZE OF ENGINE

a. Type of engine
Mark (X) ONE box that describes the type of engine used in this vehicle.
1 ☐ Gasoline 2 ☐ Diesel 3 ☐ LPG or other

b. Size of engine
Mark (X) ONE box that describes the number of cylinders in the engine used in this vehicle.
1 ☐ Four 2 ☐ Six 3 ☐ Eight 4 ☐ Other

c. What is the displacement of the engine in cubic inches? → Cubic inches

d. What is the horsepower rating of your engine? → Horsepower

Item 16 – TYPE OF TRANSMISSION
Mark (X) ONE box that describes the type of transmission used in this vehicle.
1 ☐ Manual 2 ☐ Automatic 3 ☐ Semiautomatic

Item 17 – TYPE OF BRAKING SYSTEM

a. *Mark (X) ONE box that describes the type of braking system used in this vehicle*
1 ☐ Hydraulic 2 ☐ Air 3 ☐ Other

b. Does this system also include the new anti-wheel lock device?
1 ☐ Yes 2 ☐ No

Item 18 – POWER STEERING

Does this vehicle have power steering?
1 ☐ Yes 2 ☐ No

Item 19 – FUEL CONSERVATION EQUIPMENT

Does this vehicle have the following equipment?
Mark (X) ALL applicable items
1 ☐ Radial tires
2 ☐ Drag reduction device (on top of cab)
3 ☐ Variable speed fan (clutch type)
4 ☐ Fuel efficient engine (RPM reduction), etc.
5 ☐ Axle or drive ratio change

Item 20 – AIR CONDITIONING

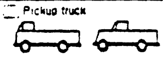
Is this vehicle air conditioned?
1 ☐ Yes 2 ☐ No

Section C – PHYSICAL CHARACTERISTICS – Con.

Item 21 – TYPE AND SIZE OF BODY
Indicate both body type and body size

BODY TYPE (a) — *Mark (X) ONE box to describe the type of the truck or combination. If the power unit is a truck-tractor, report body type of the combination most frequently used with the power unit.*

LENGTH OF LOAD SPACE OR CAPACITY (b) — *Mark (X) ONE box to indicate length of load space or capacity. If two or more trailing units, mark (X) for combined length or capacity.*

01 ☐ Pickup truck

02 ☐ Panel truck or van

03 ☐ Multi-stop or walk-in


Length of load space (Feet)
01 ☐ Less than 7 feet
02 ☐ 7 and less than 10
03 ☐ 10 and less than 13
04 ☐ 13 and less than 16
05 ☐ 16 and less than 20
06 ☐ 20 and less than 28
07 ☐ 28 and less than 36
08 ☐ 36 and less than 41

a. Does this pickup, panel, multi-stop or walk-in truck have 4-wheel drive?
1 ☐ Yes 2 ☐ No

b. What is the number of axles on vehicle?
1 ☐ Two 2 ☐ Three

c. Is this pickup, panel, multi-stop or walk-in truck equipped with a –
1 ☐ Slide in camper?
2 ☐ Pickup shell cover?
3 ☐ Camper body?
4 ☐ None of above
Mark (X) Col. (b) and SKIP to item 26

04 ☐ Platform with added devices; such as spreaders, dumpers, lifts, etc.
05 ☐ Low boy or depressed center
06 ☐ Other platform – including grain flatbed, high bed, stake
07 ☐ Cattle rack (hogs, calves, and other livestock)
08 ☐ Insulated non-refrigerated van
09 ☐ Insulated refrigerated van
10 ☐ Furniture van
11 ☐ Open top van
12 ☐ All other enclosed vans
13 ☐ Beverage
14 ☐ Utility (body equipped for mobile repair and service, e.g., telephone line truck, electric utility, etc.)
15 ☐ Winch or crane other than wrecker (including roll on, roll off)
16 ☐ Wrecker
17 ☐ Pole or logging
18 ☐ Auto transport
19 ☐ Boat transport
20 ☐ Mobile home pullers

01 ☐ Less than 7 feet
02 ☐ 7 and less than 10
03 ☐ 10 and less than 13
04 ☐ 13 and less than 16
05 ☐ 16 and less than 20
06 ☐ 20 and less than 28
07 ☐ 28 and less than 36
08 ☐ 36 and less than 41
09 ☐ 41 and less than 45
10 ☐ 45 and less than 73
11 ☐ 73 or more

30 ☐ Garbage or refuse hauler
31 ☐ Front loader
32 ☐ Rear loader packer
33 ☐ Roll off

Capacity size (Cubic yds.)
31 ☐ Less than 20
32 ☐ 20 to 25
33 ☐ 26 and over

40 ☐ Dump truck or combination

Capacity of dump (water level without side boards) (Cubic yards)
41 ☐ Under 5
42 ☐ 5 to 6.9
43 ☐ 7 to 9.9
44 ☐ 10 to 11.9
45 ☐ 12 to 14.9
46 ☐ 15 to 17.9
47 ☐ 18 to 19.9
48 ☐ 20 to 29.9
49 ☐ 30 or more

50 ☐ Tank truck or combination (for liquids)

Liquid capacity of tank (Gallons)
51 ☐ Less than 1,000
52 ☐ 1,000 to 1,999
53 ☐ 2,000 to 2,999
54 ☐ 3,000 to 3,999
55 ☐ 4,000 to 5,999
56 ☐ 6,000 to 7,999
57 ☐ 8,000 to 11,999
58 ☐ 12,000 or more

60 ☐ Tank truck or combination (for dry bulk)

Dry bulk capacity (Cubic feet)
61 ☐ Less than 300
62 ☐ 300 to 599
63 ☐ 600 to 899
64 ☐ 900 to 1,199
65 ☐ 1,200 to 1,499
66 ☐ 1,500 or more

70 ☐ Concrete mixer
71 ☐ Front discharger
72 ☐ Rear discharger

Capacity of mixer (Cubic yards)
71 ☐ Less than 6
72 ☐ 6 to 6.9
73 ☐ 7 to 7.9
74 ☐ 8 to 8.9
75 ☐ 9 to 9.9
76 ☐ 10 to 10.9
77 ☐ 11 to 11.9
78 ☐ 12 or over

90 ☐ Other body types – If the above descriptions do not satisfactorily describe your vehicle, enter identifying body type and size or capacity.

Section C – PHYSICAL CHARACTERISTICS – Con.

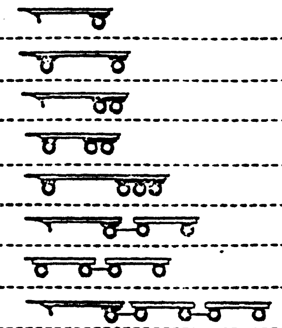
Item 22 – POWERED AXLES
How many driving (powered) axles does this vehicle have?
Report power of tandem axles as two axles
1 ☐ One 2 ☐ Two 3 ☐ Three 4 ☐ Four

Item 23 – VEHICLE TYPE
Mark (X) ONE box which best describes your vehicle

Single unit truck
1 ☐ Two axle
2 ☐ Three axle
3 ☐ Other
SKIP to item 25

Truck tractor
4 ☐ Two axle
5 ☐ Three axle
6 ☐ Other
Continue with item 24

Item 24 – AXLE ARRANGEMENT OF TRAILER UNITS
Mark (X) ONE box that illustrates the axle arrangement of the trailer unit most frequently used with the power unit.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐


9 ☐ If none of the above applies, please indicate total number of axles and trailing units → Total axles | Total trailing units

Item 25 – CAB TYPE

a. *Mark (X) ONE box that illustrates the cab type of the power unit.*

1 ☐ Cab forward of engine

2 ☐ Cab over engine

3 ☐ Short hood conventional

4 ☐ Medium hood conventional

5 ☐ Long hood conventional

6 ☐ Other – Describe

b. Is this cab equipped with a sleeper unit?
1 ☐ Yes 2 ☐ No

Remarks

Item 26 – PERSON TO CONTACT REGARDING THIS REPORT

Name

Address *(Number and street, city, State, ZIP code)*

Telephone → Area code | Number | Extension

Fleet number of vehicle

Item 27 – CERTIFICATION

This report is substantially accurate and has been prepared in accordance with instructions.

Signature

Title | Date