MARTIN MARIETTA ENERGY SYSTEMS LIBRARIES

3 4456 0328590 5

ORNL/TM-11278

OAK RIDGE NATIONAL LABORATORY

MARTIN MARIETTA

Estimating Commercial Truck VMT of Interstate Motor Carriers: Data Evaluation

Patricia S. Hu
Tommy Wright
Shaw-Pin Miaou
Dennis J. Beal
Stacy C. Davis

OAK RIDGE NATIONAL LABORATORY
CENTRAL RESEARCH LIBRARY
CIRCULATION SECTION
4500N ROOM 175
LIBRARY LOAN COPY
DO NOT TRANSFER TO ANOTHER PERSON
If you wish someone else to see this report, send in name with report and the library will arrange a loan.

OPERATED BY
MARTIN MARIETTA ENERGY SYSTEMS, INC.
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

This report has been reproduced directly from the best available copy.

Available to DOE and DOE contractors from the Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, TN 37831; prices available from (615) 576-8401, FTS 626-8401.

Available to the public from the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Rd., Springfield, VA 22161.
NTIS price codes—Printed Copy: A09, Microfiche A01

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

ORNL/TM-11278

ENERGY DIVISION

ESTIMATING COMMERCIAL TRUCK VMT OF INTERSTATE MOTOR CARRIERS: DATA EVALUATION

Patricia S. Hu
Tommy Wright
Shaw-Pin Miaou*
Dennis J. Beal*
Stacy C. Davis*

* University of Tennessee, Knoxville, Tennessee

Date Published - November 1989

Prepared for
The Office of Motor Carriers
Federal Highway Administration
Department of Transportation

Prepared by
Oak Ridge National Laboratory
Oak Ridge, Tennessee 37831
operated by
MARTIN MARIETTA ENERGY SYSTEMS, INC.
for the
U. S. DEPARTMENT OF ENERGY
under Contract No. DE-AC05-84OR21400

MARTIN MARIETTA ENERGY SYSTEMS LIBRARIES

3 4456 0328590 5

CONTENTS

Page

LIST OF TABLES vii

LIST OF FIGURES ix

ACKNOWLEDGEMENTS xi

EXECUTIVE SUMMARY xiii

1. INTRODUCTION 1

1.1 BACKGROUND 1
1.2 PARAMETERS OF INTEREST 2
1.2.1 Parameters at the State Level 4
1.2.2 Parameters at the National Level 7
1.3 DATA SOURCES 7

2. TRUCK INVENTORY AND USE SURVEY (TIUS) 11

2.1 GENERAL INFORMATION 11
2.2 SAMPLE DESIGN 11
2.2.1 Target Population 11
2.2.2 Sampling Frame 11
2.2.3 Sample Selection: A Stratified Random Sample 12
2.2.4 Sample Size Determination 12
2.3 SURVEY METHOD 16
2.3.1 Data Collection Procedure 16
2.3.2 Editing and Imputation Procedures 17
2.3.3 Response Rates 18
2.4 ESTIMATION PROCEDURE 18
2.5 EVALUATION RESULTS 18
2.5.1 Limitations 20
2.5.2 Strengths 21

3. NATIONWIDE TRUCK ACTIVITY AND COMMODITY SURVEY (NTACS) . . 23

3.1 GENERAL INFORMATION 23
3.2 SAMPLE DESIGN 23
3.2.1 Target Population 23
3.2.2 Sampling Frame 23
3.2.3 Sample Selection: A Stratified Two-Phase Three-Stage Design 25
3.2.4 Sample Size Determination 25
3.3 SURVEY METHOD 29
3.3.1 Data Collection Procedure 29
3.3.2 Response Rate 29

3.4 ESTIMATION PROCEDURE 29
3.5 EVALUATION RESULTS 30
3.5.1 Limitations 30
3.5.2 Strengths 30

4. NATIONAL TRUCK TRIP INFORMATION SURVEY (NTTIS) 33

4.1 GENERAL INFORMATION 33
4.2 SAMPLE DESIGN 34
4.2.1 Target Population 34
4.2.2 Sampling Frame 34
4.2.3 Sample Selection: A Stratified Two-Stage Cluster Design 34
4.2.4 Sample Size Determination 36
4.3 SURVEY METHOD 36
4.3.1 Data Collection Procedure 36
4.3.2 Editing and Imputation Procedures 39
4.3.3 Response Rate 40
4.4 ESTIMATION PROCEDURE 40
4.4.1 Estimation Procedure for Number of Trucks 40
4.4.2 Estimation Procedure for VMT 40
4.5 EVALUATION RESULTS 41
4.5.1 Limitations 41
4.5.2 Strengths 42

5. HIGHWAY PERFORMANCE MONITORING SYSTEM (HPMS) 45

5.1 GENERAL INFORMATION 45
5.2 SAMPLE DESIGN 45
5.2.1 Target Population 45
5.2.2 Sampling Frame 46
5.2.3 Sample Selection: A Stratified Probability Proportional to Size Design . 50
5.2.4 Sample Size Determination 50
5.3 SURVEY METHOD 51
5.3.1 Data Collection Procedure 51
5.3.2 Response Rate 55
5.4 ESTIMATION PROCEDURE 55
5.5 EVALUATION RESULTS 56
5.5.1 Limitations 56
5.5.2 Strengths 58

6. STATE FUEL TAX REPORTS 59

6.1 GENERAL INFORMATION 59
6.2 SAMPLE DESIGN 65
6.2.1 Target Population 65
6.2.2 Sampling Frame 65

6.2.3 Sample Selection 65
6.2.4 Sample Size Determination 65
6.3 SURVEY METHOD 65
6.3.1 Data Collection Procedure 65
6.3.2 Response Rate 66
6.4 ESTIMATION PROCEDURE 66
6.5 EVALUATION RESULTS 66
6.5.1 Limitations 66
6.5.2 Strengths 68

7. INTERNATIONAL REGISTRATION PLAN (IRP) 71

7.1 GENERAL INFORMATION 71
7.2 SAMPLE DESIGN 75
7.2.1 Target Population 75
7.2.2 Sampling Frame 75
7.2.3 Sample Selection 75
7.2.4 Sample Size Determination 75
7.3 SURVEY METHOD 75
7.3.1 Data Collection Procedure 75
7.3.2 Response Rate 76
7.4 ESTIMATION PROCEDURE 76
7.5 EVALUATION RESULTS 76
7.5.1 Limitations 77
7.5.2 Strengths 78

8. SUMMARY OF EVALUATION RESULTS 81

8.1 ABILITY TO ESTIMATE PARAMETERS AT THE STATE LEVEL 81
8.1.1 TIUS 84
8.1.2 NTACS 85
8.1.3 IRP 85
8.1.4 NTTIS 85
8.1.5 HPMS 86
8.1.6 State Fuel Tax Reports 86

8.2 ABILITY TO ESTIMATE PARAMETERS AT THE NATIONAL LEVEL . . . 86
8.2.1 TIUS 87
8.2.2 NTACS 87
8.2.3 IRP 89
8.2.4 NTTIS 89
8.2.5 HPMS 89
8.2.6 State Fuel Tax Reports 90
8.3 COMPARISONS OF DATA SOURCES 90
8.4 CONCLUSIONS 93

APPENDIX 1. A NUMERICAL EXAMPLE OF HOW THE SAMPLE SIZE WAS DETERMINED FOR THE 1987 TRUCK INVENTORY AND USE SURVEY A1

APPENDIX 2. 1987 CENSUS OF TRANSPORTATION, TRUCK INVENTORY AND USE SURVEY, SURVEY FORMS TC-9501 AND TC-9502 . . A2

APPENDIX 3. NATIONWIDE TRUCK ACTIVITY AND COMMODITY SURVEY, FORM NTACS-2 . . . . . A3

APPENDIX 4. QUESTIONNAIRE FOR NTTIS, PHASES ONE AND TWO A4

APPENDIX 5. CONVERSION OF VEHICLE CLASSIFICATION DATA TO AXLE CORRECTION FACTORS A5

APPENDIX 6. MILEAGE AND DAILY TRAVEL SUMMARY, PARTS ONE AND TWO A6

APPENDIX 7. SUMMARY OF LOCAL FUNCTIONAL CLASS MILEAGE BY SURFACE TYPE AND TRAFFIC VOLUME GROUP A7

APPENDIX 8. TRAVEL ACTIVITY BY VEHICLE TYPE AND FUNCTIONAL CLASS A8

APPENDIX 9. INFORMATION ON STATES THAT COULD PROVIDE VEHICLE MILES TRAVELED A9

APPENDIX 10. INTERNATIONAL REGISTRATION PLAN APPLICATION FORM, SCHEDULES A, B, AND C A10

GLOSSARY G-1

LIST OF TABLES

Table Page

1.1 VMT of Trucks Operating in Interstate Commerce and with GVWR > 10,000 lbs 5

1.2 Average VMT per Truck Operating in Interstate Commerce and with GVWR > 10,000 lbs 6

1.3 Data Availability, Data Collection Frequency and Method, and Data Coverage of Each of the Six Data Sources 9

4.1 Frame Totals and Sample Sizes for the NTTIS 37

5.1 HPMS Vehicle Types 47

6.1 Special Motor Fuel State Tax Provisions for Interstate Motor Carriers 60

7.1 International Registration Plan Members and/or Western Prorate Agreement Members 72

7.2 VMT Estimates of Alabama-Based Motor Carriers, by Jurisdiction and Business Type, 1988 80

8.1 Truck Types Included in Different Data Sources 82

8.2 Data Accessibility of Each of the Six Data Sources 83

8.3 Estimated Number of Trucks Operating in Interstate Commerce and the Associated VMT from 1982 TIUS Public Use Tape (For Hire Interstate and Polks GVWR > 10K Pounds) 88

8.4 VMT and Number of Trucks (1982 TIUS and HPMS; 1983 NTTIS) 91

8.5 Trend Variations of the Average Annual Medium/Heavy Truck Mileage from 1978 to 1987 96

LIST OF FIGURES

Figure Page

2.1 TIUS Simple Random Selection of Trucks from Each Stratum in Each State 13

2.2 Data Availability by State, by Carrier Type from TIUS 19

3.1 Sampling Frame for NTACS 24

3.2 Nine Divisions in NTACS 26

3.3 Stratification Design of the 1987 TIUS Sample Respondents for Selection of the 1989 NTACS Sample 27

3.4 Data Availability by State, by Carrier Type from NTACS 32

4.1 NTTIS Simple Random Selection of Trucks from Each Stratum in Each State 35

4.2 The Sample Allocation for the NTTIS Over Time 38

4.3 Data Availability by State, by Carrier Type from NTTIS 43

5.1 Sampling Frame for HPMS 49

5.2 Outline of HPMS Sample Data Preparations 52

5.3 HPMS Traffic Count and Vehicle Classification Collection Process 53

5.4 Data Availability by State, by Carrier Type from HPMS 57

6.1 Data Availability by State, by Carrier Type from Fuel Tax Report 67

6.2 Shares of Medium/Heavy Trucks (GVW > 10K) by Fuel Type, 1977-1987 69

7.1 Data Availability by State, by Carrier Type from IRP 79

ACKNOWLEDGEMENTS

The authors would like to express their gratitude to the following individuals who provided invaluable contributions in the preparation of this technical memorandum. First, we would like to thank Bob Gorman and the staff of the Office of Motor Carriers in the Federal Highway Administration (FHWA), U. S. Department of Transportation for their support of this project. Next, we would like to thank a panel of reviewers at the FHWA who carefully reviewed a draft of this memorandum and who provided us with extremely constructive comments: Bonnie Bass, Doug McKelvey, Rolf Schmitt, and Ed Kashuba.

In addition, we would like to acknowledge the assistance of Norman Goss of the Alabama State Department of Transportation for providing us with Alabama's IRP data; of Bonnie Brothers, Sheila Cunningham, and Roy Smith of the Tennessee State Department of Transportation who clarified many questions regarding the HPMS and the IRP; of Kent Campbell and Dan Blower of the University of Michigan in providing data and information on the NTTIS, of Eric Marr of R. L. Polk and Company who provided input in addressing the duplicate registration issue; of Ann Wakim and Joe Garrett of the Bureau of the Census who furnished TIUS' and NTACS' documents; and of the Office of Highway Information Management in the FHWA in providing the most recent documents and reports on the HPMS procedures. Finally, this memorandum would not have been possible without Jonnie Sorenson who formatted the manuscript.

EXECUTIVE SUMMARY

This memorandum summarizes the evaluation results of six data sources in terms of their ability to estimate the number of commercial trucks operating in interstate commerce and their vehicle miles of travel (VMT) by carrier type and by state. The six data sources are:

(1) Truck Inventory and Use Survey (TIUS) from the Bureau of the Census,

(2) Nationwide Truck Activity and Commodity Survey (NTACS) from the Bureau of the Census,

(3) National Truck Trip Information Survey (NTTIS) from the University of Michigan Transportation Research Institute (UMTRI),

(4) Highway Performance Monitoring System (HPMS) from the Federal Highway Administration (FHWA), Department of Transportation,

(5) State fuel tax reports from each individual state and the International Fuel Tax Agreement (IFTA), and

(6) International Registration Plan (IRP) of the American Association of Motor Vehicle Administrators (AAMVA).

TIUS, NTACS, and NTTIS are designed to provide data on the physical and operational characteristics of the Nation's truck population (or sub-population); HPMS is implemented to collect information on the physical and usage characteristics of various highway systems; and state fuel tax reports and IRP are tax-oriented registrations. While TIUS, NTACS, and NTTIS are sample surveys that obtain information from truck owners or drivers; HPMS collects traffic counts and pavement conditions data from sample road sections; and state fuel tax reports (or IFTA) and IRP registrations are required by law.

Four indicators are required to provide a complete set of estimates: (i) operation jurisdiction (interstate vs intrastate), (ii) carrier type (common, contract, exempt, or private), (iii) truck weight, and (iv) state(s) where travel occurred. At present, none of the six data sources collects all four indicators, and therefore, none of the currently existing data sources can provide estimates at the state level. Additional information will be required for some data sources to be able to provide reliable estimates at the state level. The current survey forms designed for TIUS, NTTIS, and NTACS come close to providing estimates at the state level. However, if TIUS and NTACS were to be used, two additional questions in the survey forms

will be needed: (i) a list of states where travel occurred and the amount of travel in each state, and (ii) interstate indicator for private carriers. NTTIS will need an increase in sample sizes. HPMS will be a strong candidate as a data source, in conjunction with other data sources, to determine growth factors over time. IRP and state fuel tax (IFTA) can provide useful state level information on heavy trucks if all states become members of IRP/IFTA. A comprehensive list of limitations associated with each data source in providing estimates at the state level is included in this memorandum.

Although several attempts were made in this study to bring together the strengths of different data sources such that all indicators could be synthesized and that reliable estimates might be generated, none of them was successful. Currently, three of the main obstacles in the attempt to synthesize different data sources are:

(1) At present, information at the state level is either incomplete or insufficient.

(2) The data sources are incompatible in many areas which limit the efforts to bring together the strengths from different sources. For example, the truck types (and truck weight) included and excluded are different in these data sources, and the sampling or registration period considered in these data sources are not consistent.

(3) Complete results from the 1987 TIUS are not available. NTACS has not been implemented, and state fuel tax (or IFTA) and IRP are not readily obtainable.

The outlook of these six data sources in terms of their developments in the future are: (1) TIUS will be conducted every five years; (2) HPMS will be available every year; (3) it is likely to be a long process before all states become members of IRP/IFTA; (4) NTACS' future is likely to depend on the extent of users' support; and (5) NTTIS' future is subject to the funding availability.

Because none of the currently existing data sources can meet the estimation needs, a useful study in the future would be to assess the cost-effectiveness of extending one or more data sources (e.g., extra burden on the respondents by including two additional questions in the TIUS or NTACS) so that estimates can be obtained within a desirable accuracy.

1. INTRODUCTION

1.1 BACKGROUND

The Office of Motor Carriers and other units of the Federal Highway Administration (FHWA) require estimates of **the numbers of commercial vehicles operating in interstate commerce** and their **vehicle miles of travel (VMT)**. These estimates are essential for:

- o determining accident exposure and accident rates for vehicles that are subject to FHWA safety operations,
- o determining highway investment needs and cost responsibilities related to vehicles that are subject to FHWA safety operations, and
- o estimating the economic and operational impacts of FHWA policies and regulations that affect interstate commercial vehicles.

VMT and the numbers of vehicles operating in interstate commerce are currently estimated from the Bureau of Census' Truck Inventory and Use Survey (TIUS), FHWA's Highway Performance Monitoring System (HPMS), vehicle registrations reported by the states, and, when it becomes available, the Nationwide Truck Activity and Commodity Survey (NTACS), which is being implemented by the Bureau of the Census under the sponsorship of FHWA as a follow-on to the 1987 TIUS.

There are other potential data sources for estimates of the numbers of vehicles operating in interstate commerce and their VMTs. They are:

- o Nationwide Truck Trip Survey (NTTIS) of the University of Michigan Transportation Research Institute (UMTRI),
- o International Registration Plan (IRP) of the American Association of Motor Vehicle Administrators (AAMVA), and
- o fuel consumption reports by the states, by the U. S. Treasury Department, and by the U. S. Departments of Energy and Transportation.

While some of these data sources are designed to obtain estimates of the number of trucks (interstate and intrastate combined) and their VMTs, some are designed to collect different highway usage characteristics. While some are statistical sample surveys, others are total reports (censuses) rather than samples. Given its project-specific goals, each data

source has its own scope in terms of the data collection method, target population, data items collected, level of data aggregation, and data validation and estimation procedures.

Consequently, different data collection objectives result in incompatible and inconsistent estimates of VMT and of the number of trucks operating in interstate commerce. The levels of inconsistency and incompatibility are amplified significantly when disaggregate estimates are required, broken down by carrier type (i.e., common, contract, and private) and by state. Controversy exists over the best method of combining these data into estimates of the number of trucks that are operating in interstate commerce as well as estimates of their VMTs by carrier type and by state. This study focuses on addressing this controversy.

The study has two major objectives: (1) to evaluate the sources of data relative to their ability to provide estimates of the number of trucks operating in interstate commerce, and the associated VMTs, and (2) to recommend and test the most reliable and cost-effective estimation method. A pre-determined guideline for this study is that it does not involve or recommend any new data collection effort. In this memorandum, results of the first part of the study are given: the evaluation of the data sources.

1.2 PARAMETERS OF INTEREST

In order to evaluate various data sources in terms of their ability to estimate the number of trucks that operate in interstate commerce and their VMTs, it is essential to define the parameters first. Depending on the level of data aggregation (i.e., state or national level), two sets of parameters are defined - one at the state level, and the other at the national level.

First, let the target population be defined as

$$U = \{U_i \mid U_i \text{ is a truck with Gross Vehicle Weight Rating (GVWR[1]) > 10,000 pounds operating in interstate commerce during a given year in at least one of the 48 contiguous states or Washington, D.C.}\}$$

$$= \{U_1, U_2, \cdots, U_N\}. \qquad (1)$$

Within U, each truck will fall into only one of the following four strata for a particular year. These strata are:

[1]Gross vehicle weight rating (GVWR) is the weight of a vehicle when loaded to its capacity.

Stratum 1 - those trucks that operated most of the time during the particular year as a private carrier,

Stratum 2 - those trucks that operated most of the time during the particular year as a common carrier,

Stratum 3 - those trucks that operated most of the time during the particular year as a contract carrier, and

Stratum 4 - those trucks that operated most of the time during the particular year as an "exempt" carrier.

The trucks in U (refer to Equation (1)) can be further categorized as follows:

Stratum 1 (Private)	**Stratum 2 (Common)**	**Stratum 3 (Contract)**	**Stratum 4 ("Exempt")**
U_{11}	U_{21}	U_{31}	U_{41}
U_{12}	U_{22}	U_{32}	U_{42}
U_{13}	U_{23}	U_{33}	U_{43}
.	.	.	.
.	.	.	.
.	.	.	.
U_{1N_1}	U_{2N_2}	U_{3N_3}	U_{4N_4}
N_1 Trucks	N_2 Trucks	N_3 Trucks	N_4 Trucks

where U_{ij} is the jth truck in stratum i of a particular year for i = 1, 2, 3, 4, and j = 1, 2, 3, ..., N_i. With N_i trucks in stratum i, there are in total N (i.e., $N_1+N_2+N_3+N_4$) trucks with GVWR greater than 10,000 lbs operating in interstate commerce.

With each U_{ij}, there are two vectors, $\vec{VMT}_{ij}$ and $\vec{T}_{ij}$, associated with it.

Let

$$\vec{VMT}_{ij} = <VMT_{ij1}, VMT_{ij2}, \cdots, VMT_{ijk}, \cdots, VMT_{ij,49}>$$

where

VMT_{ijk} = the number of miles traveled in state k for truck j of stratum i during the particular year, and

$VMT_{ij.}$ = total VMT for truck j of stratum i during the particular year.

Let

$$\vec{T}_{ij} = <T_{ij1}, T_{ij2}, \cdots, T_{ijk}, \cdots, T_{ij,49}>$$

where

$$T_{ijk} = \begin{cases} 1 \text{ if } VMT_{ijk} > 0, \\ 0 \text{ if } VMT_{ijk} = 0, \end{cases} \qquad \text{for } k = 1, 2, \ldots, 49,$$

$T_{i.k}$ = total number of "different trucks" in stratum i that traveled in state k during the particular year.

It should be emphasized that (1) $T_{i..}$ is not the number of "different trucks" in stratum i, and (2) $T_{...}$ does not equal the total number of heavy trucks (with GVWR > 10,000 pounds) operating in interstate commerce in the United States. However, $T_{..k}$ is the number of "different trucks" that traveled in state k during the particular year.

1.2.1 Parameters at the State Level

Two parameters of interest **at the state level** are:

$VMT_{i.k} = \sum_j VMT_{ijk}$ = the total number of miles traveled in state k by all trucks in stratum i during the particular year, and

$R_{i.k} = VMT_{i.k}/T_{i.k}$ = the average VMT per truck in stratum i traveled in state k during the particular year.

In tabular format, these parameters can be expressed as Tables 1.1 and 1.2.

Table 1.1 VMT of Trucks
Operating in Interstate Commerce and
with GVWR > 10,000 lbs

	Carrier Type				
State	Private	Common	Contract	Exempt	**Row Total**[1]
AL	$VMT_{1,1}$	$VMT_{2,1}$	$VMT_{3,1}$	$VMT_{4,1}$	$\mathbf{VMT_{.1}}$
AR	$VMT_{1,2}$	$VMT_{2,2}$	$VMT_{3,2}$	$VMT_{4,2}$	$\mathbf{VMT_{.2}}$
AZ	$VMT_{1,3}$	$VMT_{2,3}$	$VMT_{3,3}$	$VMT_{4,3}$	$\mathbf{VMT_{.3}}$
CA	$VMT_{1,4}$	$VMT_{2,4}$	$VMT_{3,4}$	$VMT_{4,4}$	$\mathbf{VMT_{.4}}$
.	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	.
WY	$VMT_{1,48}$	$VMT_{2,48}$	$VMT_{3,48}$	$VMT_{4,48}$	$\mathbf{VMT_{.48}}$
DC	$VMT_{1,49}$	$VMT_{2,49}$	$VMT_{3,49}$	$VMT_{4,49}$	$\mathbf{VMT_{.49}}$
Column[2] **Total**	$\mathbf{VMT_{1.}}$	$\mathbf{VMT_{2.}}$	$\mathbf{VMT_{3.}}$	$\mathbf{VMT_{4.}}$	$\mathbf{VMT_{..}}$

1 Represents the total VMT traveled in state k by all trucks operating in interstate commerce with GVWR > 10,000 pounds.

2 Represents the total nationwide VMT traveled by the trucks in stratum i.

Table 1.2 Average VMT per Truck Operating in Interstate Commerce and with GVWR > 10,000 lbs

	Carrier Type			
State	Private	Common	Contract	Exempt
AL	$R_{1.1}$	$R_{2.1}$	$R_{3.1}$	$R_{4.1}$
AR	$R_{1.2}$	$R_{2.2}$	$R_{3.2}$	$R_{4.2}$
AZ	$R_{1.3}$	$R_{2.3}$	$R_{3.3}$	$R_{4.3}$
CA	$R_{1.4}$	$R_{2.4}$	$R_{3.4}$	$R_{4.4}$
.	.	.	.	.
.	.	.	.	.
.	.	.	.	.
WY	$R_{1.48}$	$R_{2.48}$	$R_{3.48}$	$R_{4.48}$
DC	$R_{1.49}$	$R_{2.49}$	$R_{3.49}$	$R_{4.49}$

1.2.2 Parameters at the National level

Three relevant parameters **at the national level** are:

(1) N_i = the number of trucks operating in interstate commerce by carrier type i,

(2) $VMT_{i..} = \sum_j \sum_k VMT_{ijk}$ = total VMT of these trucks by carrier type i, and

(3) $VMT_{i..} / N_i$ = average annual VMT per truck by carrier type i.

Note that $T_{i..} = \sum_j \sum_k T_{ijk}$ is not equal to $N_{i..}$.

1.3 DATA SOURCES

Six major data sources are evaluated in this study:

(1) Truck Inventory and Use Survey (TIUS) of the Bureau of the Census,

(2) Nationwide Truck Activity and Commodity Survey (NTACS) of the Bureau of the Census,

(3) National Truck Trip Information Survey (NTTIS) of the University of Michigan,

(4) Highway Performance Monitoring System (HPMS) of the FHWA,

(5) State fuel tax reports, and

(6) International Registration Plan (IRP) of the AAMVA or Western Prorate Agreement.

The first three data sources are "nationwide" sample surveys which are likely to be conducted periodically - TIUS and NTACS every five years, and NTTIS every two years provided there is sufficient funding. The remaining three data sources are collected under reporting systems which provide uninterrupted annual data. These data sources are evaluated in terms of data accuracy, data item availability, and estimation precision. They are also assessed based on the following set of questions:

(1) the number and kinds of vehicles included;

(2) accessibility of the data to a user;

(3) frequency of the data collection;

(4) time lag between the data collection and availability to the public;

(5) the vehicle configurations and vehicle definitions.

Table 1.3 summarizes data availability, data collection frequency and method, and data coverage of each of the six data sources. As mentioned earlier because each data source has its own project-specific goal in its data collection effort, it should be reemphasized that the evaluations are not made on the basis of how these data sources perform in general or with respect to their intended uses. Instead, the evaluations are made on the basis of how these data sources perform in estimating the specific parameters of interest for this study.

Chapters 2 through 7 discuss each of the six data sources and their limitations and strengths in terms of their ability to estimate annually the numbers of trucks operating in interstate commerce and their VMTs by carrier type and by state. TIUS is discussed in Chapter 2; NTACS in Chapter 3; NTTIS in Chapter 4; HPMS in Chapter 5; state fuel tax data in Chapter 6; and IRP in Chapter 7. Each of these chapters begins with a brief description of the data source, followed by discussions on sampling frame, sample size determination, sample selection, data collection, and estimation procedures. The limitations and strengths of the data source are noted at the conclusion of each chapter. Finally, a summary of the evaluation results is presented in Chapter 8.

Table 1.3
Data Availability, Data Collection Frequency and Method, and Data Coverage of Each of the Six Data Sources

Source	Initial year	Collection frequency	No. of states covered (contiguous 48 & D.C.)	Interstate Motor carrier indicator	Carrier type indicator	Truck type included	Collection method	Variable collected	Time lag between data collection & assimilation
TIUS	1967	5 yr	All	Yes	Yes	All	Sampling	Truck mile	2 yr
NTACS	1989	5 yr	All	Yes (3-4 states each truck)	Yes	All	Sampling	Truck mile	[a]
NTTIS	1984	[b]	All except Oklahoma	Yes	Yes	Straight & tractor > 10K GVWR	Sampling	Truck mile	4 yr
HPMS	1978	Continual	All	No	No	All	Sampling	Traffic count	10 months
FUEL TAX	Vary by state[c]	Continual	All	Some states	Some states	Vary by state[c]	Accounting	Gallonage, truck mile or revenue	Vary by state
IRP	1973	Continual	39 (partially)	Yes	Yes	>26K GVWR	Accounting	Truck mile	6 months

[a] Since the NTACS has not been implemented yet, the time lag between data collection and assimilation is unknown.

[b] One time data collection effort.

[c] Some states require written requests, some require funding to support software development in retrieving data, and some provide data upon request.

2. TRUCK INVENTORY AND USE SURVEY (TIUS)

2.1 GENERAL INFORMATION

As the nation's transportation survey, TIUS provides data on the physical and operational characteristics of the nation's truck population. It is based on a probability sample of private and commercial trucks registered (or licensed) in each state during TIUS' sample years.

Frequency of Data Collection:

The survey, as part of the nation's economic surveys, is required by law to be conducted every 5 years for the years ending in 2 and 7. The next survey is scheduled to be taken in 1993 for the year 1992. Data are collected by the U. S. Bureau of the Census.

Availability of Data After Collection:

Two years after the start of data collection, complete results are made available either in printed reports or in public use tapes for sale by the U. S. Government Printing Office. Other data formats are also available upon request from Customer Services, Bureau of the Census.

2.2 SAMPLE DESIGN

2.2.1 Target Population

The target population for TIUS consists of all of the trucks that were in operation and registered in one of the 50 states or the District of Columbia, except for the following:

- trucks owned by federal, state, and local governments,
- ambulances,
- buses, and
- motor homes.

2.2.2 Sampling Frame

A sampling frame is a listing, in some form, of the units in the target population. This information is important for the assignment of probabilities of being selected as a part

of the sample, and it is essential at the estimation step. The sampling frame for TIUS is the combination of all of the truck registration files in every state (except for Hawaii) compiled by R. L. Polk and Company. A special request was sent to the state of Hawaii for its truck registration file. For the 1987 TIUS, truck registrations as of July 1, 1987, were used.

2.2.3 Sample Selection : A Stratified Random Sample

Five truck body types (strata) for the 1987 TIUS were used:

Stratum 1 - pickup,

Stratum 2 - panel trucks, van, utility vehicle, jeep and station wagon on truck chassis,

Stratum 3 - small single-unit truck with GVWR less than 26,000 lbs.,

Stratum 4 - large single-unit truck with GVWR greater than or equal to 26,000 lbs., and

Stratum 5 - truck tractor.

Because vehicle classification schemes vary from state to state, the state truck registration files were modified by R. L. Polk and Company to achieve uniform truck body type classifications across all states.

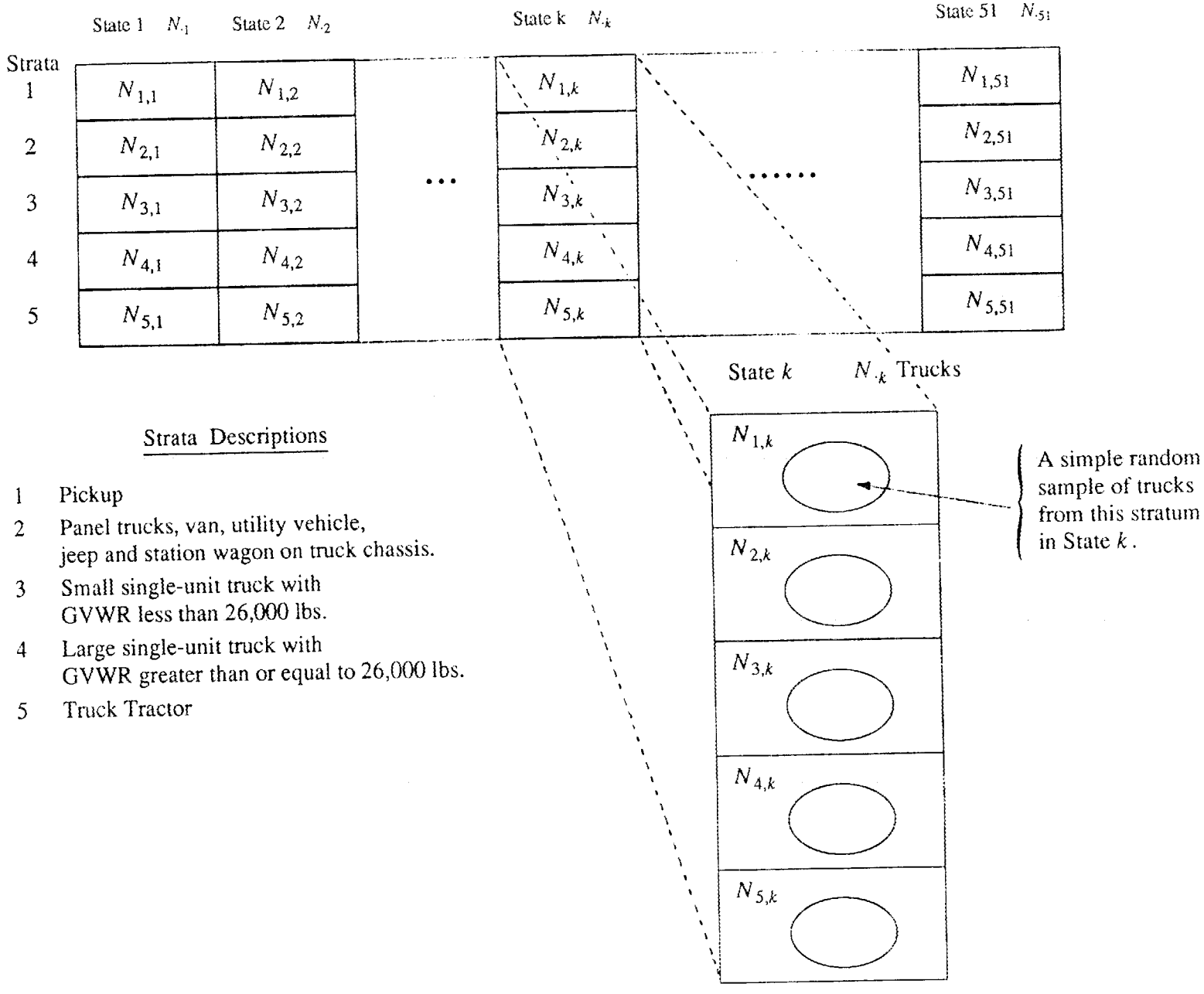
The truck population within each state was categorized into the above five body types (strata) in order to obtain more statistically reliable estimates of each body type. A random sample was then selected from each stratum within each state. Figure 2.1 demonstrates TIUS sample selection procedure.

2.2.4 Sample Size Determination

In order to determine each state's sample size for the 1987 TIUS, the Bureau of the Census used Arkansas data from the 1982 TIUS to provide needed statistical information on the target population. Arkansas data were used simply because they were the only data available at that time. Arkansas' data showed that for a typical characteristic (for example, vehicle age) 42 percent of the cells[2] had a coefficient of variation (CV) greater than 0.10;

[2] Defined by the stub characteristic.

Figure 2.1. TIUS Simple Random Selection of Trucks From Each Stratum in Each State ORNL-DWG 89-14369



Strata Descriptions

1 Pickup

2 Panel trucks, van, utility vehicle, jeep and station wagon on truck chassis.

3 Small single-unit truck with GVWR less than 26,000 lbs.

4 Large single-unit truck with GVWR greater than or equal to 26,000 lbs.

5 Truck Tractor

25 percent between 0.05 and 0.10; and 33 percent less than 0.05 (ignoring zeros). Based on these data, four broad assumptions were made in determining 1987 state sample sizes:

1. 10 percent of the trucks in each state were assumed to have each characteristic that the survey was measuring. For example, 10 percent of all trucks in each state were assumed to carry mainly agricultural and food products; 10 percent metals products; and 10 percent forestry and paper products, etc. This assumption was applied to all characteristics that the survey measured.
2. Each truck was assumed to be uniquely classified into a single stratum (body type).
3. Coefficients of variation (CV's) were assumed to be equal to 0.10 for all strata across all states.
4. Based on a "fictitious" characteristic, the proportion of trucks in each stratum having this "fictitious" characteristic was assumed to be 10% for all states.

Given the four assumptions stated above, the sample size for state k can be derived by formula (2.1) which is a standard technique in stratified random sampling (Cochran, 1977):[3]

$$n_{ok} = \frac{[\sum_i N_{ik} (p_i q_i)^{1/2}]^2}{(C^2)(N_{.k}^2)(P^2)} \qquad (2.1)$$

for i = 1, 2,...,5, and where

C = coefficient of variation = 0.10,

N_{ik} = total number of trucks in stratum i registered in state k,

$N_{.k}$ = total number of trucks registered in state k,

P = estimated proportion of trucks in each state having a particular characteristic = 0.10,

p_i = proportion of trucks in stratum i having a particular characteristic = 0.10, and

q_i = $1 - p_i$ = 0.90.

Given that C, P, and p_i are all assumed to be equal to 0.10, Equation (2.1) reduces to:

[3] Cochran, Sampling Techniques, John Wiley & Sons, 1977.

$$n_{ok} = \frac{\{\sum_i N_{ik} [(0.1)(0.9)]^{1/2} \}^2}{(0.1^2)(N_{.k}^2)(0.1^2)} \qquad (2.2)$$

$$= \frac{(0.09)[\sum_i N_{ik}]^2}{(0.1^4)(N_{.k}^2)}$$

$$= \frac{(0.09) N_{.k}^2}{(0.1^4) N_{.k}^2}$$

$$= 900.$$

Note that since sample size n_{ok} for state k is <u>not</u> a function of either N_{ik} (the total number of trucks in stratum i registered in state k) or $N_{.k}$ (total number of trucks registered in state k) under the assumptions, n_{ok} is denoted by n_o for simplicity. To take into account the finite population correction factor, n_o for state k was adjusted as in formula (2.3):

$$n_k = \frac{n_o N_{.k}}{N_{.k} + n_o} \qquad (2.3)$$

where $n_o = 900$ and $N_{.k}$ = total number of trucks registered in state k. Once sample size n_k of state k was determined, the sample size for stratum i in state k, n_{ik}, was calculated by using formula (2.4):

$$n_{ik} = \frac{n_k N_{ik} (p_i q_i)^{1/2}}{\sum_i N_{ik} (p_i q_i)^{1/2}} \qquad (2.4)$$

for i = 1, 2, ... 5.

Since $p_i = 0.10$ and $q_i = 1 - p_i = 0.90$ were assumed for all strata, formula (2.4) reduces to:

$$n_{ik} = n\left(\frac{N_{ik}}{N_{.k}}\right) \qquad (2.5)$$

Hence, the sample size for stratum i in state k was proportional to the ratio of the total number of trucks in stratum i to the state total. Using Formula (2.5) in determining state sample sizes yields a total nationwide sample size of 45,742.

In order to estimate statistics of trucks in strata 3, 4, and 5 and still maintain a CV of a typical characteristic at no greater than 0.10, larger samples sizes for these strata were needed. Formula (2.3) and (2.4) were modified assuming that the state truck population consisted of trucks in strata 3 through 5 only. These new state stratum sample sizes (for strata 3 through 5) replaced the much smaller values of n_{3k}, n_{4k}, and n_{5k}. Summing each state's new sample sizes yielded a new total nationwide sample size of 83,481 which was an adequate sample size for the 1987 TIUS.

However, the sample sizes for large single-unit trucks and truck tractors (strata 4 and 5) were too small to select sufficient subsamples of these trucks for NTACS, which is a follow-on survey to the 1987 TIUS. Therefore, the sample sizes for strata 4 and 5 were further adjusted to achieve much larger sample sizes for strata 4 and 5. These new state stratum sample sizes replaced the much smaller values of n_{4k} and n_{5k} and provided a better representation of long-haul commodity-carrying trucks in the survey. The final sample size of the 1987 TIUS was 134,321 trucks which was an increase of 14,000 trucks from the 1982 TIUS. Appendix 1 gives a numerical example of how the 1987 TIUS preliminary sample sizes were determined for the state of Washington. In addition, Appendix 1 presents a table showing how the sample sizes change for certain values of p_1, p_2, p_3, p_4, and p_5 (also P) that are not all equal to 0.1.

2.3 SURVEY METHOD

2.3.1 Data Collection Procedure

Data were collected for TIUS through questionnaires which were sent to the owners of trucks sampled for the survey. Report Forms TC-9501 were mailed to owners of trucks with GVWR less than 26,000 pounds, while Report Forms TC-9502 were mailed to owners of trucks with GVWR heavier than 26,000 pounds. The difference between Forms TC-9501 and TC-9502 is that Form TC-9502 contains approximately seven more questions which are relevant to heavier trucks only. See Appendix 2 for copies of these two questionnaires.

The forms were mailed out during the period between January 1988 and June 1988 to the owner identified in the registration records as of July 1, 1987. The owner was to respond only for the truck identified by the vehicle registration information imprinted on the form, regardless whether he/she still owned the vehicle.

In order to minimize survey nonsampling errors such as nonresponses, several follow-up attempts were made both by mail and telephone. These follow-ups not only reduced the nonresponse rate but they also minimized item nonresponses.

The information received on the returned questionnaires were processed through an extensive computer editing process. Respondents of the questionnaires which contained questionable responses were contacted again for verification of their responses.

2.3.2 Editing and Imputation Procedures[4,5]

The goal of data editing is to identify cases (i.e., TIUS sample respondents) that have incorrect, inconsistent or missing values. For TIUS, primary interest is in the values of two data items: annual mileage and lifetime miles. The editing procedures for the 1987 TIUS were developed using data from the 1982 TIUS. To set numerical boundaries, a two-step process was used. The first step was using regression methods to find the variables that affect annual and lifetime miles the most. Identified variables included truck age, vehicle type, number of axles, engine type, area of operation, and truck's major use. After these variables were identified, the second step was to develop edit bounds based on the values of these variables.

If a respondent was identified for failing to satisfy certain edits of the two major data items (annual and lifetime miles), the reported values were substituted (imputed) with estimated figures. The estimated figures are imputed using the "hot deck" approach. The basic idea of "hot deck" approach is that responding trucks with similar characteristics (truck age, vehicle type, area of operation, truck's major use, etc.) are grouped in an "imputation" cell. The acceptable values (the ones passed the edit procedure) for annual and/or lifetime miles of the trucks in the "imputation" cell were used to develop the estimated figures for annual miles and lifetime miles.

---

4 "1987 TIUS - Specifications for the Computer Edit of Data Entered Form, Part II - Annual and Lifetime," Bureau of the Census Internal Memo from H. N. Hamilton to B. M. Cohlen, December 1987.

5 "1987 TIUS - Imputation of Annual and Lifetime Miles," Bureau of Census Internal Memo from H. N. Hamilton to B. M. Cohen, December 22, 1987.

If a returned survey form contained a nonresponse for a particular data item other than annual miles or lifetime miles, usually no imputation was made and the response appears in a "not reported" category in published data.

2.3.3 Response Rates

The complete results of the 1987 TIUS will not be published until mid 1990, hence the response rate for the 1987 survey is not known at this point. However, the results from the state of Washington are available, and the response rate for Washington was 81.7 percent. For reference purposes, the response rates for the two previous TIUS surveys were 90 percent in both 1977 and 1982.

2.4 ESTIMATION PROCEDURE

In each stratum, estimates of the number of trucks for each characteristic were estimated by expanding the observations from the respondents to represent all trucks in the stratum within the scope of the survey. Factors used to expand sample data were (N_{ik} / r_{ik}), where r_{ik} was the number of respondents in stratum i in state k. This type of estimation procedure replies on an assumption that the characteristics of nonrespondents are the same as those of the respondents. The amount of bias introduced by this practice depends on the extent to which the nonrespondents differ from the respondents.

The stratum estimates were summed across strata to form the estimates for each state. National estimates were obtained by adding up all the state estimates.

2.5 EVALUATION RESULTS

Figure 2.2 demonstrates the data item availability of the TIUS in terms of its ability to estimate the number of large commercial trucks and the associated VMTs by state and by carrier type. For example, data on trucks that registered in Alabama are available for 3 carrier types (common, contract and exempt). However, data on trucks that traveled in Alabama but registered outside the state of Alabama are not available. As a result, the total number of trucks that traveled in Alabama and the associated VMT are not available. More specific limitations and strengths are documented below.

Figure 2.2. Data Availability by State, by Carrier Type from TIUS

✓ : VMT ○ : No. of Trucks Operating in Interstate Commerce ORNL-DWG 89-14370

		Carrier Type	State Registered				Row Total*
			AL	AZ	AR	• • •	
STATE TRAVELED	AL	Private					
		Common	✓				
		Contract	✓				
		Exempt	✓				
	AZ	Private					
		Common		✓			
		Contract		✓			
		Exempt		✓			
	AR	Private					
		Common			✓		
		Contract			✓		
		Exempt			✓		
	• • •	• • •				• • •	
Total		Private					
		Common	✓	✓	✓	• • •	✓
		Contract	✓	✓	✓	• • •	✓
		Exempt	✓	✓	✓	• • •	✓

* Row totals are the parameters of our interest

TIUS can not distinguish between inter- and intrastate for private carriers.

2.5.1 Limitations

(1) VMT are often estimated by truck owners (i.e., self-reported but not taken from the truck odometers). Data from the NTTIS suggested that annual mileage from the odometer readings can be 20 to 25 percent lower than self-reported annual mileage (Campbell, etc., 1988).[6]

(2) TIUS data were not adjusted to correct for the duplicate registration from state to state (i.e., there was no effort made to check or correct for the double-counting problem in the R. L. Polk registration data).[7]

(3) Although the TIUS data provide interstate truck VMT, by carrier type (for contract and common carriers only), traveled in and outside of the home state, it does not specify how many nor in which states the vehicle has traveled outside of the home state.

(4) The survey is conducted every five years. Interpolations will be needed to estimate for the intermediate years. Furthermore, based on the experience from the previous survey, there is a time lag of almost two years before the complete survey results are made available to the public.

(5) If the body type of a truck can not be determined, it was categorized in Stratum 3 (small single-unit trucks with GVWR less than 26,000 pounds). Hence Stratum 3 became the "catch-all" category for the trucks which were difficult to classify as well as the "true" single-unit trucks with GVWR less than 26,000 pounds. This scheme of classification may cause an overestimation in both the number of small single-unit trucks and the associated VMT.

---

[6] Campbell, K., etc., 1988, "Analysis of Accident Rates of Heavy-Duty Vehicles," Technical Report Number 88-17 of the Transportation Research Institute, University of Michigan, Ann Arbor, Michigan, p 23.

[7] The issue concerning the level of duplication in Polk registration files is a difficult one. The following was learned in telephone conversations with Eric Marr (Project Manager, R. L. Polk and Company) and Kent Campbell (UMTRI). Based on Mr. Marr's previous experiences with manufacturers' recalls on trucks, and when Polk pulled together a nationwide list and matched it with the Vehicle Identification Numbers (VINs), 1 to 2% duplications were noticed. However, according to Mr. Campbell's recollection of one of his conversations with a Polk staff member in 1982-83, the level of duplication increases as truck sizes increase, and the level could be as high as 8% (Mr. Marr of Polk did not dispute this figure for large trucks). Currently, ORNL is not aware of any documented estimates of the levels of duplication among state truck registrations.

(6) Based on a "fictitious" characteristic, all p_i's were assumed to be 0.1 for strata in all states. The level of the impacts of this assumption in determining the 1987 TIUS sample sizes when there are not exactly ten categories in a given characteristic (i.e., sum of p_i's is not equal to 1) is not clear. For computation of sample sizes for the state of Washington assuming other values of p_i, see the second part of Appendix 1.

2.5.2 Strengths

(1) The 1982 TIUS had a high response rate of 90 percent. The Bureau of the Census devoted a considerable amount of effort on follow-ups by mail and telephone in an attempt to improve the response rates.

(2) Each stratum in the TIUS was relatively homogeneous due to Polk's effort at standardizing each state's vehicle body-type categories. A possible exception to this homogeneity would be in Stratum 3 since it was designated as the "catch-all" category.

(3) TIUS' sampling plan used to select the sample was stratified random sampling - a standard sampling technique.

3. NATIONWIDE TRUCK ACTIVITY AND COMMODITY SURVEY (NTACS)

3.1 GENERAL INFORMATION

The NTACS is a follow-on to the 1987 TIUS to obtain additional information on commodities carried, safety features, operational characteristics, and relationships between truck usage, economic factors, geography, and highway classes. The NTACS is also designed to collect basic commodity flow information for trucks which has not been measured since the last Commodity Transportation Survey in 1977. The NTACS is being implemented by the U. S. Bureau of the Census and funded by the FHWA, with additional support from the Office of the Secretary of Transportation and the Federal Railroad Administration.

Frequency of Data Collection:

The NTACS has been funded as a one-time survey, but it is planned to become a regular component of or supplement to the quinquennial Economic Census.

Availability of Data After Collection:

Prototype data from the first NTACS is expected to be available in early CY 1990, and the complete public use file will be available at the end of CY 1990.

3.2 SAMPLE DESIGN

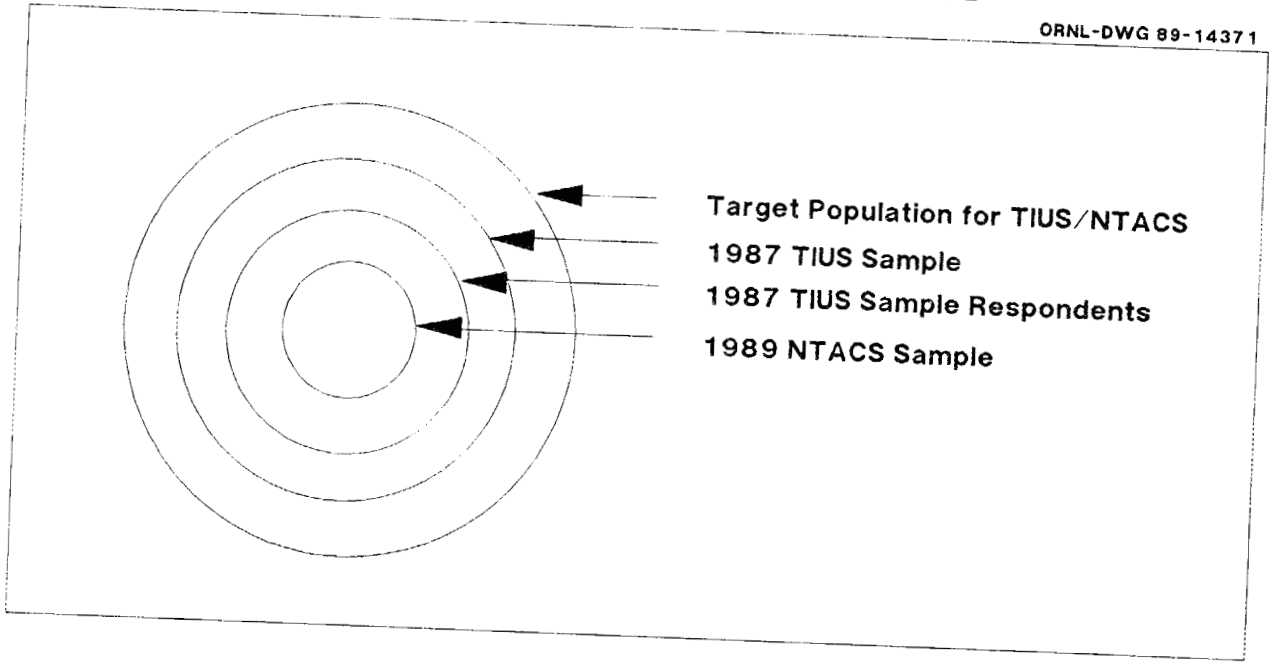
3.2.1 Target Population

The target population for NTACS consists of all trucks in the United States. More specifically, the target population for NTACS "includes all operational trucks in 1989 that were registered in one of the 50 states or the District of Columbia on July 1, 1987, and that fall within the scope of the 1987 TIUS."

3.2.2 Sampling Frame

The sampling frame for NTACS is the same as that for TIUS. However, the 1989 NTACS sample will be a subsample of the 1987 TIUS sample respondents (Figure 3.1).

Figure 3.1. Sampling Frame for NTACS



According to the NTACS sample selection plan as described in an April 26, 1989, Census memo from H. N. Hamilton to B. M. Cohen, within each of the nine census divisions (Figure 3.2) each of the 1987 TIUS sample respondents which is in scope (SCOPE=1) will be categorized into one of twenty-five strata as indicated in Figure 3.3.

3.2.3 Sample Selection: A Stratified Two-Phase Three-Stage Design

As mentioned earlier, the NTACS sample is a subsample of the sample respondents to the 1987 TIUS. Hence, the selection of the TIUS sample is the first phase, and the NTACS is the second phase of the sample selection procedure. Within each census region, sample respondents (that are in scope) to the 1987 TIUS will be further assigned to one of the twenty-five strata noted in Figure 3.3. There are to be three stages to NTACS sampling. In the first stage, the trucks will be selected from the 1987 TIUS sample respondents. In the second stage, two one-week periods (for long-haul trucks) or one one-week period (for other trucks) out of a year will be selected for each selected truck. In the third stage, a sample day and a substitute sample day will be selected from each selected week for each selected truck. This implies two sample days and two substitute days for each selected long-haul truck and one sample day and one substitute day for each selected "other" truck. The need for a second day of data collection is to provide more information on the greater geographical variability of vehicle movement for long-haul commodity carrying trucks.

3.2.4 Sample Size Determination

Approximately 44,000 trucks will be included in the NTACS sample. This preliminary sample size is about 31 percent of the total 1987 TIUS sample size. The NTACS sample will be divided among the strata approximately as follows:

ORNL-DWG 89-14372

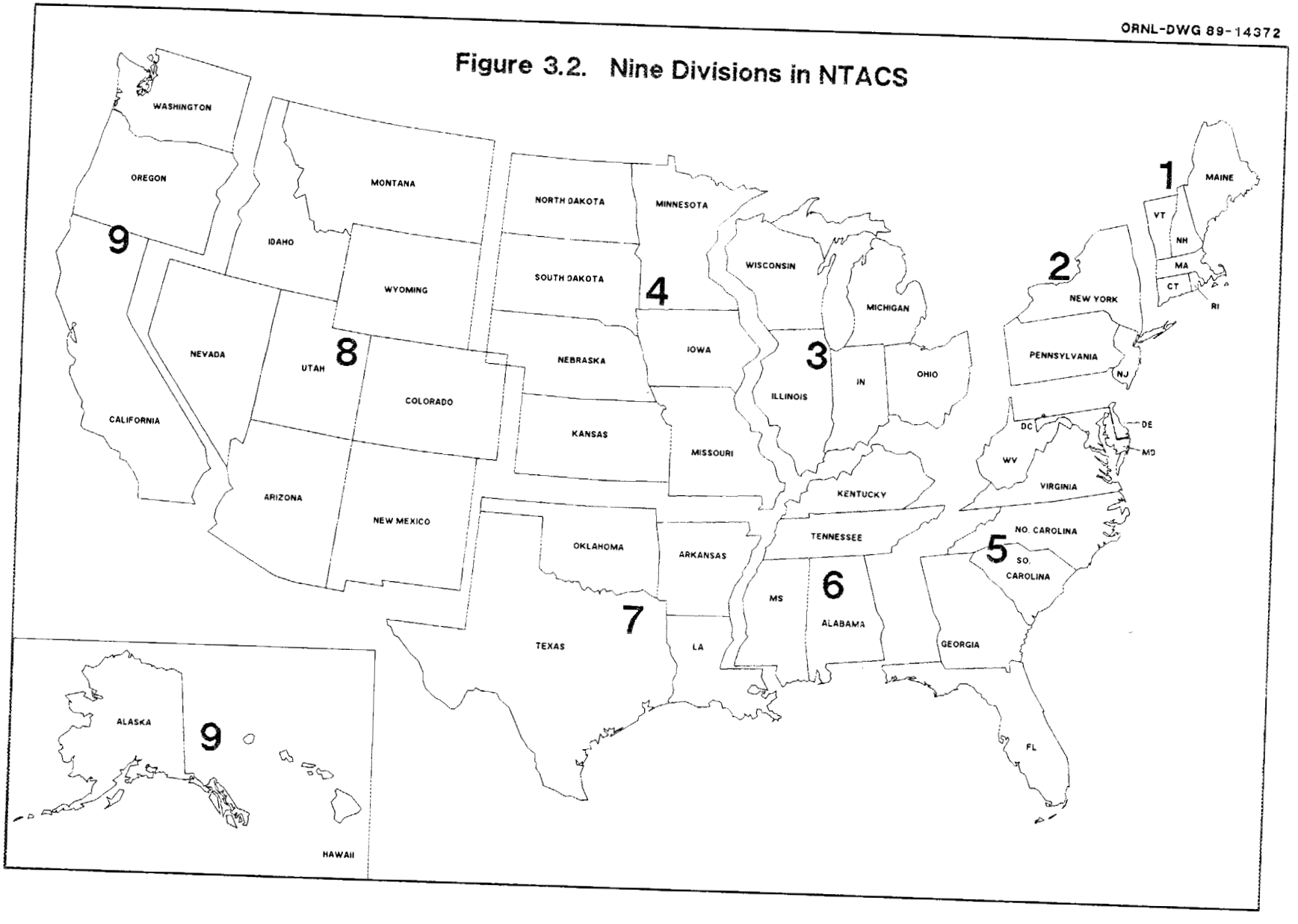
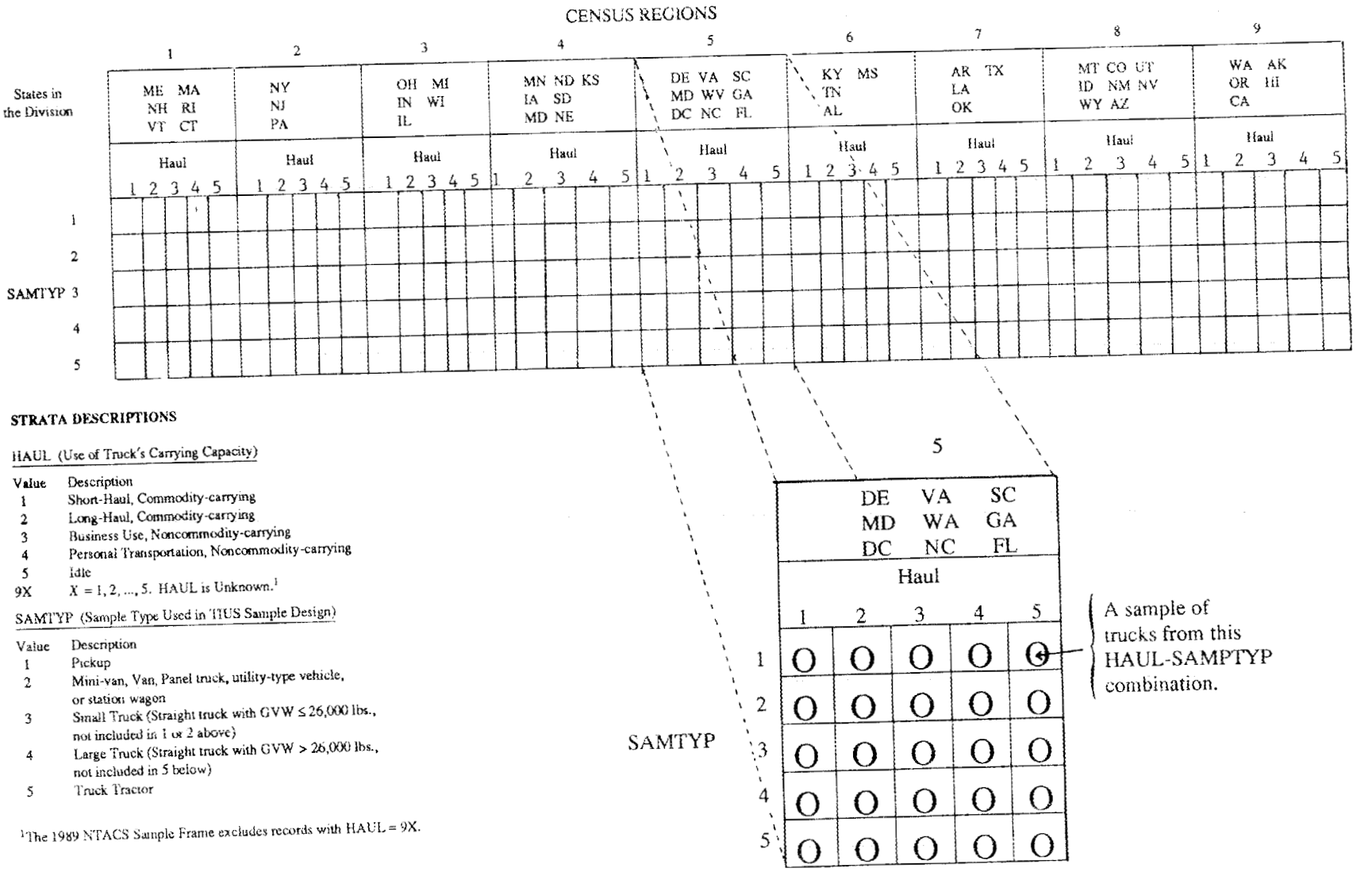


Figure 3.2. Nine Divisions in NTACS

ORNL-DWG 89-14373

Figure 3.3. Stratification Design of the 1987 TIUS Sample Respondents for Selection of the 1989 NTACS Sample



STRATA DESCRIPTIONS

HAUL (Use of Truck's Carrying Capacity)

Value	Description
1	Short-Haul, Commodity-carrying
2	Long-Haul, Commodity-carrying
3	Business Use, Noncommodity-carrying
4	Personal Transportation, Noncommodity-carrying
5	Idle
9X	X = 1, 2, ..., 5. HAUL is Unknown.[1]

SAMTYP (Sample Type Used in TIUS Sample Design)

Value	Description
1	Pickup
2	Mini-van, Van, Panel truck, utility-type vehicle, or station wagon
3	Small Truck (Straight truck with GVW ≤ 26,000 lbs., not included in 1 or 2 above)
4	Large Truck (Straight truck with GVW > 26,000 lbs., not included in 5 below)
5	Truck Tractor

[1]The 1989 NTACS Sample Frame excludes records with HAUL = 9X.

1. 16,000 long-haul commodity-carrying trucks, which includes **all** TIUS sampling units which were principally engaged in long-haul transportation in 1987 (HAUL=1);
2. 25,000 local commodity-carrying trucks, which includes half of the TIUS sampling units which were principally engaged in local-haul transportation in 1987 (HAUL=2);
3. 1,700 business-use trucks that did not carry commodities in 1987 (HAUL=3); and
4. 1,300 trucks that were used for personal transportation in 1987 (HAUL=4).

The last two strata for noncommodity-carrying trucks represent 5% of the TIUS sampling units in those categories who operated pickups, vans, and light straight trucks, and 15% of the TIUS sampling units in those categories who operated heavy straight trucks and truck tractors. The reason for including trucks of these two strata in the NTACS sample is to provide a basis for estimating vehicle activity of the entire TIUS universe if TIUS-based estimates of VMT diverge significantly from NTACS-based estimates of the VMT of commodity-carrying trucks.

The preliminary sample sizes are based on a study of the 1982 TIUS. The preliminary sample sizes are determined to provide reliable estimates of VMT at the Census Division level (see Figure 3.3) of geography for each of the following categories:

- commodity-carrying large straight trucks and commodity-carrying truck tractors;
- commodity-carrying pickups and vans;
- commodity- and noncommodity-carrying truck tractors;
- commodity- and noncommodity-carrying pickups and vans; and
- all commodity- and noncommodity-carrying trucks.

3.3 SURVEY METHOD

3.3.1 Data Collection Procedure

Two questionnaires will be used. Form NTACS-2 collects data from long-haul commodity carrying trucks and Form NTACS-1 collects data from all other trucks. Vehicle-specific data and the selected sample day(s) will be imprinted on the computer-generated questionnaires. Mail-out of the questionnaires is expected to begin in September 1989 for 13 4-week periods. Each questionnaire will be mailed to the vehicle owner at least two weeks prior to the start of the selected 4-week period. The latest version of NTACS-2 is given in Appendix 3.

The respondent will be asked to report whether the truck was operated at some time during each day of the sample week. If the truck does not operate on the sample day, then the respondent will be asked to use the substitute day for reporting truck activities. If the truck operates during the selected week but on neither the sample nor substituted day, the respondent will be asked to call the Census Bureau for a new sample day.

In an attempt to improve the survey response rate, two follow-ups will be performed: first by mail, then by telephone. The second follow-up will enable the Census Bureau to improve both the overall responses and item responses.

Responses will be edited for reasonableness and consistency. The physical characteristics of the selected vehicles will be compared with those reported in the 1987 TIUS. The operational characteristics will be edited against parameters developed from industry standards and from knowledge of the operation of various carrier types.

3.3.2 Response Rate

As of now, the response rate for the NTACS is not known.

3.4 ESTIMATION PROCEDURE

Specific parameters to be estimated and the method of estimation have not been determined.

3.5 EVALUATION RESULTS

Figure 3.4 demonstrates the data item availability of the NTACS in terms of its ability to estimate the number of large commercial trucks and the associated VMTs by state and by carrier type. The only data that are available from the NTACS are the numbers of trucks registered in individual states and the associated VMTs. More specific limitations and strengths are documented below.

3.5.1 Limitations

There are four points where NTACS data will be limited:

(1) If the NTACS is implemented every five years, one will have to estimate the number of trucks and the associated VMTs for the intermediate years.

(2) Because the trucks in the NTACS sample constitute a subsample of the 1987 TIUS respondents which are limited to registration as of July 1987, the trucks being included in the NTACS survey are at least two years old. Hence, commodity activities for newer trucks will not be included, although methods to expand and/or to correct the two-year lag biases are currently under investigation by ORNL.

(3) Division level selection of the NTACS sample might limit publication of reliable state level data in some cases if the realized sample size for a particular state is small.

(4) Some of the limitations of TIUS will be inherited by NTACS because NTACS is a subsample of TIUS. One possible limitation relates to the problem of duplicate registrations.

3.5.2 Strengths

Five strengths of NTACS in estimating the total number of trucks operating in interstate commerce and the associated VMTs by state and by carrier type were identified.

(1) Based on the documentation of the NTACS sampling model, the NTACS is designed to cover the motor carrier population using a three-stage sampling plan which is a standard statistical method.

(2) For the NTACS sample years, the variables and information are available to calculate the number of trucks operating in interstate commerce and the associated VMTs by state and by carrier type (i.e., in the questionnaire, there are fields to specify whether the driver is a common, contract, or private carrier). Therefore, there is no need to apply an estimated distribution of carrier types to the total number of interstate trucks and the associated VMTs in the state in order to obtain estimates by carrier type.

(3) Using two sample days for long-hauling trucks to record their commodity carrying activities helps to capture greater geographic variability.

(4) With the use of TIUS, one will be able to study to some extent potential biases from NTACS nonresponses because all NTACS respondents and nonrespondents will have been respondents to TIUS.

(5) NTACS could be used to identify seasonal variation because sample days will be spread throughout the year.

Figure 3.4. Data Availability by State, by Carrier Type from NTACS

✓ : VMT ○ : No. of Trucks Operating in Interstate Commerce ORNL-DWG 89-14374

		Carrier Type	State Registered				Row Total ✳
			AL	AZ	AR	• • •	
STATE TRAVELED	AL	Private					
		Common					
		Contract					
		Exempt					
	AZ	Private					
		Common					
		Contract					
		Exempt					
	AR	Private					
		Common					
		Contract					
		Exempt					
	• • •	• • •					
Total		Private	✓○	✓○	✓○	• • •	✓○
		Common	✓○	✓○	✓○	• • •	✓○
		Contract	✓○	✓○	✓○	• • •	✓○
		Exempt					

✳ Row totals are the parameters of our interest

4. NATIONAL TRUCK TRIP INFORMATION SURVEY (NTTIS)

4.1 GENERAL INFORMATION

According to Campbell,[8] the purpose of the NTTIS is

> "To provide population estimates and descriptive statistics on the national population of large trucks (with GVWR greater than 10,000 pounds) and their uses. ... The TIUS data provide data on the description of the owner and the truck. However, information on the day-to-day use of the truck is lacking. The NTTIS is designed to provide these additional data elements."

Information from the NTTIS is then combined with data from a fatal accident survey for large trucks to estimate involvement rates and uses for a broad range of truck configurations. NTTIS was conducted by the University of Michigan Transportation Research Institute (UMTRI).

Frequency of Data Collection:

NTTIS was a one-time data collection effort, implemented during the period between 1984 and 1987.

Availability of Data After Collection:

Complete results of the NTTIS became available in 1988 in the report by Campbell, Blower, Gattis, and Wolfe.[9]

---

8 Campbell, K., 1986 "Population Estimates From the National Truck Trip Information Survey," Transportation Research Record, Report Number 1068, pp. 76-84.

9 Campbell, K., etc., 1988, "Analysis of Accident Rates of Heavy-Duty Vehicles," Technical Report Number 88-17 of the Transportation Research Institute, University of Michigan, Ann Arbor, Michigan.

4.2 SAMPLE DESIGN

4.2.1 Target Population

The target population for NTTIS consists of all large commercial trucks (GVWR greater than 10,000 pounds) in the United States.

4.2.2 Sampling Frame

The source of the sampling frame for NTTIS was R. L. Polk and Company. Vehicle registrations as of July 1, 1983, were used. The Polk data for California did not include trucks with model years before 1973. Hence, the NTTIS sampling frame included the contiguous 48 states plus the District of Columbia except for Oklahoma and pre-1973 model-year trucks in California. With a much smaller sampling frame than TIUS, duplicate registrations from state to state were able to be eliminated.

Trucks included in the survey were (1) straight trucks with GVWR greater than 10,000 pounds, and (2) all road tractors. Excluded from the survey were all pickup trucks (regardless of GVWR); all passenger vehicles (such as passenger vans, recreational vehicles); farm tractors; and government-owned trucks.

4.2.3 Sample Selection : A Stratified Two-Stage Cluster Design

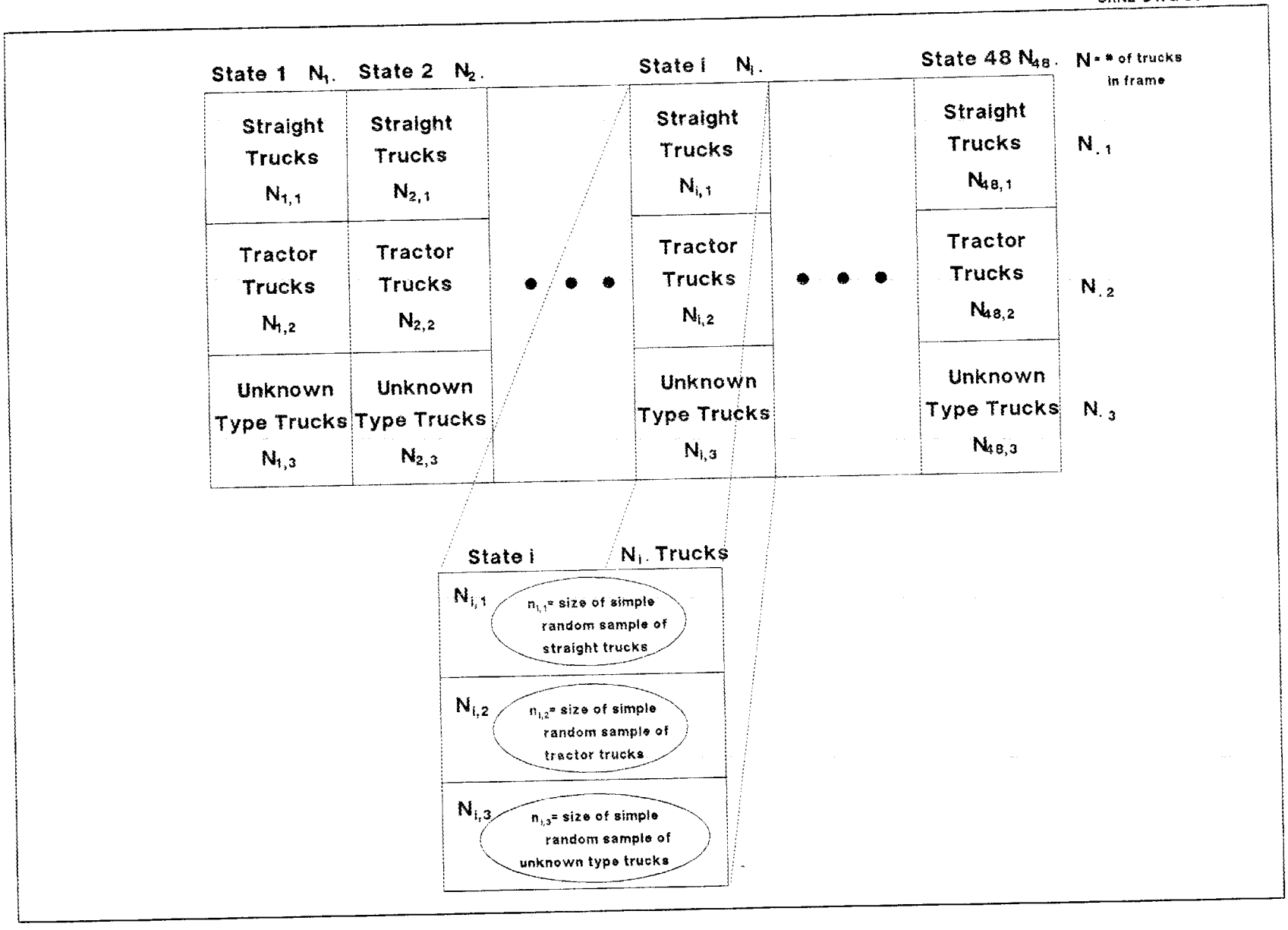
Within each of the 48 states (47 contiguous states excluding Oklahoma plus the District of Columbia), three strata were formed and a simple random sample of trucks from each stratum was selected. For each truck selected for the sample, four days of detailed travel data over a twelve-month period were collected. The details of the two stages of the sampling scheme are indicated below.

Stage 1. Figure 4.1 shows the simple random selection of trucks from each stratum in each state.

Stage 2. Selection of four sample days. One from each quarter of the 12-month period for each truck selected in Stage 1.

Figure 4.1. NTTIS Simple Random Selection of Trucks from Each Stratum in Each State

ORNL-DWG 89-14375



4.2.3 Sample Size Determination

The sample sizes for the NTTIS were determined based on the estimated coefficients of variation (CV) for estimators from two 1977 nationwide surveys (Federal Motor Vehicle Safety Standard (FMVSS) No. 121 and TIUS). The overall target sample sizes of 4,000 truck tractors and 2,000 straight trucks were proposed. Assuming a 27 percent nonresponse rate for the tractors and 20 percent for straight trucks, the proposed sample sizes were increased to 5,500 tractors and 2,500 straight trucks. A higher nonresponse rate was assumed for truck tractors because of possible misclassification of trucks assigned to the truck tractor strata.

Table 4.1 shows the final target sample sizes by state. The total sample size was n = 2,497 + 5,497 + 150 = 8,144 trucks. However, due to the misclassification of trucks, there were only 2,601 truck tractors and 3,704 straight trucks. The final realized sample size was 2,601 tractors and 2,511 straight trucks. Figure 4.2 illustrates the NTTIS sampling procedures and the corresponding number of responses over time.

4.3 SURVEY METHOD

4.3.1 Data Collection Procedure

Data for the NTTIS were collected primarily through the telephone. Mail was used when telephone attempts failed. The data collection effort was implemented in five phases. In Phase 1 (between January through mid-May 1985), initial contacts were made with the owners of those 8,144 selected trucks to

(1) secure the owners' cooperation,

(2) confirm vehicle identification, and

(3) obtain descriptive information on the vehicles.

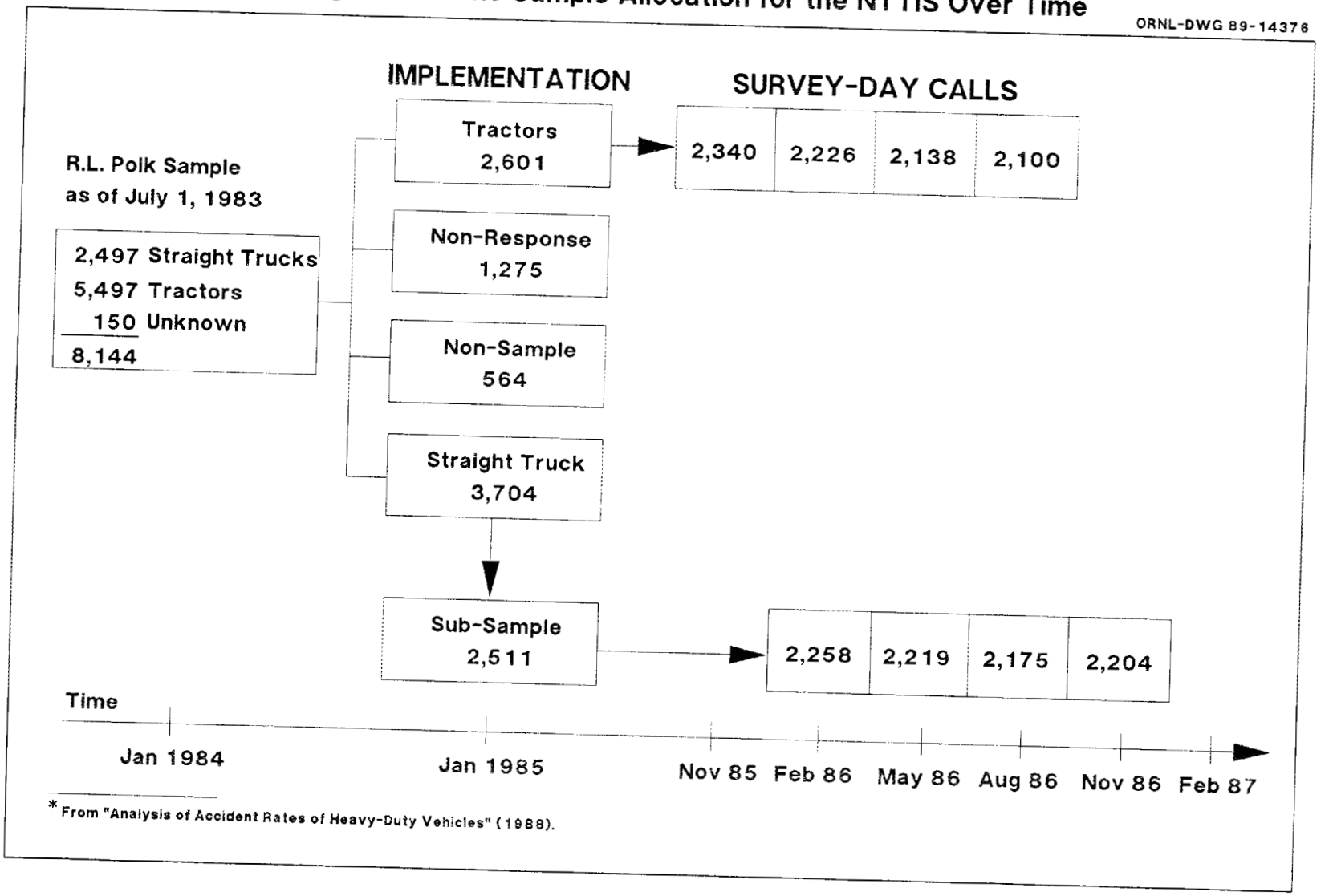
Vehicle misclassification was discovered in this phase. About 40 percent of the trucks selected from the tractor strata were found to be straight trucks, while 4 percent of the straight trucks should have been listed as truck tractors. A copy of the questionnaire used in Phase 1 is given in Appendix 4.

Phases 2 through 5 corresponded to the data collection of four sample days for each sample truck (Phase 2 was for the first sample day, etc.) Attempts were made to obtain

Table 4.1 Frame Totals and Sample Sizes for the NTTIS

State	Straight Trucks Frame N_{i1}	Straight Trucks Sample n_{i1}	Tractors Frame N_{i2}	Tractors Sample n_{i2}	Unknown Frame N_{i3}	Unknown Sample n_{i3}
Alabama	42,481	56	29,140	91	1	0
Arizona	12,144	30	9,679	60	1	0
Arkansas	27,699	37	23,409	73	--	--
California	38,318	51	79,238	495	--	--
Colorado	30,980	41	18,211	60	--	--
Connecticut	14,625	30	11,793	60	96	2
Delaware	6,146	30	6,926	60	--	--
District of Columbia	600	30	487	60	--	--
Florida	59,137	78	63,306	198	2	0
Georgia	50,787	67	33,023	103	6,263	125
Idaho	11,289	30	11,512	60	46	1
Illinois	82,648	109	88,942	278	2	0
Indiana	61,777	82	61,554	192	2	0
Iowa	43,429	58	40,125	125	94	2
Kansas	82,622	109	29,544	92	--	--
Kentucky	56,651	75	22,168	69	--	--
Louisiana	32,699	43	29,211	91	3	0
Maine	12,501	30	7,715	60	1	0
Maryland	29,120	38	19,701	61	20	0
Massachusetts	28,974	38	27,073	85	13	0
Michigan	34,886	46	40,135	314	--	--
Minnesota	63,353	84	41,399	129	11	1
Mississippi	21,592	30	21,042	66	968	18
Missouri	56,462	75	33,946	106	--	--
Montana	25,214	33	11,482	60	8	0
Nebraska	43,255	57	24,590	77	18	1
Nevada	5,443	30	4,070	60	--	--
New Hampshire	5,992	30	6,607	60	1	0
New Jersey	30,148	40	45,161	141	1	0
New Mexico	13,626	30	11,719	60	--	--
New York	61,296	81	55,720	174	--	--
North Carolina	64,948	86	47,610	149	--	--
North Dakota	51,749	69	13,899	60	--	--
Ohio	68,867	91	75,247	235	3	0
Oklahoma	--	--	--	--	--	--
Oregon	18,848	30	22,567	70	--	--
Pennsylvania	71,012	94	66,994	209	--	--
Rhode Island	4,133	30	4,199	60	1	0
South Carolina	20,639	30	15,857	60	--	--
South Dakota	21,630	30	10,264	60	1	0
Tennessee	36,651	48	30,231	94	1	0
Texas	90,870	120	115,555	361	3	0
Utah	13,455	30	13,496	60	--	--
Vermont	5,269	30	3,732	60	--	--
Virginia	45,272	60	29,983	93	--	--
Washington	26,786	35	22,615	71	2	0
West Virginia	13,173	30	9,359	60	--	--
Wisconsin	42,529	56	36,917	115	10	0
Wyoming	9,297	30	10,741	60	21	0
Total	$N_1=1{,}691{,}022$	$n_1=2{,}497$	$N_2=1{,}437{,}894$	$n_2=5{,}497$	$N_3=7{,}593$	$n_3=150$

Figure 4.2. The Sample Allocation for the NTTIS Over Time



* From "Analysis of Accident Rates of Heavy-Duty Vehicles" (1988).

truck usage data on four sample days for each of the 2,601 tractors, but only for each of the 2,511 straight trucks.[10] Thus only 5,112 (i.e., 2,601 tractors plus 2,511 straight trucks) large commercial trucks were selected for the trip survey in Phases 2 through 5.

The owner of each selected vehicle was contacted by phone not too long after the assigned survey day and asked about the vehicle's travel on that survey day. Individual trips on the survey day were exactly mapped onto special atlases developed by UMTRI. This approach made it possible to characterize each survey mile in terms of day and night miles and various road types.

Travel data of selected tractors were collected during the period between November 1985 and November 1986, while straight trucks were studied between February 1986 and February 1987. Hence, it seemed appropriate to indicate that the trip data from the NTTIS was roughly for the year 1986.

4.3.2 Editing and Imputation Procedures

Based on a review of UMTRI publications and telephone conversations relative to NTTIS, data editing was both manual and computerized. When trip mileage or other information for a day obtained from maps and other analyses differed from that reported over the telephone, the truck driver was called again for a resolution.

After data were computerized, computer edits were run mainly for consistency checks. Identified inconsistences were resolved. Checks were also made for variables including model/truck type, truck weight, length, etc. When a reported value was questionable or when a value to a particular item could not be obtained, imputed figures were developed by a knowledgeable transportation analyst using available information. The most common data item that was imputed was "cargo weight." The level of imputation was estimated to be under 10 percent.[11]

---

[10] Only 2,511 straight trucks were surveyed since the initial targeted sample size of straight trucks was 2,497.

[11] Personal communication with Kent Campbell, University of Michigan, June 1989.

4.3.3 Response Rate

Figure 4.2 shows the number of responses for each of the four sample days indicating different response rates for different phases. Of the 5,112 trucks selected following Phase 1, the overall response rate was 86 percent.

4.4 ESTIMATION PROCEDURE

4.4.1 Estimation Procedure for Number of Trucks

Recall that a simple random sample of n_{ik} trucks was selected from the ik stratum (stratum i in state k), the probability of sample selection for each truck in stratum *ik* is n_{ik}/N_{ik}. Now let $w_{ik} = N_{ik} / n_{ik}$ = the sampling weight for each truck in stratum *ik*. Each w_{ik} was then adjusted to compensate for nonresponse among the n_{ik} trucks yielding $w'_{ik} = N_{ik} / r_{ik}$ where r_{ik} is the number of sample respondents in stratum ik. The weighting factors, w'_{ik}, are adjusted to account for those cases where UMTRI was unable to obtain any information at all on a truck's travel for a particular sample day.

The estimated number of trucks in stratum i of state k was derived by multiplying the observed numbers of trucks in the sample (being either straight or tractor trucks) by w'_{ik}. The state estimates were obtained by summing all stratum estimates. National estimates were then obtained by summing all of the state estimates.

4.4.2 Estimation Procedure for VMT

Let VMT_{ik} be the total VMT of trucks during the reference period for stratum ik, and let vmt_{ik} be the total VMT of selected trucks during the four sample days for stratum ik. Thus VMT_{ik} can be estimated by using formula (4.1):

$$VMT_{ik} = vmt_{ik}\ (365/4)\ w'_{ik}. \qquad (4.1)$$

NTTIS data made it possible for UMTRI to produce three different estimates of average annual mileage. These three estimates are:

(1) self-reported = "the respondents' estimate of annual travel,"

(2) odometer = "calculated from odometer readings supplied for specific dates near the beginning and end of the one-year trip survey period," and

(3) mapped = "derived from the travel reported on the individual survey days inflated by the selection weights for these dates."

UMTRI believes that the estimates based on odometer readings are the most accurate. Annual mileage estimates using these three different approaches are listed as follows:

	Type of Truck	
Method of Estimation	Straight Truck	Truck Tractor
Self-Reported	12,300	54,700
Odometer	9,100	43,100
Mapped	6,000	29,400

4.5 EVALUATION RESULTS

Figure 4.3 demonstrates the data item availability of the NTTIS in terms of its ability to estimate the number of large commercial trucks and the associated VMTs by state and by carrier type. More specific limitations and strengths are documented below.

4.5.1 Limitations

Limitations of NTTIS are listed as follow:

(1) If NTTIS is to be implemented every two years, one needs to estimate data for the intermediate years. As of the end of 1988, NTTIS was implemented only once, starting in 1984.

(2) With a sample size of 5,112 trucks, NTTIS did not have a large enough sample size to support reliable state-level VMT estimates nor the estimates of the number of trucks. Moreover, NTTIS has a relatively small total sample size compared to TIUS and NTACS: NTTIS - 5,112 in 1986, NTACS - 44,000 in 1989, and TIUS - 120,000 in 1982 and 134,321 in 1987. At least half of the trucks in 1987 TIUS sample are medium/heavy trucks (with GVWR greater than 10,000 pounds). Smaller sample sizes tend to introduce larger variances in the estimates.

(3) There is a four-year lag between the time when NTTIS was designed (trucks were sampled from 1983 R. L. Polk registration data) and the time when it was implemented (truck use information were for the period between 1986 and 1987). Because new truck registrations after 1983 were not included, serious underestimation of the VMTs and the number of trucks could result.

(4) There was serious misclassification of trucks (i.e., straight truck or truck tractor) in the original sampling frame. Though NTTIS estimates were adjusted to account for the misclassification, the estimates are less reliable than if there had been no misclassification.

4.5.2 Strengths

(1) Since daily activities of each sample truck were recorded for one day out of each quarter, NTTIS has a potential to capture seasonal variation in travel activities.

(2) The sampling plan used for NTTIS to select the sample was stratified random sampling - a standard statistical method.

(3) There was also a great deal of effort involved in follow-ups on the sampled vehicles to reduce the nonresponse rates.

Figure 4.3. Data Availability by State, by Carrier Type from NTTIS

✓ : VMT ○ : No. of Trucks Operating in Interstate Commerce ORNL-DWG 89-14377

		Carrier Type	State Registered				Row Total*
			AL	AZ	AR	• • •	
STATE TRAVELED	AL	Private	✓	✓	✓	• • •	✓
		Common	✓	✓	✓	• • •	✓
		Contract	✓	✓	✓	• • •	✓
		Exempt	✓	✓	✓	• • •	✓
	AZ	Private	✓	✓	✓	• • •	✓
		Common	✓	✓	✓	• • •	✓
		Contract	✓	✓	✓	• • •	✓
		Exempt	✓	✓	✓	• • •	✓
	AR	Private	✓	✓	✓	• • •	✓
		Common	✓	✓	✓	• • •	✓
		Contract	✓	✓	✓	• • •	✓
		Exempt	✓	✓	✓	• • •	✓
	• • •	• • •	• • •	• • •	• • •	• • •	• • •
Total		Private	✓	✓	✓	• • •	✓
		Common	✓	✓	✓	• • •	✓
		Contract	✓	✓	✓	• • •	✓
		Exempt	✓	✓	✓	• • •	✓

* Row totals are the parameters of our interest
NTTIS can not separate common and contract carriers

Estimates by state are obtainable. However, the sample size is too small for them to be reliable.

5. HIGHWAY PERFORMANCE MONITORING SYSTEM (HPMS)

5.1 GENERAL INFORMATION

HPMS has been implemented by the FHWA to assess the highway systems by continually monitoring the physical conditions and usage of the systems. More specifically, HPMS is a data collection effort designed to provide current statistics on the mileage and usage of highways, to evaluate highway programs by monitoring changes in highway characteristics and performances, and to improve knowledge of the condition and performance of highway pavements. It also provides a basis for individual states and for the federal government to forecast their highway needs, to evaluate the impacts of existing highway programs and policies, and to plan future highway investment policies.

The HPMS Field Manual and the Traffic Monitoring Guide were developed by the FHWA to guide state Departments of Transportation in the development of state-specific traffic count programs. The state highway agencies in cooperation with local governments prepare HPMS data and submit the data to the FHWA every year before June 15 following the year for which data are being reported. Hence, HPMS is a joint effort of FHWA and all of the state highway agencies, including the District of Columbia and Puerto Rico.

Frequency of Data Collection:

As a continual monitoring system, HPMS collects data on a continual basis.

Availability of Data After Collection:

Sample data become available by October following the year for which data are being reported. Summary statistics which are relevant to this study are published annually in "Highway Statistics" by the FHWA.

5.2 SAMPLE DESIGN

5.2.1 Target Population

The target population for HPMS consists of all highway systems in one of the three areas within each state: (1) rural; (2) small urban, and (3) individual urbanized areas. Within each area, highways are classified according to their functional systems, defined as follows:

- Interstate principal arterial,
- Other principal arterial, including freeways and expressways,
- Minor arterial,
- Major collector,
- Minor collector, and
- Other.

With combinations of area type and functional system, major emphasis is focused on the following eight functional classes:

(1) Urban interstate and other freeway and expressway,

(2) Urban other principal arterials,

(3) Urban minor arterials,

(4) Urban collectors,

(5) Rural interstate,

(6) Rural other principal arterials,

(7) Rural minor arterials, and

(8) Rural collectors.

Unlike other data sources, such as TIUS, NTACS, and NTTIS, which focus on the travel characteristics of individual "vehicles," HPMS focuses on the usage of individual "road sections." However, it should be noted that HPMS does provide information on the amount of travel by vehicle type as given in Table 5.1.

5.2.2 Sampling Frame

From road maps, the boundaries between rural, small urban and urbanized areas using federal-aid boundaries are delimited. The functional systems of highway routes within each area are then identified. Each highway route of a functional system within an area is further broken down to "road sections" based on homogeneity in various characteristics and predetermined ranges in length. Figure 5.1 illustrates the sampling frame for the HPMS. Each element of this frame will be discussed in the subsequent sections.

Table 5.1

HPMS Vehicle Types

Type Code	Type Name and Description
1	Motorcycles (Optional) All two- or three-wheeled motorized vehicles. Typical vehicles in this category have saddle type seats and are steered by handle bars rather than a wheel. This category includes motorcycles, motor scooters, mopeds, motor-powered bicycles, and three-wheel motorcycles. This vehicle type may be reported at the option of the state.
2	Passenger Cars All sedans, coupes, and station wagons manufactured primarily for the purpose of carrying passengers and including those passenger cars pulling recreational or other light trailers.
3	Other Two-Axle, Four-Tire, Single-Unit Vehicles All two-axle, four-tire vehicles, other than passenger cars. Included in this classification are pickups, panels, vans and other vehicles such as campers, motor homes, hearses, El Caminos, Rancheros, ambulances, carryalls, and four-wheel drive vehicles. Other two-axle, four-tire, single-unit vehicles pulling recreational or other light trailers are included in the classification.
4	Buses All vehicles manufactured as traditional passenger-carrying buses with two-axles, six-tires or three or more axles. This category includes only traditional buses functioning as passenger-carrying vehicles. All two-axle, four-tire minibuses should be classified as other two-axle, four-tire, single-unit vehicles. Modified buses should be considered as trucks and be appropriately classified.
5	Two-Axle, Six-Tire, Single-Unit Trucks All vehicles on a single frame including trucks, camping and recreational vehicles, motor homes, etc., having two axles and dual rear wheels.
6	Three-Axle, Single-Unit Trucks All vehicles on a single frame including trucks, camping and recreational vehicles, motor homes, etc., having three axles.
7	Four or More Axle Single-Unit Trucks All trucks on a single frame with four or more axles.
8	Four or Less Axle, Single-Unit Trucks All vehicles with four or less axles consisting of two units, one of which is a tractor or straight truck power-unit.

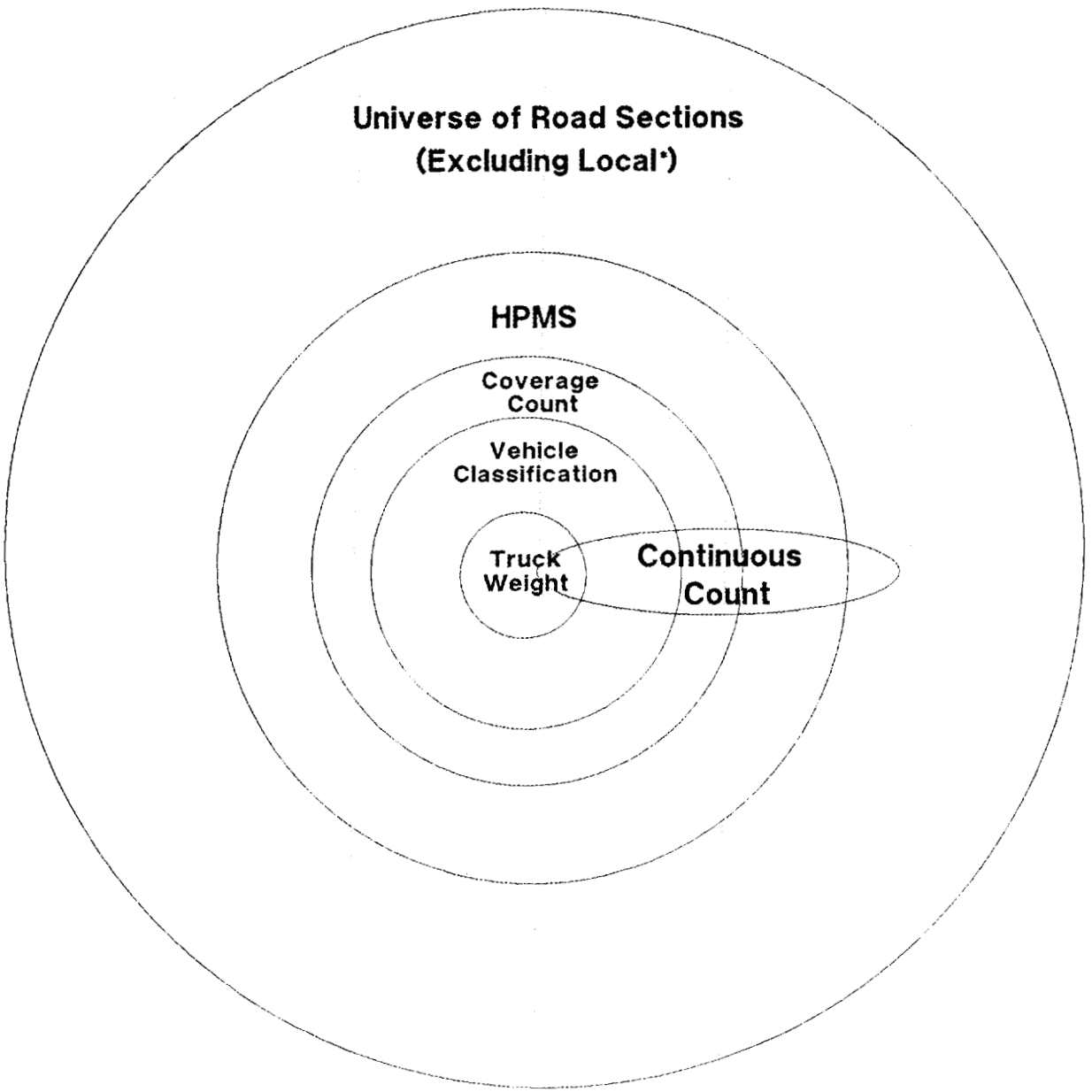
Table 5.1 (Continued)

HPMS Vehicle Types

Type Code	Type Name and Description
9	Five-Axle, Single-Trailer Trucks All five-axle vehicles consisting of two units, one of which is a tractor or straight truck power-unit.
10	Six or More Axle, Single-Trailer Trucks All vehicles with six or more axles consisting of two units, one of which is a tractor or straight truck power-unit.
11	Five or Less Axle, Multi-Trailer Trucks All vehicles with five or less axles consisting of three or more units, one of which is a tractor or straight truck power-unit.
12	Six-Axle, Multi-Trailer Trucks All six-axle vehicle consisting of three or more units, one of which is a tractor or straight truck power-unit.
13	Seven or More Axle, Multi-Trailer Trucks All vehicles with seven or more axles consisting of three or more units, one of which is a tractor or straight truck power-unit.

ORNL-DWG 89-14378

Figure 5.1. Sampling frame for HPMS



*Local includes residential streets and rural roads with very little traffic.

5.2.3 Sample Selection: A Stratified Probability Proportional to Size Design

Once the highway routes are classified by area and by functional system, they are assigned to predetermined Annual Average Daily Traffic (AADT)[12,13] volume groups. Hence, a stratum is defined as a volume group within a functional system and an area type. The road sections within each stratum are determined so that they are relatively homogeneous in terms of geometry, traffic volume, cross section, etc., and should range from 0.3 to 10.0 miles for rural sections and 0.1 to 5.0 miles for urban sections.

Within each stratum, road sections are arranged so that cumulative mileage can be calculated. A probability sample of road sections is selected from each stratum. The selection of the sample is in such a way that the longer the road section is the higher the probability it has of being selected for the sample. This can be done by either of the two recommended approaches.[14] If less than 1 percent of the total section mileage is sampled, more road sections are sampled until at least 1 percent of the total section mileage in a stratum are included. Figure 5.2 demonstrates the sample selection procedure for the HPMS.

5.2.4 Sample Size Determination

The coefficients of variation of AADT for each stratum is used to determine the sample size for that stratum. AADT's are usually determined based either on historical data or on professional judgments. The sample sizes for each stratum are derived from the following formula[15]:

$$n = \frac{A}{1 + (1/N)(A - 1)} \qquad (5.1)$$

and

---

12 See Appendix K of "Highway Performance Monitoring System: Field Manual for the Continuing Analytical and Statistical Data Base." U. S. Department of Transportation, Federal Highway Administration, December 1987, for details.

13 "Traffic Monitoring Guide," U. S. Department of Transportation, Federal Highway Administration, June 1985.

14 See Appendix H of "Highway Performance Monitoring System: Field Manual for the Continuing Analytical and Statistical Data Base," U. S. Department of Transportation, Federal Highway Administration, December 1987.

15 Cochran, Sampling Techniques, John Wiley & Sons, 1977.

$$A = \frac{Z_\alpha^2 \, (CV)^2}{d^2} \qquad (5.2)$$

where

Z_α = standard normal deviate for an α confidence interval (two-side),
n = required sample size ($n \geq 3$),
CV = AADT coefficient of variation from a state's AADT data,
d = desired precision level,[16]
N = stratum population size (i.e., the number of road sections available for sampling in a stratum).

The CV's are updated every year based on the latest state data.

5.3 SURVEY METHOD

5.3.1 Data Collection Procedure

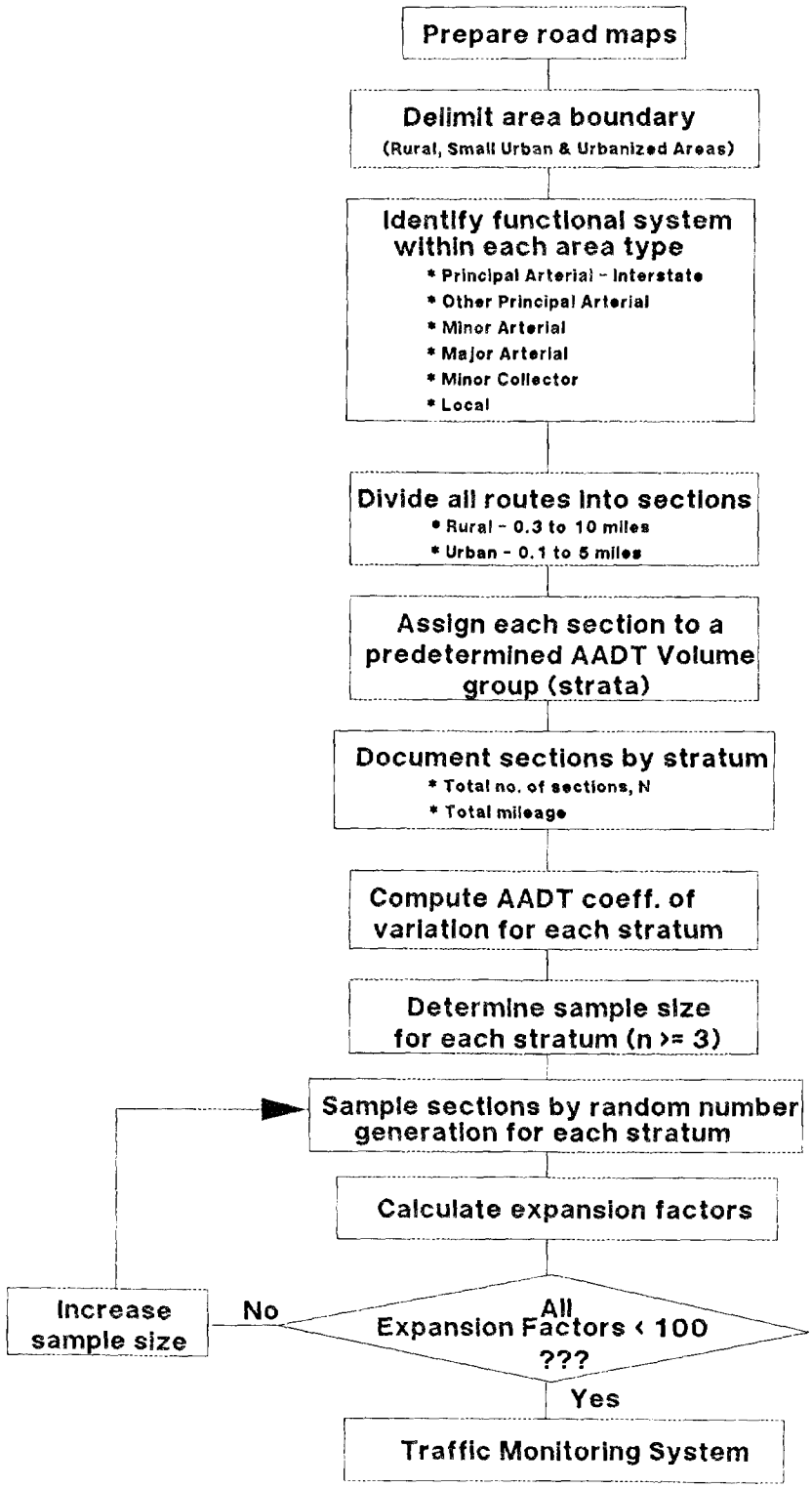
Data are collected under three traffic count programs: (1) coverage count program, (2) continuous count program, and (3) vehicle classification count program. Figure 5.3 illustrates the HPMS data collection process. The continuous count program collects continuous traffic counts (in terms of the total number of axles passing through a monitoring point) by using Automatic Traffic Recorders for at least 14 consecutive days in a month. Data from this program are used to determine the "baseline" travel pattern which includes seasonal, day-of-week traffic patterns as well as growth factors (or trend). Since the enormous costs in implementing continuous programs prohibit a large sample size, the selection of sample sections to implement continuous programs tends to be based on cost-effectiveness, and most of the continuous programs are likely lacking an ideal statistical base. According to the FHWA, a typical state has between 30 to 50 continuous counters distributed throughout the state to collect continuous traffic counts.

---

16 See Appendix F of "Highway Performance Monitoring System: Field Manual for the Continuing Analytical and Statistical Data Base." U. S. Department of Transportation, Federal Highway Administration, December 1987, for details.

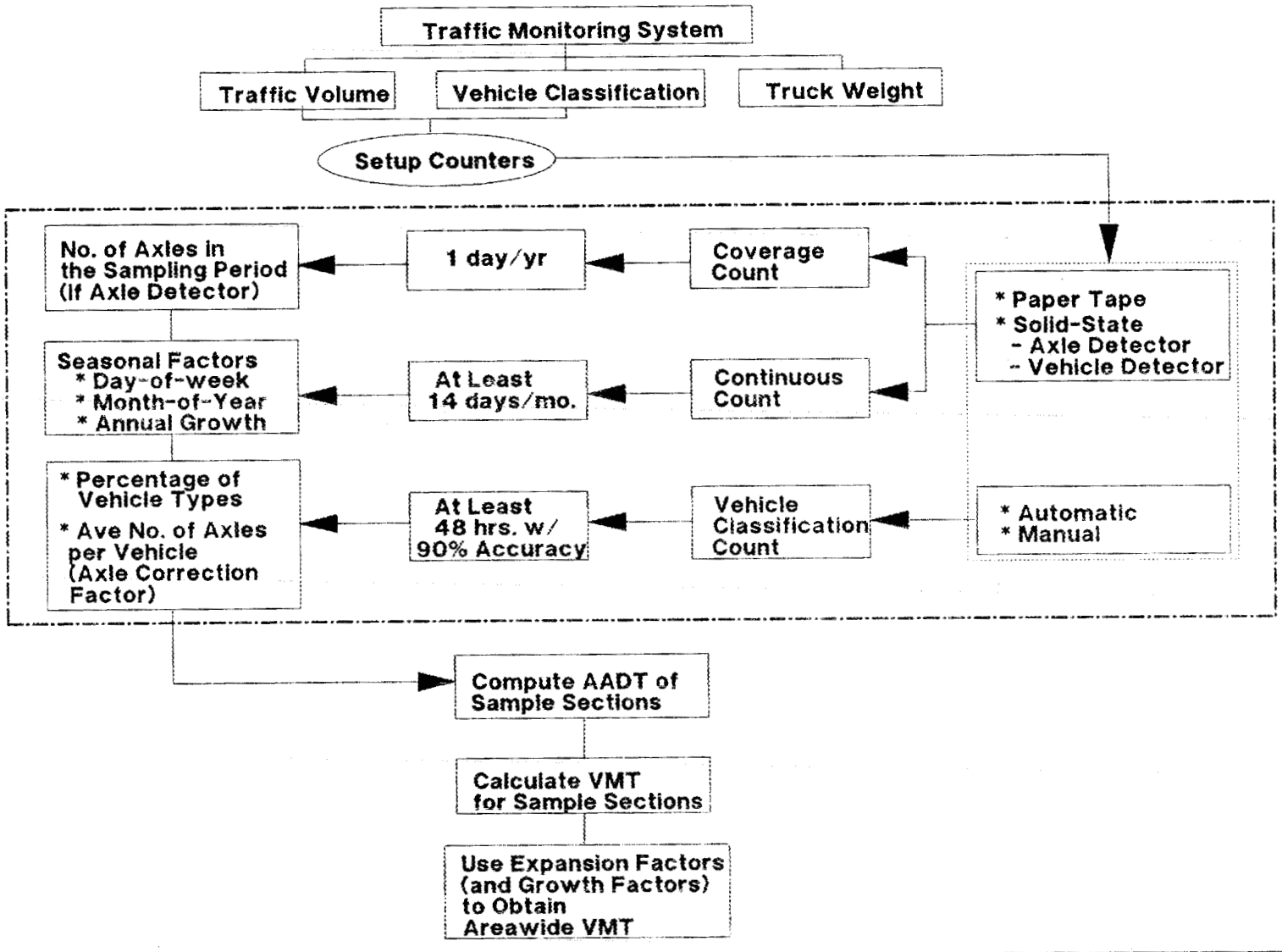
ORNL-DWG 89-14379

Figure 5.2. Outline of HPMS Sample Data Preparations



ORNL-DWG 89-14380

Figure 5.3. HPMS Traffic Count and Vehicle Classification Collection Process



On the other hand, coverage count programs are implemented on selected road sections (as described in Section 5.2.3) to collect traffic count data for a one-day period. These data are then used in conjunction with the baseline data (from a continuous count program) to establish annual traffic counts for these road sections.

The vehicle classification count program is in place: (1) to calculate the "average number of axles per vehicle," and (2) to obtain percentages of each vehicle type in a given stratum. Traffic Monitoring Guide (TMG) suggests that the vehicle classification sample consists of 300 48-hour measurements over a 3-year cycle (i.e., 100 per year). Ideally, these 300 sites are randomly selected across each functional class, area type, and volume group. However, procedures in TMG recommend the use of existing monitoring sites (i.e., weight, ATR's, speed, etc.) to augment HPMS sample size or perhaps to replace HPMS sample sites if the existing sites conform or are close to the HPMS sites. Engineering judgments are involved in the sample selection procedures to ensure representativeness of these 300 sites.

Based on axle count and speed of the vehicle, automatic classification equipment is used first to determine the length of the wheelbase. Then, a classification algorithm is used to categorize each vehicle into one of the 13 vehicle types based on the axle count and the length of the wheelbase. A study conducted by Maine's Department of Transportation concluded that four of the tested vehicle classification systems were able to correctly classify more than 91 percent of the vehicles, which meets the 90 percent accuracy level required by the HPMS.[17] However, one of the tested systems failed to correctly classify 13 percent of the vehicles. Another study conducted by Kansas' Department of Transportation pointed out that (1) the accuracy level of classifying passenger vehicles was 97.6 percent, (2) truck-trailer combinations were accurately classified over 91 percent of the time, and (3) the tested equipments had a tendency to undercount heavy single unit trucks with an error up to 33.6 percent.[18] Both studies showed that all tested systems had problems with slow-moving vehicles (less than 20 mph) and vehicles in queues. The studies also noted that considerable

---

[17] "Field Evaluation of FHWA Vehicle Classification Categories," Maine Department of Transportation, January 1985.

[18] "Accuracy of the Streeter-Richardson Traficomp System Used As a Vehicle Classifier," Kansas Department of Transportation, February 1989.

improvements in classifying longer and multiple axle vehicles were evident since the last study conducted by the Maine Department of Transportation in 1982.

The "average number of axles per vehicle," called the "Axle Correction Factor" in HPMS, is used to convert the total number of axles collected from the first two programs into the total number of vehicles. For example, if a total of 2,000 axles were counted passing through a monitoring point in a given stratum and if the "Axle Correction Factor" for that stratum is 2.03 axles per vehicle, then the estimated number of vehicles traveled in that stratum during the monitoring period is 985 (=2,000/2.03). Appendix 5 illustrates how the "axle correction factor" is determined.

Prior to 1988, vehicles in the FHWA publications were classified into eight vehicle types in which three of them were truck types. Currently, the classification scheme has been modified based on FHWA's recommendation to include 13 vehicle types in which ten of them are truck types (Table 5.1). States report their HPMS data annually to the FHWA both on magnetic tape and standard forms which are given in Appendices 6 through 8.

5.3.2 Response Rate

Both hardware and software failures cause nonresponses in HPMS. However, the level of nonresponses cannot be determined without an in-depth study.

5.4 ESTIMATION PROCEDURE

The expansion factor, the ratio of the **total** mileage in a stratum to the total **sampled** mileage in that stratum, is used to expand sample data to represent the entire stratum. The total DVMT (Daily Vehicle Mile of Travel) of sample sections in a given stratum is first calculated by summing the products of the estimated number of vehicles in the sample road section in that stratum and the length of that section of road. The estimated stratum DVMT can be developed by multiplying the total sample section DVMT by the corresponding expansion factor. The estimated stratum VMT is simply the sum of its 365 stratum DVMTs. The state VMT can be obtained by summing up all of the stratum VMTs in that state.

5.5 EVALUATION RESULTS

Since the HPMS collects mileage data from all vehicles that travel on the highway systems, it is not clear how to disaggregate HPMS' data so they can provide information for VMT estimates of trucks operating in interstate commerce only. However, it may be possible to use HPMS' data in conjunction with other data sources to provide conservative upper bounds of these VMTs. Figure 5.4 shows that HPMS alone cannot provide any estimate of the number of large commercial trucks and of the associated VMTs by state and by carrier type without using information from other data sources. More specific limitations and strengths are documented below.

5.5.1 Limitations

Some limitations were identified if data from HPMS are to be used to estimate the number of trucks operating in interstate commerce with GVWR greater than 10,000 pounds and the associated VMTs. They are:

(1) One will have to use the data "as is" without knowing the **actual** sampling procedure and the **actual** expansion factors used to expand the sample data. However, it should be pointed out that 30 to 40 states currently are in or working towards compliance with the HPMS Field Manual and Traffic Monitoring Guide, and FHWA is actively working with the remaining states to bring them into compliance with the HPMS data collection procedures.[19]

(2) One will have to use the data "as is" without knowing the accuracy of the **actual** algorithm used by individual states in the vehicle classification scheme nor how the "axle correction factor" was developed for each stratum in converting the total traffic count data to the number of vehicles. For example, as indicated in Hallenbeck and Bowman,[20] some states simply assume the "axle correction factor" to be 2.0 which will be correct only if there are no multi-axle vehicles in the population.

---

[19] Letter from Director David R. McElhaney, Office of Highway Information Management in the FHWA to ORNL, dated June 20, 1989.

[20] Hallenbeck, M. E. and L. A. Bowman, "Development of A Statewide Traffic Counting Program Based On the Highway Performance Monitoring System," U. S. Department of Transportation, Federal Highway Administration, March 1984.

Figure 5.4. Data Availability by State, by Carrier Type from HPMS

✓ : VMT ○ : No. of Trucks Operating in Interstate Commerce ORNL-DWG 89-14381

		Carrier Type	State Registered				Row Total *
			AL	AZ	AR	• • •	
STATE TRAVELED	AL	Private					
		Common					
		Contract					
		Exempt					
	AZ	Private					
		Common					
		Contract					
		Exempt					
	AR	Private					
		Common					
		Contract					
		Exempt					
	• • •	• • •					
Total		Private					
		Common					
		Contract					
		Exempt					

* Row totals are the parameters of our interest

HPMS can not provide any information in this table without using information from other data sources.

(3) There is no indicator in the HPMS data to distinguish VMT traveled by interstate versus intrastate motor carriers.

(4) There is no indicator as to the type of carrier, i.e., common, contract, or private.

(5) The number of interstate motor carriers traveled in a given state cannot be obtained or estimated from HPMS data.

(6) Data are subject to errors in both hardware and software operations. The two most common errors are malfunctioning during the collection process and errors in the data transfer process.

(7) The HPMS provides data on the total vehicle mileage by vehicle type, but not on the total number of vehicles by vehicle type.

The combination of Limitations (1) and (2) raises uncertainty and concern to some extent with respect to the accuracy and the reliability of HPMS data.

5.5.2 Strengths

(1) HPMS has reported traffic count data continually since 1978. Therefore, there is no need to estimate data for any intermittent years.

(2) HPMS covers every state.

(3) The Field Manual of the HPMS describes and recommends a statistically sound sampling plan for each state to follow. In addition, more than three quarters of the states are in or working towards compliance with the Field Manual.

(4) Since the data collection and data transferring procedures are mechanical, there is no human judgment error involved in collecting the traffic count data. This does not mean, however, that there are no errors in assigning locations for the traffic counters, nor in converting traffic count data to VMTs, nor in the estimation procedures.

(5) The accuracy of the automatic vehicle classification equipment is very dependent on how well the classification algorithm used to place a vehicle into the 13 vehicle types represents a state's traffic mix. Currently, the FHWA is attempting to standardize this algorithm.

6. STATE FUEL TAX REPORTS

6.1 GENERAL INFORMATION

Each state collects fuel taxes or compatible taxes (i.e., weight-distance tax) from vehicles which travel in its jurisdiction for the privilege of using its highway system. Each state has different taxation requirements, tax structures, and administrative agencies. In 1988, FHWA compiled a comprehensive report ("Highway Taxes and Fees" - Publication No. FHWA-PL-88-017) to summarize how highway taxes are collected and distributed. Table 6.1 (Table MF-104 of the FHWA report) lists the special motor fuel tax provisions for interstate motor carriers.

Frequency of Data Collection:

Most of the states collect fuel tax reports on a quarterly basis while the remaining states collect on a monthly or annual basis.

Availability of Data After Collection:

Data availability varies from state to state. Appendix 9 lists the states which are able and willing to provide fuel tax reports.

In 1983, the International Fuel Tax Agreement (IFTA) was formed to assist inter- and intra-state fuel tax collection processes. The main purposes of this Agreement are (1) to uniform the administration of motor fuels use taxation laws with respect to motor vehicles operated in interstate commerce, (2) to enable participating jurisdictions to act cooperatively and provide mutual assistance in the administration and collection of motor fuels use taxes, and (3) to establish and maintain the concept of one license and administering base jurisdiction for each license.[21] Currently, IFTA has ten participating state members, and approximately ten more states are expected to become members of the IFTA by 1991. The concept of IFTA and the vehicles included in this Agreement is similar to that used in the International Registration Plan (IRP) which will be discussed in the next Chapter.

---

21 "Articles of Agreement: International Fuel Tax Agreement," May 1989.

Table 6.1
Special Motor Fuel State Tax Provisions
for Interstate Motor Carriers[1]

State	Vehicles Affected	Payment Period	Data Availability[2]
Alabama	Buses, road trucks, tractor trucks, and trucks with more than 2 axles except for publicly-owned vehicles and school buses.	Quarterly	VMT not available
Alaska	-	-	-
Arizona	Special-fuel vehicles	Monthly, quarterly, annually and semi-annually	VMT available
Arkansas	All	Quarterly	VMT not available
California	Special-fuel vehicles	Monthly	VMT not available
Colorado	Motor trucks and buses	Monthly	Gallonage available
Connecticut	Buses, road tractors, tractor trucks or any truck having a registered GVW of 18,000 lbs. or an empty weight over 7,500 lbs.	Quarterly	VMT available
Delaware	A bus operated by a common carrier, with a seating capacity greater than 20 passengers, any road tractor or any truck trailer, or any truck having more than 2 axles and which is propelled by motor fuel	Quarterly, (annually if $100 or less)	VMT available
Dist of Col.	Interstate buses	Monthly	Not contacted
Florida	Commercial vehicles	Annually, Semi-annually or Quarterly	Could not be contacted
Georgia	Buses, road trucks, tractor trucks and trucks with more than 2 axles except publicly-owned vehicles and school buses	Quarterly	VMT not available

Table 6.1 (Continued)

State	Vehicles Affected	Payments Period	Data Availability
Hawaii	-	-	-
Idaho	All	Quarterly	VMT available
Illinois	All	Monthly	VMT available
Indiana	Buses seating more than 9 passengers, road trucks, tractor trucks, trucks with more than 2 axles, trucks having a GVW greater than 26,000 lbs., and vehicles used in combination if the GVW of the combination is greater than 26,000 lb	Quarterly	VMT available
Iowa	Commercial vehicles	Quarterly	VMT available
Kansas	Passenger vehicles seating more than 20 passengers plus a driver, trucks with over 2 axles, road and truck tractors, and 2 axle trucks registered with a GVW of more than 12,000 lbs. and used in combination with another vehicle	Quarterly, or annually if less than $100	Gallonage available
Kentucky	All	Quarterly	VMT available
Louisiana	All	Monthly	Gallonage available
Maine	Common and contract carriers for which a permit is required and trucks, tractors, and semi-trailers licensed for over 20,000 lbs. GVW if gasoline-powered; 7,000 lbs. if special-fuel powered	Quarterly	VMT not available
Maryland	Buses with over 15 passengers (14 plus driver) capacity, tractor trucks, available or trucks with over 2 axles	Monthly or quarterly	VMT may be
Massachusetts	All except passenger cars with fuel tank capacity of 30 gallons or less	Quarterly	No information is available to us
Michigan	All	Monthly	VMT available

Table 6.1 (Continued)

State	Vehicles Affected	Payments Period	Data Availability
Minnesota	All vehicles over 26,000 lbs.; seats for 20 or more persons	Quarterly	VMT not available
Mississippi	Common, contract, private commercial carriers and private carriers over 24,000 lbs. GVW	Quarterly	VMT not available
Missouri	All	Quarterly	VMT not available
Montana	All	Quarterly	Gallonage available
Nebraska	All except those delivering products within 5 miles of the border, or private passenger vehicles	Monthly or quarterly	
Nevada	All	Gasoline - monthly; Special fuel - quarterly	VMT available
New Hampshire	All special-fuel commercial vehicles (in-state and out-of-state which need a user's license), out-of-state special fuel passenger carrying pleasure vehicles are not required to have a user's license	Quarterly	Gallonage available
New Jersey	Buses, road tractors, tractor trucks, and trucks with more than 2 axles	Quarterly	VMT not available
New Mexico	All	Quarterly	VMT available
New York	Vehicles subject to highway use tax and all omnibuses	Quarterly	VMT not available
North Carolina	Buses with over 20-passenger capacity, tractor trucks, and trucks with more than 2 axles	Quarterly	VMT available
North Dakota	All vehicles having 2 axles and a weight exceeding 26,000 lbs. or having 3 or more axles regardless of weight	Quarterly	VMT not available

Table 6.1 (Continued)

State	Vehicles Affected	Payments Period	Data Availability
Ohio	Interstate buses	90 days after August 31	VMT available
Oklahoma	All	Gasoline and diesel - quarterly; Special fuel - monthly	VMT available
Oregon	No fuel tax in this state, but a Weight-Mile tax is levied on trucks	Monthly	VMT available
Pennsylvania	Truck, truck-tractor combination having a GVW of 17,001 lbs. or more	Quarterly	VMT **not** available
Rhode Island	Trucks weighing 7,500 lbs or more empty or having a fuel tank of 30 gallons or more capacity	Quarterly	Revenue available
South Carolina	Gasoline buses, tractor trucks, and trucks with more than 2 axles and all nongasoline powered trucks	Quarterly	VMT may be available
South Dakota	All, except gasoline-powered vehicles	Quarterly	VMT available
Tennessee	Property carriers of over 26,000 lbs. GVW, or with 3 or more axles	Quarterly	VMT **not** available
Texas	Vehicles with fuel supply tank capacity of 60 gallons or more operated for commercial purposes	Quarterly	VMT **not** available
Utah	Special-fuel vehicles	Quarterly	Revenue available
Vermont	Motor trucks grossing 7,000 lbs. or over and motor buses not registered in Vermont	Quarterly	VMT **not** available
Virginia	Road tractors, tractor trucks, and trucks with more than 2 axles	Quarterly	VMT available

Table 6.1 (Continued)

State	Vehicles Affected	Payments Period	Data Availability
Washington	Commercial gasoline vehicles except automobiles, and special-fuel vehicles except private automobiles	Varies from monthly to annually	VMT available
West Virginia	Buses with over 9-passenger capacity, tractor trucks and any truck with over 2 axles	Quarterly	VMT available
Wisconsin	All	Quarterly	VMT not available
Wyoming	Special-fuel vehicles	Monthly	VMT available

[1] Data are from Table MF-104, "Highway Taxes and Fees," Publication No. FHWA-PL-88-017.

[2] Where VMT is available, see Appendix 9 for specific information on acquiring data from each state.

6.2 SAMPLE DESIGN

6.2.1 Target Population

The target population for the state fuel tax reports consists of all vehicles that are subject to state fuel taxes. Taxation requirements vary from state to state. Some states tax vehicles which are diesel powered; some states tax vehicles with GVWR greater than 18,000 pounds; some states tax vehicles which are interstate buses, etc.

However, under IFTA the target population includes any vehicle operating in interstate commerce that:

(1) has two axles and GVWR exceeding 26,000 pounds, or

(2) has three or more axles regardless of vehicle weight, or

(3) is used in a combination when GVWR of such combination exceeds 26,000 pounds.

6.2.2 Sampling Frame

The sampling frame for the state fuel tax reports are the state fuel tax reports themselves.

6.2.3 Sample Selection

Because state fuel taxes are mandatory reporting systems, there is no sample selected.

6.2.4 Sample Size Determination

Because there is no sample selection process, there is no sample size determination.

6.3 SURVEY METHOD

6.3.1 Data Collection Procedure

Operators of vehicles which are subject to state fuel taxes or compatible taxes file tax reports on either a quarterly, annual, or monthly basis depending on state-specific requirements. The total number of **taxable** gallons of fuel consumed for in-state travel during the last period is used to calculate the appropriate fees. In addition, some states require data on the total number of gallons consumed regardless of where the gallons are

consumed, vehicle type, operation type, etc. It should be pointed out once again that since each state administers its own fuel tax reporting program, there is a significant degree of diversity among states with respect to fuel tax data.

6.3.2 Response Rate

Since state fuel tax reporting is mandated by the state, every vehicle that is subject to a state fuel tax or compatible tax is required by law to file a tax report or to pay the taxes by other methods, such as the payments at the ports of entry. Because this reporting is mandated by law, the response rates for state fuel tax reports are almost 100 percent for all states.

6.4 ESTIMATION PROCEDURE

State fuel taxes are calculated based on state tax rates, vehicle characteristics (e.g., vehicle configuration, GVWR), and the number of **in-state** taxable gallons of fuel. The only parameter that needs estimation is the number of in-state taxable gallons of fuel consumed. Under the states' rigid auditing, underestimates in gallonage are not likely.

6.5 EVALUATION RESULTS

Figure 6.1 demonstrates the data item availability of the state fuel tax or compatible tax data in terms of their ability to estimate the number of large commercial trucks and the associated VMTs by state and by carrier type. More specific limitations and strengths are documented below.

6.5.1 Limitations

(1) There are different taxation requirements from state to state, and this causes incompatibility among individual state fuel tax data. For example, while the state of Arkansas taxes all of the interstate motor carriers, California only taxes special-fuel vehicles; while Minnesota uses 26,000 pounds GVWR as a cut-off point, Pennsylvania uses 17,000 pounds GVWR.

Figure 6.1. Data Availability by State, by Carrier Type from Fuel Tax Report

✓ : VMT ○ : No. of Trucks Operating in Interstate Commerce ORNL-DWG 89-14382

		Carrier Type	State Registered								Row Total*
			AL	AZ	AR	• • •	IL	• • •	VA	• • •	
STATE TRAVELED	AL	Private									
		Common									
		Contract									
		Exempt									
	• • •	• • •									
	IL	Private									✓
		Common									
		Contract									
		Exempt									
	• • •	• • •									
	VA	Private							✓		✓
		Common									
		Contract							✓		
		Exempt									
	• • •	• • •									
Total		Private					✓		✓		
		Common									
		Contract					✓		✓		
		Exempt									

* Row totals are the parameters of our interest
So far, only two states, IL & VA, interviewed are able to separate inter- and intrastate VMT (can not distinguish by carrier type).
Number of trucks are not available.

(2) Data availability and data items collected for tax purposes vary from state to state. Forty percent of the states do not have any mileage statistics from the fuel tax reports, while five states keep data on the number of gallons purchased/used, and four have tax revenue data.

(3) In order to convert the number of gallons or tax revenue data to VMTs, unverifiable and outdated fuel economies (MPG) are frequently used. The improved fuel economies of large trucks, though small but not negligible, and the major shift toward diesel-power trucks over the past decade (as showed in Figure 6.2) might lead to underestimations of large truck VMTs.

(4) In some states, there are optional ways to pay fuel tax, thus not all truck mileage is accounted for in the fuel tax report.

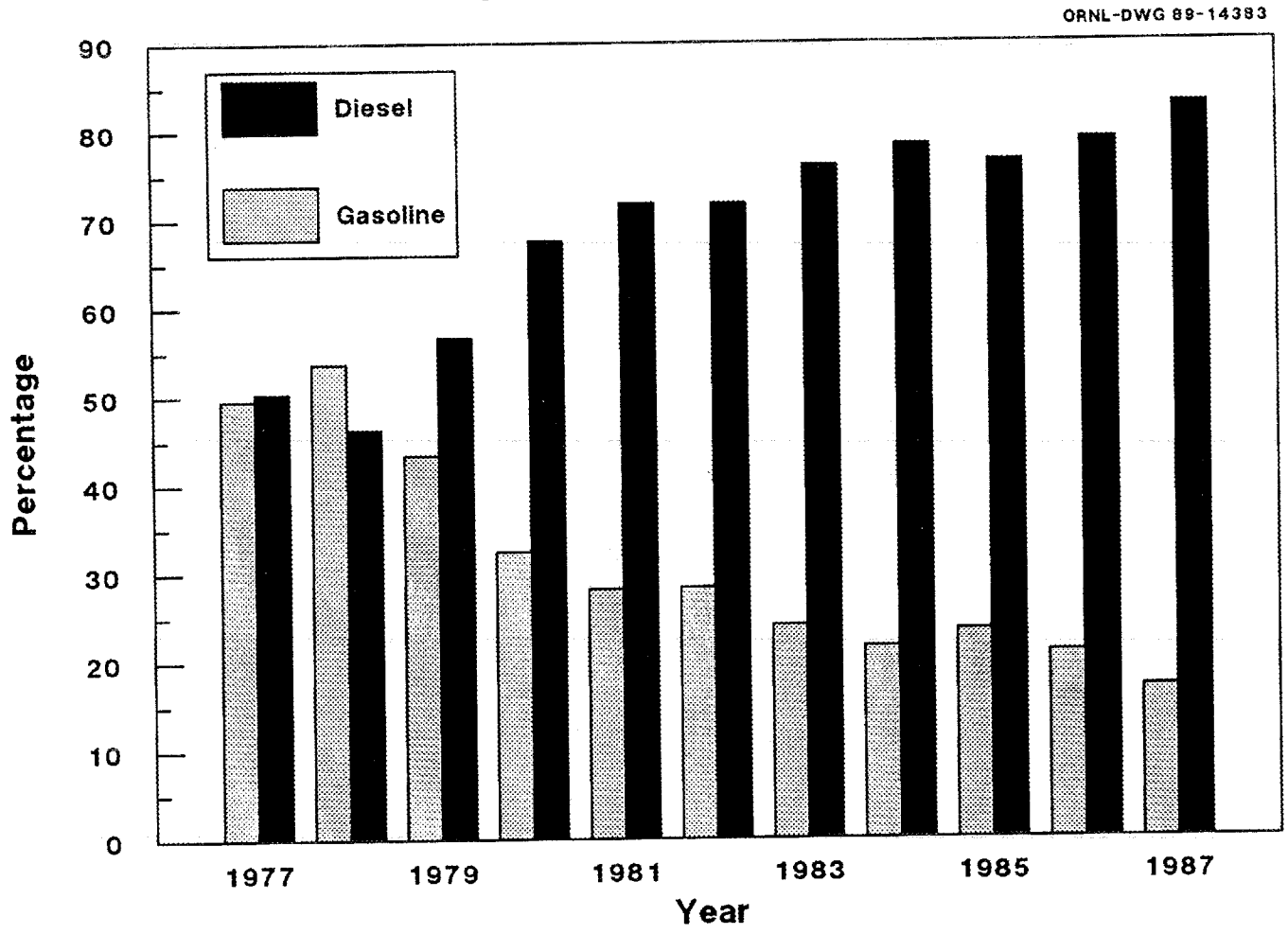
(5) Many states' mileage statistics are for intra- and interstate motor carriers combined. In those cases, the interstate mileage cannot be readily separated from the intrastate mileage.

6.5.2 Strengths

The only strengths of state fuel tax reports in estimating the number of trucks operating in interstate commerce with GVWR greater than 10,000 pounds and the associated VMTs are that state fuel tax reports are collected continually and every state has some sort of fuel taxation.

However, once most of the states become IFTA members, it will be possible to use IFTA data in conjunction with other data sources to estimate the number of trucks operating in interstate commerce and the associated VMTs.

Figure 6.2. Shares of Medium/Heavy Trucks (GVW > 10K) by Fuel Type, 1977-1987



Source: Motor Vehicle Manufacturers' Association, Motor Vehicle Facts and Figures '88, Detroit, MI, 1988.

7. INTERNATIONAL REGISTRATION PLAN (IRP)

7.1 GENERAL INFORMATION

The International Registration Plan (IRP) is a registration reciprocity agreement among states of the United States and provinces of Canada. It provides payment of license fees on the basis of fleet mileage operated in various jurisdictions. IRP, initiated in 1973, is designed specifically for interstate motor carriers. It is operated under the guidance of the American Association of Motor Vehicle Administrators (AAMVA). As of the end of 1988, there were 39 states and one Canadian province participating in the Plan.

The Western Prorate Agreement (WPA), formally the Uniform Vehicle Registration Proration and Reciprocity Agreement, started in 1956 among nine western states. Under this agreement, fleets of vehicles are proportionally registered in those member states in which they operate. Currently, 20 states and two Canadian provinces participate in the Agreement. Table 7.1 summarizes the participation status of individual states in IRP and/or WPA.

Under IRP, a truck operator files a single registration in his/her base state and receives a base state plate and a cab card. This method of registering vehicles eliminates several layers of paper handling for both operators and state highway agencies.

Frequency of Data Collection:

Licence fees are collected annually for the period between July 1 to June 30 of the next year based on fleet mileage accrued during the previous period.

Availability of Data After Collection:

Data availability varies from member to member. Some members are able to provide data immediately after the registration period on computerized format. On the other hand, some members do not have adequate resources to prepare the data for external requests. In these cases, the time lag between data collection and assimilation can be as much as six months.

Table 7.1
International Registration Plan Members
And/Or
Western Prorate Agreement Members

State	IRP[1]	WPA[2]
Alabama	Y	
Alaska		Y
Arizona	Y	Y
Arkansas	Y	
California	Y	Y
Colorado	Y	Y
Connecticut	Y	
Delaware		
Dist of Col.		
Florida	Y	
Georgia		
Hawaii		
Idaho	Y	Y
Illinois	Y	Y
Indiana	Y	
Iowa	Y	Y
Kansas	Y	Y
Kentucky	Y	
Louisiana	Y	

Table 7.1 (Continued)

State	IRP	WPA
Maine		
Maryland	Y	
Massachusetts		
Michigan	Y	
Minnesota	Y	Y
Mississippi	Y	
Missouri	Y	Y
Montana	Y	Y
Nebraska	Y	Y
Nevada		Y
New Hampshire		
New Jersey		
New Mexico		Y
New York	Y	
North Carolina	Y	
North Dakota	Y	Y
Ohio		
Oklahoma	Y	
Oregon	Y	Y
Pennsylvania	Y	
Rhode Island		

Table 7.1 (Continued)

State	IRP	WPA
South Carolina	Y	
South Dakota	Y	Y
Tennessee	Y	
Texas	Y	
Utah	Y	Y
Vermont	Y	
Virginia	Y	
Washington	Y	Y
W. Virginia	Y	
Wisconsin	Y	
Wyoming	Y	Y

[1] IRP = International Registration Plan
[2] WPA = Western Prorate Agreement
* Note: Y = Yes

7.2 SAMPLE DESIGN

7.2.1 Target Population

The target population includes any vehicle operating in interstate commerce that:

(1) has a power unit which is greater than 26,000 pounds; or

(2) has a power unit which has three or more axles, regardless of weight; or

(3) when used in combination with tractors, has a combined weight greater than 26,000 pounds.

For vehicles not included in these categories, the registration is optional.

7.2.2 Sampling Frame

The sampling frame for IRP is the collection of the IRP application forms.

7.2.3 Sample Selection

Since IRP is a vehicle registration plan required by the state governments of the IRP members, there are no sampling procedures.

7.2.4 Sample Size Determination

Similar to Section 7.2.3, no sample size determination is involved.

7.3 SURVEY METHOD

7.3.1 Data Collection Procedure

Under the IRP, a carrier registers vehicle fleets in his/her base state. A base state is determined using three criteria:

- where the registrant has an established place of business, or
- where most of the mileage is accrued by the fleet, or
- where operational records of the fleet are maintained or can be made available.

Carriers file the vehicle registrations to their base states prior to July 1 every year for the period between July 1 to June 30 of the next year. On the registration forms, the carriers provide information on the total fleet mileage, number of trucks in the fleet (fleet

size), vehicle type, carrier operation type, individual IRP jurisdictions and non-IRP states in which the fleet will be operating, and the percentages of their operation in these IRP jurisdictions and non-IRP states. Appendix 10 shows an example of the IRP registration form.

Registration fees are calculated based on: (1) the percentage of in-state mileage and the base state fee, (2) the percentage of non-IRP mileage and the base state fee, and (3) the percentage of mileage accrued in each IRP member jurisdiction and the corresponding fee. The base state usually collects the total fees and retains revenues attributable to in-state mileage and mileage occurring outside the IRP jurisdictions. The amount of fees due other IRP jurisdictions are forwarded to relevant IRP jurisdictions.

7.3.2 Response Rate

Since IRP is a mandatory vehicle registration plan in all of the IRP member states, no response rate is involved.

7.4 ESTIMATION PROCEDURE

Unlike other chapters, discussions in this section pertain to the estimation procedure as to how registrants report mileage, which is used to determine the license fees.

Under the current procedure, a carrier can apportion his registration using an estimation of travel based on a historical travel pattern with no penalty for the first year that a carrier registers under the IRP. Hence, the carrier is not subject to audit and reconciled fees. For subsequent years, the registrant reports the actual mileage that accrued in each state based on its travel during the previous year. Thus, the registration fee for year t for a carrier is based on actual mileage for year t-1. Registrants are required to maintain travel logs of the past three years for possible audits conducted by individual states.

7.5 EVALUATION RESULTS

Figure 7.1 demonstrates the data item availability of the IRP data in terms of its ability to estimate the number of large commercial trucks and the associated VMTs by state and by carrier type. More specific limitations and strengths are documented below.

7.5.1 Limitations

(1) Only 39 states and 1 Canadian province are IRP members; 20 states and 2 provinces are participating in the Western Prorate Agreement. There are 10 states which do not participate in either agreement. VMTs of vehicles from states which do not participate in these agreements are not available. Hence, none of the states will have complete VMT estimates (total number of miles traveled in a given state). Figure 7.1 illustrates this point. For example, in order to estimate the VMT traveled in the state of Alabama, one needs to sum the truck mileage traveled in the state of Alabama by all vehicles registered in any one of the continental states. "Row Totals" labelled at the right margin of Figure 7.1 are the parameters of interest. While VMT traveled in Alabama by vehicles of IRP member states are readily available, similar information is not available for vehicles of non-IRP states. Hence, even for an IRP state, the total truck mileage traveled in that state is not readily obtainable. One alternative, if IRP data are to be used, is to estimate the truck mileage traveled in the state by vehicles registered in non-IRP states using other data sources discussed in this memorandum.

(2) "Gross Vehicle Weight" that IRP member states use to determine IRP registrant's eligibility is interpreted differently from state to state. Most of the states interpret "GVW" as the weight of the vehicle when loaded to its capacity (i.e., maximum GVW). However, there are a few states that use the total unladen weight (the weight of the vehicle fully equipped except for the weight of any load); while some use the average

gross vehicle weight (the sum of the unladen weight and the average weight to be carried on the vehicle).[22]

(3) Mileage that occurs under temporary trip permits, although negligible, are not accounted for in these agreements.

(4) Registration for vehicles less than 26,000 pounds is optional in IRP, and this causes VMTs to be somewhat underestimated. Based on the data from 1982 TIUS, only 2.7 percent of total medium and heavy trucks (with GVWR greater than 10,000 pounds) are less than 26,000 pounds, but they contribute to 10 percent of the total VMT by trucks with GVWR greater than 10,000 pounds.

(5) The number of trucks of interstate motor carriers that traveled in a given state will be considerably overestimated if each vehicle of the fleet is assumed to travel in all jurisdictions where vehicle registration fees are prorated.

7.5.2 Strengths

(1) The data collection method is not subject to sampling error, although intentional or unintentional human errors might be possible.

(2) It is possible to distinguish VMTs between inter- and intrastate motor carriers. IRP data tape was obtained from the state of Alabama and Table 7.2 lists VMT estimates of all Alabama-based motor carriers by jurisdiction.

(3) There is an indicator in the data base to identify the carrier type.

(4) It is a **mandatory reporting system** for vehicles which are based in IRP member states, that carry commodities in interstate commerce, and that are over 26,000 pounds in GVWR.

(5) Data are available on an annual basis.

---

22 "Proportional Registration Manual," Department of Revenue, Motor Vehicle Division, State of Tennessee, 1989.

Figure 7.1. Data Availability by State, by Carrier Type from IRP

✓ : VMT ○ : No. of Trucks Operating in Interstate Commerce ORNL-DWG 89-14384

		Carrier Type	State Registered							Row Total*
			IRP States				Non-IRP States			
			AL	AZ	AR	• • •	GA	MA	• • •	
STATE TRAVELED	AL	Private	✓	✓	✓	• • •	N/A			
		Common	✓	✓	✓	• • •				
		Contract	✓	✓	✓	• • •				
		Exempt	✓	✓	✓	• • •				
	AZ		•	•	•					
	AR		•	•	•					
	• • •									
	GA		•	•	•		N/A			
	MA		•	•	•					
	• • •		•	•	•					
Total		Private	✓	✓	✓	• • •				
		Common	✓	✓	✓	• • •				
		Contract	✓	✓	✓	• • •				
		Exempt	✓	✓	✓	• • •				

* Row totals are the parameters of our interest

Table 7.2. VMT Estimates of Alabama-Based Interstate Motor Carriers, by Jurisdiction and Business Type, 1988 (thousands)

State	Exempt	Household Goods	Private	Haul-For-Hire	Rental	Total
Alabama	10,190	1,896	162,195	327,457	1,619	503,358
Alaska	0	0	0	6	0	6
Arizona	672	126	644	25,374	19	26,836
Arkansas	46	107	3,541	22,403	35	26,133
California	717	202	733	27,387	13	29,051
Colorado	87	67	194	3,667	4	4,019
Connecticut	7	36	294	3,925	26	4,287
Delaware	7	13	147	1,541	5	1,713
DC	1	1	12	115	0	129
Florida	1,603	639	21,941	80,969	310	105,462
Georgia	1,065	621	27,202	115,876	398	145,161
Idaho	58	18	56	2,739	3	2,873
Illinois	54	138	2,892	22,629	68	25,781
Indiana	83	120	3,296	28,229	80	31,807
Iowa	17	48	327	3,807	6	4,204
Kansas	29	168	216	3,065	7	3,484
Kentucky	192	165	7,448	39,998	144	47,947
Louisiana	662	336	10,803	46,806	127	58,735
Maine	18	8	46	833	2	907
Maryland	20	181	886	10,102	30	11,219
Massachusetts	11	26	180	2,696	11	2,923
Michigan	23	51	684	5,881	26	6,665
Minnesota	22	15	163	1,743	7	1,950
Mississippi	1,224	375	24,421	70,101	211	96,332
Missouri	26	124	2,094	16,333	48	18,625
Montana	14	10	43	747	3	815
Nebraska	14	51	155	2,935	4	3,158
Nevada	9	16	89	2,258	1	2,373
New Hampshire	5	4	22	579	1	610
New Jersey	22	68	742	7,953	35	8,820
New Mexico	334	91	486	15,507	9	16,427
New York	9	72	692	7,900	33	8,706
North Carolina	84	286	5,022	42,415	106	47,913
North Dakota	16	6	38	617	3	680
Ohio	70	107	2,538	27,659	96	30,470
Oklahoma	82	97	763	9,846	16	10,803
Oregon	65	42	61	2,609	3	2,780
Pennsylvania	42	105	1,934	22,150	90	24,320
Rhode Island	1	6	52	473	3	536
South Carolina	100	222	5,295	41,412	91	47,120
South Dakota	8	9	52	555	3	628
Tennessee	397	331	23,089	75,167	319	99,304
Texas	2,441	521	4,615	83,785	128	91,491
Utah	51	22	60	2,247	3	2,383
Vermont	5	6	25	654	2	692
Virginia	87	292	5,275	43,072	204	48,930
Washington	66	19	36	1,728	2	1,851
West Virginia	13	30	631	8,512	41	9,227
Wisconsin	62	33	524	5,018	11	5,648
Wyoming	45	31	113	3,883	4	4,076
Total	**20,875**	**7,953**	**322,768**	**1,273,363**	**4,409**	**1,629,368**

Source: Alabama IRP Tape provided by Norman Goss of the Alabama Department of Revenue.

8. SUMMARY OF EVALUATION RESULTS

An important caveat to the discussion in this study is that the evaluations of the data sources are **not** made on the basis of how they perform **in general** or relative to their intended uses. Instead, the evaluations are made on the basis of how these data sources perform in estimating (1) the number of trucks (operating in interstate commerce with GVWR greater than 10,000 pounds) of a specific carrier type that **traveled** in a given state, T_{ik}, and (2) the associated VMTs, VMT_{ik}. Six major data sources are evaluated in terms of data accuracy, data item availability, and estimation precision. They are also evaluated based on:

(1) the number and kinds of vehicles included;

(2) the vehicle configurations and vehicle definitions;

(3) accessibility of the data to a user;

(4) frequency of the data collection; and

(5) time lag between the data collection and availability to the public.

Table 8.1 summarizes vehicle types, vehicle configurations and weight indicators that are included by each one of the six data sources. Data accessibility, collection frequency and time lag (between when data are collected and when data become available) of each data source are compared in Table 8.2.

8.1 ABILITY TO ESTIMATE PARAMETERS AT THE STATE LEVEL

It should be emphasized that the parameters of interest in this study are the number of trucks of carrier type i **traveled** in state k, and the amount of VMT **traveled** in state k by these trucks. The key factor is the amount of travel **occurred** in state k by these trucks, but not the amount of travel by trucks **registered** in state k. Hence, in order to be able to estimate these parameters, four critical indicators are required in the data source: (1) jurisdiction of operation (interstate vs. intrastate), (2) carrier type (common, contract, exempt, and private), (3) truck weight, and (4) states where travel occurred.

Table 8.1 Truck Types Included in Different Data Sources

Data Source	Weight Indicator	Truck Type Included	Truck Type Excluded
TIUS	(1) GVWR ≤ 26K lbs: Avg. Wt. GVWR (1982, 87) (2) GVWR > 26K lbs: Empty Wt. Avg. Wt. GVWR (1982, 87)	(1) Pickup (2) Panel truck, van, utility vehicle, and station wagon (3) Small single-unit truck w/ GVWR ≤ 26K lbs. (4) Large single-unit truck w/ GVWR > 26K lbs. (5) Truck tractor	(1) Government owned (Federal, State & Local) Trucks (2) Ambulances (3) Buses (4) Motor Homes
NTACS	Same as TIUS		
NTTIS	Empty Wt. Cargo Wt. Combined Wt. GVWR (from VIN)	(1) Straight Trucks w/ GVWR > 10K lbs. (2) All tractors	(1) Pickups (2) Passenger Vehicles (e.g., passenger vans, recreational vehicles) (3) Farm Tractors (4) Oklahoma, Hawaii, & Alaska trucks. (5) Pre-1973 California (6) Government owned
HPMS 1988	No	(1) 2-Axle, 4-Tire, Single-Unit other than passenger vehicles (2) 2-Axle, 6-Tire, Single-Unit (3) 3-Axle, Single Unit (4) 4 or more Axle, Single-Unit (5) 4 or less Axle, Single-Trailer (6) 5-Axle, Single-Trailer (7) 6 or more Axle, Single-Trailer (8) 5 or Less Axle, Multi-Trailer (9) 6-Axles, Multi-Trailer (10) 7 or more Axle, Multi-Trailer	
Fuel Tax	Vary by State		
IRP (39 states)	GVWR	(1) GVWR > 26K lbs. (2) Power Unit ≥ 3 Axles (3) Combination > 26K lbs.	(1) GVWR ≤ 26K lbs and 2-Axles and (2) Buses are optional

Note: (1) GVWR - Gross Vehicle Weight Rating: the weight of a vehicle when loaded to its capacity.
(2) VIN - Vehicle Identification Number.

Table 8.2
Data Accessibility of Each of the Six Data Sources.

Source	Initial year	Collection frequency	No. of states covered (contiguous 48 & D.C.)	Data Accessibility	Time lag between data collection & assimilation
TIUS	1967	5 yr	All	Public Use Tape	2 yr
NTACS	1989	5 yr	All	Public Use Tape	[a]
NTTIS	1984	[b]	All except Oklahoma	Request to UMTRI	4 yr
HPMS	1978	Continual	All	Request to FHWA	10 months
State Fuel TAX	Vary by State	Continual	All	Vary by State[c]	Vary By State
IRP	1973	Continual	39 (partially)	Vary by State[c]	6 months

[a] Since the NTACS has not been implemented yet, the time lag between data collection and assimilation is unknown.

[b] One time data collection effort.

[c] Some states require written requests, some require funding to support software development in retrieving data, and some provide data upon request.

Five of the six data sources can be categorized into two groups. The first group includes data sources that monitor the number of trucks **registered** in a given state and the associated VMTs. This group includes the TIUS, the NTACS, and the IRP (for trucks registered in the IRP member states only). The second group includes data sources that monitor the number of vehicles that **traveled** in a given state and the VMTs traveled in that state. This group includes the NTTIS, the HPMS, and the IFTA. Data from the state fuel tax reports cannot be classified into either group. The in-state mileage reported in the fuel tax report includes in-state mileage traveled by the vehicles registered in that state plus the in-state mileage traveled by the out-of-the-state vehicles that file fuel tax reports to that state. The "total" mileage reported in the fuel tax report includes the total mileage of vehicles that file fuel tax reports to that state regardless of where the base state or where the travel occurred.

Based on the evaluation results, it is concluded that none of the six data sources by itself can provide reliable estimates on the number of trucks (operating in interstate commerce with GVWR greater than 10,000 pounds) of carrier type i (common, contract, exempt or private) **traveled** in state k, and the amount of travel **occurred** in state k by these trucks.

Discussions below include the assessments of individual data sources in terms of their ability and the data reliability in estimating the parameters of interest. Data sources categorized in the first group as described in the previous paragraph will be discussed first.

8.1.1 TIUS

Data from the TIUS can provide estimates of the total number of trucks registered in a state, the associated total VMT (total amount of travel by these trucks) and in-state VMT (the amount of travel occurred in that state by trucks registered in that state). However, estimates at the state level of $T_{i,k}$ and VMT $_{i,k}$ are not available. In addition, there are a few major limitations in the TIUS data. First, double-counting in vehicle registration exists and would likely cause overestimation. Second, VMTs estimated by the operators (self-reported) are likely to be higher than the actual mileage

based on odometer readings as was observed in the NTTIS. Third, there was a two-year lag between when the data were collected and when the complete survey results became available. Fourth, since the TIUS is conducted every five years, interpolations will be needed for the intermittent years.

8.1.2 NTACS

In mid 1991 when data from the NTACS become available, one will be able to estimate the total number of trucks registered in a state and their total VMT, and to identify the three most frequently traveled states for each sampled truck. Estimates at the state level of T_{ik} and VMT_{ik} are not available. Other than the limitation that only the three most frequently traveled states are identified, an additional limitation in the NTACS is that there is no information available in terms of the percentages of mileage occurring in each state (even in the three most frequently traveled states).

8.1.3 IRP

Mileage reported under the IRP provide data on the number of trucks that are registered in a state and that are operating in interstate commerce, and on the associated VMTs. Unfortunately, data on VMTs for trucks registered in non-IRP states and for trucks with GVWR less than 26,000 pounds are missing. These missing mileage data create gaps so that none of the 48 contiguous states plus the District of Columbia has complete truck VMT data. Figure 7.1 illustrates the point. However, as more states become members of the IRP, it becomes a strong candidate as a data source for providing the desired estimates.

8.1.4 NTTIS

Data from the NTTIS could be used to estimate the parameters of interest **by state and by carrier type**. However, there are two major limitations in the data. One is the sample sizes which are too small to provide reliable estimates at the state level. The other limitation is the extraordinarily high cost (both in time and effort) of the data

collection method - mapping individual trips that occurred in the sample days onto special atlases. Furthermore, it is not clear when the next NTTIS will be implemented.

8.1.5 HPMS

The state-specific traffic count program in the HPMS leads to uncertainty and concern over the accuracy and reliability of the data. Even without the concern over data quality, data from the HPMS traffic count programs have to rely on other data sources to estimate the number of vehicles by vehicle type. For example, the number of two-axle, four-tire trucks is estimated by the FHWA based on data from the TIUS. Furthermore, given its specific goal, the HPMS does not collect three of the four indicators as described earlier. Hence, even with uniform data collection procedures across all states, data from the HPMS are still unable by themselves to estimate the parameters of interest.

8.1.6 State Fuel Tax Reports

The "diversity" in how the fuel taxes are collected from state to state prohibits a general assessment of the data. Moreover, the states' cooperation in providing the data becomes a key factor with respect to "data availability." Some states have their data collection systems computerized. For these states, the data may be obtained through written requests to the states or by providing funds to the states to retrieve the data. On the other hand, for states which still rely on manual operation, data simply do not exist in machine-readable form, or at a minimum, a significant amount of effort is required to compile the desired data. At the extreme, some states simply refuse to provide the data. At present, the state fuel tax reports appear to rank low as a possible data source to meet the estimation needs. However, as more states join IFTA, fuel tax data will have great potential in providing estimates at the state level.

8.2 ABILITY TO ESTIMATE PARAMETERS AT THE NATIONAL LEVEL

The parameters of interest at the national level are (1) the total number of trucks of carrier type i (common, contract, exempt, or private) operating in interstate

commerce with GVWR greater than 10,000 pounds, and (2) the total amount of travel (VMT) by trucks of each carrier type. Evaluations of six data sources in terms of their ability to estimate these parameters are discussed below.

8.2.1 TIUS

TIUS is partially capable of providing estimates on the number of commercial trucks by carrier type, and on the associated VMTs. Table 8.3 reports these estimates derived from the 1982 TIUS public use tape. Two limitations on these estimates should be pointed out. First, the operation type of a sampled truck is defined as the "most typical" type of operation if more than one type is checked on the survey form. Second, there is no information to identify trucks that are operated for private business and are mainly operated in interstate commerce, Table 8.3 does not include statistics for these trucks.

If TIUS data are used to estimate the parameters at the national level, there are four major limitations (which are identical to the ones identified in the previous section): duplicate registration, self-reported mileage, two-year time lag before data become available, and interpolations for the intermittent years.

8.2.2 NTACS

NTACS is partially capable of providing estimates on the number of commercial trucks by carrier type, and on the associated VMTs. Similar assessments on the TIUS can be applied to the NTACS. However, the sample size of 1989 NTACS (44,000 trucks) is approximately 31 percent of the 1987 TIUS sample size. The estimates obtained from the NTACS are likely to be less reliable than those from the TIUS. However, the combination of TIUS and NTACS data can be used to identify potential trend variations from 1987 to 1989 as results of economic growth and/or impact of vehicle aging on VMT.

Table 8.3 Estimated Number of Trucks Operating in Interstate Commerce and the Associated VMT from 1982 TIUS Public Use Tape[1] (For-Hire Interstate and Polk's GVWR > 10K Pounds)

Variable	Contract			Common			Exempt		
> 10K Pounds:									
VMT (Million)	6181 (27.1%)			14718 (64.5%)			1915 (8.4%)		
No. of Trucks (Thousand)	99.48 (29.2%)			217.02 (63.6%)			24.65 (7.2%)		
VMT/Truck (Thousand)	62.13			67.82			77.69		
10K - 26K Pounds:[2]	2X-4T	OSU	COMB	2X-4T	OSU	COMB	2X-4T	OSU	COMB
VMT (Million)	16.60	121.92	79.35	40.66	206.88	134.72	0.19	7.41	1.07
No. of Trucks (Thousand)	1.31	6.64	2.57	3.00	13.51	6.15	0.04	0.64	0.07
VMT/Truck (Thousand)	12.68	18.36	30.87	13.54	15.32	21.89	4.50	11.57	15.05
> 26K Pounds:									
VMT (Million)	26.56	142.03	5794.52	9.94	131.31	14195.17	4.02	29.68	1873.05
No. of Trucks (Thousand)	0.92	5.14	82.90	0.35	4.82	189.18	0.22	1.03	22.65
VMT/Truck (Thousand)	28.75	27.64	69.90	28.49	27.23	75.04	18.13	28.76	82.73

[1]All numbers are subject to rounding errors.
[2]2X-4T: 2-Axle, 4-Tire; OSU: Other Single-Unit; COMB: Trailer Combination

8.2.3 IRP

Not until all of the states become IRP members, can IRP by itself provide estimates on the total number of trucks operating in interstate commerce with GVWR greater than 10,000 pounds, and the associated VMTs by carrier type.

8.2.4 NTTIS

Data from the NTTIS are capable of estimating the total number of straight trucks (with GVWR greater than 10,000 pounds) and all road tractors, and the associated VMTs by carrier type. However, trucks registered in the states of Oklahoma, Hawaii and Alaska, and pre-1973 California trucks are excluded. In addition, there are two limitations in the NTTIS data. First, there is a four-year lag between the time when trucks were sampled from Polk registration files (1983) and the time when the implementation was completed (1987). The exclusion of trucks registered between 1983 and 1987 is likely to result in underestimations of the VMTs and the number of trucks. Second, serious misclassification of trucks in the original sampling frame introduces larger variances in the estimates than if there had been no misclassification.

8.2.5 HPMS

HPMS data are capable of providing total truck VMT by truck type, but not the total number of trucks. Since HPMS does not have information on the types of operation (common, contract, exempt, or private) or on the jurisdiction of operation (interstate vs. intrastate), allocation of total truck VMT into different operation types and jurisdiction types by using data from other sources, such as TIUS or NTACS, will be necessary.

According to the FHWA, there are currently 30 to 40 states in compliance with the HPMS Field Manual and Traffic Monitoring Guide. However, until all of the states are in compliance with the HPMS data collection procedures, the reliability of the HPMS data cannot be determined.

8.2.6 State Fuel Tax Reports

Since fuel taxation requirements vary so greatly from state to state, it is not clear as to how the state fuel tax reports can be of any use to estimate the number of commercial trucks and the associated VMTs by carrier type. However, as more states participate in the IFTA, IFTA data will have great potential in estimating the parameters at the national level.

8.3 COMPARISONS OF DATA SOURCES

Currently, no two data sources evaluated in this study are directly comparable for the following reasons:

(1) The types of trucks included in these data sources are different as shown in Table 8.1.

(2) The truck weight indicators used in different data sources are not consistent and are not available in HPMS. Previous TIUS used "average" GVW (i.e., vehicle empty weight plus the average load carried). However, 1987 TIUS and NTACS define GVWR as the weight of the vehicle when loaded to its capacity. Similar weight definition is used by the NTTIS and the IRP.

(3) The sampling (or registration) period considered in these data sources are different. For example, TIUS and/or NTACS use trucks registered as of July 1 of that year while HPMS collects data on a calendar year basis.

(4) NTACS has not been implemented, and state fuel tax reports are not readily accessible. Other than that IRP does not include all of the states, data from IRP members are not readily and easily obtainable.

Despite these incompatibilities, Table 8.4 shows the numerical results of national totals from three data sources for 1982-83: TIUS, HPMS, and NTTIS. Estimates from TIUS and HPMS are for year 1982 while the estimate of the number of trucks (straight trucks and road tractors) from NTTIS is for 1983 and the VMT estimate is roughly for 1986. Oklahoma, Alaska, and Hawaii trucks and their VMT are included in HPMS and TIUS but not in NTTIS.

TABLE 8.4

VMT and Number of Trucks (1982 TIUS & HPMS; 1983 NTTIS)

		TIUS		HPMS[3]		NTTIS[4]		
		Polk[1] GVWR	TIUS[2] GVW	Polk GVWR	TIUS GVW	Polk GVWR Self-Report	Polk GVWR Odometer	Polk GVWR Mapped
GVW > 10K lbs.	VMT (Billion)	74.53	77.74	81.57[5]	85.10[5]	77.38	59.67	40.25
	No. of Truck (Million)	3.49	3.61	3.65[5]	3.77[5]	3.11	3.11	3.11
	VMT/Truck (Thousand)	21.36	21.53	22.35	22.51	24.88	19.19	12.94
Total[6]	VMT (Billion)	377.28		413.02				
	No. of Truck (Million)	33.83		35.38				
	VMT/Truck (Thousand)	11.15		11.67				

Note: (1) TIUS Polk GVWR data are estimated using TIUS public tape;
(2) TIUS GVW data are obtained from Census' publication;
(3) HPMS National totals are from FHWA's "Highway Statistics";
(4) NTTIS data are from the tables and charts in Campbell et al; VMT is roughly for 1986 and number of trucks is for 1983. NTTIS data do not include data from Oklahoma, Alaska and Hawaii;
(5) Obtained by breaking down the HPMS National totals using the relative percentages in TIUS; and
(6) See Table 8.1 for trucks included and excluded by each data source.

To derive HPMS estimates as shown in Table 8.4, the national totals from the HPMS are first obtained from "Highway Statistics" published by the FHWA. The number of trucks published in the "Highway Statistics" is estimated by the FHWA based on the 1982 TIUS with some adjustments to account for trucks excluded by TIUS, and to account for different time frame used by TIUS. These totals then are allocated to two groups: trucks with GVWR less than 10,000 pounds, and trucks with GVWR greater than 10,000 pounds by applying the relative percentages of these two GVWR groups from TIUS to the totals. NTTIS estimates are obtained from published tables and charts.[23]

The comparisons between the TIUS data and the HPMS data might lead one to infer that HPMS data tend to overestimate the VMTs. This can be attributed to two factors. One of these is the "axle correction factor" which is used in the HPMS to convert the total number of axles collected from the sample sections to the total number of vehicles. If a state chooses to use axle-correction factors other than the ones recommended by the Field Manual due to the budget constraint, it is likely that the number of vehicles will be overestimated. Since the DVMT of a stratum is estimated by multiplying the estimated number of vehicles in a stratum by the total length of the road sections in that stratum, the DVMT of a stratum will be overestimated as well. For example, assume that a total of 75 axles is detected passing a sensor located in a road section 10 miles long during a one-day period, and that what actually happened was as follows:

---

[23] Campbell, K., etc., 1988, "Analysis of Accident Rates of Heavy-Duty Vehicles," Technical Report Number 88-17 of the Transportation Research Institute, University of Michigan, Ann Arbor, Michigan.

Vehicle Type	Number of Axles	Number of Vehicles	Total Number of Axles
Passenger Cars	2	6	12
2-Axle 4-Tire Trucks	2	4	8
Buses	3	2	6
2-Axle 6-Tire Trucks	2	2	4
Six or More Axle Single Trailers	6	2	12
Six Axle Multi-Trailer Trucks	6	2	12
Seven or More Axle Trailers	7	3	21
Total		21	75

The DVMT of this road section should be (10 miles) x (21 vehicles) = 210 vehicle miles. However, if an "axle correction factor" for a urban area of 2.04 is used, the estimates become 75/2.04=37 vehicles and (10 miles) x (37 vehicles) = 370 vehicle miles. Unless an "axle correction factor" is adequately developed for each stratum from which sample sections are selected, the estimation procedures for the HPMS are likely to produce biased estimates. The impacts of the "axle correction factor" on the overall VMT cannot be addressed in detail without a in-depth study of the HPMS field practices.

The second factor that might cause one to infer that there is an overestimation of VMTs in the HPMS are the axle sensing devices that are currently used by many of the states. Although a considerable amount of improvement was observed during the past few years, the device is likely to be less accurate in identifying multi-axle vehicles than two-axle vehicles.[24] This may lead to overestimation of the VMT in the two-axle vehicle categories.

8.4 CONCLUSIONS

In sum, none of the six data sources evaluated in this study is capable of estimating the number of trucks operating in interstate commerce with GVWR greater

[24] "Field Evaluation of FHWA Vehicle Classification Categories," Maine Department of Transportation, January 1985.

than 10,000 pounds and the associated VMTs by state and by carrier type. However, estimates at the national level can be obtained from a combination of several data sources.

In general, nation-wide transportation surveys such as the TIUS, NTACS, and NTTIS collect the complete set, or at least some, of the information items needed in this study. The major drawback in these surveys is that the high cost and resources necessary to conduct the survey severely limit the frequency of data collection and occasionally the sample sizes. On the other hand, continual data reporting systems such as the IRP, state fuel tax reports (or IFTA), and the HPMS provide uninterrupted data, though the extent of data availability varies over a wide range.

Indeed, estimates derived from a combination of several data sources, such as IRP, TIUS, and NTACS, would likely be the most cost-effective and reliable for the years in which data were collected. Data from the HPMS or state fuel tax reports could be used to develop annual trends (or growth factors) in VMT or traffic counts and used in conjunction with data from the TIUS or the NTACS to extrapolate data for the intermittent years. Table 8.5 illustrates an example of how TIUS and HPMS might jointly produce a time series of the number of trucks and of the associated VMTs.

The outlook of these data sources in terms of their future development are as follows: (1) TIUS will be conducted every five years, (2) HPMS will be available every year, (3) IRP and IFTA will be promising data sources as more states become members, (4) NTACS's future will depend on the extend of users' support, and (5) NTTIS is subject to funding availability.

For the time being, ORNL recommends that TIUS, HPMS and the number of medium/heavy trucks reported by Polk[25] **all** be used to provide estimates at the national level, and to develop the growth factors of annual mileage. In the future if NTACS becomes a regular follow-on to the TIUS, estimates obtained from NTACS can provide a complement to the TIUS.

---

[25] "Annual National Vehicle Population Profile (NVPP)," compiled by R. L. Polk and Company, annual.

Because trucking activities are highly corrected with economic conditions, a possible extension of the future work is to statistically relate the variations of annual mileage growth factor with transportation indices (e.g., highway freight outlays for all commodities).

Table 8.5 Trend Variations of the
Average Annual Medium/Heavy Truck Mileage From 1978 to 1987

Item	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
VMT (billion)	82.08	89.24	91.76	90.51	86.94	92.65	102.95	107.04	111.07	116.36
No. of Trucks[1] (million)	3.70	4.06	4.19	3.94	3.65	3.55	3.52	3.56	3.54	3.61
VMT/Truck (Thousand)	22.17	21.98	21.91	22.97	23.82	26.07	29.25	30.10	31.36	32.21
Growth Factor[2]		0.991	0.997	1.048	1.037	1.094	1.122	1.029	1.042	1.027

$$VMT = [VMT(2)+VMT(3)] - [VMT(1)/T(1)]\ [T(2)+T(3) - T_{Polk}],$$

where

VMT = total VMT of medium and heavy trucks in the nation;

VMT(i) = total VMT of ith type of trucks in the nation (from "Highway Statistics" based on HPMS);

i = 1 for 2-axle, 4-tire trucks;
2 for other single-unit trucks;
3 for combination trucks.

T(i) = total number of registered trucks of type i (from "Highway Statistics" based on TIUS);

T_{Polk} =total number of medium and heavy trucks from Polk's NVPP file adjusted to include Oklahoma data and to make it consistent with the 1982 HPMS estimate by multiplying it by 1.077.

[1] Number of trucks = T_{Polk}

[2] Growth factor is computed as the ratio of the average annual mileage of current year over the previous year.

APPENDIX 1

A NUMERICAL EXAMPLE OF HOW THE SAMPLE SIZE WAS DETERMINED FOR THE 1987 TRUCK INVENTORY AND USE SURVEY

A Numerical Example of How the Sample Size was Determinated for the 1987 TIUS

The state of Washington was chosen to use as a numerical example.

n_0 = 900 as shown in formula (1)
N = 887,142 is the state universe count of trucks in the 1982 TIUS
N_1 = 582,608 is the state universe count of pickup trucks in the 1982 TIUS
N_2 = 214,826 is the state universe count of vans in the 1982 TIUS
N_3 = 63,445 is the state universe count of light trucks in the 1982 TIUS
N_4 = 9,771 is the state universe count of heavy trucks in the 1982 TIUS
N_5 = 16,492 is the state universe count of tractor trucks in the 1982 TIUS

Formula (2):

n = (900)(887,142) / [900 + 887,142] = 899 state sample size

Formula (3):

n_1 = (899)(582,608) / 887,142 = 590 pickup strata size

n_2 = (899)(214,826) / 887,142 = 218 van strata size

n_3 = (899)(63,445) / 887,142 = 64 light truck strata size

n_4 = (899)(9,771) / 887,142 = 10 heavy truck strata size

n_5 = (899)(16,492) / 887,142 = 17 truck tractor strata

Increasing Washington state's sample size for strata 3, 4, and 5 trucks is as follows: Note that $N_3 + N_4 + N_5$ = 89,708.

Formula (2):

n = (900)(89,708) / [900 + 89,708] = 891

Formula (3):

n_3 = (891)(63,445) / 89,708 = 630 light trucks

n_4 = (891)(9,771) / 89,708 = 97 heavy trucks

n_5 = (891)(16,492) / 89,708 = 164 truck tractors

Thus, new strata sample sizes are as follows:

n_1 = 590 as before
n_2 = 218 as before
n_3 = 630
n_4 = 97
n_5 = 164
1699

Increasing Washington state's sample size in strata 4 and 5 to represent more long haul trucks is as follows:

Note that $N_4 + N_5 = 26{,}263$. The estimated number of long haul trucks in Washington state from the 1982 TIUS was 302 in stratum 4 and 2111 in stratum 5. These sum to 2413.

Formula (1):

$$n_0 = 0.09 / [(.08)(.10)]^2 = 1406$$

Formula (2):

$$n = 1406 / \{1 + (26{,}263)(.09) / [(.1)(.08)(26{,}263)]^2\} = 1335$$

Formula (3):

$$n_4 = (1335)(302) / 2413 = 167 \text{ heavy trucks}$$

$$n_5 = (1335)(2111) / 2413 = 1168 \text{ truck tractors}$$

Finally, the preliminary state strata sample sizes used in Washington state are as follows:

$$\begin{aligned} n_1 &= 590 \\ n_2 &= 218 \\ n_3 &= 630 \\ n_4 &= 167 \\ n_5 &= \underline{1168} \\ & 2773 \end{aligned}$$

Sample Size Sensitivity

For the state of Washington and following the same steps as discussed assuming C=.1 and p_i=.1 for all strata, the following table gives a summary of the preliminary overall sample size in three steps of development for other indicated values of p_1, p_2, p_3, p_4, and p_5. The first step is for precision requirements (C=.1) for all five strata in Washington; the second step is for additional precision requirements (C=.1) for strata 3, 4, and 5; the third and final step is for additional precision requirements (C=.08) for strata 4 and 5. (Note that P is a function of p_1, p_2, p_3, p_4, and p_5.) The 30 combinations in the table are ordered with respect to the sample sizes obtained from step 3. The preliminary sample size 2773 is the preliminary sample size for Washington for the combination p_i=.1 for all i.

While the table shows the effect of each precision requirement on the final overall preliminary sample size for Washington, our comments refer only to sample sizes obtained from step 3. Note the following observations:

(i) The higher values of p_1, p_2, p_3, p_4, and p_5 call for smaller values of n.
(ii) High values of p_3 relative to smaller values of p_1, p_2, p_4, and p_5 call for larger values of n as compared to small values of p_3 and higher values of p_1, p_2, p_4, and p_5
(iii) Low values of p_1 and p_2 with higher values of p_3 and p_4 require smaller n than high values of p_1 and p_2 with smaller values of p_3 and p_4.

The results of the small sensitivity investigation can be interpreted as follows. If the true values of p_1, p_2, p_3, p_4, and p_5 correspond to combinations where n is less than 2773, then estimation will tend to be more precise than the stated coefficient of variation. On the other hand, if the true values of p_1, p_2, p_3, p_4, and p_5 correspond to combinations where n is less than 2773, then estimation will tend to be less precise than the stated coefficient of variation.

Note that n decreases as C increases.

Table A1-1
A Sensitivity Investigation for Preliminary Sample Size for
Washington (1987 TIUS)

					Overall Preliminary n to Meet Precision Requirements for:		
p_1	p_2	p_3	p_4	p_5	Step 1	Step 2	Step 3
.125	.125	.125	.125	.125	699	1323	2170
.125	.100	.075	.100	.125	763	1720	2516
.100	.100	.100	.100	.125	894	1648	2528
.100	.100	.100	.125	.100	896	1668	2619
.125	.100	.100	.100	.100	756	1575	2649
.100	.100	.125	.100	.100	881	1527	2659
.125	.100	.050	.100	.125	772	1971	2669
.100	.125	.100	.100	.100	840	1648	2722
.100	.100	.100	.100	.100	899	1699	2773*
.100	.075	.100	.100	.100	959	1750	2824
.100	.050	.100	.100	.100	1015	1796	2870
.100	.100	.075	.100	.100	916	1926	2910
.075	.100	.100	.100	.100	1089	1860	2934
.100	.100	.100	.075	.100	902	1728	2939
.100	.050	.125	.050	.100	996	1654	3065
.100	.100	.100	.100	.075	903	1749	3075
.100	.100	.050	.100	.100	930	2231	3085
.100	.100	.100	.050	.100	904	1752	3104
.050	.100	.100	.100	.100	1341	2066	3140
.100	.050	.100	.050	.100	1021	1851	3202
.050	.050	.075	.125	.125	1725	2491	3204
.100	.075	.050	.075	.100	999	2367	3337
.050	.050	.075	.100	.125	1737	2542	3338
.100	.100	.100	.100	.050	907	1793	3442
.050	.100	.125	.100	.050	1314	1941	3651
.075	.075	.075	.075	.075	1231	2324	3763
.050	.100	.050	.100	.050	1449	2953	4324
.125	.125	.075	.050	.050	732	2019	4343
.050	.075	.100	.075	.050	1540	2360	4354
.050	.050	.050	.050	.050	1896	3565	5687

*Actual preliminary sample size for Washington (1987 TIUS).

APPENDIX 2

1987 CENSUS OF TRANSPORTATION, TRUCK INVENTORY AND USE SURVEY, SURVEY FORMS TC-9501 AND TC-9502

U.S. DEPARTMENT OF COMMERCE
BUREAU OF THE CENSUS

FORM
TC-9501

1987 CENSUS OF TRANSPORTATION
TRUCK INVENTORY AND USE SURVEY

OMB APPROVAL NO. 0607-0682; EXPIRES 12/89

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**.

In correspondence pertaining to this report, please refer to this Census File Number (CFN)

Please complete this form and RETURN TO

BUREAU OF THE CENSUS
1201 East Tenth Street
Jeffersonville, Indiana 47134

DUE DATE: 15 days after receipt of form

Important — Please read

All questions on this form refer to the vehicle described below and its use **during 1987**. If you did not own the vehicle during 1987, please continue with the questionnaire answering each item according to how you used the vehicle during the last 12 months you owned (or leased) it. If there are errors in the vehicle registration information, consult the instruction sheet before continuing with the questionnaire.

ESTIMATES ARE ACCEPTABLE.

Please correct errors in name, address, and ZIP Code. ENTER street and number if not shown.

CENSUS USE	1	2	3	4	5	6	7

REGISTRATION INFORMATION

Make of vehicle	Year of model	State	License number	Vehicle identification number (VIN)
101	102	103	104	105

Item 1 — When did you obtain this vehicle? 110 Month | Year
Enter figures only

Item 2 — How did you obtain this vehicle?

111
1 ☐ Purchased it **new**
2 ☐ Purchased it **used** (or otherwise acquired)
} *SKIP to item 3*
3 ☐ **Leased** or **rented** it FROM someone else — *Continue with items 2a and b*

a. How was this vehicle leased or rented?

112
1 ☐ **Without** a driver
2 ☐ **With** a driver other than an owner-operator
3 ☐ With an **owner-operator** as driver

b. Was the agreement for 12 months or more?

113
2 ☐ NO
1 ☐ YES — **Which of the following did the leasing agreement include?**
Mark (X) all that apply
114 ☐ Financing only *(Do not mark if installment sales contract)*
115 ☐ Full maintenance
116 ☐ Maintenance on specified parts only
117 ☐ Payment on taxes
118 ☐ Obtaining licenses and permits
119 ☐ Recordkeeping for leased trucks
120 ☐ Other — *Specify*

Item 3 — Is this vehicle still in your possession?

206
1 ☐ YES — **Are you the** — 207 1 ☐ **owner?** 2 ☐ **lessee?** } *SKIP to item 4 and continue with questionnaire*
2 ☐ NO — *Please continue with this questionnaire, answering each item according to how you used the vehicle during the last 12 months you owned (or leased) it. Continue with items 3a and b.*

a. When did you dispose of this vehicle? 208 Month | Year
Enter figures only

b. How did you dispose of this vehicle?

209
1 ☐ Sold it (or gave it away)
2 ☐ Junked, scrapped, or otherwise destroyed
3 ☐ Returned to leasing company

Item 9 — Continued 333 Pounds

c. What was the loaded weight of the trailer most often attached to the vehicle?
An estimate is acceptable.

335 Inches

d. What was the width of the trailer most often attached to the vehicle?

Item 10 — How many miles was this vehicle driven during 1987? 400 Miles
An estimate is acceptable.

Item 11 — How many miles has this vehicle been driven since it was manufactured? 401 Miles

NOTE — *If it is no longer in your possession, please estimate the total lifetime mileage at the time you last operated it.*
If the odometer/speedometer is broken, please give your best estimate.
If the odometer has turned over (100,000 + miles), please enter the total figure.

Item 12 — How many miles-per-gallon (MPG) did this vehicle average during 1987? *(Use tenths, if available.)* 402 Miles | Tenths

Example: 10.5 MPG should be entered as

Miles	Tenths
10	5

Enter miles per gallon

Item 13 — Where was the home base of this vehicle on July 1, 1987?
If put into service after July 1, 1987, enter current home base.

404 City

405 County | 406 State | 407 ZIP Code

Item 14 — What percent of annual mileage was driven OUTSIDE the home base state? 408
An estimate is acceptable. *(If none, enter zero.)* %

Item 15 — What PERCENTAGE of this vehicle's ANNUAL MILEAGE was accounted for by the type of trips listed below? *(If all trips were within one range, enter 100%. If more than one range is applicable, be sure that percentages add up to 100%.)*

Trips **off-the-road**, little travel on public roads 409 %
Trips **less than a 50** mile radius of vehicle's home base 410 %
Trips **within a 50 – 200** mile radius of vehicle's home base 411 %
Trips **beyond a 200** mile radius of vehicle's home base 412 %
TOTAL — ***Should equal 100%*** → **100%**

Item 4 — Did you lease or rent out this vehicle TO anyone else?

210 1 ☐ YES — *Continue with items 4a and b*
2 ☐ NO — *SKIP to item 5*

a. How was it leased or rented out?

211 1 ☐ **Without** a driver
2 ☐ **With** a driver other than an owner-operator
3 ☐ With an **owner-operator as driver**

b. Was the agreement for 12 months or more?

213 2 ☐ NO
1 ☐ YES — **Which of the following did the leasing agreement include?** *Mark (X) all that apply*

214 ☐ Financing only *(Do not mark if installment sales contract)*
215 ☐ Full maintenance
216 ☐ Maintenance on specified parts only
217 ☐ Payment of taxes
218 ☐ Obtaining licenses and permits
219 ☐ Recordkeeping for leased trucks
220 ☐ Other — *Specify*

Item 5 — What is the body type of this vehicle?

311 01 ☐ Pickup
26 ☐ Mini-van
02 ☐ Van other than mini-van
24 ☐ Utility (For example: Bronco, Blazer, Jeep, CJ-5, 7, etc.)
25 ☐ Station wagon built on truck chassis (For example: Suburban, Wagoneer, etc.)
80 ☐ Other — *If the above descriptions do not match the body type of this vehicle, please describe the body type in detail.*

Item 6 — How many axles are on this vehicle and how many of them are driving axles? *(Do not include axles on any trailers pulled.)*

a. Total number of axles on truck (include front and rear axles)

316 1 ☐ Two axles (4 tires) 3 ☐ Three axles
2 ☐ Two axles (6 tires) 4 ☐ Four or more axles

b. Number of driving (powered) axles on truck

318 1 ☐ One driving axle
2 ☐ Two driving axles
3 ☐ Three or more driving axles

Item 7 — What is the overall length of this vehicle or vehicle and trailer (if a trailer was pulled more than 50 percent of the annual miles)? *Report distance from front bumper to rear of vehicle or trailer, whichever is applicable.* 325 Feet

Item 8a — What was the average weight (empty weight plus weight of cargo) of this vehicle as it was usually operated? An estimate is acceptable. 327 Pounds

b. What percent of annual mileage did this vehicle carry no payload? 328 %

c. What percent of annual mileage did this vehicle carry payloads that —

(1) filled its maximum cargo size? 329 %

(2) weighed the maximum cargo weight? 330 %

Item 9 — During 1987, did you attach any trailers to this vehicle?

301 1 ☐ YES — *Continue with items 9a, b, c, and d below*
2 ☐ NO — *SKIP to item 10*

a. What percent of annual mileage did this vehicle pull a trailer? *If less than 50 percent, skip to item 10* 302 %

b. How many axles were on the trailer unit which you attached most frequently to the vehicle? 303

Item 16 — Not applicable to this form.

Item 17 — What is the horsepower rating of this vehicle's engine? 341 Horsepower

Item 18 — What is the size (displacement) of this vehicle's engine? *Enter cubic inches, cubic centimeters, or liters, whichever is applicable.*

342 Cubic inches (CI) **OR** 343 Cubic centimeters (CC) **OR** 344 Liters (L)

Item 19 — What kind of fuel does this vehicle use?

345 1 ☐ Gasoline
2 ☐ Diesel
3 ☐ Liquefied petroleum gas (LPG)
4 ☐ Other — *Specify fuel*

Item 20 — Does this vehicle have any of the following? *Mark (X) all that apply.*

354 ☐ Radial tires 359 ☐ Air conditioning
358 ☐ Power steering 365 ☐ Front-wheel drive

Item 21 — Who performed the general maintenance and major overhauls on this vehicle? *Mark (X) all that apply.*

	General maintenance	Major overhauls
Yourself	370 ☐	378 ☐
Your company's own maintenance facilities	371 ☐	379 ☐
Dealership's service department	372 ☐	380 ☐
Leasing company	373 ☐	381 ☐
Independent garage or private mechanic (includes gasoline or service stations)	374 ☐	382 ☐
Component distributorship (engine, transmission, etc.)	375 ☐	383 ☐
No one	376 ☐	384 ☐
Other — *Specify*	377 ☐	385 ☐

Item 22a — Which of the following best describes the primary way this vehicle was operated?

501 1 ☐ BUSINESS USE — Operated by and for a private business (including self-employers) or a company; used in related activities of that business (including transportation of employees) — *SKIP to item 23*
2 ☐ PERSONAL TRANSPORTATION — Operated as a personal-use vehicle in place of an automobile for pleasure driving, travel to work, etc. (NO BUSINESS USE) — *SKIP to item 26*
3 ☐ FOR HIRE — *SKIP to item 22b*
4 ☐ DAILY RENTAL (Not motor carrier) — *SKIP to item 23*
5 ☐ MIXED

Percent business use 502 %
Percent personal use 503 %
Percent for hire (includes intercorporate hauling and trip leasing, etc.) 504 %

Complete b below

b. *If this vehicle was for hire, indicate below the type of for hire operation. Enter percentage of mileage for each category. (See instruction sheet for further information and definitions.)*

(1) Operation type

MOTOR CARRIER 506 %
OWNER OPERATOR
as an independent 507 %
leased to a company 508 %

(2) Jurisdiction served

INTERSTATE 509 %
INTRASTATE 510 %
LOCAL 511 %

(3) Kind of carrier

CONTRACT 512 %
COMMON 513 %
EXEMPT 514 %

(4) Was this vehicle operated under ICC authority? 518 1 ☐ YES 2 ☐ NO

Continue on reverse →

Item 23 – Which of the following best describes your business (or the part of your business in which the vehicle was used)? *If vehicle was leased, indicate business of lessee.*

526
- 01 ☐ AGRICULTURAL ACTIVITIES (including fisheries)
- 02 ☐ FORESTRY OR LUMBERING ACTIVITIES
- 03 ☐ CONSTRUCTION WORK – buildings, homes, roads, structures, etc.
- 04 ☐ CONTRACTOR ACTIVITIES OR SPECIAL TRADES – painting, plumbing, electrical work, masonry, carpentry, etc.
- 05 ☐ MANUFACTURING, REFINING, OR PROCESSING ACTIVITIES
- 06 ☐ WHOLESALE TRADE
- 07 ☐ RETAIL TRADE
- 08 ☐ BUSINESS AND PERSONAL SERVICES – used to assist in such services as lodging operations, landscaping, repair (except plumbing, electrical work, etc. – *See "Contractor Activities"*), laundry, advertising, entertainment, etc.
- 09 ☐ UTILITIES – Used to assist in operation or service of public utilities (telephone, gas, electric, etc.)
- 10 ☐ MINING OR QUARRY ACTIVITIES (includes well drilling) – used to assist in the extraction of natural resources or in hauling to processors
- 11 ☐ DAILY RENTAL – rented out, without a driver, to someone else on a daily or short-term basis
- 16 ☐ ONE-WAY RENTAL
- 12 ☐ GOVERNMENTAL OPERATIONS
- 13 ☐ NOT IN USE – vehicle idle, wrecked, awaiting repair, etc., for more than 90 days
- 14 ☐ FOR HIRE TRANSPORTATION – including small package delivery
- 15 ☐ OTHER – *Please describe in detail.*

Item 24 – From the following list of products, materials, and equipment, indicate which item or items this vehicle carried. Write in the approximate percentage of the vehicle's annual mileage that **was accounted for while carrying loads.** *(See instruction sheet for further explanation and examples.)*

Products, equipment, materials, etc.

(1) AGRICULTURAL AND FOOD PRODUCTS		
(a) Live animals – cattle, horses, poultry, hogs, live seafood, insects, etc.	526	%
(b) Fresh farm products – grain, crops, flowers, nursery stock, raw milk, raw tobacco, etc.	527	%
(c) Processed foods and tobacco products – canned goods, prepared meats, frozen foods, beverages, bottled water, dairy products, cigarettes, etc.	528	%
(2) MINING PRODUCTS, UNREFINED – crude oil, coal, metal ores	529	%
(3) BUILDING MATERIALS – gravel, sand, concrete, flat glass, etc. (except cut lumber – *See "Lumber."*)	530	%
(4) FORESTRY, WOOD, AND PAPER PRODUCTS		
(a) Logs and forest products – except cut lumber and fabricated wood products *(See below.)*	531	%
(b) Lumber and fabricated wood products – except furniture (*See (7) below.*)	532	%
(c) Paper and paper products	533	%
(5) CHEMICALS, PETROLEUM, AND ALLIED PRODUCTS		
(a) Chemicals and/or drugs (including fertilizers, pesticides, cosmetics, paints, etc.)	534	%
(b) Petroleum and petroleum products (including paving and roofing materials)	535	%
(c) Plastics and/or rubber products	536	%
(6) METALS AND METAL PRODUCTS		
(a) Primary metal products – pipes, ingots, billets, sheets, etc.	537	%
(b) Fabricated metal products – except machinery or transportation equipment *(See below.)*	538	%
(c) Machinery – electrical or nonelectrical and electronic	539	%
(d) Transportation equipment (including complete vehicles) and parts	540	%
(7) OTHER MANUFACTURED PRODUCTS		
(a) Furniture (wood and nonwood) and/or hardware – not involved in household moving	541	%
(b) Glass products	542	%
(c) Textiles and apparels – fibers, leather goods, carpets, clothing, etc.	543	%
(d) Miscellaneous products of manufacturing – including photographic goods, watches, clocks, jewelry, and toys	544	%
(8) MISCELLANEOUS		
(a) Moving of household and office furniture – from home, offices, etc., under contract	545	%
(b) Miscellaneous tools and/or parts for specialized use, as in a craftsman's vehicle – traveling workshop for plumbers, carpenters, road service crews, etc.	546	%
(c) Mixed cargo, general freight (including the delivery of small packages)	547	%
(d) Scrap, garbage, trash, septic tank waste	548	%
(e) Industrial water	549	%
(f) Hazardous waste	550	%
(9) OTHER (not elsewhere classified) – *Please describe in detail*	551	

Item 25 – At any time during 1987 was this vehicle (or combination) used to haul hazardous materials in quantities large enough to require a special placard placed on the vehicle due to the Code of Federal Regulations, title 49, Transportation?

552
- 1 ☐ YES – *Continue with items 25a and b*
- 2 ☐ NO – *SKIP to item 26*

a. What type(s) of hazardous materials were carried by this vehicle? *Mark (X) all that apply.*

Hazardous Materials

- 553 ☐ Flammable liquids
- 554 ☐ Combustible liquids
- 555 ☐ Corrosive liquids
- 556 ☐ Poison B solids
- 557 ☐ Poison B liquids
- 558 ☐ Flammable solids
- 559 ☐ Oxidizers
- 560 ☐ Flammable gas
- 561 ☐ Nonflammable gas
- 562 ☐ Poison A
- 563 ☐ Corrosive solids
- 564 ☐ Explosives, A or B
- 565 ☐ Blasting agents
- 566 ☐ Radioactive materials
- 567 ☐ ORM – A, B, or C
- 568 ☐ ORM E
- 569 ☐ Hazardous materials not listed above – *Specify*

b. Approximately what percent of this vehicle's annual mileage was accounted for by carrying these hazardous materials?

570
- 1 ☐ Below 10%
- 2 ☐ 10 – 24%
- 3 ☐ 25 – 49%
- 4 ☐ 50 – 74%
- 5 ☐ 75 – 100%

Item 26a – Was this truck or power unit involved in any accidents during 1987?

580
- 1 ☐ YES – *Continue with item 26b*
- 2 ☐ NO – *SKIP to item 27*

b. If this truck or power unit was involved in any accidents during 1987, how many –

(1) involved a fatality?	581
(2) involved no fatalities, but involved bodily injury requiring medical treatment?	582
(3) involved property damage of $4,200 or more?	583

Item 27 – *Please enter below the number of any ADDITIONAL trucks and/or trailers you own and/or operate at the same home base you listed in item 13.*

a. Pickups, small vans (includes mini-vans)	571
b. Straight trucks	572
c. Truck-tractors (power units)	573
d. Trailers (semi- and/or full)	574
e. Converter dollies	575

Item 28 – *Please enter below Employer Identification (EI) Number if vehicle owned by company or Social Security Number (SSN) if vehicle owned by individual.*

EI ☐☐–☐☐☐☐☐☐☐

Item 29 — REMARKS — *Please use this space for any explanations that may be essential in understanding your reported data.*

Item 30 — Person to contact regarding this report

Does this person have records on (or knowledge of) the daily activities of driver (stops, weight of individual shipments, destinations of shipments, etc.)?

1 ☐ YES
2 ☐ NO

Name		Address (Number and street)	
City		State	ZIP Code
Daytime telephone number →	Area code / Number	Extension, if any	If this vehicle has a fleet number, please enter it here → 5/6

U.S. DEPARTMENT OF COMMERCE
BUREAU OF THE CENSUS

FORM
TC-9502

1987 CENSUS OF TRANSPORTATION
TRUCK INVENTORY AND USE SURVEY

OMB APPROVAL NO. 0607-0582: EXPIRES 12/89

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.**

In correspondence pertaining to this report, please refer to this Census File Number (CFN)

Please complete this form and RETURN TO

BUREAU OF THE CENSUS
1201 East Tenth Street
Jeffersonville, Indiana 47134

DUE DATE: 15 days after receipt of form

Important — Please read

All questions on this form refer to the vehicle described below and its use **during 1987.** If you did not own the vehicle during 1987, please continue with the questionnaire answering each item according to how you used the vehicle during the last 12 months you owned (or leased) it. If there are errors in the vehicle registration information, consult the instruction sheet before continuing with the questionnaire.

ESTIMATES ARE ACCEPTABLE.

Please correct errors in name, address, and ZIP Code. ENTER street and number if not shown.

CENSUS USE	1	2	3	4	5	6	7

REGISTRATION INFORMATION

Make of vehicle	Year of model	State	License number	Vehicle identification number (VIN)
101	102	103	104	105

Item 1 — When did you obtain this vehicle? *Enter figures only* — 110 Month | Year

Item 2 — How did you obtain this vehicle?

111
1 ☐ Purchased it **new**
2 ☐ Purchased it **used** (or otherwise acquired)
} *SKIP to item 3*
3 ☐ **Leased** or **rented** it FROM someone else — *Continue with items 2a and b*

a. How was this vehicle leased or rented?

112
1 ☐ **Without** a driver
2 ☐ **With** a driver other than an owner-operator
3 ☐ With an **owner-operator** as driver

b. Was the agreement for 12 months or more?

113
2 ☐ NO
1 ☐ YES — **Which of the following did the leasing agreement include?** *Mark (X) all that apply*
114 ☐ Financing only *(Do not mark if installment sales contract)*
115 ☐ Full maintenance
116 ☐ Maintenance on specified parts only
117 ☐ Payment on taxes
118 ☐ Obtaining licenses and permits
119 ☐ Recordkeeping for leased trucks
120 ☐ Other — *Specify*

Item 3 — Is this vehicle still in your possession?

206
1 ☐ YES — **Are you the** — 207 1 ☐ **owner?** 2 ☐ **lessee?** } *SKIP to item 4 and continue with questionnaire*
2 ☐ NO — *Please continue with this questionnaire, answering each item according to how you used the vehicle during the last 12 months you owned (or leased) it. Continue with items 3a and b.*

a. When did you dispose of this vehicle? *Enter figures only* — 208 Month | Year

b. How did you dispose of this vehicle?

209
1 ☐ Sold it (or gave it away)
2 ☐ Junked, scrapped, or otherwise destroyed
3 ☐ Returned to leasing company

Item 8 — *Please indicate the body type which most closely resembles this vehicle or the trailer most often attached to it, if the power-unit is a truck-tractor.*

311

PLATFORM TYPES

05 ☐ Low boy (gooseneck) — platform with depressed center
06 ☐ Basic platform — including flatbed, stake, etc.
04 ☐ Platform with devices permanently mounted on bed of truck — such as high lift, lift gate, hoist, etc.

VAN TYPES

03 ☐ Multistop or step van (including hi-cube or cutaway)
12 ☐ Basic enclosed van (dry cargo)
10 ☐ Drop frame van — including furniture van, etc.
08 ☐ Insulated, non-refrigerated van
09 ☐ Insulated, refrigerated van
11 ☐ Open top van, including fruit

SPECIALIZED USE TRUCKS

18 ☐ Automobile transport
13 ☐ Beverage truck
70 ☐ Concrete mixer
40 ☐ Dump truck (including belly or bottom dump)
29 ☐ Grain bodies (including low-side grain and hoppers, etc.)
30 ☐ Garbage truck
07 ☐ Livestock truck (including livestock drop frame)
27 ☐ Oilfield truck — service equipment permanently mounted on vehicle
17 ☐ Pole, logging, pulpwood, or pipe truck
22 ☐ Service truck or "craftsman's vehicle" — body equipped for mobile repair and service
60 ☐ Tank truck for dry bulk
50 ☐ Tank truck for liquids or gases
14 ☐ Utility truck — used in public utility operations (telephone line truck, etc.), body equipped for major repair (may have aerial lift, derrick, etc.)
15 ☐ Winch or crane truck — lifting equipment (including roll on, roll off) permanently mounted on vehicle
16 ☐ Wrecker — for motor vehicle towing or lifting
23 ☐ Yard tractor — cab and chassis ONLY, used to spot trailers

***NOTE** — If none of the above descriptions match the body type of this vehicle, or the trailer usually attached to it, mark (X) the "Other" box below and specify type.*

80 ☐ Other — *Specify*

Item 4 – Did you lease or rent out this vehicle TO anyone else?

210 1 ☐ YES – *Continue with items 4a and b*
2 ☐ NO – *SKIP to item 5*

a. How was it leased or rented out?

211 1 ☐ **Without** a driver
2 ☐ **With** a driver other than an owner-operator
3 ☐ With an **owner-operator as driver**

b. Was the agreement for 12 months or more?

213 2 ☐ NO
1 ☐ YES – **Which of the following did the leasing agreement include?** *Mark (X) all that apply*

214 ☐ Financing only *(Do not mark if installment sales contract)*
215 ☐ Full maintenance
216 ☐ Maintenance on specified parts only
217 ☐ Payment of taxes
218 ☐ Obtaining licenses and permits
219 ☐ Recordkeeping for leased trucks
220 ☐ Other – *Specify*

Item 5 – How would you best describe this vehicle as it was most often operated? *(If the vehicle is a pickup, compact van, mini-van, or panel truck, enter body type on the "Other" line.)*

300 1 ☐ Straight truck
2 ☐ Straight truck pulling trailer(s)
3 ☐ Truck-tractor (power unit) pulling trailer(s)
4 ☐ Other – *Specify*

Item 6 – If you indicated in item 5 that you operated this vehicle with trailer(s) attached, indicate below the kind of trailer(s) you **most often pulled**. *Mark (X) one box only, also indicate if axles are liftable.*

a. Utility and other trailers less than 20 feet used with **straight truck**

304 1 ☐ One axle on trailer
2 ☐ Two axles on trailer
3 ☐ Three axles or more on trailer

b. One full trailer *used with **straight truck**

305 1 ☐ Two axles on trailer
2 ☐ Three axles on trailer
3 ☐ Four or more axles on trailer

How many, IF ANY, of the trailer's axles are liftable? → 306

c. One semi-trailer, used with **truck-tractor** (power unit)

307 1 ☐ One axle on trailer
2 ☐ Two axles on trailer
3 ☐ Three or more axles on trailer

How many, IF ANY, of the trailer's axles are liftable? → 306

d. Two trailers, one semi- and one full *used with **truck-tractor** (power unit)

308 1 ☐ Three axles on two trailers
2 ☐ Four axles on two trailers
3 ☐ Five axles on two trailers
4 ☐ Six or more axles on two trailers

How many, IF ANY, of the trailer's axles are liftable? → 306

e. Three trailers, one semi- and two full *used with **truck-tractor** (power unit)

309 1 ☐ Five axles on three trailers
2 ☐ Six axles on three trailers
3 ☐ Seven axles on three trailers
4 ☐ Eight or more axles on three trailers

How many, IF ANY, of the trailer's axles are liftable? → 306

f. Other – *Please describe in detail the number of trailers and axles on those trailers. Also give number of any liftable axles on trailer(s).*

310

Item 7 – If you indicated in item 5 that you operated a truck-tractor (power unit) pulling trailer(s), what percent of annual mileage did you haul –

a. Railroad, ocean-going, or similar containers? 312 %

b. Piggyback trailers? 313 %

* or Semi-trailer with converter dolly

Item 9 – How many axles are on this vehicle and how many of them are driving axles? *(Do not include axles on any trailers pulled.)*

a. Total number of axles on **truck** or **truck-tractor** (power unit) *(Include front and rear axles.)*

316 1 ☐ Two axles (4 tires)
2 ☐ Two axles (6 tires)
3 ☐ Three axles
4 ☐ Four or more axles

How many, IF ANY, are liftable axles? → 317

b. Number of driving (powered) axles on **truck** or **truck-tractor** (power unit)

318 1 ☐ One driving axle
2 ☐ Two driving axles
3 ☐ Three or more driving axles

Item 10 – What type of cab does this vehicle have?

319 1 ☐ Cab forward of engine
2 ☐ Cab over engine
3 ☐ Conventional cab
4 ☐ Cab beside engine
5 ☐ Other

Item 11a – What is the OVERALL length of this vehicle or combination as it was most often operated? *Report distance from front bumper to rear of truck or rear of the last trailer attached.* 325 Feet

b. If this is a combination vehicle, what was the width of the trailer most often attached to the truck or power unit? *(If more than one trailer was pulled, give the width of the widest trailer pulled.)* 335 Inches

Item 12 – What is the EMPTY weight (truck minus cargo) of this vehicle or vehicle/trailer combination? 326 Pounds
An estimate is acceptable.

Item 13 – What was the AVERAGE weight (empty weight plus weight of cargo) of the vehicle or vehicle/trailer combination when carrying a typical payload during the past year? 327 Pounds
An estimate is acceptable.

Item 14a – What was the MAXIMUM GROSS weight (MGW) at which this vehicle or vehicle/trailer combination was operated? 334 Pounds
An estimate is acceptable.

b. What percent of annual mileage did this vehicle carry no payload? 328 %

c. What percent of annual mileage did this vehicle carry payloads that –

(1) filled its maximum cargo size? 329 %

(2) weighed the maximum cargo weight? 330 %

Item 15 – How many miles was this vehicle driven during 1987? 400 Miles
An estimate is acceptable.

Item 16 – How many miles has this vehicle been driven since it was manufactured? 401 Miles

NOTE – *If it is no longer in your possession, please estimate the total lifetime mileage at the time you last operated it.*
If the odometer/speedometer is broken, please give your best estimate.
If the odometer has turned over (100,000 + miles), please enter the total figure.

Item 17 – How many miles-per-gallon (MPG) did this vehicle average during 1987? *(Use tenths, if available.)* 402 Miles | Tenths

Example: 10.5 MPG should be entered as

Miles	Tenths
10	5

Enter miles per gallon →

Item 18 – Where was the home base of this vehicle on July 1, 1987?
If put into service after July 1, 1987, enter current home base.

404 City

405 County | 406 State | 407 ZIP Code

Continue on reverse →

Item 19 – What percent of annual mileage was driven OUTSIDE the home base state? 408
An estimate is acceptable. *(If none, enter zero.)* %

Item 20 – What PERCENTAGE of this vehicle's ANNUAL MILEAGE was accounted for by the type of trips listed below? *(If all trips were within one range, enter 100%. If more than one range is applicable, be sure that percentages add up to 100%.)*

Trips **off-the-road**, little travel on public roads	409	%
Trips **less than a 50** mile radius of vehicle's home base	410	%
Trips **within a 50–200** mile radius of vehicle's home base	411	%
Trips **beyond a 200** mile radius of vehicle's home base	412	%
TOTAL – ***Should equal 100%*** →		100%

Item 21 – Not applicable to this form.

Item 22 – What is the horsepower rating of this vehicle's engine? 341 Horsepower

Item 23 – What is the size (displacement) of this vehicle's engine?
Enter cubic inches, cubic centimeters, or liters, whichever is applicable.

342 Cubic inches (CI)	OR	343 Cubic centimeters (CC)	OR	344 Liters (L)

Item 24 – What kind of fuel does this vehicle use?

345
1 ☐ Gasoline
2 ☐ Diesel
3 ☐ Liquefied petroleum gas (LPG)
4 ☐ Other – *Specify fuel* _____

Item 25 – What type of brakes does the power unit (truck or truck-tractor) have?

347
1 ☐ Hydraulic (standard)
2 ☐ Hydraulic with power assist
3 ☐ Air

Item 26 – Does this vehicle have any of the following equipment?
Mark (X) all that apply.

350 ☐ Aerodynamic features
351 ☐ Axle or drive ratio to maximize fuel efficiency
352 ☐ Fuel economy engine with low RPM, high torque rise, turbo-charge, etc.
353 ☐ Reflective materials (in addition to those required by law)
354 ☐ Radial tires
355 ☐ Road speed governor
356 ☐ Variable fan drives
357 ☐ Other fuel conservation features
358 ☐ Power steering
359 ☐ Air conditioning in cab
360 ☐ Engine retarder
361 ☐ Electronic vehicle management system
362 ☐ Electronic vehicle identification device (transponder), etc.
363 ☐ Trip recorders
364 ☐ Navigational systems

Item 27 – Who performed the general maintenance and major overhauls on this vehicle? *Mark (X) all that apply*

	General maintenance	Major overhauls
Yourself	370 ☐	378 ☐
Your company's own maintenance facilities	371 ☐	379 ☐
Dealership's service department	372 ☐	380 ☐
Leasing company	373 ☐	381 ☐
Independent garage or private mechanic (includes gasoline or service stations)	374 ☐	382 ☐
Component distributorship (engine, transmission, etc.)	375 ☐	383 ☐
No one	376 ☐	384 ☐
Other – *Specify*	377 ☐	385 ☐

Item 30 – From the following list of products, materials, and equipment, indicate which item or items this vehicle carried. Write in the approximate percentage of the vehicle's annual mileage that was accounted for while carrying loads. *(See instruction sheet for further explanation and examples.)*

Products, equipment, materials, etc.

(1) AGRICULTURAL AND FOOD PRODUCTS		
(a) Live animals – cattle, horses, poultry, hogs, live seafood, insects, etc.	526	%
(b) Fresh farm products – grain, crops, flowers, nursery stock, raw milk, raw tobacco, etc.	527	%
(c) Processed foods and tobacco products – canned goods, prepared meats, frozen foods, beverages, bottled water, dairy products, cigarettes, etc.	528	%
(2) MINING PRODUCTS, UNREFINED – crude oil, coal, metal ores	529	%
(3) BUILDING MATERIALS – gravel, sand, concrete, flat glass, etc. (except cut lumber – *See "Lumber."*)	530	%
(4) FORESTRY, WOOD, AND PAPER PRODUCTS		
(a) Logs and forest products – except cut lumber and fabricated wood products *(See below.)*	531	%
(b) Lumber and fabricated wood products – except furniture *(See (7) below.)*	532	%
(c) Paper and paper products	533	%
(5) CHEMICALS, PETROLEUM, AND ALLIED PRODUCTS		
(a) Chemicals and/or drugs (including fertilizers, pesticides, cosmetics, paints, etc.)	534	%
(b) Petroleum and petroleum products (including paving and roofing materials)	535	%
(c) Plastics and/or rubber products	536	%
(6) METALS AND METAL PRODUCTS		
(a) Primary metal products – pipes, ingots, billets, sheets, etc.	537	%
(b) Fabricated metal products – except machinery or transportation equipment *(See below.)*	538	%
(c) Machinery – electrical or nonelectrical and electronic	539	%
(d) Transportation equipment (including complete vehicles) and parts	540	%
(7) OTHER MANUFACTURED PRODUCTS		
(a) Furniture (wood and nonwood) and/or hardware – not involved in household moving	541	%
(b) Glass products	542	%
(c) Textiles and apparels – fibers, leather goods, carpets, clothing, etc.	543	%
(d) Miscellaneous products of manufacturing – including photographic goods, watches, clocks, jewelry, and toys	544	%
(8) MISCELLANEOUS		
(a) Moving of household and office furniture – from home, offices, etc., under contract	545	%
(b) Miscellaneous tools and/or parts for specialized use, as in a craftsman's vehicle – traveling workshop for plumbers, carpenters, road service crews, etc.	546	%
(c) Mixed cargo, general freight (including the delivery of small packages)	547	%
(d) Scrap, garbage, trash, septic tank waste	548	%
(e) Industrial water	549	%
(f) Hazardous waste	550	%
(9) OTHER (not elsewhere classified) – *Please describe in detail.* _____	551	%

Item 31 – At any time during 1987 was this vehicle (or combination) used to haul hazardous materials in quantities large enough to require a special placard placed on the vehicle due to the Code of Federal Regulations, title 49, Transportation?

552
1 ☐ YES – *Continue with items 31a and b*
2 ☐ NO – *SKIP to item 32*

a. What type(s) of hazardous materials were carried by this vehicle? *Mark (X) all that apply.*

Hazardous Materials

553 ☐ Flammable liquids
554 ☐ Combustible liquids
555 ☐ Corrosive liquids
556 ☐ Poison B solids
557 ☐ Poison B liquids
558 ☐ Flammable solids
559 ☐ Oxidizers
560 ☐ Flammable gas
561 ☐ Nonflammable gas
562 ☐ Poison A
563 ☐ Corrosive solids
564 ☐ Explosives, A or B
565 ☐ Blasting agents
566 ☐ Radioactive materials
567 ☐ ORM – A, B, or C
568 ☐ ORM E
569 ☐ Hazardous materials not listed above – *Specify* _____

Item 28a – Which of the following best describes the primary way this vehicle was operated?

501
1 ☐ BUSINESS USE – Operated by and for a private business (including self-employers) or a company; used in related activities of that business (including transportation of employees) – *SKIP to item 29*
2 ☐ PERSONAL TRANSPORTATION – Operated as a personal-use vehicle in place of an automobile for pleasure driving, travel to work, etc. (NO BUSINESS USE) – *SKIP to item 32*
3 ☐ FOR HIRE – *SKIP to item 28b*
4 ☐ DAILY RENTAL OR SHORT TERM LEASE – Rented or leased out to various operators and for various activities, under daily or short term rental or lease agreements (Not motor carrier) – *SKIP to item 29*
5 ☐ MIXED

Percent business use	502	%
Percent personal use	503	%
Percent for hire (includes intercorporate hauling and trip leasing, etc.)	504	%

Complete b below

b. *If this vehicle was for hire, indicate below the type of for hire operation. Enter percentage of mileage for each category.*

(1) Operation type

MOTOR CARRIER – Operated by a company whose primary business is to provide transportation services, carrying freight belonging to others	506	%
OWNER/OPERATOR – Operated by an independent trucker who drives vehicle for himself or on lease to a company –		
as an independent	507	%
leased to a company	508	%

(2) Jurisdiction served

INTERSTATE	509	%
INTRASTATE	510	%
LOCAL – In a single municipality, contiguous municipalities or a municipality and its suburban area; in commercial zones	511	%

(3) Kind of carrier

CONTRACT – Offered transportation service to certain shippers under contracts	512	%
COMMON – Offered transportation service to the general public over regular or irregular routes	513	%
EXEMPT – transported commodities or provided types of services that were exempt from Federal regulation; operated within exempt commercial zones	514	%

(4) Was this vehicle operated under ICC authority? 518 1 ☐ YES 2 ☐ NO

Item 29 – Which of the following best describes your business or the part of your business in which the vehicle was used? *If the vehicle was leased, indicate business of lessee.*

525
01 ☐ AGRICULTURAL ACTIVITIES (including fisheries)
02 ☐ FORESTRY OR LUMBERING ACTIVITIES
03 ☐ CONSTRUCTION WORK – buildings, homes, roads, structures, etc.
04 ☐ CONTRACTOR ACTIVITIES OR SPECIAL TRADES – painting, plumbing, electrical work, masonry, carpentry, etc.
05 ☐ MANUFACTURING, REFINING, OR PROCESSING ACTIVITIES
06 ☐ WHOLESALE TRADE
07 ☐ RETAIL TRADE
08 ☐ BUSINESS AND PERSONAL SERVICES – used to assist in such services as lodging operations, landscaping, repair (except plumbing, electrical work, etc. – *See "Contractor Activities"*), laundry, advertising, entertainment, etc.
09 ☐ UTILITIES – Used to assist in operation or service of public utilities (telephone, gas, electric, etc.)
10 ☐ MINING OR QUARRY ACTIVITIES (includes well drilling) – used to assist in the extraction of natural resources or in hauling to processors
11 ☐ DAILY RENTAL – rented out, without a driver, to someone else on a daily or short-term basis
16 ☐ ONE-WAY RENTAL
12 ☐ GOVERNMENTAL OPERATIONS
13 ☐ NOT IN USE – vehicle idle, wrecked, awaiting repair, etc., for more than 90 days
14 ☐ FOR HIRE TRANSPORTATION – including small package delivery
15 ☐ OTHER – *Please describe in detail.*

b. Approximately what percent of this vehicle's annual mileage was accounted for by carrying these hazardous materials?

570
1 ☐ Below 10%
2 ☐ 10–24%
3 ☐ 25–49%
4 ☐ 50–74%
6 ☐ 75–100%

Item 32a – Was this truck or power unit involved in any accidents during 1987?

580
1 ☐ YES – *Continue with item 32b*
2 ☐ NO – *SKIP to item 33*

b. If this truck or power unit was involved in any accidents during 1987, how many –

(1) involved a fatality?	581
(2) involved no fatalities, but involved bodily injury requiring medical treatment?	582
(3) involved property damage of $4,200 or more?	583

Item 33 – *Please enter below the number of any ADDITIONAL trucks and or trailers you own and/or operate at the same home base you listed in item 18.*

a. Pickups, small vans (includes mini-vans)	571
b. Straight trucks	572
c. Truck-tractors (power units)	573
d. Trailers (semi- and/or full)	574
e. Converter dollies	575

Item 34 – *Please enter below Employer Identification (EI) Number if vehicle owned by company or Social Security Number (SSN) if vehicle owned by individual.*

EI ☐☐–☐☐☐☐☐☐☐
or
SSN ☐☐☐–☐☐–☐☐☐☐

Item 35 – REMARKS – *Please use this space for any explanations that may be essential in understanding your reported data.*

Item 36 – Person to contact regarding this report

Does this person have records on (or knowledge of) the daily activities of driver (stops, weight of individual shipments, destinations of shipments, etc.)?

1 ☐ YES
2 ☐ NO

Name			
Address *(Number and street)*			
City		State	ZIP Code
Daytime telephone number →	Area code	Number	Extension, if any
If this vehicle has a fleet number, please enter it here		576	

APPENDIX 3

NATIONWIDE TRUCK ACTIVITY AND COMMODITY SURVEY, FORM NTACS-2

FORM NTACS-2
(8-18-89)

U.S. DEPARTMENT OF COMMERCE
BUREAU OF THE CENSUS

OMB No. 2128-0640: Approval Expires 12/31/91

NATIONWIDE TRUCK ACTIVITY AND COMMODITY SURVEY

NOTICE – Your report to the Census Bureau is confidential by law (Title 13, U.S. Code). It may be seen only by sworn Census Bureau employees 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 Census File Number (CFN).

REGISTRATION INFORMATION

100 Vehicle Identification Number (VIN)	101 Make of vehicle	102 Year	103 State

104 Sample week 1	105 Sample day 1	106 Substitute day 1

107 Sample week 2	108 Sample day 2	109 Substitute day 2

Please complete this form and RETURN TO

BUREAU OF THE CENSUS
1201 East Tenth Street
Jeffersonville, IN 47134

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

BE A PART OF AMERICA'S TRANSPORTATION PLANS FOR THE YEAR 1990's AND BEYOND!

- We need your help in this Nationwide truck Activity and Commodity Survey. The information you report on this questionnaire will be used by the government and others planning for future transportation needs such as:
  - New highways
  - Terminal facilities
  - Highway maintenance and repair
- Your vehicle identified in the **Registration Information Section** above was selected in a scientific sample of vehicles to represent the country's truck population.
- Please take some of your valuable time to complete this form for the sample days indicated in the box above.
- We suggest that you take this questionnaire with you in the sampled vehicle on the Sample Days, and complete Sections C and D as you perform your day's activities.
- Please return this questionnaire immediately after your Sample Day 2.

Please read before completing this form

This questionnaire covers the activities of the vehicle specified in the **Registration Information Section** above, for the specific sample days indicated. The questionnaire is divided into 4 sections, A, B, C, and D. Sections A and B request general information on the vehicle's characteristics and use. Section C, beginning on page 5, and Section D, beginning on page 9, refer to the vehicle's use on the sample days. Sections C and D contain a diary type listing to report the activities of the vehicle during the sample days.

If the vehicle did not operate on the sample day specified, use its substitute day. If the vehicle did not operate on either the sample day or its substitute day specified, but was active during the sample week, **call us collect on (301) 763–1744.** Do not substitute another day unless told to do so. The sample days were selected scientifically, and we want to know what the vehicle did on those particular days, even though it may not seem typical to you.

a. Is the vehicle still in your possession? 111
1 ☐ YES – **Are you the –**
1 ☐ **Owner?**
2 ☐ **Lessee?**
} *SKIP to Section A on page 2 and continue with questionnaire*
2 ☐ NO – *Continue with items b–d*

b. When did you dispose of this vehicle? *Enter figures only* 112 Month | Year

c. How did you dispose of this vehicle? 113
1 ☐ Sold it (or gave it away)
2 ☐ Junked, scrapped, or otherwise destroyed
3 ☐ Returned to leasing company
4 ☐ Other – *Specify* _____

d. Who is the current owner of this vehicle? 114 ☐ Unknown

115 Name	116 Address *(Number and Street)*	
117 City	118 State	119 ZIP Code

If this vehicle is no longer in your possession, please sign on page 11 and return the questionnaire immediately.

Section A — Vehicle Information

1a. Do you currently operate this vehicle?
If "No" indicate present status

120 1 ☐ YES
2 ☐ NO —
1 ☐ Idle 3 ☐ Dismantled
2 ☐ Wrecked 4 ☐ Other — *Specify* _____

b. How many weeks during the past 12 months did you operate this vehicle?

121 _____ Weeks

2a. Where is the current home base of this vehicle?

("Home Base" refers to where the vehicle is usually packed or stationed)

122 City

123 County	124 State	125 ZIP Code

b. How many miles was this vehicle driven during the past 12 months?

126 _____ Miles *(Estimates are acceptable)*

c. In how many states did this vehicle operate during the past 12 months?

127 _____ States

d. List the three States with the highest mileage during the past 12 months —

128 (1) _____
129 (2) _____
130 (3)

e. Did this vehicle operate in Canada during the past 12 months?

131 1 ☐ YES — *Mark (X) the provinces and territories*

132 ☐ Newfoundland
133 ☐ Prince Edward Island
134 ☐ Nova Scotia
135 ☐ New Brunswick
136 ☐ Quebec
137 ☐ Ontario
138 ☐ Manitoba
139 ☐ Saskatchewan
140 ☐ Alberta
141 ☐ British Columbia
142 ☐ Yukon Territory
143 ☐ Northwest Territories

2 ☐ NO

f. Did this vehicle operate in Mexico during the past 12 months?

144 1 ☐ YES 2 ☐ NO

3. What percent of this vehicle's fuel during the past 12 months was obtained from —

a. Private fuel dump? . . . . . 145 _____ %

b. Gas station (truck stop, etc.)? . . . . . 146 _____ %

4a. SAMPLE WEEK 1

*For each day of **sample week 1** (shown in the Registration Information on page 1) check "Yes" if the vehicle operated on that day; otherwise check "No."*

(Operating includes traveling empty)

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
147	148	149	150	151	152	153
1 ☐ YES	1 ☐ YES	1 ☐ YES	1 ☐ YES	1 ☐ YES	1 ☐ YES	1 ☐ YES
2 ☐ NO	2 ☐ NO	2 ☐ NO	2 ☐ NO	2 ☐ NO	2 ☐ NO	2 ☐ NO

b. SAMPLE WEEK 2

*For each day of **sample week 2** (shown in the Registration Information on page 1) check "Yes" if the vehicle operated on that day; otherwise check "No."*

(Operating includes traveling empty)

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
154	155	156	157	158	159	160
1 ☐ YES	1 ☐ YES	1 ☐ YES	1 ☐ YES	1 ☐ YES	1 ☐ YES	1 ☐ YES
2 ☐ NO	2 ☐ NO	2 ☐ NO	2 ☐ NO	2 ☐ NO	2 ☐ NO	2 ☐ NO

FORM MTACS-3 (6-16-89)

Section B — Vehicle Description

The following questions relate to this vehicle's use during sample day 1, sample day 2, and the past 12 months. **If the vehicle did not operate on the sample day, use its substitute day.** If the vehicle did not operate on the sample day or substitute day, **call (301) 763 – 1744 collect.**

1. This truck was MOST FREQUENTLY operated as — *Mark (X) only one box in each column*	**Sample day 1**	**Sample day 2**	**Past 12 months**
a. Personal transportation	161 ☐	162 ☐	163 ☐
b. Contract carrier	164 ☐	165 ☐	166 ☐
c. Common carrier	167 ☐	168 ☐	169 ☐
d. Other business use	170 ☐	171 ☐	172 ☐
2. How would you best describe this vehicle as it was MOST FREQUENTLY operated during the each period? *Mark only one box in each column*			
a. Straight truck with 4 tires without trailer	173 ☐	174 ☐	175 ☐
b. Straight truck with 4 tires pulling trailer(s)	176 ☐	177 ☐	178 ☐
c. Straight truck with 6 or more tires without trailer	179 ☐	180 ☐	181 ☐
d. Straight truck with 6 or more tires pulling trailer(s)	182 ☐	183 ☐	184 ☐
e. Truck-tractor (power unit) pulling trailer(s)	185 ☐	186 ☐	187 ☐
f. Truck-tractor without trailer	188 ☐	189 ☐	190 ☐
g. Other — *Specify* _____	191 ☐	192 ☐	193 ☐
3. Indicate the kind of trailer(s) you pulled for each period.	*Mark (X) all that apply*	*Mark (X) all that apply*	*Mark only one*
a. No trailer pulled	350 ☐	351 ☐	352 ☐
b. Utility and other trailers less than 20 feet used with straight truck			
(1) One axle on trailer	194 ☐	195 ☐	196 ☐
(2) Two axles on trailer	197 ☐	198 ☐	199 ☐
(3) Three or more axles on trailer	200 ☐	201 ☐	202 ☐
c. One full trailer used with straight truck			
(1) Two axles on trailer	203 ☐	204 ☐	205 ☐
(2) Three axles on trailer	206 ☐	207 ☐	208 ☐
(3) Four or more axles on trailer	209 ☐	210 ☐	211 ☐
d. One semi-trailer			
(1) One axle on trailer	212 ☐	213 ☐	214 ☐
(2) Two axles on trailer	215 ☐	216 ☐	217 ☐
(3) Three or more axles on trailer	218 ☐	219 ☐	220 ☐
e. Two trailers, one semi- and one full			
(1) Three axles on two trailers	221 ☐	222 ☐	223 ☐
(2) Four axles on two trailers	224 ☐	225 ☐	226 ☐
(3) Five axles on two trailers	227 ☐	228 ☐	229 ☐
(4) Six or more axles on two trailers	230 ☐	231 ☐	232 ☐
f. Three trailers, one semi- and two full			
(1) Five axles on three trailers	233 ☐	234 ☐	235 ☐
(2) Six axles on three trailers	236 ☐	237 ☐	238 ☐
(3) Seven axles on three trailers	239 ☐	240 ☐	241 ☐
(4) Eight or more axles on three trailers	242 ☐	243 ☐	244 ☐
g. Other — *Please describe in detail the number of trailers and axles on those trailers.*	245 ☐	246 ☐	247 ☐

FORM NTACS-2 (6-16-89)

Section B — Vehicle Description — Continued

4. Indicate the body type that most closely resembles this vehicle during each sample period. If the power unit is a truck-tractor indicate the body type of the trailer(s) attached.

Mark (X) only one box for each column.

	Sample day 1	Sample day 2	Past 12 months
A. PLATFORM TYPES, includes flatbeds, stakes, and flatbeds with added devices	248 ☐	249 ☐	250 ☐
B. PICKUP	251 ☐	252 ☐	253 ☐
C. PANEL OR COMPACT VAN	254 ☐	255 ☐	256 ☐
D. MINI VAN, UTILITY, STATION WAGON (Bronco, Blazer, Jeep, etc.)	257 ☐	258 ☐	259 ☐
E. VAN TYPES, includes enclosed vans, open top vans, drop frame vans, refrigerated and multistop and high cubes	260 ☐	261 ☐	262 ☐
F. SPECIALIZED USE TRUCKS			
1. Automobile or boat transport	263 ☐	264 ☐	265 ☐
2. Beverage truck	266 ☐	267 ☐	268 ☐
3. Removable dry container on trailer chassis	269 ☐	270 ☐	271 ☐
4. Removable liquid container on trailer chassis	272 ☐	273 ☐	274 ☐
5. Other cargo container chassis	275 ☐	276 ☐	277 ☐
6. Concrete mixer	278 ☐	279 ☐	280 ☐
7. Dump truck	281 ☐	282 ☐	283 ☐
8. Grain bodies (including hoppers, grain boxes)	284 ☐	285 ☐	286 ☐
9. Garbage truck	287 ☐	288 ☐	289 ☐
10. Livestock truck, including livestock drop frame	290 ☐	291 ☐	292 ☐
11. Pole, logging, or pipe truck	293 ☐	294 ☐	295 ☐
12. Tank truck for dry bulk	296 ☐	297 ☐	298 ☐
13. Tank truck for liquids or gases (nonhazardous materials)	299 ☐	300 ☐	301 ☐
14. Tank truck for liquids or gases (hazardous materials) — *Indicate type (from placard on tank)*	302 ☐	303 ☐	304 ☐
a. MC-307	305 ☐	306 ☐	307 ☐
b. MC-331	308 ☐	309 ☐	310 ☐
c. MC-312	311 ☐	312 ☐	313 ☐
d. MC-337	314 ☐	315 ☐	316 ☐
e. MC-306	317 ☐	318 ☐	319 ☐
15. Utility truck			
Note — *If none of the above descriptions match the body type of this vehicle or the trailer usually attached to it, mark the "Other" box and describe vehicle.*			
G. Other — *Specify*	320 ☐	321 ☐	322 ☐
	_____	_____	_____

Sample Day 1

Section C — Vehicle Use

The following questions relate to the vehicle's use DURING SAMPLE DAY 1. **If this vehicle did not operate on the sample day 1, use substitute day 1.** If this vehicle did not operate on either day given, **call (301) 763-1744 collect.**

1. Enter date used	401	_____ / _____ / _____ Month Day Year
2a. How many miles did this vehicle travel during sample day 1?	402	_____ Miles *(Estimates are acceptable)*
b. What percent of those miles were on the INTERSTATE HIGHWAY SYSTEM?	403	_____ %
c. What percent of those miles were on roads which had four or more lanes but were NOT on the INTERSTATE HIGHWAY SYSTEM?	404	_____ %
d. What percent of those miles were off-road (little travel on public roads)?	405	_____ %
3a. How much fuel was used during sample day 1?	406	_____ U.S. gallons *(Estimates are acceptable)*
b. How much was paid in highway tolls during sample day 1?	407	$ _____

4a. What was the size of the vehicle —

	As it left the starting place on sample day 1? (1)	During sample day 1 when vehicle was at its maximum weight? (2)
Length (ft.) (Front bumper to end of last trailer)	408 ft.	409 ft.
Height (ft.)	410 ft.	411 ft.
Tare weight (empty)	412 lbs.	413 lbs.
Loaded vehicle weight (weight of truck and cargo)	414 lbs.	415 lbs.
Percent of payload space utilized	416 %	417 %

b. How would you best describe the vehicle's loads during sample day 1? *(If the vehicle was empty the entire day, mark the box that typically applies)* 418

1 ☐ Single shipments (Truck-load)
2 ☐ Several shipments in a truck or trailer(s) (Less-than-truck-load), including shipments consolidated by others

5. Was this vehicle used to haul hazardous materials in quantities large enough to require a special placard due to the Code of Federal Regulations, title 49, Transportation, during sample day 1? 419

1 ☐ YES
2 ☐ NO

6a. How many employees, including owner/operators, were on board the vehicle as it left the starting place on sample day 1? 420

_____ Employees on board

b. How many of these employees drove the vehicle sometime during sample day 1? 421

_____ Employees drove

7. What was the odometer reading of the vehicle at 12:01 a.m. on sample day 1? 422

_____ Miles *(Estimates are acceptable)*

8. *Mark all boxes that correspond to your hours of operation of the vehicle during sample day 1.* 423

01 ☐ 12:01 a.m. – 4:00 a.m.
02 ☐ 4:01 a.m. – 6:00 a.m.
03 ☐ 6:01 a.m. – 8:00 a.m.
04 ☐ 8:01 a.m. – 10:00 a.m.
05 ☐ 10:01 a.m. – 4:00 p.m.
06 ☐ 4:01 p.m. – 6:00 p.m.
07 ☐ 6:01 p.m. – 8:00 p.m.
08 ☐ 8:01 p.m. – 12:00 a.m.

FORM NTACS-2 (5-16-89)

Section C — Vehicle Use — Continued

COMMODITY REFERENCE LIST FOR USE IN ITEMS 9e, f, 13, AND 14

This is a list of products, materials, and equipment the vehicle may have carried.

Part A — HAZARDOUS MATERIALS	Hazmat code
Flammable liquids	41
Combustible liquids	42
Corrosive liquids	43
Poison B solids	44
Poison B liquids	45
Flammable solids	46
Oxidizers	47
Flammable gas	48
Nonflammable gas	49
Poison A	50
Corrosive solids	51
Explosives, A or B	52
Blasting agents	53
Radioactive materials	54
ORM — A, B, or C	55
ORM E	56
Hazardous materials not listed above — *Specify* — _____	57

Part B — PRODUCTS, EQUIPMENT, MATERIALS, ETC.	Commodity code
Agricultural and Food Products	
Live animals — cattle, horses, poultry, hogs, fish, and other marine products, etc.	15
Fresh farm products — grain, crops, flowers, nursery stock, raw milk, raw tobacco, etc.	16
Processed foods — canned goods, prepared meats, frozen foods, beverages, bottled water, dairy products, tobacco products, etc.	17
Mining Products, unrefined — crude oil, coal, metal ores, and industrial water	18
Building materials — gravel, sand, concrete, glass, and stone, etc.	19
Forestry, Wood, and Paper Products	
Logs and forest products — *Except* cut lumber and fabricated wood products, *(see below)* barks or gums	20
Lumber and fabricated wood products — *Except furniture*	21
Paper, printed matter, and paper products	22
Chemicals, Petroleum, and Allied Products	
Chemicals and/or drugs — *Including fertilizers, pesticides, cosmetics, paints, etc.*	23
Petroleum, petroleum products, paving, and asphalt or tar cements	24
Plastics and/or rubber products	25

Metals and Metal Products	Commodity code
Primary metal products — pipes, ingots, billets, metal sheets, etc.	26
Fabricated metal products and bolts and nuts — *Except machinery or transportation equipment (see below)*	27
Machinery — electrical or nonelectrical	28
Transportation equipment (including complete vehicles) and parts	29
Other Manufactured Products	
Furniture (wood and nonwood) and/or fixtures — not involved in household moving	30
Textiles and apparels — fibers, leather goods, carpets, clothing, etc.	31
Miscellaneous products of manufacturing — *Including photographic goods, watches, clocks, jewelry and toys*	32
Miscellaneous	
Moving of household and office furniture, including exhibits — from home, offices, etc., under contract	33
Mixed cargo, general freight, personal goods, mail and express traffic, and small packaged freight	34
Tools/parts as in craftsman's vehicle	35
Scrap, garbage, trash	36
Other — *Please describe in detail* _____	37
_____	38
NO LOAD CARRIED — Vehicle empty	39

Type of Place Codes

(Refer to these codes for completing items 9(b), 13(b), and 14(b))

A — Railroad facility (servicing facility)
B — Railroad facility (pickup or delivery of rail shipment)
C — Airport (servicing facility)
D — Airport (pickup or delivery of air shipment)
E — Harbor or port facility (servicing facility)
F — Harbor/port facility (pickup or delivery of water shipment)
G — Truck/bus terminal not part of airport, harbor, or railroad
H — Warehouse
I — Tank farm
J — Power plant/distribution station
K — House, apartment building
L — Forest, farm, field, farm building, fisheries
M — Grain elevator, stockyard
N — Mine, quarry, gravel pit, stone crusher
O — Construction site
P — Manufacturing facility or assembly plant
Q — Store or other retail or service outlet
R — Office building, school, hospital, other public facilities
S — Park or other recreational facility
T — Other

FORM NTACS 2 (5-18-89)

Sample Day 1 Stops

Section C — Vehicle Use — Continued

9. *Enter below the following data for EACH STOP during the entire SAMPLE DAY 1 only. Exclude stops for food, fuel or rest.*

SAMPLE DAY 1 STOPS *If traveling at the beginning of sample day, enter where vehicle was at 12:01 a.m. for starting place.* (a)	Type of place code *Enter the type of place code from above* (b)	Miles from previous stop? (c)	What was the purpose of the stop? *Mark (X) all that apply* (d)	*From the reference list of commodities, on page 6 enter the code and weight for the items picked up and/or delivered at each stop (if any).* ***(See instruction sheet)*** Items delivered (e): Commodity code / Hazmat code / Weight (lbs.)	Items picked up (f): Commodity code / Hazmat code / Weight (lbs.)
9.0 **Starting place** *(Mo/Day)* Date; Departure time a.m. p.m. City; County; State Loaded vehicle wt. at departure; No. of trailers attached			1 ☐ Base 2 ☐ Pick up item 3 ☐ Pick up trailer 4 ☐ Delivery 5 ☐ Drop off trailer 6 ☐ Other or In transit — *Specify* —		
Stop 1 Time of arrival a.m. p.m.; Departure time a.m. p.m. City; County; State Loaded vehicle wt. at departure; No. of trailers attached		From starting place	1 ☐ Return to base 2 ☐ Pick up 3 ☐ Pick up trailer 4 ☐ Delivery 5 ☐ Drop off trailer 6 ☐ Other — *Specify* —		
Stop 2 Time of arrival a.m. p.m.; Departure time a.m. p.m. City; County; State Loaded vehicle wt. at departure; No. of trailers attached		From stop 1	1 ☐ Return to base 2 ☐ Pick up 3 ☐ Pick up trailer 4 ☐ Delivery 5 ☐ Drop off trailer 6 ☐ Other — *Specify* —		
Stop 3 Time of arrival a.m. p.m.; Departure time a.m. p.m. City; County; State Loaded vehicle wt. at departure; No. of trailers attached		From stop 2	1 ☐ Return to base 2 ☐ Pick up 3 ☐ Pick up trailer 4 ☐ Delivery 5 ☐ Drop off trailer 6 ☐ Other — *Specify* —		
Stop 4 Time of arrival a.m. p.m.; Departure time a.m. p.m. City; County; State Loaded vehicle wt. at departure; No. of trailers attached		From stop 3	1 ☐ Return to base 2 ☐ Pick up 3 ☐ Pick up trailer 4 ☐ Delivery 5 ☐ Drop off trailer 6 ☐ Other — *Specify* —		
Stop 5 Time of arrival a.m. p.m.; Departure time a.m. p.m. City; County; State Loaded vehicle wt. at departure; No. of trailers attached		From stop 4	1 ☐ Return to base 2 ☐ Pick up 3 ☐ Pick up trailer 4 ☐ Delivery 5 ☐ Drop off trailer 6 ☐ Other — *Specify* —		

If vehicle made more than 5 stops, use page 12 for additional stop information

Sample day 1

Section C — Vehicle Use — Continued

10. How many stops were made by this vehicle to each TYPE OF PLACE during sample day 1? *(If the place where vehicle was stopped fits into more than one type of place, pick the one that best describes it) Exclude stops for food, fuel, and rest.*

Code	Type of place	No. of stops	Code	Type of place	No. of stops
A	Railroad facility	424	K	House, apartment building	434
B	Railroad facility (pickup or delivery of rail shipment)	425	L	Forest, farm, field, farm building, fisheries	435
C	Airport	426	M	Grain elevator, stockyard	436
D	Airport (pickup or delivery of air shipment)	427	N	Mine, quarry, gravel pit, stone crusher	437
E	Harbor or port facility	428	O	Construction site	438
F	Harbor/port facility (pickup or delivery of water shipment)	429	P	Manufacturing facility or assembly plant	439
G	Truck/bus terminal not part of airport, harbor, or railroad	430	Q	Store or other retail or service outlet	440
H	Warehouse	431	R	Office building, school, hospital, other public facilities	441
I	Tank farm	432	S	Park or other recreational facility	442
J	Power plant/distribution station	433	T	Other	443

11. In addition to the stops shown above how many (food, fuel etc.) stops were made during sample day 1? 444 _____ Stops

12. What was the odometer reading of the vehicle at 11:59 p.m. on sample day 1? 445 _____ Miles *(Estimates are acceptable)*

13a. Where was the last pickup or delivery prior to sample day 1?

446 Date | 447 Time leaving this place a.m. p.m.

448 City/town | 449 County, if known | 450 State

b. What type of place was this? *Enter the type of place letter code from item 10 above*

451 _____ Type of place

c. From the reference list of commodities, enter the code and weight for the items picked up or delivered: (See Instruction sheet)

Code	Hazmat code	Weight (lbs.)

14a. Where was the first pickup or delivery after sample day 1?

452 Date | 453 City/town

454 County, if known | 455 State

b. What type of place was this? *Enter the type of place letter code from item 10 above*

456 _____ Type of place

c. How many miles from last stop on sample day 1?

457 _____ Miles *(Estimates are acceptable)*

d. From the reference list of commodities, enter the code and weight for the items picked up or delivered: (See Instruction sheet)

Items delivered			Items picked up		
Code	Hazmat code	Weight (lbs.)	Code	Hazmat code	Weight (lbs.)

FORM NTACS-2 (8-16-89)

Sample Day 2

Section D — Vehicle Use

The following questions relate to the vehicle's use DURING SAMPLE DAY 2. **If this vehicle did not operate on the sample day 2, use substitute day 2.** If this vehicle did not operate on either day given, **call (301) 763-1744 collect.**

1. Enter date used	501 _____ / _____ / _____ Month Day Year
2a. How many miles did this vehicle travel during sample day 2?	502 _____ Miles *(Estimates are acceptable)*
b. What percent of those miles were on the INTERSTATE HIGHWAY SYSTEM?	503 _____ %
c. What percent of those miles were on roads which had four or more lanes but were not on the INTERSTATE HIGHWAY SYSTEM?	504 _____ %
d. What percent of those miles were off-road (little travel on public roads)?	505 _____ %
3a. How much fuel was used during sample day 2?	506 _____ U.S. gallons *(Estimates are acceptable)*
b. How much was paid in highway tolls during sample day 2?	507 $ _____

4a. What was the size of the vehicle —

	As it left the starting place on sample day 1? (1)	During sample day 1 when vehicle was at its maximum weight? (2)
Length (ft.) (Front bumper to end of last trailer)	508 ft.	509 ft.
Height (ft.)	510 ft.	511 ft.
Tare weight (empty)	512 lbs.	513 lbs.
Loaded vehicle weight (weight of truck and cargo)	514 lbs.	515 lbs.
Percent of payload space utilized	516 %	517 %

b. How would you best describe the vehicle's loads during sample day 2? *(If the vehicle was empty the entire day, mark the box that typically applies)*	518 1 ☐ Single shipments (Truck-load) 2 ☐ Several shipments in a truck or trailer(s) (Less-than-truck-load), including shipments consolidated by others
5. Was this vehicle used to haul hazardous materials in quantities large enough to require a special placard due to the Code of Federal Regulations, title 49, Transportation, during sample day 2?	519 1 ☐ YES 2 ☐ NO
6a. How many employees, including owner/operators, were on board the vehicle as it left the starting place on sample day 2?	520 _____ Employees on board
b. How many of these employees drove the vehicle sometime during sample day 2?	521 _____ Employees drove
7. What was the odometer reading of the vehicle at 12:01 a.m. on sample day 2?	522 _____ Miles *(Estimates are acceptable)*
8. *Mark all boxes that correspond to your hours of operation of the vehicle during sample day 2.*	523 01 ☐ 12:01 a.m. – 4:00 a.m. 06 ☐ 10:01 a.m. – 4:00 p.m. 02 ☐ 4:01 a.m. – 6:00 a.m. 05 ☐ 4:01 p.m. – 6:00 p.m. 03 ☐ 6:01 a.m. – 8:00 a.m. 07 ☐ 6:01 p.m. – 8:00 p.m. 04 ☐ 8:01 a.m. – 10:00 a.m. 08 ☐ 8:01 p.m. – 12:00 a.m.

FORM HTACS-2 (5-16-89)

FD250 NTACS-2 (6-18-89)

Sample Day 2 Stops

Section D — Vehicle Use — Continued

9. *Enter below the following data for EACH STOP during the entire SAMPLE DAY 2 only. Exclude stops for food, fuel or rest.*

SAMPLE DAY 2 STOPS *If traveling at the beginning of sample day, enter where vehicle was at 12:01 a.m. for starting place.* (a)	Type of place code *Enter the type of place code from p. 6* (b)	Miles from previous stop? (c)	What was the purpose of the stop? *Mark (X) all that apply* (d)	*From the reference list of commodities, on page 6 enter the code and weight for the items picked up and/or delivered at each stop (if any). (See instruction sheet)* Items delivered (e): Commodity code / Hazmat code / Weight (lbs.) Items picked up (f): Commodity code / Hazmat code / Weight (lbs.)
9.0 **Starting place** *(Mo./Day)* Date Departure time a.m. p.m. City / County / State Loaded vehicle wt. at departure / No. of trailers attached			1 ☐ Base 2 ☐ Pick up item 3 ☐ Pick up trailer 4 ☐ Delivery 5 ☐ Drop off trailer 6 ☐ Other or in transit – *Specify*	
Stop 1 Time of arrival a.m. p.m. Departure time a.m. p.m. City / County / State Loaded vehicle wt. at departure / No. of trailers attached		From starting place	1 ☐ Return to base 2 ☐ Pick up 3 ☐ Pick up trailer 4 ☐ Delivery 5 ☐ Drop off trailer 6 ☐ Other – *Specify*	
Stop 2 Time of arrival a.m. p.m. Departure time a.m. p.m. City / County / State Loaded vehicle wt. at departure / No. of trailers attached		From stop 1	1 ☐ Return to base 2 ☐ Pick up 3 ☐ Pick up trailer 4 ☐ Delivery 5 ☐ Drop off trailer 6 ☐ Other – *Specify*	
Stop 3 Time of arrival a.m. p.m. Departure time a.m. p.m. City / County / State Loaded vehicle wt. at departure / No. of trailers attached		From stop 2	1 ☐ Return to base 2 ☐ Pick up 3 ☐ Pick up trailer 4 ☐ Delivery 5 ☐ Drop off trailer 6 ☐ Other – *Specify*	
Stop 4 Time of arrival a.m. p.m. Departure time a.m. p.m. City / County / State Loaded vehicle wt. at departure / No. of trailers attached		From stop 3	1 ☐ Return to base 2 ☐ Pick up 3 ☐ Pick up trailer 4 ☐ Delivery 5 ☐ Drop off trailer 6 ☐ Other – *Specify*	
Stop 5 Time of arrival a.m. p.m. Departure time a.m. p.m. City / County / State Loaded vehicle wt. at departure / No. of trailers attached		From stop 4	1 ☐ Return to base 2 ☐ Pick up 3 ☐ Pick up trailer 4 ☐ Delivery 5 ☐ Drop off trailer 6 ☐ Other – *Specify*	

If vehicle made more than 5 stops, use page 12 for additional stop information

Sample day 2

Section D — Vehicle Use — Continued

10. How many stops were made by this vehicle to each TYPE OF PLACE during sample day 2? *(If the place where vehicle was stopped fits into more than one type of place, pick the one that best describes it) Exclude stops for food, fuel, and rest.*

Code	Type of place	No. of stops	Code	Type of place	No. of stops
A	Railroad facility	524	K	House, apartment building	534
B	Railroad facility (pickup or delivery of rail shipment)	525	L	Forest, farm, field, farm building, fisheries	535
C	Airport	526	M	Grain elevator, stockyard	536
D	Airport (pickup or delivery of air shipment)	527	N	Mine, quarry, gravel pit, stone crusher	537
E	Harbor or port facility	528	O	Construction site	538
F	Harbor/port facility (pickup or delivery of water shipment)	529	P	Manufacturing facility or assembly plant	539
G	Truck/bus terminal not part of airport, harbor, or railroad	530	Q	Store or other retail or service outlet	540
H	Warehouse	531	R	Office building, school, hospital, other public facilities	541
I	Tank farm	532	S	Park or other recreational facility	542
J	Power plant/distribution station	533	T	Other	543

11. In addition to the stops shown above how many (food and fuel etc.) were made during sample day 2? 544 _____ Stops

12. What was the odometer reading of the vehicle at 11:59 p.m. on sample day 2? 545 _____ Miles *(Estimates are acceptable)*

13a. Where was the last pickup or delivery prior to sample day 2?

546 Date | 547 Time leaving this place a.m. p.m.

548 City/town | 549 County, if known | 550 State

b. What type of place was this? *Enter the type of place letter code from item 10 above* 551 _____ Type of place

c. *From the reference list of commodities, enter the code and weight for the items picked up or delivered:* ***(See instruction sheet)***

Code	Hazmat code	Weight (lbs.)

14a. Where was the first pickup or delivery after sample day 2?

552 Date | 553 City/town

554 County, if known | 555 State

b. What type of place was this? *Enter the type of place letter code from item 10 above* 556 _____ Type of place

c. How many miles from last stop on sample day 2? 557 _____ Miles *(Estimates are acceptable)*

d. *From the reference list of commodities, enter the code and weight for the items picked up or delivered:* ***(See instruction sheet)***

Items delivered			Items picked up		
Code	Hazmat code	Weight (lbs.)	Code	Hazmat code	Weight (lbs.)

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

Name | Date

Telephone → | Area code | Number | Extension

XM NTACS-2 (5-16-89)

FORM NTACS-2 (5-16-89)

ADDITIONAL SAMPLE DAY STOPS – *Only use this section if this vehicle made more than 5 stops on either of the sample days*

ADDITIONAL SAMPLE DAY STOPS (a)	Type of place code *Enter the type of place code from p. 6* (b)	Miles from previous stop? (c)	What was the purpose of the stop? *Mark (X) all that apply* (d)	*From the reference list of commodities, on page 6 enter the code and weight for the items picked up and/or delivered at each stop (if any). (See instruction sheet)* Items delivered (e)			Items picked up (f)		
				Commodity code	Hazmat code	Weight (lbs.)	Commodity code	Hazmat code	Weight (lbs.)
Stop Date / Time of arrival a.m. p.m. / Departure time a.m. p.m. / City / County / State / Loaded vehicle wt. at departure / No. of trailers attached			1 ☐ Return to base; 2 ☐ Pick up; 3 ☐ Pick up trailer; 4 ☐ Delivery; 5 ☐ Drop off trailer; 6 ☐ Other – *Specify*						
Stop Date / Time of arrival a.m. p.m. / Departure time a.m. p.m. / City / County / State / Loaded vehicle wt. at departure / No. of trailers attached			1 ☐ Return to base; 2 ☐ Pick up; 3 ☐ Pick up trailer; 4 ☐ Delivery; 5 ☐ Drop off trailer; 6 ☐ Other – *Specify*						
Stop Date / Time of arrival a.m. p.m. / Departure time a.m. p.m. / City / County / State / Loaded vehicle wt. at departure / No. of trailers attached			1 ☐ Return to base; 2 ☐ Pick up; 3 ☐ Pick up trailer; 4 ☐ Delivery; 5 ☐ Drop off trailer; 6 ☐ Other – *Specify*						
Stop Date / Time of arrival a.m. p.m. / Departure time a.m. p.m. / City / County / State / Loaded vehicle wt. at departure / No. of trailers attached			1 ☐ Return to base; 2 ☐ Pick up; 3 ☐ Pick up trailer; 4 ☐ Delivery; 5 ☐ Drop off trailer; 6 ☐ Other – *Specify*						
Stop Date / Time of arrival a.m. p.m. / Departure time a.m. p.m. / City / County / State / Loaded vehicle wt. at departure / No. of trailers attached			1 ☐ Return to base; 2 ☐ Pick up; 3 ☐ Pick up trailer; 4 ☐ Delivery; 5 ☐ Drop off trailer; 6 ☐ Other – *Specify*						
Stop Date / Time of arrival a.m. p.m. / Departure time a.m. p.m. / City / County / State / Loaded vehicle wt. at departure / No. of trailers attached			1 ☐ Return to base; 2 ☐ Pick up; 3 ☐ Pick up trailer; 4 ☐ Delivery; 5 ☐ Drop off trailer; 6 ☐ Other – *Specify*						

Thank you for your cooperation!

APPENDIX 4

QUESTIONNAIRE FOR NTTIS, PHASES ONE AND TWO

QUESTIONNAIRE FOR NTTIS (PHASE ONE)

COMPANY DESCRIPTION

OPERATING AUTHORITY:

Is this a daily rental truck? YES [ ]7
Is this truck govt. owned? YES [ ]6
(city/county/state/federal)
8

→ *SKIP to Power Unit Description below.*

Do any of your trucks ever carry goods interstate (across state lines)?

[ ]1 YES → Are you
- PRIVATE *(Carry own goods)* [ ]1 → [ ]1
- FOR HIRE *(Carry other people's goods)* [ ]2 → ICC Authorized *(common/contract)* [ ]2; Exempt [ ]3 → Is the owner also the driver? YES [ ]1 NO [ ]2

[ ]2 NO → Are you
- PRIVATE *(Carry own goods)* [ ]1 → [ ]4
- FOR HIRE *(Carry other people's goods)* [ ]2 → [ ]5 (11) → Is the owner also the driver? YES [ ]1 NO [ ]2

[ ]9 UNKNOWN (9) →
- PRIVATE [ ]1
- FOR HIRE [ ]2 (10) → Is the owner also the driver? YES [ ]1 NO [ ]2 (12)

POWER UNIT DESCRIPTION

Verify the make, model year, and VIN, and ask for the model name and company unit number.

1. Make _____ Year: 19___ ___ VIN _____
2. Model Name _____ Company Unit Number _____
3. *EDITOR:* Code the base state of operation ___ ___ (13 14)
4. POWER UNIT TYPE
   - Tractor [ ]8
   - Straight Truck [ ]1 (15)

   STRAIGHT TRUCK BODY STYLE:
   - Van [ ]1
   - Flatbed [ ]2
   - Tanker [ ]3
   - Refrig. [ ]5
   - Dump [ ]6
   - Refuse [ ]7
   - Other [ ]8 (16)

   _____ *(Specify)*
5. NUMBER OF AXLES
   - Two [ ]2
   - Three [ ]3
   - Four + [ ]4 (17)
6. CAB STYLE
   - Cab Forward [ ]1
   - Cab Over [ ]2
   - Short Conventional [ ]3
   - Med. Conventional [ ]4
   - Long Conventional [ ]5 (18)
7. FUEL
   - Gas [ ]1
   - Diesel [ ]2
   - Other _____ [ ]3 (19)
     (Specify)
8. Power Unit EMPTY WEIGHT: ___ ___ ___ ___ ___ ___ (20 21 22 23 24 25)
9. Power Unit LENGTH: ___ ___ ___ (26 27 28)
10. Estimated Annual Mileage *for this power unit:* ___ ___ ___ ___ ___ ___ (29 30 31 32 33 34)
11. Percent of annual mileage for each trip type *for this power unit:*
    - Local *(Pickup and delivery, with 50 mile radius)* ___ ___ ___% (35 36 37)
    - Short Haul *(Intercity, one-way, distance 50-200 miles)* ___ ___ ___% (38 39 40)
    - Long Haul *(Intercity, one-way, distance 200+ miles)* ___ ___ ___% (41 42 43)

    (Total=100%)
12. Does this power unit ever pull twin trailers?
    - [ ] Yes Percent of annual mileage with twin trailers: ___ ___ ___% (44 45 46)
    - [ ] No *(Enter 000.)*
13. Odometer Reading ___ ___ ___ ___ ___ ___ (47 48 49 50 51 52) Date of Reading ___ ___/___ ___/___ ___ (53 54 55 56 57 58)

NTTIS company and power unit description.

QUESTIONNAIRE FOR NTTIS (PHASE TWO)

(A Similar Form is Used for Phases Three, Four, and Five.)

WAS THIS VEHICLE IN USE ON THE SURVEY DAY? No [ ]00 TRIP #

VEHICLE, CARGO, AND DRIVER

1. OPERATING AUTHORITY (Private Carriers only)
   Were you operating for-hire (e.g., on backhaul)?
   [ ]1 No
   [ ]2 Yes Was it as? ICC (common/contract) [ ]2
   Exempt (interstate hauling only) [ ]3
   Intrastate for-hire [ ]5

2. DRIVER AGE: ____ Yrs. 3. DRIVER YEARS WITH COMPANY: ____ Yrs.

4. CONFIGURATION: Any trailers? No [ ]1
   Yes [ ]2

	Power Unit	1st Trailer	2nd Trailer	3rd Trailer
Type:		Semi [ ]1		
		Full [ ]2	Full [ ]2	Full [ ]2
		Utility [ ]3	Utility [ ]3	Utility [ ]3
		Other [ ]4	Other [ ]4	Other [ ]4
		None [ ]5	None [ ]5	None [ ]5
Body:		Van [ ]1	Van [ ]1	Van [ ]1
		Flatbed [ ]2	Flatbed [ ]2	Flatbed [ ]2
		Tank [ ]3	Tank [ ]3	Tank [ ]3
		Auto C. [ ]4	Auto C. [ ]4	Auto C. [ ]4
		Dump [ ]6	Dump [ ]6	Dump [ ]6
		Other [ ]8	Other [ ]8	Other [ ]8
		(Specify)	(Specify)	(Specify)
No. Axles Used:				
Lengths (Ft):				
Empty Wts (Lbs):				
5. CARGO:	[ ]	[ ]	[ ]	[ ]
Cargo Wt (Lbs):				
Hazardous Cargo	Yes [ ]1 No [ ]2	Yes [ ]1 No [ ]2	Yes [ ]1 No [ ]2	Yes [ ]1 No [ ]2

6. GROSS COMBINATION WEIGHT for the trip (Lbs): ____ [1]

MILEAGE

1. Starting Point ____ (City) ____ (State) Time: ____ AM[ ] PM[ ]
2. End Point ____ (City) ____ (State) Time: ____ AM[ ] PM[ ]
3. Via ____
   (Describe route/give road nos., etc.)
4. Total Miles for Trip: ____
5. Breakdown of Mileage:

	LIMITED ACCESS		US/STATE/MAJOR ARTERY		OTHER	
	Day (6am-9pm)	Night (9pm-6am)	Day (6am-9pm)	Night (9pm-6am)	Day (6am-9pm)	Night (9pm-6am)
Rural:						
Sm Urban: (Pop < 50000)						
Lg Urban: (Pop≥50)						

6. Specific Large Urban Area: ____ [8]

NTTIS survey day trips.

APPENDIX 5

CONVERSION OF VEHICLE CLASSIFICATION DATA TO AXLE CORRECTION FACTORS

Conversion of Vehicle Classification Data to Axle Correction Factors

(1)	(2)	(3)	(4)
Vehicle Type	Number of Axles	Percentage of Traffic Obtained From Vehicle Class Counts	Column 2 * Column 3 / 100
Passenger Cars	2	64.8	1.296
Two Axle, Four Tire Trucks	2	25.0	0.500
Buses	3	0.4	0.012
Two Axle, Six Tire Trucks	2	2.8	0.056
Three Axle Single Unit Trucks	3	0.6	0.018
Four or More Axle Single Units	4	0.2	0.008
Four or Less Axle Single Trailer Trucks	4	0.8	0.032
Five Axle Single Trailer Trucks	5	4.3	0.215
Six or More Axle Single Trailer Trucks	6	0.2	0.012
Five or Less Axle Multi-Trailer Trucks	5	0.4	0.020
Six Axle Multi-Trailer Trucks	6	0.3	0.018
Seven or More Axle Multi-Trailer Trucks	7	0.2	0.014
	Axle Correction Factor		2.201

APPENDIX 6

MILEAGE AND DAILY TRAVEL SUMMARY, PARTS ONE AND TWO

MILEAGE AND DAILY TRAVEL SUMMARY

PART 1 - STATEWIDE TOTALS, RURAL AND SMALL URBAN DATA

STATE: _____ PREPARED: _____ (DATE)

STATEWIDE TOTALS

YEAR	STATE						TOTAL PUBLIC ROAD MILEAGE	TOTAL DVMT (000)	TOTAL # SMALL URBAN AREAS	PUBLIC FERRYBOAT MILEAGE: FEDERAL-AID PRIMARY: RURAL	PUBLIC FERRYBOAT MILEAGE: FEDERAL-AID PRIMARY: URBAN	PUBLIC FERRYBOAT MILEAGE: FEDERAL-AID URBAN	PUBLIC FERRYBOAT MILEAGE: FEDERAL-AID SECONDARY	TOTAL POPULATION (000)	TOTAL LAND AREA (SQ. MI.)
1 2	3 4	5	6 7	8 9 10	11 12	13 14 15 16 17 18 19 20	21 22 23 24 25 26 27 28	29 30 31 32 33 34 35 36	37 38 39 40 41 42 43 44	45 46 47 48 49 50 51 52	53 54 55 56 57 58 59 60	61 62 63 64 65 66 67 68	69 70 71 72 73	74 75 76 77 78 79 80
					0 0									

RURAL DATA

PUBLIC ROAD MILEAGE/ DAILY VEHICLE-MILES OF TRAVEL	YEAR	STATE	R-U				FUCTIONAL SYSTEM: PRINCIPAL ARTERIAL: INTERSTATE	PRINCIPAL ARTERIAL: OTHER	MINOR ARTERIAL	COLLECTOR: MAJOR	COLLECTOR: MINOR	LOCAL	TOTAL	POPULATION (000)	LAND AREA (SQ. MI.)
	1 2	3 4	5	6 7	8 9 10	11 12	13 14 15 16 17 18 19 20	21 22 23 24 25 26 27 28	29 30 31 32 33 34 35 36	37 38 39 40 41 42 43 44	45 46 47 48 49 50 51 52	53 54 55 56 57 58 59 60	61 62 63 64 65 66 67 68	69 70 71 72 73	74 75 76 77 78 79 80
MILEAGE			1			1 0									
DVMT (000)			1			2 0									

SMALL URBAN DATA

PUBLIC ROAD MILEAGE/ DAILY VEHICLE-MILES OF TRAVEL	YEAR	STATE	R-U				FUCTIONAL SYSTEM: PRINCIPAL ARTERIAL: INTERSTATE	PRINCIPAL ARTERIAL: OTHER FREE-WAYS & EXPWYS	PRINCIPAL ARTERIAL: OTHER	MINOR ARTERIAL	COLLECTOR	LOCAL	TOTAL	POPULATION (000)	LAND AREA (SQ. MI.)
	1 2	3 4	5	6 7	8 9 10	11 12	13 14 15 16 17 18 19 20	21 22 23 24 25 26 27 28	29 30 31 32 33 34 35 36	37 38 39 40 41 42 43 44	45 46 47 48 49 50 51 52	53 54 55 56 57 58 59 60	61 62 63 64 65 66 67 68	69 70 71 72 73	74 75 76 77 78 79 80
MILEAGE			2			1 0									
DVMT (000)			2			2 0									

*R-U CODE: 1=RURAL, 2=SMALL URBAN, 3=URBANIZED

OMB No. 2125-0028

USE PART 2 FOR INDIVIDUAL URBANIZED AREA DATA

MILEAGE AND DAILY TRAVEL SUMMARY

PART 2 - INDIVIDUAL URBANIZED AREA DATA

STATE: _____ SHEET#: _____ PREPARED: _____ (DATE)

PUBLIC ROAD MILEAGE/ DAILY VEHICLE-MILES OF TRAVEL	YEAR	STATE	R-U*		URBANIZED AREA		FUNCTIONAL SYSTEM: PRINCIPAL ARTERIAL: INTERSTATE	PRINCIPAL ARTERIAL: OTHER FREEWAYS & EXPRESSWAYS	PRINCIPAL ARTERIAL: OTHER	MINOR ARTERIAL	COLLECTOR	LOCAL	TOTAL	POPULATION (000)	LAND AREA (SQ. MI.)
	1 2 3 4		5	6 7	8 9 10	11 12	13-20	21-28	29-36	37-44	45-52	53-60	61-68	69-73	74-80
MILEAGE			3			1 0									
DVMT (000)			3			2 0									
MILEAGE			3			1 0									
DVMT (000)			3			2 0									
MILEAGE			3			1 0									
DVMT (000)			3			2 0									
MILEAGE			3			1 0									
DVMT (000)			3			2 0									
MILEAGE			3			1 0									
DVMT (000)			3			2 0									
MILEAGE			3			1 0									
DVMT (000)			3			2 0									
MILEAGE			3			1 0									
DVMT (000)			3			2 0									
MILEAGE			3			1 0									
DVMT (000)			3			2 0									
MILEAGE			3			1 0									
DVMT (000)			3			2 0									
MILEAGE			3			1 0									
DVMT (000)			3			2 0									
MILEAGE			3			1 0									
DVMT (000)			3			2 0									
STATEWIDE TOTAL URBANIZED — MILEAGE			0			1 0									
STATEWIDE TOTAL URBANIZED — DVMT (000)			0			2 0									

*R-U CODE: 1=RURAL, 2=SMALL URBAN, 3=URBANIZED

USE SUPPLEMENTARY SHEETS FOR ADDITIONAL URBANIZED AREAS

OMB No. 2125-0028

APPENDIX 7

SUMMARY OF LOCAL FUNCTIONAL CLASS MILEAGE BY SURFACE TYPE AND TRAFFIC VOLUME GROUP

SUMMARY OF LOCAL FUNCTIONAL SYSTEM MILEAGE

BY SURFACE TYPE AND VOLUME GROUP

STATE: ____________________ PREPARED: ____________________ (DATE)

	MILEAGE BY SURFACE TYPE	YEAR	STATE	R-U*			RURAL AVERAGE DAILY TRAFFIC VOLUME: UNDER 50	50-199	200-499	500 & OVER	TOTAL
RURAL	PAVED			1		5 1					
	GRAVEL/SOIL			1		5 2					
	UNIMPROVED			1		5 3					
	TOTAL			1		5 4					

	MILEAGE BY SURFACE TYPE	YEAR	STATE	R-U*			URBAN AVERAGE DAILY TRAFFIC VOLUME: UNDER 200	200-499	500-1999	2000 & OVER	TOTAL
SMALL URBAN	PAVED			2		5 1					
	GRAVEL/SOIL			2		5 2					
	UNIMPROVED			2		5 3					
	TOTAL			2		5 4					
URBANIZED	PAVED			3		5 1					
	GRAVEL/SOIL			3		5 2					
	UNIMPROVED			3		5 3					
	TOTAL			3		5 4					

*R-U CODE: 1=RURAL, 2=SMALL URBAN, 3=URBANIZED

OMB No. 2125-0028

APPENDIX 8

TRAVEL ACTIVITY BY VEHICLE TYPE AND FUNCTIONAL CLASS

Figure II-4

TRAVEL ACTIVITY BY VEHICLE TYPE AND FUNCTIONAL SYSTEM

PART 1

STATE: _____

PREPARED: _____ (DATE)

	FUNCTIONAL SYSTEM	YEAR (1 2)	STATE (3 4)	R-U* (5)	FUNCTIONAL SYSTEM (6 7)	PERCENT OF TRAVEL - XX.X (ASSUMED DECIMAL)**																																					
						MOTORCYCLES (OPTIONAL) (8 9 10)	PASSENGER CARS (11 12 13)	OTHER 2-AXLE, 4-TIRE, SINGLE-UNIT VEHICLES (14 15 16)	BUSES (17 18 19)	2-AXLE, 6-TIRE, SINGLE-UNIT TRUCKS (20 21 22)	3-AXLE, SINGLE-UNIT TRUCKS (23 24 25)	FOUR OR MORE AXLE, SINGLE-UNIT TRUCKS (26 27 28)	FOUR OR FEWER AXLE, SINGLE-TRAILER TRUCKS (29 30 31)	5-AXLE, SINGLE-TRAILER TRUCKS (32 33 34)	SIX OR MORE AXLE, SINGLE-TRAILER TRUCKS (35 36 37)	FIVE OR FEWER AXLE, MULTI-TRAILER TRUCKS (38 39 40)	6-AXLE, MULTI-TRAILER TRUCKS (41 42 43)	SEVEN OR MORE AXLE, MULTI-TRAILER TRUCKS (44 45 46)
RURAL	INTERSTATE				1 0 1																																				
RURAL	OPA				1 0 2																																				
RURAL	MA				1 0 6																																				
RURAL	MAJOR COLL				1 0 7																																				
RURAL	MINOR COLL				1 0 8																																				
RURAL	LOCAL				1 0 9																																				
URBAN	INTERSTATE				4 1 1																																				
URBAN	OFE				4 1 2																																				
URBAN	OPA				4 1 4																																				
URBAN	MA				4 1 6																																				
URBAN	COLL				4 1 7																																				
URBAN	LOCAL				4 1 9																																				

*R-U CODE: 1=RURAL, 4=URBAN (SMALL URBAN AND URBANIZED AREAS COMBINED)

OMB No. 2125-0028

** IF PERCENT OF TRAVEL IS LESS THAN ONE-TENTH OF A PERCENT FOR A VEHICLE TYPE, ATTACH A SEPARATE SHEET SHOWING THE VALUE TO THE FIRST SIGNIFICANT DIGIT. IF REPORTING ON MACHINE READABLE MEDIUM, PLEASE CODE THE VALUE DIRECTLY.

APPENDIX 9

INFORMATION ON STATES THAT COULD PROVIDE VEHICLE MILES TRAVELED

States that Could Provide Vehicle Miles Traveled

State	Contact Person	Phone Number	Information
Arizona	Warren White	(602)255-7291	The mileage that would be available is the amount of miles travelled on any road surface (backroads and dirt roads included) by trucks that report fuel tax. This would include some Intrastate carriers, but not many. (Most Intrastate carriers choose to not report fuel tax, which is an option to them in Arizona law.) Also, 1986 information is available from the Ports-of-entry. That includes only trucks that are above 26,000 pounds GVW. Those trucks stop to declare their mileage when coming into that state. Those numbers, however, are not as precise as the state would like.
Colorado	Jim Huyghebaert and Tom	(303) 866-3089	Every year, a document is compiled from the fuel tax reports which includes the total gallons of fuel used in the state of Colorado. With some mpg assumptions, vmt could be calculated. The Weight-Distance Tax that is collected in the state is not entered into a computer. There are no totals to be acquired from the Weight-Distance Tax unless someone manually adds the report figures. Many Interstate carriers are required to stop at Colorado's Ports of Entry at declare their mileage in the state. This would not include all mileage, however, because many carriers have exemptions for various reasons.
Connecticut	Marian Lawrence	(203) 566-8679	The mileage information would be available by sending a written request to the Confidentiality Office - Frederick Measer, Internal Revenue, 135 High St., Hartford, CT 06103; (203)240-4062.
Delaware	Mrs. Banks	(302) 736-4538	There is no current program that can extract that information from the computer. A program could be written to perform that function, if a formal request was submitted and funding was supplied.
Idaho	Randy John	(208) 334-7702	They can furnish the mileage for Intra- and Interstate motor carriers together by extracting the information from their computer. It is also possible that they could find a way to separate the Intra- and Interstate in order to provide only Interstate mileage, but that is not promised.
Indiana	Mike Smith	(317) 232-0076	The information is obtainable, but would take a while to compile. He could not compile the information without approval from the division head.

Continued

State	Contact Person	Phone Number	Information
Iowa	Greg Howitt	(515) 281-6624	The mileage data from the tax forms are entered into a computer database. By writing a program, the information can be extracted.
Kansas	Martha Curuthers	(913) 296-3081	The state would be able to provide gallons of fuel used, from which we could calculate vmt with mpg assumptions.
Kentucky	Mr. Dotson	(502) 564-4103	His office has done a one time study to calculate the vmt for all trucks over 60,000 pounds, traveling in the state between January 1, 1987 and January 1, 1988. This vmt is 1,170,614,272 miles. There is no breakdown of this number by any categories. This number was not produced for any other year. The mileage information is contained in a computer database, but would require a programmer (and money) to extract it.
Louisiana	Susie Pace	(504) 925-7652	The amount of fuel used is available, from which we could calculate the miles using mpg assumptions.
Maryland	Karen	(301) 974-2215	The information is probably available from the computer system, but in order to be sure if it is available we must make a written request to the Comptroller of the Treasury, Motor Vehicle Fuel Tax Division, Attn. Mr. Art Price, P.O. Box 1751, Annapolis, MD 21404.
Michigan	Contact not named	(517) 373-3183	The information would be available by sending a written request to the Michigan Dept. of Treasury, Information Officer, Treasury Bldg., Lancing, MI 48922.
Montana	Norris Nichols	(406) 444-3474	The mileage could be calculated by his office using the total fuel used and average mpg. Intra- and Interstate trucks could not be separated.
Nebraska	Marcie Williams	(402) 471-2971	The total miles travelled in state would be available on a quarterly basis. The state collects total mileage travelled and miles travelled in state. No other information (specifics on the trucks) would be available.

Continued

State	Contact Person	Phone Number	Information
New Hampshire	Norman Boisvert	(603) 271-2311	The state can provide the amount of fuel purchased in the state. They calculate total state mileage by using the gallons of fuel purchased and an average mpg. They use the mileage statistics in their highway safety figures. Mr. Boisvert said that the gallons purchased in the state would reflect at least 99% of the miles driven in the state. For the figures to be released to us, a written request should be sent to Commissioner of Safety, Richard M. Flynn, Department of Safety, James H. Hayes Safety Bldg., Hazem Dr., Concord, NH 03305.
New Mexico	Steve Kirkpatrick	(505) 827-2270	He could calculate an approximate mileage figure within a day of our request. He would do this by dividing the revenue dollars by the tax rate per mile.
North Carolina	Robert Beck	(919) 733-3401	The information has previously appeared in a report sent to his office on a regular basis from the computer reports division, but that report has been streamlined and does not include mileage. He knows that some kind of vmt would still be obtainable, but does not know exactly how difficult it would be to do so.
Ohio	Richard Beckner	(614)466-3503	The mileage is available, but Inter- and Intrastate trucks cannot be separated. If needed, using some assumptions, the 3 axle trucks and the tractor trailers could be separated.
Oklahoma	David Nicholson	(405) 521-3036	The MIS (Computer Statistics Division) could generate the mileage numbers if a formal request was made.
Oregon	Mary Anne Kurt	(503) 378-6615	A program could be written to produce the vmt. The office charges a fee of approximately $100 for information. Depending on the kind of information requested, the price of may vary.
Rhode Island	Mr. O'Brian	(401) 277-2950	The total tax dollars collected could be given to us. We divide that by the amount of the tax to get the number of gallons used, and then use MPG to calculate the mileage. He suggested I call the State DOT, because they use road surveys (maybe HPMS) to collect that type of information.

Continued

State	Contact Person	Phone Number	Information
South Dakota	Mrs. Bouzek	(605) 773-5335	The mileage is available, but the information could not be released until approval from the Deputy Director of the Motor Vehicle Division. The Deputy Director's phone number is (605) 773-5747.
South Carolina	Robert Cromer	(803) 737-4872	The information from the fuel tax reports is entered into the computer, but he has no idea if the information about mileage can be summed and extracted. In order to find out if the information is available, we need to send a written request to the South Carolina Tax Commission, Office Service Division, P.O. Box 125, Columbia, SC 29214. At the very least they could give us the total revenue for each quarter, from which we may be able to estimate vmt.
Utah	Bob Jensen	(801) 530-6068	The mileage could be calculated by taking the taxes collected and converting them to gallons of fuel used, and deriving mileage from fuel use and mpg.
Virginia	Bill Fulcher	(804) 786-2488	A Road Tax Report is compiled every year for the State General Assembly which covers the last two years of data. This report gives various breakdowns of vmt - Private, For Hire, Interstate, and Intrastate.
Washington	Contact not named	(206) 753-6900	The mileage information would be available by sending a written request to Mr. Ildefonso Origenes, Dept. of Licensing, Fuel Tax Section, P.O. Box 9228, Olympia, WA 98504.
West Virginia	Mark Peyton	(304) 348-3456	The Motor Carrier Road Tax Division is able to get information on the mileage of individual accounts from the computer system, but cannot generate totals for the mileage. The information is in the computer, but it would require a programmer and funding to retrieve the information.
Wyoming	Donavon Bright	(307) 777-5293	The miles reported in the state include all miles driven in the state, which includes the rural dirt roads. There is an approximate percentage that can be applied to the total vmt to take out the backroad travel. The mileage includes Interstate and Intrastate vehicles, and there is no way that the two can be separated in the vmt figure.

APPENDIX 10

INTERNATIONAL REGISTRATION PLAN APPLICATION FORM, SCHEDULES A, B, AND C

INTERNATIONAL REGISTRATION PLAN APPLICATION
SCHEDULE A (original) or SCHEDULE C (supplement)

Name of Registrant (Print or Type)			
Business Address (Must indicate address in base jurisdiction)			
CITY	COUNTY	STATE	ZIP CODE

MAILING ADDRESS			
CITY	COUNTY	STATE	ZIP CODE

LICENSE YEAR	FLEET NUMBER	ACCOUNT NUMBER	PAGE OF
PERSON TO CONTACT REGARDING APPLICATION		SALES TAX EXEMPTION NUMBER	
CITY	STATE	PHONE NO.	

JURISDICTIONAL USE

UNITS LISTED ON THIS PAGE WILL BE AUTHORIZED TO OPERATE IN THE JURISDICTIONS AND AT THE WEIGHTS LISTED BELOW.
EXCEPTIONS ON ANY JURISDICTIONS OR WEIGHT WILL BE GROUPED ON SEPARATE PAGES.
WEIGHT WILL BE PRINTED ON THE CAB CARDS FOR ALL UNITS LISTED BELOW.

Multi Yr. _____
Original _____
Supplement _____

PRORATE BASE STATE _____

AB	AL	AR	AZ	CO	IA	ID	IL	KS	KY	LA	MN
MO	MS	MT	NC	ND	NE	OK	OR	PA	SD	TN	TX
UT	VA	WI	WY								

FEES BASED UPON _____ NUMBER OF MONTHS

1 TRANSACTION TYPE	2 OWNER'S UNIT NUMBER	3 YEAR	4 MAKE OF VEHICLE	5 VEHICLE IDENTIFICATION NUMBER	6 TYPE	7 * FUEL	8 UNLADEN WEIGHT	9 * FUEL	10 COMBINED OR GROSS WEIGHT	11 PRICE OF VEHICLE	12 FACTORY PRICE	13 DATE OF PURCHASE	14 DATE OF LEASE	15 NAME OF LESSOR OR HOUSEHOLD GOODS CARRIER	16 HORSE POWER	17 TITLE NUMBER	18 CURRENT LICENSE NUMBER	19 OFFICE USE

* VEHICLE TYPE
TT - TRUCK TRACTOR
TR - TRACTOR
TK - TRUCK (SINGLE)
RT - ROAD TRACTOR
ST - SEMI TRAILER
FT - FULL TRAILER
BS - BUS
CG - CONVERTER GEAR
DB - DOUBLE BOTTOMS

** FUEL
D - DIESEL
G - GAS
P - PROPANE

TRANSACTION TYPE
A - ADD VEHICLE
C - CORRECTION
D - DELETE
T - TRANSFER

NO. OF POWER VEH IN FLEET	NO. OF TRAILERS IN FLEET	TOTAL NO. OF VEH IN FLEET

The undersigned, under oath, swears under penalty of perjury that the information furnished in this application and the attached schedules are true and correct.

Signature _____ Title _____ Date _____

Exhibit 2-2

IRIS Original Application (Schedule A) or Supplemental Application Form (Schedule C)

Name of Registrant

Business Address (Must indicate address in base jurisdiction)

CITY COUNTY STATE ZIP CODE

MAILING ADDRESS

CITY COUNTY STATE ZIP CODE

INTERNATIONAL REGISTRATION PLAN
ORIGINAL MILEAGE SCHEDULE & RECAP SHEET
SCHEDULE B

PERSON TO CONTACT REGARDING APPLICATION

CITY STATE PHONE NO.

For the Jurisdiction of _____ Carrier Account No. _____

License Year _____ Fleet No. _____

Operational Date _____

A Mark "X" in square for each state where you are filing for proportional registration.
B List mileage and percent for each jurisdiction in which this fleet traveled July 1, 19__ through June 30, 19__

	STATE	MILEAGE	PERCENT		STATE	MILEAGE	PERCENT		STATE	MILEAGE	PERCENT
	AL (Alabama)				MI (Michigan)				TX (Texas)		
	AK (Alaska)				MN (Minnesota)				UT (Utah)		
	AZ (Arizona)				MS (Mississippi)				VT (Vermont)		
	AR (Arkansas)				MO (Missouri)				VA (Virginia)		
	CA (California)				MT (Montana) (S/C)				WA (Washington)		
	CO (Colorado)				NE (Nebraska)				WV (West Virginia)		
	CT (Connecticut)				NV (Nevada)				WI (Wisconsin)		
	DE (Delaware)				NH (New Hampshire)				WY (Wyoming) (Y/N)		
	DC (Dist of Col)				NJ (New Jersey)				AB (Alberta)		
	FL (Florida)				NM (New Mexico)				BC (Brish Columbia)		
	GA (Georgia)				NY (New York)				MB (Manitoba)		
	ID (Idaho)				NC (North Carolina)				NB (New Brunswick)		
	IL (Illinois)				ND (North Dakota)				NF (New Foundland)		
	IN (Indiana)				OH (Ohio)				NS (Nova Scotia)		
	IA (Iowa)				OK (Oklahoma)				NT (Northwest Terr)		
	KS (Kansas)				OR (Oregon)				ON (Ontario)		
	KY (Kentucky)				PA (Pennsylvania)				PE (Prince Edward Isl)		
	LA (Louisiana)				RI (Rhode Island)				PQ (Quebec)		
	ME (Maine)				SC (South Carolina)				SK (Saskatchewan)		
	MD (Maryland)				SD (South Dakota)				YT (Yukon)		
	MA (Mass.)				TN (Tennessee)				MX (Mexico)		
									TOTAL 100% FLEET MILES		

TYPE OF OPERATION

Canadian Provincial Operating Authority No. _____

Common Carrier with I.C.C. Permit No. _____

Contract Carrier with I.C.C. Permit No. _____

☐ Common Carrier Exempt Commodities
☐ Livestock ☐ Grain ☐ Logs ☐ Ore ☐ Sand, Rock or Gravel _____
☐ Produce ☐ Other _____
☐ Private Carrier ☐ Haul for Hire ☐ Household Goods Carrier ☐ Rental Company
☐ Private/Concrete

*Vehicle Type	Weight	Number	Fee Per Vehicle	Total Dollars
			x	=
			x	=
			x	=
			x	=
			x	=
			x	=
			x	=

TOTAL FEES THIS APPLICATION	
MILEAGE PERCENT	
DOLLAR APPORTIONMENT	
CAB CARD FEES	
CREDIT DUE	
TOTAL FEES DUE	

Explain in detail scope of your operation covering any estimated mileage _____

CR 550 - P (6/82)

Signature of Authorized Representative _____

Exhibit 2-3

IRIS Mileage Schedule/Recap Sheet (Schedule B)

GLOSSARY

COEFFICIENT OF VARIATION

The *coefficient of variation* is a measure of relative dispersion equal to the ratio of standard deviation to mean.

Also, let 0 be an estimator of a population parameter 0. For a given sampling plan, the value of 0 would vary from sample to sample. The average value of 0 over all possible samples is called the expected value (or mean) of 0 and is denoted by E (0). The standard error (or standard deviation) of 0, denoted by σ_0, is a measure of variability (or dispersion) of 0. The *coefficient of variation* is the standard error of 0 relative to E (0). That is,

$$\text{Coefficient of variation of } \Theta = \frac{\sigma_\Theta}{E(\Theta)}.$$

DOMAIN (or STUB CHARACTERISTIC)

A *domain* is a proper subpopulation of a target population about which some characteristics may be desired. For example, suppose a sample is selected from all of the trucks in the U.S. Then the straight trucks that appear in the sample can be used to provide some estimates of certain characteristics for the set of all straight trucks in the U.S. In this context, the subpopulation of all straight trucks in the U.S. is a domain. The stub characteristic would be "straight truck."

EXPANSION FACTOR

An *expansion factor* for a sample is a number that multiplies a quantitative sample characteristic to produce an estimate of an analogous quantitative target population characteristic. For example, under simple random sampling of size n from a population of size N, the expansion factor N/n times a sample total is an estimator

of a target population total. There are many variations of expansion factors that are determined by the method of estimation and the method of sample selection. For example, the expansion factor used in HPMS is the ratio of the total mileage in a stratum to the total sampled mileage in that stratum. Alternate expressions for *expansion factor* are *raising factor* and *inflation factor.*

NONRESPONSE RATE

The term *nonresponse* refers to the failure to measure completely the units in the selected sample. In its simplest form, *nonresponse rate* means

$$\text{nonresponse rate} = \frac{(\text{\# of units in the sample that did not respond})}{(\text{\# of units in the sample})}$$

Note that

$$\text{response rate} = 1 - (\text{nonresponse rate}).$$

It is worth noting that there are many variations of the above definition of nonresponse rate and it is not always immediately clear which one is being used in a specific application.

PARAMETER

Any characteristic of a population is called a *parameter.* Generally, the value of a parameter is unknown and must be estimated using sample data. VMT for the U.S. population of trucks for a given year is an example of a parameter.

SAMPLING FRACTION

If the number of units in the target population (i.e., sampling frame) is N and the number of units in the sample is n, then the *sampling fraction* is a n/N.

SAMPLING FRAME

In its simplest form, the *sampling frame* is an explicit listing of the units in the target population. The sampling frame is the set from which a proper subset (sample) is taken.

More generally, the *sampling frame* can include the materials or devices which delimit, identify, and allow access to the elements of the target population. In a sample survey, the units of the frame are the units to which the probability sampling scheme is applied. The *sampling frame* also includes any auxiliary information (measures of size, demographic information) that is used for (1) special sampling techniques, such as, stratification and probability proportional to size sample selections; or for (2) special estimation techniques, such as ratio or regression estimation.

TARGET POPULATION

The *target population* is the set of all units or elements about which information is wanted. For example, in NTTIS the target population is the collection of all large trucks in the U.S.

☆U.S. GOVERNMENT PRINTING OFFICE:1989 - 748-114/ 00114

INTERNAL DISTRIBUTION

1. G. J. Anderson-Batiste
2. D. J. Beal
3. J. J. Beauchamp
4. S. C. Davis
5. R. B. Honea
6. P. S. Hu
7. S. P. Miaou
8. B. E. Peterson
9. R. B. Shelton
10. L. S. Williams
11. T. Wright

12-13. Central Research Library
14. Document Reference Section
15. Laboratory Records
16-17. Laboratory Records - RC
18. ORNL Patent Office

EXTERNAL DISTRIBUTION

19. B. B. Buchanan, Professor, Department of Computer Science, Alumni Hall, Room 318, University of Pittsburgh, Pittsburgh, PA 15260
20. J. J. Cuttica, Vice President of Research and Development, Gas Research Institute, 8600 W. Bryn Mawr Avenue, Chicago, IL 60631
21. D. E. Morrison, Professor of Sociology, Michigan State University, 201 Berkey Hall, East Lansing, MI 48824-1111
22. R. L. Perrine, Professor, Engineering and Applied Sciences, Civil Engineering Department, Engineering I, Room 2066, University of California, Los Angeles, CA 90024
23. D. E. Reichle, Director, Environmental Sciences Division, Oak Ridge National Laboratory, Post Office Box 2008, Building 1505, Oak Ridge, TN 37831-6037
24. M. Williams, Professor, Department of Economics, Northern Illinois University, DeKalb, IL 60115

25-29. Transportation and Systems Research Distribution, Energy Division
30-39. OSTI, U.S. Department of Energy, P.O. Box 62, Oak Ridge, TN 37831
40. Office of Assistant Manager of Energy Research and Development, DOE/ORO, P.O. Box 2001, Oak Ridge, TN 37831-8600