U.S. Department
of Transportation
**National Highway
Traffic Safety
Administration**

www.nhtsa.gov
NHTSA

DOT HS 810 646

August 2006

Large-Truck Crash Causation Study: An Initial Overview

Published by:
NHTSA's National Center for Statistics and Analysis

NCSA
NHTSA's National Center for Statistics & Analysis

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipients's Catalog No.	
DOT HS 810 646			
4. Title and Subtitle Large-Truck Crash Causation Study: An Initial Overview		5. Report Date August 2006	
		6. Performing Organization Code NPO-121	
7. Author(s) Marc Starnes		8. Performing Organization Report No.	
9. Performing Organization Name and Address National Center for Statistics and Analysis National Highway Traffic Safety Administration U.S. Department of Transportation NPO-121, 400 Seventh Street SW. Washington, DC 20590		10. Work Unit No. (TRAIS)n code 11. Contract of Grant No.	
12. Sponsoring Agency Name and Address National Center for Statistics and Analysis National Highway Traffic Safety Administration U.S. Department of Transportation NPO-121, 400 Seventh Street SW. Washington, DC 20590		13. Type of Report and Period Covered NHTSA Technical Report 14. Sponsoring Agency Code	
15.Supplementary Notes			

16. Abstract

The Large-Truck Crash Causation Study (LTCCS) is a data collection project conducted by the National Highway Traffic Safety Administration (NHTSA) and the Federal Motor Carrier Safety Administration (FMCSA) of the United States Department of Transportation (USDOT). NHTSA's National Center for Statistics and Analysis (NCSA) worked together with FMCSA to develop the LTCCS, which was conducted within the National Automotive Sampling System (NASS) that NCSA operates.

The tables in this report were created through the use of the data collected in the LTCCS. While the LTCCS collected data on approximately 1,000 variables, the tables presented in this report comprise only a sample of these variables. The complete LTCCS variable database can be used jointly to examine a large number of issues surrounding large-truck crashes. One section in the report focuses on "crash-level" variables, which provide counts of crashes that occurred under certain characteristics (i.e., crash counts stratified according to how many vehicles were in the crash). The next section includes tables that are presented at the "vehicle level." These tables thus provide counts of the number of vehicles involved in certain types of crashes (i.e., vehicle counts that have been stratified by the injury severity of the person most severely injured in each vehicle). The tables in the following section are presented at the "driver level." These tables display counts of drivers that were involved in certain crash scenarios (i.e., the number of drivers involved in the crashes, stratified by the age of the driver). The appendix includes tables and computer programs for calculating standard errors and confidence intervals using LTCCS data.

17. Key Words	18. Distribution Statement		
Large-truck crash causation study, LTCCS, crash type, critical event, critical reason, environment	Document is available to the public through the National Technical Information Service, Springfield, VA 22161		
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No of Pages 43	22. Price

Form DOT F1700.7 (8-72)

Table of Contents

I. Executive Summary

The Large-Truck Crash Causation Study (LTCCS) is a data collection project conducted by the National Highway Traffic Safety Administration (NHTSA) and the Federal Motor Carrier Safety Administration (FMCSA) of the United States Department of Transportation (USDOT). NHTSA's National Center for Statistics and Analysis (NCSA) worked together with FMCSA to develop the LTCCS, which was conducted within the National Automotive Sampling System (NASS) that NCSA operates.

Prior to the execution of the LTCCS, no USDOT national database existed that contained information detailing the contributing factors for large-truck crashes. LTCCS is the first national study that determined the reasons and associated factors contributing to serious large-truck crashes. This study will assist DOT agencies in implementing effective countermeasures designed to reduce the frequency and severity of serious large-truck crashes.

Teams of trained researchers from NHTSA's NASS program worked with State truck inspectors to collect nationally representative data pertaining to the causes of serious large-truck crashes. The crashes that were examined occurred from April 1, 2001, through December 31, 2003. For each crash, information was collected for approximately 1,000 variables.

The data collected by the LTCCS provide detailed descriptions about the crash environment (i.e., weather, road conditions, lighting conditions), vehicles involved in the crash (i.e., vehicle type, weight, cargo type, brakes, air bag status), and drivers (i.e., driving record, fatigue, sleep patterns, restraint use), as well as information about passengers and nonmotorists involved in the large-truck crashes. Key factors that led to the crash were recorded to assist researchers in measuring associations between certain crash types and the events that led to the crash.

The LTCCS gathered data from 2,284 vehicles involved in 1,070 crashes. National estimates are calculated by applying weights to these vehicles and crashes. A total of 2,078 vehicles and 963 crashes have non-zero weights. When the counts from these crashes are weighted, they represent a total of 241,000 vehicles involved in 120,000 crashes. Of the 241,000 vehicles in the LTCCS, 141,000 are large trucks and 100,000 are "other vehicles" (i.e., passenger cars, light trucks, vans, sport utility vehicles, and motorcycles). Multivehicle crashes comprise 103,000 large trucks and 100,000 other vehicles, while single-vehicle crashes account for 38,000 large trucks. These weighted estimates were calculated through the use of statistical sampling weights for each crash. In the text of this report, the weighted count estimates are rounded off to the nearest thousand, while the weighted estimates shown in each table are not rounded off.

The tables in this report were created through the use of the data collected in the LTCCS. While the LTCCS collected data on approximately 1,000 variables, the tables presented in this report comprise only a sample of these variables. The complete LTCCS variable database can be used jointly to examine many issues surrounding large-truck crashes. All tables in the Crash Counts Available Through the LTCCS Database section (page 7) of this report are based on "crash-level" variables, which provide counts of crashes that occurred under certain characteristics (i.e., crash counts stratified according to how many vehicles were in the crash). The following section (page 11), Vehicle Counts Available Through the LTCCS Database, includes tables that are presented at the "vehicle level." These tables thus provide counts of the number of vehicles involved in certain types of crashes (i.e., vehicle counts that have been stratified by the injury

severity of the person most severely injured in each vehicle). The tables in the last section, Driver Counts Available Through the LTCCS Database (page 37), are presented at the "driver level." These tables display counts of drivers that were involved in certain crash scenarios (i.e., the number of drivers involved the crashes, stratified by the age of the driver).

One of the key variables in the LTCCS database was termed "critical event." Critical event was defined as the event that led immediately to the crash. The critical event is the action or event that made the crash unavoidable, and only one critical event is defined for each crash. This variable provides an example of what can be learned from the study. In multivehicle crashes, 4 percent of large trucks had their critical event coded as "this vehicle loss of control," while 33 percent of large trucks had their critical event coded as "other motor vehicle in lane." This is one example of data that was collected in the LTCCS, and this variable is discussed later in this report.

The variables mentioned in this report are intended to provide examples of the extensive list of variables collected in the LTCCS; however data surrounding many other issues is provided in the LTCCS, including topics such as brakes, cargo shift, driver health, nonmotorists, vehicle passengers, vehicle inspections, truck exterior, jackknives, transportation of hazardous materials, driver DMV violations, and more. The LTCCS provides an extensive database that will be used to examine a plethora of aspects of large-truck crashes. The USDOT plans to conduct more analyses and report the findings in the future.

II. Introduction

Prior to the execution of the Large-Truck Crash Causation Study (LTCCS), no USDOT national database existed that contained information detailing the causes and contributing factors for large-truck crashes. LTCCS is the first national study that determined the reasons and associated factors contributing to serious large-truck crashes. This study will assist DOT agencies in implementing effective countermeasures designed to reduce the frequency and severity of serious large-truck crashes.

The only crashes examined in the LTCCS were in-transport large-truck crashes with a maximum crash injury severity of killed, or incapacitating injury, or non-incapacitating injury; therefore, in order to be included in the LTCCS, an identifiable injury needed to result from the crash. Non-injury crashes were excluded from this study. Certain crashes were examined yet were later found to not meet the study criteria, and these crashes were given statistical weights of zero, and therefore are not represented in the tables in this report which include weighted counts. The information collected on these additional crashes was retained in the database files.

The crashes were examined in 24 locations within the United States, with the locations stratified by geographic region (Northeast, Midwest, South, West) and population size (central city, large county, group of counties). More information on the methodology of the LTCCS is available in the *Large-Truck Crash Causation Study Analysis Series: Methodology of the Large-Truck Crash Causation Study (FMCSA-RI-05-035),* written by Daniel Blower and Kenneth Campbell.

Researchers examined crash scenes that represent an estimated 120,000 crashes involving 241,000 vehicles. The 241,000 vehicles consisted of 141,000 large trucks and 100,000 other vehicles. These weighted estimates were calculated through the use of statistical sampling weights for each crash. In the appendix of this report, information is presented on calculating standard errors and confidence intervals for variables in the LTCCS database. Sample code in both the SAS and SUDAAN computer languages is included, as are the standard errors and 95-percent confidence intervals for the first table in this report, Table 1. A brief explanation of the interpretation of these tables is also in the appendix.

During the LTCCS data collection, NASS researchers received voluntary participation and cooperation from law enforcement agencies, hospitals, physicians, medical examiners, coroners, tow yard operators, garages, vehicle storage facilities, as well as the individuals involved in the large-truck crashes. Cooperation was established that allowed police agencies and hospitals to provide copies of transcripts of official records. Tow yards, police impound yards, and crash-involved parties were contacted to obtain information about vehicle and occupant characteristics and crash circumstances.

Crashes were investigated quickly following the crash occurrence. An on-scene investigation response protocol was developed, as opposed to a reactive approach (follow-up investigation), in order to assist in gathering in-depth crash-related data in a timely manner. This protocol was developed since experience has shown that the availability of crash causation data often diminishes rapidly with the passage of time.

This on-scene investigative method signified the first time in NASS history that police investigators, certified Commercial Vehicle Safety Alliance (CVSA) Level I State truck inspectors, and NASS truck researchers combined their efforts and agreed to simultaneously respond to a crash scene. This approach resulted in a higher rate of participation by crash victims, a higher quality of interview and vehicle information, and a better understanding of the events surrounding the crash. These accomplishments were made without compromising enforcement rules or research protocols. The police and CVSA State truck inspectors maintained their responsibility for enforcing traffic laws and safety regulations, while NASS maintained its obligation of ensuring research data confidentiality and data integrity.

III. Tables Included In This Report

The tables in this report were created through the use of the data collected in the LTCCS. While the LTCCS collected data on approximately 1,000 variables, the tables presented in this report comprise only a sample of these variables. The complete LTCCS variable database can be used jointly to examine a large number of issues surrounding large-truck crashes.

In this report, Section IV, Section V, and Section VI contain crash, vehicle, and driver counts respectively. Most of the vehicle counts and driver counts are stratified according to (1) whether they occurred in a single-vehicle crash or a multiple vehicle crash, and (2) whether the vehicle occupant was in a large truck or "other vehicle."

Section IV is named Crash Counts Available Through the LTCCS Database. Tables 1 through 4, which are in Section IV, are based on "crash-level" variables, which provide counts of crashes that occurred under certain characteristics (i.e., crash counts stratified according to how many vehicles were in the crash).

Section V, entitled Vehicle Counts Available Through the LTCCS Database, includes Tables 5 through 20 that are presented at the "vehicle level." These tables thus provide counts of the number of vehicles involved in certain types of crashes (i.e., vehicle counts that have been stratified by the injury severity of the person most severely injured in each vehicle).

The counts in Tables 21 through 27 are presented at the "driver level" in Section VI, Driver Counts Available Through the LTCCS Database. These tables display counts of drivers who were involved in certain crash scenarios (i.e., the number of drivers involved the crashes, stratified by the age of the driver).

At the end of this report is Section VII, which is an appendix that includes tables and other information on calculating standard errors and confidence intervals for variables in the LTCCS database.

This report introduces the reader to the LTCCS database and is designed to be a brief overview of the LTCCS. Examples of variables that are presented in this report include:

- Number of trucks and total number of vehicles in each crash (i.e., three total vehicles, which includes one large truck)
- Types of vehicles in each crash (i.e., single-unit large trucks, combination large trucks, passenger vehicles)
- Injury severity of people involved in the crashes (i.e., fatally injured, incapacitating injury)
- General crash type (i.e., right roadside departure, rear-end, head-on)
- Specific crash type (i.e., jackknife event)
- Critical event, general level* (i.e., this vehicle loss of control)
- Critical event, specific level* (i.e., blow out/flat tire)

- Critical reason, general level* (i.e., driver decision factor, vehicle-related factor)
- Critical reason, specific level* (i.e., driver inattention, brakes failed)
- Weather (i.e., rain, snow, fog)
- Lighting conditions (i.e., dark, dusk)
- Pre-crash movement (i.e., passing another vehicle, turning right)
- Pre-crash location (i.e., departed roadway, stayed in original travel lane)
- Driver age
- Driver seat air bag status
- Restraint use of driver
- Source of driver blood alcohol concentration (BAC) test result (i.e., police reported)
- BAC test status of driver (i.e., test performed and results negative)
- Driver familiarity with vehicle driven (i.e., driven 6-10 times in the last six months)

* = Explanations of the definitions of these variables are presented beginning on page 17, in the section entitled *Critical Event and Critical Reason*

The variables mentioned in this report are intended to provide examples of the extensive list of variables collected in the LTCCS; however data surrounding many other issues are provided in the LTCCS database, including topics such as brakes, cargo shift, driver health, nonmotorists, vehicle passengers, vehicle inspections, truck exterior, jackknives, transportation of hazardous materials, driver DMV violations, and more. Thus, the LTCCS provides the opportunity to examine many aspects of large-truck crashes. The USDOT plans to conduct more analyses and report the findings in the future.

IV. Crash Counts Available Through the LTCCS Database

The LTCCS provides extensive information about large-truck crashes, including details about the vehicles and people involved in the crash. This section shows several examples of the information that is available in the LTCCS database, with a focus being on crash counts. These "crash counts" or "crash-level variables" provide details about the crash, the vehicles and the drivers involved.

It is important to note that the crash counts in this chapter represent the number of crashes that existed under certain scenarios. For example, Table 1 displays the total number of vehicles involved in the crash, stratified by the number of large trucks involved the crash. Each cell in Table 1 represents the number of crashes that involved a certain number of total vehicles and a certain number of trucks (i.e., 51,000 crashes involved two total vehicles, one of which was a large truck). Therefore the counts of Table 1 are crash counts, as is consistent throughout Section IV.

The LTCCS gathered data from 1,070 crashes. Nine hundred sixty-three of these crashes have non-zero weights, and these crashes are weighted to represent a total of 120,000 crashes. This chapter includes information that is vital toward gaining an understanding of the number and type of crashes in the LTCCS. Much more crash-level information is available through the plethora of variables within the LTCCS database.

In the appendix of this report, information is presented on calculating standard errors and confidence intervals for variables in the LTCCS database. Sample code in both the SAS and SUDAAN computer languages is included, as are the standard errors and 95-percent confidence intervals for Table 1. A brief explanation of the interpretation of these tables is also placed in the appendix.

Crash Tables

Table 1 shows that 104,000 (87%) of the 120,000 crashes involved only one large truck, while 12 percent of the crashes involved two large trucks, and only 2 percent involved three or more large trucks. Among the 104,000 crashes that included only one large truck, 38,000 (37%) of them consisted of only the large truck, and 66,000 (63%) consisted of one large truck and one or more other vehicles.

Of the group of 16,000 crashes that involved multiple trucks, 84 percent involved two large trucks and 16 percent involved three or more large trucks. One-half of the crashes with two large trucks involved only large trucks, while the other half of these crashes also involved one or more other vehicles.

Table 1
Weighted Number of Crashes
By Number of Vehicles and Number of Large Trucks Involved

By Number of Vehicles	1 truck		2 trucks		3 or more trucks		Total	
	#	%	#	%	#	%	#	%
1 vehicle	38,127	37	0	0	0	0	38,127	32
2 vehicles	51,025	49	6,888	50	0	0	57,913	48
3 or more vehicles	14,501	14	6,964	50	2,698	100	24,163	20
Total	103,652	100	13,852	100	2,698	100	120,202	100

Source: NHTSA, NCSA, LTCCS. Study Time Span: April 1, 2001 - December 31, 2003

The numbers of crashes in the LTCCS are shown in Table 2, according to the number and type of large trucks that were involved in the crash. The 120,000 large-truck crashes were stratified into four categories as follows: a crash involving one single-unit large truck (25% of all large-truck crashes), a crash involving one combination large truck (61%), a crash involving several large trucks (13%), and a crash involving a large truck of unknown truck type (1%). Combination trucks include tractor- and semi-tractor-trailers.

Table 2
Weighted Number of Crashes, by Truck Type
Truck Type = Single Unit Truck, Combination Truck or Multiple Trucks

Single Unit Truck		Combination Truck		Multiple Trucks		Unknown Truck Type		Total	
#	%	#	%	#	%	#	%	#	%
22,440	25	80,757	61	16,550	13	456	1	120,202	100

Source: NHTSA, NCSA, LTCCS. Study Time Span: April 1, 2001 - December 31, 2003

The LTCCS crashes are categorized into five types of crashes in Table 3. Thirty-two percent (38,000) of the crashes involved only one vehicle (a large truck). Among the 48 percent of the crashes that were two-vehicle crashes, 88 percent (51,000) of these were between one large truck and one non-truck, with the remaining 12 percent (7,000) of these consisted of only two large trucks.

Twenty percent of all large-truck crashes (24,000) had three or more vehicles, with a large truck being involved in the first harmful event in about 80 percent of these crashes (19,000).

Table 3
Weighted Number of Crashes
By Crash Type and Vehicle Type

By Crash Type and Vehicle Type	#	%
One vehicle (has to be a truck)	38,127	32
Two vehicles: one truck and one non-truck	51,025	42
Two vehicles: both trucks	6,888	6
Three or more vehicles: one truck in 1st harmful event	19,216	16
Three or more vehicles: no truck in 1st harmful event	4,947	4
Total	120,202	100

Source: NHTSA, NCSA, LTCCS. Study Time Span: April 1, 2001 - December 31, 2003

The crashes shown in Table 3 are further stratified according to crash severity, and displayed in Table 4. This crash severity, or maximum injury severity, is defined as the maximum injury severity of all people involved in the crash. In 55 percent (66,000) of the LTCCS crashes studied in this survey, the maximum injury severity was a nonincapacitating injury, and 37 percent (44,000) of the crashes had a maximum injury severity of incapacitating injury, while the remaining 9 percent (10,000) of all LTCCS crashes involved a fatality. It is important to remember that every crash included in the LTCCS had a maximum injury severity of a non-incapacitating, incapacitating, or fatal injury.

Table 4
Weighted Number of Crashes
By Number of Vehicles Involved, Vehicle Type and Crash Severity

By Crash Type and Vehicle Type	B - Non-incapacitating injury		A - Incapacitating injury		K - Killed		Total	
	#	%	#	%	#	%	#	%
One vehicle (has to be a truck)	25,661	67	10,766	28	1,700	4	38,127	100
Two vehicles: one truck and one non-truck	23,675	46	22,507	44	4,842	9	51,025	100
Two vehicles: both trucks	3,239	47	3,284	48	364	5	6,888	100
Three or more vehicles: one truck in 1st harmful event	11,628	61	5,534	29	2,053	11	19,216	100
Three or more vehicles: no truck in 1st harmful event	1,671	34	2,005	41	1,271	26	4,947	100
Total	65,876	55	44,097	37	10,229	9	120,202	100

Source: NHTSA, NCSA, LTCCS. Study Time Span: April 1, 2001 - December 31, 2003

When the crashes were stratified by the maximum injury severity, different crash patterns emerged, as shown in Table 4. Among nonincapacitating crashes, 39 percent involved only one large truck, and 36 percent involved one large truck and one non-truck. Crashes where an incapacitating injury was the maximum injury severity were distributed in a far different manner across crash type and vehicles involved. Fifty-one percent of these crashes occurred between a large truck and a non-truck, and just 24 percent involved only a large truck. These data show that passengers in vehicles other than large trucks are more likely to be seriously injured than are the passengers within the large truck, when these two different vehicle types collide. The higher the injury severity of the crash, then the more likely the crash involved multiple vehicles.

Crashes where people were fatally injured were more likely to be three-or-more-vehicle crashes, compared to crashes where no one was fatally injured. Thirty-two percent of fatal large-truck crashes involved three or more vehicles, and over three-fifths of these crashes had a large truck in the first harmful event. Only 17 percent of fatal large-truck crashes were single-vehicle crashes, much less than the 24 percent of incapacitating injury crashes and 39 percent of nonincapacitating injury crashes that had a large truck as the only vehicle involved. This shows once again that the injury severity of the crash is less among single-vehicle large-truck crashes, compared to crashes involving one large truck and one non-truck. While only 4 percent of single-vehicle large-truck crashes involved a fatality, fatal crashes constituted 9 percent of crashes that involved a large truck and a non-truck.

V. Vehicle Counts Available Through the LTCCS Database

As shown throughout this report, the LTCCS provides extensive information about large-truck crashes, including details about the vehicles and drivers involved in the crash. This section shows examples of the detailed information that is available in the LTCCS database, with the unit of measurement being a count of involved vehicles. These "vehicle counts" or "vehicle-level variables" provide details about the crash, the vehicles, and the drivers involved.

While facts about the drivers and passengers in the vehicles are displayed, it is important to note that the vehicle counts in this chapter all represent the number of vehicles that existed under certain scenarios at the time of the crash. For example, one chart measures the "maximum injury level" of vehicle passengers, while another chart is based on the lighting conditions at the time of the crash. However, the counts of the maximum injury level and the lighting conditions are both vehicle counts, as is consistent throughout this chapter.

Thus the counts of the maximum injury level measure the injury level of the most severely injured passenger in each vehicle. Similarly, the counts of the lighting conditions measure the lighting conditions that are experienced by each vehicle. These are examples of variables that could be measured at the person level (i.e., injury severity) or the crash level (i.e., lighting conditions), but are measured at the vehicle level in this chapter.

The LTCCS gathered data from a total of 241,000 vehicles. All 38,000 single-vehicle crashes in the LTCCS are large-truck crashes. The multivehicle crashes in the LTCCS include 103,000 large trucks and 100,000 "other vehicles" (i.e., passenger cars, light trucks, vans, sport utility vehicles, and motorcycles). These vehicle counts are stratified into two above-mentioned crash types: single-vehicle crashes and multivehicle crashes. Within each crash type, the vehicle counts fall into two categories: large trucks and other vehicles.

The tables in this chapter include information about topics such as vehicle type, crash type, critical event and critical reason, maximum injury level, crash environment, crash location, and pre-crash movement.

Vehicle Tables

Fifty-nine percent of the vehicles in the LTCCS are large trucks, with 15 percent being single-unit trucks, and 44 percent combination trucks. As shown in Table 5, the other vehicles are almost all passenger cars or light trucks (41%).

Table 5
Weighted Number of Involved Vehicles, by Vehicle Body Type

Single-Unit Trucks		Combination Trucks		Passenger Cars and Light Trucks		Other Vehicles (i.e., Motorcycles and Buses)		Total	
#	%	#	%	#	%	#	%	#	%
34,962	15	106,245	44	98,401	41	1,420	1	241,028	100
Source: NHTSA, NCSA, LTCCS. Study Time Span: April 1, 2001 - December 31, 2003									

The LTCCS categorized the variable "general accident type" into 13 categories, and the "specific accident type" into dozens of categories. The general accident type is made of broad categories, such as "rear-end." Comparatively, each category of the specific accident type is, as the variable name suggests, more informative about the specifics of the crash (see Table 7 for the categories of the specific accident type). Among the large trucks, the general accident type includes 23 percent "rear-end" and 10 percent "right roadside departure," with the general accident type of 26 percent of the trucks being labeled as "miscellaneous" (see Table 6).

Table 6
Weighted Number of Trucks by General Accident Type (of the Vehicle)

By General Accident Type	#	%
Right Roadside Departure	14,023	10
Rear-End	31,935	23
Head-On	4,033	3
Turn Across Path	7,033	5
Straight Paths	8,272	6
Same Trafficway Opposite Directions - Sideswipe/Angle	6,433	5
Left Roadside Departure	11,110	8
Same Trafficway Same Direction - Forward Impact	126	0
Same Trafficway Opposite Directions - Forward Impact	146	0
Turn Into Path	4,251	3
Single Driver - Forward Impact	2,644	2
Same Trafficway Same Direction - Sideswipe/Angle	14,785	10
Miscellaneous	36,409	26
Total	141,200	100
Source: NHTSA, NCSA, LTCCS. Study Time Span: April 1, 2001 - December 31, 2003		

The specific accident type includes dozens of categories such as "single driver, right roadside departure, drive off road" (6%), "single driver, left roadside departure, control/traction loss" (4%), "same trafficway, same direction, rear end: stopped (striking vehicle)" (6%), and "same trafficway, same direction, sideswipe/angle: straight ahead" (4%). These categories are listed below in Table 7. In a multivehicle crash, a striking vehicle impacts and delivers force to a struck vehicle.

For more information on the many categories shown below for the "specific accident type" variable, one can refer to the NASS CDS 2000 Coding and Editing Manual (see page 292). The internet address for this publication is the following:
http://www-nass.nhtsa.dot.gov/NASS/CDS/DataColl/man2000.pdf

Table 7
Weighted Number of Trucks, by Specific Accident Type (of the Vehicle)

By Specific Accident Type	#	%
Miscellaneous – Others – No Impact	1,321	1
Single driver, right roadside departure, drive off road	7,802	6
Single driver, right roadside departure, control/traction loss	5,574	4
Single driver, right roadside departure, avoid collision with vehicle, pedestrian, animal	519	0
Single driver, right roadside departure, specifics unknown	127	0
Single driver, left roadside departure, drive off road	4,407	3
Single driver, left roadside departure, control/traction loss	5,494	4
Single driver, left roadside departure, avoid collision with vehicle, pedestrian or animal	853	1
Single driver, left roadside departure, specifics unknown	356	0
Single driver, forward impact, parked car	45	0
Single driver, forward impact, stationary object	32	0
Single driver, forward impact, pedestrian or animal	2,290	2
Single driver, forward impact, end departure	125	0
Single driver, forward impact, specifics other	151	0
Same trafficway, same direction, rear-end: Stopped (striking vehicle)	7,766	6
Same trafficway, same direction, rear-end: stopped, forward moving (struck vehicle)	3,650	3
Same trafficway, same direction, rear-end: stopped, turning left (struck vehicle)	292	0
Same trafficway, same direction, rear-end: slower (striking vehicle)	5,244	4
Same trafficway, same direction, rear-end: slower, forward moving (struck vehicle)	5,768	4
Same trafficway, same direction, rear-end: slower, turning left (struck vehicle)	196	0
Same trafficway, same direction, rear-end: slower, turning right (struck vehicle)	34	0
Same trafficway, same direction, rear-end: decelerating (striking vehicle)	4,788	3
Same trafficway, same direction, rear-end: decelerating, moving forward (struck vehicle)	2,908	2
Same trafficway, same direction, rear-end: decelerating, turning right (struck vehicle)	535	0
Same trafficway, same direction, rear-end: specifics other	755	1
Same trafficway, same direction, forward impact, specifics other	119	0
Same trafficway, same direction, forward impact, specifics unknown	7	0
Same trafficway, same direction, sideswipe angle, straight ahead on left	138	0
Same trafficway, same direction, sideswipe/angle, straight ahead	5,807	4
Same trafficway, same direction, sideswipe angle, merging to right	4,515	3
Same trafficway, same direction, sideswipe angle, merging to left	2,457	2
Same trafficway, same direction, sideswipe angle, specifics other	1,867	1
Same trafficway, opposite direction, head-on, lateral move, infringing vehicle	1,441	1
Same trafficway, opposite direction, head-on, lateral move (going straight)	2,284	2
Same trafficway, opposite direction, head-on, specifics other	308	0
Same trafficway, opposite direction, forward impact, specifics other	146	0
Same trafficway, opposite direction, sideswipe/angle, lateral move, infringing vehicle	848	1

By Specific Accident Type	#	%
Same trafficway, opposite direction, sideswipe/angle, lateral move, this vehicle going straight	4,707	3
Same trafficway, opposite direction, sideswipe/angle, specifics other	878	1
Change trafficway vehicle turning, turn across path, initially opposite direction, turning right	1,424	1
Change trafficway vehicle turning, turn across path, initially opposite direction, going straight	1,821	1
Change trafficway vehicle turning, turn across path, initially same direction, turning right, across	949	1
Change trafficway vehicle turning, turn across path, initially same direction, going straight	668	0
Change trafficway vehicle turning, turn across path, initially same direction, turning left, across	1,280	1
Change trafficway vehicle turning, turn across path, initially same direction, going straight	780	1
Change trafficway vehicle turning, turn across path, specifics other	112	0
Change trafficway vehicle turning, turn into path, turn into same direction, turning left	250	0
Change trafficway vehicle turning, turn into path, turn into same direction, going straight	39	0
Change trafficway vehicle turning, turn into path, turn into same direction, turning right	112	0
Change trafficway vehicle turning, turn into path, turn into same direction, going straight	416	0
Change trafficway vehicle turning, turn into path, turn into opposite direction, turning right	234	0
Change trafficway vehicle turning, turn into path, turn into opposite direction, going straight (L	206	0
Change trafficway vehicle turning, turn into path, turn into opposite direction, turning left	409	0
Change trafficway vehicle turning, turn into path, turn into opposite direction, going straight (R	2,535	2
Change trafficway vehicle turning, turn across path, specifics unknown	50	0
Intersecting paths, straight paths, t-bone frontal impact (L to R)	2,806	2
Intersecting paths, straight paths, t-bone right side impact	1,749	1
Intersecting paths, straight paths, t-bone frontal impact (R to L)	1,134	1
Intersecting paths, straight paths, t-bone left side impact	2,543	2
Intersecting paths, straight paths, specifics other	40	0
Miscellaneous – backing, etc – backing vehicle	474	0
Miscellaneous – others – other crash type	34,614	25
Total	141,200	100
Source: NHTSA, NCSA, LTCCS. Study Time Span: April 1, 2001 - December 31, 2003		

The maximum injury level of all people in the vehicle (see Table 8) varies greatly between large trucks and other vehicles. The "no injury" category is more than three times as likely to be seen among large trucks (52%) as opposed to other vehicles (17%), while in other vehicles the leading categories of the maximum injury levels are "nonincapacitating injury" (44%) and "incapacitating injury" (29%). The percent of vehicles where someone was killed is more than four times as high in other vehicles (7.4%) as compared to large trucks (1.6%). Table 8 is measured at the vehicle level, and thus single-vehicle crash where the maximum injury level in the vehicle is "no injury" is an example of where a crash was included in the study due to a pedestrian or other non-occupant who was injured.

In multivehicle crashes, the maximum injury level was "no injury" for 69 percent of large trucks and only 17 percent of other vehicles. For all other injury level categories, a higher percentage was seen in the other vehicles. This clearly shows that when a large truck and an "other vehicle" are involved in a crash, the passengers in the other vehicle are far more likely to be killed or seriously injured.

Table 8
Weighted Number of Involved Vehicles
By Maximum Injury Level, Crash Type, and Vehicle Body Type

MAXIMUM INJURY LEVEL	Single-Vehicle Crash		Multivehicle Crash						Total					
	Truck		Truck		Other Vehicle		Total		Truck		Other Vehicle		Total	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
No injury	1,843	5	71,631	69	16,531	17	88,161	43	73,473	52	16,531	17	90,004	37
Possible injury	0	0	506	0	1,080	1	1,586	1	506	0	1,080	1	1,586	1
Non-incapacitating injury	25,227	66	20,706	20	43,821	44	64,527	32	45,933	33	43,821	44	89,754	37
Incapacitating injury	9,670	25	7,441	7	28,980	29	36,421	18	17,111	12	28,980	29	46,091	19
Killed	1,031	3	1,228	1	7,411	7	8,639	4	2,259	2	7,411	7	9,670	4
Injury, severity unknown	356	1	1,562	2	2,005	2	3,567	2	1,919	1	2,005	2	3,924	2
Total	38,127	100	103,074	100	99,828	100	202,902	100	141,200	100	99,828	100	241,028	100

Source: NHTSA, NCSA, LTCCS. Study Time Span: April 1, 2001 - December 31, 2003

Table 9 shows that the distributions of crash type configuration are quite different between large trucks and other vehicles. For example, although "rear-end" was the crash type configuration for 23 percent of large trucks and other vehicles, 10 percent of large trucks and only 1 percent of other vehicles were coded as "right roadside departure."

In single-vehicle crashes, 61 percent of the large trucks had either a right roadside departure (34%) or left roadside departure (27%). In multivehicle crashes only 1 percent of vehicles were coded as right roadside departure and 2 percent coded as left roadside departure. Twenty-seven percent of vehicles in multivehicle crashes had their crash type coded as "rear-end," as shown in Table 9.

Table 9
Weighted Number of Involved Vehicles
By General Accident Type, Crash Type, and Involved Vehicle Type

General Accident Type	Single-Vehicle Crash		Multivehicle Crash						Total					
	Truck		Truck		Other Vehicle		Total		Truck		Other Vehicle		Total	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Right Roadside Departure	13,099	34	924	1	622	1	1,545	1	14,023	10	622	1	14,644	6
Rear-End	0	0	31,935	31	23,454	23	55,389	27	31,935	23	23,454	23	55,389	23
Head-On	0	0	4,033	4	3,117	3	7,151	4	4,033	3	3,117	3	7,151	3
Turn Across Path	0	0	7,033	7	5,406	5	12,439	6	7,033	5	5,406	5	12,439	5
Straight Paths	0	0	8,272	8	6,369	6	14,641	7	8,272	6	6,369	6	14,641	6
Same Trafficway Opposite Directions - Sideswipe/Angle	0	0	6,433	6	8,431	8	14,865	7	6,433	5	8,431	8	14,865	6
Left Roadside Departure	10,229	27	881	1	3,794	4	4,675	2	11,110	8	3,794	4	14,904	6
Same Trafficway Same Direction - Forward Impact	0	0	126	0	119	0	246	0	126	0	119	0	246	0
Same Trafficway Opposite Directions - Forward Impact	0	0	146	0	146	0	292	0	146	0	146	0	292	0
Turn Into Path	0	0	4,251	4	4,219	4	8,470	4	4,251	3	4,219	4	8,470	4
Single Driver - Forward Impact	2,432	6	212	0	212	0	424	0	2,644	2	212	0	2,855	1
Same Trafficway Same Direction - Sideswipe/Angle	0	0	14,785	14	14,247	14	29,032	14	14,785	10	14,247	14	29,032	12
Miscellaneous	12,367	32	24,042	23	29,692	30	53,734	26	36,409	26	29,692	30	66,101	27
Total	38,127	100	103,074	100	99,828	100	202,902	100	141,200	100	99,828	100	241,028	100

Source: NHTSA, NCSA, LTCCS. Study Time Span: April 1, 2001 - December 31, 2003

Critical Event and Critical Reason

The "critical event" of the crash is defined as the event that immediately led to the crash. One and only one critical event is defined for each crash. The critical event is the action or event that made the collision unavoidable.

The "critical reason" is the immediate reason for the critical event, and it describes why the critical event occurred. Possible critical reasons include driver decisions, vehicle failures, and environmental conditions.

Both the critical reason and the critical event were recorded at the general level and the specific level. Each critical reason at the general level (i.e., "driver performance factor") has a variety of different specific levels (i.e., "panic/freezing" and "too fast for curve/turn"). In addition, each critical event at the general level (i.e., "this vehicle traveling") has a variety of different crash types (i.e., "off the edge of the road on the right side").

Table 10 shows that in multivehicle crashes, the critical event (general level) for 65 percent of large trucks and 63 percent of other vehicles falls into the three categories of "this vehicle traveling," "other motor vehicle in lane," or "other motor vehicle encroaching into lane." The critical event in 4 percent of the large trucks in multivehicle crashes and 47 percent of large trucks in single-vehicle crashes were coded as "this vehicle loss of control." In multivehicle crashes, 28 percent of other vehicles and 19 percent of large trucks have a critical event coded as "this vehicle not involved in first harmful event."

Table 10
Weighted Number of Involved Vehicles
By Critical Event (General Level), Crash Type, and Involved Vehicle Type

Critical Event (General Level)	Single-Vehicle Crash		Multivehicle Crash						Total					
	Truck		Truck		Other Vehicle		Total		Truck		Other Vehicle		Total	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
This vehicle loss of control	17,917	47	4,117	4	7,468	7	11,585	6	22,034	16	7,468	7	29,502	12
This vehicle traveling	15,545	41	19,884	19	24,125	24	44,008	22	35,429	25	24,125	24	59,553	25
Other motor vehicle in lane	638	2	34,009	33	23,293	23	57,302	28	34,647	25	23,293	23	57,941	24
Other motor vehicle encroaching into lane	692	2	23,806	23	15,974	16	39,780	20	24,498	17	15,974	16	40,472	17
Pedestrian, pedacyclist, or other nonmotorist	2,058	5	112	0	0	0	112	0	2,170	2	0	0	2,170	1
Object or animal	735	2	59	0	440	0	498	0	794	1	440	0	1,233	1
Other (specify)	542	1	1,367	1	1,031	1	2,398	1	1,909	1	1,031	1	2,940	1
This vehicle not involved in first harmful event	0	0	19,720	19	27,497	28	47,217	23	19,720	14	27,497	28	47,217	20
Total	38,127	100	103,074	100	99,828	100	202,902	100	141,200	100	99,828	100	241,028	100

Source: NHTSA, NCSA, LTCCS. Study Time Span: April 1, 2001 - December 31, 2003

The specific level of the critical event provides more detail about the crash than does the general level of the critical event. In Table 11, each general level of the critical event is stratified into the applicable specific levels. Table 11 has critical event row categories (general level by specific level), with columns that are stratified by crash type (single-vehicle versus multivehicle) and vehicle type (large truck versus other vehicle). For example, for vehicles where the general level of the critical event is coded as "this vehicle loss of control," Table 11 shows that specific level categories such as "traveling too fast for conditions" and "cargo shift" make up 58 percent and 8 percent respectively. Sixty-five percent of large trucks and 36 percent of other vehicles were "traveling too fast for conditions" and 11 percent of large trucks and zero percent of other vehicles experienced a "cargo shift."

Examples of the outcomes of the critical event are listed below and shown in Table 11:

- Among single-vehicle crashes where the general level of the critical event was "this vehicle loss of control," the specific level category "traveling too fast for conditions" accounted for 67 percent of the large trucks involved.
- For crashes where the general level of the critical event was "this vehicle traveling," the specific level category "off the edge of the road on the right side" was seen for 57 percent of large trucks in single-vehicle crashes, and only 2 percent of large trucks in multivehicle crashes, while "over the lane line on left side of travel lane" was seen for 1 percent of the large trucks in single-vehicle crashes, 27 percent of large trucks in multivehicle crashes, and 41 percent of other vehicles in multivehicle crashes.
- "Traveling in same direction with higher speed" was a specific level category under the general level category of "other motor vehicle in lane." In multivehicle crashes, this specific level category was seen for 39 percent of large trucks and 50 percent of other vehicles.
- In multivehicle crashes with a general level of "other motor vehicle encroaching into lane," the distribution of specific level categories for both large trucks and other vehicles were quite similar.

Table 11
Weighted Number of Involved Vehicles
By Critical Event (General Level and Specific Level),
Crash Type and Involved Vehicle Type

Critical Event (General Level and Specific Level)	**Single-Vehicle Crash**		**Multivehicle Crash**						**Total**					
	Truck		**Truck**		**Other Vehicle**		**Total**		**Truck**		**Other Vehicle**		**Total**	
	#	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
This vehicle loss of control														
Blow out / flat tire, (specify blow out / flat, location / make)	294	2	344	8	930	12	1,274	11	638	3	930	12	1,568	5
Disabling vehicle failure (e.g., wheel fell off) Specify:	1,219	7	130	3	0	0	130	1	1,349	6	0	0	1,349	5
Non-disabling vehicle problem (e.g., hood flew up) Specify:	220	1	47	1	0	0	47	0	267	1	0	0	267	1

Critical Event (General Level and Specific Level)	Single-Vehicle Crash		Multivehicle Crash						Total					
	Truck		Truck		Other Vehicle		Total		Truck		Other Vehicle		Total	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
This vehicle loss of control (Continued)														
Poor road conditions (puddle, pot hole, ice, etc.) Specify:	216	1	13	0	991	13	1,004	9	229	1	991	13	1,220	4
Traveling too fast for conditions	11,998	67	2,340	57	2,716	36	5,056	44	14,338	65	2,716	36	17,054	58
Jacknife Event	436	2	1,044	25	0	0	1,044	9	1,479	7	0	0	1,479	5
Other cause of control loss (specify)	1,219	7	135	3	1,965	26	2,099	18	1,353	6	1,965	26	3,318	11
Unknown cause of control loss	0	0	0	0	867	12	867	7	0	0	867	12	867	3
Cargo Shift	2,316	13	65	2	0	0	65	1	2,381	11	0	0	2,381	8
Sub Total	17,917	100	4,117	100	7,468	100	11,585	100	22,034	100	7,468	100	29,502	100
This vehicle traveling														
Over the lane line on left side of travel lane	180	1	5,307	27	9,921	41	15,228	35	5,487	15	9,921	41	15,408	26
Over the lane line on right side of travel lane	450	3	4,422	22	2,242	9	6,665	15	4,872	14	2,242	9	7,114	12
Off the edge of the road on the left side	5,382	35	227	1	1,946	8	2,173	5	5,610	16	1,946	8	7,556	13
Off the edge of the road on the right side	8,816	57	459	2	790	3	1,249	3	9,276	26	790	3	10,065	17
End departure	125	1	0	0	0	0	0	0	125	0	0	0	125	0
Turning left at intersection	420	3	2,619	13	5,101	21	7,720	18	3,040	9	5,101	21	8,141	14
Turning right at intersection	171	1	1,428	7	464	2	1,892	4	1,599	5	464	2	2,063	3
Crossing over (passing through) intersection	0	0	4,884	25	3,230	13	8,114	18	4,884	14	3,230	13	8,114	14
This vehicle decelerating	0	0	537	3	430	2	967	2	537	2	430	2	967	2
Sub Total	15,545	100	19,884	100	24,125	100	44,008	100	35,429	100	24,125	100	59,553	100

Critical Event (General Level and Specific Level)	Single-Vehicle Crash		Multivehicle Crash						Total					
	Truck		Truck		Other Vehicle		Total		Truck		Other Vehicle		Total	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Other motor vehicle in lane														
Other vehicle stopped	0	0	8,407	25	4,140	18	12,547	22	8,407	24	4,140	18	12,547	22
Traveling in same direction with low steady speed	0	0	3,280	10	3,590	15	6,870	12	3,280	9	3,590	15	6,870	12
Traveling in same direction while decelerating	638	100	5,215	15	2,928	13	8,143	14	5,854	17	2,928	13	8,782	15
Traveling in same direction with higher speed	0	0	13,167	39	11,758	50	24,926	43	13,167	38	11,758	50	24,926	43
Traveling in opposite direction	0	0	3,583	11	625	3	4,209	7	3,583	10	625	3	4,209	7
In crossover	0	0	356	1	50	0	406	1	356	1	50	0	406	1
Backing	0	0	0	0	201	1	201	0	0	0	201	1	201	0
Sub Total	638	100	34,009	100	23,293	100	57,302	100	34,647	100	23,293	100	57,941	100
Other motor vehicle encroaching into lane														
From adjacent lane (same direction) - over left lane line	184	27	5,183	22	4,185	26	9,368	24	5,367	22	4,185	26	9,552	24
From adjacent lane (same direction -over right lane line)	508	73	6,261	26	4,019	25	10,280	26	6,769	28	4,019	25	10,788	27
From opposite direction-over left lane line	0	0	6,134	26	3,844	24	9,978	25	6,134	25	3,844	24	9,978	25
From opposite direction -over right lane line	0	0	61	0	128	1	188	0	61	0	128	1	188	0
From crossing street, across path	0	0	3,916	16	2,555	16	6,471	16	3,916	16	2,555	16	6,471	16
From crossing street, turning into same direction	0	0	60	0	398	2	458	1	60	0	398	2	458	1

Critical Event (General Level and Specific Level)	Single-Vehicle Crash		Multivehicle Crash						Total					
	Truck		Truck		Other Vehicle		Total		Truck		Other Vehicle		Total	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Other motor vehicle encroaching into lane (Continued)														
From crossing street ,turning into opposite direction	0	0	1,665	7	243	2	1,908	5	1,665	7	243	2	1,908	5
From driveway, turning into same direction	0	0	131	1	30	0	161	0	131	1	30	0	161	0
From driveway, across path	0	0	160	1	437	3	597	2	160	1	437	3	597	1
From driveway, turning into opposite direction	0	0	235	1	136	1	371	1	235	1	136	1	371	1
Sub Total	692	100	23,806	100	15,974	100	39,780	100	24,498	100	15,974	100	40,472	100
Pedestrian, pedalcyclist, or other nonmotorist														
Pedestrian in roadway	1,307	64	112	100	0	0	112	100	1,419	65	0	0	1,419	65
Pedestrian approaching roadway	134	7	0	0	0	0	0	0	134	6	0	0	134	6
Pedalcyclist or other nonmotorist in roadway (specify):	617	30	0	0	0	0	0	0	617	28	0	0	617	28
Sub Total	2,058	100	112	100	0	0	112	100	2,170	100	0	0	2,170	100
Object or animal														
Animal in roadway	260	35	0	0	0	0	0	0	260	33	0	0	260	21
Object in roadway	475	65	59	100	440	100	498	100	533	67	440	100	973	79
Sub Total	735	100	59	100	440	100	498	100	794	100	440	100	1,233	100
Other (specify)														
Other (specify)	542	100	1,367	100	1,031	100	2,398	100	1,909	100	1,031	100	2,940	100
Sub Total	542	100	1,367	100	1,031	100	2,398	100	1,909	100	1,031	100	2,940	100
This vehicle not involved in first harmful event														
Not involved first harmful event	0	0	19,720	100	27,497	100	47,217	100	19,720	100	27,497	100	47,217	100
Sub Total	0	0	19,720	100	27,497	100	47,217	100	19,720	100	27,497	100	47,217	100
Grand Total	38,127	100	103,074	100	99,828	100	202,902	100	141,200	100	99,828	100	241,028	100

Source: NHTSA, NCSA, LTCCS. Study Time Span: April 1, 2001 - December 31, 2003

At the general level, the critical reason was "no driver error" for 60 percent of large trucks in multivehicle crashes, and only 4 percent of large trucks in single-vehicle crashes (see Table 12). In single-vehicle crashes, driver-related factors (including "Physical Driver Factor," "Driver Recognition Error," "Driver Decision Factor," and "Driver Performance Error") accounted for over 81 percent of the critical reasons for large trucks, while both vehicle-related factors (13%) and environment-related factors (2%) were seen less likely than driver-related factors.

Table 12
Weighted Number of Involved Vehicles
By Critical Reason (General Level), Crash Type, and Vehicle Type

By Critical Reason (General Level)	Single-Vehicle Crash		Multivehicle Crash						Total					
	Truck		Truck		Other Vehicle		Total		Truck		Other Vehicle		Total	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
No Driver Error	1,447	4	61,913	60	58,252	58	120,164	59	63,360	45	58,252	58	121,612	50
Physical Driver Factor	7,744	20	1,377	1	6,214	6	7,590	4	9,121	6	6,214	6	15,335	6
Driver Recognition Factor	6,309	17	15,883	15	12,421	12	28,304	14	22,193	16	12,421	12	34,613	14
Driver Decision Factor	12,621	33	16,886	16	11,106	11	27,992	14	29,507	21	11,106	11	40,612	17
Driver Performance Factor	4,425	12	2,758	3	7,617	8	10,375	5	7,182	5	7,617	8	14,800	6
Vehicle Related Factor	4,831	13	2,956	3	1,577	2	4,533	2	7,787	6	1,577	2	9,364	4
Environment - Highway	599	2	950	1	510	1	1,460	1	1,549	1	510	1	2,059	1
Environment - Weather	127	0	114	0	541	1	655	0	241	0	541	1	782	0
Unknown Reason	23	0	238	0	1,591	2	1,829	1	261	0	1,591	2	1,852	1
Total	38,127	100	103,074	100	99,828	100	202,902	100	141,200	100	99,828	100	241,028	100

Source: NHTSA, NCSA, LTCCS. Study Time Span: April 1, 2001 - December 31, 2003

Table 13, seen below, shows the distribution of the critical reason (general level and specific level). The "critical reason" is the immediate reason for the critical event, and it describes why the critical event occurred. As stated earlier, the "critical event" of the crash is defined as the event that immediately led to the crash. One and only one critical event is defined for each crash. The critical event is the action or event that made the collision unavoidable.

Out of the 240,000 vehicles that were involved in the LTCCS, the critical reason was coded for only the 119,000 vehicles that were coded for a critical event. These 119,000 vehicles are shown separately in Table 14, which displays a percentage breakdown of the critical reasons (specific level) for the vehicles for which the critical event was coded. There are dozens of specific level categories for the critical reason, including "illegal maneuver," "brakes failed," "external distraction," and "heart attack or other physical impairment of the ability to act." "Too fast for curve/turn" was recorded for 12 percent of large trucks, and zero percent of other vehicles, while "inadequate surveillance (e.g., failed to look, looked but did not see)" was recorded for 12 percent of large trucks and 10 percent of other vehicles (see Table 14).

Table 13
Weighted Number of Involved Vehicles
By Critical Reason (General Level, and Specific Level), Crash Type and Vehicle Type

By Critical Reason (General Level, and Specific Level)	**Single-Vehicle Crash**		**Multivehicle Crash**						**Total**					
	Truck		**Truck**		**Other Vehicle**		**Total**		**Truck**		**Other Vehicle**		**Total**	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
No Driver Error														
Critical event not coded to this vehicle	1,447	4	61,913	60	58,252	58	120,164	59	63,360	45	58,252	58	121,612	50
Sub Total	1,447	4	61,913	60	58,252	58	120,164	59	63,360	45	58,252	58	121,612	50
Physical Driver Factor														
Sleep, that is, actually asleep	4,876	13	454	0	3,755	4	4,210	2	5,330	4	3,755	4	9,085	4
Heart attack or other physical impairment of the ability to act	2,242	6	872	1	2,335	2	3,207	2	3,114	2	2,335	2	5,449	2
Other critical non-performance (specify)	138	0	50	0	0	0	50	0	188	0	0	0	188	0
Unknown critical non-performance	489	1	0	0	123	0	123	0	489	0	123	0	612	0
Sub Total	7,744	20	1,377	1	6,214	6	7,590	4	9,121	6	6,214	6	15,335	6

By Critical Reason (General Level, and Specific Level)	Single-Vehicle Crash		Multivehicle Crash						Total					
	Truck		Truck		Other Vehicle		Total		Truck		Other Vehicle		Total	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Driver Recognition Factor														
Inattention (e.g., daydreaming)	2,253	6	2,408	2	1,966	2	4,374	2	4,660	3	1,966	2	6,626	3
Internal distraction	1,285	3	1,247	1	3,487	3	4,734	2	2,532	2	3,487	3	6,020	2
External distraction	341	1	1,606	2	1,062	1	2,668	1	1,947	1	1,062	1	3,009	1
Inadequate surveillance (e.g., failed to look, looked but did not see)	1,376	4	8,016	8	4,145	4	12,162	6	9,392	7	4,145	4	13,537	6
Other recognition error (specify)	0	0	0	0	240	0	240	0	0	0	240	0	240	0
Unknown recognition error	1,055	3	2,605	3	1,520	2	4,126	2	3,661	3	1,520	2	5,181	2
Sub Total	6,309	17	15,883	15	12,421	12	28,304	14	22,193	16	12,421	12	34,613	14
Driver Decision Factor														
Too fast for conditions to be able to respond to unexpected actions of other road users (specify)	2,459	6	4,717	5	3,786	4	8,503	4	7,176	5	3,786	4	10,961	5
Too slow for traffic stream	0	0	0	0	148	0	148	0	0	0	148	0	148	0
Misjudgment of gap or other's speed	62	0	2,107	2	1,700	2	3,807	2	2,169	2	1,700	2	3,869	2
Following too closely to respond to unexpected actions	144	0	3,153	3	487	0	3,640	2	3,296	2	487	0	3,784	2
False assumption of other road user's actions	0	0	1,325	1	877	1	2,202	1	1,325	1	877	1	2,202	1
Illegal maneuver	157	0	3,424	3	2,889	3	6,313	3	3,581	3	2,889	3	6,470	3

By Critical Reason (General Level, and Specific Level)	Single-Vehicle Crash		Multivehicle Crash						Total					
	Truck		Truck		Other Vehicle		Total		Truck		Other Vehicle		Total	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Driver Decision Factor (Continued)														
Inadequate evasive action, e.g., braking only, not braking and steering	0	0	528	1	128	0	656	0	528	0	128	0	656	0
Aggressive driving behavior	814	2	205	0	803	1	1,008	0	1,019	1	803	1	1,822	1
Other decision error (specify)	485	1	609	1	50	0	659	0	1,094	1	50	0	1,144	0
Unknown decision error	0	0	7	0	59	0	66	0	7	0	59	0	66	0
Too fast for curve/turn	8,501	22	811	1	178	0	989	0	9,312	7	178	0	9,490	4
Sub Total	12,621	33	16,886	16	11,106	11	27,992	14	29,507	21	11,106	11	40,612	17
Driver Performance Factor														
Panic/Freezing	0	0	2	0	0	0	2	0	2	0	0	0	2	0
Overcompensat-ion	1,596	4	355	0	2,503	3	2,859	1	1,952	1	2,503	3	4,455	2
Poor directional control e.g., failing to control vehicle with skill ordinarily expected	1,512	4	745	1	1,008	1	1,753	1	2,257	2	1,008	1	3,266	1
Unknown performance error	0	0	0	0	83	0	83	0	0	0	83	0	83	0
Type of driver error unknown	1,316	3	1,655	2	4,023	4	5,678	3	2,971	2	4,023	4	6,994	3
Sub Total	4,425	12	2,758	3	7,617	8	10,375	5	7,182	5	7,617	8	14,800	6
Vehicle Related Factor														
Tires/wheels failed	387	1	416	0	927	1	1,343	1	803	1	927	1	1,730	1
Brakes failed	323	1	395	0	159	0	555	0	719	1	159	0	878	0
Steering failed	69	0	0	0	0	0	0	0	69	0	0	0	69	0
Cargo shifted	2,503	7	233	0	0	0	233	0	2,736	2	0	0	2,736	1
Trailer attachment failed	0	0	19	0	0	0	19	0	19	0	0	0	19	0

By Critical Reason (General Level, and Specific Level)	Single-Vehicle Crash		Multivehicle Crash						Total					
	Truck		Truck		Other Vehicle		Total		Truck		Other Vehicle		Total	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Vehicle Related Factor														
Suspension failed	791	2	13	0	0	0	13	0	803	1	0	0	803	0
Body, doors, hood failed	0	0	59	0	0	0	59	0	59	0	0	0	59	0
Other vehicle failure (specify)	0	0	59	0	427	0	486	0	59	0	427	0	486	0
Unknown vehicle failures	0	0	0	0	61	0	61	0	0	0	61	0	61	0
Degraded braking capability	758	2	1,740	2	0	0	1,740	1	2,498	2	0	0	2,498	1
Transmission/engine failure	0	0	23	0	2	0	26	0	23	0	2	0	26	0
Sub Total	4,831	13	2,956	3	1,577	2	4,533	2	7,787	6	1,577	2	9,364	4
Environment – Highway														
Signs/signals missing	0	0	791	1	0	0	791	0	791	1	0	0	791	0
View obstructed by other vehicles	0	0	0	0	39	0	39	0	0	0	39	0	39	0
Road design - roadway geometry (e.g., ramp curvature)	2	0	0	0	0	0	0	0	2	0	0	0	2	0
Road design - other	356	1	0	0	0	0	0	0	356	0	0	0	356	0
Slick roads (low friction road surface due to ice, loose debris, any other cause)	240	1	159	0	471	0	630	0	400	0	471	0	870	0
Sub Total	599	2	950	1	510	1	1,460	1	1,549	1	510	1	2,059	1
Environment – Weather														
Fog	0	0	7	0	0	0	7	0	7	0	0	0	7	0
Wind gust	127	0	0	0	34	0	34	0	127	0	34	0	162	0
Glare	0	0	107	0	507	1	613	0	107	0	507	1	613	0
Sub Total	127	0	114	0	541	1	655	0	241	0	541	1	782	0

By Critical Reason (General Level, and Specific Level)	Single-Vehicle Crash		Multivehicle Crash						Total					
	Truck		Truck		Other Vehicle		Total		Truck		Other Vehicle		Total	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Unknown Reason														
Unknown reason for critical event	23	0	238	0	1,591	2	1,829	1	261	0	1,591	2	1,852	1
Sub Total	23	0	238	0	1,591	2	1,829	1	261	0	1,591	2	1,852	1
Grand Total	38,127	100	103,074	100	99,828	100	202,902	100	141,200	100	99,828	100	241,028	100
Source: NHTSA, NCSA, LTCCS. Study Time Span: April 1, 2001 - December 31, 2003														

Table 14
Weighted Number of Involved Vehicles
By Critical Reason (General Level, and Specific Level), Crash Type and Vehicle Type
WHERE CRITICAL EVENT WAS CODED

By Critical Reason (General Level, and Specific Level)	Single-Vehicle Crash		Multivehicle Crash						Total					
	Truck		Truck		Other Vehicle		Total		Truck		Other Vehicle		Total	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Physical Driver Factor														
Sleep, that is, actually asleep	4,876	13	454	1	3,755	9	4,210	5	5,330	7	3,755	9	9,085	8
Heart attack or other physical impairment of the ability to act	2,242	6	872	2	2,335	6	3,207	4	3,114	4	2,335	6	5,449	5
Other critical non-performance (specify)	138	0	50	0	0	0	50	0	188	0	0	0	188	0
Unknown critical non-performance	489	1	0	0	123	0	123	0	489	1	123	0	612	1
Sub Total	7,744	21	1,377	3	6,214	15	7,590	9	9,121	12	6,214	15	15,335	13
Driver Recognition Factor														
Inattention (e.g..,	2,253	6	2,408	6	1,966	5	4,374	5	4,660	6	1,966	5	6,626	6
Internal distraction	1,285	4	1,247	3	3,487	8	4,734	6	2,532	3	3,487	8	6,020	5

By Critical Reason (General Level, and Specific Level)	Single-Vehicle Crash		Multivehicle Crash						Total					
	Truck		Truck		Other Vehicle		Total		Truck		Other Vehicle		Total	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Driver Recognition Factor (Continued)														
External distraction	341	1	1,606	4	1,062	3	2,668	3	1,947	3	1,062	3	3,009	3
Inadequate surveillance (e.g., failed to look, looked but did not see)	1,376	4	8,016	19	4,145	10	12,162	15	9,392	12	4,145	10	13,537	11
Other recognition error (specify)	0	0	0	0	240	1	240	0	0	0	240	1	240	0
Unknown recognition error	1,055	3	2,605	6	1,520	4	4,126	5	3,661	5	1,520	4	5,181	4
Sub Total	6,309	17	15,883	39	12,421	30	28,304	34	22,193	29	12,421	30	34,613	29
Driver Decision Factor														
Too fast for conditions to be able to respond to unexpected actions of other road users (specify)	2,459	7	4,717	11	3,786	9	8,503	10	7,176	9	3,786	9	10,961	9
Too slow for traffic stream	0	0	0	0	148	0	148	0	0	0	148	0	148	0
Misjudgment of gap or other's speed	62	0	2,107	5	1,700	4	3,807	5	2,169	3	1,700	4	3,869	3
Following too closely to respond to unexpected actions	144	0	3,153	8	487	1	3,640	4	3,296	4	487	1	3,784	3
False assumption of other road user's actions	0	0	1,325	3	877	2	2,202	3	1,325	2	877	2	2,202	2
Illegal maneuver	157	0	3,424	8	2,889	7	6,313	8	3,581	5	2,889	7	6,470	5

By Critical Reason (General Level, and Specific Level)	Single-Vehicle Crash		Multivehicle Crash						Total					
	Truck		Truck		Other Vehicle		Total		Truck		Other Vehicle		Total	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Driver Decision Factor (Continued)														
Inadequate evasive action, e.g., braking only, not braking and steering	0	0	528	1	128	0	656	1	528	1	128	0	656	1
Aggressive driving behavior	814	2	205	0	803	2	1,008	1	1,019	1	803	2	1,822	2
Other decision error (specify)	485	1	609	1	50	0	659	1	1,094	1	50	0	1,144	1
Unknown decision error	0	0	7	0	59	0	66	0	7	0	59	0	66	0
Too fast for curve/turn	8,501	23	811	2	178	0	989	1	9,312	12	178	0	9,490	8
Sub Total	12,621	34	16,886	41	11,106	27	27,992	34	29,507	38	11,106	27	40,612	34
Driver Performance Factor														
Panic/Freezing	0	0	2	0	0	0	2	0	2	0	0	0	2	0
Overcompensation	1,596	4	355	1	2,503	6	2,859	3	1,952	3	2,503	6	4,455	4
Poor directional control e.g., failing to control vehicle with skill ordinarily expected	1,512	4	745	2	1,008	2	1,753	2	2,257	3	1,008	2	3,266	3
Unknown performance error	0	0	0	0	83	0	83	0	0	0	83	0	83	0
Type of driver error unknown	1,316	4	1,655	4	4,023	10	5,678	7	2,971	4	4,023	10	6,994	6
Sub Total	4,425	12	2,758	7	7,617	18	10,375	13	7,182	9	7,617	18	14,800	12
Vehicle Related Factor														
Tires/wheels failed	387	1	416	1	927	2	1,343	2	803	1	927	2	1,730	1
Brakes failed	323	1	395	1	159	0	555	1	719	1	159	0	878	1
Steering failed	69	0	0	0	0	0	0	0	69	0	0	0	69	0
Cargo shifted	2,503	7	233	1	0	0	233	0	2,736	4	0	0	2,736	2

By Critical Reason (General Level, and Specific Level)	Single-Vehicle Crash		Multivehicle Crash						Total					
	Truck		Truck		Other Vehicle		Total		Truck		Other Vehicle		Total	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Vehicle Related Factor (Continued)														
Trailer attachment failed	0	0	19	0	0	0	19	0	19	0	0	0	19	0
Suspension failed	791	2	13	0	0	0	13	0	803	1	0	0	803	1
Body, doors, hood failed	0	0	59	0	0	0	59	0	59	0	0	0	59	0
Other vehicle failure (specify)	0	0	59	0	427	1	486	1	59	0	427	1	486	0
Unknown vehicle failures	0	0	0	0	61	0	61	0	0	0	61	0	61	0
Degraded braking capability	758	2	1,740	4	0	0	1,740	2	2,498	3	0	0	2,498	2
Transmission/ engine failure	0	0	23	0	2	0	26	0	23	0	2	0	26	0
Sub Total	4,831	13	2,956	7	1,577	4	4,533	5	7,787	10	1,577	4	9,364	8
Environment – Highway														
Signs/signals missing	0	0	791	2	0	0	791	1	791	1	0	0	791	1
View obstructed by other vehicles	0	0	0	0	39	0	39	0	0	0	39	0	39	0
Road design - roadway geometry (e.g., ramp curvature)	2	0	0	0	0	0	0	0	2	0	0	0	2	0
Road design - other	356	1	0	0	0	0	0	0	356	0	0	0	356	0
Slick roads (low friction road surface due to ice, loose debris, any other cause)	240	1	159	0	471	1	630	1	400	1	471	1	870	1
Sub Total	599	2	950	2	510	1	1,460	2	1,549	2	510	1	2,059	2

By Critical Reason (General Level, and Specific Level)	Single-Vehicle Crash		Multivehicle Crash						Total					
	Truck		Truck		Other Vehicle		Total		Truck		Other Vehicle		Total	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Environment – Weather														
Fog	0	0	7	0	0	0	7	0	7	0	0	0	7	0
Wind gust	127	0	0	0	34	0	34	0	127	0	34	0	162	0
Glare	0	0	107	0	507	1	613	1	107	0	507	1	613	1
Sub Total	127	0	114	0	541	1	655	1	241	0	541	1	782	1
Unknown Reason														
Unknown reason for critical event	23	0	238	1	1,591	4	1,829	2	261	0	1,591	4	1,852	2
Sub Total	23	0	238	1	1,591	4	1,829	2	261	0	1,591	4	1,852	2
Grand Total	36,680	100	41,161	100	41,576	100	82,737	100	77,840	100	41,576	100	119,417	100
Source: NHTSA, NCSA, LTCCS. Study Time Span: April 1, 2001 - December 31, 2003														

Environment, Location, and Pre-Crash Variables

Other examples of data collected in the LTCCS are mentioned briefly here. These variables are all counted at the vehicle level. The vehicle-level variables mentioned throughout this chapter are just a small sample of the information gathered in the LTCCS that is measured on the vehicle level.

As seen in Table 15, most of the vehicles in the LTCCS faced no adverse environmental conditions (84%), while 14 percent were in the rain, and 1 percent in the snow. Three-quarters of the vehicles traveled in the daylight, compared to only 9 percent that traveled in the dark and 12 percent that traveled in a "dark, but lighted" lighting condition (see Table 16).

Table 15
Weighted Number of Involved Vehicles
By Crash Environmental Condition

Rain		Snow		Wind Gusts		Other Conditions		Fog		Sleet		No Adverse Conditions		Other		Total	
#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
33,679	14	1,974	1	69	0	2,790	1	230	0	69	0	201,800	84	416	0	241,028	100
Source: NHTSA, NCSA, LTCCS. Study Time Span: April 1, 2001 - December 31, 2003																	

Table 16
Weighted Number of Involved Vehicles
By Crash Lighting Condition

Daylight		Dark		Dark, but lighted		Dawn		Dusk		Total	
#	%	#	%	#	%	#	%	#	%	#	%
181,475	75	21,897	9	28,656	12	5,658	2	3,343	1	241,028	100
Source: NHTSA, NCSA, LTCCS. Study Time Span: April 1, 2001 - December 31, 2003											

Regarding road alignment as shown in Table 17, 79 percent of the vehicles in multivehicle crashes traveled straight at the time of the crash, while 10 percent curved to the left and 11 percent curved to the right. The road alignment was quite different in single-vehicle crashes, where 43 percent of the large trucks traveled straight, and 21 percent curved to the left, and 37 percent curved to the right. As expected, single-vehicle crashes were much more likely to occur on roads that were curved, compared with multivehicle crashes.

The road profile, shown in Table 18, was recorded as "level" for 64 percent of the vehicles in multivehicle crashes, and "uphill grade (> 2 %)" and "downhill grade (> 2%)" were 16 percent and 16 percent, respectively. Compared to multivehicle crashes, single-vehicle crashes were more likely to occur on roads that were "uphill grade (>2 %)" (21%) or "downhill grade (> 2%)" (26%), suggesting that the profile of the road is more likely to play a role in a single-vehicle crash than a multivehicle crash.

Table 17
Weighted Number of Involved Vehicles
By Road Alignment, Crash Type, and Involved Vehicle Type

Road Alignment	Single-Vehicle Crash		Multivehicle Crash						Total					
	Truck		Truck		Other Vehicle		Total		Truck		Other Vehicle		Total	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Straight	16,261	43	82,753	80	77,631	78	160,384	79	99,014	70	77,631	78	176,645	73
Curve right	13,991	37	10,320	10	12,033	12	22,353	11	24,311	17	12,033	12	36,343	15
Curve left	7,875	21	10,001	10	10,165	10	20,165	10	17,875	13	10,165	10	28,040	12
Total	38,127	100	103,074	100	99,828	100	202,902	100	141,200	100	99,828	100	241,028	100
Source: NHTSA, NCSA, LTCCS. Study Time Span: April 1, 2001 - December 31, 2003														

Table 18
Weighted Number of Involved Vehicles
By Road Profile, Crash Type, and Involved Vehicle Type

Road Profile	Single-Vehicle Crash		Multivehicle Crash						Total					
	Truck		Truck		Other Vehicle		Total		Truck		Other Vehicle		Total	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Level	19,007	50	67,236	65	63,571	64	130,806	64	86,243	61	63,571	64	149,813	62
Uphill grade (>2%)	8,180	21	15,257	15	16,797	17	32,054	16	23,437	17	16,797	17	40,234	17
Hill crest	540	1	2,733	3	3,797	4	6,530	3	3,272	2	3,797	4	7,069	3
Downhill grade (>2%)	9,916	26	17,476	17	15,135	15	32,612	16	27,392	19	15,135	15	42,528	18
Sag	427	1	236	0	177	0	413	0	663	0	177	0	840	0
Unknown	58	0	135	0	351	0	486	0	193	0	351	0	544	0
Total	38,127	100	103,074	100	99,828	100	202,902	100	141,200	100	99,828	100	241,028	100

Source: NHTSA, NCSA, LTCCS. Study Time Span: April 1, 2001 - December 31, 2003

The distribution of the "pre-crash movement" categories varied between large trucks and other vehicles. Table 19 shows that 54 percent of large trucks and 42 percent of other vehicles were coded as "going straight." While large trucks were roughly one-third as likely to be "stopped in a traffic lane" (7%) compared to other vehicles (20%), large trucks were more than twice as likely to be "negotiating a curve" (19%) as opposed to other vehicles (9%).

In single-vehicle crashes, the pre-crash movement was "negotiating a curve" for 44 percent of large trucks. Among multivehicle crashes, "negotiating a curve" was seen much less often, only in 10 percent of large trucks and 9 percent of other vehicles.

Table 19
Weighted Number of Vehicles
By Pre-Crash Movement, Crash Type and Involved Vehicle Type

Pre-Crash Movement	Single-Vehicle Crash		Multivehicle Crash						Total					
	Truck		Truck		Other Vehicle		Total		Truck		Other Vehicle		Total	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
No driver present	0	0	2,496	2	214	0	2,710	1	2,496	2	214	0	2,710	1
Going Straight	13,850	36	62,319	60	41,477	42	103,797	51	76,169	54	41,477	42	117,646	49
Decelerating in traffic lane	1,375	4	5,750	6	10,380	10	16,130	8	7,125	5	10,380	10	17,505	7
Accelerating in traffic lane	815	2	2,216	2	1,276	1	3,492	2	3,031	2	1,276	1	4,307	2
Starting in traffic lane	139	0	326	0	910	1	1,236	1	465	0	910	1	1,375	1
Stopped in traffic lane	329	1	9,140	9	20,114	20	29,254	14	9,469	7	20,114	20	29,583	12
Passing or overtaking another vehicle	659	2	1,992	2	4,364	4	6,357	3	2,651	2	4,364	4	7,015	3
Disabled or parked in travel lane	0	0	2	0	2	0	5	0	2	0	2	0	5	0
Turning right	461	1	527	1	0	0	527	0	987	1	0	0	987	0
Turning left	1,023	3	1,971	2	1,445	1	3,416	2	2,994	2	1,445	1	4,439	2
Making a U-turn	0	0	32	0	310	0	342	0	32	0	310	0	342	0
Backing up (other than for parking position)	26	0	179	0	73	0	253	0	205	0	73	0	279	0
Negotiating a curve	16,604	44	10,453	10	9,114	9	19,566	10	27,056	19	9,114	9	36,170	15
Changing lanes	1,028	3	2,592	3	4,333	4	6,925	3	3,619	3	4,333	4	7,952	3
Merging	30	0	248	0	517	1	765	0	278	0	517	1	795	0
Successful avoidance maneuver to a previous critical event	1,789	5	2,279	2	2,891	3	5,170	3	4,068	3	2,891	3	6,960	3
Other (specify)	0	0	544	1	839	1	1,383	1	544	0	839	1	1,383	1
Unknown	0	0	7	0	1,569	2	1,575	1	7	0	1,569	2	1,575	1
Total	38,127	100	103,074	100	99,828	100	202,902	100	141,200	100	99,828	100	241,028	100

Source: NHTSA, NCSA, LTCCS. Study Time Span: April 1, 2001 - December 31, 2003

The most common pre-crash location for both large trucks (57%) and other vehicles (66%) was coded as "stayed in original travel lane." This pre-crash location was seen nearly three times as often in multivehicle crashes (68%) than single-vehicle crashes (24%). Almost one-quarter of large trucks as well as other vehicles "stayed on roadway, but left original lane." "Departed roadway" was the pre-crash location for 49 percent of vehicles in single-vehicle crashes and 5 percent of vehicles in multivehicle crashes (see Table 20).

Table 20
Weighted Number of Vehicles
By Pre-Crash Location, Crash Type and Involved Vehicle Type

Pre-Crash Location	Single-Vehicle Crash		Multivehicle Crash						Total					
	Truck		Truck		Other Vehicle		Total		Truck		Other Vehicle		Total	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
No driver present	0	0	2,496	2	214	0	2,710	1	2,496	2	214	0	2,710	1
Stayed in original travel lane	9,261	24	71,543	69	66,089	66	137,633	68	80,805	57	66,089	66	146,894	61
Stayed on roadway but left original travel lane	8,614	23	23,958	23	23,876	24	47,834	24	32,572	23	23,876	24	56,448	23
Stayed on roadway, not known if left original travel lane	356	1	447	0	58	0	505	0	803	1	58	0	862	0
Departed roadway	18,748	49	2,544	2	6,999	7	9,543	5	21,292	15	6,999	7	28,291	12
Remained off roadway	260	1	471	0	53	0	524	0	731	1	53	0	784	0
Returned to roadway	875	2	374	0	1,713	2	2,087	1	1,249	1	1,713	2	2,962	1
Entered roadway	12	0	484	0	579	1	1,064	1	496	0	579	1	1,076	0
Unknown	0	0	756	1	245	0	1,001	0	756	1	245	0	1,001	0
Total	38,127	100	103,074	100	99,828	100	202,902	100	141,200	100	99,828	100	241,028	100

Source: NHTSA, NCSA, LTCCS. Study Time Span: April 1, 2001 - December 31, 2003

VI. Driver Counts Available through the LTCCS Database

This section shows examples of data that exist in the LTCCS database, with the focus being driver characteristics. As shown throughout this report, the LTCCS provides extensive information about large-truck crashes. In addition to vital information about the drivers involved in the crash, the LTCCS has collected data on the vehicles involved in the crash and the characteristics surrounding the crash.

The LTCCS gathered data from 2,078 vehicles involved in 963 crashes. When the counts from these crashes are weighted, they represent a total of 241,000 vehicles involved in 120,000 crashes. Of the estimated 241,000 vehicles in the LTCCS, 141,000 are large trucks and 100,000 are "other vehicles" (i.e., passenger cars, light trucks, vans, sport utility vehicles, and motorcycles). A driver was present in 99 percent (238,000) of the vehicles in this study.

Information presented in this section includes driver age, driver restraint use, driver blood alcohol concentration, and the status of the driver seat air bag. These variables are examples of the plethora of driver variables available from the data collected in the LTCCS.

Driver Tables

The age distribution of large-truck drivers was quite different than that of drivers of other vehicles, as shown in Table 21. While only 5 percent of large-truck drivers involved in the LTCCS were 25 or younger, a much larger 23 percent of the drivers of other vehicles were 25 or younger. There were no large-truck drivers in the LTCCS who were 75 or older, compared to 3 percent of the drivers of other vehicles.

The percent of large-truck drivers who were 25 to 34 (22%), 35 to 44 (27%), 45 to 54 (31%), and 55 to 64 (10%) were higher than the corresponding percentages of drivers of other vehicles. Only 17 percent of the drivers of other vehicles were 45 to 54 years old, compared to the 31 percent of large-truck drivers in this age category. The number of large-truck drivers who were 45 to 54 was more than three times greater than the number of large-truck drivers of 55 to 64.

Table 21
Weighted Number of Drivers
By Driver Age, Crash Type, and Involved Vehicle Body Type

Driver Age	Single-Vehicle Crash		Multivehicle Crash						Total					
	Truck		Truck		Other Vehicle		Total		Truck		Other Vehicle		Total	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Other / Unknown	356	1	1,083	1	323	0	1,406	1	1,439	1	323	0	1,762	1
16-20	50	0	670	1	11,050	11	11,720	6	720	1	11,050	11	11,770	5
21-25	2,177	6	3,890	4	12,067	12	15,957	8	6,067	4	12,067	12	18,133	8
25-34	6,164	16	24,168	24	19,995	20	44,163	22	30,332	22	19,995	20	50,327	21
35-44	11,759	31	26,241	26	23,189	23	49,430	25	38,000	27	23,189	23	61,189	26
45-54	12,802	34	30,531	30	17,149	17	47,680	24	43,333	31	17,149	17	60,482	25
55-64	3,798	10	10,398	10	7,869	8	18,267	9	14,196	10	7,869	8	22,065	9
65-74	1,021	3	3,598	4	4,478	5	8,076	4	4,619	3	4,478	5	9,097	4
75 Or Older	0	0	0	0	3,352	3	3,352	2	0	0	3,352	3	3,352	1
Total	38,127	100	100,578	100	99,472	100	200,050	100	138,705	100	99,472	100	238,177	100

Source: NHTSA, NCSA, LTCCS. Study Time Span: April 1, 2001 - December 31, 2003

The status of air bags in the drivers' seats was quite different when comparing large-truck drivers to drivers of other vehicles. In 58 percent of large trucks, there was no air bag available in the driver's seat, while police did not indicate driver air bag availability in an additional 31 percent of large trucks (see Table 22). While an air bag deployed in less than one-half of 1 percent of large trucks, air bags played a much larger role in protecting drivers of other vehicles. An air bag deployed for 24 percent of the drivers of these other vehicles. No driver air bag was available in only 21 percent of other vehicles, versus 58 percent of large trucks.

Table 22
Weighted Count of Driver's Seat Air Bag Status
By Crash Type and Involved Vehicle Type

Driver's Seat Air Bag Status	Single-Vehicle Crash		Multivehicle Crash						Total					
	Truck Driver		Truck Driver		Other Vehicle Driver		Total		Truck Driver		Other Vehicle Driver		Total	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
No air bag available	22,105	58	58,820	58	21,837	21	80,657	40	80,925	58	21,837	21	102,763	42
Police did not indicate air bag availability/function	11,949	31	31,538	31	28,961	28	60,499	30	43,487	31	28,961	28	72,448	30
Deployed	0	0	24	0	25,218	24	25,242	12	24	0	25,218	24	25,242	10
Not deployed	1,637	4	4,301	4	22,864	22	27,165	13	5,939	4	22,864	22	28,802	12
Unknown if deployed	30	0	242	0	201	0	443	0	272	0	201	0	473	0
Police indicated 'unknown'	2,440	6	5,722	6	3,997	4	9,718	5	8,161	6	3,997	4	12,158	5
Total	38,161	100	100,647	100	103,078	100	203,725	100	138,808	100	103,078	100	241,886	100

Source: NHTSA, NCSA, LTCCS. Study Time Span: April 1, 2001 - December 31, 2003

While the status of air bags in the driver's seat was very different between drivers of large trucks and drivers of other vehicles, the restraint use activated by the driver was much more homogeneous (see Table 23). Sixty-nine percent of large-truck drivers used a lap and shoulder belt, 21 percent were unrestrained, and 6 percent used a lap belt. Among drivers of other vehicles, the restraint use was quite similar (69% lap and shoulder belt, 21% unrestrained, and 3 percent% lap belt).

Large-truck drivers were much more likely to be restrained in a multivehicle crash (80% restrained, 14% unrestrained) than in a single-vehicle crash (59% restrained, 37% unrestrained). Belt use was unknown in 6 percent of all vehicles.

Table 23
Weighted Count of Driver's Restraint Use
By Crash Type and Involved Vehicle Type

Driver's Restraint Use	Single-Vehicle Crash		Multivehicle Crash						Total					
	Truck		Truck		Other Vehicle		Total		Truck		Other Vehicle		Total	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Not used/ not available/ removed or destroyed	14,274	37	14,432	14	20,443	21	34,875	17	28,705	21	20,443	21	49,149	21
Inoperative (specify)	0	0	469	0	0	0	469	0	469	0	0	0	469	0
Lap belt	1,657	4	5,973	6	3,205	3	9,178	5	7,630	6	3,205	3	10,835	5
Lap and shoulder belt	21,070	55	74,050	74	68,353	69	142,403	71	95,120	69	68,353	69	163,473	69
Belt used - type unknown	0	0	129	0	186	0	315	0	129	0	186	0	315	0
Unknown if belt used	1,126	3	5,525	5	7,285	7	12,810	6	6,651	5	7,285	7	13,936	6
Total	38,127	100	100,578	100	99,472	100	200,050	100	138,705	100	99,472	100	238,177	100
Source: NHTSA, NCSA, LTCCS. Study Time Span: April 1, 2001 - December 31, 2003														

The LTCCS gathered much information about alcohol use, including the source and outcome of blood alcohol concentration tests. As shown in Table 24, 66 percent of large-truck drivers were not given a BAC test, while a police-reported BAC test result was collected for 10 percent of large-truck drivers, and a company-reported BAC test result was collected for 9 percent. Only 6 percent of drivers of other vehicles had a police-reported BAC test result, with no company-reported BAC test results. Seventy-five percent of the drivers of other vehicles were not given a BAC test, which is 9 percentage points above the 66 percent of large-truck drivers who were not tested.

In single-vehicle large-truck crashes, a BAC test was not given to 55 percent of large-truck drivers, while 27 percent of large-truck drivers had their source of a BAC test result coded as "other (specify)." Only 7 percent of large-truck drivers in multivehicle crashes had the source of their BAC test result coded as "other (specify)," with 71 percent coded as "no BAC test."

Table 24
Weighted Number of Drivers
By Source of BAC Test Result, Crash Type, and Involved Vehicle Type

Source of BAC Test Result	Single-Vehicle Crash		Multivehicle Crash						Total					
	Truck Driver		Truck Driver		Other Vehicle Driver		Total		Truck Driver		Other Vehicle Driver		Total	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
No BAC test/Not applicable	20,906	55	72,688	71	75,303	75	147,991	73	93,594	66	75,303	75	168,897	70
Police reported	3,359	9	10,944	11	5,972	6	16,916	8	14,303	10	5,972	6	20,275	8
Company reported	3,358	9	9,279	9	0	0	9,279	5	12,637	9	0	0	12,637	5
No driver present	0	0	2,496	2	214	0	2,710	1	2,496	2	214	0	2,710	1
Other (specify)	10,185	27	7,341	7	17,759	18	25,100	12	17,526	12	17,759	18	35,285	15
Unknown	319	1	325	0	580	1	905	0	644	0	580	1	1,224	1
Total	38,127	100	103,074	100	99,828	100	202,902	100	141,200	100	99,828	100	241,028	100

Source: NHTSA, NCSA, LTCCS. Study Time Span: April 1, 2001 - December 31, 2003

The BAC test status is recorded for all drivers in the LTCCS, as shown in Table 25. Around 90 percent of large-truck drivers and drivers of other vehicles were listed as having "no alcohol use." For less than 1 percent of large-truck drivers and for 4 percent of drivers of other vehicles, a BAC test was performed and the results were positive, showing that that driver had recently consumed alcohol. Drivers of other vehicles were more than six times as likely to have a positive BAC test (4.5%), compared to large-truck drivers (0.7%). The BAC test status did not vary significantly between single-vehicle crashes and multivehicle crashes, as shown in Table 25.

Table25
Weighted Number of Drivers
By Blood Alcohol Concentration (BAC) Test Status, Crash Type, and Involved Vehicle Type

BAC Test Status	Single-Vehicle Crash		Multivehicle Crash						Total					
	Truck		Truck		Other Vehicle		Total		Truck		Other Vehicle		Total	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
No alcohol use	34,654	91	93,971	91	90,063	90	184,034	91	128,625	91	90,063	90	218,687	91
BAC test performed, results positive	817	2	154	0	4,451	4	4,605	2	972	1	4,451	4	5,423	2
Field observation of NASS researcher	84	0	68	0	2,101	2	2,168	1	152	0	2,101	2	2,252	1
BAC test performed, results negative	146	0	354	0	331	0	685	0	500	0	331	0	832	0
None given	356	1	291	0	546	1	837	0	647	0	546	1	1,193	0
BAC test performed, results unknown	1,750	5	4,593	4	1,737	2	6,330	3	6,343	4	1,737	2	8,080	3
No driver present	0	0	2,496	2	214	0	2,710	1	2,496	2	214	0	2,710	1
Unknown	319	1	1,147	1	385	0	1,533	1	1,466	1	385	0	1,851	1
Total	38,127	100	103,074	100	99,828	100	202,902	100	141,200	100	99,828	100	241,028	100

Source: NHTSA, NCSA, LTCCS. Study Time Span: April 1, 2001 - December 31, 2003

Some patterns in the data are more easily noticeable after removing the roughly 90 percent of drivers who were coded as having “no alcohol use” (see Table 26), and examining the remaining 22,000 drivers in the LTCCS study who were not coded as having “no alcohol use." Eight percent of the remaining 13,000 large-truck drivers tested positive for alcohol use, compared to 46 percent of the 10,000 drivers of other vehicles who tested positive for alcohol use. However, large-truck drivers (50%) were almost three times as likely as drivers of other vehicles (18%) to have had a BAC test performed whose results were “unknown.” Information on a drivers’ BAC was limited to a field observation by an NASS researcher for only 1 percent of large-truck drivers, compared to 22 percent of the drivers of other vehicles.

In multivehicle crashes in Table 26, only 2 percent of large-truck drivers received a positive result from their alcohol test, versus 46 percent of drivers of other vehicles; comparatively, 50 percent of large-truck drivers and 18 percent of other drivers received unknown results from the alcohol test that was performed. This BAC test status variable was coded as "no driver present" in 27 percent of the large trucks in multivehicle crashes, and in just 2 percent of other vehicles in multivehicle crashes.

Table 26
Weighted Number of Drivers
By Blood Alcohol Concentration (BAC) Test Status,
Crash Type, and Involved Vehicle Type
EXCLUDING THE CATEGORY 'NO ALCOHOL USE'

Drivers' BAC Test Status	Single-Vehicle Crash		Multivehicle Crash						Total					
	Truck		Truck		Other Vehicle		Total		Truck		Other Vehicle		Total	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
BAC test performed, results positive	817	24	154	2	4,451	46	4,605	24	972	8	4,451	46	5,423	24
Field observation of NASS researcher	84	2	68	1	2,101	22	2,168	11	152	1	2,101	22	2,252	10
BAC test performed, results negative	146	4	354	4	331	3	685	4	500	4	331	3	832	4
None given	356	10	291	3	546	6	837	4	647	5	546	6	1,193	5
BAC test performed, results unknown	1,750	50	4,593	50	1,737	18	6,330	34	6,343	50	1,737	18	8,080	36
No driver present	0	0	2,496	27	214	2	2,710	14	2,496	20	214	2	2,710	12
Unknown	319	9	1,147	13	385	4	1,533	8	1,466	12	385	4	1,851	8
Total	3,473	100	9,102	100	9,765	100	18,868	100	12,576	100	9,765	100	22,341	100
Source: NHTSA, NCSA, LTCCS. Study Time Span: April 1, 2001 - December 31, 2003														

As shown in Table 27, 3 percent of large-truck drivers were driving their large truck for the first time (in the six months prior to the crash), and another 7 percent had driven their large truck 10 times or less. Only 1 percent of drivers of other vehicles were driving their vehicle for the first time, with just another 3 percent having driven their vehicle 10 times or less. Almost two-thirds of all vehicle drivers had driven their vehicle more than 10 times in the last six months, with the driving patterns of the remaining drivers being coded as "unknown."

Table 27
Weighted Number of Drivers
By Whether the Driver Was Familiar with the Vehicle Driven at the Time of the Crash, Crash Type, and Involved Vehicle Type

Driver Familiarity with Vehicle	Single-Vehicle Crash		Multivehicle Crash						Total					
	Truck		Truck		Other Vehicle		Total		Truck		Other Vehicle		Total	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
First time driving this vehicle	976	3	3,434	3	1,237	1	4,671	2	4,410	3	1,237	1	5,647	2
Had driven this vehicle 2-5 times in the past six months	1,497	4	3,363	3	1,591	2	4,954	2	4,860	3	1,591	2	6,451	3
Had driven this vehicle 6-10 times in the past six months	2,245	6	2,975	3	1,322	1	4,298	2	5,221	4	1,322	1	6,543	3
Had driven this vehicle more than 10 times in the past six months	24,314	64	74,166	72	61,622	62	135,788	67	98,480	70	61,622	62	160,102	66
No driver present	0	0	2,496	2	214	0	2,710	1	2,496	2	214	0	2,710	1
Unknown	9,094	24	16,639	16	33,842	34	50,481	25	25,734	18	33,842	34	59,576	25
Total	38,127	100	103,074	100	99,828	100	202,902	100	141,200	100	99,828	100	241,028	100

Source: NHTSA, NCSA, LTCCS. Study Time Span: April 1, 2001 - December 31, 2003

VII. Appendix

The following items are included in this appendix, in order to assist the reader in interpreting and/or producing standard errors and confidence intervals that correspond to the tables in this report:

Tables

The two tables shown later in the appendix have crash counts that are the same as shown in Table 1 of this report. These tables also show the standard errors that can be used with the crash counts of Table 1, in order to produce confidence intervals for each count. The 95-percent confidence intervals are shown in the SAS output displayed below. The SUDAAN output, shown following the SAS output, has the same counts and standard errors.

Programming Code

Programming code in two statistical programming languages (SAS and SUDAAN) were used to calculate the standard errors for the counts in this report. These two pieces of code were each used to individually calculate the output (both counts and standard errors) that are shown below. The SAS and SUDAAN standard errors, and therefore the 95-percent confidence intervals, are equivalent. The programming is shown in both languages in order to appeal to a wider audience. The SUDAAN code is appended to the end of the SAS code, in order to help the reader compare the programming languages. The SAS portion of the program was used by itself to produce the SAS chart of counts and standard errors, and confidence intervals. The SUDAAN code also can be used by itself, if the variables have been previously created in the program.

Explanation of the Tables in the Appendix

A brief explanation of the tables, in order to help the reader interpret the findings, is placed here, immediately prior to the tables. Two examples of counts, standard errors, and confidence intervals are described below.

It may be helpful to the reader to look back at Table 1 in this report. The counts shown in Table 1 are the same counts that are seen in the SAS output, below, and the SUDAAN output, below.

Example #1: For crashes where the only vehicle was a large truck, the weighted estimate of the crash count is 38,127. The standard error for this crash count is 9,407. This estimate and standard error were used to calculate the 95-percent confidence interval (17,631 to 58,623) shown below. Please note that since these data are not normally distributed, the 95-percent confidence interval is not calculated using the z-values of the standard normal curve.

Example #2: For crashes where there is exactly one large truck and one other vehicle (i.e., a passenger car), the number of vehicles is two. Table 1 shows that the estimate for the count of crashes in this scenario is 51,025, and the standard error is shown below to be 10,389. The 95-percent confidence interval for this count is shown below to be (28,389 to 73,660).

SAS Output

SAS 9 ESTIMATES

The SURVEYFREQ Procedure

Table of NUMBER_OF_VEHICLE by NUMBER_OF_TRUCK

NUMBER_OF_VEHICLE	NUMBER_OF_TRUCK	Weighted Frequency	Std Dev of Wgt Freq	95% Confidence Limits for Wgt Freq	
1	1	38127	9407	17631	58623
	2	0	0	0	0
	3 or more	0	0	0	0
	Total	38127	9407	17631	58623
2	1	51025	10389	28389	73660
	2	6888	2375	1714	12062
	3 or more	0	0	0	0
	Total	57913	11133	33656	82169
3 or more	1	14501	1863	10441	18561
	2	6964	2156	2266	11662
	3 or more	2698	1464	0	5889
	Total	24163	4502	14354	33972
Total	1	103652	20020	60031	147273
	2	13852	3987	5165	22539
	3 or more	2698	1464	0	5889
	Total	120202	23798	68352	172053

SUDAAN Output

S U D A A N

Number of observations read : 963 Weighted count : 120202

The CROSSTAB Procedure

Variance Estimation Method: Taylor Series (WR)
SUDAAN OUTPUT
by: NUMBER_OF_VEHICLE, NUMBER_OF_TRUCK.

NUMBER_OF_VEHICLE		NUMBER_OF_TRUCK Total	1	2	3 or more
Total	Weighted Size	120202	103652	13852	2698
	SE Weighted	23797.72	20020.47	3987.10	1464.30
1	Weighted Size	38127	38127	0	0
	SE Weighted	9407.07	9407.07	0.00	0.00
2	Weighted Size	57913	51025	6888	0
	SE Weighted	11132.94	10388.96	2374.53	0.00
3 or more	Weighted Size	24163	14501	6964	2698
	SE Weighted	4501.99	1863.40	2156.39	1464.30

SAS Code and SUDAAN Code

The codes below were used to produce the SAS and SUDAAN output above. The SUDAAN code is inserted into the program at the end of the SAS code.

Note that comments for the code are listed below, and surrounded by asterisks.

SAS Code

```
proc sort data=lt.crash;            *** Sort crash file by caseid ***
  by caseid;
run;

proc sort data=lt.generalvehicle;    *** Sort general vehicle file by caseid ***
  by caseid;
run;

data table1;     *** merge crash and general vehicle files ***
  merge lt.crash (in=a)
        lt.generalvehicle (in=b);
  by caseid;
  if a and b;
run;

data table1;     *** remove cases where the weight is zero ***
  set table1;
  if ratweight gt 0;
run;

DATA TABLE1_SE;
   SET TABLE1;
*** The NUMTRK variable was created just for this program.  It was used to count the number of
large trucks in the crash.  The "3 or more trucks" category was created using a new variable
NUMBER_OF_TRUCK ***
   IF NUMTRK>=3 THEN NUMBER_OF_TRUCK=3;
   ELSE NUMBER_OF_TRUCK=NUMTRK;
*** The NUMVEH variable was also created just for this program.  It was used to count the number
of overall vehicles in the crash.  The "3 or more vehicles" category was created using a new variable
NUMBER_OF_VEHICLE ***
   IF NUMVEH>=3 THEN NUMBER_OF_VEHICLE=3;
   ELSE NUMBER_OF_VEHICLE=NUMVEH;
   RUN;
```

```
 proc surveyfreq data=TABLE1_SE;
       TITLE "SAS 9 ESTIMATES";
*** PSU is the primary sampling unit variable in the LTCCS database.  PSUSTRATA is also in the
LTCCS database.***
       strata  PSUSTRATA / list;
       cluster PSU;
***RATWEIGHT is used for weighted data.  Failure to use this variable will lead to only a raw count
in the table ***
         weight  RATWEIGHT;
         tables  NUMBER_OF_VEHICLE*NUMBER_OF_TRUCK / CLWT NOPERCENT NOFREQ;
       run;
```

SUDAAN Code: This code was appended to the SAS code above.

```
PROC SORT
  DATA=TABLE1_SE;
  BY PSUSTRATA PSU;
RUN;

PROC CROSSTAB DATA=TABLE1_SE DESIGN=WR;
      WEIGHT RATWEIGHT;
      NEST PSUSTRATA PSU;
      SUBGROUP NUMBER_OF_TRUCK NUMBER_OF_VEHICLE;
      LEVELS   3               3;
*** The 3 levels for the NUMBER_OF TRUCK variable and the NUMBER_OF_VEHICLE variable are
for counts of 1, 2, and 3 or more ***
      TABLE NUMBER_OF_VEHICLE*NUMBER_OF_TRUCK;
*** WSUM is weighted sum, SEWGT is the standard error of the weighted sum ***
      PRINT WSUM SEWGT/WSUMFMT=F10.0;
      RTITLE "SUDAAN OUTPUT";
RUN;
```

DOT HS 810 646
August 2006

U.S. Department
of Transportation
**National Highway
Traffic Safety
Administration**

www.nhtsa.gov
NHTSA