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Federal Motor Carrier Safety Administration

Report to Congress on the Large Truck Crash Causation Study

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EXECUTIVE SUMMARY

The Motor Carrier Safety Improvement Act of 1999 (MCSIA), P.L. 106-159, mandated a study to determine the causes of, and contributing factors to, crashes involving commercial motor vehicles. MCSIA also directed the Secretary to transmit to Congress the results of the study. The U.S. Department of Transportation's (DOT) Federal Motor Carrier Safety Administration (FMCSA) and National Highway Traffic Safety Administration (NHTSA) conducted a multiyear, nationwide study of factors that contribute to truck crashes. The Large Truck Crash Causation Study (LTCCS) identifies areas that need to be addressed by effective crash countermeasures.

A nationally representative sample of large truck fatal and injury crashes was investigated during 2001 to 2003 at 24 sites in 17 States. Each crash involved at least one large truck and resulted in at least one fatality or injury. Data were collected on up to 1,000 elements in each crash. The total sample involved 967 crashes, which included 1,127 large trucks, 959 non-truck motor vehicles, 251 fatalities, and 1,408 injuries.

An action or inaction by the drivers of the truck or the other vehicles involved were important reasons leading to crashes in a large majority of the cases. Driver recognition and decision errors were the type of driver mistakes coded by crash investigators or law enforcement officials most often for the trucks and passenger vehicles. Truck drivers, however, were coded less frequently for both driving performance errors and non-performance problems (e.g., asleep, sick, incapacitated) than passenger vehicle drivers. In crashes between trucks and passenger vehicles, driving too fast for conditions and fatigue were important factors cited for both drivers. However, fatigue was coded twice as often for passenger vehicle drivers and speeding more often for truck drivers.

Brake problems were coded for almost 30 percent of the trucks but only 5 percent of the passenger vehicles. Roadway problems were present in 16 percent of the two-vehicle cases, and adverse weather conditions were present in approximately 13 percent of the crashes. Interruption in the traffic flow (previous crash, work zone, rush hour congestion, etc.) was coded in almost 25 percent of the two-vehicle crashes.

The LTCCS contains a large amount of descriptive data. Additional analysis must be conducted in order to identify specific crash risk factors. The LTCCS database will be electronically available to the public by the end of 2005. This will allow many other government agencies, universities, private groups, and individuals to analyze the data in order to increase the total knowledge about truck crash factors. FMCSA believes analysis from many sources is the best path for realizing the full potential of the LTCCS.

PURPOSE

The Motor Carrier Safety Improvement Act of 1999 directed the Secretary of Transportation to conduct a comprehensive study to determine the causes of, and contributing factors to, crashes involving commercial motor vehicles. The law authorized $3 million for Fiscal Year (FY) 2000 and $5 million per year for the study for FY 2001, 2002, and 2003. MCSIA also directed the Secretary to transmit the study results to Congress.

INTRODUCTION

No motor vehicle crash databases in the United States focus on the causes of, or factors related to, large truck crashes. The primary national traffic safety databases all contain descriptive data primarily collected from police crash reports. NHTSA’s Fatality Analysis Reporting System (FARS) includes descriptive data on vehicles, drivers, roadways, and environmental conditions collected from police reports, emergency medical service reports, hospital records, and coroner's reports. The Trucks Involved in Fatal Accidents database from the University of Michigan Transportation Research Institute supplements FARS data with additional data from interviews with police, drivers, and motor carriers. NHTSA’s General Estimates System (GES) is a probability-based, nationally representative sample of all police-reported fatal, injury, and property-damage-only crashes, that collects descriptive data based exclusively on police crash reports. FMCSA’s Motor Carrier Management Information System includes a limited amount of descriptive data on all trucks and buses involved in fatal, injury, or tow-away crashes, reported by the States from their police reports and is used primarily for enforcement purposes.

The LTCCS contains the same type of descriptive data as the primary national traffic safety databases described above, but also focuses on pre-crash factors such as driver fatigue and distraction, vehicle condition, weather, and roadway problems. This makes the LTCCS the only national examination of all factors related to causation in large truck crashes. In the LTCCS, FMCSA obtained information from official reports, in-depth interviews, and onsite investigations of the scene, truck, and driver. The LTCCS was conducted at 24 data collection sites in 17 States by researchers from NHTSA’s National Automotive Sampling System (NASS) and State truck inspectors. Crash data were coded in two NASS Zone Centers and reviewed by FMCSA and NHTSA personnel and national truck crash experts. The coding of the events surrounding the crash begins with the “critical event,” “critical reason” for the critical event, and “associated factors” present.

Methodology

The LTCCS collected data on crashes at 24 sites in 17 States in 2001 through 2003. An attempt was made to ensure that each crash involved at least one large truck with a gross vehicle weight rating of more than 10,000 pounds, and resulted in at least one fatality or at least one incapacitating or non-incapacitating but evident injury. An explanation of the sampling procedure to select crash cases is included in the Appendix. Data were collected on up to 1,000 elements in each crash. To get the highest quality data possible, the onsite investigations began as soon as possible after the crash occurred.

Data collection was performed at each crash site by a two-person team consisting of a trained researcher and a State truck inspector. Researchers collected data at crash scenes through driver, passenger, and witness interviews. The 28-page truck driver interview form, for example, covered areas such as the following:

- crash scene description including roadway and weather;
- vehicle rollover, fire, jackknife, cargo shift, and component problems with brakes, tires, steering, engine, and lights;
- driver credentials, history, method of wage payment, physical condition, fatigue (sleep pattern, work schedule, recreational activities, etc.), inattention/distraction, perception, and decisions; and
- trip information including intended start time, purpose, intended length, and familiarity with the route.

Subsequent to the crash, each truck and truck driver were subjected to a thorough inspection. The inspection covered thirteen critical areas such as brakes, exhaust systems, frames, cargo securement, tires, wheels and rims, and fuel systems. It covered driver data on licenses, medical cards, duty status, and log books.

After leaving the crash scene, researchers collected additional interview data by telephone from motor carriers responsible for the trucks, and surrogate drivers of trucks and other vehicles when the actual drivers could not be interviewed as a result of a fatal or serious injury. Researchers also reviewed police crash reports, hospitals records, and coroners' reports. In addition, researchers often revisited the crash scene to make more accurate scene diagrams and search for additional data.

Together the teams collected data on approximately 1,000 variables on each crash. Crash case data were provided to NHTSA crash experts for coding, difficult cases were reviewed by NHTSA and FMCSA headquarters staff, and finalized cases were sent to DOT's Volpe National Transportation Systems Center for inclusion in the study's electronic database.

LTCCS CASE CHARACTERISTICS

This LTCCS report includes information on 967 total crashes, each involving at least one large truck. In these 967 crashes, there were 1,127 large trucks, 959 non-truck motor vehicles, 251 fatalities, and 1,408 injuries. The following three tables provide basic data about the 967 study crashes and the 1,127 trucks in those cases. The data in these tables represent raw, simple counts from the study and, therefore, have not been weighted to reflect a nationally representative sample.

As shown in Table 1, 23 percent of the LTCCS cases resulted in at least one fatality. Although this number of fatal crashes appears large compared to other national crash databases, the LTCCS only involved cases with at least one injury.

Table 1 – Crashes by Severity Level

Severity Level	Number	Percent
Fatal	223	23.1%
Incapacitating Injury	278	28.7%
Non-Incapacitating Injury	466	48.2%
Total Crashes	967	100.0%

Source: Unweighted LTCCS Database, July 2005

Table 2 shows that one-fourth of the cases involved only one truck including those that rolled over, struck an object, hit a pedestrian, or collided with a non-motorized vehicle such as a bicycle. Three-fourths of the crashes involved a collision between a least one truck and at least one other motor vehicle.

Table 2 – Crashes by Number of Vehicles Per Crash

Number of Vehicles	Number	Percent
One	241	24.9%
Two	492	50.9%
Three or More	234	24.2%
Total Crashes	967	100.0%

Source: Unweighted LTCCS Database, July 2005

Table 3 presents data on the type of trucks involved in the 967 crashes. Over 60 percent of the 1,127 trucks involved in the LTCCS crashes were tractors pulling a single semi-trailer. The majority of these are the ubiquitous 18-wheelers that haul most of the Nation's freight. Single-unit or straight trucks include those used for local package delivery, towing disabled vehicles, delivering fuel oil, collecting trash, and many other uses.

Table 3 – Trucks in Crashes by Vehicle Configuration

Truck Configuration	**Number**	**Percent**
Single-Unit Trucks		
Two Axles	125	11.1%
Three or More Axles	157	13.9%
Single Unit - Axles Unknown	2	0.2%
Combination Unit Trucks		
Truck Tractor (Bobtail)	29	2.6%
Truck pulling Trailer(s)	40	3.5%
Tractor pulling Semi-Trailer	701	62.2%
Tractor pulling Two Trailers	55	4.9%
Tractor pulling Three Trailers	0	0.0%
Other/Unknown/Missing	18	1.6%
Total Trucks	1,127	100.0%

Source: Unweighted LTCCS Database, July 2005

NATIONAL ESTIMATES FROM LTCCS

The remaining tables in the report present national estimates based on weighted data. During the 2-year and 9-month study period of the project, FMCSA estimated that there were approximately 141,000 large trucks involved in fatal, incapacitating, and non-incapacitating injury crashes. Each of the 967 LTCCS study cases was assigned a sampling weight (based on the probability of selection into the sample for the site associated with the case) that allows for national estimates of total truck crashes, broken down by various characteristics for these 141,000 trucks.

The estimates presented may differ from true values because they are based on a probability sample of crashes and not a census of all crashes. The size of these differences may vary depending on which sample of the crashes is the focus of each particular table and analysis. A discussion of standard errors associated with estimates drawn from the LTCCS database will be included in the Users Manual, which will accompany the public release of the database.

Table 4 shows almost one-fourth of the crash involvements consist of a truck running into the rear end of a non-truck, a non-truck running into the rear end of a truck, or one truck hitting another in the rear end. About 18 percent of the crashes represent a truck either running off the road or out of its lane.

Table 4 – Estimated Number of Trucks in Crashes by Crash Type

Type	Number*	Percent**
Rear End	33,000	23.1%
Ran off Road/Out of Lane	25,000	17.8%
Side Swipe, Same Direction	15,000	10.3%
Rollover	13,000	8.9%
Turning across Path/into Path	11,000	8.0%
Intersecting Vehicles, Straight Paths	8,000	5.8%
Side Swipe, Opposite Direction	6,000	4.6%
Head-on	4,000	3.0%
Hit Object in Road	3,000	1.8%
No Impact (fire, jackknife, other,)	1,000	0.9%
Backing into Other Vehicle	***	0.3%
Other Crash Type	22,000	15.5%
Total Trucks	141,000	100.0%

Notes:
* Numbers rounded to closest 1,000.
** Percent calculated on unrounded estimates.
*** Weighted numbers lower than 500 are rounded to zero.

Source: LTCCS Database, July 2005

Crash Events and Associated Factors

Researchers collected interview data on a large number of variables that provide a very detailed description of the events of each crash, along with extensive documentary information on the vehicles, drivers, environment, and crash scene. The coding of the events surrounding the crash begins with the "critical event," "critical reason" for the critical event, and "associated factors" present. Crashes are the probabilistic result of a range of factors. This study was designed to permit consideration of a broad range of factors that could be used to guide development of crash countermeasures. A thorough discussion of these and other issues is included in the Analysis Brief "Methodology of the Large Truck Crash Causation Study" (February 2005, Publication #FMCSA A-RI-05-035). To understand the analysis presented in this report, a brief review of key terms and examples follows:

- Critical Event – the starting point for the LTCCS data collection and analysis. It is the event that immediately led to the crash. The critical event is the action or event which put the vehicle or vehicles on a course that made the collision unavoidable, given reasonable driving skills and vehicle handling. Each vehicle in each crash is coded with a critical event.

  Example: On a four-lane divided local road, a passenger vehicle turns left at a stoplight, and is hit in the intersection by a wrecker which is unable to avoid a crash. The critical event for the passenger vehicle is turning left at the intersection. The critical event for the wrecker is the passenger vehicle encroaching into its lane from the opposite direction – over the left lane line.

- Critical Reason – immediate reason for the critical event; failure leading to the critical event. The critical reason describes why the critical event occurred. Possible critical reasons include driver decisions and conditions; vehicle failures; and environmental conditions, including weather and roadway conditions and even highway design features. Only one critical reason is coded for each crash. Note that many factors can contribute to a crash, and generally speaking, barring a catastrophic failure in the vehicle or roadway, the driver is effectively the last party who can intervene to avoid a crash. Identification of a single critical reason merely begins the process of explaining why a crash occurred. Critical reason coding works together with other factors present to determine the full range of risk events that produced the crash. The critical reason is always assigned to the vehicle with the critical event.

  Example: The critical reason for the crash is inadequate surveillance on the part of the passenger vehicle driver (e.g., failed to look or looked but did not see).

- Associated Factors – any of approximately 1,000 conditions or circumstances present at the time of the crash is coded. The factors coded are selected from a broad range of factors thought to contribute to crash risk. No judgment is made as to whether any factor is related to the particular crash, just whether it was present. The factors present work with the assignment of a critical reason to identify the range of events that lead to crashes. The list of the factors that can be coded provides enough information to comprehensively describe circumstances of the crash.

Example: The passenger vehicle driver was coded with the following factors: alcohol use and fatigue. There were no vehicle or environmental factors coded for the passenger vehicle. The driver of the wrecker was coded with the following factors: being in a hurry prior to the crash and conversing with a passenger. The wrecker was coded with a defective tail light. There were no environmental factors coded for the wrecker.

Other information is also provided in this analysis on the crash events, including pre-event maneuver, right of way, crash avoidance maneuvers and results, the relative position and movements of the vehicles prior to the first harmful event, and a listing of each collision event for each vehicle in the crash. The coded factors provide enough information about the crash to describe it completely. In addition, there are narrative descriptions included with each case. The tables in this section focus on crash type, critical events, critical reasons, and associated factors, first for all 967 LTCCS cases, and then for a subset of cases involving one truck and one passenger vehicle. Critical events, critical reasons, and associated factors, in and of themselves, do not describe "cause," but when considered together give a good picture of crash causation.

Trucks in All Crashes

The following tables use the data from all 1,127 trucks involved in the 967 study cases to produce various weighted national estimates. Nationally, there were 141,000 large trucks involved in fatal, incapacitating, and non-incapacitating injury crashes during the 33-month study period.

Table 5 shows LTCCS estimates for the distribution of trucks by the type of collision as defined by the number and type of vehicles involved. Two-vehicle crashes are split by whether the other vehicle was a passenger vehicle, a truck, or some other vehicle type – usually a bus or motorcycle. Passenger vehicles include automobiles, pickup trucks, vans, and sport utility vehicles. Where three or more vehicles are involved in a crash, the cases are divided into the following four classes based on the two vehicles involved in the first collision:

- a large truck collides with a passenger vehicle;
- two large trucks collide;
- a large truck collides with a non-passenger motor vehicle; and
- two non-large trucks collide.

Table 5 – Estimated Number of Trucks in All Crashes by Crash Type			
Number of Vehicles	**First Motor Vehicle Collision**	**Number***	**Percent****
One	Truck only	38,000	26.9%
Two	Truck/Passenger Vehicle	51,000	36.1%
	Truck/Truck	13,000	9.5%
	Truck/Other Vehicle	1,000	0.7%
Three or More	Truck/Passenger Vehicle	15,000	10.8%
	Truck/Truck	8,000	5.5%
	Truck/ Other Vehicle	***	0.1%
	Other****	15,000	10.5%
Total		141,000	100.0%

Notes:
* Estimates are rounded to the nearest 1,000.
** Percents are calculated on unrounded weighted numbers.
*** Weighted numbers lower than 500 are rounded to zero.
**** Other crashes are those where a truck was not involved in the first collision in the crash.

Source: LTCCS Database, July 2005

Almost 27 percent of large trucks were involved in crashes where they were the sole motor vehicle. Nearly all of these were non-collision crashes, but a few involved collisions with pedestrians, bicycles, or other non-motorists. About 46 percent of the trucks were involved in two-vehicle crashes, and the remaining 27 percent involved three-or-more vehicle crashes. When involved in three-plus vehicle crashes, approximately 39 percent of large trucks were not involved in the first collision

While this section covers the estimated 141,000 large trucks involved in fatal, incapacitating, and non-incapacitating injury crashes during the course of the study, an estimated 64,000 trucks were not assigned the critical reason for their crashes. All numbers and percentages in Table 6 cover only the estimated 77,000 trucks that were coded with the crash critical reason. These trucks represent 55 percent of the trucks involved in all study cases.

Table 6 – Estimated Number of Trucks in All Crashes by Critical Events, where the Truck was Coded with the Critical Reason		
Events	**Number***	**Percent****
Over the Lane Line or Off the Road	25,000	32.1%
Loss of Control (Traveling too Fast for Conditions, other)	22,000	28.6%
Other Motor Vehicle in Travel Lane	17,000	21.7%
Turning, Crossing an Intersection	8,000	10.3%
Pedestrian/Bicyclist/Other Non-motorist in Roadway	2,000	2.5%
Other Motor Vehicle Encroaching into Travel Lane	1,000	1.7%
Other	2,000	2.4%
Not Involved in First Harmful Event	***	0.6%
Total	77,000	100.0%
Critical Reason not assigned to Truck	64,000	

Notes:
* Estimates are rounded to the nearest 1,000.
** Percents are calculated on unrounded weighted numbers.
*** Weighted numbers lower than 500 are rounded to zero.

Source: LTCCS Database, July 2005

Four types of critical events in Table 6 account for 93 percent of the trucks assigned critical events and critical reasons. The truck crossing over a lane line or departing from the roadway was coded for almost one-third of the trucks. Loss of control, either through traveling too fast or another reason, was coded for about 29 percent of the trucks, and another vehicle that was traveling in the truck's travel lane was coded for 22 percent of the trucks. Turning at an intersection or crossing an intersection accounted for another 10 percent of critical events assigned to trucks that were also assigned the critical reason.

When the critical reason was assigned to a large truck, it was assigned to the driver in a large majority of the cases. The LTCCS codes four types of driver errors. Some examples of the specific errors are the following:

- Non-Performance – Driver fell asleep, was disabled by a heart attack or seizure, or was physically impaired for another reason;
- Recognition – Driver did not recognize the situation by not paying proper attention, was distracted by something inside or outside the vehicle, or failed to adequately observe the situation;
- Decision – Driver drove too fast for conditions, misjudged the speed of other vehicles, followed other vehicles too closely, or made false assumptions about other driver's actions; and
- Performance – Driver froze, overcompensated, or exercised poor directional control.

Table 7 presents weighted data on the critical reasons assigned to the large truck in the 967 study cases. The critical reason was assigned to 77,000 trucks involved in the crashes. Non-truck motor vehicles were coded with the critical reason in almost all other crashes, but the critical reason was assigned to pedestrians in a few crashes.

Driver decisions were coded as being the critical reason in over one-third of the cases where the large truck was assigned the reason. In 28 percent of the cases, driver recognition was the critical reason. Factors in these two areas accounted for two-thirds of the critical reasons assigned to the trucks.

Table 7 – Estimated Number of Trucks in All Crashes by Critical Reasons

Reasons	**Total***	**Percent****
Driver		
Non-Performance	9,000	11.6%
Recognition	22,000	28.4%
Decision	29,000	38.0%
Performance	7,000	9.2%
Driver Total	67,000	87.2%
Vehicle	8,000	10.1%
Environment	2,000	2.4%
Unknown	***	0.3%
Totals – Assigned to Large Trucks	77,000	100.0%
Critical Reason not assigned to Truck	*64,000*	

Notes:
* Estimates are rounded to the nearest 1,000.
** Percents are calculated on unrounded weighted numbers.
*** Weighted numbers lower than 500 are rounded to zero.

Source: LTCCS Database, July 2005

A wide range of vehicle factors were coded in the study but these factors were coded as being the critical reason for only 10 percent of the trucks in the study assigned a critical reason. The critical reasons for large trucks were concentrated in just three areas: braking capacity, tire or wheel failure, and cargo shift.

In only 2 percent of the cases, the critical reason was assigned to the environment. In these cases, the impact of environmental conditions (roadway or weather) was the critical reason for the crash.

Approximately 1,000 associated factors were coded during the LTCCS. Table 8 presents the top 20 most coded factors, and 6 other factors of interest. Some factors listed are composites of a group of factors. For example, the brake factor includes everything from failed brakes to brakes out of adjustment. Breaking down this group into its parts will be a major focus of future analysis of vehicle factors in crashes. Other factors, such as driver fatigue and driving too fast for conditions, are single variable factors.

Most of the factors involve the driver. A number of the factors center on the condition of the truck driver at the time of the crash. Legal drug use, prescription and over-the-counter drugs, show up in a large number of cases. On the other hand, the use of illegal drugs and alcohol and truck driver illness are rare. Driver fatigue is a prominent factor, ranking sixth of the driver list with 13 percent of the truck drivers coded as being fatigued at the time of the crash.

Table 8 – Estimated Number of Trucks in All Crashes by Associated Factor		
Top 20 Factors	**Number of Trucks***	**Percent****
Drivers		
Prescription Drug Use	37,000	26.3%
Traveling Too Fast For Conditions	32,000	22.9%
Unfamiliar with Roadway (less than 6 times in 6 months)	30,000	21.6%
Over-the-Counter Drug Use	24,000	17.3%
Inadequate Surveillance	19,000	13.2%
Fatigue	18,000	13.0%
Under Work-Related Pressure	13,000	9.2%
Illegal Maneuver	13,000	9.1%
Inattention	12,000	8.5%
External Distraction Factors	11,000	8.0%
Inadequate Evasive Action	9,000	6.6%
Aggressive Driving Behavior (tailgating, weaving, other)	9,000	6.6%
Unfamiliar with Vehicle (less than 6 times in 6 months)	9,000	6.5%
Following Too Closely	7,000	4.9%
False Assumption of Other Road Users Actions	7,000	4.7%
Vehicle		
Brake Failure, out of adjustment, etc.	41,000	29.4%
Environment		
Traffic Flow Interruption (previous crash, congestion, other)	39,000	28.0%
Roadway Related Factors	29,000	20.5%
Driver Required To Stop Before Crash (traffic control device, other)	28,000	19.8%
Weather Related Factors	20,000	14.1%
Other Factors		
Cargo Shift	6,000	4.0%
Driver Pressured to Operate Even though Fatigued	5,000	3.2%
Cargo Securement	4,000	3.0%
Illness	4,000	2.8%
Illegal Drug Use	3,000	2.3%
Alcohol Use	1,000	0.8%

Notes:
* Estimates are rounded to nearest 1,000.
** Percents are calculated on unrounded weighted numbers.

Source: LTCCS Database, July 2005

Crashes between a Truck and a Passenger Vehicle

Much of the literature on truck safety focuses on the fear of collisions between automobiles and large trucks. Most of the crashes in the LTCCS involve at least one large truck and one passenger vehicle. For Tables 9 and 10, a two-vehicle large truck-passenger vehicle crash will include the following two categories of crashes:

- crashes which involve a single truck and a single passenger vehicle, and
- crashes involving more than two vehicles when the first two vehicles that collide are a truck and a passenger vehicle.

Table 9 – Estimated Number of Crashes by Critical Reasons in One Truck, One Passenger Vehicle Crashes

	Frequency		**Percent**	
Reasons	**Large Truck***	**Pass. Vehicle***	**Large Truck****	**Pass. Vehicle****
Driver				
Non-Performance	1,000	6,000	2.8%	15.6%
Recognition	10,000	11,000	35.5%	30.3%
Decision	12,000	9,000	42.6%	23.5%
Performance	2,000	7,000	6.8%	19.3%
Total Driver	25,000	33,000	87.7%	88.7%
Vehicle	3,000	2,000	8.0%	4.1%
Environment	1,000	1,000	3.7%	3.3%
Unknown	***	1,000	0.7%	3.9%
Total – Critical Reason Assigned to These Vehicles	29,000	37,000	100.0%	100.0%

Notes:
* Estimates are rounded to nearest 1,000.
** Percents are calculated on unrounded weighted numbers.
*** Weighted numbers lower than 500 are rounded to zero.

Source: LTCCS Database, July 2005

In two-vehicle crashes involving a large truck and a passenger vehicle, the passenger vehicle was assigned the critical reason in 56 percent of the crashes and the large truck in 44 percent. The critical reasons coded were similar. Driver recognition and decision reasons were the two most common reasons for drivers of both classes of vehicles. For truck drivers, these two reasons accounted for three-fourths of the cases, while they accounted for half the passenger vehicle cases. On the other hand, passenger vehicle drivers were coded with condition and performance reasons in a higher percent of the cases where their vehicle was coded with the critical reason. Vehicle critical reasons were coded twice as often for trucks than passenger vehicles in percentage terms, but the weighted numbers in both cases were low. Environmental factors do not play a major role in critical reasons for either class of vehicle.

Following, Table 10 presents the top 20 associated factors assigned to large trucks in two-vehicle crashes, and the corresponding number of times these factors were coded for the passenger vehicles. Driver factors predominate in the list. Legal drug use was very common for drivers of both types of vehicles, but illegal drug use was a factor only for passenger vehicle drivers. Truck drivers were coded as driving too fast for conditions at a rate almost 50 percent higher than passenger vehicle drivers, while passenger vehicle drivers were coded as being fatigued twice as often as truck drivers. Brake issues were coded for over a quarter of the trucks but only 2 percent of the passenger vehicles. Traffic flow interruptions and the need to stop before crashes were coded in almost 25 percent of these two-vehicle crashes.

Table 10 –Estimated Large Trucks and Passenger Vehicles in Two-Vehicle Crashes by Associated Factor				
	Number*		**Percent****	
Factor	**Large Truck**	**Passenger Vehicle**	**Large Truck**	**Passenger Vehicle**
Drivers				
Prescription drug use	19,000	22,000	28.7%	33.9%
Over-the-counter drug use	13,000	7,000	19.4%	10.3%
Unfamiliar with roadway (less than 6 times in 6 months)	13,000	6,000	19.1%	9.7%
Inadequate surveillance	10,000	9,000	15.8%	13.2%
Driving too fast for conditions	10,000	7,000	15.2%	10.4%
Making illegal maneuver	8,000	9,000	11.5%	13.1%
Felt under work pressure	6,000	2,000	9.9%	2.6%
Driver inattentive to driving	6,000	6,000	8.5%	9.2%
External distraction	5,000	4,000	7.7%	5.6%
Driver fatigue	5,000	10,000	7.5%	14.7%
Inadequate evasion	4,000	5,000	6.5%	6.9%
False assumption of other road user's actions	4,000	2,000	5.9%	3.1%
Unfamiliar with Vehicle (less than 6 times in 6 months)	4,000	2,000	5.4%	2.4%
Vehicle				
Brake failure, out of adjustment, etc.	18,000	2,000	27.0%	2.3%
Lights/Tape deficiencies	4,000	1,000	6.1%	1.1%
Environment				
Traffic flow interrupted	16,000	16,000	23.7%	24.6%
Required to stop before crash (traffic control device, other)	14,000	16,000	21.0%	24.5%
Roadway problems (missing signs, slick surface, other)	11,000	11,000	16.6%	16.2%
Weather problems (rain, snow, fog, other)	9,000	9,000	13.3%	13.3%
Sightline to other vehicle obstructed	5,000	3,000	6.9%	4.9%
Other Factors				
Driver ill	1,000	5,000	12%	7.6%
Cargo shift	***	***	0.6%	0.0%
Illegal drug use	***	4,000	0.4%	6.7%
Driver used alcohol	***	6,000	0.3%	9.0%

Notes:
* Estimates are rounded to nearest 1,000.
** Percents are calculated on unrounded weighted numbers.
*** Weighted numbers lower than 500 are rounded to zero.

Source: LTCCS Database, July 2005

CONCLUSION

The Large Truck Crash Causation Study examined 967 crashes involving at least one large truck. Each case was given a weight to allow derivation of national estimates of crash characteristics for the estimated 141,000 large trucks involved in fatal and injury crashes during the 33-month study period. The study collected information on almost 1,000 data elements associated with the drivers, the trucks and other vehicles, and the environmental conditions involved in the crash. The coding of the events surrounding the crash begins with the "critical event," the "critical reason" for the critical event, and "associated factors" for the crash. None of these variables in and of themselves should be considered the cause of the crash, but when analyzed properly, can lead to a better understanding of crash causation and guide countermeasure development.

For all crashes in the study (single and multiple vehicle crashes), trucks were assigned the critical reason in 55 percent of the cases. Driver reasons accounted for 87 percent of the reasons, and most involved failure to correctly recognize the situation or poor driving decisions. Thirteen percent of the coded reasons involved the truck, weather conditions, or roadway problems. The most common associated factors recorded were driver factors, such as legal drug use, traveling too fast for conditions, unfamiliarity with the roadway, inadequate surveillance, fatigue, and feeling under pressure from motor carriers. The most common vehicle associated factor was brake problems. Traffic flow interruption and requirements that the driver stop before the crash were prevalent roadway factors.

For two-vehicle crashes involving a truck and a passenger vehicle, trucks were assigned the critical reason in 44 percent of the crashes and passenger vehicles in 56 percent. Driver reasons accounted for the overwhelming majority of the critical reasons – 88 percent for the trucks assigned reasons and 89 percent of the passenger vehicles assigned reasons. Driver recognition and driver decision errors were the most frequently cited critical reasons for both types of vehicles. The most common associated factors recorded for both classes of drivers were traveling too fast for conditions, making an illegal maneuver, legal drug use, unfamiliarity with the roadway, and fatigue. Fatigue was recorded for the passenger vehicle driver twice as often as for the truck driver. There was very little illegal drug use or alcohol use assigned to truck drivers, but more of both recorded for passenger vehicle drivers.

Although a large amount of descriptive data from the LTCCS is presented here, much more data analysis is necessary to reach conclusions about the reasons, causes, and factors for large truck crashes. The complex nature of causation in crashes is explored in detail in the Analysis Brief **"**Methodology of the Large Truck Crash Causation Study**"** (February 2005, Publication #FMCSA A-RI-05-035). Additional analysis must be conducted on the study data to identify specific crash risk factors that can be subjected to countermeasures by the government and the public.

FMCSA will sponsor analyses of the LTCCS data in many areas, including, but not limited to, driver fatigue, speed, legal and illegal drug use, vehicle condition, and the contrast between single-unit and combination unit trucks in crashes. NHTSA will also conduct analyses of additional truck crash issues.

In addition, the LTCCS database will be electronically available to the public by the end of 2005. The public copy of the database will not contain data from interviews that cannot be validated from some other source. However, the full database with interview data included will be made available to qualified researchers, academic institutions, and government agencies. This will allow many other government agencies, universities, private groups, and individuals to analyze the data in order to increase the total knowledge about truck crash factors. FMCSA believes analysis from many sources is the best path for realizing the full potential of the LTCCS.

APPENDIX - Large Truck Crash Causation Study Sampling Procedure

The selection of crashes for the LTCCS was accomplished in two stages, using the infrastructure of the NASS Crashworthiness Data System (CDS). The first stage is the selection of geographic areas called primary sampling units (PSU). The United States has been divided into 1,195 PSUs where each PSU is comprised of a large city, a large county, or a group of counties. The PSUs are grouped into 12 categories or strata described by geographic region (northeast, midwest, south, west) and degree of population (central city, large county, and group of counties). For the NASS CDS, two PSUs were selected from each stratum (category) with probability proportional to the number of police-reported fatal and injury crashes in each PSU. These 24 PSUs were also used for the LTCCS.

In the second stage of the LTCCS sample, researchers were notified of truck crashes within their PSU and arrived, as soon as possible, at the scene of the crash, where they determined whether the crash qualified for the study and, if so, initiated data collection. To qualify for the LTCCS, a crash was to involve a large truck and at least one fatal or non-fatal injury to an occupant in an involved vehicle (not necessarily the large truck) or to a non-motorist. Detailed explanation of these operations can be found in DOT HS 809 527, September 2002, Large Truck Crash Causation Study Interim Report, prepared by NHTSA's National Center for Statistics and Analysis.

In most PSUs, the goal was to respond to all qualifying crashes. However, due to notification difficulties, the crashes sampled were in reality a subset of the crashes occurring in the PSU. The difference is accounted for in the sampling weights, which are an integral part of the final data set and are used to generate the estimates provided in this report. As a result of notification issues and small sample sizes, breaking down crashes into time periods such as days of the week or months of the year will not provide valid estimates in the LTCCS data. Therefore, all estimates provided in this report are based on the entire sample of crashes over the entire 33 month period of the study.