

The goal of the Federal Motor Carrier Safety Administration (FMCSA) is to reduce the number and severity of large truck-involved crashes through more commercial motor vehicle and operator inspections and compliance reviews, stronger enforcement measures against violators, expedited completion of rulemaking proceedings, scientifically sound research, and effective CDL testing, recordkeeping, and sanctions.

The Office of Data Analysis and Information Systems develops and maintains systems for collecting and analyzing motor carrier data, and disseminates information on the motor carrier industry.

This Analysis Brief was produced by the Analysis Division in FMCSA's Office of Data Analysis and Information Systems. The division analyzes motor carrier data pertaining to crashes, inspections, compliance reviews, and drug and alcohol testing, and supports research on the effectiveness of FMCSA inspections and compliance review programs.



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# Cost of Large Truck- and Bus-Involved Crashes

## Introduction

Crashes involving trucks and buses with gross weight ratings over 10,000 pounds impose a variety of costs on the drivers of those vehicles; other drivers, involved either directly or indirectly in the crashes; and society as a whole. Such costs include medical expenses, emergency services, property damage, lost productivity, travel delays, and the monetized value of pain, suffering, and quality-of-life lost.

Safety analysts use crash cost data for a variety of purposes, from analyzing the effectiveness of a roadway enhancement to measuring the impact of seatbelt use. Such data are critical when comparing the relative efficacy of crash countermeasures and calculating the cost-effectiveness of proposed safety regulations. Efficient allocation of resources for research, enforcement, and analysis depends on reliable crash cost data.

This analysis brief summarizes the results of a Federal Motor Carrier Safety Administration (FMCSA) study on the cost (in 1999 dollars) of highway crashes involving large trucks and buses. The study final report is available at <http://ai.volpe.dot.gov>.

## Methodology

The following section provides a broad overview of the methodology used in the study; for a more detailed analysis, refer to the complete report.

In order to determine the costs associated with large vehicle crashes, analysts considered the following factors: estimates of the number of people and vehicles involved in a crash, the severity and cost of each person's injuries, and the cost of associated vehicle damage and travel delay.

## Incidence and Severity Estimation

To estimate injury incidence and severity (i.e., the number of people and vehicles involved in a crash and the severity of each person's injuries), analysts used adjusted data from the National Highway Traffic Safety Administration's (NHTSA) Fatality Analysis Reporting System (FARS) and General Estimates System (GES). FARS is a census of fatal crashes, but it does not always accurately describe the injuries to crash survivors. GES provides a sample of crashes by police-reported severity for all crash types. Police generally use the KABCO scale, which classifies crash victims as:

- K – killed,
- A – disabling injury,
- B – evident injury,
- C – possible injury, or
- O – no apparent injury.

KABCO ratings are coarse and inconsistently coded between states and over time. To minimize the effects of variability in police-reported injury descriptions, analysts used NHTSA data sets that included both police-reported KABCO ratings and medical descriptions of injuries in the Occupant Injury Coding system. Analysts used both the 1988–91 Crashworthiness Data System (CDS), which describes injuries to passenger vehicle



photo courtesy of the Federal Highway Administration

**The estimated cost of police-reported crashes involving large trucks in 1997 averaged \$76,000 per crash (in 1999 dollars).**

occupants involved in towaway crashes, and the 1982–86 National Accident Sampling System (NASS), which provides the most recent available medical descriptions of injuries to large truck and bus occupants, non-occupants, and other crash victims not included in the CDS.

The 1988–1997 GES data were used to weight the data from the CDS and NASS so they represented the annual estimated GES injury victim counts in large vehicle crashes by sample strata in the two systems. The process resulted in a hybrid CDS/NASS file with weights that summed to the estimated annual GES incidence by police-reported injury severity and other relevant factors.

Trucks and buses with a gross weight rating of over 10,000 pounds were grouped into the following categories:

- straight truck, no trailer;
- straight truck with trailer;
- straight truck, unknown if with trailer;
- truck tractor, no trailer (bobtail);
- truck tractor with one trailer;
- truck tractor with two or three trailers;
- truck tractor with unknown number of trailers;
- large truck, unknown if with trailer;
- all large trucks; and
- transit/inter-city bus.

### Cost Estimation

Analysts then generated estimates of crash costs by severity. Cost per injury by Maximum Abbreviated Injury Scale (MAIS) score and body region injured were adapted from the costs in two previous studies and merged onto the GES-weighted CDS/NASS file (Miller, 1997; Miller et al., 1999). Analysts determined the present value, computed at a 4 percent discount rate, of all costs over a victim's expected life span that result from a crash. The following five major categories of costs were identified.

- **Medically Related** include hospital, physician, rehabilitation, prescription, and related expenses; coroner and burial costs; and claims processing costs of medically related loss compensation through

insurance and the courts. Analysts computed the total medical costs of crashes in 1996, then used that aggregate information to adjust prior detailed cost estimates by MAIS score and body region injured. Then they estimated the incidence of injury in motor vehicle crashes and computed medical costs for each crash victim.

- **Emergency Services** are made up of police, fire, ambulance, and helicopter services. The cost per transport was calculated using published helicopter medical transport statistics and other data. Analysts computed fire and police costs from assumed response patterns by crash severity and vehicle involvement, constrained by data on total responses.
- **Property Damage** is the cost to repair or replace damaged vehicles, cargo, and other property, including the cost of damage compensation. Analysts based these costs on crash reports (which were not audited for accuracy) filed by motor carrier owners with the former Bureau of Motor Carrier Safety. Analysts then inflated the costs using the Consumer Price Index.
- **Lost Productivity** includes wages; fringe benefits; household work lost by the injured; cost of processing productivity loss compensation claims; productivity lost by people delayed in crash-related traffic jams; and productivity lost by coworkers and supervisors investigating crashes, recruiting and training replacements for disabled workers, and repairing damaged company vehicles. Earnings lost by family and friends caring for the injured and the value of schoolwork lost are *not* included in this category.
- **Monetized Quality-Adjusted Life Years** value the pain, suffering, and quality-of-life lost because of a death or injury. A quality-adjusted life year is a health outcome measure that assigns a value of 1 to a year of perfect health and 0 to death. Quality-adjusted life years generally are assessed along seven dimensions: cognitive; mobility; bending, grasping, lifting; sensory; cosmetic; pain; and the ability to work. Analysts determined the monetized value of quality-adjusted life years lost by considering the amount people routinely spend—in dollars or time—to reduce their risk of death and injury. Such expenditures include auto safety features, pedestrian safety, smoke detectors, and extra wages paid to workers who take risky jobs. In determining the percentage of quality-adjusted life years lost over an injured victim's lifetime, analysts averaged the fraction of perfect health lost during each year the victim recovers from a health problem or lives with a residual disability.

### Findings

The following findings are based on the latest data available and include costs that represent the present value, compounded at a 4 percent discount rate, of all



**Table 1.**  
Per-Crash Cost for Select Vehicles in 1997 by Vehicle Type and Crash Severity  
(in 1999 dollars)

TYPE OF VEHICLE	SEVERITY OF CRASH			AVERAGE PER-CRASH COST
	Property Damage Only	Injury	Fatal	
All Large Trucks	\$11,299	\$217,005	\$3,419,202	\$75,637
Straight Truck, No Trailer	11,605	182,404	3,315,062	64,667
Straight Truck With Trailer	11,851	200,662	3,215,199	69,203
Bobtail	11,233	229,565	3,437,995	74,695
Truck Tractor, 1 Trailer	11,025	245,472	3,367,873	84,588
Truck Tractor, 2 or 3 Trailers	9,940	328,008	3,542,774	117,309
Transit/Inter-City Bus	11,253	131,214	3,351,173	54,455

**Table 2.**  
Total Cost of Large Truck Bus Crashes in 1997 by Vehicle Type and Cost Type  
(in 1999 dollars and millions of dollars)

TYPE OF VEHICLE	TYPE OF COST					TOTAL
	Medical	Emergency Services	Property Damage	Lost Productivity	Monetized Quality-of-Life Years	
All Large Trucks	\$941	\$58	\$1,520	\$8,731	\$13,127	\$24,376
Straight Truck	460	25	676	3,492	4,913	9,566
Truck Tractor	477	32	835	5,205	8,188	14,738
Unknown	4	0	9	34	25	72
Transit/Inter-City Bus	36	3	93	433	412	978
<b>TOTAL</b>	<b>977</b>	<b>61</b>	<b>1,613</b>	<b>9,164</b>	<b>13,539</b>	<b>25,354</b>

**Table 3.**  
Per-Crash Cost for All Large Trucks in 1997 by Cost Type and Crash Severity  
(in 1999 dollars)

TYPE OF COST	SEVERITY OF CRASH		
	Property Damage Only	Injury	Fatal
Medical	\$182	\$8,448	\$28,429
Emergency Services	70	343	1,757
Property Damage	2,764	6,409	17,975
Lost Productivity	7,565	65,739	969,247
Monetized Quality-of-Life Years	718	136,066	2,401,793
<b>TOTAL</b>	<b>11,299</b>	<b>217,005</b>	<b>3,419,202</b>

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## Availability

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## Key Words

bobtail, bus, cost, crash, truck

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costs over a victim's expected life span that result from a crash. The cost estimates are provided in 1999 dollars and do not include mental health care costs for crash victims, roadside furniture repair costs, or cargo delays.

## Cost Per Crash

The estimated cost of police-reported crashes involving large trucks averaged \$76,000 per crash in 1997. Of all large vehicles, truck tractors with two or more trailers had the highest per-crash cost—\$117,000 per crash. Crashes involving truck tractors with one trailer cost \$85,000 per crash. The average cost of crashes involving transit and inter-city buses was \$54,000 per crash—the lowest cost among all large vehicles. Crashes involving bobtails had higher average costs than straight truck crashes. Bobtail crashes cost \$75,000 per crash, compared to \$65,000 for crashes involving straight trucks without trailers. (See **Table 1**.)

## Total Cost in 1997

The cost of large truck crashes in 1997 was \$24.4 billion, including:

- \$13.1 billion in quality-of-life losses,
- \$8.7 billion in productivity losses,
- \$1.5 billion in property damage,
- \$941 million in medical costs, and
- \$58 million in emergency services.

Of the total, crashes involving truck tractors with one trailer cost the most—\$13.2 billion. Combination trucks with two or more trailers accounted for an additional \$1.2 billion in crash costs. Single straight truck crashes made up about one-third—\$8.2 billion—of truck crash costs. Crashes involving straight trucks with one trailer cost \$1.4 billion. Bus crashes cost much less than truck crashes—\$978 million. (See **Table 2**.)

## Cost by Crash Severity

Fatal crashes had the highest per-crash cost than any other crash: the per-crash cost for fatal crashes for all large trucks was \$3.4 million in 1997. Fatal crashes involving transit and inter-city buses also cost \$3.4 million per crash. The cost per crash with injuries averaged \$217,000 for all large trucks and \$131,000 for buses. The cost per crash with only property damage was \$11,000 for both large trucks and buses. (See **Tables 1 and 3**.)

## Cost Per Truck-Miles

The crash costs per 1,000 truck-miles were \$259 for single-unit trucks, \$138 for single-combination trucks, and \$134 for multiple combinations. Although their crash costs per mile are less, combination unit trucks travel three-to-four times more miles per vehicle than single-unit trucks and have higher average annual crash costs.

## Conclusion

This study provides economically sophisticated and reliable estimates of the average cost of large truck and bus crashes with differing levels of severity. The FMCSA will use the data for a variety of purposes, from improving safety regulations to ensuring the efficient allocation of resources.

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