FEDERAL MOTOR CARRIER SAFETY ADMINISTRATION (FMCSA) CRASH COST METHODOLOGY

This document outlines the Federal Motor Carrier Safety Administration's (FMCSA or the Agency) methodology for calculating crash costs for fatal, injury, and non-injury crashes. This update incorporates the most recent crash data from the National Highway Traffic Safety Administration (NHTSA), from calendar year 2023.

The Agency uses crash cost values to assess and estimate the safety benefits of various regulatory initiatives. By publishing this methodology on the FMCSA website, stakeholders can access detailed information about how these crash cost values are derived, enhancing transparency. The crash cost estimates are available in the FMCSA Pocket Guide.[1] This update does not revise the methodological approach. FMCSA will continue to review the methodology periodically and update as new data and data sources become available.

Background

Crash costs are used in benefit-cost analyses (BCAs) to evaluate and quantify the impact of FMCSA's rulemaking actions with regard to the number of commercial motor vehicle (CMV) related crashes, injuries, and fatalities. FMCSA updates crash cost estimates annually using inputs from NHTSA's Fatality Analysis Reporting System (FARS)[2] and Crash Reporting Sampling System (CRSS)[3] (which provide information on police-reported crashes), updated economic costs, and the Department's annual updates on the Value of Statistical Life (VSL).

Methodology

FMCSA relies on the Federal Highway Administration (FHWA) report on Crash Costs for Highway Safety Analysis, which enumerates different methodologies that can be utilized to develop crash costs for various uses such as, but not limited to, BCAs for various DOT policies and regulations.[4] After careful consideration of various methodologies, FMCSA implemented an approach similar to that of the 'FHWA Safety BCA tool Crash Costs' detailed in Chapter 6 of the FHWA report[5], which uses NHTSA comprehensive cost estimates as a basis and develops a process for translating injuries from the five-point KABCO scale to the seven-point Maximum Abbreviated Injury Scale (MAIS), as shown in the table below.[6] The MAIS scale provides more detailed information for each type of injury, leading to more accurate crash cost estimates.

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[1] FMCSA Pocket Guide. Available at: https://www.fmcsa.dot.gov/safety/data-and-statistics/commercial-motor-vehicle-facts

[2] Fatality Analysis Reporting System. Available at: https://www.nhtsa.gov/research-data/fatality-analysis-reporting-system-fars

[3] Crash Report Sampling System. Available at: https://www.nhtsa.gov/crash-data-systems/crash-report-sampling-system

[4] Crash Costs for Highway Safety Analysis, January 2018. Available at: https://highways.dot.gov/sites/fhwa.dot.gov/files/2022-09/fhwasa17071.pdf

[5] Ibid, p.58

[6] The KABCO scale is less specific than the MAIS scale; ranking injury severity into 5 categories. The data used for injuries and fatalities is reported on the KABCO scale. Definition available at: https://highways.dot.gov/media/20141

Table 1: MAIS and KABCO Scale and Description				
MAIS	**Injury Description**		**KABCO**	**Injury Description**
6	Maximum Fatal		K	Fatal
5	Critical		A	Incapacitating
4	Severe		B	Non-incapacitating injury
3	Serious		C	Possible Injury
2	Moderate		O	Property Damage Only
1	Minor			
0	No Injury			

Consistent with NHTSA's methodology as described in The Economic and Societal Impact of Motor Vehicle Crashes, 2019 (Revised),[7] FMCSA developed a comprehensive cost estimate for CMV crashes based on the MAIS scale. Comprehensive costs include economic costs and costs associated with Quality Adjusted Life Years (QALY). Economic costs include lost productivity; medical costs; legal and court costs; emergency service costs; insurance administration costs; congestion costs; property damage; and workplace losses.[8] Following the NHTSA methodology, FMCSA divides economic costs into two components, injury costs estimated on a per-person basis and non-injury costs estimated on a per-crash basis. In lieu of QALY estimates, FMCSA calculates the societal impact as a fraction of the VSL based on the severity of the injuries, as outlined in NHTSA's report. FMCSA took this approach as our analyses rely generally on VSL estimates and not on QALYs. DOT provides guidance on the VSL for use in BCAs.[9]

The first step of estimating crash costs is to ascertain both the total number of crashes and the number of individuals injured, categorized by the severity of their injuries. FMCSA sourced data on non-fatal crashes and injuries from CRSS while sourcing data on fatal crashes and injuries from FARS. As mentioned earlier, these crash incident records are based on police accident reports, which include injury severity levels on a five-level scale known as KABCO (see table above for classification scale and definitions).

FMCSA tallies crashes by injury severity, based on the most severe injury sustained in each crash. For instance, a crash involving two vehicles where one person sustained a fatal injury (K) and another sustained a non-fatal A-level injury (i.e., incapacitating), is categorized as a fatal (K) crash. After tallying all crashes according to the maximum injury severity, FMCSA examines the number of individuals injured within each severity category. For instance, the fatal crash in the example above is considered a "K" crash and includes one K-level fatality and one A-level injury.

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[7] Blincoe, L., Miller, T., Wang, J.-S., Swedler, D., Coughlin, T., Lawrence, B., Guo, F., Klauer, S., & Dingus, T. (2023, February). The economic and societal impact of motor vehicle crashes, 2019 (Revised) (Report No. DOT HS 813 403). National Highway Traffic Safety Administration. Available at: https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/813403

[8] Ibid

[9] Departmental guidance on Value of Statistical Life. Available at: https://www.transportation.gov/office-policy/transportation-policy/revised-departmental-guidance-on-valuation-of-a-statistical-life-in-economic-analysis

FMCSA utilizes the MAIS translator[10], developed by NHTSA, to convert crashes and injuries from the KABCO scale to the MAIS scale. The number of crashes on the KABCO scale is multiplied by the MAIS translator to estimate the number of individual crashes by MAIS level. FMCSA then applies the same process to injured persons, translating injuries from the KABCO scale to the MAIS scale.

To calculate the total per person-unit cost of a crash, FMCSA combines the economic injury costs and the QALY costs.

- Injury Economic Costs: Costs derived from the NHTSA report. The unit costs were adjusted for inflation. These include medical expenses, lost productivity, legal costs, and other financial losses resulting from a crash.
- QALY Costs: Derived from DOT's VSL guidance and the NHTSA report, which provides an estimate of the disutility factor for each MAIS level, valued as a fraction of the VSL. For fatalities, costs are assessed using DOT's full VSL estimate.

Table 2: Disutility Factors for MAIS Scale[11]

Severity	Fraction of VSL
MAIS 6	1
MAIS 5	0.593
MAIS 4	0.266
MAIS 3	0.105
MAIS 2	0.047
MAIS 1	0.003
MAIS 0	0

FMCSA computes the total person injury costs for each MAIS level by multiplying the person-unit crash costs and the number of injuries sustained in all crashes categorized by respective MAIS levels. FMCSA then divides the resulting total person injury costs for fatal, injury, and non-injury crashes (also known as PDO crashes) by the number of crashes in each respective injury severity category to estimate the total person-unit crash cost for fatal (MAIS 6), injury (MAIS 1-5), and PDO crashes (MAIS 0). Total person-unit crash costs include NHTSA economic and QALY costs and are estimated at the per injured person level, while excluding non-injury economic costs, which are calculated per crash.

Non-injury economic costs include costs related to delays and property damage. FMCSA deviates from the NHTSA approach and bases non-injury economic crash cost estimates on the 2013 report, *Delay and Environmental Costs of Truck Crashes*, due to its focus on large truck

[10] Wang, J.-S. (2023, April). KABCO-to-MAIS translators - 2022 update (Report No. DOT HS 813 420). National Highway Traffic Safety Administration. Available at: https://crashstats.nhtsa.dot.gov/Api/Public/Publication/813420

[11] Note that the methodology uses revised factors of Table 2 of Departmental Guidance on Treatment of the Value of Preventing Fatalities and Injuries in Preparing Economic Analyses, March 2021. Available at: https://www.transportation.gov/sites/dot.gov/files/2021-03/DOT%20VSL%20Guidance%20-%202021%20Update.pdf

and bus crashes.[12] FMCSA is working on a study to update the non-injury costs related to delay, emissions, and property damages.

FMCSA utilizes the per-unit fatal crash cost of congestion for MAIS 6 crashes, the per-unit injury crash cost of congestion for MAIS 1-5 crashes, and the per-unit PDO crash cost of congestion for MAIS 0 crashes. FMCSA adopts the mean property damage crash cost from the 2013 report representing costs associated with property damages, irrespective of crash severity. Finally, FMCSA sums up the person-unit cost per crash and the congestion and property damage cost per crash, resulting in a comprehensive cost of a fatal crash, injury crash, and non-injury crash. Although FMCSA calculates comprehensive crash costs by crash type (non-injury, injury, and fatal crash), this methodology can provide a societal crash cost estimate for each MAIS level.

The table below shows the comprehensive cost estimate of a bus crash, a large truck crash, and a weighted average CMV crash cost, including both vehicle types.

Table 3: Cost per Crash in 2023 Dollars

Crash Type	Bus	Large Trucks	CMV* (Weighted Average)
Cost per Non-Injury Crash	$48,176	$49,398	$49,261
Cost per Injury Crash	$383,569	$326,810	$330,946
Cost per Fatal Crash	$15,460,033	$15,230,414	$15,216,588

Note: While some vehicles classified as large trucks or buses are not CMVs, this analysis does not distinguish between those vehicles due to the difficulty in authoritatively determining whether a vehicle is being used for commercial purposes.

[12] Hagemann, Garrett, et al. *Delay and Environmental Costs of Truck Crashes*, March 2013. Available at: https://rosap.ntl.bts.gov/view/dot/10074

Summary

The methodology involves a six-step process to calculate comprehensive costs for CMV crashes. This includes assessing crash data on the KABCO scale, converting it to the MAIS scale, determining economic and QALY costs for each severity level, calculating total costs for non-injuries, injuries, and fatalities, and then computing unit costs by dividing the total by the number of crashes. Finally, non-injury costs are added to each injury severity level to determine the comprehensive cost of crashes.

Step 1: Ascertain the number of crashes and number of non-injuries, injuries, and fatalities on the KABCO scale

Step 2: Translate the crashes, non-injuries, injuries, and fatalities into the MAIS scale

Step 3: Add economic costs of injuries and QALY costs for the respective MAIS level

Step 4: Multiply the number of non-injuries (MAIS 0), injuries (MAIS 1-5), and fatalities (MAIS 6) by the costs in step 3 to come up with total person economic costs + QALY costs

Step 5: Divide the total person economic costs + QALY costs by the number of crashes to come up with a unit cost for each injury severity level

Step 6: Add the non-injury costs (congestion and property damage costs) to the unit cost for each injury severity level to compute comprehensive costs for non-injury, injury, and fatal crash