

Efficiency of Motor Carrier Interventions Final Report



U.S. Department of Transportation
Federal Motor Carrier Safety Administration

June 2020

FOREWORD

This report measures the efficiency of Federal Motor Carrier Safety Administration (FMCSA) investigations, measured in terms of *crashes and injuries prevented per dollar spent*, and in *lives saved per dollar spent*. It combines existing agency estimates of benefits obtained from motor carrier interventions (measured in terms of crashes prevented, injuries prevented, and lives saved) with cost data obtained from the agency's Investigation Cost Survey. to provide estimates of crashes prevented, injuries prevented, and lives saved per dollar spent in fiscal year 2016.

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Technical Report Documentation Page

1. Report No. FMCSA-RRA-20-002		2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle Efficiency of Motor Carrier Interventions				5. Report Date June 2020	
				6. Performing Organization Code	
7. Author(s) Gruberg, Richard				8. Performing Organization Report No.	
9. Performing Organization Name and Address Federal Motor Carrier Safety Administration 1200 New Jersey Avenue, Washington D.C. 20590				10. Work Unit No. (TRAIS)	
				11. Contract or Grant No. N/A	
12. Sponsoring Agency Name and Address U.S. Department of Transportation Federal Motor Carrier Safety Administration Office of Analysis, Research, and Technology 1200 New Jersey Ave. SE Washington, DC 20590				13. Type of Report and Period Covered Final Report, May 2018–October 2019	
				14. Sponsoring Agency Code FMCSA	
15. Supplementary Notes None					
16. Abstract The Carrier Intervention Effectiveness Model (CIEM) provides the Federal Motor Carrier Safety Administration (FMCSA) with tools to measure the safety benefits produced by interventions. The CIEM does not, however, measure the efficiency of these interventions, in terms of benefits derived per agency dollar spent. This report combines existing CIEM results with recent data from the agency's 2018 Investigation Cost Survey to provide such estimates.					
17. Key Words Motor carrier interventions, safety benefits, efficiency				18. Distribution Statement No restrictions	
19. Security Classif. (of this report) Unclassified		20. Security Classif. (of this page) Unclassified		21. No. of Pages 11	
				22. Price	

SI* (MODERN METRIC) CONVERSION FACTORS

Approximate Conversions to SI Units				
Symbol	When You Know	Multiply By	To Find	Symbol
Length				
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
Area				
in ²	square inches	645.2	square millimeters	mm ²
ft ²	square feet	0.093	square meters	m ²
yd ²	square yards	0.836	square meters	m ²
ac	Acres	0.405	hectares	ha
mi ²	square miles	2.59	square kilometers	km ²
Volume (volumes greater than 1,000L shall be shown in m³)				
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft ³	cubic feet	0.028	cubic meters	m ³
yd ³	cubic yards	0.765	cubic meters	m ³
Mass				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2,000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
Temperature (exact degrees)				
°F	Fahrenheit	5(F-32)/9 or (F-32)/1.8	Celsius	°C
Illumination				
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m ²	cd/m ²
Force and Pressure or Stress				
lbf	poundforce	4.45	newtons	N
lbf/in ²	poundforce per square inch	6.89	kilopascals	kPa
Approximate Conversions from SI Units				
Symbol	When You Know	Multiply By	To Find	Symbol
Length				
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
Area				
mm ²	square millimeters	0.0016	square inches	in ²
m ²	square meters	10.764	square feet	ft ²
m ²	square meters	1.195	square yards	yd ²
Ha	hectares	2.47	acres	ac
km ²	square kilometers	0.386	square miles	mi ²
Volume				
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m ³	cubic meters	35.314	cubic feet	ft ³
m ³	cubic meters	1.307	cubic yards	yd ³
Mass				
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2,000 lb)	T
Temperature (exact degrees)				
°C	Celsius	1.8c+32	Fahrenheit	°F
Illumination				
lx	lux	0.0929	foot-candles	fc
cd/m ²	candela/m ²	0.2919	foot-Lamberts	fl
Force and Pressure or Stress				
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in ²

* SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380. (Revised March 2003, Section 508-accessible version September 2009.)

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LIST OF ACRONYMS, ABBREVIATIONS, AND SYMBOLS

Acronym	Definition
CIEM	Carrier Intervention Effectiveness Model
CMV	commercial motor vehicle
FMCSA	Federal Motor Carrier Safety Administration
FMCSR	Federal Motor Carrier Safety Regulation
FY	fiscal year
GS	General Schedule
MCMIS	Motor Carrier Management Information System
MCSAP	Motor Carrier Safety Assistance Program
PA	program analyst
SI	safety investigator
USDOT	U.S. Department of Transportation

EXECUTIVE SUMMARY

STUDY PURPOSE

The Carrier Intervention Effectiveness Model (CIEM) provides the Federal Motor Carrier Safety Administration (FMCSA) with tools to measure the safety benefits produced by interventions. The CIEM, however, does not measure efficiency, in terms of benefits derived per agency dollar spent. This report combines existing CIEM results with cost data obtained from the agency's 2018 Investigation Cost Survey to provide such estimates.

PROCESS

The analysis draws from the Investigation Cost Survey conducted in 2018, which provides a basis for estimating cost per intervention performed. Coupled with data from the CIEM, the information allows for the calculation of expenditure per crash or injury prevented or life saved, broken out by intervention type.

STUDY FINDINGS

The study produced efficiency estimates for two intervention types: on-site comprehensive investigations and on-site focused investigations.

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1. INTRODUCTION

The Federal Motor Carrier Safety Administration (FMCSA) performs interventions on motor carriers with high crash rates or a history noncompliance with agency regulations (based on data, in large part, from roadside inspections). The safety benefits accrued by these interventions are estimated by the agency's Carrier Intervention Effectiveness Model (CIEM). The CIEM estimates these benefits by assessing the overall change in crash rates experienced by these motor carriers, based on the 1-year period prior to the intervention and the 1-year period after the intervention. Safety benefits generated from the model are expressed in terms of estimated crashes and injuries prevented, and in estimated lives saved. The agency produces these estimates annually for all interventions performed during the fiscal year (FY). Beginning with model estimates for FY 2016, the CIEM also produces more granular estimates of annual safety benefits associated with the various types of investigations performed during the year.

Estimates from the CIEM provide the agency with a measure of the effectiveness of motor carrier interventions, but the model does not account for the costs associated with conducting them. Hence, the CIEM does not address the question of cost efficiency for these investigations. Information on the cost of conducting various types of agency investigations is now available from FMCSA's Investigation Cost Survey, conducted during the summer of 2018. Combining this cost information with results from the CIEM, allows one to estimate the efficiency of the various types of intervention, in terms of crashes and injuries prevented per dollar spent, as well as lives saved per dollar spent.

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2. CALCULATING COSTS ASSOCIATED WITH CONDUCTING INVESTIGATIONS

FMCSA conducted its Investigation Cost Survey between May and July of 2018. The survey collected data related to costs incurred by FMCSA safety investigators (SIs) and program analysts (PAs) when preparing for, conducting, and documenting results from on-site comprehensive, on-site focused, and offsite focused investigations of motor carriers throughout the United States.

During the study, State Division office staff entered the requested cost data into a SharePoint website, upon completing their investigation reports. These costs included preparation for the investigation; all travel costs associated with the investigation (lodging, meals, and transportation costs including vehicle depreciation); and labor costs incurred while en route, labor costs related to conducting the investigation, and labor costs related to documenting and uploading the findings of the investigation into the agency's Motor Carrier Management Information System (MCMIS). Appendix A provides the investigative cost information requested by FMCSA from its division offices after SIs had completed an in-scope investigation during the study period.

Converting total hours worked to dollar amounts requires making assumptions about employee wage rates. Although the Agency is privy to the wage rates of all its employees, it was neither practicable or reasonable to expect the SIs and PAs participating in the study to upload such sensitive information to the survey database. Based on discussions with agency field staff, all SIs participated in the study were assigned a pay grade level of General Schedule (GS)-12, Step 5, and all PAs were assigned a pay grade level of GS-9, Step 5, adjusted for locality. These values were considered reasonable salary estimates for the participating SIs and PAs. Wage rates values are based on the State associated with the investigator's assigned FMCSA division office, regardless of the location of the motor carrier investigation (at times, a motor carrier in one State may be investigated by an SI from another State division office, depending on a State's manpower needs and the proximity of the motor carrier's facility to each State division office).

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3. RESULTS

3.1 ESTIMATED SAFETY BENEFITS

Estimates of the safety benefits from various types of investigations during FY 2016 are presented below in Table 1. Because a carrier may receive more than one type of investigation during a given fiscal year, the investigation categories assigned to each motor by the CIEM are based on the first intervention received by the carrier.⁽¹⁾ Although the CIEM estimated no safety benefits associated with off-site focused investigations and non-ratable reviews conducted during FY 2016, it should be noted that only 122 off-site focused investigations and 506 non-ratable reviews were conducted as first interventions during that period. Hence, these two investigation types may also generate safety benefits, but measuring these benefits may require a larger sample size.⁽²⁾

Table 1. Estimated crashes prevented, injuries prevented, and lives saved, by intervention type, FY2016.

Investigation/Intervention Type	All Carriers Receiving Interventions: Number of Carriers	Crashes Prevented	Injuries Prevented	Lives Saved
On-site focused	6,548	1,289	710	37
On-site comprehensive	5,470	1,014	559	29
Off-site focused	122	0	0	0
Non-ratable review	506	0	0	0
Warning letter	30,377	5,364	2,955	155

Both on-site focused investigations and on-site comprehensive investigations generated approximately the same of safety benefits per investigation: roughly one crash prevented per five investigations conducted. These findings do not, however, necessarily speak to the relative effectiveness of these two types of individual intervention types, as the safety profile of a typical carrier receiving an on-site focused investigation may drastically differ from the safety profile of a carrier receiving an on-site comprehensive investigation, and carriers with different safety profiles may respond differently to particular intervention types. Thus, one can only state that, for those carriers currently receiving these two types of reviews, the resultant safety benefits appear similar.

One should also bear in mind that the CIEM cannot control for the possibility of carriers experiencing “regression to the mean” during the post-intervention period.⁽³⁾ If the average size

¹ Although this procedure creates some degree of confounding among the intervention types in terms of safety benefits, the number of carriers receiving more than one type of intervention during a given fiscal year is very small (less than five percent) and, consequently, the impact of this confounding is considered minimal. These carriers are retained in the treatment group, since removing them from the estimation process could introduce an upward bias in the estimated safety benefits for any given intervention type, given that a carrier generally receives a second intervention only when the carrier continues to underperform in some manner.

²For example, if one crash were prevented for every 150 offsite focused investigations conducted, on average no safety benefits would be observed from a sample of 122 carriers receiving such reviews.

³ This refers to the notion that crashes are rare events and, due to this fact, many carriers, particularly small ones, may experience a decrease in their crash rates in the post-intervention period, simply by virtue of the fact that their crash experience in the pre-intervention period may have been an

of a carrier receiving one type of intervention is small relative to those receiving another type of investigation, then carriers receiving the first intervention type will be more likely to be affected by this phenomenon. In such instances, the estimated safety benefits accrued for these carriers, as measured by the CIEM, may have an upward bias.

3.2 AVERAGE COST OF INVESTIGATIONS

Average and median cost per investigation for three types of motor carrier interventions are available from the FMCSA Investigation Cost Survey and are presented below in Table 2. Median costs represent the midpoint value across all motor carrier interventions used in the analysis (that is, 50 percent of the carriers had a lower cost, and 50 percent had a higher cost). The median cost value, if significantly different from average cost, may indicate that the calculated average cost was heavily impacted by one or two investigations with unusually high (or low) costs.⁽⁴⁾ The lower level of precision associated with the average cost estimate for off-site investigations, as reflected in a wider confidence interval half-width (21 percent), stems from the limited amount of data collected in the survey for this type of investigation (36 cases).

Table 2. Average and median costs associated with individual intervention types (in U.S. dollars).

Investigation Type	Cases	Average Cost	Half-width for 95% Confidence Interval	Median Cost
On-site focused	869	\$2,032.50	+/- 83.09 (4%)	\$1,817.75
On-site comprehensive	410	\$2,540.24	+/- 150.08 (6%)	\$2,231.28
Offsite	36	\$1,145.29	+/- 236.72 (21%)	\$1,018.55

Combining the number of carriers receiving each type of investigation from Table 1, with the estimated average costs⁽⁵⁾ associated with conducting on-site focused, on-site comprehensive, and off-site focused investigations from Table 2,⁽⁶⁾ gives the estimated total costs incurred by the agency for conducting these three types of investigations during FY 2016, as shown in Table 3.

Table 3. Estimated total cost incurred for on-site focused, on-site comprehensive, and off-site focused investigations, FY 2016.

Investigation/Intervention Type	All Carriers Receiving Interventions: Number of Carriers	Estimated Total Cost Incurred
On-site focused	6,548	\$13,308,810
On-site comprehensive	5,470	\$13,895,113
Off-site focused	122	\$139,725

anomaly. In such instances, the carrier may simply revert to a pattern of behavior (in terms of crashes) that is historically more typical for them during the post-intervention assessment period.

⁴ Thus, for example, if 9 interventions each had a total cost of \$1,000, and 1 intervention had a total cost of \$1,000,000, the average cost, based on these 10 observations would be \$100,900. The median cost, however, would be \$1,000.

⁵ Average costs must be used here, and not median costs, because the average cost, multiplied by the population size, represents an unbiased estimate of a total cost, according to statistical theory. This is not true in the case of median values.

⁶ These are the only types of investigations for which cost data were collected in the survey.

Dividing these costs by the total estimated crashes prevented, injuries prevented, and lives saved from Table 1 gives an estimate of the total dollars spent per crash and injury prevented, and per life saved. These estimates are presented below in Table 4.

Table 4. Estimated cost efficiency of intervention types: dollars spent per crashes prevented, injuries prevented, and lives saved, by intervention type, FY2016.

Investigation Type	Carriers Receiving Intervention	Dollars Spent per Crash Prevented	Dollars Spent per Injury Prevented	Dollars Spent per Life Saved
On-site focused	6,548	\$10,325	\$18,745	\$357,698
On-site comprehensive	5,470	\$13,703	\$24,857	\$479,142
Off-site focused	122	N/A*	N/A*	N/A*

*Zero safety benefit (as indicated in Table 1) results in division by zero for this table cell.

The table indicates that on-site focused investigations generated more benefits per dollar spent than did on-site comprehensive investigations. Because the accrued safety benefits (in terms of crashes and injuries prevented, and lives saved) from the 122 off-site focused investigations conducted during FY 2016 were estimated to be zero (see Table 1), the rate of dollar expenditure per crash and injury prevented, and per life saved, could not be estimated for this intervention type.

As with the effectiveness of the various intervention types, these results do not necessarily speak to the relative cost efficiency of the individual intervention types, since the safety profile of a typical carrier receiving one type of intervention may drastically differ from the safety profile of a carrier receiving another type, and carriers with different safety profiles may respond differently to each intervention type. One can state only that for those carriers currently receiving these two types of reviews, the cost efficiency achieved, in terms of dollars spent to achieve the safety benefits, is estimated to be higher for on-site focused reviews than for on-site focused reviews.

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4. CONCLUSION

This report documents the methodology used and the results obtained, when estimating the efficiency of on-site focused and on-site comprehensive investigations, measured in terms of *crashes and injuries prevented per dollar spent*, and in *lives saved per dollar spent*. The approach used combines data from the CIEM (pertaining to safety benefits achieved from various intervention types) with cost data obtained from the agency's Investigation Cost Survey.

Safety benefits associated with particular types of interventions (in terms of crashes and injuries prevented, and lives saved) were introduced into the CIEM, beginning with model estimates for FY 2016. For that year, the CIEM evaluated safety benefits obtained from on-site focused, on-site comprehensive, off-site focused, and non-ratable investigations, as well as from warning letters. The model found positive safety benefits for on-site focused investigations, on-site comprehensive investigations, and warning letters.

Investigation cost data are available from the Investigation Cost Survey, but only for on-site focused, on-site comprehensive, and off-site investigations. Since both positive safety benefits and cost data are needed to calculate a cost efficiency metric, a cost efficiency metric could only be estimated for on-site focused and on-site comprehensive investigations. This analysis suggests that the agency spent an average of \$10,325 on investigation-related costs per crash prevented from on-site focused investigations, and an average of \$13,703 in investigation related costs per crash prevented from on-site comprehensive investigations. In terms of lives saved, the analysis suggests that the agency spent an average of \$357,698 in investigation-related costs per life saved from on-site focused investigations, and an average of \$479,142 in investigation related costs per life saved from on-site comprehensive investigations.

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APPENDIX A: COST INFORMATION COLLECTED FROM INVESTIGATIONS CONDUCTED BY FMCSA STAFF

1. #SIs involved – number of SIs that were involved in the investigation. When greater than one, the contribution of those SIs should be totaled and entered into the time and cost fields below.
2. SI investigation labor hours (to the nearest ½ hr.) – this includes time spent in preparatory work prior to contacting the carrier, time spent with the carrier representative(s) and reviewing carrier records while conducting the investigation, and time spent completing the investigation documentation, including Part C, up to the time the report is uploaded.⁷
3. PA labor hours (to the nearest ½ hr.) – this includes time spent in support of the investigation from pre-investigation through report upload. For example, preparatory work and the collection and review of carrier records and documentation.⁸
4. Travel time (to the nearest ¼ hr.) – this includes travel time to and from the carrier’s facility for on-site investigations,⁹ air travel time (if any), travel to and from airport to lodging (if any).
5. Borderless investigation – select “Yes” if the SI is performing this investigation in a different State than the State of the SI’s division office. “No,” otherwise.
6. Government miles – this includes mileage, if any, when a Government vehicle is used for travel in connection with an on-site investigation.¹⁰
7. Voucher expenses – this includes travel voucher expenses for such things as airfare, privately owned vehicle (POV) use, lodging, etc., in connection with any on-site investigation.
8. Other expenses – this includes any other expenses directly related to the investigation, such as tolls not included in a travel voucher, postage, UPS fees, etc.

⁷ Does not include any hours related to enforcement activity after the investigation report is uploaded.

⁸ Does not include any hours related to enforcement activity after the investigation report is uploaded.

⁹ If there are multiple trips to/from a carrier for an on-site investigation, includes the total travel time for all trips.

¹⁰ If there are multiple trips to/from a carrier for an on-site investigation, includes total government miles traveled for all trips.