

The vision of the Office of Motor Carriers is to help move people, goods, and commercial motor vehicles on our Nation's highways in the most efficient, economical, and crash-free manner possible. The OMC research and technology program focuses on improving safety in interstate commercial motor vehicle operations and serves a trucking and motor coach industry that carries more than 40 percent of all intercity freight.

Studies are conducted in the following areas: commercial driver human factors, health, and performance needs; new and emerging driver and vehicle technologies; safety-related data collection and analysis needs; and performance-based changes to the Federal Motor Carrier Safety Regulations.

The OMC's information analysis research activities support the collection, analysis, application, and dissemination of motor carrier industry safety data.



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Risk-based Evaluation of Commercial Motor Vehicle Roadside Violations: Process and Results

Introduction

Risk management is the process by which an organization identifies and understands sources of risk, makes decisions on how to allocate resources to address these risks, and confirms the validity of these decisions using performance results. The Federal Highway Administration's Office of Motor Carriers (OMC) is investigating the use of risk management and risk-based decision-making to enhance agency efforts to promote the safe operation of commercial motor vehicles (CMVs).

One way to apply this approach is in the risk-based differentiation of the vehicle, driver, and hazardous materials (HM) violations found during roadside inspections of CMVs. By differentiating between violations that present a high likelihood of being contributing factors to a crash or HM incident and those violations that are "lower risk," OMC can focus government safety and inspection resources on controlling violations that present the highest risk of crash, injury, and fatality. As a part of its risk management efforts, OMC sponsored a risk-based evaluation of roadside violations; this tech brief summarizes the study final report.

Purpose

This evaluation sought to categorize each CMV roadside violation according to the potential risk posed by the conditions covered by the violation. Risk was defined as the likelihood that a violation will be a contributing factor to a crash or HM release or exposure.

The resulting categorization was designed to distinguish among violations that contribute to a significant, immediate risk of a crash or HM incident; violations that pose less significant risks; and violations that pose little or no risk. This categorization provides information that may:

- Support OMC decisions regarding allocation of enforcement resources;
- Support potential changes to vehicle and driver out-of-service criteria; and
- Provide a basis for numerical weighting of CMV roadside violations in carrier evaluation systems.

Methodology

The report authors developed a risk-based categorization of CMV roadside violations through a synthesis of expert knowledge and judgment regarding the risks associated with different roadside violations. Risk categories were defined according to the potential consequences of the driver, vehicle, and HM violations, and the likelihood that the



Table 1.
Risk-Based Categorization of Roadside Violations: Driver and Vehicle

Risk Categorization	Number of Violations		
	All	Out of Service	Non-Out of Service
Violation is <i>potential single, immediate factor</i> leading to crash or injuries/fatalities given crash.	24	18	6
Violation is <i>potential single, eventual factor</i> leading to crash or injuries/fatalities given crash.	71	40	31
Violation is <i>potential contributing factor</i> in crash or injuries/fatalities given crash.	87	44	43
Violation is <i>unlikely potential contributing factor</i> in crash or injuries/fatalities given crash.	20	1	19
Violation has <i>little or no connection to crashes</i> or prevention of injuries/fatalities.	21	0	21

Note: Eight vehicle and driver violations (four out-of-service violations) were determined to be duplicative of other violations or defined too vaguely for valid evaluation. These violations were not categorized.

potential consequences would occur. There were five consequences considered for this evaluation:

- Motor vehicle crash
- Injuries and fatalities as a result of a crash
- Release or spill of hazardous materials, or the exposure of hazardous materials to the public or emergency response personnel
- Motor vehicle crash *and* the release, spill, or exposure of hazardous materials
- No crash or hazardous material release, spill, or exposure

A qualitative “likelihood scale” was used to stratify the risk categories, representing different orders of magnitude for the likelihood that the defined consequences would occur, given the existence of a violation.

Panels with expertise in CMV safety and representing diverse viewpoints, were convened to evaluate and categorize violations for their potential risk. The panels included representatives from the industry, state and local enforcement agencies, and insurance companies along with representatives from research organizations, insurance companies and insurance industry professional organizations, and public safety advocacy groups. Each panel was asked to categorize more than 500 driver, vehicle, and HM violations identified by CMV roadside inspection software, ASPEN. All panel members evaluated the 231 driver and vehicle violations identified in ASPEN. Only the first

panel evaluated the 333 HM violations in ASPEN.

Within each panel, most violations were assigned to risk-based categories by group consensus. When a consensus was not reached, the categorization was based on the majority judgment within the panel. After the panel meetings, the evaluations by each of the panels were compared. In those cases in which the evaluations differed, a categorization was recommended that was consistent with the risk category consequences and likelihood definitions.

Results

The results of the panel evaluations are shown in tables 1 and 2. **Table 1** gives the recommended risk-based characterization of the 231 driver and vehicle violations and the number of violations in each category; **table 2** presents the recommended categorization of the 333 HM violations and the number in each category.

Driver and Vehicle Violations

The risk-based categorization of driver and vehicle violations is primarily defined according to the significance of the violation as a potential contributing factor in a crash. The results summarized in table 1 lead to the following observations:

The majority of driver or vehicle violations (182 violations/82 percent) were considered potentially significant primary or contributing factors in crashes, including:

- Inoperable head lamps

Table 2.
Risk-Based Categorization of Roadside Violations: Hazardous Materials

Risk Categorization	Number of Violations		
	All	Out of Service	Non-Out of Service
Violation is <i>potential single, immediate factor</i> leading to hazardous materials release or exposure.	13	1	12
Violation is <i>potential single, eventual factor</i> leading to hazardous materials release or exposure.	57	5	52
Violation is <i>potential contributing factor</i> in hazardous materials release or exposure.	118	10	108
Violation is <i>unlikely potential contributing factor</i> in hazardous materials release or exposure.	54	0	54
Violation has <i>little or no connection</i> to hazardous materials release or exposure.	83	3	80

Note: Eight hazardous materials violations (two out-of-service violations) were determined to be duplicative of other violations or defined too vaguely for valid evaluation. These violations were not categorized.

- Inoperative/defective brakes
- Operating a CMV without a CDL
- Improper or no load securement
- Power steering violations

The remaining 18 percent of violations (41 violations) were considered insignificant as potential contributing factors to crashes, such as:

- Driver record of duty status not current
- Unauthorized passenger on board
- Inadequate floor condition
- Damaged or discolored windshield
- Tampering with bus heater

Among this group, 21 violations (9 percent of all violations) were considered to have no connection to crashes or preventing injuries in the event of a crash.

The majority of driver or vehicle out-of-service violations (58 violations/56 percent) were considered potential factors in a crash with no additional failures or occurrences needed. Within this group, most violations were not considered an imminent risk of leading to a crash. The remaining 44 percent of driver or vehicle out-of-service violations (45 violations) were not considered potential factors leading to crashes unless occurring with additional failures, deterioration, or occurrences. These violations were judged to pose a

lower likelihood of leading to a crash than 31 percent of violations that were not out-of-service violations.

Hazardous Materials Violations

The categorization of hazardous materials violations is defined according to the significance of the violation in potentially contributing to the release or spill of HM, or the exposure of the public or emergency response personnel to HM.

The majority of HM violations (188 violations/58 percent) were considered potentially significant, primary contributing factors in HM releases or exposure; these included:

- Release of HM from package
- Unauthorized packaging
- Smoking while loading or unloading
- Package not secure in vehicle
- Vehicle not placarded as required

The remaining 137 HM violations (42 percent) were not considered likely contributing factors to releases or exposure, including the following:

- Total quantity not listed
- Failed to display duplicate label as required
- Description is not in proper sequence
- Bulk package marking is incorrect size

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The study final report is
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A significant number of HM violations (83 violations/ 26 percent) were considered to have little or no effect on the potential for a release or exposure. The majority of HM out-of-service violations (13 violations/ 68 percent) were not considered to be potential factors in releases or exposures unless they occur in conjunction with additional failures, deterioration, or other events. These violations were considered to be less likely to lead to the release or exposure of HM than 21 percent of violations that are not out-of-service violations. Three HM out-of-service violations were judged to have little or no effect on the potential for release or exposure.

Conclusions

The results of the roadside evaluation and the risk-based categorization of CMV violations indicate significant differences in the level of risk associated with different violations and provide the basis for several conclusions.

The categorization of CMV violations provides information to assist enforcement personnel in setting priorities among items to inspect. This evaluation suggests that violations considered "low-risk" should be examined to assess if these violations should remain important parts of the *Federal Motor Carrier Safety Regulations (FMCSR)* or *Hazardous Materials Regulations (HMR)*. In addition, many violations represent a broad range of risk levels, depending upon the severity of the conditions that warrant the violation. These violations could be broken down further; the conditions posing different levels of risk could be evaluated and categorized separately. Researchers also recommend that out-of-service violations that were judged not to involve significant immediate risks be examined further to determine if they should remain as part of the out-of-service criteria.

While OMC is a data-driven organization, the lack of detailed crash causation data forces the agency to rely on its knowledge and logic, rather than directly applicable data on crashes associated with specific roadside violations. The evaluation of crash risk requires both science and judgment. Researchers believe that the use of expert knowledge and judgment in the risk-based categorization of CMV violations constitutes a resource for making future decisions about changes to the FMCSRs, HMRs, and out-of-service criteria. These changes could lead to an efficient use of scarce regulatory and enforcement resources, while minimizing the risk of crashes and HM incidents.

Finally, the risk-based categorization of roadside violations may provide a basis for assigning numerical weights to violations as part of carrier evaluation and selection systems. The assigned weight for each violation would be proportional to the level of risk represented by the category assigned in the evaluation process. The risk categories defined for violations would represent decreasing orders of magnitude of risk.

Risk management provides OMC with a process by which agency resources may be rationally allocated so that they focus on the most important issues affecting industry performance. This approach could help to assure the optimal use of agency resources by potentially providing a logical, structured, and defensible mechanism by which OMC can evaluate the relative significance of each candidate activity in relation to the maximum national safety benefit it supports. OMC is continuing to explore ways in which risk management can be used to improve agency performance.

Currently OMC is investigating three areas of risk management application: agenda management; planning and resource allocation; and supporting changes to the FMCSRs and HMRs.