U.S. DEPARTMENT OF TRANSPORTATION
OFFICE OF INSPECTOR GENERAL

FMCSA's Plan Addresses
Recommendations on Prioritizing
Safety Interventions but Lacks
Implementation Details

FMCSA

FMCSA's Plan Addresses Recommendations on Prioritizing Safety Interventions but Lacks Implementation Details

Mandated by the Fixing America's Surface Transportation Act of 2015

Federal Motor Carrier Safety Administration | ST2019084 | September 25, 2019

What We Looked At

The Fixing America's Surface Transportation Act of 2015 (FAST Act) directed the Federal Motor Carrier Safety Administration (FMCSA) to commission the National Academy of Sciences (NAS) to evaluate the methodology and data it uses to identify carriers that are not fit to operate commercial motor vehicles, and develop a corrective action plan in response. The FAST Act also directed our office to assess FMCSA's plan and its responses to our prior recommendations, as well as those from NAS and the Government Accountability Office (GAO). Accordingly, our audit objectives were to (1) assess the extent to which FMCSA's corrective action plan addresses the NAS recommendations and relevant OIG and GAO recommendations and (2) identify challenges FMCSA may face when implementing the corrective action plan.

What We Found

While FMCSA's corrective action plan addresses motor carrier safety interventions, it lacks implementation details for improving transparency and its assessment of carrier safety rankings. For example, in response to recommendations from NAS and GAO, the Agency is testing an Item Response Theory (IRT) statistical model to gauge how it prioritizes motor carrier safety interventions. Regarding the NAS recommendation on collecting more accurate and diverse types of data, FMCSA determined that much of the data either do not exist. As a result, FMCSA no longer plans to collect additional data. Similarly, the plan describes putting datasets on a publicly available website but does not discuss making them user-friendly, or outline costs and implementation steps—hindering FMCSA's efforts to make its data, safety measures, and rankings more transparent. Finally, the complexity of the IRT model may make implementation and public outreach difficult.

Our Recommendations

We made two recommendations to improve the corrective action plan FMCSA developed in response to the NAS study. FMCSA partially concurred with both recommendations. We consider the recommendations resolved but open pending completion of planned actions.
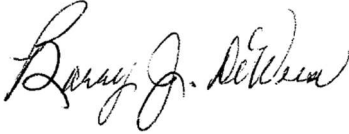

Contents

Memorandum

Date: September 25, 2019

Subject: ACTION: FMCSA's Plan Addresses Recommendations on Prioritizing
                 Safety Interventions but Lacks Implementation Details | Report No.
                 ST2019084

From: Barry J. DeWeese
                 Assistant Inspector General for Surface Transportation A

To: Federal Motor Carrier Safety Administrator

The commercial motor carrier industry plays a vital role in the Nation's economy; in 2017, for example, the industry carried nearly 65 percent of all domestic freight weight in the United States.[1] The Federal Motor Carrier Safety Administration (FMCSA) reports that the number of large trucks and buses on the roads has increased in recent years, as have the safety issues related to these vehicles. According to FMCSA data, these fatalities have consistently risen in recent years—from 4,455 fatalities in 2013 to 4,949 in 2018, an 11-percent increase.[2]

FMCSA utilizes a data-driven safety compliance and enforcement program called the Compliance, Safety, and Accountability (CSA) program. This program consists of the Safety Measurement System (SMS), an interventions process,[3] and safety fitness determinations that identify carriers that are not fit to operate commercial motor vehicles. Congress—through the Fixing America's Surface Transportation Act of 2015 (FAST Act)[4]—directed FMCSA to commission the National Academy of Sciences

---

[1] Department of Transportation, Bureau of Transportation Statistics and Federal Highway Administration, *Freight Analysis Framework*, version 4.5 (2019).
[2] Based on FMCSA data as of June 30, 2019. States are expected to report crash data to FMCSA within 90 days of the crash. Data are considered preliminary for 22 months to allow for changes, so these numbers may understate the increase in fatalities. The National Highway Traffic Safety Administration (NHTSA) has finalized its 2017 fatality data and shows a 20.1-percent increase in large truck and bus crashes during the same period, with a 12.6-percent increase in fatalities per million vehicle miles traveled (VMT).
[3] SMS is a prioritization tool that allows FMCSA to identify motor carriers that warrant intervention due to safety compliance problems.
[4] Pub. L. 114–94, § 5221.

(NAS) to study[5] the CSA methodology for identifying problem motor carriers and evaluate the SMS data. The FAST Act also required (1) FMCSA to develop a corrective action plan in response to the NAS study and (2) the Office of Inspector General (OIG) to assess that plan in a report to Congress,[6] particularly how well FMCSA responded to recommendations issued by NAS, OIG, and the Government Accountability Office (GAO). Accordingly, our audit objectives were to (1) assess the extent to which FMCSA's corrective action plan addresses the NAS recommendations and relevant OIG and GAO recommendations and (2) identify challenges FMCSA may face when implementing the corrective action plan.

We conducted our work from October 2018 through July 2019 in accordance with generally accepted Government auditing standards. To assess whether FMCSA's corrective action plan addresses the NAS recommendations, we sought to determine whether the plan incorporated cost estimates and implementation steps with benchmarks; and programmatic reforms, revisions to regulations, or proposals for legislation as required by the FAST Act. We also reviewed applicable Federal laws, regulations, and academic literature, as well as relevant OIG and GAO reports. Exhibit A details our scope and methodology; exhibit B lists the entities we visited; and exhibit C is a list of the acronyms in this report. Exhibit D illustrates the operational model for the CSA program, and exhibit E lists the recommendations from the NAS study.

We appreciate the courtesies and cooperation of Department of Transportation (DOT) representatives during this audit. If you have any questions concerning this report, please call me at (202) 366-5630 or Kerry R. Barras, Program Director, at (817) 978-3318.

cc: The Secretary
        DOT Audit Liaison, M-1
        FMCSA Audit Liaison, MCPRS

---

[5] National Academies of Sciences, Engineering, and Medicine, *Improving Motor Carrier Safety Measurement* (Washington, DC: The National Academies Press, 2017).
[6] Specifically, the Senate Committee on Commerce, Science, and Transportation and the House of Representatives Committee on Transportation and Infrastructure.

Background

The FAST Act requires FMCSA to create a corrective action plan to (1) respond to the deficiencies or opportunities identified in the NAS study, (2) identify the Agency's plans for addressing such deficiencies or opportunities, and (3) provide a cost estimate with respect to changes in staffing, enforcement, and data collection the Agency must make to address those deficiencies and opportunities. The FAST Act also calls for FMCSA to develop an implementation plan that provides benchmarks (timeframes for taking specific actions); and recommends programmatic reforms, revisions to regulations, or proposals for legislation.

The Agency established the CSA program to reduce crashes of large trucks and buses, as well as related fatalities and injuries, by prioritizing higher risk carriers for safety interventions. FMCSA uses the SMS algorithm to identify carriers for intervention by computing percentile rankings for each carrier in seven areas, called Behavior Analysis Safety Improvement Categories (BASIC).[7] FMCSA maintains the data it uses for SMS in its Motor Carrier Management Information System (MCMIS).[8] Carriers with percentile ranks above FMCSA thresholds may receive interventions, which range from warning letters to onsite investigations.

On June 27, 2017, NAS issued its study, *Improving Motor Carrier Safety Measurement*, and made six recommendations (summarized below[9]) to help FMCSA update its carrier prioritization methodology; improve the accuracy, completeness, and scope of its data; and enhance transparency:

- **NAS Recommendation 1**: Develop an Item Response Theory (IRT)[10] model over the next 2 years [i.e., by June 2019], and if it performs well in identifying and prioritizing motor carriers for intervention, use the IRT model to replace SMS.

- **NAS Recommendation 2**: Collaborate with States and other agencies to improve the quality of MCMIS data in support of SMS. Two specific data elements require immediate attention: carrier exposure[11] and crash data.

---

[7] BASICs group related violations into six categories: Unsafe Driving, Hours of Service Compliance, Vehicle Maintenance, Controlled Substances/Alcohol, Hazardous Materials Compliance, and Driver Fitness. The seventh BASIC is referred to as the Crash Indicator, which is a weighted crash frequency.
[8] MCMIS is an FMCSA database with inspection, crash, compliance review, safety audit, registration, and other data.
[9] See exhibit E for the full text of the NAS recommendations.
[10] An IRT model is a formal statistical model used to measure unobserved characteristics of an individual or firm.
[11] For the purposes of this report, exposure is a measure of all trips taken by a carrier's vehicles, such as the total number of VMT. NAS specifically stated that firm-level VMT is a limited measure of exposure and recommended that it be enhanced with data on the States and months in which vehicles traveled.

The current exposure data are missing with high frequency, and what are collected is likely of unsatisfactory quality.

- **NAS Recommendation 3**: Investigate ways of collecting data that will likely benefit the recommended methodology for safety assessment, including data on carrier characteristics such as driver turnover rate, type of cargo, method and level of compensation, and better information on exposure. This additional data collection will likely require additional funds for research and development of the data collection instrument.

- **NAS Recommendation 4**: Structure a user-friendly version of the MCMIS data file without personally identifiable information to facilitate its use by external parties, such as researchers and carriers. Make user-friendly computer code used to compute SMS elements [publicly] available to individuals in accordance with reproducibility and transparency guidelines.

- **NAS Recommendation 5**: Undertake a study to better understand the statistical operating characteristics of the percentile ranks to support decisions regarding the usability of public scores.

- **NAS Recommendation 6**: Given that there are good reasons for both absolute and relative measures[12] on safety performance, use both SMS percentile ranks and the SMS measures to prioritize which carriers receive alerts. Compute safety scores conditionally within groups of similar carriers, as well as unconditionally for all motor carriers.

The NAS report listed 12 specific advantages the IRT model has over SMS, such as the ability to determine the significance of different violations based on data and expert opinion (and ultimately on data alone); potentially enhance transparency of the evaluation system; account for the probability that carriers are selected for inspection(s); estimate the variability of carriers' scores and rank; and adapt to changes in safety and available safety measures over time.

---

[12] A relative measure helps push for progressively safer performance; an absolute measure requires a set standard. According to NAS, these measures also apply within an IRT framework.

Results in Brief

FMCSA's corrective action plan addresses carrier safety interventions, but lacks implementation details for improving SMS transparency and its assessment of carrier safety rankings.

FMCSA's corrective action plan addressed some, but not all, of the NAS recommendations. For example, NAS recommended that FMCSA use a statistically principled approach, such as the IRT model, as an alternative method for prioritizing carrier safety interventions. To address this recommendation, FMCSA developed and tested an IRT model to gauge its suitability, and will decide whether to adopt the IRT model by September 2020. The Agency's corrective action plan states this effort—which responds both to a NAS recommendation and an open GAO recommendation[13]—will take 2 years and an estimated $2.28 million,[14] meeting the FAST Act requirement to include costs and benchmarks. There are no open OIG recommendations related to the CSA program, including SMS or data analysis.[15] Regarding the NAS recommendation on improving the quality of carrier data, FMCSA determined that much of the data to be collected do not exist. As a result, FMCSA no longer plans to collect additional data and thus will not identify the associated costs as the FAST Act requires. Additionally, FMCSA did not fully respond to the NAS recommendations to improve SMS transparency and carrier safety rankings. The Agency's plan acknowledges there are benefits to making SMS data publicly available and includes steps to provide web-based datasets. However, FMCSA neither explained how these would be user-friendly nor included FAST Act–required estimated costs or an implementation plan. The plan also lacks details on how it would improve its assessment of motor carrier safety rankings, such as by using percentile rankings and relative and absolute measures, to help determine which carriers will receive safety alerts. FMCSA plans to address these areas once it decides whether to adopt the IRT model to prioritize carrier safety interventions. Until the Agency makes this decision, it may face delays in making its MCMIS database, safety measures, and rankings more transparent—whether it continues to rely on SMS or turns to the IRT model.

---

[13] GAO, *Modifying the Compliance, Safety, Accountability Program Would Improve the Ability to Identify High Risk Carriers* (GAO-14-114), February 2014. In the report, GAO recommended that FMCSA revise its SMS methodology to better account for limitations in comparing safety performance information across carriers.

[14] In April 2019, FMCSA informed us that the Agency anticipates making a decision regarding the IRT model in September 2019 and updated its cost estimate to $1.9 million.

[15] OIG reports and recommendations are available on our website: https://www.oig.dot.gov/.

FMCSA may face additional challenges in implementing its IRT model.

IRT's complexity may make implementation and public outreach more difficult. For instance, one obstacle to developing the proposed IRT model is acquiring highly specialized technical expertise in IRT model development. Another one is decreasing the computational burden—the time and resources needed to run the full-scale IRT model—which may prevent FMCSA from meeting its 2-year benchmark. To mitigate these challenges, Volpe worked with the NAS Standing Committee and university-based experts to give the Volpe implementation team IRT-related guidance and oversight. However, FMCSA remains concerned about its staff's ability to explain the model to the motor carrier industry and the public because the Agency does not have an in-house IRT expert. Finally, the Agency's lack of current data could affect the model's accuracy. According to FMCSA officials, efforts to obtain data are hindered by resistance from the industry and the length of time needed to update regulatory requirements. In addition, after conducting an analysis on data from the International Registration Plan (IRP), Agency officials said they do not plan to acquire additional exposure data. As a result, the Agency will not have made the NAS-recommended improvements to ensure that exposure data are accurate and complete when it evaluates the IRT model, which could limit the model's effectiveness.

We are making recommendations to help FMCSA respond to the NAS recommendations and FAST Act requirements.

FMCSA's Corrective Action Plan Addresses Carrier Safety Interventions, but Lacks Implementation Details for Improving SMS Transparency and Its Assessment of Carrier Safety Rankings

In response to the first NAS recommendation, FMCSA is developing and testing a new statistical model for prioritizing safety interventions. However, the Agency's plans for collecting higher quality and additional data—addressing the second and third NAS recommendations—are missing costs, benchmarks, and other implementation details. However, FMCSA officials do not plan to collect this additional data, which they believe do not exist or would require additional authorities to collect. FMCSA's plan to make its carrier prioritization program more transparent and improve its assessment of motor carrier safety rankings (NAS recommendations 4 and 5) does not clearly address the deficiencies and opportunities identified by NAS and is missing an implementation plan. Finally,

FMCSA does not plan to address NAS recommendation 6—regarding the use of relative and absolute safety measures—until it makes a decision on adopting the IRT model.

FMCSA Is Developing and Testing a Statistical Model for Prioritizing Carrier Safety Interventions

In its study, NAS concluded that SMS, FMCSA's current method for prioritizing carrier safety interventions, is reasonably structured and its means of identifying carriers is defendable. However, NAS added that SMS relies on ad hoc details and subject-matter expertise that was not sufficiently empirically validated. NAS recommended that FMCSA use a statistically principled model—specifically, an IRT model—as a better approach for prioritizing carrier safety interventions.

FMCSA responded to this recommendation by developing and testing an IRT model for prioritizing carrier safety interventions, work that is currently underway (see figure). The Agency's corrective action plan includes a 2-year timeframe to develop and test the IRT model for an estimated cost of $2.28 million,[16] meeting the FAST Act requirements to provide benchmarks and estimated costs. FMCSA also has identified which of its 899 violation codes to consolidate to improve the model's efficiency.[17] The Agency is conducting this work through an existing agreement with the John A. Volpe National Transportation Systems Center (Volpe)[18] and external contractor support, as well as guidance and oversight from an NAS Standing Committee and academic experts. According to Volpe,[19] the full-scale IRT model should be completed in September 2019, which is within the previously established benchmarks (see figure).

---

[16] In April 2019, FMCSA updated its cost estimate to $1.9 million.

[17] Violations are listed in the Federal Motor Carrier Safety Regulations, Title 49, Code of Federal Regulations, Part 390 (2018). FMCSA officials stated that they will not remove violation codes from the IRT model.

[18] FMCSA has a 5-year interagency agreement with Volpe, at an estimated cost of $46 million, to provide consulting and support services such as program planning and management, information systems resources, research analysis and performance metrics, and other services. The statement of work describes Volpe's role as providing expert resources to support safety studies and evaluate the validity of safety data.

[19] Volpe Project Plan, March 18, 2019.

Figure. FMCSA's Timeline for Testing the IRT Model
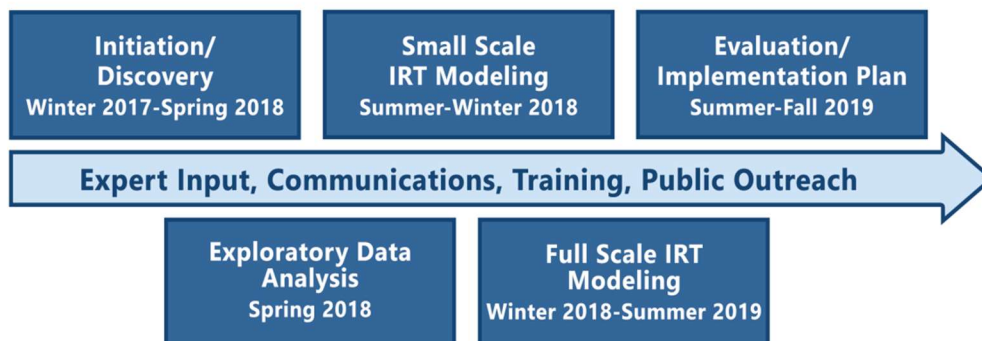
Source: FMCSA

In its corrective action plan, FMCSA makes a direct connection between IRT development and improvements to its process for measuring exposure—a measure of all trips taken by a carrier's vehicles, generally determined through VMT. FMCSA also expects to develop multiple iterations of the IRT model over time to refine the results and measure the impact of changes. According to FMCSA, if the model performs well and can be reasonably explained to stakeholders, it will replace SMS, as NAS recommended. Adopting the IRT model could help FMCSA address the methodological challenges inherent in SMS and enhance the credibility of the CSA program.

As we mentioned above, the FAST Act also requires us to report to Congress on how well FMCSA's corrective action plan corresponds to recommendations issued by OIG and GAO before the law was enacted. None of the related OIG recommendations remain open and only one of two open GAO recommendations relates to the NAS study. In February 2014, GAO recommended that FMCSA revise its SMS methodology to better account for limitations in comparing safety performance information across carriers.[20] Specifically, GAO reported that FMCSA had not demonstrated relationships between groups of violations and the risk that an individual motor carrier will crash. Similarly, NAS recommended that FMCSA remove violations that do not clearly indicate whether a carrier prioritizes safe operations. One advantage of the IRT model, the NAS study explained, is its empirical method for analyzing individual violations.

GAO also reported that insufficient performance information has resulted in limited precision and low confidence in many SMS scores. Similarly, NAS found that sporadic inspections of small carriers have led to highly variable assessments

---

[20] GAO, *Modifying the Compliance, Safety, Accountability Program Would Improve the Ability to Identify High Risk Carriers* (GAO-14-114), February 2014.

of this group due to uncertainty about the frequency of their violations. NAS suggested that the IRT model could reduce the variance between these assessments, but added that more research would help FMCSA make more informed policy decisions about safety rankings for small carriers.

GAO official told us that their recommendation could be addressed by FMCSA's plan to replace SMS with a formal statistical model. An FMCSA official stated that if the IRT model replaces SMS, the Agency will revise its policies and procedures, and no regulatory changes will be necessary. According to Agency officials, FMCSA will make a decision about the IRT model by September 2020.

FMCSA's Plan for Collecting More Accurate and Complete Data Lacks Implementation Details

NAS identified two data elements—exposure and crashes—as needing immediate attention because both elements were "likely of unsatisfactory quality," and the exposure data were incomplete. Accordingly, NAS recommendation 2 focused on improving the quality of MCMIS data in support of SMS.[21]

To further improve the accuracy of exposure data, FMCSA plans to update its biennial registration system by adding edit checks to the online registration form.[22] According to Agency officials, motor carriers self-report the data on these forms, which are prone to data-entry errors. The corrective action plan states that introducing edit checks to the reporting system will identify suspect data entries and validate exposure data. FMCSA also plans to encourage motor carriers to voluntarily provide updated information and to identify ways to recognize motor carriers that work proactively with the Agency.

According to the experts working with Volpe, IRT models help organizations flag questionable data and measure the impact of data errors on safety scores. Specifically, Volpe can develop simulations that would allow it to measure how

---

[21] *Actions Are Needed To Strengthen FMCSA's Compliance, Safety, Accountability Program* (OIG Report Number MH2014032), March 5, 2014. This audit found that between January 2011 and February 2013, only about 401,000 of the roughly 803,000 interstate carriers active in MCMIS had updated their data in accordance with regulatory requirements. This impeded FMCSA's ability to prioritize carriers for safety interventions because incorrect data could lead to incorrect computations of carriers' BASIC percentile rankings. As a result, we recommended that FMCSA implement a process for deactivating the DOT numbers of carriers who do not submit the required data. We closed this recommendation in 2014 after confirming that FMCSA had taken the recommended action.

[22] FMCSA requires motor carriers to update their registrations every 2 years, and uses its online Unified Registration System for these biennial updates. FMCSA described the proposed edit checks as an automated review that rejects data entries that are likely incorrect.

safety scores are influenced by incorrect VMT data. The experts told us that, if Volpe validates the model, FMCSA will be able to use it to quantify the impact. FMCSA also plans to partner with the National Highway Traffic Safety Administration to encourage States to participate in a national crash data repository. Over a longer timeframe, FMCSA aims to upgrade its inspection software to improve data uniformity.

The Agency's corrective action plan does not include specific information on cost estimates and benchmarks for implementing NAS recommendation 2. This is because FMCSA determined that much of the relevant exposure data do not exist. FMCSA's plan had included working with two interstate taxing authorities—IRP and International Fuel Tax Agreement (IFTA)—to determine whether additional mileage data were available. In March 2019, Volpe staff completed an analysis on the usability of IRP data and concluded such data would improve only 2 percent of the MCMIS data. Based upon this analysis—which we did not validate as it was not within our audit scope—FMCSA officials decided that collecting the additional mileage data would not be beneficial. As a result, FMCSA no longer plans to collect additional exposure data and thus will not identify the associated costs as the FAST Act requires.

FMCSA No Longer Plans To Collect Additional Data on Carrier Operations for the IRT Model

The NAS study concluded the information in MCMIS is too limited to help FMCSA determine the factors that contribute to a crash. Specifically, MCMIS is missing information about the practices and procedures that describe carrier operations. Since a premise of SMS is that "a substantial fraction of crashes" are related to carrier operations, NAS recommendation 3 directed FMCSA to collect more information on carrier cargo, driver turnover rate, and level of driver compensation, and address the protection of these data. According to the study, such information would also benefit the IRT model.

In its corrective action plan, the Agency responded to the NAS recommendation by stating that it would analyze legal protections afforded to carrier data as well as the cost to the industry to provide such data. If a cost-benefit analysis supported collecting additional data, the Agency would request the information. According to the IRT experts working under contract with Volpe, additional safety-related information would make the IRT model results more precise. To determine whether the information was safety-related, the experts stated, the implementation team would need to test it.

The FAST Act required FMCSA's implementation plan to recommend programmatic reforms, revisions to regulations, or proposals for legislation to address the NAS recommendations. However, FMCSA officials indicated they are not planning any rulemaking that would allow collection of the NAS-recommended information.[23] Further, the officials told us that since publishing the corrective action plan, they have determined these additional data are not available, and therefore they will not conduct the cost-benefit analysis identified in the plan.

FMCSA did not provide alternative actions or implementation details, such as cost estimates and benchmarks for completion, for addressing NAS recommendation 3. This may limit the Agency's ability to improve its identification of high-risk motor carriers and mitigate future crashes.

FMCSA's Plan To Make MCMIS and SMS More Transparent Lacks Clarity

The NAS study concluded that carriers have difficulty monitoring their safety measures or progress independently. According to FMCSA, the primary reason for this difficulty is that the MCMIS database is not easy to understand. Similarly, the NAS study cited the challenges associated with reproducing SMS measures and percentile ranks. Thus, NAS recommendation 4 directs FMCSA to make a user-friendly version of the MCMIS data and SMS code publicly accessible.

In its corrective action plan, FMCSA acknowledges there are benefits to making SMS data available to industry and the public. Accordingly, the Agency plans to develop a webpage where researchers, carriers, safety consultants, and the public at large can obtain datasets from MCMIS. However, the plan did not include specifics on how the Agency would ensure the datasets will be user-friendly, and did not include programmatic reforms related to the SMS code.

FMCSA's corrective action plan also did not include implementation details for NAS recommendation 4, such as cost estimates and benchmarks for completion. According to FMCSA, improving the MCMIS dataset before deciding whether the IRT model will use the data could waste resources. We understand that FMCSA should strive to use its resources efficiently. But as a result, it has delayed an opportunity to improve transparency of its MCMIS database, safety measures, and rankings in a timely manner—whether the Agency relies on SMS or the IRT model.

---

[23] Under Title 49, U.S. Code, section 31133, FMCSA has broad authority to "prescribe recordkeeping and reporting requirements."

FMCSA's Plan To Better Understand Percentile Ranks Lacks Specificity

The NAS report concluded that SMS does not perfectly distinguish between safe and unsafe carriers. Thus, FMCSA's disclosure of percentile rankings to the public could result in safe carriers listed as unsafe (and vice versa).[24] This is a particular concern among smaller carriers, for whom limited information is available. On the other hand, NAS heard from industry stakeholders that releasing percentile ranks publicly has also brought positive changes. One example is the development of a common language among industry partners—such as shippers and insurance companies—interested in monitoring and assessing risk in carrier operations.

NAS also found that motor carriers may find it difficult to understand changes in SMS percentile ratings, which are based on rankings received by similar types of carriers.[25] According to the NAS study, this may make a carrier reluctant to share safety best practices because its ranking could fall when other companies improve theirs.

NAS recommendation 5 asked FMCSA to conduct a study to better understand the statistical operating characteristics of percentile ranks to determine whether to make them publicly available. Additionally, if FMCSA decides not to use the IRT model, the NAS report stated that FMCSA will need to fully validate SMS by determining the degree to which carriers with high violation rates are operating unsafely. NAS predicted this would be an expensive endeavor and added that an alternative would be to adopt the IRT model because it could distinguish between safe and unsafe carriers better than SMS.

In response to NAS recommendation 5, the corrective action plan explains that FMCSA will gather public input about usability of public scores and percentile ranks and use that input to scope a study of carrier safety. However, the plan does not specify how the Agency will study the statistical operating characteristics of percentile ranks, as NAS recommended, in order to determine what information to release. Such a study could guide a data-driven programmatic reform on how to disclose percentile rankings.

FMCSA does not plan to address this recommendation before it decides whether to adopt the IRT model. As a result, the corrective action plan did not include cost

---

[24] According to FMCSA, certain information related to property carrier compliance and safety performance, which was previously available on the SMS website, is no longer publicly accessible. Specifically, information on the Crash Indicator and Hazardous Materials Compliance BASICs are now hidden from public view.

[25] FMCSA distinguishes between two types of carriers: those that are primarily vehicles with permanently mounted bodies and those that are primarily vehicles that pull trailers. FMCSA then further groups the carriers based on the number of times their vehicles have been inspected.

estimates, benchmarks for completion, or other implementation details for NAS recommendation 5. According to an FMCSA official, studying SMS before deciding whether to adopt the IRT model could waste resources.

FMCSA's Plan To Improve Absolute and Relative Safety Measures Lacks Timely Actions

The NAS study concluded that relative and absolute safety measures have advantages and disadvantages. A relative measure helps push for progressively safer performance, while an absolute measure requires a set standard. Relative measures also help the Agency make the best use of its limited resources to conduct interventions. Unlike absolute measures, however, relative measures change based on the performance of other carriers.

As a result, NAS recommended that FMCSA use both absolute and relative measures to prioritize carriers for intervention, and compute percentile ranks—conditionally within groups of similar carriers and among all motor carriers. The NAS study specified that one advantage of the IRT model is that it can rank carriers using absolute and relative measures that quantitatively account for uncertainty in carriers' rankings—something that SMS does not do. The NAS study also suggested that it would be worthwhile to explore a hybrid measure that combines relative and absolute measures.

In response to this NAS recommendation, FMCSA's plan states that it will take action after IRT modeling is complete, since the absolute and relative measures are SMS products. Moreover, according to an FMCSA official, the Agency may not take action on this recommendation if it implements IRT because absolute and relative measures do not exist in that model.

The NAS study proposes a methodology for calculating absolute and relative measures using the IRT model. A NAS official told us that "both relative and absolute measures are simple functions of an IRT model approach to [assess the] safety culture of motor carriers." According to the same official, the Volpe implementation team has already begun consulting with NAS on the computation of absolute and relative measures.

FMCSA has delayed programmatic reforms related to the use absolute and relative measures until after it decides whether to adopt the IRT model. Agency officials stated they cannot plan for such reforms until they identify which reforms are necessary.

Like other parts of the corrective action plan, this section does not include implementation details, such as cost estimates and benchmarks for completion.

FMCSA plans to address these areas once it makes a decision about the IRT model.

FMCSA May Face Other Challenges Specifically Related To Implementing the IRT Model

Several other potential obstacles stand in the way of implementing the corrective action plan. Specifically, FMCSA may have to determine how to explain the complex IRT model to industry and the public, and problems obtaining data timely could impact the model's accuracy and suitability.

IRT Model Complexity May Affect Implementation and Is a Challenge to Public Outreach

As we mentioned above, according to the corrective action plan, if the IRT model performs well, it will replace the existing SMS. However, FMCSA may need to address a variety of challenges before it can implement an IRT model that satisfies its needs. According to NAS, one challenge in developing the proposed IRT model is acquiring highly specialized technical expertise in IRT model development. A NAS representative stated that there are a limited number of individuals in the United States with experience in developing large-scale IRT models.

Another significant challenge is decreasing the computational burden—the time and resources needed to run the full-scale IRT model. For example, Volpe officials told us that it took more than 2 weeks to run small-scale versions of the model. Given that the full-scale model will involve hundreds of thousands of motor carriers and potentially several hundred distinct violation codes, Volpe will need to decrease the computational burden to a feasible level.

To mitigate these challenges, Volpe worked with the NAS Standing Committee[26] and university-based experts to give the Volpe implementation team IRT-related guidance and oversight. A NAS official told us that Volpe has made commendable progress, but there would be challenges in implementing the IRT

---

[26] FMCSA contracted with NAS to help craft its response to the study's recommendations. NAS established a new Standing Committee to succeed the public committee that conducted the original study. The Standing Committee includes subject matter experts on organization safety, statistics, research and evaluation methods, motor carrier operations, enforcement, and IRT modeling.

model on the scale the Agency requires. Still, one of the university-based experts said that despite those challenges, implementation was feasible, and the process would take no longer than 2 years, the timeframe identified in the corrective action plan. According to Volpe officials, Volpe and FMCSA will have to evaluate whether the model will meet FMCSA's needs. The inherent risk is whether FMCSA can meet the costs and benchmarks for the model listed in its corrective action plan.

Furthermore, senior officials at the Agency are concerned about its ability to explain the model to industry and the public since FMCSA does not have an IRT expert on staff. Specifically, they are concerned about explaining the complicated IRT calculations. This issue is important, as one official stated, because it is the Agency's responsibility to demonstrate the IRT model to the public. Another official told us that the key to this challenge is describing the model in language the public can understand. Ensuring that the Agency can effectively communicate the model is essential for gaining buy-in from the industry and the public, as well as establishing the IRT model as a transparent prioritization tool.

Lack of Access to Improved Exposure Data Could Affect the Accuracy of the IRT Model

In the corrective action plan, FMCSA states that there is a direct connection between developing the IRT model and improving data, specifically the measurement of carrier exposure. To that end, the plan outlines steps for collecting more accurate and different types of data, as recommended by NAS. However, Agency officials told us that they are unlikely to collect the data—either through voluntary submissions from carriers or amendments to regulatory requirements—before the IRT model is complete. FMCSA officials explained that this is due to resistance from the motor carrier industry and the length of the regulatory process.

A NAS official stated that limited data on VMT was FMCSA's most significant problem. As discussed above, FMCSA planned to pursue data on additional VMT from the States—via IRP and IFTA—to measure carrier exposure to safety violations and crashes. However, based on the Volpe analysis that determined the IRP data would improve only 2 percent of the MCMIS data, FMCSA officials concluded they would not acquire additional exposure data from either IRP or IFTA.

FMCSA plans to assess the effectiveness of the IRT model without collecting more accurate and different types of data. Thus, the Agency will not have made the NAS-recommended improvements to ensure that exposure data are accurate and

complete when it evaluates the IRT model, which could limit the model's effectiveness.

Conclusion

In response to a congressional mandate, FMCSA created a corrective action plan to improve the way it monitors and evaluates the safety practices of motor carriers. As required by the FAST Act, FMCSA's plan addresses many of the NAS recommendations. However, it lacks details about the benchmarks, costs, and program reforms required to fully address the act's requirements as they address the NAS recommendations. As a result, FMCSA faces the risk that it will be unable to improve its system for prioritizing motor carriers in an accurate, efficient, and timely manner.

Recommendations

We recommend that the Federal Motor Carrier Safety Administrator, in accordance with the Fixing America's Surface Transportation Act, respond to the National Academy of Sciences (NAS) recommendations as follows:

1. *For the fifth NAS recommendation*, provide (a) cost estimates that account for staffing, enforcement, and data collection; and (b) benchmarks for completion.

2. *For the fourth and sixth NAS recommendations,* provide (a) cost estimates that account for staffing, enforcement, and data collection; (b) benchmarks for completion; and (c) potential programmatic reforms, revisions to regulations, or proposals for legislation.

Agency Comments and OIG Response

We provided FMCSA with our draft report on July 25, 2019, and received its technical comments on August 28, 2019, and its formal response on September 9, 2019. We incorporated the technical comments into our final report as appropriate. FMCSA's response is included in its entirety as an appendix to this report. FMCSA partially concurred with our two recommendations.

FMCSA partially concurred with OIG recommendation 1. The Agency stated that after it reached out to the industry to discuss other data for improving

exposure estimates, it determined that much of the data was not readily available. Additionally, the Agency analyzed additional data sources, including IRP. Based on its analysis, FMCSA determined that IRP would not be a feasible source for the NAS–recommended data, as the IRP data would improve only 2 percent of the MCMIS data. Consequently, FMCSA has no immediate plans to collect data on carrier exposure and additional crash data (NAS recommendation 2). FMCSA also will not take any action on the impact of public access (NAS recommendation 5) until it determines whether it will implement the IRT model or another prioritization model. Based on the Agency comments, we limited the scope of our first recommendation to NAS recommendation 5.

FMCSA partially concurred with OIG recommendation 2, stating that the IRT modeling is to be completed by September 30, 2019, and then the Agency will complete a full review of the IRT model. After that review, but no later than September 30, 2020, FMCSA will decide how to move forward with its prioritization methodology and include estimates and benchmarks for the remaining open NAS recommendations.

FMCSA provided OIG with appropriate actions and a completion date of September 30, 2020, to address our recommendations.

Actions Required

We consider recommendations 1 and 2 resolved but open pending completion of planned actions.

Exhibit A. Scope and Methodology

We conducted this performance audit between October 2018 and July 2019 in accordance with generally accepted Government auditing standards as prescribed by the Comptroller General of the United States. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

The FAST Act required OIG to submit a report to the Senate Committee on Commerce, Science, and Transportation and the House Transportation and Infrastructure Committee that addresses the responsiveness of FMCSA's corrective action plan to the NAS report. Accordingly, our audit objectives were to (1) assess the extent to which FMCSA's corrective action plan addresses the NAS recommendations and relevant OIG and GAO recommendations, and (2) identify challenges FMCSA may face when implementing the corrective action plan. The scope of our audit included only related GAO and OIG recommendations that were open during the audit.

To determine whether FMCSA's corrective action plan addresses the NAS recommendations and relevant OIG and GAO recommendations, we reviewed FAST Act requirements, related FMCSA regulations, the NAS study, and relevant OIG and GAO reports. We identified FAST Act criteria for the corrective action plan—cost estimates and an implementation plan with benchmarks; and programmatic reforms, revisions to regulations, or proposals for legislation. We then assessed whether the plan included these criteria, as well as steps that aligned with the opportunities and deficiencies identified in the NAS study and related, open GAO and OIG recommendations. Finally, we interviewed FMCSA, Volpe, and NAS officials to obtain further details of the Agency's planned actions. Of note, the FAST Act also required FMCSA to consider the plan in any related rulemaking to the CSA program. Since the rulemaking process was outside the scope of this audit and the legal opinion of OIG and FMCSA is that this consideration is not a requirement of the plan itself, we did not assess this requirement as part of this audit.

To identify management challenges FMCSA might face when implementing the corrective action plan, we interviewed FMCSA officials, NAS representatives, Volpe staff, and university-based IRT experts to understand their roles and responsibilities and identify any challenges they might face. We identified challenges associated with IRT modeling by reviewing the NAS study, academic literature, and lecture notes on IRT modeling.

Exhibit B. Organizations Visited or Contacted

Department of Transportation

Federal Motor Carrier Safety Administration, Washington, DC

John A. Volpe National Transportation Systems Center, Cambridge, MA

Other Organizations

National Academy of Sciences, Washington, DC

Exhibit C. List of Acronyms

BASIC	Behavior Analysis and Safety Improvement Categories
CSA	Compliance, Safety, and Accountability Program
DOT	Department of Transportation
FAST Act	Fixing America's Surface Transportation Act
FMCSA	Federal Motor Carrier Safety Administration
GAO	Government Accountability Office
IFTA	International Fuel Tax Agreement
IRP	International Registration Plan
IRT	Item Response Theory
MCMIS	Motor Carrier Management Information System
NAS	National Academy of Sciences
NHTSA	National Highway Traffic Safety Administration
OIG	Office of Inspector General
SMS	Safety Measurement System
VMT	Vehicle miles traveled

Exhibit C. List of Acronyms   20

Exhibit D. Operational Model for the CSA Program
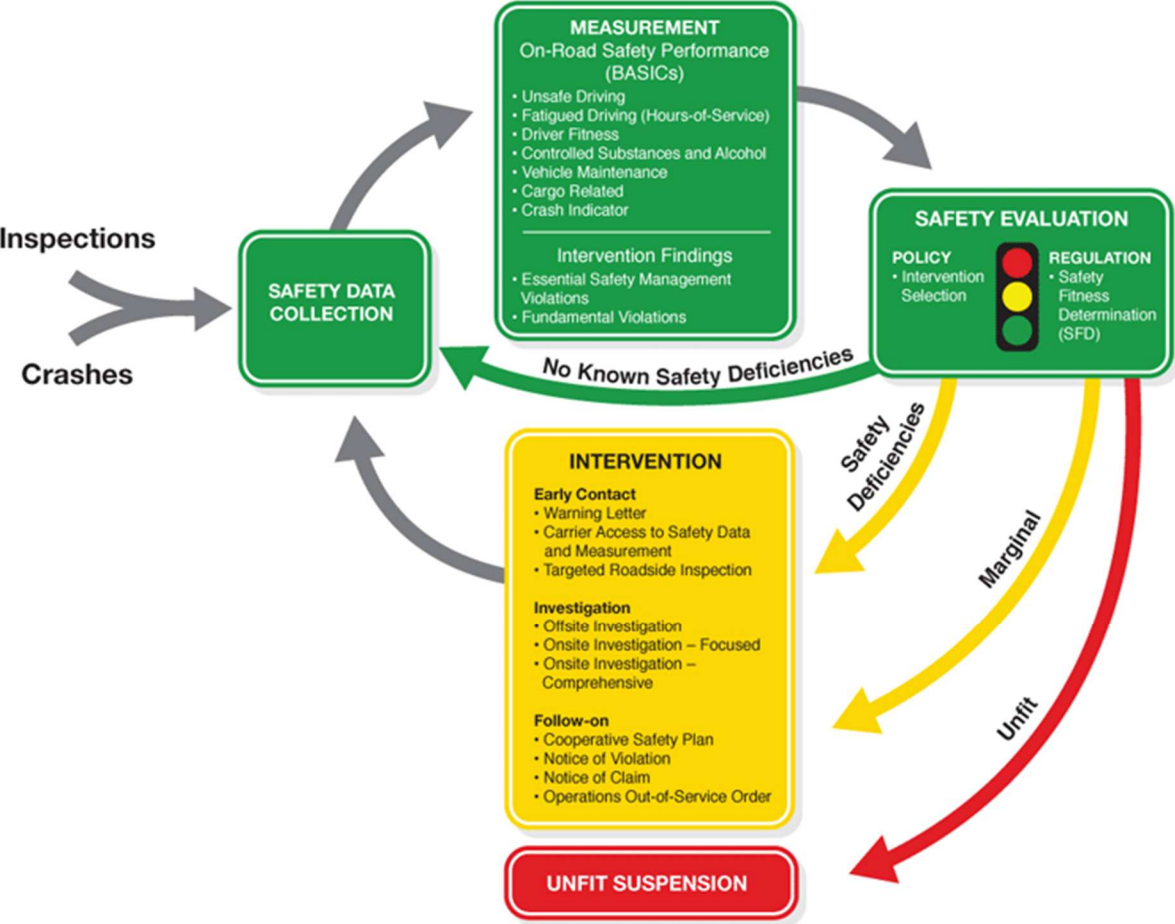
Source: FMCSA CSMS Methodology, version 3.0.1 (August 2013)

Exhibit E. Recommendations from the National Academy of Sciences Study

Recommendation 1

FMCSA should develop the suggested IRT model over the next 2 years. If it is then demonstrated to perform well in identifying motor carriers for alerts, FMCSA should use it to replace SMS in a manner akin to the way SMS replaced SafeStat. Specifically, IRT models would have the following specific advantages over SMS:

1. Instead of severity weights being based on expert opinion or dated empirical information, the item discrimination parameters are estimated based on a combination of current observed data and expert opinion, and ultimately on data alone;

2. IRT models can enhance the transparency of the evaluation system;

3. They support the direct estimation of variability of scores and ranks;

4. They can account for the probability of being selected for inspection;

5. They can provide a basis with which to evaluate how data insufficiency could impact safety ratings of carriers;

6. They can provide a basis to more rigorously evaluate the structure of the current BASICs, including which violations go into which BASIC;

7. They can provide for a natural way to examine the issue of further stratification;

8. They can provide for the possibility that safety is inherently multidimensional, which could inform how many BASICs are needed in the SMS model;

9. They can take account of time and thereby inform about the proper time weights in SMS;

10. They can allow for the addition of new safety measures as they become available, without having to start from scratch;

11. They can produce ranking ranges (by sampling from the posterior distribution of theta) to better understand overlap in the rankings (i.e., uncertainty);

12. They can adapt to changes in safety over time.

Recommendation 2

FMCSA should continue to collaborate with states and other agencies to improve the quality of MCMIS data in support of SMS. Two specific data elements require immediate attention: carrier exposure and crash data. The current exposure data are missing with high frequency, and data that are collected are likely of unsatisfactory quality. Further, to improve the exposure data collected involves not only collecting higher-quality VMT data, but also collecting this information by state and by month. This will enable SMS to (partially) accommodate existing heterogeneity in the environments where carriers travel. Crash data are also missing too often. Also, there is information available from police reports currently not represented on MCMIS that could be helpful in understanding the contributing factors in a crash. Such information could help to validate the assumptions linking violations to crash frequency. To address these issues, FMCSA should support the states in collecting more complete crash data, and in universal adoption of the Model Minimum Uniform Crash Criteria, as well as developing and supplying the code needed to automatically extract the data needed for the MCMIS crash file.

Recommendation 3

FMCSA should investigate ways of collecting data that will likely benefit the recommended methodology for safety assessment. This includes data on carrier characteristics—including information on driver turnover rate, type of cargo, method and level of compensation, and better information on exposure. This additional data collection will likely require additional funds for research and development of the data collection instrument, and greater collaboration between FMCSA and the states as to how to undertake this new data collection effort so that it is standardized across the states. Protection and use of carrier specific data must be addressed as well.

Recommendation 4

FMCSA should structure a user-friendly version of the MCMIS data file used as input to SMS without any personally identifiable information to facilitate its use by external parties, such as researchers, and by carriers. In addition, FMCSA should make user-friendly computer code used to compute SMS elements available to individuals in accordance with reproducibility and transparency guidelines.

Recommendation 5

FMCSA should undertake a study to better understand the statistical operating characteristics of the percentile ranks to support decisions regarding the usability of public scores.

Recommendation 6

Given that there are good reasons for both an absolute and a relative metric on safety performance, FMCSA should decide on the carriers that receive SMS alerts using both the SMS percentile ranks and the SMS measures, and the percentile ranks should be computed both conditionally within safety event groups and over all motor carriers.

Exhibit F. Major Contributors to This Report

KERRY R. **BARRAS**	PROGRAM DIRECTOR
JULIAN **PLATT**	PROJECT MANAGER
OLIVIA **MOORE**	SENIOR ANALYST
JAMES **MCGEE**	ANALYST
BRAD **SHRAGO**	ECONOMIST
JANE **LUSAKA**	WRITER-EDITOR
TOM **DENOMME**	PROJECT CONSULTANT
SETH **KAUFMAN**	SENIOR COUNSEL

Appendix. Agency Comments

U.S.Department of
Transportation

Federal Motor Carrier Safety
Administration

Administrator

1200 New Jersey Avenue, SE
Washington, DC 20590

Date: September 05, 2019

To: Barry J. DeWeese
             Assistant Inspector general for Surface Transportation Audits

From: Raymond P. Martinez
             Administrator, Federal Motor Carrier Safety Administration

Subject: **ACTION:** Management Responses to FMCSA's Plan Addresses Recommendation
             on Prioritizing Safety Interventions but Lacks Implementation Details: Project
             No. 18S3006S000

The Federal Motor Carrier Safety Administration's (FMCSA) core mission is to reduce crashes, injuries, and fatalities involving large trucks and buses on the Nation's roads. An important step toward achieving this mission is to identify unsafe motor carriers and prioritize FMCSA and State enforcement resources on those carriers that pose the greatest safety risk. Prioritization of carriers is based primarily on the data received from carriers' inspections and compliance with Federal regulations.

In response to a mandate in the Fixing America's Surface Transportation Act of 2015 (FAST Act), FMCSA commissioned the National Academy of Sciences (NAS) to study and evaluate the Safety Measurement System (SMS), the Agency' s methodology for identifying and prioritizing unsafe motor carriers. On June 27, 2017, NAS issued its study, "Improving Motor Carrier Safety Measurement," and made six recommendations to help FMCSA update its carrier prioritization methodology; improve the accuracy, completeness, and scope of its data; and enhance transparency.

On July 16, 2018, FMCSA completed its Corrective Action Plan to address the NAS recommendations and submitted that plan to Congress. In the almost 18 months since beginning its work and more than 12 months since the Corrective Action Plan was submitted, FMCSA has completed most of the work it planned. For example, FMCSA:

- acquired the necessary expertise and computation power needed for the Item Response Theory (IRT) modeling. Workingwith NAS, a variety of models have been developed, including a full-scale Item Response Theory model.

- held a public meeting to discuss other data that the industry might be able to provide the Agency to improve exposure estimates. It was determined that much of the data discussed was not readily available and the Agency did not have a means to collect any

existing data from motor carriers. In addition, stakeholders expressed concern about the concept of providing information, such as pay data, to the Agency. Therefore, FMCSA decided not to go forward with additional efforts in that area.

- completed analysis of additional data sources such as International Registration Plan (IRP) and determined IRP is not a feasible alternative for the data NAS recommended. The IRP data would improve only 2 percent of the Motor Carrier Management Information System (MCMIS) data.

- completed the aggregation and consolidation of 899 current potential violations down to 381 violations, which are being used in the IRT modeling to improve the model's efficiency, as well as to produce a cleaner dataset of violations.

Based on our review of the OIG draft report, we concur partially with OIG's two recommendations to: (1) provide (a) cost estimates for staffing, enforcement and data collection and (b) benchmarks for completion for the NAS Recommendations 2 and 5;[1] and (2) provide (a) cost estimates that account for staffing, enforcement, and data collection; (b) benchmarks for completion and (c) potential programmatic reforms, revisions to regulations, or proposals for legislation for NAS recommendations 4 and 6.[2]

FMCSA does not concur with providing cost estimates for data collection due to its limited utility in improving the existing data, FMCSA has no immediate plans to collect data on carrier exposure and additional crash data. Additionally, FMCSA is not taking any action on the impacts of public display until it determines whether the Agency is implementing the IRT model or another prioritization model.

However, upon completion of the IRT modeling by September 30, 2019, FMCSA will decide how to move forward with its prioritization methodology, including providing estimates and benchmarks to complete the remaining open NAS recommendations. FMCSA plans to make this decision by September 30, 2020, after completing a full review of the IRT model.

We appreciate the opportunity to review the OIG draft report. Please contact Joseph DeLorenzo, Director, Office of Enforcement and Compliance, at (202) 366-8577 or via email at joseph.delorenzo@dot.gov with any questions.

---

[1] Summary of NAS Recommendations 2 and 5 to FMCSA: Recommendation 2-Collaborate with States and other agencies to improve the quality of MCMIS data in support of Safety Management System (SMS). Two specific data elements require immediate attention: carrier exposure and crash data; and Recommendation 5- Undertake a study to better understand the statistical operating characteristics of the percentile ranks to support decisions regarding the usability of public scores.

[2] Summary of NAS Recommendations 4 and 6 to FMCSA; Recommendation 4-Structure a user-friendly version of the Motor Carrier Management Information System (MCMIS) data file without personally identifiable information to facilitate its use by external parties, such as researchers and carriers. Make user-friendly computer code used to compute SMS elements [publicly] available to individuals in accordance with reproducibility and transparency guidelines; and Recommendation 6- Given that there are good reasons for both absolute and relative measures on safety performance, use both types of measures to prioritize which carriers receive alerts. Compute safety scores conditionally within groups of similar carriers, as well as unconditionally for all motor carriers.

U.S. DOT OIG
Fraud & Safety
Hotline

hotline@oig.dot.gov | (800) 424-9071

https://www.oig.dot.gov/hotline

Our Mission

OIG conducts audits and investigations on behalf of the American public to improve the performance and integrity of DOT's programs to ensure a safe, efficient, and effective national transportation system.