Transit Advisory Committee for Safety (TRACS) 16-02 Final Report

03/16/2017

Safety Data and Performance Measures in Transit

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Executive Summary

The Federal Transit Administration (FTA) tasked the Transit Advisory Committee for Safety (TRACS) with developing recommendations for FTA on the functional requirements and data elements of a comprehensive safety data collection and analysis framework to support improvements in the transit industry's safety performance.

Representatives from state and local transit agencies, labor unions, state safety oversight agencies, research organizations, and national transportation associations worked together to create recommendations for FTA to guide improvements in safety performance data collection and analysis. These recommendations address improvements in safety performance measures, granularity in data collection efforts, and a reporting and analysis framework. This report begins by introducing safety performance measurement, how safety performance measurement informs the safety management system (SMS) approach, and then discusses improvements in safety performance measurement, the functional reporting and analysis requirements of an improved reporting platform, and leading and lagging safety performance indicators that may be of interest to transit agencies. The report then presents safety performance measures in public transportation, detail in data collection, reporting and analysis requirements, and finally suggested data outputs to aid in setting national safety goals and agency peer reporting. Finally, the report presents TRACS' recommendations on the functional requirements and data elements of a comprehensive safety data collection and analysis framework to support improvements in the transit industry's safety performance.

The recommendations focus on FTA refining and improving safety performance measurements and a reporting and analysis framework. Recommendations discussed in this report include:

- The reporting of fatalities and injuries by both revenue miles traveled by mode, as well as per total unlinked passenger trips by mode to ease comparison by mode of transportation;
- Including sensible cut-off dates for injury and fatality documentation, and the ability of transit agencies to append injury documentation submitted to the national transit database (NTD);
- Including sensible thresholds in the reporting of safety events;
- Developing and implementing non-punitive, confidential, close-call safety reporting systems[1] for transit agencies and modes that fall under their purview;
- Supporting and documenting functional analyses of safety-critical systems in both rail and non-rail modes to determine the components and sub-components whose failures could result in catastrophic events;
- Providing guidance on the data requirements, policies, and practices that would constitute an effective SMS for transit agencies;
- Developing streamlined processes and tools for the collection of detailed safety data and require that detailed safety data be reportable to the NTD for any safety event that results in a fatality, serious injury, or serious damage while ensuring that the process of collecting more

[1] Also known as "safety reporting systems," to indicate any safety issue is reportable, not just ones that have resulted in a close-call or near miss.

refined and detailed safety data is appropriately scaled for transit agencies of differing sizes and capacities;

- Updating the NTD, or developing a new reporting system to include: ease of use, system queries, more consistent data validation and quality check efforts, ability to amend and append data as needed, and analytical tools and reporting functions;
- Providing guidance and clarity to transit agencies on requirements for collection of safety performance measures while taking into account differences in size and mode of agencies; and
- Continuing to collect security-related event data and issuing annual reports on the top security trends in the industry that detail best practices that transit agencies have adopted in efforts to mitigate those trends.

TRACS concludes that FTA should take a stronger role in implementing change and driving improvements. For example, TRACS recommends that FTA establish a working group of transit officials from various agencies to provide guidance on the functions and system capabilities of an improved web-based reporting platform for safety performance data. TRACS also recommends that FTA seek improved communication between the Transit System Safety Office (TSO) and the NTD.

In other cases, TRACS recommends that FTA conduct further research, including:

- Developing SMS effectiveness measures; and
- Providing transit agencies with tools and guidance on how to assess SMS processes and effectiveness, with the four pillars of SMS (safety policies, safety risk management, safety assurance, and safety promotion) serving as the basis for research and development of SMS effectiveness measures.

Together, the recommendations in this report represent a comprehensive review of the strategies available to FTA and transit agencies in improving safety performance measurement and the reporting and analytical framework to support these improvements. By following these recommendations, FTA can promote transit agencies' use of appropriately scaled safety performance measures to drive continuous progress in safety policies, procedures, and practices, thereby ensuring safer conditions for transit workers and driving the advancement of SMS approaches.

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FTA's Tasking 16-02 to TRACS

The Moving Ahead for Progress in the 21st Century Act (Pub. L. 112-141 (2012)) created a performance-based and multimodal program to strengthen the U.S. transportation system. By focusing on national goals, increasing accountability, and improving transparency, these changes will improve decision-making through better informed planning and programming.

FTA has adopted a SMS approach to the development and implementation of the Public Transportation Safety Program. Data collection and analysis are critical to the success of any effective Safety Management System. FTA's ability to set National safety goals, identify mitigations, and guide improvements in safety performance is dependent upon its collection of relevant information. Therefore, FTA is tasking TRACS to develop recommendations that help define the functional requirements and data elements of a comprehensive safety data collection and analysis framework intended to support improvements in the transit industry's safety performance.

Issues to be considered include, but are not limited to:

1) Actions and processes for improving existing safety performance measures. Often, the only numerical results provided in National level documents are total fatalities and total injuries in transit operations. To better understand safety performance, these analyses must include increased granularity and be based not only on the collection of lagging indicators, but also on leading indicators. Accordingly, FTA will need to collect more and different data and information than what is currently reported to the National Transit Database.
2) The development of recommended requirements for the collection of transit events, including accidents, incidents and occurrences. Recommend minimum collection requirements that may include the following: date and time, weather, pavement and light condition, geographic location, property damage, number of injuries and/or fatalities, number of vehicles and/or pedestrians involved, type of vehicle involved, indication of preventability, etc.
3) What type of reporting platform would FTA need to support its collection, analysis and dissemination of safety information? What functionalities for a National reporting system to collect, analyze and disseminate safety information would be most useful to transit agencies and other reporters (e.g., ability to generate reports, ability to modify/delete previously entered data, ability to email reported information, ability to access other reporters' data)?

Introduction

Importance of Safety Performance Measurements

"You can't manage what you can't measure."

~Peter Drucker

Safety is important in all organizations, particularly those where safety is inherent to the effective and efficient functioning of the organization. What this quote by Peter Drucker means is that you cannot know whether you are successful unless success is defined and tracked. This is no truer than with safety performance. With clearly established safety metrics, organizations can quantify progress and adjust processes to produce desired safety outcomes. Indeed, measurement is an accepted part of the 'plan-do-check-act' management process. In public transportation, the primary safety concern is with the rates of incidents, accidents, and fatalities for employees, passengers, patrons, and the public in general.

Safety performance measures are vital to ensuring that organizations consider and address safety issues. Safety performance measurement not only informs policies, procedures, practices, and continuous improvement, but can also aid in the understanding of negative safety outcomes (e.g., fatalities), and why they occurred. Moreover, if done right, safety performance measurement can aid in preventing deleterious safety outcomes through increased understanding and measurement of hazards and risks associated with safety outcomes. Constant monitoring and analysis of safety performance data in the transportation system can help pinpoint goals to guide transportation planning efforts and focus attention and resources on safety-related challenges, and monitoring progress toward their achievement.

Description of Safety Performance Measurement

Safety performance measures are indicators that enable the organization and other stakeholders to monitor changes in safety conditions and performance against established visions, goals, and objectives. Safety performance measurement should focus on the features of the organization that ensure safety outcomes. Safety outcomes are a function of operational factors (e.g., core processes, risks), systemic factors (e.g., support processes, reporting system, compliance management), and external factors (e.g., competition, new technologies). Features of the organization that are intended to ensure safety outcomes include: allocation of resources, operational procedures, supervision of front-line employees, selection and training of employees, identification of risks, safety controls and barriers for any identified risks, communication and decision-making structures, as well safety committees and offices, and external factors that impact the components of the organization that influence safety.

The primary purposes[2] of safety performance measurement include:

[2] Health & Safety Executive. (2001). A Guide to Measuring Health and Safety Performance. Retrieved from http://www.hse.gov.uk/opsunit/perfmeas.pdf.

- Providing information on incidents and safety events
- Answering questions about the effectiveness of safety mitigation strategies
- Guiding decision making on resources and measures to mitigate safety concerns
- Addressing information needs on potential trends and new hazards

Safety performance measurement should provide information on the progress and status of the policies, procedures, processes, and operational activities used by organizations to control risks to safety. Safety performance measurement should also seek to answer questions, such as "is our management of safety effective," and "Is safety getting better or worse over time?" Furthermore, safety performance measurements should guide decision-making processes at all levels within the organization, and should address different informational needs regarding safety. For instance, top leadership within the organization can require different safety information than front-line employees in day-to-day job role requirements, so delineating those informational needs are important.

The characteristics of good safety performance measures[3] are as follows:

- Quantifiable (ease of analysis and examining trends)
- Representative of what is being measured
- Consistent when measuring the same conditions
- Detectable even when there are changes in environmental or behavioral conditions
- Efficiency of obtaining and using measures is consistent with the benefits
- Easily understood by those who collect and analyze them
- Capable of data quality control and verification
- Manageable total set of measures, metrics, and indicators

Ultimately, safety performance measures should align with the overall performance framework set forth at the national, state, and agency level. While performance measures should align with the national framework, targets for performance measures are primarily set by each individual agency.

Leading vs. Lagging Indicators

Safety performance indicators fall into two categories, leading indicators and lagging indicators. Currently, there are a variety of indicators used to monitor and manage safety performance in public transportation. Broadly stated, lagging indicators measure past performance, while leading indicators measure past performance and predict future performance.

Leading and lagging indicators should[4]:

- Allow accurate and detailed comparisons
- Lead to correct or help avoid erroneous conclusions

[3] Rockwell, T.H. (1959). Safety Performance Measurement. *Journal of Industrial Engineering, 10,* 12-16.
[4] International Council on Mining & Metals (ICMM). (2012, November). Overview of leading indicators for occupational health and safety in mining.

- Be well understood by everyone, especially those responsible for implementing change
- Have a quantitative basis (even when measuring a qualitative dimension)
- Measure what they are supposed to, consistently, accurately, and reliably
- Collect information that is relevant to required decisions and actions
- Adequately map and identify causal linkages (root causes, precursors, events, and outcomes)
- Lead to a consistent focus on implementing change

Many transit agencies report lagging indicators, such as accidents and injuries, which can offer insight into an organization's operational processes and procedures intended to ensure safety, but cannot contribute to improving safety within the organization and transit system (i.e., employees and the public). This is because lagging indicators assess outcomes, they identify hazards after they have manifested. On the other hand, the collection of leading indicators can "serve as a catalyst for change" in the organization[5], supporting improvements in all aspects of safety (e.g., operational policies and procedures, safety culture, identification of risk and hazards). This is because leading indicators assess circumstances preceding hazards, ideally preventing those hazards from manifesting. The use of both leading and lagging indicators can indicate cause and effect pathways.

However, many transit agencies do not collect leading indicators, which is necessary as these types of indicators can be used to alert agencies of developing safety problems and vulnerabilities. Examples of leading indicators include safety audits, near misses, number of safety interviews, number of education/outreach efforts, and number of safety committee meetings per month. The table below[4] highlights key differences between the characteristics of leading and lagging indicators.

Leading Indicators	Lagging Indicators
Are actionable, predictive and relevant to objectives	Are retrospective
Identify hazards before the fact	Identify hazards after the fact
Allow preventative actions before the hazard manifests as an incident	Require corrective actions to prevent another similar incident
Allow response to changing circumstances through implementing control measures before the incident	Indicate that the circumstances have changed; control measures can be implemented after the incident
Measure effectiveness of control systems	Measure failures of control systems
Measure inputs and conditions	Measure outcomes
Direct towards an outcome that is wanted or away from an outcome that is not wanted	Measure the current outcome without influencing it
Give indications of systems conditions	Measure system failures
Measure what might go wrong and why	Measure what has gone wrong
Provide proactive monitoring of desired state	Provide reactive monitoring of undesired effects
Are useful for internal tracking of performance	Are useful for external benchmarking
Identify weaknesses through risk control system	Identify weaknesses through incidents
Are challenging to identify and measure	Are easy to identify and measure
Evolve as organizational needs change	Are static

[5] Blair, E., & O'Toole, M. (2010). Leading measures. *Professional Safety, 55*(8), 29-34.

The collection of leading and lagging indicators are not only vital to informing and improving safety within and outside the organization, but also to an effective SMS.

Relationship to MAP-21 and the National Safety Plan

Moving Ahead for Progress in the 21st Century (MAP-21) and the Fixing America's Surface Transportation (FAST) Act grants the Federal Transit Administration (FTA) license to establish and enforce a comprehensive framework to oversee the safety of public transportation in the United States. MAP-21 requires that FTA establish a National Public Transportation Safety Plan (NSP), Public Transportation Safety Certification Program, Public Transportation Agency Safety Plans (PTASP), and State Safety Oversight (SSO) Programs.

The National Safety Plan (NSP)[6] has two primary objectives:

- Meet the statutory requirement to develop and implement a plan to improve the safety of public transportation systems that receive Federal transit funds
- Communicate FTA's approach to improving safety to the public transportation industry

Noted within the NSP is the requirement that the NSP includes criteria for safety performance measures for all modes of transportation. FTA's focus is on the reduction of safety events, and fatalities and injuries of people operating, accessing, and riding public transportation. In an effort to reduce negative safety events, FTA through the NSP has developed categories of safety performance measures that are broad in scope and can apply to all modes of public transportation. Categories of safety performance measures outlined in the NSP include:

- fatalities
- injuries
- safety events (e.g., fires, derailments)
- system reliability (i.e., mean distance between failures by mode)

How Safety Performance Measurement fits into FTA's SMS Model

In response to the requirements set forth by MAP-21 and the FAST Act, the FTA has decided to implement a SMS framework[7] in order to guide the improvement of safety to the public transportation industry. The FTA's SMS consists of four pillars: safety policies, safety risk management, safety assurance, and safety promotions. Safety performance measurement, to some extent, supports all four pillars of SMS. However, safety performance measurement is vital to the effective functioning of the safety risk management and safety assurance pillars. Safety risk management includes processes and procedures for identifying, analyzing, prioritizing, and mitigating hazards and their associated risks within an organization, as well as processes and procedures for any changes in operations that arise

[6] FTA. (2016). Proposed National Public Transportation Safety Plan.
[7] American Public Transportation Association (APTA). (2016, March). Safety management system manual: Public passenger transportation systems. Retrieved from https://www.apta.com/resources/safetyandsecurity/Documents/3-15-16%20%20APTA%20Safety%20Management%20System%20Manual%20(without%20appendices).docx

within the organization. Safety assurance, on the other hand, includes processes and procedures to ensure that the mitigations developed through safety risk management are adequate and assurances that the system's SMS is functioning effectively. Continuous improvement in safety performance characterizes organizations that utilize an SMS approach to safety, and safety performance features (e.g., processes and operations) and outcomes (e.g., accidents, incidents, fatalities) are indicative of an organization's safety culture.

Within safety risk management, safety performance measurements inform the identification, analysis, and prioritization of hazards. With safety assurance, safety performance measurements and the analysis of safety data informs the organization that the controls, processes, procedures, and policies regarding safety are working effectively and efficiently to ensure the continuous improvement of safety within the organization. Indeed, the NSP[6] notes that effective collection, analysis, and sharing of safety data as well as active, accurate and routine safety performance measurement are important to the success of the SMS approach.

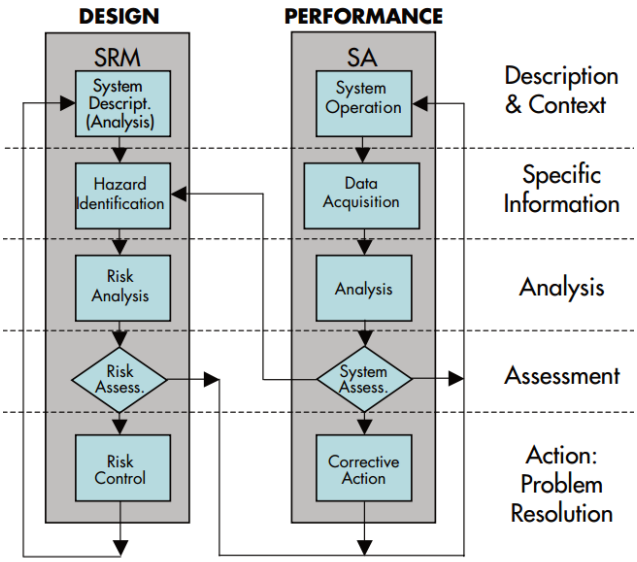

Figure 1: Interaction of the Safety Risk Management and Safety Assurance processes in SMS

It is important to note that safety data collection and performance measurement have been an important topics in a number of federal rule-makings and upcoming rule-makings for transit agencies:

- 49 CFR Part 659
- 49 CFR Part 673
- 49 CFR Part 674

Safety Measurement in the Transportation Sector

While FTA has chosen to adopt an SMS approach in the management and mitigation of negative and potentially catastrophic safety outcomes, they are not the first to do so. In fact, the adoption of SMS

principles in guiding safety management is popular in other transportation agencies within the United States, as well as around the globe. For example, the Federal Aviation Administration (FAA) adopted an SMS approach to safety management and mitigation approximately 15 years ago, and thus has one of the more advanced SMS systems in transportation. Other agencies that have chosen to adopt SMS principles and/or frameworks include the Federal Highway Administration (FHWA), the Federal Motor Carrier Safety Administration (FMCSA), the Federal Railroad Administration (FRA), and most recently the Pipeline and Hazardous Materials Safety Administration (PHMSA). Furthermore, a number of transportation agencies around the globe have undertaken SMS principles in their approach to safety, including the Railway Safety and Standards Board (RSSB) and the International Civil Aviation Organization (ICAO). What all of these agencies have in common is not only the adoption of SMS principles, but also the active collection, analysis, and utilization of safety performance metrics in guiding and continuously improving safety within their agency and within those organizations that fall under their purview.

Focus of Measurements in Other Transportation Agencies

While all transportation agencies focus on lagging indicators, such as injuries, accidents, and fatalities, there are differences among the transportation agencies regarding the focus of their safety performance measurements.

FMCSA collects information based on seven behavior analysis and safety improvement categories (BASICs). These categories include: unsafe driving (e.g., texting while operating a commercial motor vehicle (CMV), crash indicators (e.g., history of crash involvement), hours-of-service compliance (e.g., operating a CMV while ill or fatigued), vehicle maintenance (e.g., inoperative brakes, lights, and other mechanical defects), controlled substances/alcohol (e.g., use or possession), hazardous materials compliance (e.g., failure to mark, label, or placard in accordance with regulations), and driver fitness (e.g., failure to have a valid and appropriate commercial driver's license (CDL).

Under MAP-21 and the FAST Act, FHWA implemented the Highway Safety Improvement Program (HSIP) with the overarching goal being the reduction of fatalities and serious injuries on all public roads. Additional goals of the HSIP program include improving data by providing greater consistency in the reporting of serious injuries and improving transparency by requiring the reporting of serious injuries and fatalities through a public reporting system. HSIP requires states to collect and report five lagging safety performance indicators: number of fatalities, rate of fatalities per VMT, number of serious injuries, rate of serious injuries per VMT, and number of combined non-motorized fatalities and serious injuries. Furthermore, regulations require states to calculate 5-year rolling averages. In addition, under the National Highway Performance Program (NHPP), states are required to assess a number of risks, corresponding to leading safety performance indicators, such as: condition of the pavements on the Interstate system and condition of the bridges on the National Highway System, to name a few. In addition, safety performance measurement varies by state, with many states collecting safety metrics such as type of accident, location of accidents, and road characteristics.

The FAA includes many entities under their purview, for example, commercial and private air carriers, and air traffic organizations. Like other transportation agencies, the FAA is concerned with the reduction of injuries, accidents, and fatalities that occur within the National Airspace System (NAS). However, the FAA is progressive in their collection, prioritization, and mitigation of hazards that could lead to catastrophic failures. For instance, the Air Traffic Organization (ATO) collects data from voluntary safety reporting programs (VSRPs), as well as other entities under FAA, and utilizes this data to identify the Top 5 Safety Hazards that contribute to risk in the NAS. Examples of leading safety indicators that FAA is concerned with include runway excursions and runway incursions, as well as operational and procedural compliance.

While the FRA is also concerned with fatalities, accidents, and injuries, they also collect a number of leading safety performance indicators, such as engineering decertifications and safety behavioral observations. Engineering decertifications include metrics such as going past a red signal or speeding in a controlled speed zone, as well as not performing airbrake tests. Behavioral observations include process metrics and the observation and number of risks over time. Furthermore, FRA tracks the behavioral change following the voluntary training activities of railroad employees.

How other Agencies use Safety Performance Measures

The central tenet of an effective and efficient SMS process is continuous improvement. Transportation agencies, which have adopted SMS principles and/or approaches, focus on how safety performance measurement can lead to the identification and mitigation of hazards, and continuous safety improvement over time.

FMCSA uses a risk management algorithm based on compliance and crash information to prioritize their workload and more efficiently apply resources to bring carriers and drivers into safety compliance to prevent incidents, accidents, and fatalities. FMCSA's safety measurement system uses all roadside inspection and crash information to quantify the safety performance of carriers based on the previously described BASICs categories. With this information, FMCSA quantifies a crash risk score for each carrier that falls under their purview, and utilizes these scores in order to prioritize resources and interventions that can improve safety.

FHWA includes a focused approach to safety. First, states are required to submit to the U.S. Department of Transportation (USDOT) the status of their performance on 10 safety areas, and how they are meeting and/or progressing toward target performance levels that they set based on guidelines provided by HSIP. Based on information collected, the FHWA designates focus states by crash type, which is a prioritization method to identify states that are in need of resource allotment and interventions in order to mitigate the number of crashes that occur.

FAA collects a vast assortment of information through voluntary and mandatory safety programs and reporting systems in order to identify and prioritize hazards and their associated risks. Data collected through these voluntary and mandatory safety programs and reporting systems facilitate early detection and improved awareness of operational deficiencies and adverse trends, and support to identify and correct deficiencies in all areas of flight operations. As mentioned above, the ATO utilizes this

information to identify the Top 5 Safety Hazards in the NAS, and prioritize mitigation and control efforts for these hazards and their associated risks.

The FRA implemented two similar programs in order to identify, analyze, evaluate, and ultimately mitigate hazards and their associated risks prior to the development of negative safety events. One program is for railroads that carry freight, with the other concerned with railroads that carry passengers. Both programs have similar requirements in that they must include a risk-based hazard management program and risk-based hazard analysis. Risk-based hazard analysis must address infrastructure, equipment, staffing levels and work schedules, operating rules and practices, management structure, employee training, and other areas impacting railroad safety that are not covered by railroad safety laws and regulations. Furthermore, both the freight and passenger railroad programs include safety performance evaluation (i.e., safety monitoring and assessment), as well as a safety outreach component whereby safety information must be communicated to railroad personnel. At a minimum, communications must convey safety-critical information, explain why safety actions were taken and explain why safety procedures are introduced and/or changed. Ultimately, the goal is the evaluation and management of hazards to reduce safety-related negative events. Furthermore, like the FAA, the FRA uses voluntary reporting programs to exemplify risk reduction. These reporting programs include voluntary, confidential close-call reporting, root-cause-analysis problem solving, identification and implementation of corrective actions, tracking the results of change, and reporting the results of change to employees.

What these agencies and others share is the continuous collection, analysis, and evaluation of safety performance data in order to identify and mitigate hazards and their associated risks.

The National Aeronautics and Space Administration (NASA) has an SMS that has gradually evolved over time. Elements of it like risk analysis started in the 1960s. However, consistent use and development occurred in the aftermath of the Challenger shuttle accident in 1986. Over time, NASA's SMS has evolved and NASA applies SMS globally to their projects. A critical element that NASA stresses in its application of SMS is continuous risk measurement. NASA engages in continues risk measurement to select among alternatives, assess the inflow of information, and guide decision-making. Another critical element that NASA's SMS requires is the consultation of various stakeholders and subject matter experts to deliberate decisions. This in essence defines their level of acceptable operational residual risk or safety thresholds.

"Fundamental to every SMS is the principle of collecting and analyzing operational data in order to identify and quantify potential risks and develop and implement corrective actions in a timely way to eliminate or reduce the risk to an acceptable level…Clearly this requires both highly detailed data on routine operations and the means to analyze those data in a comprehensive and timely way."

The National Transit Database

Congress established the National Transportation Database (NTD)[8] to serve as the primary source for information and statistics on public transportation systems across the United States; FTA administers the NTD. Regulation states that any transit agency receiving Federal funds must submit data to the NTD. Furthermore, FTA utilizes the performance data reported in the NTD to apportion Federal funds to transit agencies in urbanized areas.

NTD reporting distinguishes between agencies in urbanized areas (UZA) and rural and tribal agencies. Currently, FTA distinguishes[9] agencies as urban or rural reporters based on 2010 census data, whereby they must serve a population of at least 50,000 for FTA to consider the agency as an urban reporter. Currently, agencies classified as full reporters (i.e., receive 5307 funds and have 30+ vehicles) report to the Safety and Security (S & S) module monthly, while small system urbanized agencies and rural reporters submit data on an annual basis.[10] In addition, while many different modes of public transportation report to the NTD (e.g., cable car, ferryboat, light rail, bus), the NTD groups transit modes into two broad categories: rail and non-rail.

The NTD reports on agency funding sources, inventories of vehicles and maintenance facilities, safety event reports, measures of transit service provided and consumed, as well as data on transit employees. Ultimately, users are able to query the system in order to assess national transit summaries and trends, as well as time series of safety data provided. Safety data required to be reported to the NTD include major safety events (e.g., fatalities, suicides), and non-major safety events (e.g., fires, derailments, injuries).

While there are benefits to the NTD, the shortcomings include the fact that the interface is not user-friendly and many agencies indicate that the number of safety events that require reporting are not available (e.g., derailments, fires). Indeed, while the NTD requires reporting of major and non-major safety events, the only information that comes out of the system when queried are fatalities and injuries by agency, mode, and person-type (i.e., employee, customer, patron, or member of the public). The inability to query the system to receive more detailed safety information inhibits the ability of transit agencies to engage in benchmarking and comparisons, inhibiting continuous improvement of SMS processes. Indeed, in their response to FTA's advance notice of proposed rulemaking (ANPRM) detailing the NSP, PTASP, and safety certification training program, the National Transportation Safety Board (NTSB) indicated that the NTD should enhance the "analysis, trending, and dissemination of [the] information…on a national basis to foster improvement," (pg. 4). What's more, the NTD has drawn widespread criticism from stakeholders at all levels who cite that the data submitted to the NTD are lagging and not granular enough to set national safety goals, and that NTD reports do not contain causal or contributing factors, which limits stakeholders' ability to perform risk-based analyses.

[8] www.transit.dot.gov/ntd
[9] Federal Transit Administration. (2015, February). National Transit Database: National Transit Summary & Trends.
[10] Federal Transit Administration. (2015, January). National Transit Database: Safety & Security Reporting Manual.

A pervasive issue is the discrepancy in data between agency and SSO reporting which indicates the need for more consistent data validation efforts. There is also extreme variation as to how agencies evaluate costs, and other safety events (e.g., fatalities per vehicle mile traveled vs. fatalities per 100,000 miles). Another issue is the fact that the original purpose of the NTD was to serve as a financial management system, so the safety and security functions are not well developed. Furthermore, the NTD lacks consistent data monitoring and data for non-rail events. In summary, more consistent data quality standards would provide more accurate and useful data.

Key Principles in the Development and Use of Safety Performance Measures

Given the level of importance of safety performance metrics to SMS principles and approaches it is vital to identify elements that ensure their effectiveness and efficiency. The key principles, outlined below, have been adopted in various industries, and particularly transportation to achieve a cohesive, functional, and informative SMS.

Measures Reflect Achievement towards Safety Performance Goals and Targets

At an industry or nation-wide level, this goal is usually the enhancement of safety through continuous improvement achieved through implementation and use of SMS principles and approaches. In public transportation, goals focus on the safety of employees and the public. Setting clear safety performance goals and targets aids in the development of safety performance metrics that inform the organization on their state of safety.

Measures Reflect the Current State of Safety of the Transit System

Safety performance indicators describe the state of the different components of the organization. Mechanical, human, and operational safety performance indicators inform the organization on their current state of safety and aid in the safety decision-making process. Safety performance indicators describe the overall state of safety of an operation, process, or organization. Aggregate-level indicators allow for comparison between organizations and agencies at the national level.

Measures Assess Risk Control Effectiveness

Another key principle of safety performance measures includes the collection, assessment, and use of risk control measures. Examples of risk control measures include system maintenance, effectiveness of training, and employee competency. These measures are useful in development and employment of mitigation strategies and informing the organization on the state of SMS.

Voluntary Safety Data Must Protect the Employee and Agency from Liability

A vital element of success in determining meaningful safety performance measures and developing hazard mitigation strategies is the establishment and use of non-punitive, confidential, voluntary safety reporting systems. Such systems are effective because they allow for the collection of data on near misses and other safety events from employees without fear of retaliation. Furthermore, these reporting systems are particularly effective in collecting data that can lead to catastrophic failures, allowing the organization to work on mitigations of hazards prior to their becoming safety events. It is

important to note that TRACS previously recommended the implementation of non-punitive, confidential, close-call safety reporting systems for rail transit.[11]

Measures Should Guide Resource Decision Making

Good safety performance measurement informs the allocation and use of resources. At the national level, agencies like FAA, FHWA, and FRA, need to see that organizations that fall under their purview are meeting national safety goals or at the very least, progressing towards them. This is true at the organizational level, as well.

Safety Performance Indicators, Data Inputs, and Reporting should be Standardized Across the Industry

At the national level, safety performance data and reporting should be standardized and consistent across agencies. In addition, data should be meaningful and useful. Thresholds for safety performance indicators should also be clear and account for operational variability in transportation mode and operational size. Additionally, there needs to be clear guidance on the collection, assessment, and use of safety performance measures, as well as quality control processes. Consistency in data collection and reporting provides decision transparency, which fosters industry and public support. Moreover, standardized, consistent safety performance data and reporting across agencies allows for benchmarking and comparisons. Comparison of safety performance indicators can assist in driving SMS processes forward at the agency, state, and national level, as comparisons help drive continuous improvement efforts.

Safety Performance Measurement in Public Transportation

FTA has recently published the first edition of their proposed NSP that outlines FTA's categories for safety performance measures, which transit agencies falling under their purview, must collect and report. These categories of safety performance measures include[6]:

- Fatalities: total number of reportable fatalities and rate per total unlinked passenger trips by mode
- Injuries: total number of reportable injuries and rate per total unlinked passenger trips by mode
- Safety events: total number of reportable events and rate per total vehicle miles by mode
- System reliability: mean distance between failures by mode

However, as stated above, data currently reported by transit agencies to the NTD lack the granularity necessary to aid agencies as they develop, implement, and ultimately improve their SMS processes. Furthermore, while the NSP safety performance criteria are a start in establishing safety performance measurement standards, more is needed.

The following sections detail:

[11] FTA TRACS. (2012). Establishing a confidential, non-punitive, close-call reporting system for the rail transit industry. Please see: https://www.transit.dot.gov/regulations-and-guidance/safety/tracs-work-groups.

- Safety performance categories as specified by the NSP, as well as refining factors for increased granularity of reporting;
- Data repository and system capabilities needed to support transit agencies as they seek to improve safety performance measurement and SMS processes; and
- Data and reporting outputs transit agencies could utilize and benefit from.

Benefits of comparison include continuous improvement and outreach on risk control and hazard mitigation strategies, among others.

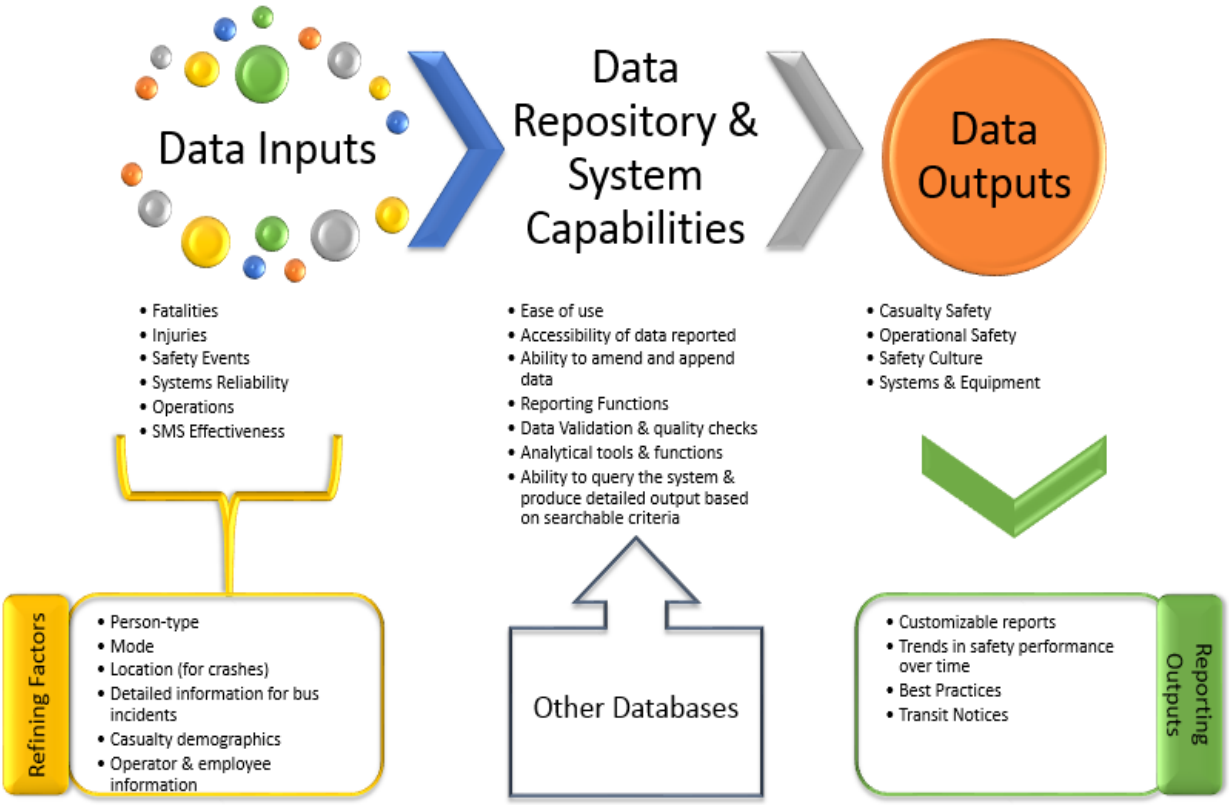

Figure 2: Safety Data and Performance Measures Input-Process-Output Model

Data Inputs: Safety Performance Measures Collected by Transit Agencies

While the measurement criteria set forth by the NSP are a good start, more is necessary to move safety performance measurement in public transportation forward. Increased granularity of data collected and reported not only assists transit agencies in implementation and continuous improvement of SMS processes, but also aids improvements in safety performance measures at the national level through comparison, benchmarking, and communication between agencies on hazard mitigation and risk control strategies.

Fatalities

Proposed NSP Measure

SAFETY PERFORMANCE CRITERION: FATALITIES *(total number of reportable fatalities and rate per total unlinked passenger trips by mode)*

(Customer, employee, and public)

- Paratransit – measured relative to total unlinked passenger trips
- Bus – measured relative to total unlinked passenger trips
- Rail – measured relative to total unlinked passenger trips
- Other modes – measured relative to total unlinked passenger trips

The proposed NSP fatality criterion is distinguished by person-type and mode. Fatalities are reported to the NTD on the major safety event form of the S & S module. While the NSP calls for the calculation of fatalities per unlinked passenger trip by mode, there is concern that there is no standard metric for reporting fatalities by mode. For example, currently, the NTD reports fatalities per 100,000 revenue miles, while New York Transit measures fatalities per one million revenue miles.

Injuries

Proposed NSP Measure

SAFETY PERFORMANCE CRITERION: INJURIES *(total number of reportable[12] injuries and rate per total unlinked passenger trips by mode)*

(Customer, employee and public)

- Paratransit – measured relative to total unlinked passenger trips
- Bus – measured relative to total unlinked passenger trips
- Rail – measured relative to total unlinked passenger trips
- Other modes – measured relative to total unlinked passenger trips

The NSP criterion concerns injuries related to the movement of a revenue vehicle. However, when reporting in the NTD, transit agencies are required to submit safety and security incidents occurring on

[12] "Reportable" means the following information that is reported to the NTD:
A safety or security incident occurring on transit property or otherwise affecting revenue service that results in one or more of the following conditions:
- A fatality confirmed within 30 days of the incident;
- An injury requiring immediate medical attention away from the scene for one or more persons;
- Property damage equal to or exceeding $25,000;
- An evacuation for life safety reasons; or
- A mainline derailment.

Also, in the SSO final rule and all future safety rulemakings we are defining “reportable accident/incident” in terms of injuries as:
A report of a serious injury (Accident). OR A personal injury that is not a serious injury; one or more injuries requiring medical transport (Incident).

transit property or affecting revenue service. Therefore, there is a lack of consistency in reportable injuries between what NTD requires and what FTA is proposing in their NSP.

Safety Events

Proposed NTSP Measure

SAFETY PERFORMANCE CRITERION: SAFETY EVENTS *(total number of reportable[12] events and rate per total vehicle miles, by mode)*

- Derailments
- Collisions
- Fires
- Evacuations for life safety

Safety events include derailments, collisions, fires, and evacuations. Information reported to the NTD on safety events used to include a dollar threshold, reportable safety events included those that exceeded $25,000. However, recently FTA has eliminated this dollar threshold leaving ambiguity over whether non-major safety events are reportable along with major ones.

Systems Reliability

Proposed NSP Measure

SAFETY PERFORMANCE CRITERION: SYSTEM RELIABILITY *(mean distance between failures by mode)*

- Total vehicle miles operated divided by total failures for each mode of service operated, based on the NTD definitions (FTA 2014).
    1. Major Mechanical System Failures: Major mechanical system failures prevent a vehicle from completing or starting a scheduled revenue trip because actual movement is limited or because of safety concerns. Examples of major bus failures include breakdowns of brakes, doors, engine cooling systems, steering, axles, and suspension.
    2. Other Mechanical System Failures: Other mechanical system failures prevent a vehicle from completing or starting a scheduled revenue trip even though the vehicle is physically able to continue in revenue service without creating a safety concern. Common examples include breakdowns of fare boxes, wheelchair lifts, heating, ventilation, and air conditioning (HVAC) systems.

The system reliability criterion is broad and there is concern for smaller agencies that reporting may be burdensome, therefore system reliability measures should be limited to those concerning safety critical systems. Safety-critical systems and subsystems “are those systems whose failures could result in loss of

life, significant property damage, or damage to the environment."[13] If failure of a system leads to outcomes that are unacceptable, then that system is safety-critical.

Operations Performance Measures

Category	Performance Measure	Leading/Lagging Indicator	Who Owns and Maintains Data
Incidents	Rate of major incidents (normalized per passenger trip, vehicle mile, passenger mile)	Lagging	FTA; NTD
Incidents	Ratio of major/all incidents	Leading & Lagging	FTA; NTD
Rule Violations	Rate of rule violations (normalized as above)	Leading	Transit Agency; report to SSO
Rule Violations	Rule violations weighted by seriousness (normalized as above)	Leading	Transit Agency; report to SSO
Errors	% of total incidents related to operator error	Lagging	Transit Agency; report to SSO
Fitness for Duty	% of total incidents related to operator fitness for duty	Lagging	Transit Agency; report to SSO

Operations performance measures concern safety risks related to transit operations. Reportable major incidents, which are safety events that relate to or affect revenue service, include fatalities, injuries, property damage, evacuations, and derailments. Currently, only rate of major incidents normalized by exposure and ratio of major incidents to all incidents are computable using NTD data. However, more detail is necessary in order to understand safety risks related to transit operations.

Major incidents can provide a wealth of data that may allow FTA to identify more refined incident performance measures that target specific areas of concern, such as incidents related to rule violations. Transit agencies should report rule violations, both the rate of rule violations, as well as rule violations weighted by seriousness of the incident. Rule violations are leading indicators that can assist transit agencies in identifying and understanding hazards and lead to risk control and mitigation strategies. In addition, transit agencies should report on errors and fitness-for-duty. For example, reporting on how many incidents were attributed to operator error, error on the part of a third party, or fitness-for-duty.

[13] Knight, J.C. (2002). Safety critical systems: Challenges and directions. *ICSE '02: Proceedings of the 24th International Conference on Software Engineering*, 547-570.

There is a lot of diversity in transit agencies and modes; therefore, composite measures may be most appropriate. For example, potential elements of a composite rule violation statistic, weighted by seriousness of the incident, could include:

- number of traffic tickets (normalized by distance/trips)
- recorded speeding events (normalized by distance/trips)
- failed drug/alcohol tests (normalized by number of employees/trips)
- signal passed at danger/run red lights (normalized by distance/trips)

SSOs maintain databases of the transit agencies that fall under their purview, and these databases require regular monitoring for trends in operations safety measures.

Detailed safety performance measures are necessary as transit agencies begin moving their SMS processes forward. Furthermore, more detailed breakdowns of incidents can aid FTA and transit agencies in tracking progress toward specific incident reduction goals.

SMS Performance Measures

Currently, transit agencies do not report to the NTD on SMS performance measures, although individual transit agencies may collect them. SMS performance measures constitute leading safety indicators that can aid transit agencies in the continuous improvement of their SMS process and safety in general. Examples of potential SMS performance measures outlined in the following table.

Category	Performance Measure
SMS Maturity Index	Change in average SMS maturity assessment from baseline (reported by mode and system size)
Responsiveness to national safety recommendations	Percent of high-priority safety recommendations adopted by transit agencies (reported by mode and system size)
Corrective actions in response to identified hazards	Average days to implement corrective actions
Staff training	Percent of Full-time Equivalent Employees that meet training and certification guidelines
Safety Audits	Percent of planned safety audits completed on time (Agency or SSO audits)

While SMS performance measures may not be necessary to report on a national level, they can aid individual transit agencies in continuing to move safety forward.

Refining Factors: Data Granularity for Safety Performance Measures

Regardless of the type of safety event being reported, transit agencies should seek to collect detailed data that could aid agencies and FTA in developing more refined safety performance measures and targets. These details should not necessarily be collected for all types of incidents, but should be collected and reported for major events that result in a fatality, serious injury[14], or significant damage (see recommendation 8). Furthermore, the collection and reporting of more granular safety data should be considered in conjunction with the sizes and capacities of transit agencies. Examples of increased data granularity include:

- person-type (e.g., employee, patron, passenger, member of the public);
- mode (e.g., light rail, commuter rail, fixed-route bus, ferryboat, etc.);
- location (for crashes);
- roadway functional class and track type;
- casualty demographic information;
- operator level of experience; and
- accident cause.

Person-type and Mode

All fatality, injury, and safety incident data should be distinguishable by person type and mode. Person-type refers to the classification of individuals who fall victim to, or are injured in an incident. For example, person type should include reporting fields for employee, patron, passenger, and member of the public. The employee classification should be distinguishable by operator or other employee type, while the member of the public classification should be further distinguishable by pedestrian, bicyclist, and other vehicle occupant. The mode of transit classification should include such distinctions as bus, light rail, heavy rail, ferryboat, etc.

Location, Roadway Functional Class, and Track Type

Crashes require location data. Location data could include latitude/longitude, geographical information system (GIS), global positioning system (GPS), or characteristics of safety event location (e.g., intersection, 4-way stop). However, location data reporting should be consistent and standardized such that all transit agencies report location in the same format.

Accident investigations are currently conducted for both rail and bus transit systems when an accident occurs. However only rail transit accidents are reportable to the SSO agency. There is no standard in accident investigation for bus modes. However, transit agencies should collect data such as location, time of day, weather, road condition, posted speed, and roadway type (e.g., intersection, straightaway).

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[14] 49 CFR Part 674 defines serious injury as any injury which:

1. Requires hospitalization for man than 48 hours, commencing within 7 days from the date of the injury received;
2. Results in a fracture of any bone (except simple fractures of fingers, toes, or nose);
3. Causes severe hemorrhages, nerve, muscle, or tendon damage;
4. Involves any internal organ; or
5. Involves second- or third- degree burns, or any burns affecting more than 5 percent of the body surface.

When accidents do occur, transit officials and local police may investigate, and transit agencies should utilize this information in accident investigation data reporting.

Casualty Demographic Information

When a casualty occurs, transit agencies should collect demographics of the individual(s) involved. While the Health Insurance Portability and Accountability Act (HIPAA) makes collecting demographic information difficult, transit agencies should attempt to collect this information to target public outreach safety campaigns. Transit agencies should utilize information from both police reports and coroner's reports in their data collection and reporting efforts. At the national level, demographic information may aid FTA in providing guidance and developing national safety campaigns. Other uses of demographic data at the national level include increased communication between transit agencies that may be experiencing the same or similar issues regarding demographic characteristics of accident victims.

Operator Level of Experience

Furthermore, transit agencies should be collecting and reporting information on their operators and employees. For example, operator's level of experience and hours-of-service may be particularly relevant to casualty and safety incident measures. Operator and employee information can provide insight into the level of training of the individual, and whether the individual may have been too fatigued to operate a vehicle.

Accident Cause

Determination of accident causes can be useful at the transit agency, state, and national level. For example, it is important to determine the causal contributions of public error, operator error, and/or environmental conditions, such as weather and road conditions.

The use of more detailed data can assist transit agencies at the local, state, and national level by aiding in the development of more refined safety performance measures and targets. The use of safety performance data at the national level can benefit transit agencies through the ability to engage in comparisons and benchmarking in the efforts to drive continuous improvement of SMS processes.

Data Repository & System Capabilities: An Improved Reporting Platform

While the NTD is a good repository for fatality and injury data, the large amount of information reported to the NTD is not readily accessible by transit agencies. Accessibility of data reported is necessary for transit agencies as they develop, implement, and improve their SMS processes. The following is an outline of the functionalities of an improved reporting system.

Data Collection and Reporting of Information

First, like the NTD, an improved reporting platform needs to be web-based, with data entered directly into a web-based platform to ease the burden of data entry. However, unlike the NTD that collects information monthly and quarterly, an improvement would include a web-based tool for simultaneous internal and external (reportable) data input immediately after an accident has occurred. Furthermore, to assist in data consistency, SSO and transit agencies should be able to input data into the same web-

based form that could pre-populate some data fields. Moreover, transit agencies and SSOs should be able to utilize mobile entry of data at the scene of a safety event or during the safety auditing process. This would allow the transit agency to upload data in real-time, with the possibility of adding photographs or diagrams to the database when accident investigations are being conducted. Additionally, data should be modifiable following entry into the system. Fields for inputting police and medical reports should also be available.

Analytical and Reporting Capabilities

An improved reporting platform would benefit from analytical tools. FTA should develop analytical tools that a local transit agency or SSO could use for their own purposes. These would include tools for root-cause analysis and for developing hazard mitigation strategies that local transit agencies could utilize for investigations and risk control. Tools should be generic and standardized to allow for their use across a wide variety of modes. Furthermore, reporting and analytical functions should include mapping capabilities, and users should have the ability to query the system to obtain outputs that are more detailed. For example, users should be able to look up the number of accidents that occurred at a certain time of day during rainy weather conditions.

Currently, the NTD reports statistics on individual transit agencies every year. However, these reports are brief and include no detailed information on safety performance measures. An improved reporting platform should allow a transit agency to produce customized reports and examine safety trends over time. Additionally, transit agencies should be able to query the system to produce peer reports for other transit agencies based on a set of comparison criteria (e.g., like-sized agency, safety measurement results on passenger miles by mode, grade crossing collision rates by type of grade crossing, etc.).

Data Quality and Confidentiality

An improved reporting platform would benefit from data quality checks and consistent validation efforts. Currently, NTD's validation process is time consuming and a burden for transit agencies and SSOs. An improved reporting platform should have fields for edit checks that generate an automatic response to indicate if data entered may be inaccurate. Additionally, critics of the NTD state that it is not very user friendly. An improved reporting platform would need to be user friendly and would benefit from readily accessible definitions to ease reporting by transit agencies and SSOs. Additionally, an improved reporting platform would need to ensure confidentiality of personally identifiable information (PII), and protect this data from public distribution.

Furthermore, an improved reporting platform would benefit from field validation checks and real-time error trapping. Currently, no one reviews or questions data collected in the field prior to entering it into the NTD. However, data validation and accuracy is a critical component of SMS processes. More consistent validation efforts could be conducted through SSO triennial audit process as data validation serves as a check and balance process.

Data & Reporting Outputs: Safety Performance Measures and Reporting Functions

Through standardized data and reporting efforts, and the reporting of safety performance criteria established by the FTA, transit agencies should be able to query an improved reporting platform and

receive detailed information pertinent to specified data queries (e.g., like-sized agencies). Data outputs of interest to transit agencies, SSOs and/or FTA fall into the following broad categories:

- Casualty safety
- Operational safety
- System and Equipment Safety
- Safety Culture

It is important to note that the following measures are ***suggested data outputs*** that transit agencies, SSOs, and/or FTA would like to see following a data system query of leading and lagging safety performance measures. Thus, the measures that follow are not recommendations; rather they are elements that inform the safety assurance process of transit agencies. Transit agencies may currently collect some or all of these measures in their agency-specific safety performance databases.

Casualty Safety[15]

Accident Rate

The number of accidents per specified distance or time

Examples:	vehicle accidents, pedestrian accidents
Modes:	all
Scope:	route, system
System Size:	any
Audience:	public, FTA, SSOs, transit agencies

Data requirements: accident records, odometers, driver logs
Data type: lagging indicator

Passenger Safety

Rate at which incidents or accidents occur in relation to passenger movement

Examples:	fatal accidents per passenger trips or miles; injury accidents per passenger trips, property damage only passenger accidents per passenger trip, response time, incident/accident durations
Modes:	all
Scope:	route, system
System Size:	any
Audience:	public, FTA, SSOs, transit agencies

Data requirements: Transit agencies collect data on fatalities, injuries, and property damage and report this information to the NTD. Response time and incident/accident duration times are not reported to

[15] Transit Cooperative Research Program (TCRP) Report 88. (2003). A Guidebook for Developing a Transit Performance Measurement System.

the NTD, but can be estimated based on incident/accident reports from law enforcement agencies and the state department of motor vehicles.
Data type: Traditionally used as a lagging indicator. However, when examined in a regional perspective, it becomes a community-leading indicator.

Employee Work Days Lost to Injury

Employee injuries resulting workdays lost due to absence

Modes: all, excluding small and rural bus systems
Scope: system
System Size: any
Audience: FTA, SSOs, transit agencies

Data requirements: Payroll or workers compensation record identifying employee time off due to injury. Marking injuries that resulted in 1-5 days lost and more than 5 days lost, or using more granular categories, can capture injury severity.
Data type: Lagging indicator. When tracked by department or type of injury, it can help focus attention on specific unsafe practices or work environments.

Number of Fires

Number of fires per year or per million passenger miles traveled

Modes: all, excluding small and rural bus systems. Frequently used by rail systems with underground sections
Scope: system
System Size: any
Audience: FTA, SSOs, transit agencies

Data requirements: Incident logs
Data type: Lagging indicator. Fires can be further classified by vehicle, station/transit, passenger public area, and other infrastructure.

Number of Mainline Derailments

Number of mainline derailments per year or per million passenger miles travelled

Modes: rail
Scope: route, system
System Size: any
Audience: FTA, FRA, SSOs, transit agencies

Data requirements: Incident logs.
Data type: Lagging indicator.

Number of Yard Derailments

Number of yard derailments per year or per million passenger miles travelled

Modes: rail
Scope: route, system
System Size: any
Audience: FTA, FRA, SSOs, transit agencies

Data requirements: Incident logs.
Data type: Lagging indicator.

Number of Evacuations for Life Safety

Number of evacuations for life safety per year or per million passenger miles travelled

Modes: all, excluding small and rural bus systems
Scope: route, system
System Size: any
Audience: FTA, SSOs, transit agencies

Data requirements: Incident logs.
Data type: Lagging indicator.

Operational Safety[15]

Percent of Revenue Vehicles Exceeding the Speed Limit

Number of revenue vehicles exceeding the speed limit per million vehicle miles travelled.

Modes: all, excluding small and rural bus systems
Scope: route, system
System Size: any
Audience: FTA, SSOs, transit agencies

Data requirements: Speeding tickets, data recorders, number of observations.[16]
Data type: Leading indicator.

Number of Station Overruns

Number of station overruns per year or per million passenger miles travelled

Modes: rail
Scope: system
System Size: any
Audience: FTA, SSOs, transit agencies

Data requirements: Logs from equipment used to monitor train positions.
Data type: Leading indicator.

Number of Rule Violations

Number of rule violations per million passenger miles travelled

Modes: all, excluding small and rural bus systems
Scope: system
System Size: any
Audience: SSOs, transit agencies

Data requirements: Inspections, investigations, and/or audits and their frequency.[17]
Data type: Leading indicator.

[16] May also need to be normalized by speed-observation frequency.
[17] May also need to be normalized by rule compliance observation frequency.

System and Equipment Safety[15]

Road Calls

Number of unplanned revenue service road calls per specified distance and time

Modes: all, excluding small and rural bus systems
Scope: system
System Size: any
Audience: FTA, SSOs, transit agencies

Data requirements: Maintenance records, vehicle miles.
Data type: Leading indicator.

Number of Safety-Critical System Failures

Number of failures in safety-critical systems identified per specified distance and time

Modes: all, excluding small and rural bus systems
Scope: system
System Size: any
Audience: FTA, SSOs, transit agencies

Data requirements: Incident logs, maintenance records, vehicle miles.
Data type: Lagging or leading indicator.

Number of Defects

Number of defects reported per specified distance and time

Modes: all, excluding small and rural bus systems
Scope: system
System Size: any
Audience: FTA, SSOs, transit agencies

Data requirements: Incident logs, maintenance records, route miles, vehicle miles.
Data type: Leading indicator.

Safety Culture[15]

Percent Positive Drug/Alcohol Tests

Number of positive drug/alcohol tests per total employees tested

Modes: all
Scope: system
System Size: any
Audience: FTA, SSOs, transit agencies

Data requirements: Product of random drug testing program.
Data type: Leading indicator.

Number of Traffic Tickets Issued to Operators

Number of traffic tickets issued to operators per total number of operators

Modes: all, excluding small and rural bus systems
Scope: system
System Size: any
Audience: FTA, SSOs, transit agencies

Data requirements: Motor vehicle records for operators.
Data type: Leading indicator.

Benefits of an Improved National Database on Transit Safety Performance Measures

A national database of transit safety performance measures is in the interest of transit agencies, the states, employees, the public, and the FTA. First, a national database would allow transit agencies to engage in benchmarking and comparisons. The additional benefit is that based on the information available, transit agencies could generate peer reports stimulating communication between agencies on hazard mitigation strategies. A more efficient national database on safety performance measures would ease reporting requirements for SSOs and allow SSOs to utilize the system to examine trends and other analyses in the examination of progress towards meeting safety performance targets. An improved national database would also benefit FTA through a more thorough examination of safety performance targets. Furthermore, more detailed data inputs and outputs could aid FTA in establishing best-practice documentation on risk control and hazard mitigation strategies, as well as more easily track trends that would warrant the issue of transit notices.

Recommendations

In an effort to identify safety performance measures, reporting tools, and processes that can promote continuous improvement in transit agencies of various sizes and modes, the Committee recommends the following be considered by FTA for implementation.

Data Inputs

1. FTA should report fatalities by both revenue miles traveled by mode, as well as per total unlinked passenger trips by mode. This eases comparison by mode of transportation, as NTD currently reports number of miles traveled by mode.
2. FTA should allow transit agencies the ability to append data and injury documentation submitted to the NTD. For example, currently transit agencies must report on an injury if a fatality occurred within 30 days of an incident; however if the fatality occurs 31 days following the incident, FTA does not consider this reportable as a fatal incident. Furthermore, like fatalities, FTA should report injuries by both revenue miles traveled by mode, as well as per total unlinked passenger trips by mode.
3. FTA should clarify the reporting of safety events to include sensible thresholds for reporting. TRACS believes that reporting of safety events would benefit from clarification and standards. Thresholds set parameters for reporting. FTA should both consider inflation-adjusted dollar thresholds for reportable safety events, as well as other factors that would contribute to clarifying thresholds for transit agencies. Thresholds should be appropriately scaled taking into consideration the sizes and capacities of transit agencies.
4. FTA should develop and implement non-punitive, confidential close-call safety reporting systems for transit agencies and modes that fall under their purview. Near misses constitute leading safety performance indicators. Near-miss data should undergo frequent analysis and monitoring to help identify trends that can help transit agencies in hazard identification, mitigation, and risk control strategies, furthering their SMS processes. The NTSB notes that establishing such safety reporting systems “would enable FTA to identify risks and develop

controls to address and mitigate or eliminate those risks, including unusual or aberrant conditions, and to identify meaningful [safety] performance criteria."[18] FTA should report on the trends of near-miss incidents and the interventions implemented by transit agencies to mitigate them, aiding in continuous improvement efforts.

5. Public transportation contains many systems and sub-systems, both operational and mechanical, whose failures could lead to detrimental outcomes. FTA should support and document functional analyses of safety-critical systems in both rail and non-rail modes to determine the components and sub-components whose failures could result in catastrophic events. These systems and sub-systems need regular monitoring and data collection to ensure they are functioning at optimum levels. Furthermore, when transit agencies encounter failures and issues of safety-critical systems and sub-systems, especially if the failures trigger a fleet-wide inspection, there should be a platform with which to share lessons learned with the rest of the transit industry. This would aid in the development of risk control and hazard mitigation strategies central to SMS processes.
6. FTA should research and develop SMS effectiveness measures and provide transit agencies with tools and guidance on how to assess SMS processes and effectiveness. Transit agencies that have implemented SMS processes need to know that their processes are working and need to know the next steps to aid in continuous improvement in order to more fully develop a well-defined SMS maturity model. The four pillars of SMS (safety policies, safety risk management, safety assurance, and safety promotion) should serve as the basis for research and development of SMS effectiveness measures. SSOs and transit agencies should use the developed SMS effectiveness tools and measures when conducting safety audits.
7. FTA should provide guidance on the data requirements, policies, and practices that would constitute an effective SMS for transit agencies. It is not enough to say that SMS is flexible to the size of the transit agency. Furthermore, when developing SMS effectiveness measures, FTA should be considerate of the size and location of transit agencies, keeping in mind appropriate scalability for transit agency size and capacity. *This recommendation should be given a high priority by FTA, as this information will be very helpful to transit agencies as they integrate SMS into their organizations.*

Increased Granularity of Reportable Data

8. FTA should require that detailed safety event data be collected and reported to the NTD in the event of the following: fatality, serious injury, and/or a serious damage (TRACS recommends that major accident be defined as any accident resulting in $25,000 or more in damage and that this amount be adjusted annually accordingly with inflation). FTA should develop a streamlined process and tools for the collection of detailed safety data so the process is appropriately scaled for transit agencies of differing sizes and capacities and not overly burdensome. Moreover, FTA

[18] National Transportation Safety Board. (2014, February 13). Response to Docket No. FTA-2013-0030 (RIN 2123-AB20, 2132-AB07).

should report annually, based on the data collected, the Top 5 Safety Incidents, Hazards, and Rule Violations that contribute to risk by mode.

Data Repository and System Capabilities

9. FTA should update the NTD or develop a new reporting system to support the ideal system functionalities detailed through this report to include ease of use, ability to query the system, more consistent data validation and quality-check efforts, ability to amend and append data as needed, and analytical tools and reporting functions. FTA should develop a working group of transit officials from various agencies to provide guidance on the functions and system capabilities of an improved web-based reporting platform for safety performance data.
10. FTA should link the NTD (or new reporting system) and the Drug and Alcohol Management Information System (MIS) databases that would allow transit agencies to query based on the number of positive drug and alcohol tests documented at their agencies. This feature should also allow agencies to compare their pass/fail test rates with peer agencies' rates.
11. FTA should establish more communication and collaboration between the Transit Safety Office (TSO) and the NTD.
12. FTA should provide guidance and clarity to transit agencies on requirements for collection of safety performance measures while taking into account differences in size and mode of agencies. Safety performance measures should be beneficial to all transit agencies under FTA's purview, and must not only be beneficial to large agencies, but also not overly burdensome to small and rural transit agencies. Small and rural agencies express concern that the number of safety measures proposed will be more burdensome to report given the low rates of crashes and fatalities that they experience.
13. While security events were not explicitly stated in the tasking statement, the committee recommends that FTA continue to collect data on security-related events, and produce an annual report on the top security trends in the industry that details best practices that transit agencies have adopted in efforts to mitigate those trends.

Conclusion

Safety is not achievable unless clear safety goals are established, safety performance measures are defined, and safety data is gathered, analyzed, and utilized in productive ways to drive improvement.