TCRP

REPORT 149

TRANSIT
COOPERATIVE
RESEARCH
PROGRAM

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Improving Safety-Related Rules Compliance in the Public Transportation Industry

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TCRP REPORT 149

Improving Safety-Related Rules Compliance in the Public Transportation Industry

Judith Gertler
Amanda DiFiore
QinetiQ North America, Inc.
Technology Solutions Group
Waltham, MA

Gordon Hadlow
Fort Collins, CO

Alan Lindsey
Lantana, TX

Roy Meenes
Carlsbad, CA

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TRANSIT COOPERATIVE RESEARCH PROGRAM

The nation's growth and the need to meet mobility, environmental, and energy objectives place demands on public transit systems. Current systems, some of which are old and in need of upgrading, must expand service area, increase service frequency, and improve efficiency to serve these demands. Research is necessary to solve operating problems, to adapt appropriate new technologies from other industries, and to introduce innovations into the transit industry. The Transit Cooperative Research Program (TCRP) serves as one of the principal means by which the transit industry can develop innovative near-term solutions to meet demands placed on it.

The need for TCRP was originally identified in *TRB Special Report 213—Research for Public Transit: New Directions,* published in 1987 and based on a study sponsored by the Urban Mass Transportation Administration—now the Federal Transit Administration (FTA). A report by the American Public Transportation Association (APTA), Transportation 2000, also recognized the need for local, problem-solving research. TCRP, modeled after the longstanding and successful National Cooperative Highway Research Program, undertakes research and other technical activities in response to the needs of transit service providers. The scope of TCRP includes a variety of transit research fields including planning, service configuration, equipment, facilities, operations, human resources, maintenance, policy, and administrative practices.

TCRP was established under FTA sponsorship in July 1992. Proposed by the U.S. Department of Transportation, TCRP was authorized as part of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA). On May 13, 1992, a memorandum agreement outlining TCRP operating procedures was executed by the three cooperating organizations: FTA, the National Academies, acting through the Transportation Research Board (TRB); and the Transit Development Corporation, Inc. (TDC), a nonprofit educational and research organization established by APTA. TDC is responsible for forming the independent governing board, designated as the TCRP Oversight and Project Selection (TOPS) Committee.

Research problem statements for TCRP are solicited periodically but may be submitted to TRB by anyone at any time. It is the responsibility of the TOPS Committee to formulate the research program by identifying the highest priority projects. As part of the evaluation, the TOPS Committee defines funding levels and expected products.

Once selected, each project is assigned to an expert panel, appointed by the Transportation Research Board. The panels prepare project statements (requests for proposals), select contractors, and provide technical guidance and counsel throughout the life of the project. The process for developing research problem statements and selecting research agencies has been used by TRB in managing cooperative research programs since 1962. As in other TRB activities, TCRP project panels serve voluntarily without compensation.

Because research cannot have the desired impact if products fail to reach the intended audience, special emphasis is placed on disseminating TCRP results to the intended end users of the research: transit agencies, service providers, and suppliers. TRB provides a series of research reports, syntheses of transit practice, and other supporting material developed by TCRP research. APTA will arrange for workshops, training aids, field visits, and other activities to ensure that results are implemented by urban and rural transit industry practitioners.

The TCRP provides a forum where transit agencies can cooperatively address common operational problems. The TCRP results support and complement other ongoing transit research and training programs.

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The members of the technical panel selected to monitor this project and to review this report were chosen for their special competencies and with regard for appropriate balance. The report was reviewed by the technical panel and accepted for publication according to procedures established and overseen by the Transportation Research Board and approved by the Governing Board of the National Research Council.

The opinions and conclusions expressed or implied in this report are those of the researchers who performed the research and are not necessarily those of the Transportation Research Board, the National Research Council, or the program sponsors.

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FOREWORD

By Dianne S. Schwager
Staff Officer
Transportation Research Board

TCRP Report 149: Improving Safety-Related Rules Compliance in the Public Transportation Industry was developed as a resource for improving safety-related rule compliance in the public transportation industry. Transit agencies should view the practices as ideas for consideration when looking for ways to improve an existing rules compliance program or when designing a program for a new operation. This report will be of interest to public transit professionals who play a role in a transit agency's rules compliance program, including the safety director, rules program officials, training director, or supervisors involved in daily oversight of transit operations and maintenance.

The critical importance of safety to the public transportation industry makes compliance with safety-related rules a key concern. Despite the industry's solid safety record, one major accident stemming from rule noncompliance can call into question the safety of the entire industry. While APTA's adoption of a voluntary standard for rule compliance in 2004 is an important step, more remains to be done. Of particular concern are safety-related rules that are designed to prevent high-consequence events, especially those where the public is affected or where there may be harm to transit agency employees.

Safety-related rules apply to employees involved in the operation and maintenance of the transit system. This includes vehicle operators, dispatchers, and other operations personnel, as well as those who maintain the vehicles and track infrastructure. With few exceptions, the practices described in this report are applicable to all public transit modes and are scalable to the size of the transit agency.

QinetiQ North America conducted the research for TCRP Project A-34. The research began with a comprehensive review of safety-related and organizational research that identified proven approaches for improving rules compliance in public transportation and other safety-critical industries, including the railroad, aviation, trucking, motorcoach, and petrochemical industries. Using criteria relevant to public transportation, the research team selected best practices for improving safety-related rule compliance.

Achieving safety-related rule compliance requires more than monitoring for noncompliance and responding to it when it occurs. It requires preventive actions designed to encourage compliant behavior. This document suggests best practices for all of the elements of a comprehensive approach to safety-related rules compliance. The categories of best practices, which correspond to the elements of a safety-related rules compliance program, are the following:

- Screening and Selecting Employees
- Training and Testing

- Communication
- Monitoring Rules Compliance
- Responding to Noncompliance
- Safety Management

The report also presents best practices for a prototype safety reporting system for public transportation. The safety reporting systems for aviation, railroading, and firefighting as well as two systems in the public transportation industry were investigated and were the basis for the prototype safety reporting system. The focus of this investigation was on understanding how the safety reporting system was developed, stakeholder concerns during system design, key features and provisions of each, and experiences to date.

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Note: Many of the photographs, figures, and tables in this report have been converted from color to grayscale for printing. The electronic version of the report (posted on the Web at www.trb.org) retains the color versions.

CHAPTER 1

Introduction

To address safety-related rule noncompliance by transit operators, the American Public Transportation Association (APTA) adopted a voluntary standard for compliance testing in light and heavy rail transit systems. While this standard is an important step toward achieving safe operating practices in the public transportation industry, more remains to be done.

Recent incidents resulting from violations of safety-related rules have called into question the safety of public transportation. Most notable was the September 2008 commuter rail crash in Chatsworth, California, that killed 25 and injured 135 others. The National Transportation Safety Board (NTSB) concluded that "the probable cause . . . was the failure of the Metrolink engineer to observe and appropriately respond to the red signal . . . because he was engaged in prohibited use of a wireless device . . . that distracted him from his duties." (NTSB 2010). Texting has also been implicated in a subsequent collision on the Massachusetts Bay Transportation Authority (MBTA) Green Line in May 2009. Most recently, NTSB's report on the June 2009 collision of two Washington Metropolitan Area Transit Authority (WMATA) trains recommended that the Federal Transit Administration (FTA) facilitate the development of a nonpunitive safety reporting system at all public transit agencies. The purpose of such a system would be to collect reports from all employees regarding near-misses and unsafe conditions. Under TCRP Project A-34, this project had the objective to develop a resource for improving safety-related rule compliance in the public transportation industry because of the potentially serious consequences of safety-related rule noncompliance.

Intended Report Usage

The information, methods, and techniques in this report are designed to be administered by the public transit professional who plays a role in a transit agency's rules compliance program. This might be the safety director, rules program officials, training director, or supervisors involved in daily oversight of transit operations and maintenance. Not all tools and strategies will work at a particular transit agency because of cultural and operational differences. With few exceptions, the practices described in Chapter 4 are applicable to all public transit modes and are scalable to the size of the transit agency. Transit agencies should view the practices as ideas for consideration when looking for ways to improve an existing rules compliance program or when designing a program for a new operation.

Safety-related rules apply to employees involved in the operation and maintenance of the transit system. This includes vehicle operators, dispatchers, and other operations personnel, as well as those who maintain the vehicles and track infrastructure. The scope of this report is primarily on safety-related rules that are designed to prevent high consequence events, especially those where the public is affected or where there may be harm to transit agency employees.

Development of *TCRP Report 149*

The research began with a comprehensive review of safety-related and organizational research that identified proven approaches for improving rules compliance in public transportation and other safety-critical industries. A review of accident reports prepared by NTSB and two state agencies identified the errors or rule violations that caused or contributed to public transit accidents. Structured interviews with safety officials in the public transportation industry as well as the railroad, aviation, trucking, motorcoach, and petrochemical industries were used to gather information on rule compliance best practices in each industry. The interviews covered approaches for preventing and managing noncompliance stemming from both errors and violations.

Using criteria relevant to public transportation, the research team selected best practices for improving safety-related rule compliance. The applicability of each of the best practices to transit agencies of different sizes and different transit modes was assessed.

Separately, existing safety reporting systems for aviation, railroading, and firefighting as well as two systems in the public transportation industry were investigated. The focus of this investigation was on understanding how the system was developed, stakeholder concerns during system design, key features and provisions of each, and experiences to date. Best practices for a prototype safety reporting system for public transportation drew on the experiences of the other systems.

All these elements—literature review, accident report review, selected best practices, design of a public transportation safety reporting system—plus feedback from the TCRP Project A-34 panel formed the basis for the content of this report.

How to Use *TCRP Report 149*

Achieving safety-related rule compliance requires more than monitoring and responding to noncompliance when it occurs. It requires preventive actions designed to encourage compliant behavior. It begins with the prospective employee screening and hiring process. By hiring employees who are not likely to engage in risky behavior, noncompliance with safety-related rules is less likely to occur. Once hired, the training program must teach proper application of the rules as well as their purpose. The training program must also provide ample opportunity for the employee to practice application of the rules while receiving coaching and positive feedback. Once on the job, effective communication methods will reinforce compliant behavior and provide the means to communicate changes in the rules. Ideally, every public transit agency has a safety management system or a mechanism for employees to report safety risks and concerns without risk of punitive consequences. *TCRP Report 149* suggests best practices for all the elements of a comprehensive approach to safety-related rules compliance. The categories of best practices, which correspond to the elements of a safety-related rules compliance program, are the following:

- Screening and Selecting Employees
- Training and Testing
- Communication
- Monitoring Rules Compliance
- Responding to Noncompliance
- Safety Management

Recommended Steps

The following is the recommended approach for most effectively using this report:

1. First, develop an understanding of the various factors that can lead to rule noncompliance by reading Chapter 2. This is a prerequisite to developing a new safety-related rules compliance pro-

gram as well as improving an existing one. Chapter 2 explains the nature of rule noncompliance and the reasons it occurs. Without understanding the underlying reason(s) for the noncompliance, efforts to correct it and prevent future occurrences may be ineffective. Chapter 2 also provides background information and research on issues related to encouraging compliance.

2. Next, read Chapter 3 which lays out a structure for classifying noncompliance. The noncompliance structure defined here provides a methodology for examining an instance of rule noncompliance to determine its root or underlying cause(s).
3. Review the checklist in Table 1. This checklist uses the six program elements listed above. For each "yes" item, read the description of the related best practice(s) to see if improvements in

Table 1. Safety-related rules compliance program checklist.

Checklist Questions	Practices
Screening and Selecting Employees	
Do you screen for risk-taking behavior when you evaluate candidates for employment?	Screening and selecting employees
Training and Testing	
Does your rules training program follow effective preparatory practices?	Effective training preparation
Does your rules training explain the purpose of the rule?	Information transfer methods
Does your rules training demonstrate the application of the rule?	Information transfer methods Action-based rules training
Do you provide opportunity for trainee to practice or apply the rule?	Action-based rules training
Do you give feedback to the trainee during and after practice?	Action-based rules training
Do you incorporate teambuilding in your training?	Crew resource management
Do you measure the effectiveness of rules training?	Metrics highlighted in Chapter 4 Training and Testing
Communication	
Do you have communication strategies that reinforce the importance of adhering to rules?	Proactive rules communication
Do you provide a forum for your employees to raise questions or concerns regarding rules?	Opportunities to ask questions
Does your rules communication process ensure that the employees receive information about changes to rules?	Communicating changes to rules
Do you use positive safety language in your communications with employees?	Positive safety language
Do you have a mechanism for your customers to communicate about operator behavior?	Customer feedback
Monitoring Rules Compliance	
Do you have an operational testing program?	Operational testing
Do you have a method to observe employee behavior (interior or exterior to the vehicle)?	Observational methods
Do you have an automated means to collect data from the vehicle or signal system that allows you to detect noncompliant vehicle operation?	Automated methods
Do you review your accidents and/or incidents for rules noncompliance?	Chapter 3 Classifying Noncompliance
Do you have the ability to monitor radio communications?	Review radio transmissions

(continued on next page)

Table 1. (Continued).

Checklist Questions	Practices
Responding to Noncompliance	
Do you assign personnel to investigate each instance of noncompliance?	Chapter 3 Classifying Noncompliance
Do you identify the underlying cause(s) of noncompliant events?	Chapter 3 Classifying Noncompliance
Do you have a noncompliance classification system (levels that define severity of violation) that allows you to determine which corrective measures (training/coaching and/or discipline) apply?	Responding to noncompliance
Safety Management	
Does your process for evaluating your rules compliance program incorporate both leading and lagging indicators?	Assessing the rules compliance program
Do you have a rules review process that incorporates the views of both management and labor?	Encouraging employee involvement
Do you have a confidential, nonpunitive and voluntary means for employees to report near misses or unsafe conditions?	Reporting near-misses and other safety risks
Do you have a safety incentive program that rewards rules compliance and encourages desired behavior?	Incentivizing rules compliance

your transit agency's current program are possible. For each "no," consider whether or not the best practice is suitable for the agency. Chapter 4 describes each of the best practices listed in Table 1. Again, the best practices are grouped by the six program elements listed. The unique characteristics of a transit agency, such as size and modes, its existing rules compliance activities, and budgetary constraints will determine the combination of activities that are feasible for the organization. The best practice descriptions include potential metrics for measuring the impact of the practices.

4. If your transit agency is interested in implementing a safety reporting system, read Chapter 5. A safety reporting system is one of the best practices in the Safety Management group of best practices. Because the implementation of this type of system involves significant effort, a separate chapter addresses it.

TCRP Report 149 includes several appendices that complement the information in the various chapters. The best practices of Chapter 4 were developed based on the experiences of other industries as well as public transit agencies. Appendix A describes the practices and experiences of other industries and Appendix B provides similar information for the various public transit modes. Before formulating an approach to a safety reporting system for transit, the research team explored the experiences of other transportation modes as well as existing practices in the public transportation industry. Appendix C describes these safety reporting systems. Appendix D offers some Rules Compliance Program Success Stories as examples of successful approaches to achieving compliance. Finally, the table in Appendix E summarizes the effectiveness metrics that appear with the best practices in Chapter 4.

Initiating a Safety-Related Rules Compliance Program

For transit agencies that are initiating a safety-related rules compliance program for either an existing or new public transit service, consider the following approach:

1. Contact other public transit agencies offering similar services to learn from their experiences. The Success Stories in Appendix D as well as the callout boxes in Chapter 4 should help.
2. Begin by establishing a program for monitoring rules compliance, including metrics for measuring effectiveness. The Monitoring Rules Compliance section in Chapter 4 describes methods for doing this.
3. Develop policies that clearly define your transit agency's response to different types of noncompliance.
4. Next consider the screening and selection of employees, followed by new hire training.
5. Keep employees informed of the new rules compliance program as it is developed and implemented.
6. Consider a safety reporting system only after the other elements of your program are successfully operating.

If a contract operator provides your transit service, there are two key factors to ensure that the contract operator follows practices for safety-related rules compliance. They are the following:

- Include specific language in the contract as to what exactly is expected.
- Closely oversee the contractor operation to ensure that contract provisions are followed.

CHAPTER 2

Understanding Rules Noncompliance

A significant body of research exists regarding the factors that influence safety-related rules noncompliance including the reasons underlying errors and violations and ways to mitigate noncompliance. This chapter summarizes factors and mitigation strategies that are applicable to public transit operations. It describes the factors from a bottom-up perspective, concluding with a discussion of the role of safety culture and safety management in the rules compliance process.

Framework for Understanding Noncompliance

Just as there is no single cause of an accident, reasons for noncompliance are multifaceted. Noncompliance can be willful, a violation, or it can be unintentional, resulting from human error. Numerous error and violation taxonomies exist that differentiate among the underlying causes of noncompliant behavior. A popular error classification system, known as the skill-, rule-, knowledge-based (SRK) approach, was based on information processing models and is described in a number of publications (Rasmussen 1979, 1980, 1986; Reason 1990). Figure 1 presents an adaptation of the SRK model and includes other types of error classifications in the context of human information processing.

Knowledge-based errors occur when someone does not have the correct mental model or information to assess a situation, resulting in formation of an incorrect plan of action. These errors often occur when an individual has to work out solutions to a problem from "scratch." High pressure situations exacerbate problem solving by reducing cognitive resources. Inexperienced employees often fall prey to these types of errors.

In contrast, rule-based errors occur when an employee has a clear understanding of the situation, but either chooses an incorrect plan to deal with the situation or mis-executes a well-chosen plan. The outcome is poor. These types of decision-based errors arise when an employee is not adequately trained via classroom and field exposure to handle unexpected situations; the employee does not possess the strategies needed to address low-frequency events. Rule-based errors do not refer to an organization's rules. Rather, rules in the context of the SRK model refer to decision-making strategies a person has. (To prevent confusion regarding the term rules, the term strategy-based processing/errors is used in lieu of the term rule-based for the remainder of the report.)

Skill-based errors, also known as slips, occur when performance is highly automatic (as indicated by the dashed line in Figure 1) and a cue in the operational environment triggers the behavior at an inappropriate time (Norman 1981). While slips are errors of commission, lapses are errors of omission, resulting from memory failure. DiFiore and Cardosi (2006) found pilot reports of air traffic control (ATC) personnel who forgot that aircraft were holding in position on the runway (a lapse) and cleared another aircraft to land on the same runway. Employee distraction, workload, and fatigue are among the risk factors for these types of incidents and are discussed in subsequent subsections.

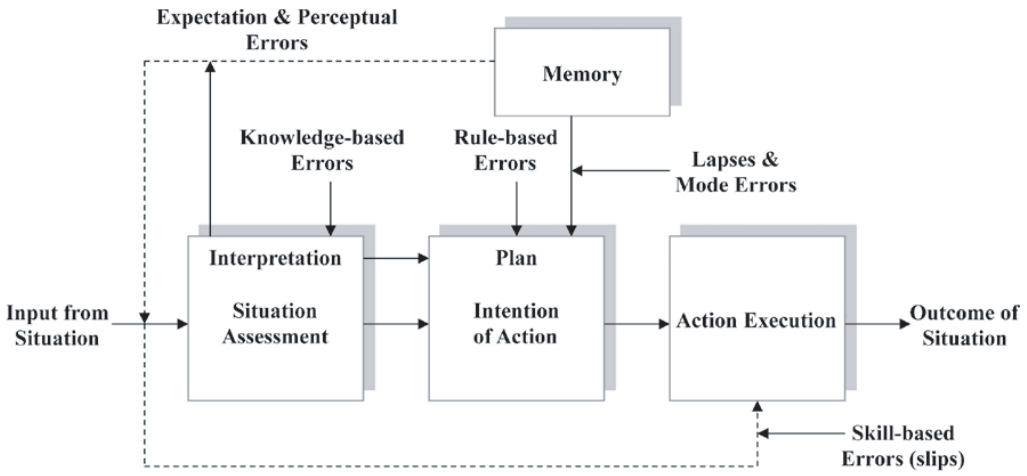


Figure 1. Information processing model of human error.

Reason (1997) makes an important point that "a purely cognitive analysis of error mechanisms fails to capture some of the more important human contributions to [accidents]" (p. 204). An examination of violations, that is, deliberate acts of noncompliance, fills this gap. The University of Texas has developed a methodology to examine flight operations, the Line Operational Safety Audit (Helmreich 2000). The data from these studies indicate that more than one-half of the in-flight noncompliance observed was intentional.

Lawton (1988) distinguishes among three types of violations: situational, exceptional, and routine. The classification is based on data obtained from a survey of United Kingdom (UK) rail shunters' experience with rule noncompliance. (In the UK, shunters refer to people who work on the ground switching cars in a railroad yard.) For the most part, Lawton argues that violations tend to be perceived as well-intentioned desires to get the job done. Situational violations result from motivations to keep the job going under adverse conditions. There is often an inconsistent approach to dealing with these types of violations. That is, when the job is completed without incident, the employee is rewarded. However, if an accident occurs, the response is often disciplinary action. This inconsistent response does little to curb these types of violations.

Situational violations are frequently observed in the public transportation industry because of the time pressure employees feel trying to adhere to schedules. Exceptional violations occur when unusual circumstances call for an unusual response and the employee knowingly does not comply with the organization's rules and chooses an alternative action. Routine violations occur when a shortcut presents itself and is taken regularly. This often happens when an employee no longer thinks a rule applies either because of lack of supervisory enforcement or the employee is overconfident in his or her skill.

Incident taxonomies provide a framework to identify reasons for noncompliance with safety-related rules and guide appropriate countermeasures. The Human Factors Analysis and Classification System (HFACS) is a well-known error and violation taxonomy used in aviation and served as the basis for the pilot safety reporting system in the railroad industry that is reviewed in Appendix C (Wiegmann and Shappell 2001). With an understanding of the underlying reason, a public transit agency supervisor or safety officer can determine the appropriate strategy to correct or manage noncompliance. For example, did noncompliance occur because the employee did not understand the situation and unintentionally failed to comply (knowledge-based error)? Training is a possible remedy when this is the cause of noncompliance. Was there a willful decision by the employee to disobey the rules because the organization placed more emphasis on getting

the job done on time than on its safety policies (situational violation)? In this circumstance, the organization's safety culture may be the cause. Perhaps an employee consistently chooses not to comply because he or she did not understand why the rule is required (routine violation). Closer enforcement and explanation of the rules may prevent this behavior.

The following sections describe factors and countermeasures known to influence noncompliance.

Perceptual Errors

Perception is a psychological construct that describes the neural processes that transform sensory information that enters the brain from sensory organs (e.g., eyes, ears). Most research on perception involves vision and audition (or hearing). Perception occurs as the result of both bottom-up and top-down processes. Bottom-up processing refers to the brain's ability to combine simple, bottom-level features that allows humans to recognize more complex whole patterns. Bottom-level features are the individual components that make up a representation. Visually, it is the simple lines and shapes that form more complex patterns, like a face. An aural example is phonemes, or individual sounds, that make up words. Many times, however, information in our environment at the bottom-level is degraded or obscured. Through top-down-processing, in the form of expectation, the brain fills in the missing information. Top-down processing refers to the brain's ability to use a person's knowledge about how the world is organized to identify patterns (Proctor and Van Zandt 1994).

Top-down processing provides humans with an efficient way to process in-coming information. If all information were processed piecemeal as it would be in a totally bottom-up system, human information processing would occur too slowly to allow humans to be able to respond to safety-critical situations, a highly adaptive feature. However, there is a disadvantage regarding the role of expectation with respect to safety-critical situations. A person's expectations, which are based on previous experience, can lead to error (Green 2003).

A relevant example of error arising from expectation occurs in the runway environment. Pilots are often familiar with the standard taxi routes at the airports they frequently fly to. However, due to unexpected operational changes, air traffic controllers sometimes instruct pilots to traverse a different taxi route. There are reports that describe the scenario where pilots will hear and confirm the non-standard taxi route, but during execution, they will revert to the more familiar taxi route (DiFiore and Cardosi 2006). Often times, they report that they heard what they expected. Expectation is an important contributing factor to rules noncompliance involving safety-critical communication.

Top-down processing can also be a source of human error with respect to visual perception. Obscured or degraded signage cannot be processed completely with bottom-up processing (Wickens and Hollands 2000). Therefore, the brain attempts to fill in the missing information via top-down processing. Errors can occur when the brain fills in incorrect information leading to misinterpretation. These types of errors occur in the medical industry where medication labels are often not dissimilar enough with respect to medication or dosage, sometimes resulting in fatalities (Frey et al. 2002).

Distraction

Vehicle control is a complex activity involving multiple tasks and multichannel information input. Because humans are inherently limited in processing complex tasks simultaneously, activities or conditions that compete for the driver's attention pose a risk to the driver's control over the vehicle (Sheridan 2004). Wickens' multiple resource theory states that tasks that draw on the

same mode or stage of processing will suffer significantly more than tasks that rely on different cognitive resources (Wickens 1984). Previous research has also found that "cognitive load combined with the loss of exogenous cues, which can occur when the driver briefly glances away from the roadway, may be particularly detrimental." (Lee, Lee, and Ng 2007). This diversion can occur willingly, for example, using a cell phone or tuning radio controls, or as a consequence of some environmental stimuli, like passing a billboard or a flashing warning sign (Regan, Lee, and Young 2008). With the increase of technology proliferation into vehicles, driver distraction is becoming more common, leading to an increase of risk exposure. However, even though the effects of driver distraction are well documented, research into fully understanding the sources of distraction, the underlying causal mechanisms, and mitigation techniques are all still undeveloped and lacking (Regan, Lee, and Young 2008).

Workload

The study of workload has a long history in psychology as well as human factors transportation research. In this project, only mental workload is considered. Gopher and Donchin (1986) define a measure of workload as "the difference between the capacities of the information-processing system that are required for task performance to satisfy expectations and the capacity available at any given time." There is an optimal level of mental workload. Under circumstances where workload is either too high or too low there are performance decrements. Low-workload conditions do not provide enough arousal to sustain vigilance and high-workload conditions cause employees to over-focus resulting in cognitive tunneling, both of which potentially lead to human error (Proctor and Van Zandt 1994).

Cox-Fuenzalida (2007) noted that previous research described a general decrement in performance following a decrease in task demand. In an experimental study of workload variability, she confirmed that a condition involving a shift from high workload to low workload impaired performance. Additionally, she observed that abrupt increases or decreases in workload led to a loss of accuracy and slower response time. The high to low condition may be an artifact of fatigue. Regardless, measuring the dynamics of workload is important given the potential for performance decrement.

Fatigue

Research has documented the performance effects of fatigue. The performance effects of inadequate sleep can affect an individual's ability to work safely and efficiently. Belenky et al. (2003) have shown that performance declines initially with mild to moderate sleep restriction of 7 and 5 hours, respectively, and after a few days it stabilizes at a less than fully rested level. The relevant performance effects include the following (Institute of Medicine 2006):

- Response time slows
- Attention to intensive performance is unstable, with increased errors of commission and omission
- Involuntary microsleeps occur
- Performance declines in short-term recall of working memory

The susceptibility to any of the above becomes an urgent concern when the job carries safety risks for the employee, co-workers, or the public. The job performance of public transit operators getting less than 7 hours of sleep on workdays is likely compromised. Research of Van Dongen, Mullington, and Dinges (2003) has shown that sleep loss-related performance declines often go unrecognized by the affected individuals making them at increased risk of error.

TCRP Report 81: Toolbox for Transit Operator Fatigue contains approaches for managing operator fatigue (Gertler, Popkin, Nelson, and O'Neil 2002).

Workstation Design

Workstation design is a potential source of safety-related rules noncompliance. Given that improper securement of wheelchairs is the leading cause of injuries to passengers, Herring and Wolf (2002) conducted an observational study of wheelchair tie down operations in transit buses. They found that the general consensus among bus operators was that systems were very difficult to use, a factor that decreases the probability of compliance.

Regarding the vehicle operator's workstation, it is imperative that it be designed considering the principles of human factors and ergonomics. Bucciaglia et al. (1995) suggest beginning the process with an analysis to identify primary and secondary operator tasks. This provides a basis to ensure that all safety-critical controls and displays are in the primary visual area and are easily accessed (Wickens, Lee, Liu, and Becker 2004).

Risk Taking

Trimpop (1994) defines risk taking as "any consciously, or non-consciously, controlled behavior with a perceived uncertainty about its outcome, and/or about its possible benefits or costs for the physical, economic or psychosocial well-being of oneself or others." In essence, risk taking is acting without fully considering the consequences of one's actions. To a certain extent, we all engage in some form of risk-taking behavior because it is not practical to always fully weigh each and every consequence prior to action. For the sake of efficient and timely behavior, humans engage in heuristic evaluations for decision-making (Matlin 1994). That is, they combine past experience with the present circumstances to take cognitive shortcuts to determine the best possible choice of action. However, because these heuristics are shortcuts, they may exacerbate the uncertainty of the situation at hand. Of interest to public transit agencies is the need to identify individuals who may engage heavily in risk-taking behavior to the point that it is either pathological or at least increases the probability of a safety incident during day-to-day operations.

Personality and Risk Takers

There is a long history in aviation psychology of trying to identify personality features of pilots who are risk takers (Hunter and Burke 1990). Personality is a psychological construct that describes the inherent behavioral attributes of an individual. Personality assumes a set of stable traits that persist across situations. Due to the high risk associated with flight, the aviation community was interested in identifying psychometric measures associated with pilots who engaged in risk-taking behavior. However, Besco (1994) conducted a literature review that examined the validity of using personality inventories to predict pilot behavior and found it to be an unreliable method.

The approach of looking at personality as the root of error and/or violations comes from Heinrich's early work that suggested that about 80% of industrial accidents results from the human in-the-loop (Heinrich, Peterson, and Roos 1980). Unfortunately, many researchers began to examine what was wrong with the human that caused the error (i.e., personality and/or character flaws). The rationale for this approach is flawed because of the classification of these original studies; they failed to examine the root cause of the industrial incidents. Therefore, the operator was erroneously assigned blame instead of the many contextual fac-

tors associated with the situation. This is a well-known social psychological phenomenon known as the fundamental attribution error, whereby negative events are attributed to the personal characteristics of the individual involved in the event without considering the situational factors (Jones and Harris 1967).

Situational Factors

Looking for character flaws using psychometric tools is not useful for predicting risk taking because it perpetuates the act of blaming the employee; however, it is worthwhile to understand the situations that may lead to increased risk-taking behavior. In this light, researchers have begun to examine the factors that moderate risk perception including its effect on rules compliance. Diaz and Resnick (2000) used the Johnson Personality Inventory–Revised (JPI-R) and found that the risk-taking scale measures of this test were positively correlated with personal protective equipment (PPE) compliance. The researchers discuss that there are multiple factors that influence risk perception including time on the job without incident. The longer someone is employed, the more likely he or she is to have encountered a hazardous situation and perhaps recovered from it. Recovery from these events can lead to overconfidence in one's ability or complacence thereby negatively influencing risk perception as is evident in pilot risk taking during adverse weather (Pauley and O'Hare 2008). Research in driver behavior demonstrates that operator overconfidence is associated with an impaired ability to evaluate a driver's own performance (Kidd and Monk 2009). Therefore, inflated driver confidence makes it unlikely that mistakes will be acknowledged and recovered from.

Gonzalez and Sawicka (2003) refer to risk homeostasis theory that was developed in the context of automobile safety. The theory involves a model that presents the actual risk of a situation and contrasts it with the perceived risk. The discrepancy between the two is modulated by the individual's ability to accurately perceive the risk (perceptual skills) and to make an appropriate decision about what sort of adjustment is necessary (decision-making skills). Both types of skills are heavily influenced by experience, or top-down processing.

The aforementioned theory is related to Kahneman and Tversky's (1979) prospect theory which suggests that people either grossly overestimate the likelihood of improbable events or fail to consider them a possibility at all. The latter is a bias that may lead employees to underestimate the possibility of disastrous events. These biases are evident immediately after safety incidents. Workers often become hypervigilant after an accident followed by a steady decrease in safety vigilance as time goes on. As such, a decline in safety vigilance can become an organizational hazard where the organization, like individuals, becomes complacent over time underestimating the possibility of an unexpected safety occurrence.

Predicting Risk-Taking Behavior

While risk perception helps to explain why some people are more likely to take chances than others, past behavior can also be used as a predictor of future behavior. Using a logistic regression analysis of approximately 309,000 pilot records, McFadden (2002) showed that driving while intoxicated (DWI) convictions were associated with alcohol-related aviation accidents. Pilots convicted of driving while intoxicated were 3.5 times more likely than pilots without these types of convictions to have alcohol-related general aviation accidents. In commercial aviation, pilots with a history of DWI were more likely to engage in risky flight maneuvers than pilots with no such history.

Most of the research conducted on attitudes involving risk used explicit measures of attitude. Explicit measures rely on self-report and are not always a reliable indicator of a person's attitude,

because people may respond based on the questionnaire administrator's expectations. Recent research has focused on the use of implicit measures of attitude. Adapted from the field of social cognition, the implicit attitude test (IAT) measures unconscious attitudes, which are impervious to experimental demand characteristics. Using the IAT, aviation researchers have demonstrated that the use of this tool, at least experimentally, can identify pilots who are likely to make risky flight decisions (Molesworth and Chang 2009). However, this research is still in its infancy and is not ready for practical application.

Summary Points

- Traditional psychometric inventories are not useful for identifying individuals as having risk-taking personalities; therefore, they do not serve as useful screening tools for the hiring process.
- High scores on the risk-taking scales of the JPI-R were associated with failure to comply with PPE requirements. The applicability of this study to public transportation is limited.
- Identifying the situational factors that influence risk taking in public transit operations is useful. Examples of factors to consider include length of time an organization has without incident, length of time an individual is on the job without incident, and the number of employee incidents he, or she, successfully recovers from.
- DWI convictions are predictors of pilot risk-taking behavior; however, there is no empirical evidence to suggest this as a predictor in public transit operations.
- The IAT is a promising methodology that may be adapted as a practical tool to identify individuals who may engage in risk-taking behavior. This may lead to improved employee screening and targeted training.

Training

Training employees is an effective way to promote safety-related rules compliance. Tannenbaum, Beard, McNall, and Salas (2009) report that learning in organizations needs to address four core areas:

- Intent to learn
- Experience and action
- Feedback
- Reflection

To optimize training effectiveness, employees need to be prepared for the learning experience. An organization can accomplish this by informing employees about upcoming training opportunities and requirements. The information about training should include why the organization is sponsoring it, the goals and objectives, and any potential benefits.

Improving Self-Efficacy

Research shows that even under optimal training circumstances, individual differences related to an employee's intention to learn plays a role in training effectiveness. Some individuals have low self-efficacy. This refers to a person's belief that he or she has the capacity to successfully perform specific behaviors or tasks. Day et al. (2007) describe how Bandura's (1978) social learning theory can be used to promote behavior modeling to mitigate the effects of low self-efficacy. Behavior modeling fosters confidence and promotes skill development in those with low self-efficacy.

These researchers examined the effects of a collaborative training protocol for improving employee self-efficacy. Active interlocked modeling (AIM) requires trainees to practice half of a training task and then observe a partner performing the remaining half of the task. Results from

this study indicate that training with an experienced partner using AIM provides an effective way to increase self-efficacy.

Effective Types of Training

The type of experience one has during training influences its effectiveness. The three types of action-based, or experiential, training included in the review are on-the-job (OJT), computer-based, and simulation. None of these training techniques should be used alone. Rather a balanced combination of them provides optimal training effectiveness.

On-the-Job Training

The use of OJT is most appropriate when work procedures need to be passed on to employees and implemented immediately. This can occur during initial job orientation as well as when there are new procedures that need to be trained long after an individual is hired. The advantages of OJT include that the organization does not have to hire trainers or conduct training offsite, which can be costly. However, OJT does take supervisors away from their regular duties and potentially increases supervisor workload. Mullaney and Trask (1992) also point out that supervisors and subject-matter experts are not always exceptional trainers. Their proficiency may cause them to skip certain steps in the process that learners, particularly those with low self-efficacy, need to understand.

Additionally, OJT must meet the needs of the trainee so that it builds upon his or her existing skill set. OJT is also a good opportunity to use the commentary drive technique (McKenna, Horswill, and Alexander 2006). During training, instructors in the vehicle (or cab) observe and then give feedback after the session concludes. Observing other employees' commentary drive sessions is also an effective training tool and is easily implemented using video recording of OJT sessions.

Derouin, Parrish, and Salas (2005) provide several guidelines for optimizing the effectiveness of OJT including the following:

- Ensure upper management support for OJT.
- Standardize OJT programs.
- Include training staff in the design and development of OJT programs.
- Train the trainer.
- Prepare trainees for OJT.
- Provide descriptive, but not evaluative, feedback during training.
- Encourage practice in a non-evaluative environment, allowing trainees to make errors where possible.
- Evaluate OJT effectiveness.

Computer-Based Training

Computer-based training (CBT) can also be incorporated into a successful training program. It can be conducted during work hours, linked to the Internet for remote access, and incorporated into classroom-led instruction. Fisher et al. (2002) found that PC-based risk awareness training reduces the likelihood of risk-taking behavior, though this research only examined young, inexperienced drivers.

Horrey, Lesch, Kramer, and Melton (2009) systematically examined the effectiveness of CBT of distraction mitigation. Research demonstrates that operators may not be aware of the distracting effects of in-vehicle tasks on performance (Horrey, Lesch, and Garabet 2008; Lesch and Hancock 2004). As such, zero-tolerance policies regarding the operation of electronic

equipment during safety-critical tasks may not be as effective as when these policies are combined with a training program that educates individuals on the dangers of operating a vehicle while talking or texting on a cell phone. The following is a list of the information contained within the distraction mitigation training modules, which successfully deterred individuals operating electronic devices while driving:

- Distraction facts and information
- Video demonstrations of distraction involving others
- Interactive demonstrations of distraction
- Training how to deal with distraction
- Video demonstrations using commentary drives

Simulation

Simulation is another useful training tool; however, high-fidelity training simulators involving motion and tactile feedback are costly and not widely available. Some studies examined the use of low-cost, low-fidelity simulators and found positive training effects (Chase and Donohoe 2008). The positive effects of low-fidelity simulators are for improving awareness of safety-critical situations not vehicle handling. Simulation provides the opportunity to conduct safety error management training (EMT). This type of training specifically encourages operators to make mistakes so that they learn how to recover from them. Generating one's own solution to a problem is much more effective than reading or hearing about potential solutions from someone else. This is based on the generation effect in cognitive psychology (Crutcher and Healy 1989). EMT is particularly suited for training novel tasks when compared with error-avoidant methods.

Summary Points

- Effective training, at a minimum, includes preparing the learner prior to training, providing the optimal training experience based on the science of training, nonevaluative feedback, and encouraging the trainee to reflect on the learning process.
- Promote self-efficacy during training by pairing a more experienced partner with one who is less sure of him- or herself.
- Follow the recommendations regarding OJT.
- CBT and simulator training provide opportunities to train employees about human information processing limitations and go beyond traditional classroom training to promote effective error recovery strategies.

Incentive and Discipline Programs

Incentive and discipline programs draw from behavioral management theory, which predicts specific behavioral outcomes based on the effects of reinforcement (increases target behavior) and punishment (decreases target behavior) (Lieberman 1990; Lefrançois 1995). An incentive is a reward, which may be monetary or in some other form, to recognize a specific accomplishment by an employee or a group of employees. The incentive differs from other forms of compensation, because it must be earned during each incentive cycle; whereas salary is generally a constant and guaranteed base compensation. An incentive can be something tangible or intangible.

Incentive Best Practices

Cash payment is one of the most commonly used incentives (Hartman, Kurtz, and Moser 1994). The amount is small, usually less than $200. Hartman, Kurtz, and Moser reported the following examples of incentives offered by public transit agencies:

- Up to $500 bond based on safety points accumulation
- $50 cash for safe driving
- $75 to $250 plus 8 hours of extra pay for rewarding attendance, safe driving, and customer service

Rewards can also be in the form of special benefits, such as extra days off, a designated parking space, or prizes. For example, safe employees may be offered free restaurant meals, watches, and retail gift cards. Another common form of incentives is recognition rewards. Recognition rewards are "low cost/high impact." Recognition also can be in the form of an event, like a banquet, or in the form of something tangible, such as shirt patches, certificates, and special nameplates. Employees can be recognized in newsletters, personalized letters of gratitude from management, or even in a press release to the local media. A survey found that respondents viewed recognition rewards more highly than cash payments (Hinze 2002).

Common elements of successful incentive programs include the following:

- Management support must be visible.
- Achievement criteria must be clear and precise with objective metrics.
- Incentive cycle or monitoring period must be defined.
- Process must be transparent to the employees.
- Eligibility to participate must be defined.
- Incentive programs can be tiered but the tiers and performance expectations must be well defined.
- Smaller, frequent, non-monetary rewards that highlight the employee's achievement seem to be the most effective.

While an effective incentive program may create positive behavior changes in employees, there is contention in the literature about the use of incentives. Some advocate their use while others claim that incentives do more harm than good (Geller 1996). Common criticisms of incentive programs include the following:

- Motivation can decline over time and after the incentive is reduced/removed.
- Programs may encourage the employees to hide injuries and under report incidents.
- In some cases, it can be difficult to define employee vs. group contributions to safety.
- The projected budget for these programs may not be enough to cover 100% compliance.
- Programs may not take into account factors not under the control of the employee (e.g., other people's unsafe behavior).

Critique of Incentive Programs

Traditional behavior theory predicts that the effects of reinforcement, or reward, will dissipate over time if the reinforcement is discontinued. While this criticism is well founded in behavioral theory, cognitive psychologists note that human motivation exists beyond external environmental consequences. Sometimes, motivation is internal and linked to the values of a person. Changing a person's behavior through reinforcement and their attitudes through education may enhance rules compliance more than either would alone.

Many employers view their compensation programs as sufficient motivators for the job roles they define and are not inclined to adopt incentive programs. Some employers believe regular monetary compensation is sufficient to expect that their employees will perform their jobs adequately. However, this view is problematic when compensation programs are not strictly performance-based and linked to safe behavior. For example, an employee initially may be compliant with safety-related rules 100% of the time. Over time, the compliance rate may drop due to complacency or poor supervision. If the supervisor does not address the performance

decline immediately, or through a performance-based compensation program, the employee learns that he or she can be less compliant and still reap the same rewards. In this example, the employer is no longer requiring the behavior it would like its employees to exhibit. An incentive program is one option to use as a bridge to improve rules compliance in the short term until a performance-based compensation program can be implemented and supervisor deficiency can be corrected.

It is imperative that incentive programs geared toward improving safety link the reward to safe behavior. Many incentive programs exist that reward being incident or accident free. The latter only discourages employees to report accidents or the factors that led to them. Ideally, safe behaviors that lead to rewards or incentives should be linked to the leading indicators that the agency uses to measure the effectiveness of its safety-related rules compliance program. (See the Measuring Compliance with Leading and Lagging Indicators section.) Linking a point system to the following safety-promoting behaviors is reportedly effective:

- Attending safety meetings
- Leading a safety meeting
- Writing, reviewing, and revising a job safety analysis
- Conducting periodic safety audits
- Certain safe work habits

Using Discipline Effectively

Discipline, in the form of punishment, is often used by managers to quell noncompliance. Punishment is most often used as a last resort when other interventions do not prove effective. While punishment is effective for reducing, or eliminating, unwanted behavior, it does not teach the correct behavior. Punishment may be in two forms, positive and negative punishment. Positive punishment occurs when the addition of an aversive stimulus is used to curb a behavior (e.g., adding to the workload of an individual; additional workload must be viewed negatively for this to qualify as punishment). Negative punishment occurs when a valued, or pleasant, stimulus is taken away. An example of this is demotion (removal of status), or termination in the extreme.

Punishment has its place in the workplace for shaping employee behavior. However, it must be delivered in a specific manner to achieve the desired effect and avoid negative consequences. Behavior theory predicts that reward works best when delivered intermittently. Punishment, in contrast, is optimal when it occurs after each instance of the undesirable behavior. Consequently, employees learn they will only be punished when they are caught in the act. They may fail to develop internal monitoring during situations when they are not being directly supervised.

Punishment also arouses a strong emotional response. This is particularly true when punishment is viewed as unfair or overly harsh. Under these circumstances, employees may harbor resentment or seek retribution. The following are best practices for including punishment as part of the disciplinary process:

- It must be administered immediately.
- It should be consistently applied across employees.
- Negative punishment is a better option than positive punishment.
- It should have sufficient intensity, but not perceived as overly harsh.
- A rational explanation must accompany delivery, which should be privately conveyed.
- Punishment should be used in conjunction with reinforcement, or incentives, to encourage positive safety behavior.

Measuring Compliance with Leading and Lagging Indicators

Continuous improvement in safety-related rules compliance requires ways to monitor and measure practices that public transit agencies use to encourage safe behavior. Safety professionals advocate that "You can't improve what you don't measure." Many safety systems, including those focused on rules compliance, focus on *lagging indicators.* Lagging indicators are measures of undesirable outcomes that have already occurred (Blair and O'Toole 2010). The numbers of rule violations, vehicle accidents, and injuries are examples. In contrast, *leading indicators* focus on activities or conditions that, if completed, will prevent or reduce the risk of lagging indicators. They help improve future performance by promoting action to correct the latent factors that create safety risks. Leading indicators focus on process and are achievement-oriented while lagging indicators are avoidance-oriented. Leading indicators include measures such as number of individuals trained, number of safety meetings, number of safety-related communications, and number of reports to a safety reporting system.

Safety Culture, Management, and Rules Compliance

While the academic literature does not share a single standard definition regarding safety culture, researchers as well as practitioners agree that safety culture is a subset of organizational culture (see Figure 2). As such, safety culture represents that part of an organization's culture that relates to safety. Therefore, safety culture encompasses organizational structure as it pertains to safety as well as the way people think, feel, and behave with respect to safety practices (Cooper 2002).

Related to the notion of safety culture is safety climate. While these two terms have sometimes been used interchangeably, they are different constructs. According to Flin, Mearns, O'Connor, and Bryden (2000), "safety climate can be regarded as the surface features of the safety culture discerned from the workforce's attitudes and perceptions at a given point in time." Given this definition, assessing safety climate provides a "snapshot" of an organization's safety culture. Safety climate assessment tools provide a way for transit agencies to measure their organizational commitment to safety.

A review of the relevant safety culture and climate literature suggests that rules compliance is optimal when an organization addresses the following dimensions of safety culture (Antonsen 2009; Cooper 2002; Flin, Mearns, O'Connor, and Bryden 2000):

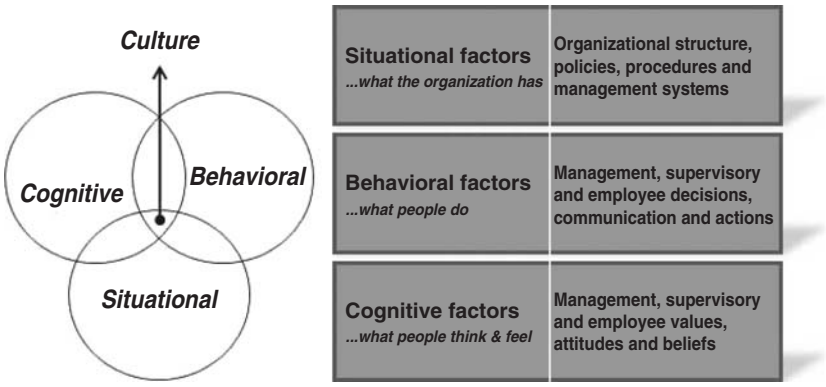


Figure 2. Organizational culture.

Management and Supervision

When assessing safety culture, one of the most important factors to consider is the level of commitment of management and supervisors to encouraging safe operations. This must be a genuine effort so that employees are able to perceive organizational commitment and internalize this attitude into their own set of personal values. Also, leadership style of both upper management and first-line supervisors is an important impetus for worker safety. The types of questions that formal assessment tools must answer include the following:

- When it comes to safe operations, do management and supervisors "walk the walk" or just "talk the talk?"
- Is there a consistent message regarding safety from top-level management as well as at the level of first-line supervisors?
- Do workers perceive that management is specifically committed to safety and in general concerned with their overall well-being?

Safety System

Safety culture assessments usually involve characterizing the makeup and functionality of an organization's safety system. Elements of a safety system include a safety management system (SMS), the presence and hierarchical position of safety officials, safety committees, policies, and equipment.

Fernández-Muñiz, Montes-Peón, and Vásquez-Ordás (2007) define an SMS as "a set of policies and practices aimed at positively impacting on the employees' attitudes and behaviors with regard to risk." The aim of an SMS is to intervene on the circumstances that result in risks and accidents. This involves identifying and analyzing both latent and visible hazards. Bottani, Monica, and Vignali (2009) surveyed 400 manufacturing firms, some with and some without formal SMSs. The results demonstrated that the attitudes regarding several safety-related variables were better for safety officials from the companies that had formal SMSs. Further research is needed that uses process measures in addition to attitudinal ones. There have been guidelines set forth for conducting a hazard analysis for transit projects (Adduci, Hathaway, and Meadow 2000). Recently, the FTA released a guidebook describing how to implement a transit SMS (Ahmed 2011). The guidebook is an excellent source of information for public transit agencies interested in adopting a transit SMS including information regarding safety performance measurement.

Many safety systems include a program for rewarding safe work practices as a means to encourage safe behavior. Behavior-based safety (BBS) programs focus on the interaction between people and their working environment. There are functional variations of these programs with the most common using members to monitor the behavior of a workgroup and managers to monitor their own safety-related leadership behavior. The most common employee protocol involves peer observation with on-the-spot feedback. However, there are reports of self-observation approaches where single operators perform their own checklists. The data is compiled over a number of self-observations and the results are used to inform training needs and other remedial action (Cooper, 2007). Self-observations are most appropriate for transit operators. However, there is no empirical data to support the efficacy of the self-observation approach. Cooper (2007) presents the IDEAL components of a BBS program. They include the following:

- **I**dentify unsafe behaviors
- **D**evelop appropriate observation lists
- **E**ducate everyone and train observers
- **A**ssess ongoing safety behaviors
- **L**imitless feedback

A safety reporting system, such as those in aviation and the railroad industry, is a proactive element of any safety system. Formalizing the safety system within an organization by means of the aforementioned elements provides protective barriers against unexpected occurrences related to safety-related rule noncompliance. These systems are reviewed in Appendix C.

Work Pressure

Safety-critical service industries such as public transportation must effectively balance the need for on-time performance with the need to perform safely. Assessing the tension between these two often competing goals provides a way to determine if the effects of top-level management commitment have "trickled down" to the supervisory and employee level. Sometimes supervisors and top-level management establish safety goals without consulting the workforce to determine if the goals are practical and attainable. When safety and performance compete at the level of the operator, supervisors may choose to look the other way when safety violations occur to maintain on-time performance or keep equipment in service. This in turn sends the message to employees that safety is not truly valued and sacrificing safe operations to stay on schedule is acceptable.

Procedures and Rules

While not traditionally part of most formal safety culture and climate assessments, the perceptions of and attitudes toward safety rules and procedures provide an indicator of whether or not individuals within an organization accept and value them. Rules and procedural adherence can be improved when management partners with labor to create safety rules and procedures. In essence, this process empowers individuals by giving them input to the safety system. Labor feels management respects their opinions as expert operators and they feel ownership of the rules and policies. Therefore, employees are more likely to comply. The rules and procedures in a truly resilient organization empower the employees to deal with unanticipated events.

From a behavioral economics perspective, Battmann and Klumb (1993) suggested that procedural and rules violations originate primarily from the following:

- Unclear or conflicting rules or constraints
- Delayed, ambiguous, or missing feedback
- Absence of clear priority rules in cases of conflicts between high-level and low-level safety commitments

Dekker (2003) comments that operators fail to adapt procedures when adapting is necessary, or alternatively they attempt procedural adaptations that ultimately prove futile. To improve rules compliance, organizations should avoid increasing pressure to comply. Rather, they should invest in their understanding of the gap between procedures and practice, and help develop operators' skill at adapting.

Employees

There are many factors related to the workforce that provide an indicator of safety culture and climate including employee competence, safety training, safety attitudes and risk-taking behavior, and job satisfaction and security. Organizations committed to safety adhere to rigorous screening procedures when hiring to ensure that their employees have the required knowledge, skills, and abilities to perform their jobs. They provide exemplary training to ensure the workforce understands how to operate under both typical and atypical operating circumstances. They train the workforce to recover from unexpected occurrences as well. Finally, employees are more likely

to be committed to their organization's safety goals if they are satisfied with and feel secure in their jobs. Genuine management commitment to the employee fosters employee commitment to the organization.

Summary Points

- There must be a top-level management commitment to safety that permeates the public transit agency from the top level all the way down to the employees.
- Safety reporting systems, hazard analyses, and safety management systems are all effective ways to improve a public transit agency's safety culture thereby improving rules compliance.
- Safety must be a higher priority than on-time performance at all levels of a public transit agency.
- The safety-related rule-making process must involve the employees who are required to follow the rules.
- Safety-related rules must be clear, concise, and easily understood by employees.
- Genuine management commitment to the employee fosters employee commitment to the public transit agency.

CHAPTER 3

Classifying Noncompliance

This taxonomy is intended to aid public transit agencies in identifying the reason(s) or root cause(s) for any given instance of safety-related rule noncompliance. The taxonomy is based on several human error/violation taxonomies that exist in other human performance domains. Combining the results of a review of transit accidents with some of the classic taxonomies, the authors present the following information, which is tailored for public transit agencies to use to investigate the cause of safety-related rule noncompliance. Because this taxonomy is tailored to the needs of public transit agencies to investigate noncompliance, the user is discouraged from comparing other taxonomies to this one as there may be subtle but meaningful differences. The examples provided are based on actual transit incidents and accidents but have been altered to enhance their illustrative properties.

The taxonomy is influenced by the work of James Reason (1990), who identified that accidents are the result of a long chain of events. While the employee's act is the last link in the chain of events leading to an accident, there are many other contextual factors that most likely contributed to the event. Reason suggested that creating barriers to these contextual factors may thwart the opportunity for future accidents by breaking the intermediate links in the chain. Akin to the metaphor of a chain, Reason proposed the Swiss cheese model of accident causation (Figure 3). In this model, contextual factors are the latent failures or preconditions that allow unsafe acts, such as rule noncompliance, to occur. Ultimately, "an accident is one incident too many" (Reinhart 1996).

Consider the head-on collision of a bus with a car. The accident report indicated that the bus operator fell asleep at the wheel and veered into the lane of oncoming traffic. By examining the chain of events leading to this accident, the creation of a robust explanation for the accident is possible. The operator unintentionally fell asleep at the wheel (Level I factor). The employee did not have adequate rest prior to his or her shift (Level II factor). The employee's supervisor scheduled the employee to return to duty without an adequate opportunity for rest (Level III factor). The public transit agency recently had budget cuts which reduced the number of bus drivers (Level IV). This made it difficult for supervisors to have an adequate number of personnel for the service routes. If one or more of these events did not occur, the accident may have been avoided. By addressing these factors after an incident occurs, future accidents may be prevented.

The following guidelines are recommended practices for using the taxonomy. Chapter 2 explains much of the terminology in the taxonomy. It is important to review this entire chapter before attempting to use the taxonomy. The first step is to determine the employee's intent. Determining whether noncompliance was intentional or due to human error is key to understanding why an employee failed to comply. Understanding the employee's intent will also allow identification of the appropriate response or remedial action.

The taxonomy consists of four levels that are based on Reason's accident causation model. The levels are designated by the Roman numerals I through IV and the subfactors for each level are

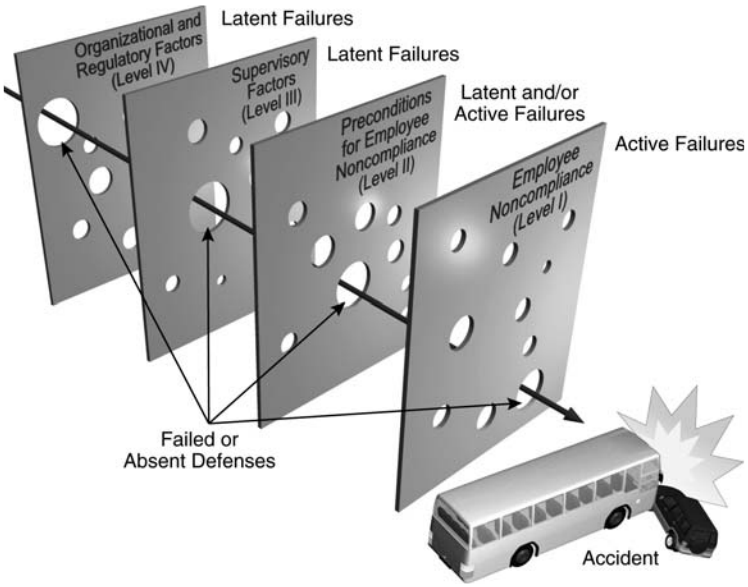


Figure 3. Reason's Swiss cheese model of accident causation (Reason 1990).

numbered as well. The numbering system corresponds to the levels in Figure 3 and Figure 4 as well as the numbers for the root cause questions in the Investigating the Causal and Contributing Factors of Safety-Related Rules Noncompliance section of this chapter. If a close call, incident, or accident involved multiple instances of noncompliance, use the taxonomy to "drill down" the underlying factors for each noncompliant act. Figure 4 presents a diagram of the taxonomy and illustrates its hierarchy. While the categories of Level I are mutually exclusive for a single noncompliant act, subsequent levels are not. It is important to capture as many contributing factors for Levels II through IV as possible so that corrective actions (i.e., barriers) can be implemented to prevent reoccurrence of noncompliance. A table summarizing the elements of each level of the taxonomy follows the description of that level.

Level I: Employee Noncompliance

Employee actions are the last event in a chain of events that are closest in time and physical proximity to an incident that has resulted from rules noncompliance. While these actions most recently contributed to an incident's occurrence, they are only one of several contributing factors. Based on the intention of the employee, an action can be classified as an error (unintentional noncompliance) or a violation (intentional noncompliance). Errors and violations can be further classified based on the underlying reasons for the noncompliance. In-depth classifications will provide a better understanding of why the noncompliance occurred as well as aid the identification of the appropriate corrective measures.

1. Intentionality

Determining intentionality is key to understanding the reasons behind noncompliance. Intentional noncompliance is referred to as a violation, whereas unintentional noncompliance is considered human error. The challenge to distinguishing violations from errors is the willingness of the employee to share this information. In an environment where the employee fears disciplinary action, he or she may not be forthcoming about intentionally violating a rule. Some employees

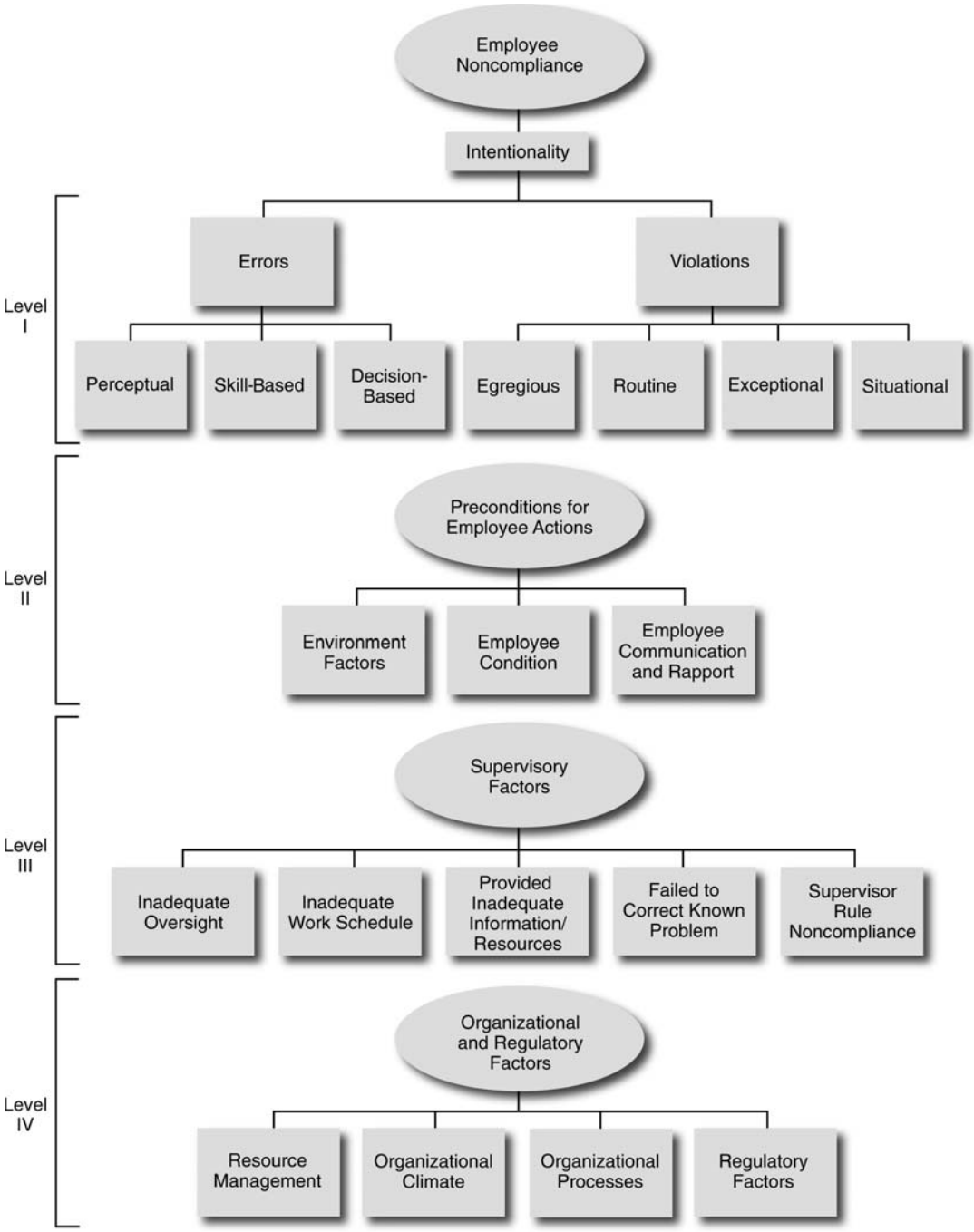


Figure 4. Levels of the taxonomy.

may claim they were unaware of their noncompliance to avoid disciplinary action. As a result, the noncompliant act may be inappropriately categorized as an error. Because errors and violations have distinct factors contributing to them as well as different strategies to mitigate them, wrongly categorizing actions at this level of the taxonomy will not allow the user to identify the actual reasons behind the noncompliant act. Nor will the user identify the appropriate corrective measures to prevent similar instances of noncompliance from reoccurring in the future.

One transit agency investigated signal noncompliance and found that the event recorder data, specifically speed, was useful for identifying the underlying reasons for these events. The agency

found that the noncompliant events fell into two speed categories, those occurring at high speed and those at lower speeds. Those that occurred at high speeds were generally attributable to human error (unintentional) often the result of distraction. The reasons for noncompliance at the lower speeds were variable. The transit agency identified that train handling, a skill-based technique error, was sometimes the culprit. At a different transit agency, a root-cause investigation of signal noncompliance showed that the majority of light rail vehicle operators who had violated the stop signal reported that they presumed that the signal would be permissive by the time they reached it. The latter is an example of a violation where the operator engaged in risky behavior due to overconfidence in his or her ability to predict the signal.

2. Errors

Human error arises because our brains are organized in a way that allows us to solve problems by processing information automatically (i.e., often without conscious thought) and making educated guesses (i.e., heuristics). While automaticity and shortcuts make us fast and efficient, inevitably we will succumb to error. Much of noncompliance is due to errors we are unaware of until it is too late. Identifying the type of error that occurred will inform an effective mitigation strategy.

2.1 Perceptual Errors

Perception is the psychological construct used to describe how people experience their environment with their senses (seeing, hearing, touching, etc.). These errors occur when one experiences something in the environment that is different from reality. Sometimes people hear or see what they expect to experience. Blind spots resulting from the manner in which mirrors are laid out in an operator's workspace can give the illusion that no person or object is near the vehicle. However, another object, vehicle, or person could be in the blind spot and not be detected by the operator. Sometimes, people incorrectly "fill in" missing or degraded information (e.g., signage) or experience illusions that result in the wrong action.

2.2 Skill-Based Errors

Skill-based errors often occur during the execution of highly practiced routines in which there is little or no conscious thought required. These errors commonly happen to everyone in everyday life. As such, they should not be considered an anomaly when they happen during work-related activities. Someone who experiences this type of error is not necessarily incompetent. Rather, the person is so skilled at what he or she does, the work becomes automatic. Some common, everyday examples include intending to drive to the grocery store after work, but then driving home instead because the route home is similar and more frequently traveled. Also included are leaving out a step in a task or walking into a room and not remembering the purpose for going there. Skill-based errors can be further categorized into slips, lapses, and technique errors.

2.2.1 **Slips.** Slips refer to the execution of the wrong action during activities when the employee is not consciously aware of his or her action because he or she is so highly skilled. Slips include habit capture errors (the grocery store example above), misordering, repeating or inserting erroneous steps in a task sequence; they tend to be errors of commission. For example, a bus maintainer without awareness of his mistake installed an air line that was longer than the original hose. As a result, the brakes failed while the bus was in service causing the bus to strike the rear of an automobile that was stopped at a red traffic signal.

2.2.2 **Lapses.** Lapses, often failures of short-term memory, refer to the omission of some part or all of a task. As such, lapses tend to be omission errors. An employee may become distracted by, or sometimes hyperfocused on, a second task or an extraneous situation to the detri-

ment of the primary task. As a result, the employee either forgets where he or she was in the first task sequence, omitting a critical step, or the employee forgets to resume the first task completely. This can occur, for example, when a bus driver becomes so engrossed in passenger relations, he or she may forget to make a scheduled stop. A lapse occurred when an experienced engineer forgot to make sure that the position of the forward/reverse switch on the master control panel was in the correct position before operating the train.

2.2.3 **Technique errors.** As employees develop their skill set, they acquire their own personal techniques that may differ from employee to employee. These techniques become engrained into how the employee performs his or her job. Technique errors occur when an employee has developed a maladaptive way of performing his or her job. While the techniques may not violate any specific rule, per se, they set employees up for rule noncompliance. Failure to exercise defensive driving skills is a good example of this. Employees develop personal driving techniques over the course of many years before they become professional drivers (e.g., bus drivers). While some companies may require defensive driving courses, it is difficult for employees to abandon how they have driven for years with limited time spent in defensive driving training courses.

2.3 Decision-Based Errors

Decision-based errors are also unintentional and can be divided into two subcategories: strategy-based and knowledge-based errors. These errors can be thought of as ineffective decisions or honest mistakes involving the application of rules.

2.3.1 **Strategy-based decision errors.** As employees develop experience, they acquire a repertoire of strategies to accomplish different aspects of their jobs. Sometimes an individual chooses the wrong strategy for a situation or misapplies an effective strategy to the wrong situation; this is known as a strategy-based decision error. An example of a strategy-based error occurred when the procedure of a bus maintenance department did not sufficiently describe the actions required to properly construct, route, and secure a steel braided surge tank vent hose. The mechanic followed the procedure to the best of his or her ability, but used a less than ideal method to secure the hose (the method for that part of the procedure was not specifically defined). The result was a bus engine compartment fire.

2.3.2 **Knowledge-based decision errors.** Other times employees are inexperienced or are unfamiliar with some aspect of their jobs. They may have a limited set of pre-formed plans they can use when performing their job. These employees may have to identify novel solutions to a problem or find themselves in a situation where they have to interpret and execute rarely used or difficult to understand rules. When an employee fails to comply because of a lack of understanding of a rule or how to execute it, a knowledge-based decision error has occurred. A knowledge-based error occurred when a novice dispatcher was called by a light rail operator faced with a fire in a tunnel. This is a rare occurrence and one for which the rules and procedures are somewhat complex depending on which tunnel is involved. The dispatcher had to respond quickly and neglected to activate the fans in the tunnel. The transit agency determined that the dispatcher did not understand the rule because she had inadequate training on emergency procedures.

3. Violations

Within the context of this taxonomy, violations, are always intentional, that is, the employee understands the rule and knows how to apply it, but voluntarily chooses not to comply. Many times supervisors and management think that the only reason people violate rules is because of some personal attribute (e.g., risk taker, no respect for rules). While this is sometimes true, particularly in the

case of egregious violations or criminal acts, many times there are other reasons an employee may violate a rule. These factors include issues with employee supervision and management, environment and ergonomics, as well as problems with organizational culture. The purpose of calling out the factors associated with violations is not to shift blame from the employee to management or other external factors, but to identify all factors that contribute to a violation so that problems at all levels can be addressed to minimize the probability of reoccurrence.

3.1 Egregious and Criminal Acts

As a general rule, transit agencies should have a no tolerance policy for criminal acts such as illegal drug use and working while under the influence of drugs and alcohol. Some transit agencies now consider cell phone use while on duty to be an egregious act. Each agency must define what qualifies as an egregious act. Caution should be taken not to make this category too broad because the response to these types of noncompliance is zero-tolerance generally resulting in removal from employment. For example, including violations such as speeding in this category is not useful. Speeding may occur because an employee feels pressure from a supervisor to be on time. By categorizing these types of violations in this category, there is no opportunity to identify the supervisory factor.

Because of an organization's response (typically termination) to egregious and criminal acts, determining the root cause of such violations is nearly impossible because there is no incentive for the employee to share information. Therefore, in the case of truly criminal acts, foregoing root cause analysis is warranted. Transit agencies can enhance compliance with zero-tolerance policies by educating the employees regarding the risk associated with noncompliance.

3.2 Routine Violations

These occur when a shortcut or quicker way to the end goal presents itself and is taken on a regular basis. While the act may be against the rules, employees reason that their skill offsets the possible consequences of or risk associated with the noncompliance. A routine violation occurred when track maintainers were found to regularly forego the application of a redundant shunting device to protect a crew working on the tracks because they believed that protection from the train dispatcher was adequate.

3.3 Exceptional Violations

These often occur when employees are faced with unusual circumstances that call for an unusual response (e.g., emergency situations). Often times, the rules or procedures may be inadequate to accommodate the situation. The distinguishing feature between decision-based errors, as they previously are described, and exceptional violations is the employee's intention. With respect to decision-based errors, the employee is unaware that he or she misunderstood the rule or failed to apply it correctly. With exceptional violations, the employee understands the rule, but either does not trust the rule's effectiveness (or appropriateness) or thinks that the alternate response he or she conceived is more appropriate. When exceptional violations occur, the applicability of the rule that is broken should always be revisited in the context of the situation in which it was violated.

The following example describes an exceptional violation: a public transit agency has a rule that forbids bus operators from letting off passengers between stops. Due to bad weather and a passenger's request, a bus operator let off an elderly passenger between stops. The passenger felt it was too icy to walk from the stop to her home.

3.4 Situational Violations

These occur because an employee is conflicted regarding the balance between adherence to the rules (e.g., procedures designed to ensure safety) and meeting performance goals (e.g., on-

Table 2. Employee noncompliance (Level I).

Category	Subcategory	Description	Potential Causes
Error			
	Perceptual Error	Employee's perception of work conditions is different from reality	Degraded signage, radio communications and the employee's expectations
	Skill-Based Slip	Habit capture, misordering, repeating or inserting erroneous steps in a task sequence	Distraction, fatigue, loss of situation awareness
	Skill-Based Lapse	Failures of short-term memory resulting in the omission of some part or all of a task	Distraction, multi-tasking, high workload
	Skill-Based Technique Error	Personal technique places an operator at risk for rule noncompliance	Personality, maladaptive operating practices
	Strategy-Based Decision Error	Applied the wrong rule or misapplied the correct rule to a work situation	Vague rules, lack of or inadequate rule training
	Knowledge-Based Decision Error	Employee did not understand or was unaware of a rule	Lack of experience or inadequate rule training
Violation			
	Egregious/Criminal Act	Acts for which a transit agency has zero-tolerance such as drug or alcohol abuse	Personality and psychopathology
	Routine Violation	Occurs when a shortcut or quicker way to the end goal presents itself and is taken on a regular basis	Inadequate supervision, overconfidence in skill, pressure to adhere to performance goals
	Exceptional Violation	Occurs when employee is required to handle an unexpected circumstance	Lack of or inadequate training, vague rules
	Situational Violation	Occurs when there are competing performance goals (e.g., safety v. on-time performance)	Inconsistent supervision and/or disciplinary action

time performance). Due to the employees' work conditions or demands, they often find it difficult or impossible to remain within the boundaries of safe working practices defined by the rules. When performance targets are met, these violations are overlooked. However, employees committing these types of violations are often disciplined when accidents ensue. The inconsistent disciplinary approach to enforcement is not an effective way to reduce these violations. The following example illustrates a situational violation: a bus mechanic has many routine maintenance checks to do on buses that must go out today. Pressured by his supervisor to stay on schedule at all cost, he chooses not to complete the final checklist to save time and prevent delays in the bus schedule. As a result, he fails to catch a loose bolt on one of the wheels that had been removed for brake work. An accident resulted later that day.

Table 2 summarizes the factors of Level I.

Level II: Preconditions for Employee Noncompliance

Preconditions for employee acts are those work-related, contextual, environmental and personal factors that exist prior to the incident but indirectly contribute to an incident's occurrence, often by setting up or fostering a situation in which one or more operator acts occurs. Preconditions are organized into three major categories: environmental factors, employee condition, and personnel factors.

1. Environmental Factors

Environmental factors refer to the conditions in the employee's immediate working environment that encouraged noncompliance. The factors are subdivided into three categories.

1.1 Natural Environment

This factor refers to conditions such as weather and time of day that are completely beyond the control of the employee. This factor was evident when blowing snow and ice build-up contributed to the failure of a train operator when she overran the platform and struck the bumper block.

1.2 Physical Environment

This factor refers specifically to the employees' assigned workspace, which could be behind the wheel of a bus or outdoors maintaining track. A less than ideal workspace existed when an engineer's view of a signal was obstructed by the cab car's configuration and control stand leaving the engineer to rely solely on the conductor to inform of the signal aspect. If the conductor is mistaken, the engineer does not have the opportunity to correct the situation.

1.3 Human–Work System Interface

This factor refers to a mismatch between what the employee requires in the workspace to adequately perform his or her job and what is actually provided in the form of technology, equipment, and the functional design of the workspace. This factor contributed to a perceptual error resulting in an accident. Poor color markings of the horn and emergency stop cords caused the conductor to activate the horn rather than the emergency stop. This factor is also known to contribute to situational violations as well. Wheel chair tie downs are reported as difficult to secure by operators. Sometimes schedule pressure causes an operator not to secure them properly placing the passenger at risk of injury.

2. Employee Condition

The condition of the employee refers to the state of the employee's mental and physical well-being at the time of the noncompliant event. This category is divided into five subcategories.

2.1 Employee Readiness

This factor refers to the extent to which an employee is mentally and physically able to perform his or her job. This category may include the following factors: insufficient rest or overexertion due to non work-related activities, use of performance impairing substances (e.g., over-the-counter, prescription, or illicit), untreated medical issue, or failure to adhere to medical treatment. An event involving lack of employee readiness occurred when a vehicle operator used an over-the-counter cough medicine that had a sedating effect. As a result, the operator's attention was impaired and she failed to notice a red signal and passed it.

2.2 Mental State

The employee's mental state refers to any temporary cognitive limitations he or she may experience as a result of events that happened prior to reporting for duty (e.g., emotional upset) or the person's task/job demands. Sometimes high workload can lead an employee to become overly focused when he or she is unfamiliar with certain aspects of his or her job. Other times, an employee can become distracted under high workload conditions. An example of distraction occurred when flashing lights in a field next to the rail right-of-way distracted the engineer and caused him to run a red signal. Another result of high workload is mental fatigue. Mental fatigue can occur when a person is well-rested but may be required to be vigilant for long periods during his or her job; vigilance is known to produce mental fatigue.

Low workload, as well as overconfidence in one's ability, can result in employee complacence. Complacence occurred when a bus driver failed to exercise defensive driving skills and collided with another vehicle.

2.3 Attitude and Personality

An employee's attitude and personality can contribute to noncompliance. An employee's attitude regarding a rule may play a role in noncompliance as do job dissatisfaction and overconfidence in one's skills. These factors can further lead an employee to have a history of noncompliant behavior as well as a pattern of underestimating the risk associated with noncompliance. The latter occurred when an experienced track worker believed he did not have to wear personal protective equipment because he thought he would always hear an approaching train. This was a contributing factor to the track worker being struck by an oncoming light rail vehicle.

2.4 Adverse Physiological State

An adverse physiological state, such as medical illness or even physiological incapacitation, may contribute to noncompliance. For example, a diabetic bus driver failed to eat. The driver's blood sugar dropped, impairing his judgment and causing the driver to stop where there was no bus stop. The chain of events led to a collision with another vehicle. In a different incident, a driver choked on a piece of candy and lost consciousness. The bus she was driving struck another bus from the rear as a result of her incapacitation.

2.5 Mental or Physical Limitations

There may be aspects of an employee's inherent mental or physical limitations that contributed to noncompliance. These may include visual limitations, incompatible intelligence or aptitude, incompatible physical capability, poor inference/reasoning skills, or slow reaction time. In one incident an engineer's undiagnosed color blindness caused him to pass a red signal and strike another train.

3. Employee Communication and Rapport

This factor refers to how peer members of the operational staff communicate and coordinate work efforts with one another. This can involve the simple discourse between a commuter rail engineer and dispatcher or the more complex interactions among track maintenance crew members. This factor may contribute to noncompliance when there is a failure in communication or coordination among peer staff members, when employees fail to use all available resources, or when there is a failure of leadership in the workgroup. A breakdown in communication within a track engineering department resulted when staff members did not properly interpret the results of a track geometry car inspection and issue their findings in a timely manner. As a result, a train derailed because of the condition of the track. In a different incident involving a failure of leadership, a foreman failed to follow regulations that ensured a safe working environment on a job site. The foreman allowed the signalman to raise the crossing gate before checking for trains in the area, resulting in a train striking a car at the crossing.

Table 3 presents the factors associated with Level II of the taxonomy.

Level III: Supervisory Factors

Supervisory factors sometimes play a role in noncompliance. These factors typically fall into one of five categories: supervisor provided inadequate oversight, supervisor/management planned inadequate work schedule, supervisor provided inadequate information and/or resources, supervisor failed to correct a known problem, and supervisor noncompliance.

Table 3. Preconditions for employee noncompliance (Level II).

Category	Examples
Environmental Factors	
Natural environment	Climate, weather, time of day, glare, etc.
Physical environment	Workspace
Human–work system interface	Human–machine interaction
Employee Condition	
Personal readiness	Over-exertion
	Self-medicating
	Lack of sleep/physical fatigue
Mental state	Overfocused
	Distracted
	Complacent
	Mental fatigue
	Emotional upset
	Workload
Attitude/personality	Attitude toward the system
	Job dissatisfaction
	History of noncompliant behavior
	Misperceiving risk of hazard
	Low self-esteem
Adverse physiological state	Medical illness
	Physiological incapacitation
Mental/physical limitation	Insufficient reaction time
	Visual limitation
	Incompatible intelligence/aptitude
	Incompatible physical capability
	Poor inference/reasoning
Employee Coordination and Rapport	
N/A	Failure of leadership
	Failure to communicate/coordinate
	Failure to conduct adequate job briefing

Factor 1. Inadequate Oversight

This factor is evident when a supervisor fails to provide guidance, particularly to less experienced and confident staff. This category also includes failure of supervisors and/or management to provide and encourage training opportunities. Poor leadership and failure to verify employee qualifications and monitor job performance are included in this category. An example of a lack of supervisory oversight occurred when the supervisor did not oversee a car inspector's work and the inspector failed to properly secure the locking nut on a brake shoe assembly later resulting in a derailment. Another incident occurred when a supervisor failed to monitor employee qualifications. All employees at this public transit agency are required to have training before operating a new type of vehicle. Because the supervisor failed to make sure that all employees received the training, an untrained employee operated the new vehicle improperly causing an accident.

Factor 2. Inadequate Work Schedule

A supervisor or the scheduling department may plan work schedules that do not allow for adequate rest. The result may influence an employee's noncompliance because of fatigue. Fatigue promotes human error and can tempt an employee to take shortcuts (i.e., rule violation) to get the job done. An example of this happened when, in spite of an operator's complaint of work-schedule-related fatigue, the supervisor insisted that the employee operate the train. The employee fell asleep on duty and rear-ended another train. Another example involving inadequate rest occurred when a work schedule only allowed 8 hours between consecutive work periods that involved an

overnight split assignment. Due to fatigue, an engineer failed to stop at the stop marker before entering a station.

Factor 3. Inadequate Information and Resources

A supervisor may also fail to provide the operational information that an employee needs to perform the job (e.g., fail to provide job brief). A supervisor may also fail to provide adequate staffing, thereby stretching the resources of the operational staff. A maintenance supervisor had an inadequate number of personnel assigned to perform the periodic preventive maintenance inspection for a light rail fleet. Trying to adhere to the maintenance schedule and prevent delay in operations, the inspection personnel skipped steps in the inspection checklist. One of the light rail cars had a loose bolt which caused a derailment.

Factor 4. Failure to Correct a Known Problem

Failing to correct a known problem is a supervisor inaction that may contribute to noncompliance. This occurs when a supervisor does not identify and address at-risk employees with remedial or corrective action. An example of this occurred when a bus driver was reported by peers to take risks while operating the bus (e.g., speeding, closing doors before looking to see if a passenger was still in the doorway). While aware of these behaviors, the supervisor did not coach the employee on the risks of these behaviors. The driver was subsequently involved in an intersection accident caused by the driver's failure to properly judge the speed of oncoming vehicles. In a different incident, many operators reported that a signal was difficult to see in bright sunlight but management did not take action to correct the problem until an accident occurred.

Factor 5. Supervisor Rule Noncompliance

Supervisors may themselves commit errors and violations associated with noncompliance that contribute to their subordinates' lack of compliance. This may include authorizing employees to break the rules and failing to enforce rules or regulations. An incident occurred when a supervisor authorized an employee to break the rules. A bus supervisor emphasized schedule adherence as the most important goal, even at the expense of maintaining a safe operating speed. The bus driver was later involved in an accident where speeding by the bus operator was cited as the probable cause. In another incident, a track maintenance supervisor failed to ensure that the rail was properly secured prior to authorizing a train to travel through the work area. The train passed over the loose rail and derailed.

Table 4 lists the factors associated with Level III of the taxonomy.

Level IV: Organizational and Regulatory Factors

The decisions and policies of upper management and regulatory agencies directly influence public transit supervisor practices. As such, they can directly contribute to incidents or accidents stemming from rules noncompliance. Contributing to these factors are economic challenges that wax and wane over time.

During times of economic prosperity, public transit agencies may be able to satisfactorily balance the requirements associated with safe operating practices with the performance goals of the agency (e.g., customer satisfaction and on-time performance). Historically, when economic constraints come into play, commitment to safety often takes a back seat to performance goals. This has a trickle-down effect to first-line supervisors as well as front-line employees. During times of economic hardship, cutbacks in staffing, training, incentives, and maintenance often lead to

Table 4. Supervisory factors (Level III).

Category	Examples
Inadequate oversight	Failed to provide guidance
	Failed to provide training opportunities
	Poor leadership
	Lack of oversight
	Failed to monitor employee qualifications
	Failed to track performance
Inadequate work schedule	Provided inadequate opportunity for employee rest
Inadequate information/resources	Failed to properly brief employee
	Failed to give the employee necessary information
	Provided inadequate staffing
Failure to correct known problem	Did not call out at-risk employee
	Did not report unsafe tendencies
	Did not initiate remedial or corrective action
Supervisor rule noncompliance	Authorized employee to break the rules
	Failed to enforce rules or regulations
	Allowed unqualified employees to perform job

an overworked, less motivated, and less qualified staff operating suboptimal equipment. This scenario, when combined with an organization that values performance goals over safety, may lead supervisors and their employees to break safety-related rules, resulting in an accident.

The factors in this category include those of resource and acquisition management, organizational climate, an organization's operations, and regulatory influences.

Factor 1. Resource and Acquisition Management

This factor includes the acquisition and management of public transit employees, equipment, and facilities. Resource management may involve human resources, monetary or budget resources, and equipment and facility resources including maintenance. With respect to the latter two contributors, budget restrictions may prevent a public transit agency from replacing old equipment that require extra maintenance and repairs. As a result, there is more opportunity during the maintenance process for errors that may lead to equipment failure.

Factor 2. Organizational Climate

Organizational climate can generally be regarded as the working atmosphere within an organization. Safety climate is the collective values of management, supervisory staff, and employees as they relate to work safety at a given point in time. Alignment of an organization's formal safety policies, procedures, and rules with the informal values, beliefs, and attitudes of an organization's management and staff is a predictor of a positive safety climate. However, when upper level management claims to embrace an organization's safety policies (i.e., talk the talk) only to overlook those same policies behind the scenes (i.e., failing to walk the walk), erosion of the organization's safety climate occurs.

Organizational structure in a public transit agency may contribute to climate erosion when the agency's safety management personnel are not represented at every level of the organization. An agency's safety policies as well as their safety culture may also contribute to noncompliance. In organizations entrenched in a culture of blame, there is often no attempt to identify risks before an incident occurs. Instead of being proactive and preventive, the managers in this type of environment are reactive, looking to blame an employee when there is noncompliance or an accident.

Table 5. Organizational and regulatory factors (Level IV).

Category	Examples
Resource/Acquisition Management	Human Resources
	Monetary Budget Resources
	Equipment/Facility Resources
Organizational Climate	Organizational Structure
	Policies
	Safety Culture
Organizational Operations	Process
	Procedures
	Oversight
Regulatory Factors	Lack of regulatory oversight
	Lack of regulations

Factor 3. Organizational Processes

This factor includes work tempo, incentives, operating practices and procedures (or lack of), and public transit agency specific oversight activities that help to ensure a safe work environment (e.g., risk management programs). A problem with an organizational process occurred when a failure in procedures led maintenance staff to use the wrong sized bolts during the repair of a work train causing it to derail. There was a lack of quality control procedures to ensure the correct hardware was used during the maintenance process.

Factor 4. Regulatory Factors

Regulatory factors, including legislative ones, are beyond the control of a public transit agency. Yet, they affect operations because of the adherence requirement. Some regulations may strain transit agencies' already tenuous budgets and resources. Lack of regulations or regulatory oversight may contribute to incidents stemming from noncompliance to an agency's safety-related rules. For example, prior to the FTA requirement that all rail systems have system safety plans with state oversight, public transit agencies did not necessarily have formal rules compliance programs.

Table 5 presents the factors associated with Level IV of the taxonomy.

Investigating the Causal and Contributing Factors of Safety-Related Rules Noncompliance

Based on the previous descriptions and explanations of the taxonomy, the following tables present questions designed to help a public transit agency investigate the underlying factors of safety-related rules noncompliance. If an incident involves more than one instance of noncompliance, use the taxonomy to investigate each instance. Keep in mind that the categories of Level I of the taxonomy are mutually exclusive; whereas subsequent levels are not. Therefore, consider the applicability of all categories for Levels II through IV.

If it is not possible to determine the Level I factors, you should continue to identify any contributing factors in Levels II through IV as well as review the rule that was broken. A rule review should be conducted for all instances of rule noncompliance and, at a minimum, include the following questions:

- Is the safety-related rule's noncompliance rate high?
- Is the safety-related rule easily comprehended?
- Have safety-related rules been explained well both verbally and in written form?
- Has the safety-related rule been demonstrated to the employee in classroom, computer-based, and/or on-the-job training?

- Have you queried employees or labor representatives regarding the relevance of the safety-related rule?
- Do employees report that it is difficult to comply with a safety-related rule and if so, why?

Tables 6 through 9 contain the root cause questions for Levels I through IV of the taxonomy, respectively. If the answer to a question is yes, the number associated with the question corresponds to the description of the factor(s) described in the previous taxonomy. The user is encouraged to review the taxonomic information associated with the factors identified in the root-cause process. This information will aid in identifying strategies to mitigate the contributing factors.

Table 6. Root cause questions for employee noncompliance (Level I).

	Questions	Does it apply?	
1.	Determine employee intent.		
1.1	Was the noncompliance unintentional? Was the employee unaware that he, or she, failed to comply with a rule until an unexpected occurrence happened?	☐Y	☐N
	If yes, then noncompliance is the result of an **error**; go to 2.		
1.2	Was the noncompliance intentional? Was the employee aware that he, or she, broke a rule?	☐Y	☐N
	If yes, then noncompliance is the result of a **violation**; go to 3.		
1.3	If intention cannot be determined, conduct a rule review and proceed to Level II.	Cannot determine	
2.	What type of error occurred?		
2.1	Perceptual Error		
2.1.1	Did the employee indicate that they experienced (e.g., saw or heard) something in a way that was different from reality? Was information in the employee's environment obscured or degraded in any way when noncompliance occurred? Did the employee indicate that they experienced what they expected rather than what was actually present?	☐Y	☐N
	If yes, then a **perceptual error** occurred; proceed to Level II.		
2.2	Skill-Based Error		
2.2.1	Did the employee perform the wrong action (e.g., habit capture, misordering, repeating or inserting the wrong steps while performing their job) and did the employee report being surprised that their action did not produce the intended result?	☐Y	☐N
	If yes, then a **skill-based slip** occurred; proceed to Level II.		
2.2.2	Did the employee report "forgetting" to do something and not realize they forgot until the incident occurred?	☐Y	☐N
	If yes, then a **skill-based lapse** occurred; proceed to Level II.		
2.2.3	Did the employee's personal style of performing his or her job lead him or her to not comply with a rule?	☐Y	☐N
	If yes, then a **skill-based technique error** occurred; proceed to Level II.		
2.3	Decision-Based Error		
2.3.1	Did the employee incorrectly apply a strategy to the situation, or did the employee use a proven strategy, but applied it to the wrong situation?	☐Y	☐N
	If yes, then a **strategy-based decision error** occurred; proceed to Level II.		
2.3.2	Did the employee express difficulty understanding the rule? Is the employee relatively inexperienced?	☐Y	☐N
	If yes, then a **knowledge-based decision error** occurred; proceed to Level II.		

(continued on next page)

Table 6. (Continued).

Questions	Does it apply?	
3. What type of violation occurred?		
3.1 Egregious/Criminal Acts		
3.1.1 Was the noncompliance the result of the employee intending harm? Did the employee engage in criminal behavior?	☐Y	☐N
If yes, then an **egregious/criminal act** occurred; stop here, root cause cannot be determined.		
3.2 Routine Violations		
3.2.1 Does the employee have a history of this type of noncompliance? Do other workers in the employee's peer group have the same pattern of noncompliant behavior? Does the employee's supervisor(s) fail to take action for this type of noncompliance?	☐Y	☐N
If yes, then a **routine violation** occurred; proceed to Level II.		
3.3 Exceptional Violations		
3.3.1 Was the situation where the rule was broken a rare event? Was the employee's action perceived as more effective for the situation than following the required rule, or procedure?	☐Y	☐N
If yes, then an **exceptional violation** occurred; proceed to Level II.		
3.4 Situational Violations		
3.4.1 Did the employee feel compelled to break the rule or not follow a procedure in order to meet performance goals? Do supervisors provide inconsistent disciplinary action for this type of noncompliance, i.e., overlook it when it supports performance goals and punish when it results in incident?	☐Y	☐N
If yes, then a **situational violation** occurred; proceed to Level II.		

Table 7. Root cause questions for preconditions for employee noncompliance (Level II).

	Questions	Does it apply?	
1.	Was the environment a factor?		
1.1	Did factors such as the weather, time of day, temperature, or glare contribute to the operator's noncompliance?	□Y	□N
	If yes, then the **natural environment** was a factor in the noncompliance; proceed to next question.		
1.2	Was the workspace or work environment inadequate? Was there a lack of or inadequate equipment available to perform the job? Was there an operational problem with the transit vehicle?	□Y	□N
	If yes, then the **physical environment** was a factor; proceed to next question.		
1.3	Was there a mismatch between the employee and some aspect of the work system? Was there a functional design issue with the workspace or an interface such that perception was obscured or situational awareness was impaired? Did the work system or procedures not match the needs or requirements of the employee?	□Y	□N
	If yes, then the **human-work system interface** was a factor; proceed to next question.		
2.	Was the employee's condition a factor?		
2.1	Did the employee get insufficient rest, or overexert him/herself while off duty? Did the employee use over-the-counter, prescription or illicit drugs (including alcohol) that may have affected his or her ability to perform optimally while on-duty? Did the employee, in any way, fail to prepare for duty, mentally or physically?	□Y	□N
	If yes, **employee readiness** was a factor; proceed to next question.		
2.2	Were there any mental factors, perceptions, attitudes, moods, conditions, or states that momentarily and negatively affected the operator's performance? Was the employee generally distracted or focused on non-work factors? Was the employee anxious, stressed, worried, excited, or otherwise in an unusual mental state? Was the employee fixated on a particular task or did he or she lose situation awareness?	□Y	□N
	If yes, the employee's **mental state** was a factor; proceed to next question.		
2.3	Did the employee have a poor attitude regarding the safety rules or the public transit agency, in general? Does the employee have a history of risk-taking behavior? Was the employee complacent, overconfident, or under-confident?	□Y	□N
	If yes, the employee's **attitude and/or personality** was a factor; proceed to next question.		
2.4	Were there any medical or physiological conditions that momentarily and negatively affected the employee? Was the employee in poor health resulting from an acute or chronic medical condition? Was the employee negatively affected by the medical condition?	□Y	□N
	If yes, the employee experienced an **adverse physiological state**; proceed to next question.		
2.5	Did the job demands exceed the ability of the employee? Was the employee able to see or hear everything he or she needed to complete the job assignment? Was the employee not adequately trained, inexperienced or lack the necessary knowledge to perform the job? Was the employee not able to keep up with the pace of operations? Was the employee's aptitude, ability, strength or proficiency an influencing factor?	□Y	□N
	If yes, the employee had **mental and/or physical limitations** that contributed to the noncompliance; proceed to next question.		
3.	Employee Communication and Rapport		
3.1	Was there poor communication or poor coordination among those involved? If applicable, was a job briefing omitted or abridged? Was there any type of personnel conflict that contributed to the noncompliance?	□Y	□N
	If yes, then **employee communication and/or rapport** was a factor; proceed to next question.		

Table 8. Root cause questions for supervisory factors (Level III).

	Questions	Does it apply?
1.	Was there inadequate oversight of the employee?	
1.1	Did front-line supervisors or other managers provide insufficient guidance, leadership, oversight, tracking of operator qualifications/performance, or incentives? Was the supervisor over-tasked, over-worked or under-trained/qualified to such an extent that he or she lost awareness of his or her assigned responsibilities?	☐Y ☐N
	If yes, then **inadequate oversight** was a factor in the noncompliance; proceed to next question.	
2.	Was the employee assigned an inadequate work schedule?	
2.1	Did the assigned work schedule prevent the employee from getting adequate rest? Was there no quiet room for the employee to get rest between shifts? Did the work schedule prevent the employee from obtaining at least 8 hours of undisturbed sleep?	☐Y ☐N
	If yes, then an **inadequate work schedule** was a factor; proceed to next question.	
3.	Did the supervisor fail to provide adequate information and/or resources for the employee?	
3.1	Did the supervisor fail to provide the employee with a job briefing, documents and materials (e.g., up-to-date bulletins, rule books, special instructions, etc.) or training that prevented the employee from performing optimally? Did the supervisor fail to provide an adequate number of staff to perform operations, i.e. did a lack of peer personnel stretch the limits of the noncompliant employee?	☐Y ☐N
	If yes, then **inadequate information/resources** was a factor; proceed to next question.	
4.	Did the supervisor fail to correct a known problem?	
4.1	Have there been recent situations in which inadequacies or shortcomings in materials, equipment, work schedules, personnel or training were known to one or more supervisors, but were allowed to continue uncorrected? Did the supervisor know that unsafe behaviors were occurring regularly but failed to correct the problem?	☐Y ☐N
	If yes, then the supervisor **failed to correct a known problem** and it contributed to the employee's noncompliance; proceed to next question.	
5.	Did the supervisor fail to comply with a safety rule(s)?	
5.1	Did the employee's supervisor knowingly disregard an organization's rule policy or regulation, such as allowing employees to perform their jobs without proper licensing or qualifications? Did the supervisor actively encourage the employee to bend or ignore safety rules or punish the employee for following the rules?	☐Y ☐N
	If yes, then **supervisor rule noncompliance** was a factor; proceed to next question.	

Table 9. Root cause questions for organizational and regulatory factors (Level IV).

	Questions	Does it apply?
1.	Did the organization's resource management play a role in the noncompliance?	
1.1	Did the acquisition, allocation, management or maintenance of business assets contribute to the incident's occurrence? Business assets include human resources, equipment, facilities and financial resources. Is staffing inadequate to a point where workload is excessive? Did the employee lack the equipment or resources needed to work safely? Did excessive cost-cutting or budgetary restrictions contribute to the incident?	☐Y ☐N
	If yes, then **resource management** was a factor in the noncompliance; proceed to next question.	
2.	Was the organizational climate a factor?	
2.1	Did the non-operating work environment (organizational climate) appear to contribute to the incident's occurrence? The organizational climate includes the formal and informal organizational structure, policies and culture. Was there poor communication regarding safety policy and rules between upper and middle management? Does upper management have an inconsistent message regarding safety policies and rules? Do they proclaim the importance of these policies and rules, yet send the message to their employees that on-time performance is more important? Do fellow employees have a low regard for the agencies safety policies, rules and procedures?	☐Y ☐N
	If yes, then **organizational climate** was a factor; proceed to next question.	
3.	Were the organization's processes a factor in the noncompliant event?	
3.1	Was the work pace (operational tempo) too fast? Were there any unsafe or inadequate operating practices, procedures, rules or administrative controls that contributed to the noncompliance? Were corporate safety programs and risk management programs inadequate? Was there a lack of, or an inadequate, safety reporting system that would have helped to identify patterns of noncompliance that could have prevented the incident being investigated? Did upper-level management or an agency executive bend or violate either internal or external procedures, processes or regulations?	☐Y ☐N
	If yes, then **organizational processes** was a factor; proceed to next question.	
4.	Did non-agency regulatory factors play a role in the noncompliance?	
4.1	Could a government regulation, law, action or order, if one had been in place, prevented or reduced the likelihood of noncompliance? Was there relevant government regulation, law, action or order in place at the time of the incident, but it was inadequate or ambiguous in terms of specifying requirements or performance standards for an operation, practice or equipment? Did an existing government regulation, law, action or order appear to contribute to the noncompliance?	☐Y ☐N
	If yes, then **regulatory factors** contributed to the noncompliance; stop root cause process here.	

CHAPTER 4

Best Practices You Can Use

This chapter provides specific practices that a transit agency can use to improve safety-related rules compliance. The practices are grouped into six categories: screening and selecting employees, training/testing, communication, monitoring rules compliance, responding to noncompliance, and safety management.

Table 10 lists the specific practices in each category. Some of the practices listed in this table are further divided. For example, observational methods for monitoring rules compliance consists of ride-along, mystery rider, observation external to the vehicle, speed monitoring, video data recording, and safety audit.

Where appropriate, sample documents illustrate the implementation of the practice. Callout boxes contain examples of how selected practices have been implemented by a transit agency. The suggested effectiveness metric(s) for each best practice follows its description as a bulleted item in a box. A table summarizing the relevant metrics appears in Appendix E. As suggested in the Measuring Compliance with Leading and Lagging Indicators section of Chapter 2, the majority of these metrics are leading indicators.

Screening and Selecting Employees

DOT regulations require that transit agencies screen for drug- and alcohol-related offenses. In addition, many transit agencies examine a job candidate's record of moving violations, as well as any history of criminal activity. Within the airline industry, research has demonstrated that previous drug and alcohol offenses (e.g., driving under the influence) were predictive of risky flight maneuvers. While the research has not been extended to apply to the public transportation industry, it is likely an effective practice.

- ✓ % of candidates screened

Training and Testing

The following highlight best practices for training and testing knowledge of safety-related rules. The reader is encouraged to review the following in the context of the training section of Chapter 2.

- ✓ % of training programs that measure training effectiveness
- ✓ Is there a post test for all rules training? (Rating scale that evaluates effectiveness on multiple dimensions)

Note: The above metrics apply to all the training and testing best practices.

Table 10. Best practices by category.

Category	Practices
Screening and Selecting Employees	• Screening and Selecting Employees
Training/Testing	• Effective Training Preparation • Information Transfer Methods • Action-Based Rules Training • Assessing Effectiveness of Rules Training • Crew Resource Management
Communication	• Proactive Rules Communication • Opportunities to Ask Questions • Communicating Changes to Rules • Positive Safety Language • Customer Feedback
Monitoring Rules Compliance	• Operational Testing • Observational Methods • Automated Methods
Responding to Noncompliance	• See Chapter 3 for investigating and responding to noncompliance • Rule Evaluation • Task Analysis • Improving Training • Improving Workspace, Tools and Equipment • Improving Safety Culture • Behavioral Coaching • Discipline
Safety Management	• Assessing the Rules Compliance Program • Encouraging Employee Involvement • Reporting Near-Misses and Other Safety Risks • Incentivizing Rules Compliance

Effective Training Preparation

For training to be effective, trainers must prepare their trainees for the learning experience. A public transit agency's training curriculum can accomplish this by informing employees about upcoming training opportunities and requirements. The training department may send traditional mail or email announcing any upcoming training. Agencies may also use posters and flyers to announce training opportunities. The information about training should include why the transit agency is sponsoring it, the training goals and objectives, and any potential benefits to the employee and the agency.

Yes/No:
✓ Include staff in design and development of training program
✓ Train the trainer
✓ Prepare trainees for rules training by explaining expectations

Information Transfer Methods

Information transfer methods typically occur in a classroom setting. However, it is important that the information imparted in this setting has the opportunity to be demonstrated in an action-based learning paradigm (see next subsection). The most effective training will encompass a broad cross section of training methods.

✓ Pre/post tests that evaluate understanding the purpose of rules
✓ % of rules with explanations

Instructor-led training. This is the most typical form of classroom training. The instructor will preside over a class explaining the content via lecture, handouts, static visual presentation (e.g., slides), and other audio-visual teaching aids. Instructor-led training is most effective when the leader provides students with real-world exemplary material that demonstrates the following:

- Necessity for a rule
- Proper execution of the rule in the operational environment
- Potential outcomes if the rule is not followed
- Skill does not protect an employee from the safety risks associated with rule noncompliance
- Actual examples of incidents or accidents stemming from rule noncompliance

Instructor-led training should also provide the employee with the opportunity to ask questions in a non-evaluative manner, that is, instructors should encourage their students to ask questions without placing value on the quality of questions.

Video presentation. Videos are an effective way to bring a lecture and static course materials to life. Instructors can use video to present the positive image of employees following the rules thereby modeling the expected behavior and proper execution. Alternatively, video may also be used to present the negative consequences of employees who failed to comply with rules. The latter may include video of actual accident scenes and/or scenario-based re-enactment.

Computer-based training (CBT). Many organizations are migrating toward this type of training either by supplementing classroom training or replacing it altogether. The disadvantage to replacing classroom training altogether with CBT is that employees lose the ability to ask questions and they may not learn from comments from their peers. As a supplementary form of training, CBT has advantages. It is less costly than traditional classroom training; therefore, transit agencies can conduct CBT throughout the year to reinforce less frequent classroom training. CBT offers employees the flexibility to complete the training at their own convenience outside of work hours.

Refresher training. Transit agencies as well as organizations in other safety-critical industries provide periodic training throughout the year to reinforce initial rules training. Refresher training may be classroom-based, via CBT or through action-based training described in the next subsection.

Virginia Regional Transit Authority (VRTA) has a multi-method training system for relating safety-related rules. Employees are notified of safety rules beginning the first day of employment. Throughout the year, VRTA provides monthly and approximately 40 hours of safety- and security-related training to employees via Saturday training meetings. This includes an intensive 8-hour boot camp typically held in early Spring. All employee meetings include video training that may cover specific incidents. The Accident Review Committee complements VRTA's training program by conducting monthly incident and accident briefings with employees as needed.

Mountain Line Transit Authority uses an effective video program from the trucking industry to inform its drivers of safety-critical scenarios. The video shows scenarios from the perspective of someone behind the wheel of a transit vehicle. The program is reportedly successful for initial driver training as well as for periodic refresher training.

Action-Based Rules Training

Action-based or experiential training focuses on educating the employee about how to execute the rule in an operational setting. This can occur when the employee is on-the-job or in a simulated scenario. Action-based training is most effective when combined with information transfer methods.

- ✓ Pre/Post tests that evaluate understanding how a rule is applied
- ✓ % of rules with examples
- ✓ % of rules with practice opportunities
- ✓ Annual opportunities for refresher training
- ✓ % of scheduled refresher training completed
- ✓ % of action-based training that incorporates positive feedback during training
- ✓ Course evaluation containing questions about frequency and quality of feedback during training

Simulator training. Other industries, particularly aviation, make simulation a central component of rules and competency training. Many bus and rail operators make use of simulator training. While the disadvantage of simulator training is the cost of high-fidelity simulators, smaller operators should consider lower cost alternatives. Low-fidelity simulators may not provide the vehicle operator with the tactile and motion feedback that more expensive simulators provide; however, they still provide the opportunity to place the vehicle operator in situations they may not frequently encounter in passenger operations. This better prepares the operator for unexpected situations that may arise, which may call for the execution of less frequently used rules. Simulator training also provides a means to train an operator to respond to high-risk scenarios without putting the individual at risk of experiencing negative consequences.

On-the-job training (OJT). All transit agencies use OJT as a form of training. Effective OJT guidelines are discussed in the training section of Understanding Rules Noncompliance.

Practice in nonpassenger operation. Transit agencies, particularly bus operators, provide their employees with the opportunity to learn to operate transit vehicles without passengers on board. This is particularly useful for novice employees as they are not distracted by persons on board.

Defensive driving course. Many bus transit agencies, as well as other commercial driving organizations, require their employees to complete a defensive driving course. This type of instruction teaches employees to be proactive on the roadways considering ways to prevent accidents due to the poor driving choices of other drivers on the road. To maximize the effectiveness of defensive driving, the skills learned should be periodically reviewed with the employee.

Crew Resource Management

Background. Crew Resource Management (CRM) has been an extremely successful training program in the aviation industry. Although this training program was initially directed toward airline crews, it has been expanded over the years to include such employees as dispatchers and maintenance personnel. In addition, it is a program that can include employees who work alone but have a direct working relationship with other related employees, such as transit vehicle operators and dispatchers. Further, CRM training addresses many of the topics covered in this report including perceptual errors, distraction, fatigue, workload, risk taking, and safety culture.

History. CRM was established within the airline industry in the early 1980s, in response to a series of aviation accidents caused solely by human factors and not mechanical failures. It has been so successful that this training is now mandated by the Federal Aviation Administration for all passenger airlines, and will soon be expanded to include all cargo operations as well.

Purpose. The CRM training program recognizes that human error will occur, and develops techniques and strategies to deal with such errors. It promotes a working environment that encourages all employees to speak up and assert their views, thus preventing small errors from being magnified and ultimately affecting the safety of flight. It is sometimes defined as "the management of errors."

How it works. The CRM training program emphasizes human factors. All new employees working in operational areas requiring this training receive their introductory information during the orientation process. To reinforce this initial training, annual recurrent training is also provided. In addition, to be successful, the program must receive the full support from the company's executive management as well as from the operational managers. A successful CRM program is one that becomes an integral part of the corporate culture. Again, CRM training goes beyond crew interaction, and encourages all employees to use all available resources to complete the tasks safely. The operating mantra becomes "what is right" and not "who is right."

Results. Through emphasis on resource management and human factors, CRM programs have been a highly successful strategy in substantially reducing accidents through the management of errors. Much of the training could also be applied to the public transportation industry, particularly with those employees who work together as a crew (train operations, track crew) or those who work directly with other employees such as operators and dispatchers (bus operations or light rail).

For more information. Additional information regarding crew resource management is available from the following resources:

U.S. Department of Transportation. (1992). *Crew Resource Management: An Introductory Handbook.* Report No. DOT/FAA/RD-92/26, DOT/VNTSC-FAA-92-8. Washington, DC: Research and Development Services.

Kern, Tony. (2001). *Controlling Pilot Error: Culture, Environment, and CRM.* New York: McGraw Hill.

Beaty, David. (1995). *The Naked Pilot: The Human Factor in Aircraft Accidents.* Shrewsbury, England. Airlife Publishing Company.

✓ Number of teams trained

Communication

Communication plays a key role in a safety-related rules compliance program. A number of techniques exist for informing employees of new rules as well as encouraging compliance. The techniques described in this section supplement any training that occurs.

Proactive Rules Communication

Communicating the purpose of a safety-related rule and the consequences of noncompliance helps to reinforce compliance with the rule. *Posters* are an effective means for doing this. Figure 5 contains a poster designed to communicate Los Angeles County Metropolitan Transportation Authority's (LACMTA) cell phone policy. Posters such as this one may be placed in the operator/crew reporting area or any other location where the target group of employees frequently passes.

Safety or training bulletins are another method for proactively communicating with employees. These bulletins might provide an actual example of the consequences of a rule violation at the transit agency or at another transit agency. The bulletin might be in the form of a poster or a more detailed document that is posted on a bulletin board. Figure 6 contains a safety bulletin from Orange County Transportation Authority (OCTA) in the form of a poster. This bulletin is an example of how an incident that occurred at the transit agency can become a learning experience for others.

Figure 5. Example of poster from LACMTA.

ORANGE COUNTY TRANSPORTATION AUTHORITY

INCIDENT ALERT

Transit Operations

WHAT HAPPENED

Railroad Crossings – Two Coach Operators Fail to Take Correct Action

Incident #1 - April 2010, Santa Ana
Incident #2 - June 2010, Anaheim

After stopping at the limit line and then proceeding to cross the tracks, the railroad warning lights and bells activated. In each case, the operator stopped the bus, shifted into reverse, and backed up. Both buses were struck by the crossing arm.

LESSONS LEARNED

In each case, the operators endangered themselves, their passengers, and the train by not following procedure. Stopping and backing up increases the time the bus is in the danger zone. If anything goes wrong while shifting into reverse, or another vehicle pulls directly behind the bus – the bus will be hit by the train!

When you decide it is safe, proceed Full Throttle!
Always "Cross and Clear" – Do Not Stop!

Please take the time to review the Railroad Crossing Procedures.

For further information, please contact your base trainer or the Health, Safety, & Environmental Compliance Department.

Figure 6. OCTA safety bulletin for posting.

Many transit agencies have a *rule of the day/week* as a means to proactively maintain employee knowledge of the rules. San Diego Trolley, Inc. (SDTI) publishes *Rule of the Week* for posting in crew areas (see Figure 7). Many transit agencies discuss the rule of the day at a daily job briefing.

- ✓ % of crew reporting locations with bulletin boards or variable message signs
- ✓ % of rule changes posted

Metro-North Crew Debriefing

Metro-North Railroad (MNR) found that conducting a *crew debriefing* at the end of the day's runs is an effective way to reinforce knowledge and application of its operating rules. The engineer and conductor(s) spend a few minutes with their supervisor talking about what happened that day. They focus on any unanticipated occurrences, such as a crossing gate being out of service, and how they handled them, mentioning the rules that they applied. This is now standard practice at MNR.

Opportunities to Ask Questions

Rules training classes provide an opportunity for employees to ask questions about the intent or application of a rule, but the employee needs a means to resolve issues after the class ends and he or she is back on duty. Some transit agencies encourage trainees to contact their instructor with questions that arise on the job. A *daily job or safety briefing* is another means for doing this. The rule of the day/week may be discussed at this time. SDTI provides guidance to its supervisors for these types of discussions (see Figure 8). Some public transit agencies also conduct periodic *safety meetings* with their employees. These meetings provide an opportunity to review recent rules changes and to allow employees to ask questions. Safety meetings are longer than daily job briefings. Conducting them may require removing employees from their job or paying them overtime to participate after their normal work period. Unfortunately, budgetary and logistical considerations may prevent a transit agency from doing this.

There must also be an opportunity for employees to ask questions and voice their concerns outside of the formal meetings. Having an open door policy where supervisors and managers make themselves available encourages employees to seek help or raise issues. Having a blame-free safety culture in the organization assures employees that there will be no retribution for asking questions.

- ✓ Number of safety meetings or other discussion opportunities

San Diego Trolley, Inc.

Rule of the Week

January 25, 2009

Will you ask or just 'Assume'?

Requirement: (Rule, SOP, or other instruction)

1.2.4 Employees who do not understand any rule, bulletin, notice, instruction or order must promptly ask their Supervisor for an explanation. Ignorance will not be accepted as an excuse for failure to comply.

Understanding: (How compliance protects or serves employees, passengers or equipment)

No matter how structured or complete rules, procedures and other instructions may be, they are only as good as the understanding and application by employees. In our industry, most instructions are safety-related. Some provide direction on schedule adherence and customer service elements, while others define expectations of employee behavior. Combined, they define the 'what' and 'how' we perform.

Liability: (Why rule exists, and potential problems if rule not complied with)

Safety is protected by knowledge and awareness - ignorance or inattentiveness tend to be the primary cause of accidents in the transportation industry. Schedule/Service is a matter of 'customer first' - without customers (which includes more than just passengers), our jobs serve no real purpose. Behavioral items are those an employee has direct control over and makes a choice - not a mistake or error, but a conscious decision to comply or not.

Execution: (How rule should be applied in daily duties)

Train operators have an obligation to themselves, their coworkers and our customers to be conversant at all times with system operations. Your skills and ability to understand and comply with new instructions and your ability to be flexible to respond to ever changing conditions are challenged during special operations or events. Ask for clarification when confusion exists. Report the unexpected when encountered. And never assume.

Remember, if you don't know... don't go.

Figure 7. **Rule of the Week** ***publication from San Diego Trolley, Inc.***

Communicating Changes to Rules

When there is a change in safety-related rules, there are a variety of methods available to communicate a new or modified rule. If the new rule is intended to eliminate a serious safety risk, then a *Meet and Greet* strategy may be used in addition to a printed notice that is mailed to each affected employee. Meet and Greet involves the supervisor explaining the new rule to each employee on a one-on-one basis. The advantage of this approach is that it provides the employee an opportunity to task questions and the transit agency is certain that each employee knows about and understands the rule change.

Another strategy, which may be used in conjunction with Meet and Greet, is having the employee sign that he or she has received and read the new rule. The new rule may be distributed via mail or email. A periodic newsletter may also reinforce the nature and importance of the new rule.

- ✓ % of employees who participated in "meet and greet"
- ✓ % of employees who acknowledge receipt of new rule in writing

San Diego Trolley, Inc.

Super Vision

June 17, 2007

Operating Clearance

Super Vision shares a topic with this week's Rule of the Week. Foremost is a common understanding of where instructions or orders should be found on the Operating Clearance. Reference the following:

- **Track Restrictions –** These are supplements to the permanent speed restrictions, in effect for all train movement over that portion of track. In most instances the reason for the restriction will be noted in parenthesis after the restriction (track, catenary, ride quality).
  - Track Restrictions should always be listed in direction encountered (i.e. in sequence Eastbound on the Eastward Track, westbound on the Westward Track). When issuing a new restriction, make sure to use reference points clearly visible to the operator before the reduced speed applies – don't say two poles BEFORE a Mile Post maker, but rather reference AFTER a Mile Post, crossing, switch or other common knowledge or marked reference point.
- **Advisories –** These are information items that do not have a designated speed restriction, but alert you to conditions that can affect how you perform your job in compliance with existing rules or procedures, including the need to adjust your speed. Examples include broken or malfunctioning equipment, yard tracks out of service, track inspectors on the right-of-way, potential traffic congestion, scheduled power outages, etc. Advisories may also include the need for particular public address announcements (i.e. special events).
  - If the instruction requires a speed restriction, it likely belongs under a Track or Temporary Restriction. Also important to remember are things like E/S nearside indicators, or other equipment problems. If operators feel an incorrect "Express" isn't important enough to tell them about, they won't feel it is important enough to tell us about.
- **Temporary Restrictions –** These restrictions are limited in time and generally due to track closures, work crews on the right-of-way, or other situations that require a train operator to modify their operation, including a speed limit below the otherwise maximum speed.
  - The primary difference between a Track and Temporary Restriction is a Track Restriction is due to physical conditions, while a Temporary Restriction is due to activity. In either case, whenever possible, appropriate discs should be in place in the field.

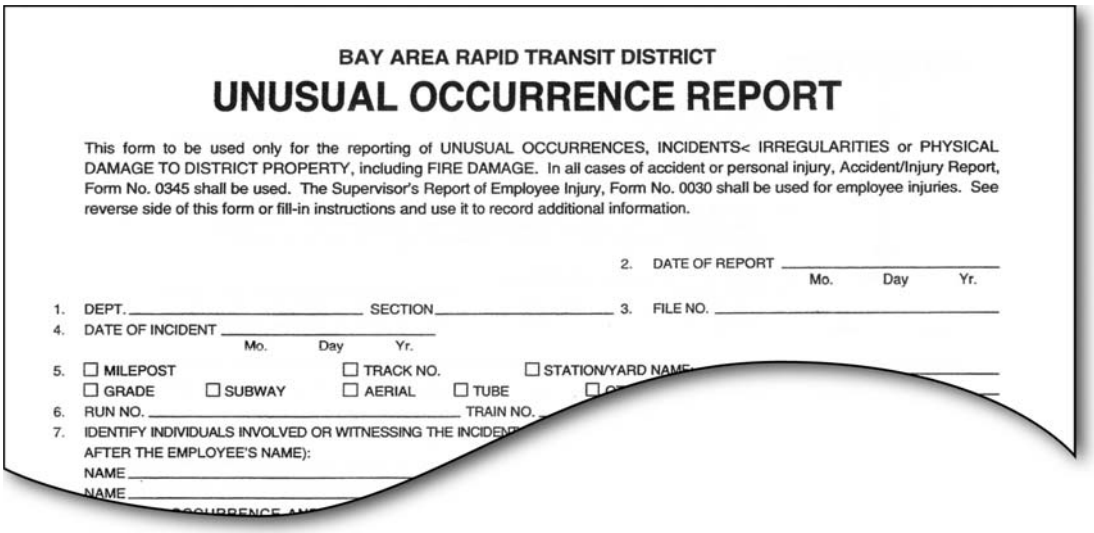
Controllers – Referencing this document should be part of your check-in, and integrated into your oversight of the operation. How closely do you look at what is actually going on in the field? How involved are you in close clearance/grade separated work crews? (Jesse Loo did a great job last week of 'Controlling' and not just reminding trains to protect a work crew on the Laurel Street Bridge.) If you are the one preparing the Operating Clearance, know that no other document issued by Central Control is more safety critical. Proof, double-check, and ask someone else to give it a glance before you copy.

Line Supervisors – When performing operating checks, official or casual, include a check of the Operating Board where you inspect it, not just see it in the cab or operator's hand. Confirm that crossing stop advisories are written clearly, as well as any other additions or changes that were issued.

Yard Supervisors – While Yard Operators are not required to carry an Operating Clearance with them, make sure you keep the Controllers apprised of operating issues in the yard. Some situations only require an entry on the Controllers log (on-time or carryover), while others should be included as part of the "All Line" Operating Clearance.

We work as a team. No one person or position can effectively handle everything. AM, PM or Graveyard; Controller, Yard Supervisor or Line Supervisor; we must all work together as a team to safely and effectively manage the day-to-day operation of the system.

Figure 8. **Super Vision** *guidance document for San Diego Trolley, Inc., supervisors.*



BAY AREA RAPID TRANSIT DISTRICT

UNUSUAL OCCURRENCE REPORT

This form to be used only for the reporting of UNUSUAL OCCURRENCES, INCIDENTS< IRREGULARITIES or PHYSICAL DAMAGE TO DISTRICT PROPERTY, including FIRE DAMAGE. In all cases of accident or personal injury, Accident/Injury Report, Form No. 0345 shall be used. The Supervisor's Report of Employee Injury, Form No. 0030 shall be used for employee injuries. See reverse side of this form or fill-in instructions and use it to record additional information.

2. DATE OF REPORT _____ Mo. Day Yr.

1. DEPT. _____ SECTION _____ 3. FILE NO. _____

4. DATE OF INCIDENT _____ Mo. Day Yr.

5. ☐ MILEPOST ☐ TRACK NO. ☐ STATION/YARD NAME

☐ GRADE ☐ SUBWAY ☐ AERIAL ☐ TUBE

6. RUN NO. _____ TRAIN NO.

7. IDENTIFY INDIVIDUALS INVOLVED OR WITNESSING THE INCIDENT

AFTER THE EMPLOYEE'S NAME):

NAME

NAME

Figure 9. BART reporting form for unanticipated occurrences.

Positive Safety Language

The term "incident" implies an event that has negative consequences. "Unanticipated or unusual occurrence" implies simply an event that was not expected (see Figure 9). In addition, the results of operational testing should be reported in terms of % passing rather than % failing. This conveys the positive message that the goal is for everyone to pass rather than a focus on those who do not.

- ✓ Number or % of safety communications containing positive safety language

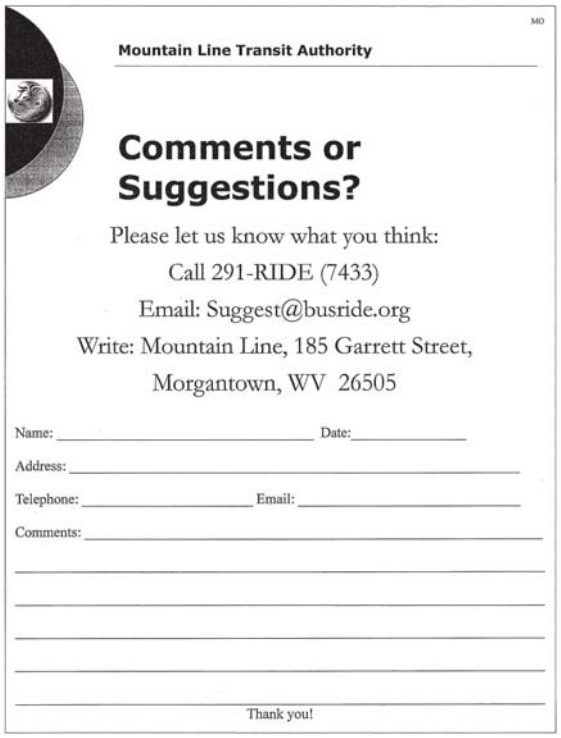
Customer Feedback

Patron feedback can be a source of reports of noncompliant safety behavior. Today, even the smaller paratransit agencies provide a means for their patrons to submit their concerns by email, paper form submittal, telephone, or through the transit agency's website (see Figure 10). Paratransit agencies provide service under contract to social service agencies in the community. Soliciting feedback from these agencies is another means of evaluating driver compliance with safety-related rules. The existence of these communication channels may serve to motivate employees to comply with the rules.

- ✓ Number of reports regarding operator behavior
- ✓ Average follow-up time

Monitoring Rules Compliance

A formal operational testing program is one method for monitoring compliance with safety-related rules. Monitoring may involve observational and/or automated data collection methods. The following sections describe the elements of an operational testing program as well as the various methods for monitoring.



MO

Mountain Line Transit Authority

Comments or Suggestions?

Please let us know what you think:
Call 291-RIDE (7433)
Email: Suggest@busride.org
Write: Mountain Line, 185 Garrett Street,
Morgantown, WV 26505

Name: _____ Date: _____
Address: _____
Telephone: _____ Email: _____
Comments: _____

Thank you!

Figure 10. Customer comment form for Mountain Line Transit Authority.

Operational Testing

The Federal Railroad Administration (FRA) requires that all railroads, including commuter rail operators, have a program of operational testing to ensure rules compliance. Many public transit agencies have adopted this model and created operational testing programs for light rail, subway, and bus operations.

The elements of an operational testing program are the following:

- Organizational responsibility
- Employees covered
- Rules covered and testing methods for conducting tests
- Frequency of testing and number of tests
- Employee notification and recordkeeping
- Corrective action

Organizational Responsibility

Transit agencies use a variety of organizational structures to administer their safety-related rules compliance programs. Some appoint a Director of Rules or Rules Compliance Program Administrator who reports to the transit agency's safety officer or training manager. Alternatively, the agency may constitute a committee to define and oversee the testing program. The committee would have representatives from the various operating departments as well as the Safety Director and others that the agency deems appropriate. If a committee has responsibility, then this committee establishes the scope of the program as well as all the testing and notifica-

tion procedures. The agency must also decide who conducts the tests and what qualifications they must have.

Employees Covered

In accordance with FRA regulations, all locomotive engineers and conductors must have periodic operational tests. Transit agencies with heavy or light rail systems should have an operational testing program for their vehicle operators as part of their system safety plan. At some transit agencies, such as the MBTA, the testing program also includes bus operators.

Rules and Testing Methods

At a minimum, commuter rail operators must have tests that cover all the FRA prescribed rules in 49 C.F.R. that deal with the movement of trains. Some transit agencies, such as Southeastern Pennsylvania Transportation Authority (SEPTA), are expanding their testing program to cover all rules in their rulebook. Test coverage for heavy and light rail operations will likely differ somewhat from commuter rail operations. One reason for this difference is that some heavy rail lines have trip stops that prevent speeding so a speed test would not be meaningful. Also, on a rail transit system that operates in automatic mode, the vehicle operator has less control of the train and hence less opportunity for rule noncompliance.

For each rule, the testing program must specify how the rule is tested. For example:

- Speed may be tested with a properly calibrated radar gun or analysis of event recorder data, if available.
- Visual observation is suitable to check for unauthorized personnel in the cab but a video recording system may be the preferred method if more frequent observation is necessary.
- Use monitoring of live or recorded radio transmissions to check for proper radio protocol to authorize train movement.
- Use event recorder data to determine if the engineer/operator sounded the whistle at a highway-rail crossing.

Test Coverage

The program should define the frequency of testing and the number and types of tests. Tests for critical safety-related rules, such as speed and compliance with signal indications, may occur monthly while other rules, such as those involving shove moves in a yard, may occur less frequently. Alternatively, the transit agency may have a more limited set of rules to test and all rules may be tested monthly. For example, a bus operator may test every month for speed, intersection maneuvers, and pre-trip inspections. The agency may set up the testing program so that every operator is tested at least once annually. Any vehicle operator who has had a preventable accident may be subject to additional testing. The transit agency should constantly review its test results and accident experience and adjust the rules testing program to focus on any problematic rules.

Employee Notification and Recordkeeping

The result of a test may be a simple pass or fail. SEPTA's commuter rail testing program includes three levels of noncompliance: level l–Noncompliance: instruction provided; level 2–Noncompliance: written/follow-up action; level 3–Noncompliance: withheld/remove from service. The importance of the rule determines the level of noncompliance. For example, running a red signal is a serious level 3 violation so a vehicle operator who ran thru a red signal would be removed from service. SEPTA is in the process of applying these levels of noncompliance to the testing program for its suburban rail, heavy rail, and light rail operations.

Train Crews' Cab Observations - Heavy Rail Lines

RCP- 008

Issue Date: _____ Required Observation Period: _____

Area: _____ Date: _____

Location: _____ Observation Done By: _____

Page _____ of _____

Vehicle #	Emp#	Time of Observation	Direction of Vehicle	Compliant (Y/N)	Violation (1-4)	Employee Immediately Reinstructed? (Y/N)
Possible violations listed below. Enter the violation number, or other observation, in the reason section.						
1	Unauthorized Personnel in Cab					
2	Unauthorized Reading Material in Cab					
3	Cab Curtain Closed					
4	Prohibited Electronic Devices					
Operator must be immediately reinstructed on violation, and checked for "fitness for duty". The OCC Dispatcher must be notified immediately of any violation.						

Revision Date: 03/17/2009
Revision #: 2

Figure 11. Log used by MBTA observers for heavy rail testing.

The employee needs to know the outcome of any test, regardless of whether the employee passed or failed. Ideally, the notification should occur immediately following the test regardless of the outcome. If the employee fails a test and there is any possibility of an accident or injury, then immediate action must be taken by the supervisor. Sometimes immediate notification may not be possible without interruption of transit operations. It is important to commend the employee on passing. Employees need reassurance and commendation for performing their jobs in accordance with the transit agency's expectations.

Most transit agencies have a computer-based system for maintaining test results. Testers record their observations on a paper log which is then entered into the database (see Figure 11). Electronic recording is also possible if a tablet PC or other similar device is available. Periodic reports are prepared to monitor the frequency and types of tests as well as the success/failure rates.

Corrective Action

The severity of the rule violation will determine the appropriate corrective action. (See the Responding to Noncompliance section.) For example, transit agency policy may stipulate immediate dismissal from the agency for certain failures such as use or possession of a personal electronic device while on duty.

- ✓ Number and types of tests
- ✓ % passing
- ✓ Number of major rule violations

Observational Methods

The most common technique for monitoring safety-related rules compliance involves the use of observational methods. These may be done with or without advance notice to the employee. Some believe that if employees know they are being observed, they will be extra vigilant in observing rules and therefore there should be no advance warning of who will be observed on a given day. The observation may be part of a formal rules test or it may be for employee evaluation and coaching or part of a training experience. The ride-along, mystery rider, and observer in a separate vehicle should all have a checklist to guide their observations.

- ✓ Number and types of observations
- ✓ % and number in compliance with rules

Ride-Along

A ride-along involves a supervisor or training officer accompanying the vehicle operator on a daily run to observe how the operator handles the vehicle and possible passenger interactions. If the ride-along is part of a training experience, the observer will coach the operator as appropriate.

Mystery Rider

A mystery rider is an individual who poses as a patron and rides the transit vehicle to observe the operator. It is usually an experienced transit operator whom the transit agency hires for this purpose. If the vehicle operator or other attendant handles cash, a mystery rider may be engaged to ensure that all cash received is properly handled and delivered to the agency. In this situation, the mystery rider may also observe selected operator behavior such as improper use of an electronic device or the presence of unauthorized people in the cab compartment.

Observation Exterior to Vehicle

If there is a location where transit vehicles pass frequently, an observer stationed at that location can observe multiple vehicle operators. This may occur at a busy intersection or an overpass. Alternatively, an observer may follow a transit or paratransit vehicle in another vehicle.

Speed Monitoring with Radar Gun

Monitoring bus speed is most easily done with a radar gun by a trained observer. Radar guns may be used with heavy or light rail if the vehicle does not have a data recorder that captures speed. Radar guns require periodic calibration. (See Figure 12.)

Video Data Recording Systems

Recent improvements in video data recording systems make them a viable option for monitoring transit operator performance.

MBTA Safety Rules Compliance Program

The NTSB's report on a collision between two MBTA light rail trains in May 2008 pointed to the lack of an established formal testing program that would provide a comprehensive evaluation of employee rule compliance. In February 2009, recognizing the need for such a program, the MBTA established its Safety Rules Compliance Program (SRCP). The agency stated in its Standard Operating Procedure that the goals of the program are to

- Reduce accidents caused by human error.
- Improve and enhance the vigilance of employees to comply with established rules and procedures.
- Determine the degree of compliance with established rules to improve compliance.
- Focus attention on rules and areas where there is a need to improve employees' knowledge, training, and skill level.
- Incorporate lessons learned into existing training programs.

A Safety Rules Compliance Steering Committee governs and oversees the SRCP. It is co-chaired by the Director of Safety and the Deputy Chief Operating Officer. This oversight committee has representatives from the operating bus and subway departments as well as the Director of the Operations Control Center and Training. The committee established the procedures for the operational tests. Each inspection procedure covers the elements of a testing program as described above. The committee meets monthly to review test results and make changes as necessary. Approximately 1,000 tests are performed monthly. Since the start of the testing program, there has been a decline in the number of safety rule violations.

MBTA SAFETY RULES COMPLIANCE PROGRAM INSPECTION PROCEDURE AND FORM

Department(s): Green Line – Subway	**Persons Notified:** OCC Dispatcher Line Superintendent On duty Line Supervisor	**Rules Compliance Staff:(s)** Two Light Rail Supervisors or two Light Rail Instructors
Department: Element 14.1–Rules Compliance–**Radar Observation**		**RCP-001** **2/14/2009 Rev 2**

Reference Criteria:

- SSPP – 8.0 Subway Operations employees are governed by specific rules and procedures so they may safely perform their duties in a manner consistent with MBTA Policy.
- SSPP – 4.5 Operators/Maintenance Personnel – Obey established Authority rules and "standard operating procedures."

Element/Characteristics and Method of Verification:

This observation verifies that train crews follow the rules on proper speed limits.

- One Rules Compliance Staff stands in a safe location where the speed of the vehicle can be observed and recorded by radar.
- One Rules Compliance Staff stands on the platform and reinstructs the Motorperson in the event that a violation was noted.
- In order to perform the test, the Rules Compliance Staff must have the following equipment: radar gun, testing compliance form, and pen. NOTE: Radar gun must be calibrated prior to each observation session.

Testing and Observations:

- If any violation is observed, the employee must be reinstructed prior to leaving the location and/or station.
- If any violation is observed, the employee must be checked "fit for duty" prior to their leaving the location and/or station.
- Written in ink, fully complete the form for this particular observation.
- You must personally ensure that the original form is presented to the Superintendent.
- Rules Compliance Staff have no latitude in recording rules violations. What is observed is what is recorded.
- If other rule violations are observed, the Rules Compliance Staff must immediately take action to stop or otherwise appropriately address the violation. The other violation should be documented and followed up on as required by rules and procedures. Do not document on this Inspection Form.

Comments/Corrective Action: If a violation is noted the employee is reinstructed and checked "fit for duty" immediately. Reinstruction shall be performed as follows:

- If the employee was operating faster than five (5) miles per hour above the posted speed, Rules Compliance Staff must reinstruct the employee: "You are in violation of the posted speed limit. You must operate your train at the posted speed limit".
- If the employee was operating faster than the posted speed, but equal to or less than five (5) miles per hour faster than the posted speed, Rules Compliance Staff must reinstruct the employee: "You have exceeded the posted speed. You were within the acceptable variance, so you are not in violation. You must operate your train at the posted speed."

Figure 12. MBTA inspection procedure for radar speed observation.

Purpose. Systems that provide video recordings and vehicle performance data in the event of safety-related rule noncompliance are a means to document errors and violations. Beyond that, the data from these systems can be incorporated into training and coaching with the employee involved. Video clips may also become case examples for future operator training classes. Public transit bus and paratransit operators as well as private motorcoach operators report success with this type of system.

How they work. A series of small video cameras are installed on the interior of the bus. Some record interior views and others record the roadway ahead. A data logger mounted on the interior of the vehicle records exceptional forces such as hard braking, swerving or a collision. When an event triggers the data logger, the data describing the event along with related video data is either saved on the data logger for later download or transmitted wirelessly to a central location. Figure 13 shows a video camera mounted behind the rear view mirror of a transit bus.

Figure 13. Video data recording system installed behind rearview mirror in a transit bus (photo courtesy of DriveCam, Inc.).

How to use them. Supervisors receive a report for each event that the system logs. It is the supervisor's responsibility to respond appropriately. If the event is a minor error, coaching is appropriate. A more serious violation will likely result in discipline and retraining.

The following are guidelines for implementing a video data recording system.

- Train supervisors on effective use of the video system.
- Notify your labor organization about plans for the system (training and rules compliance monitoring) and how the transit agency plans to use it to benefit their members. Share experiences with labor from the motorcoach and other transit agencies. (See the Motorcoach section of Appendix A.) Labor acceptance can be enhanced when the tool is primarily used for training. The system is also useful for documenting accidents caused by other vehicle operators.
- Establish guidelines for supervisors regarding how quickly to deal with a reported event.
- Communicate with vehicle operators regarding why the system is being implemented and how it can benefit them.
- Incorporate the system into any transit agency reward program. For example, acknowledge miles or hours of incident free driving.
- Use video clips of near-miss incidents at safety meetings and training sessions to reinforce the need for safe driving practices and rules.

Safety Audit

Purpose. A safety audit is a process for observing activities in the workplace. The objective is to identify safe and unsafe work behaviors and to acknowledge safe behavior while correcting any deficiencies. The audit is a non-punitive process. An audit team with representatives from both labor and management, and possibly an official from the safety department, conducts the audit using a checklist. The auditing process should be interactive with auditors talking with workers about their tasks. If the auditor observes an unsafe behavior, the auditor should discuss the consequences of the unsafe act and suggest a safer way to perform the task. In the transit environment, safety audits are most suitable for use with track gangs and employees at equipment repair facilities.

Metrolink Locomotive Digital Video Recorder System

After the Chatsworth, California, incident between a Metrolink and Union Pacific train in September 2008, the Board of Directors for the Southern California Regional Rail Authority (Metrolink) approved the procurement and use of cameras in their locomotive cabs. Following the Board's action, and as a result of the NTSB's investigation of the Chatsworth incident, the NTSB also recommended the use of in-cab audio and image recording systems that would discourage the type of noncompliant behavior that caused this incident. In October 2009, Metrolink introduced its Locomotive Digital Video Recorder (LDVR) system in all of its locomotives. The system has three cameras per locomotive: an outward-facing camera to record activity in front of the locomotive and two inward-facing cameras to record the control panels and human activities inside the locomotive cab. The system records both audio and video data to an external hard drive. New cab cars will also have LDVRs.

Metrolink may use the data for the investigation of specific incidents such as an impact between a Metrolink train and a highway vehicle, a derailment, or an alleged block signal rules violation. Metrolink's policy also limits the use of this video and audio data to random testing for compliance with three specific rules:

- Prohibition on use of electronic devices
- Prohibition of sleeping while on duty
- Presence of unauthorized persons in the cab

Stringent procedures govern the authorized usage, retrieval, preservation, and disclosure of the recordings to ensure that they are used only for the purposes permitted in the agency's policy.

The following are guidelines for implementing a safety audit process.

- Develop a checklist for the audits.
- Select and train the individuals on the audit team.
- Design a process for recording the results of audits so that problems or trends can be identified.
- Communicate with employees who will be audited regarding the purpose and scope of the audits, what to expect when the audit occurs, and how it can benefit them.
- Design and monitor a process for following up on deficiencies.

✓ Number of safety audits
✓ Number and types of problems observed and coached

Review Radio Transmissions

If radio transmissions are recorded, reviewing them provides a means to check proper radio procedure. A field observer can complement visual observations with the operator's communication with the dispatcher or operations center during the operational test thus providing a more complete picture of rules compliance.

✓ % and number of communications in compliance with rules

Automated Methods

A number of automated methods for monitoring safety-related rules compliance exist. Not all automated methods are suitable for all modes.

✓ % and number of people in compliance with rules
✓ % and number of operations in compliance with rules

Onboard Event Recorder

Onboard event recorders for locomotives record train speed, direction of movement, time, distance, throttle position, and application and operation of the braking systems. In other words, the onboard data logger records what the engineer is doing with the locomotive. These systems include software for automatically downloading event recorder information and scanning the data for exceptions. This software applies criteria to identify two types of exceptions: those with a safety implication and those related to proper train handling. The primary safety-related exception is the engineer- or conductor-induced emergency brake application. Train handling exceptions arise when the train is not operated in accordance with company policies intended to reduce wear on the equipment or achieve optimal fuel economy.

The Class I railroads have specific trackside locations where data automatically downloads when a train passes. For example, when a locomotive is within 1 mile of a download location, the event recorder information is automatically downloaded to the base station. Every hour a server at a central location receives all downloads for all base stations. (Download of the data may occur at a yard or other central location if field locations do not exist.) At a designated time, the server automatically scans the previous day's downloads for exceptions. This information is forwarded to a database to match the train, engineer, and location. A central group or an individual supervisor may review the exceptions identified by the system.

Each exception usually receives additional scrutiny. For example, assume the data indicates that the engineer induced an emergency brake application. Upon investigating further, the supervisor discovers that the engineer put the train into emergency because of a car stopped on the tracks at that location. This is an appropriate use of emergency braking. If, however, no such circumstance existed, then the emergency braking may have been due to human error.

Data from Signal System

A signal system that controls rail operations provides the capability to identify rule violations such as passing a red signal. These data should be reviewed periodically to determine whether or not there are problem locations. Frequent red signal violations at a specific location necessitate a closer examination of the situation. Management will likely want to determine how the problem signal differs from others and whether there are unique characteristics that are causing the signal overruns. Is it on a curve? Is the signal obscured by signal or foliage? What is the distance from the previous signal?

NYCT Safety Audit Teams

As a result of two fatalities involving track workers in April 2007, New York City Transit's (NYCT) Office of System Safety (OSS), Bus and Rail Field Operations Division began a safety audit program in mid-May 2007 designed to observe on-track work and correct any unsafe work practices or safety rule noncompliance. There are two audit teams working 4 nights per week. The team usually consists of two Transportation Workers Union (TWU) representatives, one or two staff from OSS, and two flaggers.

The audit team uses a 21-question checklist that was developed by NYCT OSS. The checklist includes items such as the following:

- Flagging procedures
- Implementation of General Orders with regard to protecting out of service track
- Use of the third-rail alarm devices
- Proper lighting
- Use of PPE
- Toolbox safety talk
- Identification of job hazards
- Knowledge of egress from the site
- Pre-site inspection before starting work
- Inspection of tools and equipment
- Training and qualifications of the workers engaged in on-track work

Most noncompliance is corrected with re-instruction onsite. If necessary, the gang will be removed from the tracks until the problem is corrected. The audit goal is to correct at-risk behaviors or conditions so that the work is completed safely and without harm to any of the workers.

The inspection teams recently moved to using a triplicate form in which the OSS representative, TWU representative, and the job site supervisor sign to acknowledge that notification of noncompliance was made. A weekly report of the inspections is sent to the executive leadership of the Departments of Subways and Capital Program Management for response.

OSS monitors the number of deficiencies per site. On a quarterly basis, OSS issues a report on the average number of deficiencies per site as well as the types of deficiencies. The number of deficiencies has declined substantially since initiation of the program in 2007.

Two key factors are responsible for the success of NYCT's Safety Audit Teams: management support and adequate resources. The transit agency's CEO has supported this effort since its inception. His endorsement of the program plus the willingness of NYCT's managers to support the findings of the safety audits have made the program a meaningful component of the agency's overall safety program.

For one major railroad, a typical month resulted in 4,269 different items examined on the event recorder downloads. Of these, there were 142 exceptions of which 30 were found to be significant. Decertification of the engineer resulted for 13 of these incidents. Without the analysis of the event recorder data, management would not have identified these events.

Responding to Noncompliance

When a transit agency determines that an employee has been noncompliant with a safety-related rule, the first response should be to determine why the employee failed to comply. For each instance of noncompliance, the agency should use the taxonomy and questions designed to determine root cause presented in Chapter 3. Once the agency determines root cause, it can work to remediate the underlying cause(s) and contributing factors. Remedial efforts may be in conjunction with or in addition to the following methods.

Rule evaluation. The evaluation should consider safety-related rules in the context of the work environment. At a minimum, the agency should determine the answers to the following questions.

- Is the rule's noncompliance rate high?
- Is the rule easily comprehended?
- Has it been explained well both verbally and in written form?
- Has the rule been demonstrated to the employee in classroom, computer-based, and/or on-the-job training?
- Have you queried employees or labor representatives regarding the relevance of the rule?
- Do employees report that it is difficult to comply with a rule and if so, why?

Task analysis. Conducting a job or cognitive task analysis may help the transit agency evaluate the job's task demands to make sure an employee is able to comply with the rules. The purpose of task analysis is to clearly define what thoughts, actions, and tasks are necessary to successfully perform one's job. Task analysis may help the agency understand that an existing rule might conflict with how a person is expected to do the job. The results may help the agency to improve its safety-related practices, procedures, rule books, manuals, written instructions/materials and other written job aids. The premise behind task analysis is to fit the task or rule to the human, not vice versa. Making it easier for an employee to comply with safety-related rules will reduce the rate of noncompliance. The following is an excellent resource that describes these methods:

Kirwan, B., and Ainsworth, L. K. (1992). *A Guide to Task Analysis.* CRC Press: Boca Raton, FL.

Improve training. The agency may find that employees had insufficient training regarding rules. See the training section in Chapter 2 to identify ways to improve the training process.

Improve workspace, tools, and equipment. In the same way that it is important to fit the rule to the employee, it is also imperative that the working environment be tailored to the user. When regular noncompliance occurs with a particular rule, the workspace, including tools and equipment, should be evaluated to ensure employees are able to comply with their expected workspace interactions.

Improve safety culture. Safety culture is the focus of TCRP Project A-35, "Improving Safety Culture in Public Transportation." The reader is encouraged to review the information contained within the TCRP Project A-35 final report as well as the information regarding safety culture in Chapter 2 of this report. As previously discussed, adopting a no-blame policy will greatly improve the safety culture of an organization. The transit agency's top-level management must embrace this policy and communicate through the ranks of the organization. Implementing a safety reporting system as suggested in Chapter 5 is an important step in improving safety culture. Making safety a higher priority than the agency's performance goals is also an imperative component of safety culture. The agency should not tolerate supervisory or management acceptance of noncompliance to meet performance goals.

Behavioral coaching. Many transit agencies provide remedial coaching and/or training for their employees when they are found to be noncompliant. This may occur during ride-alongs in passenger operations, during action-based training exercises, or after noncompliance has been found to occur during operational testing or some other monitoring exercise. Behavioral coaching is most effective when positive reinforcement is used in conjunction with non-evaluative identification of the incorrect behavior. For example, first the coach should comment on the correct actions of the employee providing praise for a job well done. Then the coach should identify ways to improve performance or safety-related rule compliance. Coaching should occur as soon as possible after noncompliance occurs.

Discipline. This topic, including best practices, is reviewed in greater detail in Chapter 2. A majority of transit agencies subscribe to some form of a progressive discipline program with a no tolerance policy for egregious and criminal acts. This generally entails verbal warning/reprimand for the first offense, written reprimand with or without remedial training efforts, and then dismissal as a last resort.

- ✓ % and number of discipline cases
- ✓ % and number of dismissals
- ✓ % and number of coaching cases
- ✓ % and number of remedial training cases

The Burlington Northern Santa Fe (BNSF) Railway has an Alternative Handling Agreement with the United Transportation Union and the Brotherhood of Locomotive Engineers and Trainmen. They use the term alternative handling in lieu of alternative discipline because the infraction does not go on the employee's permanent record. The employee has a choice between using the traditional progressive discipline program and alternative handling. Certain infractions are not eligible for the program including decertification violations specified by federal regulation and other high-risk incidents. The employee may be disqualified for alternative handling if repeated noncompliance occurs in a 12-month period.

Safety Management

Assessing the Safety-Related Rules Compliance Program

Since the overall goal of a safety-related rules compliance program is to reduce the risk of a low-probability, high-consequence event, the evaluation process for that program should include leading as well as lagging indicators. Leading indicators focus on process and are achievement-oriented while lagging indicators are avoidance-oriented. Complacency can occur if only lagging indicators are used, especially if they focus on an infrequently occurring undesirable outcome. If the focus is on lagging indicators, there may be a tendency to manage the numbers rather than to improve or manage the factors leading to the undesirable result, in this case, a safety-related rule violation.

There is no prescribed mix of measures that a transit agency should use. Rather it depends on the nature and size of the operation and the agency's experience with safety-related rules compliance. Ideally, there should be a mix of leading and lagging indicators with more leading than lagging metrics. Each agency must pick the set of metrics that is appropriate for its situation. It is important to limit the number of metrics. If there are too many measures, it is possible that the burden of the recordkeeping will result in the organization abandoning the leading indicators and only using lagging indicators such as the number of test failures and the number of preventable accidents.

The description in this chapter for each practice includes suggested metrics for monitoring the effectiveness of that practice. Since the goal of the majority of the best practices is to reduce risk, the suggested metrics are primarily leading indicators. For any practices that already exist to encourage safety-related rule compliance, the transit agency may want to adopt one of the suggested metrics or consider developing their own leading indicator.

In establishing a way to measure the effectiveness of a safety-related rules compliance program, there are three key factors:

- Select the appropriate set of metrics for the transit agency.
- Limit the number of metrics that are tracked.
- Monitor and acknowledge progress over time (see Schneider National Trucking Company in Appendix D).

In addition, a transit agency may want to benchmark its rules compliance experience with peer agencies.

Encouraging Employee Involvement

Transit agencies can employ a number of strategies to encourage employee commitment to safety-related rules compliance. A joint labor/management safety committee that meets on a regular basis may solicit suggestions from employees. Posters or other notices may inform employees of the existence of the safety committee and how to offer suggestions to either the committee or the safety department.

✓ Number of management/labor committees
✓ Number of posters/notices inviting employees to express concerns

Reporting Near-Misses and Other Safety Risks

Safety reporting system. Chapter 5 provides an in-depth description of best practices for implementing a safety reporting system. The chapter reviews how to implement a full-scale system; it also describes how to adopt interim safety reporting mechanisms prior to adopting a full-scale system—a lengthy process requiring significant commitment from stakeholders as well as budgetary considerations.

Safety hotline. Many transit agencies also have a safety hotline whereby employees can anonymously report general safety concerns. This type of system presents an opportunity for employees to report safety-related rules noncompliance. However, employees may be reluctant to report each other's noncompliance, because it is seen as "ratting out" one's fellow coworkers. Creating a no-blame work culture will help to encourage employees to report noncompliance. A transit agency can also encourage employees to use the hotline to report ineffective or confusing rules. Employees can use the hotline to report incidents stemming not only from safety-related rules noncompliance, but also incidents stemming from poorly defined rules or situational variables (e.g., workspace design) that prevent employees from successfully executing safety-related rules.

✓ Number of reports per month
✓ Average time to respond to reporting employee
✓ Number of recommendations implemented

Incentivizing Safety-Related Rules Compliance

Chapter 2 presents many best practices for incentivizing rules compliance. If the incentive program rewards the types of behaviors that relate to the transit agency's leading indicators, it should encourage compliance. A safety point system is one approach. The system would award points for

activities such as attending a voluntary rules or safety training class, coaching another employee, making a presentation at a department safety meeting, or suggesting a change in procedure that improves safety-related rules compliance. This type of system makes it possible for every employee to receive an incentive in recognition of accumulating a set point level. There might be different levels that the employee could achieve over his or her career.

✓ Number of annual awards per 100 employees

CHAPTER 5

Safety Reporting System Best Practices

This chapter presents best practices for a safety reporting system for the public transportation industry. Table 11 presents a checklist of the integral components of a safety reporting system based on a review of effective systems in other industries. Appendix C describes these in detail. While the initial project objectives called for the development of an incident reporting system, the research team's review of safety reporting systems revealed that the majority of reports (nearly 80% for some systems) did not relate a specific incident but rather general safety concerns and issues. As such, these systems saw great success in the identification of safety risks that did not necessarily result in an incident. Therefore, the proposed system should encompass both types of reports. The term "system" in this chapter refers to the processes, procedures, and mechanics associated with reporting safety concerns and incidents. The term "program" is reserved for the oversight and management of the system.

The safety reporting systems reviewed in Appendix C varied from centralized reporting systems such as the Aviation Safety Reporting System (ASRS) to organization-based systems such as the Aviation Safety Action Program (ASAP) and the Confidential Close Call Reporting System (C^3RS). The general recommendation for the public transportation industry is that the safety reporting system should reside at the level of the transit agency. The reason is that the information gleaned from locally based systems is more easily related to transit management in contrast to centralized systems where it can take months to years for the information to become beneficial. A pilot implementation of the design suggested herein should be the next step.

Scalability of a Safety Reporting System

Table 11 presents the recommended core elements of a full-scale safety reporting system. Implementing such a system can be a lengthy process thereby delaying the benefits of implementation. While the safety reporting system best practices presented in this chapter describe the most effective approach, intermediate steps can be adopted in the interim before a full-scale implementation.

The simplest form of a safety reporting system is a comment box. Employees can be supplied with comment cards to submit to their supervisors whereby they voluntarily relate rules noncompliance or general safety issues and/or concerns. An anonymous system may yield a higher input of reports with the disadvantage being that the supervisor or safety manager does not have the opportunity to follow up with the employee to gain more information about the event. While a completely anonymous system will assure employees that no retribution for their comments will be incurred, a confidential system is more useful. A confidential system ensures that the employees' supervisor(s), or other direct management, will not be privy to the identification of

Table 11. Best practices checklist for implementing a safety reporting system.

Identify relevant stakeholders (e.g., transit management, labor, industry organizations) and obtain program "buy-in"
✓ Form a committee composed of stakeholder representatives to oversee pilot and system implementation
✓ Provide stakeholder training regarding building consensus and conflict resolution
Pilot system
✓ Negotiate MOU between labor and management
✓ Provide assurances for the safety reporting system to be voluntary, nonpunitive and confidential
✓ Recruit a non-biased third party to manage pilot system and assign role of system liaison and support staff
✓ Identify/develop data collection and analysis software
✓ Assemble report review team and provide appropriate training
✓ Provide training prior to roll-out of pilot system
✓ Pilot system with at least two transit agencies
✓ Refine report taxonomy based on initial reports
✓ Evaluate system success
Make system available to entire transit industry
✓ Disseminate the results of the pilot safety reporting system to stakeholders
✓ Provide implementation assistance
✓ Provide on-going training regarding the importance of a safety reporting system
Disseminate system information
✓ Provide timely follow-up to reporting employee
✓ Conduct analyses and distribute to management and employees
✓ Newsletters
✓ Use reports as tools for training

the employee supplying the information. To implement a confidential system, a public transit agency should assign an impartial safety representative to review reports from comment boxes or other sources so that employees will not be "outed" to their supervisors. This option will also allow the safety representative the opportunity to follow up with the employee to further explore the contributing factors of the incident. The importance of confidentiality for safety reports is discussed later the System Assurances section.

The most important factor to consider when adopting an interim safety reporting system is that the richness and number of reports will be enhanced if the transit agency can ensure a no-blame culture. This means that the transit agency will value any information obtained about an incident stemming from noncompliance more so than punishing the individuals involved in the incident. This is true for all but the most egregious events that involve criminal or malicious intent.

A safety reporting system of any size is only useful if it yields information about the reasons why noncompliance or some other safety breach occurred. To the extent that a public transit agency is able to ensure confidentiality within a no-blame culture for submitting voluntary reports, the detail of reports should yield sufficient information to conduct a root cause analysis, that is, provide the reason(s) why an event occurred. The taxonomy and root cause questions presented in Chapter 3 may be used to analyze reports of safety-related rules noncompliance to determine the factors involved.

Stakeholder "Buy-In"

A strong foundation for a safety reporting system begins with encouraging a cooperative environment for the reporting system's stakeholders, otherwise known as obtaining "buy-in." By getting the interested parties to agree up front about the goals and objectives of the safety reporting system, deadlock and dispute may be minimized as the system evolves. All of the safety reporting programs reviewed were successful in getting "buy-in" from their respective regulators, industries, management, and labor unions. None had a formal process for encouraging stakeholder "buy-in"; however, there were activities the stakeholder representatives engaged in that facilitated cooperation. One of these activities involved assembling a planning committee or implementation group with representation from each of the stakeholder groups. The members of these committees worked toward the common goal of creating a safety reporting system. In doing so, trust developed over time.

A second successful activity included having exploratory workshops whereby stakeholder representatives invited safety leaders from other industries to discuss and present the merits of their approaches to safety reporting systems. Stakeholder attendees then had the opportunity to discuss the benefits and limitations of these safety reporting systems for their own industry. This provided a means for these individuals to express concerns and issues prior to the implementation phase.

System Assurances

Barriers to a reporting culture include fear of individual or organizational retribution, the incorrect assumption that human error is a measure of competence, and the legal complications associated with discovery of error reports. There are three necessary assurances that minimize these barriers and encourage employees to report. The most successful systems are voluntary, nonpunitive, and confidential.

Mandatory safety reporting systems require an individual to file a report. However, most errors have many underlying causes and may involve more than one individual, which makes it unclear who should file a report. As such, reporting responsibility for mandatory systems often places the reporting burden on the supervisor. Because the supervisor did not experience the event and is only reporting it secondhand, the fidelity of the information may be lacking and not reveal significant information regarding the root cause(s) of the event. Voluntary systems encourage the employees who experienced the events firsthand to report them.

A culture of blame will most certainly deter widespread safety reporting. Many reporting systems offer reporting incentives that minimize or eliminate any disciplinary action for an incident except for the most egregious violations. The nonpunitive aspect of these systems eliminates any fear of retribution.

Last, confidentiality is a hallmark feature of a successful safety reporting system. However, this assurance may be one of the most difficult to implement. In blame-ridden organizational cultures, management may resist keeping the information confidential. The rationale in a culture of blame is that those committing errors and violations are inherently inadequate employees in need of punishment. A cultural shift is necessary and requires educating middle management that it is more important to identify the root cause(s) of errors and violations than to assign blame and punish. Root causes can be mitigated; however, punishing someone for something he or she could not prevent is not an effective practice.

Because this last assurance is key to a successful safety reporting system, the stakeholders of the systems reviewed took great care to ensure this feature. The reports from many of the systems

were handled by a third-party agent who was responsible for de-identifying the reports and in some instances coding the incident factors.

Pilot Implementation

Prior to full-scale implementation, piloting the system is recommended. The merits of instituting a pilot system are as follows:

- Allows the safety reporting system to be tested at a few choice sites or departments to identify program strengths and weaknesses
- Gives the implementation team an opportunity to monitor program effectiveness and make any necessary adjustments before full-scale implementation
- Lowers the overall cost of the system because the system design is optimized before its adoption

The research team learned that one of the most important practices for implementing a pilot system is that it must have high visibility. Ways to market a pilot safety reporting system include posters, news conference at trade shows, and trade publications. One program used direct mail with a program kit to encourage reporting. Most safety reporting programs held town hall-like meetings with representatives from labor and management whereby employees could raise concerns and have their questions answered. One program used focus groups conducted with employees to evaluate the reporting form and reporting system features. These methods are highly recommended before rolling out a pilot safety reporting system.

Training for the program stakeholders should include the following:

- Provide consistent information across all stakeholders.
- Educate how program addresses transit agency's safety goals and culture.
- Educate how safety reporting removes threats to safety.
- Clearly define and explain reporting incentives.
- Make sure stakeholders fully understand the safety reporting process.
- Provide training on the principles of trust and how to develop it.
- Develop teamwork skills for report review teams.
- Explain how to use the taxonomy to classify events and the related causal and contributing factors including root cause analysis.
- Stress importance of responding to recommendations of report review teams.
- Provide periodic refresher training.
- Integrate with new hire training.

Memorandum of Understanding

For existing organization-based safety reporting systems (i.e., not a centralized repository of incident reports such as ASRS), an agreement between the organization's management (e.g., airline or railroad), the labor union, and the regulatory agency had to be negotiated. Originating from the airline industry model of safety reporting systems, this agreement is referred to as an MOU.

The basic (core) information included in an MOU is as follows:

- Describes how the information obtained from the reports will be analyzed
- Authorizes nonpunitive response to noncompliance including skill enhancement or system corrective action to help solve safety issues; reports accepted under the program will result in lesser action or no action, depending on whether it is a sole-source report

- Describes the egregious events that are not acceptable; examples include gross negligence, criminal activity, substance abuse, controlled substances, alcohol, or intentional falsification of information
- Describes the reporting process and the role of the report review team
- Outlines the provisions for information dissemination from the safety reporting system

For both the aviation and railroad safety reporting systems, the template MOU was developed by committees composed of stakeholders representing all facets of their respective industries. The program managers of the safety reporting systems reported that negotiating the final Implementing Memorandum of Understanding (IMOU) was the lengthiest part of the implementation. This was due in large part to the numerous stakeholder requirements. Team- and consensus-building training for the stakeholders will facilitate negotiations. In addition, the language of the MOU template needs to be amenable to the changes that may be required during negotiations (i.e., a single MOU suitable for all public transit agencies is not practical).

Reporting Process

Figure 14 presents a diagram of the recommended reporting process as well as the report review as described in the next section. The most important aspect of the report submission process is to encourage timely submission. For a voluntary safety reporting system, the only way to accomplish this is to incentivize the process by setting a time limit for submittal of reports that will be covered by protective provisions (i.e., immunity). For some safety reporting systems, the time limit ranges from 24 hours to 10 days. It is important for the reporter to relate the event before

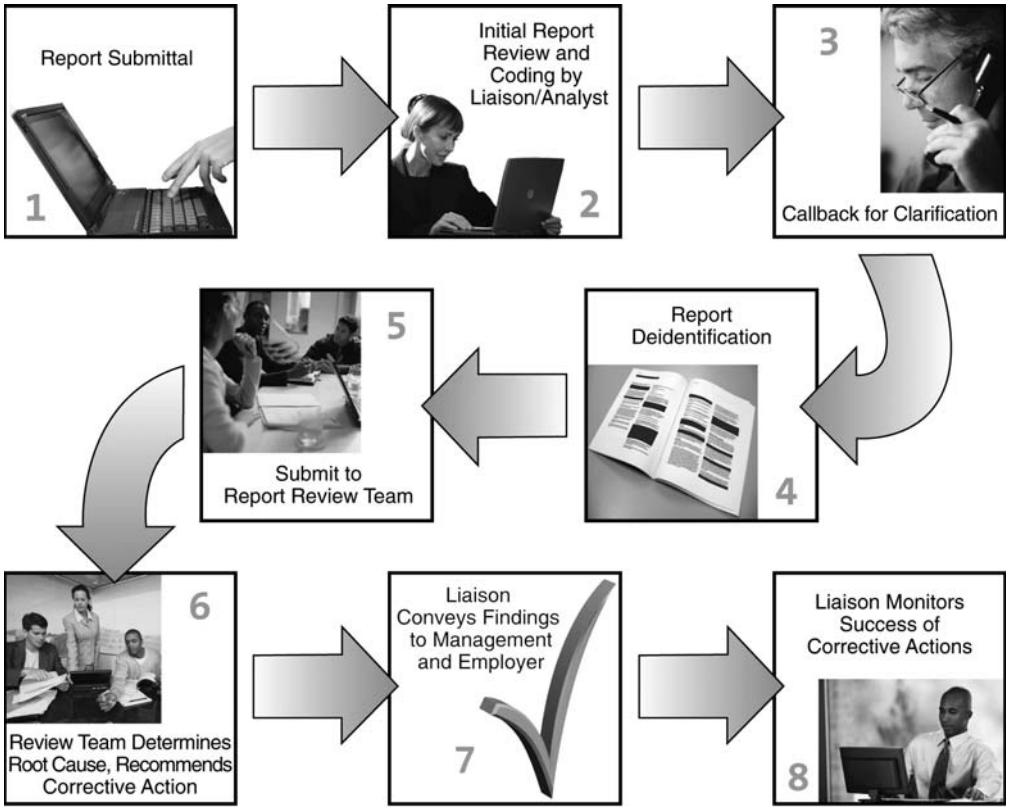


Figure 14. Safety reporting process.

memory of it becomes contaminated or begins to degrade. Twenty-four hours with the option of requesting to extend the time limit to 72 hours is a sufficient timeframe for reporting.

It is also imperative that the reporting process be as simple and efficient as possible for the reporter. To do so requires a user-friendly electronically available system, which ideally is accessible from home. The system should have the following features at a minimum:

- Data fields pre-populated with relevant information, e.g., employee name
- Drop-down boxes for commonly used responses
- Format that guides the submitter through a series of questions that when answered, automatically directs him/her to other related data fields
- Ability to upload attachments used as part of the investigation process
- Email capability (allows communication to be tracked but kept confidential)
- System-generated-acknowledgment of receipt of report

Report Review Team

Ideally, the report review team should be a three-person group composed of individuals that represent labor, management, and the regulatory agency. Since there is no federal regulator for transit, as there is for aviation and railroads, the third member of this team might be a representative from the state safety oversight agency, FTA, or an impartial arbitrator. The presence of a third person on the review team prevents deadlock from occurring during the report deliberation process. The purpose of this group is to review the report and supporting documentation to determine if there are any corrective actions or recommendations to be made regarding the reporter as well as the public transit agency. Remedial training is an example of a recommended action for an employee; whereas, adopting a new safety-related rule is something a transit agency might be asked to do.

To accomplish their tasks, the report review team needs specific types of training, which include consensus-building, conflict management, team-building, and root cause analysis (RCA). There are specific attributes that help qualify someone for a position on a report review committee. These include the following:

- Expert knowledge about the work processes the reports will involve
- Knowledge of safety principles
- Effective communication skills
- Ability to compromise

It is important to document the review team's processes and procedures in a manual; it should include important contact information and procedures for handling difficult situations. Additionally, the team should set aside one meeting annually to review program guidelines, the review process, and member roles and responsibilities. New members should be required to shadow veteran members and observe other review teams before full group membership.

In addition to the members of the report review team, the transit agency should assign program management responsibility to a liaison. As a nonvoting member of the report review team, the program liaison is an objective staff member that oversees the information capture process and facilitates the activities of the team. In addition, this person is the point of contact for the transit agency management as well as labor with regard to the safety reporting system. This person would most likely be on the staff of the transit agency's safety department.

For additional information regarding report review teams, the American Institutes of Research (2009) reviewed the best practices of "event review committees" in the context of the Aviation Safety Action Program (ASAP). This document is a valuable resource for implementing a report review team.

Review Process

After submittal, the report will go through a multistep process before it reaches the attention of the report review team (Figure 14). The safety reporting program liaison or an appointed report analyst managed by the liaison must perform several intermediary steps. These include coding the report with respect to the event and report taxonomies, clarifying any vagaries during a callback with the reporter and de-identification. The analyst needs to be a subject-matter expert familiar with the transit operations he or she will be reviewing. The taxonomy presented in Chapter 3 can be used as an initial prototype classification system for a pilot safety reporting system. The taxonomy may be modified based on the types of reports and comments received from the results of a pilot safety reporting system.

Just as the reporting process needs to occur in a timely manner, the review process needs to be expedited to ensure that the review team's corrective actions and recommendations are relevant. Timely feedback will be a testament to the system's effectiveness and therefore promote system trust among public transit agency employees. Therefore, team meetings should be scheduled as often as possible. Report review teams should meet either weekly or monthly depending on the number of reports they must review.

Some recommendations for the review process include the following:

- Reports should only be reviewed when sufficient/required information is available for the review team to deliberate on.
- Review old reports first to close them out then review the newer ones. Prioritize the new reports by risk level, if possible.
- Corrective actions and recommendations should be the end-product of risk assessment and root cause analysis.
- Maintain complete records of the report review process.
- Follow up with appropriate persons to make sure recommendations have been implemented and are successful; examine trends from reports before and after implementation to judge success.

Disseminating Safety Reporting System Information

To fully realize the benefits of a safety reporting system, there must be a process for the data to be disseminated to the reporting employees, the workforce in general, and transit management. To accomplish this, the data management system must have a user-friendly way to provide meaningful analyses. There are two levels of analyses: (1) the report level containing the narrative, which informs corrective actions for individuals and (2) the event level, which informs organizational improvement.

It is important to summarize the data to identify trends. Important ways to summarize the data include the following:

- Event characteristics
- Causal and contributing factors
- Risk assessment
- Corrective actions and recommendations

The following are common ways data are disseminated from safety reporting systems:

- Newsletters
- Report of the month
- Reports to enhance training and safety drills
- Periodic reports of data trends
- Periodic reports to management by the review team

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Abbreviations

AAR	Association of American Railroads
AIM	active interlocked modeling
AOV	Air Traffic Safety Oversight Service
APTA	American Public Transportation Association
ARC	accident review committee
ASAP	Aviation Safety Action Program
ASIAS	Aviation Safety Information Analysis and Sharing System
ASRS	Aviation Safety Reporting System
ATC	air traffic control
ATSAP	Air Traffic Safety Action Program
BBS	behavior-based safety
BLET	Brotherhood of Locomotive Engineers and Trainmen
BTS	Bureau of Transportation Statistics
CAST	Civil Aviation Safety Team
CBT	computer-based training
CDL	commercial driver's license
CIPSEA	Confidential Information Protection and Statistical Efficiency Act
CIRAS	Confidential Incident Reporting and Analysis System
CP	Canadian Pacific Railroad
CRM	crew resource management
DHS	Department of Homeland Security
DWI	driving while intoxicated
EMT	error management training
ERC	Event Review Committee
FAA	Federal Aviation Administration
FAR	Federal Air Regulations
FMCSA	Federal Motor Carrier Safety Administration
FTA	Federal Transit Administration
HFACS	Human Factors Analysis and Classification System
IAFC	International Association of Fire Chiefs
IAT	implicit attitude test
JPI-R	Johnson Personality Inventory–Revised
LACMTA	Los Angeles County Metropolitan Transportation Authority
LOFT	Line Oriented Flight Training
MBTA	Massachusetts Bay Transportation Authority
MNR	Metro-North Railroad
MOU	memorandum of understanding
MOW	maintenance of way

MVTA	Minnesota Valley Transit Authority
NAS	National Airspace System
NASA	National Aeronautics and Space Administration
NATCA	National Air Traffic Controllers Association
NJT	New Jersey Transit
NTSB	National Transportation Safety Board
NYCT	New York City Transit
OCTA	Orange County Transportation Authority
OJT	on-the-job training
OSS	Office of System Safety
PPE	personal protective equipment
RCA	root cause analysis
RTO	Rail Transit Operations
SDTI	San Diego Trolley, Inc.
SEPTA	Southeastern Pennsylvania Transportation Authority
SMS	safety management system
SRCP	Safety Rules Compliance Program
SRK	skill-, rule-, knowledge-based
SRTD	Sacramento Regional Transit District
TWU	Transport Workers Union
UO	unanticipated occurrence
UP	Union Pacific Railroad
UTU	United Transportation Union
VRTA	Virginia Regional Transportation Association
WBAT	Web-based access tool
WMATA	Washington Metropolitan Area Transit Authority

APPENDIX A

Rules Compliance Practices in Other Industries

Other industries, similar to public transportation, must address safety-related rules compliance in an effort to prevent low-probability, high-consequence events. The research team selected aviation, railroad, motorcoach, trucking, petrochemical, and construction as industries that face low-probability, high-consequence events and might offer best practices that are applicable in the public transportation industry. Two criteria led to the selection of these industries: the individual operator/employee is at significant risk for personal harm as a result of noncompliance and the operator/employee puts the public at significant risk for harm as a result of rules noncompliance.

Structured interviews with representatives from each industry provided the means to gather information on current industry practices. The interview questions covered the various activities these industries use to teach employees the rules, make sure employees understand the rules, ensure rules are followed, and respond to noncompliance. In addition, the interview explored proactive measures to encourage rules compliance and voluntary safety reporting programs designed to allow employees to self-report rule violations and near-misses.

Table 12 summarizes the number of organizations contacted by industry as well as the number of interviews that were conducted. The research team assured anonymity to the organizations that were interviewed; consequently, this information is not included in this report.

The interviews produced a great deal of information on each industry. The aviation, railroad, motorcoach, and trucking industries offer many best practices relevant to public transportation. To facilitate the organization and presentation of the best practices for these industries, there is a summary table for each industry that presents the best practices for the following aspects of the safety-related rules compliance program:

- Initial rules communication
- Communicating new rules
- Validating rules comprehension
- Monitoring adherence
- Responding to noncompliance
- Encouraging compliance
- Evaluating program effectiveness
- Safety reporting mechanisms

Federal Aviation Administration (FAA) regulations govern the training and certification of pilots. In addition, FAA examiners conduct check rides with commercial pilots to audit their compliance with FAA safety regulations. Since these procedures do not differ from airline to airline, this information was available from published sources. Therefore, the interviews with aviation industry representatives focused on voluntary safety reporting systems for pilots.

Table 12. Number of organizations interviewed by industry.

Industry	Number of Interviews	
	Contacted	Completed
Aviation	20	12
Railroad	17	15
Motorcoach	8	6
Trucking	9	6
Petrochemical	8	2
Construction	1	1

Aviation

Table 13 summarizes the rules compliance and safety reporting practices of the aviation industry.

FAA regulations govern flight operations as well as the certification and training of pilots (Title 14 C.F.R., although still commonly referred to as the Federal Air Regulations or FAR). A student pilot who begins training is introduced immediately to the flying regulations that apply to the student's level of flying. At each level of certification, both a written examination as well

Table 13. Rules compliance practices of the aviation industry.

Program Characteristic	Industry Practices
Initial rules communication	• Classroom presentations • Computer-assisted training
Communicating new rules	• Through computer-based files indicating information has been read • Memorandums with copies that must be signed/initialed and returned
Validating rules comprehension	• Written or computer-based testing • Recurrent classroom training • Recurrent simulator training • Operational line checks
Monitoring adherence	• Voluntary Safety Reporting Systems • Operational Flight Monitoring Systems • Operational error and pilot deviations and reports • FAA violations
Responding to noncompliance	• Dependent on level of deviation/violation and current labor agreement • Informal conference with supervisor • Formal investigation within company • Formal investigation with FAA
Encouraging compliance	• Voluntary safety programs • Crew Resource Management • Top-down safety culture • Emphasizing the causes of safety issues rather than an emphasis on disciplinary action
Evaluating program effectiveness	• Decrease in incidents/accidents • Analysis of voluntary safety reports • Benchmarking with other airlines • Input from the FAA • Line operational safety audits
Safety reporting mechanisms	• Safety hot lines • Aviation Safety Reporting System • Aviation Safety Action Program • Other company reporting systems

as a practical, or flying, test is required. As a pilot moves through the various levels of certification, he or she is introduced to the appropriate flying regulations, and must understand these regulations in order to complete the written, oral, and flying evaluations. In order to be hired by an airline or a corporate flight department, a pilot must be certified at the commercial level, with an instrument rating, and have a certain level of flying experience. During this period of preparation, the individual will have been exposed to the flight regulations through both the academic and practical flying environment. Therefore, when the pilot is then hired by a flying corporation, he or she is already expected to be familiar with the FAR. During the pilot's initial training, he or she is then presented with the flight regulations that apply to the particular type of flying that he or she has been hired to do. Follow-on simulator and in-flight training re-emphasize the general flight regulations, as well as the specific regulations. Thus, when the pilot begins operational flying, he/she has been exposed to, and is expected to know, all the flight regulations that apply to the new flight environment. In summary, then, as a baseline, the new employer has trained the new pilot to understand any specific regulation that applies to the particular type of flying, and has also re-emphasized general flight regulations.

Once a pilot is employed, the FAA requirements for continuous recurrent training apply. The basic requirement calls for a certain amount of annual ground school, a certain number of simulator periods that include flight checks, and the requirement that Pilots-in-Command (Captains) receive a periodic operational line check. In addition, a flight crew may receive an unannounced random line check from an FAA flight inspector at any time. In recent times, many airlines have moved to the Advanced Qualification Program, another voluntary program through the FAA that emphasizes training outcomes and scenario-based training. In general terms, this type of training moves away from the pass/fail checkride mode, and highlights training and proficiency goals. This type of training also uses a simulator exercise called Line Oriented Flight Training (LOFT), which accomplishes the training in an operational scenario, rather than simply dealing with specific flight maneuvers. This type of training is a major change to the older concept of periodic checkrides and results in more effective training and pilot proficiency.

In the distant past, once a pilot began operational flying, the pilot's major concern involved incidents and potential violations, resulting in discipline from the FAA or the airline. This resulted in a mentality in which any potential safety issue that was not detected by the system was kept secret. Pilots feared potential discipline, especially certificate suspension or revocation. In addition, it was common for a company to terminate a pilot for such incidents or violations. Needless to say, this did not encourage an environment where a pilot was willing to voluntarily disclose any safety issue. To help combat this perception, the Aviation Safety Reporting System (ASRS) was created in the 1970s. ASRS encouraged pilots to report safety data so that safety trends could be analyzed and system corrections could be made. A detailed description of this system is in Appendix C.

Data gathered in ASRS revealed that the most common incident or violation involved an altitude deviation. As a result, a program was developed whereby airlines and corporate aviation departments could develop a voluntary system for reporting these events, and in return the pilot would again receive protective provisions. The Aviation Safety Action Program (ASAP) is explained in more detail in Appendix C. This successful voluntary safety program, which is classified as confidential and nonpunitive, is today a leading contributor to overall flight safety, and has been fully accepted by the FAA, the airlines, and the labor unions.

Aviation groups, unions, industry groups, and the FAA offered the following comments regarding ASAP:

- The system emphasizes the root cause of incidents and violations, rather than a punitive discipline program.

- Approximately 90% more incidents and violations are being uncovered due to the nonpunitive aspect of the program.
- All the stakeholders have a high level of confidence in the system.
- Safety concerns are now being examined by all parties and system corrections are being made so that these concerns do not develop into accidents/incidents.

The FAA's Flight Operations Quality Assurance Program (FOQA) is another example of a successful voluntary program. This program allows airlines to download information regarding the movement of an aircraft from one point to another via flight data recorders. The program is confidential and negotiated through a memorandum of understanding among the FAA, labor, and airlines. The information obtained is not used punitively. Rather, it provides information about aircraft handling that otherwise would go unnoticed.

Railroad

Table 14 summarizes the rules compliance practices of the railroad industry.

The Federal Railroad Administration (FRA) regulations prescribe a program of operational or efficiency testing (40 C.F.R. 217) to determine compliance with operating rules. As of January 1, 2009, this program must place emphasis on those operating rules that cause or are likely to cause the most accidents or incidents. In addition, FRA requires that locomotive engineers be certified every 3 years. Each engineer must have a check ride every year. Each railroad sets the frequency of rules exams but Federal Regulations require that the railroad's program/policy be filed with FRA. Because of these requirements, the approach of all railroads to validating rules compliance is similar. Labor agreements and the Railway Labor Act prescribe procedures for progressive discipline for rules violations so the response is similar from railroad to railroad. In spite of these common requirements, there are significant differences in each railroad's approach to the overall rules compliance process.

Locomotive engineers and conductors are trained by the railroad that hires them. The length of this training may vary but all railroads use some combination of instructor-led classroom training and action-based training, and sometimes CBT. Feedback from labor indicates that the most effective rules training is instructor-led, involves practical application or illustration of the rule, and includes an explanation of the purpose of the rule. Railroads use written tests or computer-based tests to validate the employee's rules knowledge. When there is a change in a rule or a new rule, the method for conveying this information will depend upon the complexity and impact of the rule. For major changes, a class or video and job briefing will occur. Other changes will be covered in a general order or system bulletin and then be incorporated into the rule book.

All railroads use operational/efficiency testing to monitor rules compliance. In addition, some download locomotive event recorder data to monitor an engineer's performance relative to operating and train handling rules. One railroad reported that this method allows it to identify red light run-throughs that it would not otherwise have known about. Labor expressed the concern that this technology can be overused and in some cases have a negative impact. Most railroads also review radio transmissions. Per FRA requirements, all railroads use accident and injury data to focus their testing programs. One railroad reported focusing on human factors accidents for possible rules problems.

There is some variation in the responses to noncompliance. Some railroads do not discuss the operational test results with the employee unless there is unacceptable performance. Many railroads have a policy that supervisors are to give feedback but the positive feedback usually comes later while failures are handled at the time of the test. One railroad reported that it gives feedback immediately, regardless of the outcome. Labor prefers this approach. The supervisor

Table 14. Rules compliance practices of the railroad industry.

Program Characteristic	Industry Practices
Initial rules communication	• Instructor-led classroom training with scenarios • Computer-based training • Action-based training
Communicating new rules	• Track Bulletin, System Bulletin, Timetable • Class or video and job briefing for major change
Validating rules comprehension	• A minimum of biennial rules class and testing • Scenario-based simulator for train handling • Operational/efficiency testing • Monthly meeting of management/labor committee discusses problematic rules • Review test results to identify areas that need more attention
Monitoring adherence	• Operational/efficiency testing–may be scenario-based • Review accident/injury data with focus on human factors accidents • Download locomotive event recorder data to monitor operating and train handling rules • Audit teams to validate testing • FRA violations • Review radio transmissions • One-day safety assessment of co-workers
Responding to noncompliance	• Discuss test failure with employee immediately so cause can be identified • Progressive discipline per labor agreement • Alternative process with minor, serious and major violation instead of formal investigation • Supervisor interview to determine appropriate actions, e.g., training, coaching
Encouraging compliance	• Safety briefings • Train supervisors how to coach and counsel employees • Mutual accountability–both supervisor and employee hold each other to standard of accountability • Crew Resource Management • Signal awareness forms (conductor records each signal passed) • Safety audit program not part of discipline process • Safety Assurance and Compliance Program at System and Division levels • Debriefing of every accident and incident with no discipline attached • 7Cs Program–confirming,correcting, caring, collaborating, coaching, conciliating, clarifying
Evaluating program effectiveness	• Relationship between results of operational testing and accidents/incidents and FRA violations • Change in number of accidents and injuries • Change in operational/efficiency test failures • Benchmarking with other railroads
Safety reporting mechanisms	• Close Call Reporting System Pilot Program • Safety hotline • Open communication between supervisors and their people

may discuss unsatisfactory test results with the employee and recommend an appropriate action such as training or coaching.

Railroads reported a variety of proactive strategies for encouraging rules compliance. These include training supervisors how to coach and counsel employees, adopting a policy of mutual accountability between the employee and supervisor, conducting safety audits that are not part of the discipline process, and conducting a debriefing of every accident with no discipline attached.

The railroad industry has been characterized by some as having a culture of blame but there are efforts to change this. The ongoing Confidential Close Call Reporting System (C^3RS) pilot will determine whether a nonpunitive near-miss reporting system will identify hazardous situations before an incident or rule violation occurs. (See Appendix C.) Aside from C^3RS, one Class I railroad is implementing a nonpunitive reporting mechanism that will be managed by the labor organizations that represent its employees. There are also efforts to promote open communication between supervisors and their people.

Advice from railroad industry and labor representatives to public transit agencies included the following:

- Train the first line supervisor to deal with individuals that violate an operating rule in a non-confrontational way.
- Discuss noncompliance issues with other transit agencies and similar industries.
- Implement programs such as job briefings and increased rules classes that promote more communication between first line supervision and labor.
- Know your people and listen to them. Make sure supervisors are spending time in the field getting to know their people and talking to them.
- Make sure employees know the rule, the intent of the rule and how the rule is applied.
- In order to take safety and rules compliance to the next level you have to understand why the violation occurred. A misunderstanding or lack of knowledge should be treated differently than conscious disregard of a rule.
- Involve employees in the development of operating rules and procedures.
- Consider additional regulations for the public transportation industry that will help improve its safety performance.

Motorcoach

Table 15 summarizes the rules compliance practices of the motorcoach industry.

Other than medical standards and commercial driver's license (CDL) requirements, Federal Motor Carrier Safety Administration (FMCSA) has no oversight of driver rules compliance.

Most over-the-road motorcoach companies provide both classroom and over-the-road training. One company did report that it only hires experienced drivers with a CDL. This company does a review of all candidates including an extensive background check and a psychological profile test to be sure that the individual meets the company's requirements for drivers. Orientation at this company covers company rules and policies and also includes a crisis management program. Most companies have written exams but one smaller motorcoach operator reported that it relied on the recommendation of an experienced driver who trains the new hire.

Motorcoach operators use a variety of methods to monitor compliance with safe driving rules. These methods are the following:

- A majority of the companies that the research team contacted reported that they use a video-based system for monitoring driver behavior. The system is triggered by an unsafe driving

Table 15. Rules compliance practices of the motorcoach industry.

Program Characteristic	Industry Practices
Initial rules communication	• Initial training that may include self-directed study via CBT, classroom and over-the-road training
Communicating new rules	• Notices mailed to drivers' homes • Memorandum posted in drivers' area • Safety meetings • Update training
Validating rules comprehension	• Written exam • Check out by veteran driver or trainer • Discussion at safety meetings
Monitoring adherence	• Onboard cameras for video recording • GPS tracking data • Mystery riders • Public feedback via internet or 800-number • On-road observation by field safety staff • Ride-along by operations staff
Responding to noncompliance	• Coaching • Retraining • Progressive discipline
Encouraging compliance	• Awards or financial incentive for no preventable accidents or other safety violation such as cell phone use while on duty
Evaluating program effectiveness	• Track at fault collisions, customer complaints • Accident Review Board • Review events from video data recording system
Safety reporting mechanisms	• 800-number for reporting; treated as confidential • Safety committees • Driver suggestion box • Management open door policy

behavior such as hard braking or speed. When the event occurs, the system saves a video recording of the event along with engine data.

- Some companies hire mystery riders who purchase a ticket and ride the bus to observe the driver with regard to speed, customer service, distracting activities while driving, following distance, and other safety behaviors.
- Some companies have GPS tracking systems on their vehicles. These systems provide position and speed data.
- Some companies rely on observation by safety managers from a trailing vehicle.

In addition to the above activities, motorcoach operators also review customer complaints that come through an 800 number or email.

When management becomes aware of an unsafe driving behavior through one of the methods described above, the driver's supervisor will meet with him or her to discuss the observation. The driver may be coached or sent for retraining. The information from the video monitoring system is used as a training tool, not as a means to discipline drivers. In every place where this system is in operation, labor initially resisted it. After a number of instances where the video data showed that the driver was not at fault in an accident, that is, it was a non-preventable accident, the drivers began to support its use. Discipline is an option when the driver does not respond to coaching and training.

All motorcoach companies evaluate their compliance programs based on the number of avoidable accidents. Those with video monitoring also look at the number of events that are

reported. Motorcoach operators that use video monitoring all reported a decline in accidents after the system was installed.

Nearly all of the motorcoach companies have an incentive program to reward safe driving. Many of the people interviewed stressed that the drivers value these programs because the programs recognize the drivers as professionals. Both labor and management made this point. In some companies, compensation is based on safe driving.

Motorcoach industry and labor representatives offered the following advice to the transit industry:

- The most important way to encourage safe driving is to have open communication between the employees and management. Have an open-door policy and do one-on-one counseling.
- Safety must be a goal for everyone. Management sets the tone for safety, starting at the top.
- Conduct periodic safety meetings that include a review of actual situations that have occurred.
- Do a thorough background check and conduct a comprehensive road test before hiring a driver. If you hire the right people, there are fewer performance issues.

Trucking

Table 16 summarizes the rules compliance practices of the trucking industry.

FMCSA has no direct oversight of driver rules compliance. Therefore, the agency thought the interview efforts of this project would best be suited for specific fleets and industry organizations. The following summarize these efforts.

Table 16. Rules compliance practices of the trucking industry.

Program Characteristic	Industry Practices
Initial rules communication	• Instructor-led training • Practice in nonrevenue service • Read and sign policy
Communicating new rules	• Read and sign policy • Safety briefing
Validating rules comprehension	• Periodic safety quizzes • Periodic driver re-certification • Quarterly Internet-based safety training
Monitoring adherence	• Ride-along • Public reporting via 800 phone number • Private monitoring services for covert observation • Hard braking data from engine recorder
Responding to noncompliance	• Remedial training • Peer coaching • Progressive discipline • Conduct root cause analysis
Encouraging compliance	• Periodic safety meetings • Monthly newsletter • Posters • Incentive award system for positive safety behavior • Employee recognition program (nonmonetary) • No tolerance policy for use of electronic devices • Defensive driving program
Evaluating program effectiveness	• Evaluate rule book and modify for clarity • Hard braking frequency
Safety reporting mechanisms	• Confidential report to safety department

The trucking industry is a proud proponent of safe operating practices. These companies realize they can either pay up front for proactive safety measures, or they can pay later (most likely at greater loss to the company) for accidents resulting in injury and claims. Therefore, they consider safety to be an investment.

The industry hires inexperienced as well as experienced drivers and uses various employee screening methods. The most predictive of these methods are the drug and alcohol offender screening process and the review of moving violations. The types of initial training for each differ based on experience. Subsequent information regarding rules may be relayed during periodic safety briefings. Some have traditional types of training (e.g., biennial spring/winter training). In the winter, specific types of safety rules can be revisited such as driving in icy weather, whereas spring training will highlight different driving challenges (e.g., fatigue resulting from the driver pushing him- or herself because of the extra daylight hours). There is a trend toward moving from these traditional types of training to more frequent (sometimes five times a year) CBT along with an annual rules recertification and in-truck assessment.

One company recently revised its rulebook examining each operating rule for relevance. It assigned employees, including drivers, to working groups for each section of the operating manual. The process took 3 months and uncovered areas where retraining was necessary. The end product was a streamlined version of the rulebook that was driver-friendly and provided much-needed clarity of the written rules.

The trucking profession consists of primarily two types of drivers. Some have dedicated routine assignments while others are long-haul operators. Both types of drivers present unique challenges to the companies that employ them. It is particularly difficult to manage long-haul drivers and create a sense of cohesiveness among the workforce. Large companies feel the need to create an atmosphere of individual responsibility given the sometimes geographically distributed workforces. In addition to fostering self-monitoring, these companies will require periodic ride-alongs, monitor motorist reports, as well as review automated truck-handling reports. They also keep track of accident data to inform risk assessment. These monitoring strategies act as proactive ways to prevent accidents, but they also provide a means for the company to identify noncompliant individuals, intervene through coaching or procedural changes, and then track subsequent behavior.

The industry is proactive in many regards. One trucking company reported that it looks beyond the cause of accidents attributed directly to driver error. This company recognizes the fact that 65% of accidents are due to reasons other than faulty driving. As a result, the company looks at these incidents to identify ways to improve driver ability to prevent similar occurrences. To facilitate this proactive approach, the company relies heavily on a private methodology geared toward teaching drivers to be aware of their surroundings.

These companies rely on incentive programs to engage their employees. They report traditional bonus programs, but also use non-monetary rewards like safety recognition (e.g., the CEO of the company might send a personalized letter to a valued employee). One trucking company reported that it believes these programs are undervalued. The interviewee stated that many trucking companies spend so much time identifying when things potentially go wrong, that they sometimes forget the importance of acknowledging the people who provide safe and efficient transport services.

A labor representative commented that it is important to train and recognize vehicle operators as professionals. While much of the responsibility of professionalism falls on the shoulders of the drivers, the companies that employ these individuals are responsible for providing the opportunity for professional certification, honoring good driving behavior, and compensating their drivers competitively. These company actions will go a long way toward encouraging safe driving behavior

and helping drivers not feel the need to take shortcuts or make unsafe actions in the interest of generating more income (e.g., violating hours of service, speeding, etc).

When asked what advice to offer the public transportation industry, one company remarked that you "must start with a foundation of safety culture." Management commitment from the top-level down is the only way this can be accomplished. Labor also remarked on the importance of fostering a safe culture.

Petrochemical

The research team conducted interviews with two petrochemical companies. Table 17 summarizes the practices of these two petrochemical companies.

All employees, including office workers, receive safety training as part of their initial orientation. Those employees who handle chemical products are trained in the standards relevant to their particular job. Some training is computer-based/online, but most is on-the-job with an experienced employee. In addition, one petrochemical company reported holding monthly safety meetings. This company emails new or changed rule details to employees if the monthly meeting is scheduled more than a few days after a rule change is effective.

One company conducts safety audits of all hazardous material remediation projects as well as its plant operations. Audit results are summarized in a Safe Act Index. Any employee found to be non-compliant during the safety audit will be educated appropriately. The other petrochemical company relies on its shift supervisors in the plant to monitor adherence to safety rules. This is the primary way that management becomes aware of rule noncompliance. Employees at both companies are also strongly encouraged to self-report incidents as well as near-misses, also referred to as unanticipated occurrences (UO).

Remedial training may be recommended when there is a safety violation. Dismissal would occur only in the most egregious cases or if there are repeated willful actions. One company reported that management expects supervisors and managers to intervene and coach on the spot for any actions that do not follow policy, regardless of whether or not it results in an event.

Both companies use leading/lagging indicators to monitor the effectiveness of their safety compliance programs. Examples of leading indicators are monthly safety meeting attendance,

Table 17. Rules compliance practices of the petrochemical industry.

Program Characteristic	Industry Practices
Initial rules communication	• Computer-based training • OJT
Communicating new rules	• Email changes • Monthly safety meetings
Validating rules comprehension	• Safety audit
Monitoring adherence	• Safety audit • Supervisor observation
Responding to noncompliance	• Remedial training • Coaching
Encouraging compliance	• Monthly safety meetings • Coaching • Safety audit
Evaluating program effectiveness	• Leading/lagging indicators
Safety reporting mechanisms	• Self-report incidents and near-misses

completion of UO reports on time, and the requirement for one safety contact per employee quarter. Safety contacts can be providing training at monthly safety meetings, audit completion, completing a Project Safety Analysis, or calculating a Safe Act Index. Lagging indicators are environmental deviations, incidents, and injuries.

The petrochemical companies report that they use safety training, safety meetings, peer coaching, and auditing to encourage compliance. Representatives at one company reported that "Safety is not an option; it is a culture." Management expects employees to comply. When asked for advice to public transportation industry management, interviewees offered the following:

- You will achieve the level of safety excellence that you *demonstrate* that you want to achieve.
- There must be a way to check if rules are being followed.
- A clear focus from senior management that safety is important and is a fundamental policy of the company will set the tone for how people work.

Construction

The research team contacted a major construction company based in Massachusetts to learn about its safety rules. Because this industry involves the use of construction equipment and large trucks, there was a possibility that some useful practices with application to transit operations would exist. (Its vehicles cover 3 to 5 million miles a year in total.)

Most of the initial training to new hires involves personal safety but the training also covers driving safety. The company has the employee sign a safety "agreement" after reviewing the safety handbook. New hires are assigned a mentor, usually a senior foreman, who works with them to help them identify and avoid hazards.

There is no formal rules compliance testing or evaluation. Foremen are responsible for monitoring employees. If an incident occurs, a superintendent or project manager may then increase monitoring of the foreman and the foreman's people. The company keeps a record of all safety infractions. Depending upon the nature of the safety infraction, there is a progressive discipline policy.

The company evaluates the effectiveness of its safety program by monitoring the number of injuries requiring first aid, number of recordable injuries, and lost-time injuries per hours worked.

The company treats near-misses as an incident and asks employees to report them on the incident report form. These reports, which go to the safety director, are confidential but not anonymous.

The safety director reported that the company tries to maintain a culture of safety but that this requires personal involvement from management. When asked what advice he would offer to public transit management, his comments were more about safety culture than rules compliance. He offered the following:

- Share information with everyone, be it good or bad. Report the what and why, not the who.
- Management involvement and support is very important. If the management is involved, then the employees will follow.
- Be constantly alert; just because there has not been an incident does not mean it cannot happen.

Since the practices of the construction industry did not appear to offer any practices or strategies that were not present in the other industries, there were no additional interviews with construction companies.

APPENDIX B

Rules Compliance Practices in the Public Transportation Industry

The public transportation industry currently employs a variety of practices to ensure compliance with safety-related rules. Structured interviews with representatives of transit agencies across all modes and sizes, labor, and industry as well as representatives from regulatory agencies provided the means to gather information on current industry practices. The questions used for these interviews covered initial rules communication, notification of rules changes, verifying employee rules knowledge, monitoring for rules compliance, responding to rules compliance, and measures to encourage rules compliance. The interviews also covered evaluating rules compliance program effectiveness and asked the organizational representative "What advice would you give another public transit agency with regard to fostering rules compliance?"

The following sections highlight the research team's findings with regard to each transit mode. Table 18 summarizes the number of organizations contacted as well as the number of interviews that were conducted. As Table 18 indicates, not all the public transit agencies contacted were available for interviews. The ferry operator is summarized along with the cable car operator under *Other* in the narrative section. As was the case with the nontransit industries, the research team assured anonymity to these organizations so this information does not appear in this report.

Commuter Rail

Table 19 provides a summary of the practices reported by the five commuter rail agencies that were contacted.

The FRA regulations that apply to railroads also apply to the commuter railroads. This means that the commuter railroads must have a program of operational testing and their locomotive engineers must have biennial rules examinations and annual ride checks with the supervisor of locomotive engineers.

All commuter railroads have training programs for their engineers and conductors. Some hire all new recruits as conductors or assistant conductors and then after some period of time allow them to apply to become a locomotive engineer. Initial training for both engineers and conductors includes rules instruction and a written examination. While FRA requires a rules class for engineers every 2 years, some commuter railroads require this annually for both engineers and conductors. One labor representative commented that the most effective training includes an explanation of the reason or need for the rule, a demonstration of practical application, and hands-on practice applying the rule.

One commuter rail operator reported that prior to some rules classes, it administers a pre-test to gauge the group's understanding prior to the class. These results are compared with the scores

Table 18. Number of transit agencies contacted by mode.

Mode	Number of Interviews Contacted	Number of Interviews Completed
Commuter rail	8	5
Light rail	7	6
Heavy rail	8	6
Bus	12	11
Paratransit	3	3
Ferry	2	1
Other (cable car)	1	1
Labor	6	4
FTA	1	1
Industry Organization	2	2

Table 19. Rules compliance practices in commuter rail operations.

Program Characteristic	Industry Practices
Initial rules communication	• Instructor-led training • Onboard OJT
Communicating new rules	• Short class or safety briefing for major rules • "Meet and greet" notification from supervisor for major rules • Issue as bulletin order then general order • Update rule book • Cover in next annual rules class
Validating rules comprehension	• Written exam • Annual rules class and exam
Monitoring adherence	• Supervisor observations per FRA operational testing • Check ride in cab • Download data from onboard recorder • Data from signal system • Onboard spotters (cell phone use)
Responding to noncompliance	• Minor noncompliance, supervisor coaches and counsels employee, may require retraining • Decertification if FRA specified violation per regulation • Dismissal for cell phone use
Encouraging compliance	• Encourage employees to bring issues to local safety committees • Post notices to emphasize consequences of serious violations • Posters to heighten awareness • Safety bulletins to address special situations in proactive manner
Evaluating program effectiveness	• Monthly review of all accidents, incidents, near-misses • Results of operational/efficiency testing • FRA Audit reports
Safety reporting mechanisms	• Confidential Close Call Reporting System • Daily crew de-briefing • Confidential report to safety department

of the group at the end of the class. This is done for informational purposes only and provides a means to judge the effectiveness of the training.

All commuter railroads have a program for operational/efficiency testing that is driven by accident and injury experience. In addition, commuter rail operators identify rule noncompliance using data that is downloaded from the locomotive and indications from the signal system. The check ride that is part of locomotive engineer certification also may identify noncompliance. One commuter railroad reported that it uses onboard spotters to monitor handling of cash by conductors in ticket sales. These people have also been instructed to report unauthorized use of cell phones by the train crew. As with other public transit operations, commuter rail operators receive complaints from patrons which may lead to the identification of a rule violation. The most common violations are signal violations and entering a work zone without proper permission. On commuter rail systems with at-grade rail-highway crossings, improper protection violations occur.

FRA regulations prescribe engineer de-certification for certain rule violations. For minor noncompliance, the employee's supervisor will coach and counsel the employee and retraining may be required. Most commuter railroads have a "no tolerance" policy with regard to cell phones and anyone found using one will be terminated. Some permit the employee to have it in a grip that is on the train, but the device must be off. Since the locomotive engineer is alone in the cab, detecting cell phone use or texting is difficult. One of the NTSB recommendations following the Chatsworth accident was that video cameras be placed in the locomotive cab to detect this behavior.

Commuter railroads have employed a number of proactive strategies to encourage rules compliance. Examples are the following:

- For key rule changes, such as a new cell phone policy, one commuter railroad uses a "meet and greet" approach where a supervisor explains the new rule one-on-one.
- Training bulletins that address special situations (e.g., taking shortcuts) in a proactive fashion are given to supervisors for distribution to their people.
- Safety bulletins or alerts to give actual examples of the consequences of rule violations on the property or at another commuter railroad. These may be used in safety briefings.
- Conduct of a hazard analysis to identify risks related to rule violations and unsafe situations.
- Daily job de-briefing at the end of the day's last run including review of how unanticipated situations were handled.

One commuter railroad is participating in the Close Call pilot implementation. The other commuter railroads reported waiting to see the results before committing to that type of nonpunitive safety reporting system.

All commuter railroads review the results of operational tests as well as all accidents, incidents, and near-misses. If there is a pattern in either accidents or rule noncompliance, observations in the operational testing program may be refocused. This review may occur monthly and/or quarterly. One large commuter railroad took this review to a different level. It established a task force to look at hazards as a proactive measure to prevent rule violations and accidents.

Commuter rail operators offered the following suggestions on ways to foster rules compliance:

- There is no substitute for supervision. Supervisors must observe their employees.
- Address a problem when it occurs.
- Be proactive rather than reactive.
- Encourage employees to speak up and ask for help if they don't know how to do something.
- Frontline supervisors must work with the hourly people. They must create an atmosphere of trust. The vehicle operators need to know that they are going to be supported for working

safely. Supervisors must be accountable for the overall performance of their employees, not just on-time performance.
- Rules compliance requires a holistic approach that is based on a safety culture that comes from the top of the organization.

Light Rail and Heavy Rail

Table 20 provides a summary of the practices reported by the six light rail and six heavy rail transit agencies that were contacted.

The approach that most public transit agencies use for monitoring rules compliance is very similar to that used by the railroad industry. Unlike the railroad industry, oversight comes from state agencies, not a federal agency. The one exception is any light rail service that operates over track shared with a freight railroad and is part of the national railroad network. That service is subject to FRA requirements. This applies to two light rail operators that the research team interviewed.

Table 20. Rules compliance practices in light and heavy rail operations.

Program Characteristic	Industry Practices
Initial rules communication	• Instructor-led training • Practice in nonpassenger operation • Onboard OJT
Communicating new rules	• Safety bulletins, employee acknowledges by signature • Classroom training • Posters
Validating rules comprehension	• Written exam • Practice operation • Rule of the day/month • Quarterly safety workshops
Monitoring adherence	• Operational/efficiency testing • Download data • Observation by roving supervisor (off vehicle) • Ride-along • Public input
Responding to noncompliance	• Progressive discipline depending upon severity of violation • Employee counseling • Retraining
Encouraging compliance	• Quarterly workshops with LR operators • Rules of the week • Defensive driving course (LR) • Safety award program • Hazard analysis • Management/labor safety audits
Evaluating program effectiveness	• Results of efficiency tests • Accidents
Safety reporting mechanisms	• Safety committee with hourly and supervisory personnel • Open door policy • Confidential report to Safety Department • Use of positive safety language • Near-miss reporting system

Training for rail transit operators is always a combination of instructor-led classroom and field training. The representative for one light rail operator mentioned that since situational awareness is a key skill, this agency screens for this skill during the recruitment process. There is a written exam to validate the candidate's knowledge of the rules. Rules recertification, including signals, beyond the initial test varies by location.

For example, California requires annual rules exams for all rail operators. Other rail transit systems require biennial recertification.

In addition to periodic testing, rail transit agencies use a number of strategies to validate rules knowledge. These include having a rule of the day that is discussed at safety meetings or a rule of the month that the supervisor reinforces with each operator. One heavy rail transit operator queries vehicle operators during their shift and asks them to repeat back the rule of the day. One light rail transit operator conducts quarterly workshops with vehicle operators. These are half-day informal events that are intended to communicate information regarding recent industry accidents or incidents, or rulemaking that has occurred. There is no testing at these workshops.

The common element in all rail transit safety-related rules compliance programs is operational/efficiency testing. The rail transit agency has a written plan with goals for the number and types of tests that must be done each month. These tests are planned, but supplemental unannounced tests may occur. Some rail transit agencies report that they make these tests transparent to their vehicle operators while others feel they should be done without operator knowledge. Only one rail transit agency reported giving positive feedback to the operator after successfully passing a test. Failures are always communicated immediately. Other techniques for monitoring compliance include download of vehicle data, roving supervisors who observe operations, and supervisor ride-along with the operator. Public input received via toll-free number, Internet, or email may also identify rules violations. When asked about the most frequent types of violations, rail transit agency representatives mentioned failing to sound the horn in a work zone and accepting an improper route at a switch as light rail violations. Heavy rail operators mentioned failure to stop or hold at a specific location and closing the door on a passenger.

When a violation is detected, the response will depend upon the severity of the violation. The supervisor may counsel or coach the operator, or retraining with follow-up observations may be recommended. Most rail transit systems have prohibitions regarding the use of cell phones and texting while on duty. Some have a "no tolerance" policy requiring immediate dismissal. Others apply progressive discipline. Progressive disciplinary action occurs for serious rule infractions. Union agreements prescribe the discipline process. One labor representative commented that if a vehicle operator has a bad attitude and does not want to come to work, forcing the operator to take off 3 days without pay is not punishment. He added that this individual needs retraining, not punishment.

More than one labor representative pointed to the need for root cause analysis to identify any underlying problems that are responsible for or contribute to safety-related rules violations. The researchers learned of two noteworthy examples where root cause analysis identified the underlying contributing factors. They are the following:

- NJTransit's River Line experienced a number of red signal violations that exceeded the industry average over a 3-year period. A thorough investigation of these incidents revealed that the majority of LRV operators who had violated the stop signal reported that they presumed that the signal would be permissive by the time they reached it. Understanding that it was presumption not distraction or some other reason led River Line management to the appropriate way to reduce these violations.
- Two track worker fatalities on the New York City Transit (NYCT) subway system led to the formation of a labor/management task force to identify the underlying reasons for these

fatalities. In addition to measures to improve track worker safety, the task force investigated the safety culture and current perceptions of safety. Among the recommendations of this task force effort are joint labor/management safety audits that are nonpunitive, injury and illness data analysis, root cause analysis of accidents and near-misses, and an ongoing evaluation of the safety consciousness and culture. The final report from the Joint Track Safety Task Force is impressive. Other materials that the research team obtained indicate that changes were made in operating rules for train operators, track workers, and flaggers.

Rail transit agencies employ a variety of measures to encourage rule compliance. NYCT conducts safety audits to reinforce compliance with safety rules and identify hazards before there are problems. Appendix C contains a description of this NYCT program. Other strategies include quarterly workshops with operators, focusing on a Rule of the Week in safety meetings or via bulletins, selecting a rule for operator coaching sessions, and safety incentive programs. Some public transit agencies conduct a hazard analysis to identify problem areas that are a risk for a rule violation or accident. One labor representative commented that vehicle operators become complacent after 5 to 7 years of experience and that for this reason they need reminders as to how to operate in accordance with the rules. This same individual also commented that, in his experience, peer coaching can and does reduce this complacency.

All public transit agencies evaluate the effectiveness of their compliance programs in terms of the results of their efficiency tests and number of accidents. Agencies review these data on a periodic basis, usually monthly, and adjust their test plans accordingly.

There is a variety of mechanisms for transit employees to report safety issues but only NYCT has a system that is specifically designed to encourage reporting of near-miss incidents. (Appendix C contains a description of this program.) Transit agency and union safety committees accept issues from operators and most safety departments provide a confidential 800 number for reporting safety issues and near-misses. Labor believes that if there are honest good faith efforts by management to listen and act on problems, then employees will report these situations. Lacking trust, the reporting will not happen.

Rail operators offered numerous suggestions on ways to foster rules compliance. These suggestions included the following:

- Get the employees actively involved in safety. This occurs when management removes the motivation for "gotcha" actions to penalize the employees and fosters dialog on the underlying reason for each rule and how it protects the operator.
- Build a training curriculum that teaches using both classroom methods and practical application of rules and procedures.
- Line supervisors must be able to coach vehicle operators. Not every operational deviation requires harsh discipline.
- Remain consistent in training and communication with operators.
- Let people know they are appreciated.

Bus

Table 21 provides a summary of the practices reported by the 11 bus transit agencies that were contacted.

Safety rules compliance programs for bus operators are similar to those in the trucking and motorcoach industries. However, many of these properties are small, which has advantages and disadvantages. The main advantage of small transit agencies is that they have open-door policies and managers personally know their employees. This aspect fosters the communication necessary

Table 21. Rules compliance practices in bus operations.

Program Characteristic	Industry Practices
Initial rules communication	• Instructor-led training • Onboard OJT
Communicating new rules	• Written and video presentation during orientation, refresher training, and following incident • Monthly driver safety meetings • Monthly employee newsletter • National Safety Council publications • Rule of the week program • Read/Sign policy for new rules • Bulletin board • Broadcast email, data messages on screens in buses and radio alerts • Weekend safety retreat
Validating rules comprehension	• Periodic supervisor ride-along • Employee interview and field observation following incident • Review of safety incidents • Random ride check with instructor • Monthly performance evaluations • Periodic safety rules quizzes • Exams following orientation and retraining sessions • Safety discussions at periodic driver meetings
Monitoring adherence	• Periodic supervisor ride-along • Onboard camera f or video recordingand GPS monitoring • Ghost riders • Passenger reports • Operational testing
Responding to noncompliance	• Supervisor disciplinary discretion based on interviews and review objective incident information (e.g., camera) • Demerit/point system • Coaching and counseling; retraining when necessary • Progressive discipline • Union input if property is represented • Accident Review Committee recommendation for discipline
Encouraging compliance	• Video training • Rules revision in response to risky procedures • Increase length of initial and refresher training • No tolerance policy for specific types of risky behavior (e.g., cell phone use) • Regular evaluations linked to incentive program • Expansion of video monitoring • Operator self-assessment programs • Accident reduction team • Safety campaigns • Adopt improved safety policies • Annual awards program
Evaluating program effectiveness	• Field and written exams • Quantitative risk assessment • Accident frequency statistics • Accident trends • Safety point system for employee evaluation • Passenger reports • Annual safety audit
Safety reporting mechanisms	• May be reported on accident/incident form submitted to supervisor or safety department

to ensure people understand safety rules. The major disadvantage of smaller agencies is smaller revenue. As a result, this group of transit agencies is challenged with respect to acquiring expensive monitoring and training programs.

With respect to communicating safety rules, transit agencies rely on the following traditional types of methods:

- Video presentations
- Rulebook
- Safety meetings
- Various safety publications
- Bulletin boards

Some transit agencies reported innovative ways to relate safety rules to their employees. These include weekend safety retreats where employees take part in intensive safety training sessions. Additionally, one transit agency has an accident review committee (ARC) that operates much like event-review committees in aviation safety reporting systems. That is, the ARC reviews accident reports and disseminates information regarding safety breaches and potential safety enhancements. To determine that employees understand the rules, transit agencies conduct ride-alongs, perform employee evaluations, and test for rules knowledge. Assessing knowledge retention occurs by using informal methods such as safety discussions as well as formal methods that include exams after orientation and retraining sessions.

Bus transit agencies also use ride-alongs to make sure their employees are adhering to safety rules. Often, these ride-alongs occur covertly, a.k.a., ghost rides. These agencies also rely on passenger reports of unsafe behavior. However, bus operators sometimes feel pressured to avoid customer complaints and as a result will break rules. One transit agency reported that one of its most frequent safety violations was stopping to pick up passengers between stops. Obviously, bus drivers feel pressured to appease the riding public at the expense of safety. Many transit agencies rely on video-monitoring equipment. Several commercial systems are available and in use at a number of bus transit agencies. These systems record continuously but only maintain data for a pre-set time before and after an incident and can be reviewed later. Initially, labor was opposed to this type of system. However, subsequent accidents have shown that the camera system can be used to determine that the driver was not at fault. Bus transit agencies also report using this tool non-punitively, purely as a training tool.

Transit agencies providing bus service report various actions when they discover noncompliance. They use traditional progressive discipline, demerit or point systems, as well as more progressive interventions. The latter includes coaching and counseling as well as recommended interventions from a non-biased group like an ARC. Not surprisingly, the most commonly reported bus driver violations were cell phone use, following too closely, and speeding. Many transit agencies have found that an enforced zero tolerance policy for cell phone use is an effective deterrent.

One labor representative pointed out that management pressure to meet a schedule may cause a vehicle operator to compromise safety. Labor encourages members to make safety their top priority. Their priorities are “Safety, service, schedule.”

When asked what advice these transit agencies had for other transit agencies, the most notable responses included the following:

- Be proactive with instilling safety culture rather than reactive. Be adaptable.
- Provide clear communication of rules compliance to employees.
- Give constant feedback from management to employees.
- Use driver performance review programs.
- Establish safety incident point system for employee evaluations.

- Use driver incentive programs.
- Use state of the art technology for observation of safety-related rules compliance.
- Provide training, explain expectations and have a clear disciplinary process.
- Use simulator video driver training programs.
- Be vigilant every day to ensure employee adherence to rules compliance.

Paratransit

The approach to safety-related rule compliance in paratransit is very similar to the programs identified in the bus transit interviews. These transit systems inform their employees of the rules initially at orientation, during periodic retraining, and in response to incidents and/or accidents. Some use instructor-led training to explain safety rules. Most disseminate safety information and changes to existing rules via the company bulletin board and/or employee newsletter. They assess employees' knowledge of rules through ride-alongs, employee performance reviews, and by word-of-mouth gathered by the supervisor. Like bus transit, these systems are also beginning to rely on video-camera technology to monitor rule adherence. These systems have their own safety noncompliance issues such as vehicle backing accidents, improper wheelchair tie down, and under- or overestimating vehicle size because drivers often switch between operating mini-vans and cut-away buses. This can result in serious injury and damage to vehicles because the operator forgets which vehicle he or she is operating and fails to adhere to clearance height. All these systems point out that open communication between employees and management is key to safe operations.

Many paratransit systems provide service in small communities and as such provide a vital link for the patrons that they serve. Because these services operate in small communities where everyone in town knows everyone else, patrons readily share feedback on the service and the manager of the service knows how the drivers perform. A key motivator to the drivers is that they most likely know the riders (and know that they will tell others about their experiences), so they tend to provide safe service in accordance with the agency's safety rules.

Other Transit

The research team spoke with one ferry system. Its safety rules compliance program is similar to other transit modes. It does not have a formal safety reporting system, but does rely on comment cards that can be submitted anonymously. The ferry system makes a point to implement worthy suggestions. It did mention that educating via shipboard drills is an effective practice that may benefit other modes. This is akin to simulator or scenario training in other industries.

The research team spoke with one cable car operator. The operator's methods are the same as those that apply to the light rail operation.

APPENDIX C

Safety Reporting Systems

Review of safety reporting systems from other transportation modes and other industries provides models for the development of a safety reporting system for the public transportation industry. This chapter describes the following safety reporting systems:

- Aviation Safety Reporting System (ASRS)
- Aviation Safety Action Program (ASAP)
- Air Traffic Safety Action Program (ATSAP)
- Confidential Close Call Reporting System (C^3RS)
- Confidential Incident and Analysis Reporting System (CIRAS)
- Firefighter Near-Miss Reporting System
- NYCT Near-Miss Reporting System

Publicly available documents and interviews with developers and administrators for these systems provided information on the various systems. In addition, the research team reviewed accident/incident reporting forms that provide a means for transit employees to report a near-miss.

Aviation Reporting Systems

Three different safety reporting systems exist in the aviation industry: ASRS, ASAP, and ATSAP. Each provides a reporting mechanism for a different group of stakeholders or employees. Table 22 summarizes the characteristics of each system. The subsections below describe each one.

Aviation Safety Reporting System

The need for a safety reporting system in aviation operations was recognized by the military and industry during World War II. However, it was the crash of TWA flight 514 on December 1, 1974, that prompted the creation of ASRS. TWA 514 was en route to Washington National Airport but was redirected to Dulles International due to turbulence and rapidly deteriorating weather conditions. As with all accidents, many factors led to the crash, including confusion regarding instrument approach procedures and poor cockpit communication. As a result, the captain piloted the aircraft below the minimum vectoring altitude and collided with the west slope of Mount Weather, Virginia. Seven crew members and 85 passengers died in the crash. There were no survivors. A similar incident had occurred almost six weeks prior involving a United Airlines flight. The accident and near-miss highlighted the need for an aviation safety reporting system so that problems with the National Airspace System (NAS) could be identified to prevent future accidents.

ASRS was begun in 1976, funded by the FAA, and administered by the National Aeronautics and Space Administration (NASA). At the time, this was an innovative program, because it introduced

Table 22. Aviation safety reporting systems.

Feature	Reporting System Aviation Safety Reporting System (ASRS)	Aviation Safety Action Program (ASAP)	Air Traffic Safety Action Program (ATSAP)
Managing organization	National Aeronautics and Space Administration (NASA) and the Federal Aviation Administration (FAA)	FAA, Office of Voluntary Safety Reporting, AFS-230	FAA Safety Services AJS-1 and CSSI, Inc., a private third-party company
Year initiated	1976	1997	2008
Coverage	All individuals working within the National Airspace (NAS) involved with safety-critical operations	Airline employees with a Memorandum of Understanding (MOU) with the FAA	Air traffic control specialists, both non-bargaining unit employees and bargaining unit employees contingent upon a MOU with FAA
Annual cost	Approximately $3M, of which $2.4 M comes from FAA and the remaining from NASA	Salary cost for 8 FAA employees, 5 contract personnel and office computer costs	Information not available
Staffing	Staffing services provided by Battelle Memorial Institute and includes highly experienced pilots, air traffic controllers, mechanics, and human factors analysts.	8 FAA personnel, 5 Contract personnel. Individual Airline Employees	FAA oversight personnel, CSSI personnel and the regional ERCs
Annual number of reports	Received approximately 49,000 in 2009	45,000 reports generated in 2008	Information not available
Report submission	Online and written paper submission via US Post	Online, mostly through WBAT. Option to send copy of report to NASA's ASRS	Online
Time limit on submission	10 days	Variable by airline	Within 24 hours of the incident
Implementation issues	None discussed	Confidentiality, liability, trust, protection from discipline/certificate action.	NATCA reported no major issues and commented that the program was "put together well." Air traffic control culture was militaristic and punitive.
Program oversight	NASA Program Manager	FAA Program Manager	FAA Program Manager

a confidential, voluntary safety reporting system for pilots, air traffic controllers, and any other personnel working in safety-critical operations within the NAS. Additionally, it featured what was then referred to as limited immunity from the FAA's disciplinary system of potential fines and certificate action, with certain caveats. The objective of the program was to gather data on violations or flight incidents that may never have surfaced. As this data was reported, general trends and potential safety deficiencies could be uncovered. ASRS has evolved into a highly successful program generating nearly 49,000 safety reports during calendar year 2009.

Staffing for the system is made up of highly skilled pilots, air traffic controllers, mechanics, and psychologists knowledgeable in the field of human factors. These employees serve as analysts that review each report as it enters the system. An analyst conducts an initial review, screening the reports for actionable items. If a hazardous situation is identified, a resultant safety alert is issued. The analyst then identifies multiple reports of the same incident and cross-references the related reports. Then the analyst codes the event using the ASRS coding taxonomy. The taxonomy has a minimal number of error and causal categories. When asked why the ASRS team does not use a more comprehensive taxonomy, the director replied that information may become obscured by an overabundance of categories. The incident narrative, although de-identified, serves to provide additional information when the initial taxonomic categories do not provide sufficient information.

After coding an incident, an analyst will clarify (if necessary) any information with the reporter during a callback. After this, the report is de-identified, submitted to a quality check, and entered into the system. All original documentation is destroyed. De-identification is an important part of the process that is more than just removing the names of individuals and locations referenced in the reports. This process requires a trained professional to be able to identify potential contextual cues in the report that may identify the reporter. As such, de-identification requires intense scrutiny by individuals who can spot potentially identifying information that an untrained individual might not recognize.

The information gleaned from ASRS can be accessed via many different sources. The data are available for public download online as well as through specific search requests submitted to ASRS staff. Many safety researchers use the information from ASRS to conduct archival analyses of safety issues in the NAS. In addition, ASRS staff conducts quick response analyses for government agencies such as the FAA, NTSB, NASA, and Congress. *CALLBACK,* a monthly newsletter, provides valuable safety information to pilots and air traffic controllers.

Aviation Safety Action Program

The next iteration in the development of voluntary safety reporting systems came with the Altitude Awareness Program. Prior to this, a group of senior executives from all facets of aviation and the FAA formed the beginnings of what is now the Commercial Aviation Safety Team (CAST), a group that examines all aspects of flight safety from a comprehensive viewpoint. At the time, the most common flight safety issue was altitude deviations. In order to gather more data to determine the causes of these deviations, from a pilot and air traffic control perspective, a program was developed that would gather altitude deviation data from voluntary reporting. Again, limited immunity was given in order to increase the reporting level and data collection. The program became highly successful, generating a large amount of data. In addition, the program also began to take the factual data and from that examine why the deviations were occurring.

This reporting program was very successful in reducing altitude violations, because with the data from the confidential voluntary reports, not only what happened but also the ability to see why these deviations happened became possible. In addition, data that ordinarily would never have surfaced with the current inspection systems was collected in great detail. Again, the basic

elements that made the data gathering successful were the voluntary and confidential aspects of the CAST reporting system and the limited immunity from the standard FAA enforcement procedures. Based on the success of the Altitude Awareness Program, the CAST group began to discuss some kind of similar voluntary reporting system that would cover all aviation events. The CAST group envisioned a total reporting system that would include any safety incident or concern. The complexity of this, however, would dictate a more formal system for the future. These initial discussions are what eventually led to ASAP.

Establishing a formal safety reporting system required a pilot implementation. In the mid-1990s, the FAA, American Airlines, and the Allied Pilots Association were enthusiastic with the initial intent of the program, especially in light of the successful Altitude Awareness Program. Nonetheless, each party had its own individual concerns with the new system (see Table 23). The pilots' union was concerned with the confidentiality of the reports, as well as protection from discipline by the FAA and airline management. Management voiced concerns regarding liability for any of the reported incidents, as well as any possible tarnish to their public image. The FAA had concerns regarding how to deal with violations of the FAR, as well as the perception that any immunity from prosecution would be perceived as excessive leniency, since this immunity was often referred to as a get out of jail free card.

The key concern that affected all of the stakeholders involved trust between each of the three parties. This program was a distinct departure from the punitive system involving any breach of the airline or FAA regulations. As a result, this involved a substantial change in these relationships, and was difficult for many of the participants to overcome. In addition, labor found it difficult to believe that the FAA and airline management would really operate differently in this new environment, considering it was such a radical change. Trust among all the parties thus became the overriding concern as the program moved into the test phase.

The test phase employed the services of the University of Texas, which had been involved with the design of the program. A pilot implementation with American Airlines led to changes and improvements were made. All parties considered the test phase successful. However, there were still issues to be resolved. Some of the senior FAA personnel and some of its line inspectors were not fully accepting of the program. Senior FAA personnel were not happy with the concept of foregoing enforcement action and particularly the term immunity. Some FAA inspectors, as well as airline pilot management, believed that the program usurped some of their authority. All of these concerns had to be worked out over time, and some elements of them still exist, although today these concerns are pretty well isolated. In terms of administration, a Memorandum of Understanding (MOU) was developed between the FAA and the airline, detailing how the pro-

Table 23. ASAP stakeholders concerns.

Stakeholder	Concerns
Labor	• Confidentiality of the information • Protection from discipline by the FAA (fines/certificate action) • Protection from discipline by the airline management
Airline Management	• Liability for any reported incidents • Public image
Federal Aviation Administration	• Handling an incident that involves a FAR violation • Sole source versus non-sole source • Appearance of leniency

gram would be operated. This document was to become the guiding directive on the operation of the program, and is a requirement today for any operational ASAP system.

The first ASAP system went into effect in 1997, and over the years the program has continued to experience some changes. The current operation of the system is based on the template MOU that has been worked out over time. In the beginning of the program, the FAA agreed to a tailored MOU to encourage more airlines to participate in the program. As the program expanded and matured, the use of the tailored MOU became unwieldy, especially as the program became more standardized. Today, the FAA insists on the use of the template MOU. Previously, some of these changes were the result of labor's effort to put more immunity into the program. Now the FAA prefers that airlines accept the template MOU and make any changes between the airline and its employees, assuming those changes do not alter the fundamental objectives of the program.

As mentioned, the senior level of the FAA was concerned about the term immunity, believing this nomenclature gave the implication of some kind of leniency. The new concept of voluntary reporting, however, was a significant departure from the standard inspection and violation process that was inherent in the original system. To satisfy the FAA, a formal procedure was established within the ASAP system that would categorize how each incident or violation would be handled. Further, the phrase "regulatory incentive" replaced the older term "immunity," and this newer phrase is now found in the current MOU. Also, there is delineation between reports that are considered sole source versus non-sole source. If an incident or violation is sole source, it means that it only surfaced because it was reported voluntarily. If the incident or violation comes to the attention of the FAA or the airline management from another avenue, it is then considered non-sole source and is handled somewhat differently.

Each airline's ASAP has an Event Review Committee (ERC), composed of representatives from the FAA, airline management, and airline labor. These committees review all ASAP reports. When a person submits a report, (s)he also has the option to submit a companion report to ASRS. After the ERC receives a voluntary report, the first step is to determine whether or not the report qualifies for the program. While more than 95% of the reports are accepted by the committee, there are five exclusions. These are (1) criminal activity, (2) substance abuse, (3) controlled substances, (4) alcohol, and (5) intentional falsification. If the ERC determines that the report does not qualify, the incident or violation in question can then be handled by the FAA and airline management in a disciplinary manner. However, most reports are accepted into the program, and they are then examined in terms of an actual violation or an incident/safety concern. The ERC decides action based on consensus, not unanimity. That is, all three parties must agree that the final decision and/or action is something each of them can live with.

Historically, violations have made up only about 20% of the reports, so most of the reports do not involve the regulatory incentive part of the program. For those reports that involve an actual violation of the FAR, there is no penalty or discipline given for a sole source report. For a non-sole source report, as long as the report was filed prior to the second source information, the FAA will impose an administrative penalty, such as a letter of admonishment, rather than the standard fine or certificate action.

The result of processing the report generates two actions. The first establishes any corrective action or training that may be required. Smaller issues can be completed in approximately 30 days. If the report is determined to be a systemic issue, the period for corrective action could be much longer. The second action involves categorizing the violation/input in accordance with the established taxonomy, and submitting the data to a computerized database for later retrieval. Today, most airlines use the Web-based Access Tool (WBAT) for their ASAP system.

Keeping track of self-reported safety incidents allows airlines to compare report frequency and type of report before and after remedial actions, thereby giving them a means to track the

effectiveness of their remediation efforts. This latter approach solves a long-standing problem with reporting systems like ASRS. While ASRS is a valuable data source, it has traditionally been a challenge to take the information from these reports and feed it back into the system with the goal of improving operations. By having each airline responsible for its reporting system, the information source (i.e., safety reports) was closer to operations and could easily be fed back up the operation chain to improve safety.

By any measure ASAP is a success story. The FAA estimates that 90 to 95% of the reports are sole source. This is data that would never have surfaced without a voluntary reporting system. With the categorization and analysis of this data, potential incidents as well as systemic problems can be detected before they become an issue. In general, all of the stakeholders, FAA, airline managements, and labor groups fully support this voluntary reporting system. Moreover, the sharing of this data through the Aviation Safety Information Analysis and Sharing System (ASIAS), the FAA's large-scale data compilation effort, is another step forward in the effort to solve problem areas before they become accidents. In summary, this program is a transition to a prognostic and diagnostic safety program, and is a valuable addition to the existing FAA line inspection program that will continue to exist.

Today, virtually all pilot groups in the United States have an ASAP program. Additionally, many of the other labor groups, such as airline dispatchers, airline maintenance personnel, and flight attendants have ASAP systems as well. The program works especially well with any labor group that is licensed or subject to the FAR.

Air Traffic Safety Action Program

In August 2007, the FAA released a call to action to reduce runway incursions. One of the action items that came about involved a renewed interest in developing a reporting system specifically for air traffic controllers. While controllers were able to file confidential reports to NASA's ASRS, they were not afforded the same protective provision incentives (i.e., immunity) that pilots benefited from. Because of this, there were significantly fewer reports from controllers in ASRS that could be used to help identify the root causes of operational errors resulting in runway incursions. Given the success of the ASAP program for airlines and the impetus to reduce runway incursions, the FAA began development efforts for ATSAP.

ATSAP began as a demonstration program in March 2008 and underwent review in August 2009 at which time it was judged to be successful and designated a continuing program. As with ASAP, the FAA and labor negotiated an MOU. There were obstacles to implementing ATSAP including the reactive culture of air traffic management. A culture of blame existed in air traffic operations with the mindset that managers must identify those committing errors and punish them without necessarily trying to understand why a controller committed the error in the first place. For this reason, the program was phased in at centers over time due to acceptance issues. The program was fully implemented system-wide in the fall of 2010.

The staged implementation included a required 4-hour training program that labor and management had to attend in order to be able to participate in the program. Training was onsite and in-person with both labor and middle management. The training involved explaining the importance of safety culture and the concept of a just culture.

The program is modeled after ASAP. However, the immunity portion of the program has wider latitude than that of the ASAP program. Only in the case of egregious violations (e.g., illegal acts, acts of sabotage) do protective provision incentives not apply. This is in stark contrast to the way things were prior to the implementation of the program. ATSAP has gone a long way to changing the reporting culture of air traffic in a relatively short period of time.

As with ASAP, a controller will electronically submit a report in which he or she was directly involved within 24 hours of the incident. A phone message to a hotline can be made to request up to 3 additional days, if additional time is needed. ATSAP interfaces with NASA's ASRS the same way ASAP does, that is, controllers are given the option of checking a box to enable an electronic copy of that report to be submitted to ASRS. The major benefit to this interface is the increase in the number of controller ASRS reports filed to the national database. Prior to adding this option to ATSAP, the percentage of ASRS reports from controllers was about 1%. Post ATSAP, the percentage is now close to 12%. Reporters also have the option to file a report regarding general safety concerns (i.e., issues that do not specifically result in an incident but are worth reporting). An analyst reviews the report and then follows up with the reporter to complete any missing information or clarify any vagaries.

An ERC is composed of three representatives from the FAA Air Traffic Organization (ATO), the FAA Air Traffic Safety Oversight Service (AOV), and NATCA and they meet weekly to review reports and come to a consensus regarding the best response to the incident based on the root cause. Complete de-identification of the reports is particularly important for this step in the process to ensure that members of the ERC remain objective regarding the review of and response to incident reports. Potential solutions are implemented and tracked to determine their effectiveness. Three ERCs are in operation, one to represent each service area.

While every reporter will receive follow-up from the ERC regarding his or her own at-risk behavior, this effort does not disseminate important information to the larger ATC community that might benefit from learning about the information contained in these reports. The ATSAP team releases a weekly briefing sheet and a monthly briefing report describing recent trends in the reporting data. However, data dissemination continues to be an inherent problem in the system. The program guarantees complete confidentiality; therefore, it becomes a challenge to get the word out about particular system problems or even successful solutions to problems. Data dissemination is an on-going work-in-progress for ATSAP.

Trust in a transformational system such as ATSAP is difficult to obtain particularly in a reactive and punitive environment such as ATC. Given this limiting factor, the change in reporting culture has been very positive. ERC members and analysts have reported that they are amazed at the amount of information contained in the reports and how useful the reports are. Like the airlines after the implementation of ASAP, air traffic management commented that they cannot imagine a time when this data was not available. NATCA and the FAA plan follow-up visits to facilities to gauge the long-term acceptance of the program.

Advice for Transit Industry Regarding Reporting Systems

Interviews were conducted with various sized airlines, their labor unions, industry organizations, and the FAA. During these interviews, the parties were asked what they would recommend to a transit agency that would want to initiate a voluntary safety program. The following is a summary of the comments that were offered:

- The key and overriding issue in the establishment of any voluntary safety reporting system is the establishment of trust among all of the participants. Without mutual trust, a satisfactory reporting system will simply not work.
- All safety systems need to be supported by the highest levels of management, and re-emphasized at each organizational level. Any voluntary safety reporting system will collapse if employees feel that there is no real commitment to the program from the executive levels, and they will perceive that the program is simply a façade or window dressing.
- Before any voluntary safety reporting system is put into effect, a complete understanding and support for the new system must come from each element that will be involved. All employees

that will come under the new system need to fully understand the program. In addition, employees who are not participants in the new program must feel that the new system is not a threat to them. Proper training is the key to a successful system.

- Make sure any voluntary reporting system is used only for the purpose that it was intended. Attempts to use the system for other reasons will cause a lack of trust among the employees.
- Make sure that all the employees who serve on the program oversight committee are thoroughly trained and support the philosophy of voluntary safety reporting programs.
- There must be a basic understanding of system hazards from frontline employees. This can be accomplished through a safety reporting system. The industry must have a genuine desire to improve safety and this mindset must be adopted by the organization's safety manager. There has to be an emphasis placed on adopting incentives to be proactive about safety. While subjective data, such as that obtained from safety reporting systems, is invaluable, you must look to a variety of subjective as well as objective data (e.g., on board recorders) to tell the whole story.

Confidential Close Call Reporting System

Table 24 summarizes the features of C^3RS, a pilot reporting system for railroad employees. This pilot system is currently under evaluation with four railroads.

Background

In 2000, FRA's Office of Research and Development (R&D) realized that improvements in safety in the railroad industry would only happen if the safety culture in the industry could improve. R&D sought a way to get both labor and management to talk about the railroad industry's safety culture. Exploring the feasibility of a close call or near-miss reporting system was a way to foster the discussion. FRA, working closely with the Volpe Center, invited key represen-

Table 24. Confidential Close Call Reporting System.

Feature	Description
Managing organization	Federal Railroad Administration, Office of R&D
Year initiated	2005
Coverage	Employees at selected pilot sites
Annual cost	$1.6M for implementation and evaluation (Volpe) plus $130K per month for processing reports
Staffing	Information not available
Annual number of reports	1½ calls per day with three pilot sites
Report submission	Paper copy submitted by mail
Time limit on submission	File within 3 days of event to receive protection from discipline
Implementation issues	Confidentiality, liability, trust, protection from discipline
Program oversight	Steering Committee

tatives from both railroad labor and management to participate on a Planning Committee to explore the feasibility of a voluntary safety reporting system for the railroad industry.

The Planning Committee held its first meeting in April 2002. Initially the committee members were skeptical about the concept of a close call reporting system. They sought a definition for "close call." Volpe Center staff prepared a white paper to meet this need. Ultimately there was total buy-in and the committee took ownership and planned a workshop to bring the issue before the entire industry.

An FRA-sponsored workshop on Improving Railroad Safety Through Understanding Close Calls took place on April 23–24, 2004, in Baltimore. The purpose of the workshop was to inform the railroad industry of the benefits of understanding close call events and the challenges to implementation and success of a close call reporting system. A close call was defined as "an opportunity to improve safety practices in a situation or incident that has a potential for more serious consequences." The workshop focused on experiences in the U.S. airline industry and the Confidential Incident and Analysis Reporting System (CIRAS) for UK railroads. The outcome of the workshop was that there was unanimous support from both railroad management and labor to proceed with planning a pilot confidential reporting system as a demonstration for U.S. railroads.

Designing the System

After the workshop, the Planning Committee focused on designing C^3RS. Each stakeholder had concerns to be considered (see Table 25). For labor, confidentiality was the top concern. It was also concerned about whether or not an employee who reported a close call incident could later be penalized if data in the locomotive recorder indicated failure to obey an operating rule. Railroad management had liability concerns while the FRA saw a potential conflict with agency regulations. As the group members built trust amongst themselves, they were able to work through all of these concerns.

In designing C^3RS, staff from the Volpe Center benchmarked other confidential safety reporting systems then worked with the Planning Committee to create a workable system for the railroad industry. Volpe considered the CIRAS system in use with UK railroad operators and the ASRS operated by NASA for the aviation industry. CIRAS is funded by the rail operators while a government agency, FAA, pays for ASRS.

Confidentiality was such a key concern that FRA and the committee determined that a third party had to collect and protect the data. FRA initially chose to use the Bureau of Transportation

Table 25. C^3RS stakeholder concerns.

Stakeholder	Concerns
Labor	• Confidentiality of the information • Protection from punishment if employee voluntarily reported incident and locomotive data recorder indicates a rule violation • Must all crew members report an incident or does one report cover all present?
Railroad Management	• Federal Employers Liability Act (FELA) liability for consequences of any reported incidents • Public image
FRA	• Handling an incident that involves a violation of FRA regulations

Statistics (BTS) for this important role. BTS protects data under the provisions of Confidential Information Protection and Statistical Efficiency Act (CIPSEA).

FRA proposed a 5-year pilot implementation of the system at four railroads to validate the concept and to evaluate its effectiveness and function. The Planning Committee worked to develop a model MOU that would be signed by all participating stakeholders at a location that wanted to participate in the C^3RS pilot. By March 2005, the model MOU was signed by all stakeholder groups. The model MOU describes the provision of the C^3RS Demonstration Project and explains the rights, roles, and responsibility of the participants under the project. Ultimately each site would have to make changes to meet the specific needs of the stakeholders at the specific location.

System Operation

The first step in initiating C^3RS at a railroad is negotiation of an Implementing MOU (IMOU). This can take considerable time as the stakeholders work through their concerns and establish trust that the system will work. After railroad management, the relevant labor union, and FRA negotiate and sign an IMOU, a Peer Review Team (PRT) must be established. The PRT is a local joint labor/management/FRA problem-solving group that will review all the de-identified reports and ultimately recommend corrective action to railroad management. For the pilot implementation, Volpe Center staff have been responsible for training the PRT on team building and root cause problem solving designed for C^3RS.

The Volpe Center is also responsible for evaluation of the pilot demonstration project. Its evaluation has several aspects. One is to determine the costs and benefits associated with the project. Another is to document the implementation experiences at each site. Finally, Volpe is monitoring the ongoing experiences at each site so as to detect problems and issues before they lead to failure of the project.

Employees who see or experience unsafe conditions may submit a written report to BTS. In order to be immune to disciplinary action, the report must be postmarked within 48 hours of the event. If the employee is unable to do this, the employee may notify BTS by phone within 48 hours of the event and have the written report postmarked within 3 calendar days of the call. BTS removes all identifying information, follows up with all employees who submit a report within 2 weeks, and forwards reports back to the PRT of the railroad involved once a month. The PRT meets, usually monthly, to review the reports, establish the root causes, and recommend corrective actions to management.

As C^3RS moved from the design stage into an operational pilot, the Planning Committee became a Steering Committee that meets periodically via face-to-face meetings and phone conferences to review progress.

Experience to Date

The Union Pacific Railroad's North Platte Service Unit (UP) was the first to become a pilot site. In February 2006, UP initiated a series of activities to build confidence in C^3RS among its employees. UP, with guidance from Volpe Center staff, undertook a series of teambuilding activities for its PRT where the group discussed confidentiality of the data, methods for root cause analysis, and other issues. Posters in the crew reporting points announced the system and for a 72-hour period, labor and management representatives went to the crew reporting points to talk about C^3RS. Press releases from the Association of the American Railroads (AAR), the Brotherhood of Locomotive Engineers and Trainmen (BLET), and United Transportation Union (UTU) announced the formal rollout of the system in February 2007. There was an immediate response

from covered UP employees. Employees began submitting reports of incidents as soon as the system was available.

The Canadian Pacific Railroad's Chicago Area Service Unit (CP) was the next to become a pilot participant. It came onboard about a year after UP and in November 2009, New Jersey Transit (NJT) initiated its participation. Amtrak joined in the latter part of 2010.

Based on experience to date, FRA reports the following potential impacts of C^3RS:

- Corrective action is being taken on close call events that can have a pronounced impact on safety.
- The PRT identified processes that merited corrective action, some of which were not identified as key problems prior to implementation of the reporting system.
- The process of analyzing close call reports identified classes of close calls whose existence were known in a general way and highlighted their importance as systemic issues.
- C^3RS created a new process for communicating about safety-critical information across the railroad.
- Safety culture may be shifting into a more collaborative mode (FRA 2008).

A union representative reported that the program has been very successful to date resulting in a reduction in accidents and injuries, a reduction in discipline, and an improvement in employee/employer relationships.

FRA has decided to explore an alternative model for handling the incident reports to determine if access to the data is easier and if this is a more cost-effective arrangement. This alternative model involves having NASA as the repository for reports from Amtrak. (NASA currently manages ASRS and served as a model for the Firefighter Near-Miss Reporting System.)

FRA plans to support each pilot site for 5 years. The source of funding for C^3RS after the four pilot sites complete their respective test periods remains to be determined. It is likely that C^3RS will migrate to FRA's Risk Reduction Program at that time.

Advice to Transit Industry

Representatives from FRA and the Volpe Center who have been involved with the design and implementation of the C^3RS pilot offered the following advice to the transit industry with regard to establishing a similar system for transit:

- Put together a committee of leaders from the stakeholder groups in government, labor, and railroad management to design the system. Use this group to assess the feasibility of the proposed system with stakeholders.
- Trust among the stakeholders is critical to implementing the system.
- Once the system is active, employees need to hear the "lessons learned" from the system.

Firefighter Near-Miss Reporting System

Table 26 provides a summary of the features of the Firefighter Near-Miss Reporting System.

Background

In 2000, the former Executive Director of the International Association of Fire Chiefs (IAFC) saw the need for a near-miss reporting system for firefighters involved in structural firefighting. The purpose of the system would be to improve firefighter safety through sharing of experiences. At that time, firefighters involved in wildland fire safety already had SAFENET, a safety reporting

Table 26. Firefighter Near-Miss Reporting System.

Feature	Description
Managing organization	International Association of Fire Chiefs (IAFC)
Year initiated	2005
Coverage	Primarily structural firefighters but some reports from specialty fields such as wildland firefighting, EMS, hazmat, etc.
Annual cost	$1M (grant from DHS) Fireman's Fund Insurance Company provided matching funds for 2004–2005
Staffing	1 project manager, 1 administrative support, 8 part-time report reviewers
Annual number of reports	~600 1,058 in 2009, probably due to outreach at fire academies
Report submission	Online but have option to fax or mail
Time limit on submission	None
Implementation issues	Confidentiality
Program oversight	Advisory Board

system for wildland fire operations. (SAFENET provides a means for reporting any safety concern of wildland firefighters, not just near-misses.) The aftermath of 9/11 delayed progress on the near-miss initiative until 2004 when the Department of Homeland Security (DHS) awarded IAFC a grant under its Assistance to Firefighters Grant Program to develop the near-miss reporting system.

IAFC assembled an informal committee, including representation from the firefighters union, to design and test the new safety reporting system. It became clear early in the process that the system could not be punitive and that ensuring confidentiality was the key to a viable system. IAFC used the SAFENET system and the ASRS as examples of how the reporting system might be designed. Focus groups with firefighters across the country provided a means to gather feedback on proposed system features and the form that would be used for reporting near-miss incidents. The system design drew heavily on NASA's experience with ASRS.

A 6-month pilot test at 38 fire departments demonstrated that the system would work. Prior to initial launch of the reporting system website in August 2005, IAFC promoted it through trade publications, a direct mail campaign to 30,000 fire departments, press releases, and a news conference at a trade show. The direct mail campaign included a program kit sent to each fire department following an initial postcard.

System Operation

Any firefighter may submit a report of a near-miss incident. There is no time limit for submitting a report following an incident. Most reports are submitted online but the system offers the option to submit the report via fax or mail. The reporting form asks for a description of the event as well as lessons learned as a result of the incident.

Every report is reviewed by two independent reviewers to de-identify the information. There are eight reviewers who are active duty firefighters from various locations across the country. The goal is to review each report within 72 hours of submission. Since the reviewer may contact the person who submitted the report, the review process sometimes takes longer. Feedback from firefighters indicates that the personal connection with the reviewer assures the person submitting the report that his or her information is important. Additional datapoints are collected on the administrative side of the database during the reviewing process. After the reviewers have ensured that the report contains no identifying information and a reviewer has followed up with the firefighter who submitted the report, it is entered in the database on the National Firefighter Near-Miss Reporting System's web page.

Experience to Date

Since initiation of the National Firefighter Near-Miss Reporting System in 2005, there have been over 3,900 reports submitted. In 2009, two reviewers trained instructors at selected state fire academies. As a result, the number of reports for 2009 was over 1,000.

The case histories are in a searchable database that facilitates searching by topic or situation. State fire academies have used cases from the database to enhance training programs. At the local level, cases have been used for drills. Each week the reviewers select one case as the Report of the Week to feature on the web page and to email to a list of 13,000 individuals. The Report of the Week includes, in addition to the circumstances of the incident, a set of discussion questions so that the case may be used for discussion or training.

The IAFC has not yet used the information in the reports to identify trends or underlying problems. There is, however, an ongoing project to identify risks or hazards in the firefighter environment.

Confidential Incident Reporting and Analysis System

Table 27 describes the features of CIRAS, a safety reporting system for the UK rail industry.

Table 27. Confidential Incident Reporting and Analysis System.

Feature	Description
Managing organization	Rail Safety and Standards Board
Year initiated	1999
Coverage	All UK railroad workers, including contractors
Annual cost	Not available
Staffing	Not available
Annual number of reports	550
Report submission	Submit report on form via mail, telephone or text message to CIRAS
Time limit on submission	None
Implementation issues	Confidentiality
Program oversight	Executive Committee

Background

After a serious rail accident in November 1999, the UK Rail Industry made a decision to develop a national reporting system for safety-related concerns. The rail regulator mandated that all rail operators make the system available to their employees and that they pay an enrollment fee to participate. An Implementation Group representing all industry stakeholder groups developed the system. As with other reporting systems of this nature, confidentiality of the data was a critical issue.

System Operation

All UK railway employees as well as infrastructure contractors and subcontractors may report a safety concern to CIRAS. The reporting and follow-up process has four steps:

1. Employee contacts CIRAS by phone or text message, or mails a written statement to CIRAS.
2. A trained CIRAS staff person contacts the employee to discuss the concern. The CIRAS staff person writes a report that will not contain any identifying information.
3. CIRAS sends the report to the relevant company.
4. Company responds to CIRAS and CIRAS sends the response to the employee who reported the concern.

CIRAS publishes a bi-monthly newsletter as well as quarterly reports that summarize the reports and responses that were processed that quarter. The newsletter includes selected reports along with the response from the railway operator or contractor. In addition, CIRAS regularly analyzes the reports that it receives to identify possible trends and themes that may be occurring. When such themes are identified, the CIRAS team will thoroughly research the issues and report these back to the industry. For example, in 2006, CIRAS examined precursor conditions that led to signals passed at danger (failure to stop for a red signal).

Experience to Date

From April 2009 through March 2010, CIRAS received over 550 reports. Of these, 43% led to an investigation or actual change in practices. CIRAS reports that the majority of the companies that it contacts welcome the opportunity to examine the issues that are brought to their attention. These companies recognize that CIRAS can be a vital tool that supports their existing safety management systems. CIRAS provides the means to identify problems before there is an accident or incident and as such supports a proactive safety culture where both managers and their staff feel comfortable reporting what appears to be an unsafe condition. Based on the reports produced to date, it appears that CIRAS is achieving its intended purpose.

Sacramento Regional Transit District

Table 28 describes the features of the Near Miss Incident Review Program implemented at Sacramento Regional Transit District.

Background

In July 2008, a Sacramento Regional Transit District (SRTD) light rail train struck and killed a wayside maintenance worker. Investigation of this accident revealed that there were safety risks inherent in the SRTD operating practices. Workers were aware of these risks but were unwilling to report them to management because of concerns related to discipline for reporting a near-

Table 28. Sacramento Regional Transit Near Miss Incident Review Program.

Feature	Description
Managing organization	Sacramento Regional Transit District
Year initiated	2010
Coverage	Employees or contractors working along ROW with trains or maintenance equipment
Annual cost	Information not available
Staffing	Information not available
Annual number of reports	>20 in first 7 months
Report submission	Paper copy
Time limit on submission	None
Implementation issues	Protection from discipline
Program oversight	None

miss incident. SRTD management believed that knowing about these near-misses was more important that punishing employees so it was willing to establish a near-miss incident reporting system as a non-disciplinary program. SRTD's Near Miss Incident Review Program officially began in March 2010 following a brief pilot test.

System Operation

SRTD has a simple straight-forward near-miss program. The Departmental Operating Procedure states "It is the responsibility of every Light Rail (LR) employee to report areas of concern that occur along the ROW to their immediate supervisor." The supervisor records information about the incident on a 1-page form and forwards it to either the wayside or transportation superintendent. If video data or other vehicle download data is available, the supervisor requests that it be captured for analysis of the incident.

LR operations runs the program but the SRTD safety director is consulted on solutions to specific issues. The LR and/or Wayside Superintendent(s) investigate all reported incidents and provide a response to the person who reported the incident. The reports and investigations are reviewed at the monthly Hazard Resolution and Fire/Life Safety Committee meeting along with results of efficiency checks and unusual occurrence reports. In addition, the Chief Operating Officer discusses near-miss reports at the weekly meeting of supervisors. De-identified reports of completed investigations are available to all LR employees so that everyone can learn from the experiences.

While a single report will not result in discipline, multiple occurrences by the same individual(s) may result in additional training and/or counseling.

Experience to Date

As soon as SRTD management initiated the system, employees began to submit reports. Employees have submitted over 20 reports from initiation of the program through October 2010, a period of 7 months. The system was initially designed to report near-miss incidents but employees have also reported concerns with rules. Through this system, management became aware of inconsistencies between practices and the rules. As a result, some rules are being changed. In one

case, an employee concern was due to a lack of understanding of a rule so this became an opportunity for training.

A key factor in the success of the SRTD Near-Miss Incident Review program has been management's willingness to abandon the belief that near-misses require discipline. In addition, the process for reporting a concern is straightforward. The continuous filing of reports is an indication that the employees trust the system. The challenge for management will be to maintain employee interest so that concerns continue to be reported. If employees continue to see that there is management response to the reports, this should not be a problem.

NYCT Near-Miss Reporting System

NYCT has an agency system for reporting near-misses. NYCT defines near-misses as

> *An incident that involves train and/or right of way operations, which did not involve personal injury or damage to equipment or property, but could have resulted in death or serious injury.*

Prior to 2003, there was a process for handling near-miss incident reports at the divisional level, while NYCT's Office of System Safety (OSS) tracked the incidents for the purposes of trend analysis. At that time, it was somewhat of a fledgling system. The operating departments were responsible to investigate near-misses. As part of negotiations with TWU in 2003, labor requested that a formal structured near-miss investigation process be instituted. In 2004, the current system was put into place. In 2007, after two fatalities within weeks of each other in the track department, OSS began to conduct investigations of significant near-miss incidents and issued its own reports for incidents where employee contact was an issue (e.g., employee could have come in contact with a train or other on-track equipment).

As defined in a 2004 NYCT Memorandum, any employee involved in or witnessing a near-miss incident must immediately report it to his/her supervisor. The supervisor of the involved employees must verbally report the incident to the Rapid Transit Operations (RTO) Control Center, the Divisional Chief Officer, and the Office of System Safety. A March 2008 RTO Bulletin requires that "any employee who witnesses or becomes aware of a near-miss incident must immediately report it to the Rail Control Center." There are posters throughout the transit system reminding employees of their responsibility to report near-misses. The supervisor in the operating department must initiate an investigation within 24 hours of the incident in order to determine the causative factors related to the incident. Separately, the OSS will investigate those incidents where employee contact issues were involved. Within 30 days of the incident, the supervisor must issue an incident report to the relevant Divisional Chief Officer and also submit a copy to OSS. OSS will issue a separate report on its findings for the cases investigated.

Support of the transit agency's executive management, in terms of both budget and safety as a core value, has been key to making this reporting system successful. The number of near-miss reports that involved potential employee contact has dropped from a high of 24 in 2008 to 15 in 2009, 15 in 2010 and for the first two months of 2011, there were two.

Other Transit Near-Miss Reporting Mechanisms

Many transit agencies provide mechanisms for their employees to report near-misses and unsafe conditions. These mechanisms are typically part of the transit agency's accident/incident reporting system. One large transit agency has a form for reporting "Unsafe Condition or Hazard/Near-Miss." This form may be submitted anonymously. Another large transit agency has an "Unusual Occurrence" form for its rail operation but the categories on the form do not include

"near-miss." One large bus transit agency has a form for reporting an occupational illness, injury, or near-miss that could have caused an injury or illness. These latter two forms must be submitted to the employee's supervisor so they are not confidential or anonymous. A multimodal transit agency has a very detailed accident report form that includes "near-miss" as an option under "Type of Accident." While many transit agencies do provide a way for employees to report information about near-miss incidents, the interview process did not identify any agency, other than NYCT and Sacramento Regional Transit District, which has a separate process to identify and investigate near-misses.

APPENDIX D

Rules Compliance Program Success Stories

Continental Airlines

Continental Airlines entered into the Aviation Safety Action Program (ASAP) in 2001. The establishment of this voluntary reporting system has proven to be a genuine success, and is fully supported by the Federal Aviation Administration (FAA), Continental Flight Operations Management, and the pilots as represented by the Airline Pilots Association. Credit should be given to all of the above participants, who established the system, as it involved a substantial amount of effort on everyone's part. The concept of a voluntary reporting system within the company's framework was indeed a new concept. Because of the unfamiliarity with a nonpunitive safety reporting system and the departure from a culture of blame, the involved parties had to work through their concerns to establish a high level of trust, a requisite basis of any voluntary reporting system.

The operation of the ASAP system at Continental Airlines has been extremely successful, and there is no doubt that this system has made the aviation operating environment a much safer place. The system generates from 130 to 160 reports per month, and there are now over 8,600 reports in the database, arranged according to a specific taxonomy. Continental has also developed a distribution system that sends the de-identified reports to upper management and the training department. Pilots have access to the last 12 months of reporting data. Continental management personnel believe that over 95% of the data uncovered through this program would never have been reported without a voluntary safety reporting system in place. In addition, this system is responsible for analyzing why certain events take place, rather than just the documentation of a safety breach. Further, the system mandates some type of corrective action in each case. Finally, corrections to the overall airline system based on preventive actions addressing small incidents may prevent major incidents or accidents.

The system has been successful because of the trust and mutual respect established among the FAA, Continental management, and the pilot's union. This has superseded the older mentality of punishment for any perceived violation of the operating rules. The employees now feel empowered to report any perceived degradation of safety without fear of reprisal, and as a result this has substantially raised the level of safety. As of August 2010, Continental also has an ASAP system with their dispatchers, maintenance personnel, and their load planners. Other employee groups will be added in the future. (Note: Continental Airlines has agreed to a merger with United Airlines, and this union is estimated to be completed during 2011.)

Union Pacific Railroad and Brotherhood of Maintenance of Way Employees Division

Background

In May 2009, the Brotherhood of Maintenance of Way Employees Division of the International Brotherhood of Teamsters (BMWED) and the Union Pacific Railroad (UP) signed an agreement

to establish a pilot program designed to encourage employees to report rule violations and personal injuries without fear of reprisal from UP. The initiation of this program came about due to concerns from labor that employees were being pressured to not report injuries. This program has two elements: the Safety Analysis Process (SAP) and Close Call Reporting. The pilot began in December 2009 and will run for 2 years. It involves about a quarter of the BMWED-represented employees on the UP system. Based on the pilot experience, BMWED and UP will decide whether or not to continue the program and if so, whether it should be extended to all BMWED employees on the UP. David Connell, UP's Vice President-Engineering said, "Although rule compliance is the foundation of workplace safety, we believe this pilot program will take us beyond rule compliance to more of a team approach to identify and eliminate risk." (*BMWED Journal,* July/August 2009, Volume 118, Number 4, p. 19.)

Program Operation

As part of this program, UP established seven full-time safety coach positions to serve as a liaison between 2000 BMWED represented employees and UP management. Coaches listen to and convey safety concerns of covered employees to management. Organizationally, they report to a safety manager at corporate headquarters in Omaha. They attempt to resolve questions or concerns on safety-related matters and provide advice regarding improving safety performance, as appropriate. The safety coaches do not participate in any disciplinary procedures. UP appointed and trained the safety coaches prior to the start of the pilot program in December 2009.

The goal of SAP is the identification and elimination of factors that lead to an incident or accident. SAP provides employees with an alternative to the discipline process. At the employee's discretion, the employee may opt for SAP, except for certain egregious violations such as use of drugs or alcohol and actions that involve willful and wanton behavior. Multiple violations of the same rule that occur within one year and result in an accident or injury are not candidates for the SAP process.

When an employee chooses SAP, a labor/management team (LMT) consisting of a safety coach and a management representative meets with the employee to gather information concerning the incident. The LMT formulates a corrective action plan (CAP). The CAP may include recommended changes to work processes or the work environment, skills training for the employee, recommendations for rule or policy development, hazard correction, counseling of the employee, and use of the incident with others as a learning experience. The LMT must schedule a follow-up review within 90 days to ensure that the CAP has the intended impact. All SAP-related information is confidential and may not be used in conjunction with any litigation.

An advisory board consisting of three BMWED officials and three UP management officials oversees the SAP. At the end of the two-year pilot period, this group will determine whether or not the program continues.

Separately, covered employees may report close call incidents.

Experience to Date

The BMWED employees have embraced the safety coaches as indicated by a June 2010 survey designed to measure their effectiveness. Employees were unanimous in their positive ratings of the impact of the safety coaches in creating a safer workplace in the track department. BMWED officials report that letting go of the punishment mentality is key to the success of the SAP and close call reporting. Based on the survey results, the safety coaches are playing a critical role in changing this mindset.

Overall SAP is working as intended. The only issue to date has been the need for a clearer definition of what constitutes willful and wanton behavior. BMWED and UP are currently

working on this. Through the end of October 2010, a total of 26 employees requested the SAP; four were denied as involving willful and wanton behavior. The close call hotline has had fewer reports, but this is changing as the employees develop more trust in the safety coaches.

Minnesota Valley Transit Authority

Minnesota Valley Transit Authority (MVTA) is a small bus operator that provides over 2 million passenger trips annually. The agency reports that it has worked very hard to create a safety-focused culture by developing a comprehensive safety program that requires each employee to put safety first. The agency constantly seeks ways to further reduce the number of safety-related incidents. A safety review in 2007 indicated that the majority of safety-related incidents occurred within three months of new bus operator training. In an effort to reduce these incidents involving recent hires, MVTA made changes to its hiring and training practices.

Prior to 2008, operator candidates could have no more than three traffic citations or moving violations in the prior three years. Once employed, operators were removed from service if they received more than three moving violations or preventable accidents in a 12-month period. Beginning in 2008, candidates may have no more than three citations or moving violations in the prior five years. In addition, MVTA will remove from service any operator who receives more than one moving violation or preventable accident in a 12-month period. While these changes reduced the applicant pool, MVTA found that it improved the quality of the applicants.

In addition to changing hiring and retention criteria, MVTA made changes to its operator training program. Prior to 2008, the training was 62 to 70 hours. Beginning in 2008, all new hires must participate in 96 hours of training, regardless of prior experience. Included in the 96-hour training period is 5 days of cadetting. Previously only two days of cadetting occurred. During cadetting, an experienced trainer accompanies the new hire when first operating in revenue service. The trainer observes and coaches the operator and helps the new operator to deal with any problems or questions that arise.

These changes in hiring and training policies have brought results. MVTA experienced a 30 percent drop in the number of safety-related incidents between 2007 and 2009 while the number of trips increased. Specifically, safety-related incidents decreased from once every 83,000 miles to once in 179,000 miles in 2009. While training costs did increase, as operator retention increased due to the higher quality hires, the annual investment in training has now leveled out. Another indicator of the success of these changes has been an increase in the number of commendations that MVTA received from patrons.

MVTA recognizes employees for safe driving behavior. The agency documents a commendation from a patron with a Letter of Commendation that is placed in the employees file. Every year the agency identifies those operators who qualify for Driver of the Year. Qualification is based on a number of factors but number of patron commendations is a key factor. The drivers vote to select one full-time and one part-time Driver of the Year. The selected drivers are honored at an annual dinner.

MVTA's service is through a contract provider. The contract with the service provider is lengthy because it contains extensive detail with regard to both the hiring and training standards (described above) as well as other performance standards. MVTA's staff is co-located with the contractor so they are able to oversee the contractor's operation on a daily basis and ensure that contractual standards are met. The contract also includes provision for incentive and penalty payments to the contractor based on overall performance and the contractor must use any incentive payments for the benefit of the drivers. For this reason, the drivers have an incentive to work

together to operate safely and to monitor one another for safe driving practices. MVTA feels that a detailed contract combined with intensive oversight of the contractor are key elements in achieving safety-related rule compliance when a contractor is the service provider.

Schneider National Trucking Company

Schneider National, employing approximately 15,000 drivers, is committed to ensuring its drivers adhere to safe operating practices. Schneider realizes it can either pay up front for proactive safety measures, or pay later (most likely at greater loss to the company) for accidents resulting in injury and claims. Therefore, Schneider considers safety to be an investment.

Schneider hires inexperienced as well as experienced drivers and uses various employee screening methods. During the hiring process employees are screened for drug and alcohol offenses and their records are reviewed for moving violations. Safety-rules training for new hires is based on their previous professional driving experience. Experienced drivers receive a four-day orientation. Inexperienced drivers receive two weeks of classroom training and two weeks on-the-road training.

Schneider keeps its employees informed about changes to rules during periodic safety briefings. The company takes the opportunity during these briefings to explain the safety policies it has as well as their purpose. A safety official at the company stated that people are more likely to adhere to a rule when they know the risky maneuvers the rules are designed to prevent can have dire consequences. As such, it is not enough to inform employees of safety rules, but educate them about the risk associated with precarious driving behavior. Many drivers, not just those in commercial operations, believe their driving skills are better than average so they are unlikely to be involved in accidents. Schneider tries to reinforce that accidents can happen to anyone.

To reinforce safety rules retention, Schneider provides periodic refresher training. It reported providing traditional types of training, e.g., biennial spring/winter training. In the winter, specific types of safety rules can be revisited such as driving in icy weather, whereas spring training will highlight different driving challenges, e.g., fatigue resulting from the driver pushing him- or herself beyond performance limits because of the extra daylight hours. Schneider reported it is moving from these traditional types of training to more frequent CBT (as much as five times a year) along with an annual rules recertification and in-truck assessment.

Schneider employs two types of drivers. Some have dedicated routine assignments while others are long-haul operators. A distributed workforce presents a unique challenge to management. It is particularly difficult to manage long-haul truck drivers and create a sense of cohesiveness among the employees. Schneider encourages individual responsibility in the form of self-monitoring. In addition, Schneider conducts periodic ride-alongs, monitor motorist reports, as well as review automated truck-handling reports. It investigates vehicle incidents and conduct root cause analysis. Schneider uses onboard monitors to measure hard braking. It calculates the average number of hard brakes per x number of operations and compares that to the average hard braking for the employee population. Schneider determines the cause of excessive hard braking when an individual's average is significantly greater than that of the employee population. Schneider has an onboard fatigue counter that measures how long a driver has been operating since the employee's last break. It also uses an onboard collision/lane departure automation tool.

Schneider has an internal system for tracking incidents that involve rules noncompliance. The results are sent to the fleet manager who intervenes. Accident information is also sent to a centralized database that uses the information as risk data. Schneider conducts monthly risk assessments. It assigns severity points to at-risk individuals. It will identify 3 to 6 of these individuals and provide a group intervention including counseling and a remedial training

session. Then Schneider monitors these individuals to make sure they do not revert to risky behavior. Schneider engages its employees with incentive programs. There is a traditional monetary bonus program linked to safe driving, but also use non-monetary rewards like safety recognition, e.g., the CEO of the company might send a personalized letter to a valued employee.

One of Schneider's most progressive philosophies is its organizational approach to safety. When asked what advice to offer the transit industry, a safety official at the company stated that rules compliance "must start with a foundation of safety culture." Management commitment from the top level down is the only way this can be accomplished and this is evident at this company.

Metro-North Railroad

FRA requirements for operational or efficiency testing apply to Metro-North Railroad (MNR) but MNR's rules compliance program far exceeds what FRA requires. MNR's rules compliance program is part of the agency's comprehensive Priority One safety program that has evolved over the past 15 years.

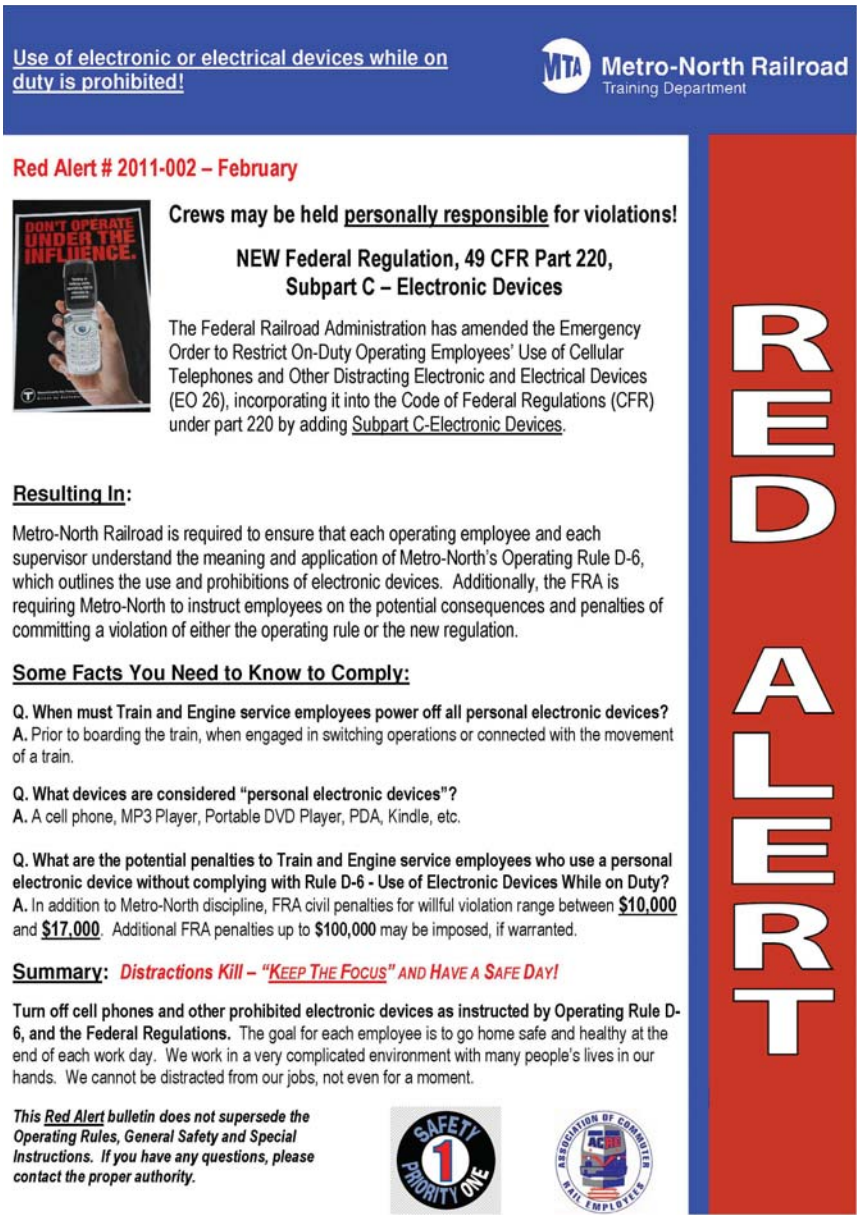
MNR conducts operations tests in accordance with FRA regulations. The agency developed a computerized system to record test results and to identify those subject to testing. The computerized system not only provides the means for management to be certain of meeting minimum testing requirements but it also provides the data for identification of rules subject to noncompliance.

The railroad's Priority One program has been a work in progress. The underlying philosophy is continuous improvement, not constant change. Data, such as that generated by the operational testing program, is used to assess status, measure progress, and identify areas in need of improvement. There is a focus on leading indicators to identify safety risks before problems occur. Operating departments review all incidents along with test results to determine if there are any patterns to these events.

There is a Priority One comprehensive communication strategy that is evident in the rules compliance program as well. MNR uses Red Alerts, such as the one shown in Figure 15, to inform employees of new rules and to use rules noncompliance incidents as a learning experience for others. The agency has also developed a series of posters to heighten awareness of rules compliance issues.

Because it is difficult to determine which strategies work and which do not, MNR has tried multiple approaches to encourage rules compliance. Railroad management found that conducting a crew debriefing at the end of the day's runs is an effective way to reinforce knowledge and application of its operating rules. The engineer and conductor(s) spend a few minutes with their supervisor talking about what happened that day. They focus on any unanticipated occurrences, such as a failure of in-cab signals, and how they handled them, mentioning the rules that they applied. This is now standard practice at MNR. When the agency adopts new rules that every operating employee must understand, such as the cell phone ban, the "meet and greet" method is used. Every supervisor talks with each of his/her direct reports to notify the employee and to explain the application of the new or modified rule.

MNR does not have a formal safety incentive program because it believes it does not necessarily reinforce safety as a core value. Instead line management has the discretion to give safety recognition within the group by sponsoring a lunch or giving out caps if the group has achieved a safety milestone such as 1 year without an injury or rule violation.



Use of electronic or electrical devices while on duty is prohibited!

Metro-North Railroad
Training Department

Red Alert # 2011-002 – February

Crews may be held personally responsible for violations!

NEW Federal Regulation, 49 CFR Part 220, Subpart C – Electronic Devices

The Federal Railroad Administration has amended the Emergency Order to Restrict On-Duty Operating Employees' Use of Cellular Telephones and Other Distracting Electronic and Electrical Devices (EO 26), incorporating it into the Code of Federal Regulations (CFR) under part 220 by adding Subpart C-Electronic Devices.

Resulting In:

Metro-North Railroad is required to ensure that each operating employee and each supervisor understand the meaning and application of Metro-North's Operating Rule D-6, which outlines the use and prohibitions of electronic devices. Additionally, the FRA is requiring Metro-North to instruct employees on the potential consequences and penalties of committing a violation of either the operating rule or the new regulation.

Some Facts You Need to Know to Comply:

Q. When must Train and Engine service employees power off all personal electronic devices?
A. Prior to boarding the train, when engaged in switching operations or connected with the movement of a train.

Q. What devices are considered "personal electronic devices"?
A. A cell phone, MP3 Player, Portable DVD Player, PDA, Kindle, etc.

Q. What are the potential penalties to Train and Engine service employees who use a personal electronic device without complying with Rule D-6 - Use of Electronic Devices While on Duty?
A. In addition to Metro-North discipline, FRA civil penalties for willful violation range between **$10,000** and **$17,000**. Additional FRA penalties up to **$100,000** may be imposed, if warranted.

Summary: *Distractions Kill – "Keep The Focus" and Have a Safe Day!*

Turn off cell phones and other prohibited electronic devices as instructed by Operating Rule D-6, and the Federal Regulations. The goal for each employee is to go home safe and healthy at the end of each work day. We work in a very complicated environment with many people's lives in our hands. We cannot be distracted from our jobs, not even for a moment.

This Red Alert bulletin does not supersede the Operating Rules, General Safety and Special Instructions. If you have any questions, please contact the proper authority.

RED ALERT

Figure 15. Sample MNR red alert.

Today MNR experiences few serious violations. The agency has worked hard to achieve this level of performance. MNR safety and rules officials attribute this success to their comprehensive approach to safety and rules compliance that is supported by a safety culture that comes from the top of the organization.

APPENDIX E

Effectiveness Metrics

Table 29 summarizes the effectiveness metrics for each best practice.

Table 29. Effectiveness metrics by best practice.

Practices	Relevant Metrics
Screening and Selecting Employees	
Effective candidate screening.	• % of candidates screened
Training and Testing	
Effective training preparation	Yes/No: • Include staff in design and development of training program • Train the trainer • Prepare trainees for rules training by explaining expectations
Information transfer methods	• Pre/Post tests that evaluate understanding purpose of rules • % rules with explanations
Action-based rules training	• Pre/Post tests that evaluate understanding how rule is applied • % rules with examples • % rules with practice opportunities • Annual opportunities for refresher training • % scheduled refresher training completed • % of action-based training that incorporates positive feedback during training • Course evaluation containing question about frequency and quality of feedback during training
Crew resource management	• Number of teams trained
Assessing effectiveness of rules training	• % training programs that measure training effectiveness • Is there a post test for all rules training? (Likert scale that evaluates effectiveness for multiple dimensions)
Communication	
Proactive rules communication	• % of crew reporting locations with bulletin boards or variable message signs • % rule changes posted
Opportunities to ask questions	• Number of safety meetings or other discussion opportunities
Communicating changes to rules	• % employees participated in "meet and greet" • % employees who acknowledge receipt of new rule in writing
Positive safety language	• number or % of safety communications containing nonthreatening safety language
Customer feedback	• number of reports regarding operator behavior • average follow-up time

(continued on next page)

Table 29. (Continued).

Practices	Relevant Metrics
Monitoring Rules Compliance	
Operational testing	• number and types of tests • % passing • number of major rule violations
Observational methods	• number and types of observations • % and number in compliance with rules • number of safety audits • number and types of problems observed and coached
Automated methods	• % and number in compliance with rules
Responding to Noncompliance	
Noncompliance investigative process	• number or % of noncompliance incidents investigated • number or % of incidents where root cause analysis was applied
Handling noncompliance	• % and number of discipline cases • % and number of dismissals • % and number coaching cases • % and number of remedial training cases
Safety Management	
Assessing the rules compliance program	Outcome will be the application of the metrics in this table to the agency's rules compliance practices.
Encouraging employee involvement	• number of management/labor committees • number of posters/notices inviting employees to express concerns
Reporting near-misses and other safety risks	• number of reports per month • average time to respond to reporting employee • number of recommendations implemented
Incentivizing rules compliance	• number of awards per 100 employees (or some other number)

Abbreviations and acronyms used without definitions in TRB publications:

AAAE	American Association of Airport Executives
AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ACI–NA	Airports Council International–North America
ACRP	Airport Cooperative Research Program
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	Air Transport Association
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
HMCRP	Hazardous Materials Cooperative Research Program
IEEE	Institute of Electrical and Electronics Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCFRP	National Cooperative Freight Research Program
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
PHMSA	Pipeline and Hazardous Materials Safety Administration
RITA	Research and Innovative Technology Administration
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TCRP	Transit Cooperative Research Program
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S.DOT	United States Department of Transportation