



## Improving Safety Culture in Public Transportation

### DETAILS

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TRANSIT COOPERATIVE RESEARCH PROGRAM

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**TCRP REPORT 174**

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**TRANSPORTATION RESEARCH BOARD**

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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.

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# FOREWORD

By Dianne S. Schwager

Staff Officer

Transportation Research Board

*TCRP Report 174: Improving Safety Culture in Public Transportation* is intended for public transportation agencies seeking to improve their safety culture. The report (1) provides a working definition of safety culture and identifies its key components for use by the public transportation industry, (2) presents methods and tools for assessing safety culture, (3) identifies performance indicators and reporting practices to support improved safety culture, (4) presents best practices in use by public transit and other organizations as tried-and-true strategies for improving safety culture, and (5) provides guidelines that can be used to initiate and build a program for improving safety culture by public transportation agencies.

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Building a positive safety culture within an organization is considered critical to safety performance, yet defining safety culture has been somewhat elusive. There are many definitions for the concept of safety culture and numerous components to what is described as a multifaceted phenomenon, with scores of contributing components.

This report presents considerable research on the definition and elements that make up and influence safety culture within public transportation and in other industries. The research included a review of available literature, stakeholder interviews, surveys of transit industry leaders and experts, interviews on safety culture with leaders in other industries, and case studies. Drawing on the successes of organizations both within and outside the transit industry, the report presents specific strategies for improving safety culture and guidelines for public transportation agencies.

Improving safety culture is a goal that requires a long-term, organization-wide commitment. *TCRP Report 174* is a useful resource for pursuing and meeting this goal.

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## S U M M A R Y

# Improving Safety Culture in Public Transportation

### Introduction

Safety in the workplace—any workplace—is not accomplished through the simple act of posting a sign noting the number of days that have passed without an injury or accident. It is a matter of the culture of that workplace. Culture has been called the personality of an organization. It consists of the assumptions, values, norms, and tangible signs (artifacts) of organization members and their behaviors. The goal of TCRP Project A-35 was to help transit agencies improve safety culture in public transportation. The research team needed to answer a number of key questions designed to provide insight into safety cultures inside and outside the public transportation industry:

- What is safety culture?
- How do key transit agency stakeholders perceive safety culture?
- How are safety values and safety information communicated throughout the agency—that is, from the board to the shop floor and the worker?
- What key components affect safety culture?
- What methods do transit systems use to assess, improve, and monitor safety culture?
- Are there transit agencies with positive safety cultures?
- What factors set these agencies apart from their peers?
- How are improvements in safety culture made?
- What methods do organizations outside the public transportation industry use to assess, improve, and monitor safety culture?
- What industries and organizations outside the public transportation industry have positive safety cultures?
- What factors set these organizations apart from their peers?
- How are safety culture improvements made? What are the methods for monitoring and achieving continuous improvement?
- How can these insights be applied to the public transportation industry?

This project has recently become more important to public transportation because of the passage of MAP-21. MAP-21 stands for “Moving Ahead for Progress in the 21st Century.” This legislation grants the Federal Transportation Administration (FTA) license to establish and enforce a new comprehensive framework to oversee the safety of public transportation in the United States. MAP-21 requires that the FTA develop safety performance criteria for all transportation modes, vehicle safety performance standards, and a public transportation safety certification program for safety auditors and safety oversight officers. It requires all transit agencies receiving federal funds to develop and have certified a safety plan and all states to establish safety oversight programs. MAP-21 also gives the FTA comprehensive

authority to issue directives and conduct safety inspections, audits, and investigations. MAP-21 gives the FTA enforcement authority as well, including the option of requiring that formula grant funds be spent to correct safety deficiencies before they are spent on other projects (U.S. Department of Transportation, Federal Transit Administration, 2012). Finally, the subsequent formal adoption of the safety management system (SMS) approach as the FTA's legislatively required comprehensive safety framework ushers in "the promise of a stronger (safety) culture for employees and managers to work together to solve safety problems" (U.S. Department of Transportation, Federal Transit Administration, 2013).

## Literature Review Highlights

Since little has been written about the role of safety culture in public transportation, the research team relied heavily on the literature of the theory of safety culture and its application to aviation, nuclear power operations, natural resource extraction, and related fields.

Early accident investigations and discussions of safety science mostly focused on technical failures and human error. There were a few studies that focused on organizational and social factors. For example, Turner (1978) used accident case studies to produce a theory of socio-technical accidents that examined such causes.

## Theoretical Foundations

The literature presents two research streams that form the theoretical foundation for safety culture. These are the fields of safety climate research and safety culture research.

- Safety climate research flows from the concept of organizational climate, which is grounded in psychology.
- Safety culture research, on the other hand, is based on organizational culture, with organizational culture's roots being found in anthropology and sociology.

The effective application of safety climate research really began when Zohar (1980) took the organizational/social factors derived from the theory of organizational climate and devised a safety climate questionnaire to examine how the workforce perceived these factors. When collecting safety data from various Israeli manufacturing organizations, he found that scores developed from safety climate data significantly correlated with company accident rates and ratings by safety inspectors. Additional safety climate studies involving a formal quantitative approach ("quantitative" defined as measures of attitudes and empirical relationships to other variables, versus qualitative measures characterized by conclusions derived from case studies) followed in different industries and cultural contexts. These quantitative studies generally supported a relationship between safety climate scores and safety performance.

Safety culture research got a boost from a series of serious accidents—Three Mile Island (1979), Bhopal (1984), Chernobyl (1986), Zeebrugge Ferry (1987), King's Cross Underground (1988), Clapham Junction (1989), and Piper Alpha (1990). These accidents highlighted the significant role played by organizational and social factors (Zhang et al., 2002). The International Nuclear Safety Advisory Group (INSAG) first introduced the term "safety culture" in the aftermath of the nuclear disaster at Chernobyl. It was used in a number of subsequent accident inquiries as an umbrella term for a combination of managerial, organizational, and social factors that were seen as causally contributing to accidents. In this way, the concept of safety culture—unlike that of safety climate—initially sprang into public consciousness without benefit of an equivalent degree of theoretical derivation.

## Definitions of Safety Culture

In “Safety Culture: A Concept in Chaos?” Zhang et al. (2002) review a number of studies conducted in high-risk industries and conclude that there is “considerable disagreement among researchers as to how to define safety culture.” Guldenmund (2000) cited 16 disparate studies that appeared from 1980 through 1997 alone. The research team, based on its experience in public transportation, found the following two definitions from the literature to be the most compelling and relevant to public transportation:

The first is the Uttal definition: “Shared values (‘what is important’) and beliefs (‘how things work’) that interact with an organization’s people, structures, and control systems to produce behavioral norms (‘the way we do things around here’)” (Uttal, 1983).

The second is the UK Health and Safety Commission definition: “The product of individual and group values, attitudes, competencies, and patterns of behaviour that determine the commitment to, and the style and efficiency of, an organization’s health and safety programs. Organizations with a positive safety culture are characterized by communications founded on mutual trust, by shared perceptions of the importance of safety, and by confidence in the efficacy measures” (Health and Safety Commission, 1993).

The Uttal definition has been echoed in a number of definitions adopted by different federal government organizations.

- The Energy Facilities Contractor Group of the Department of Energy (EFCOG/DOE) says a safety culture is “an organization’s values and behaviors, modeled by its leaders and internalized by its members, which serve to make safe performance of work the overriding priority to protect the public, workers, and the environment” (EFCOG/DOE, 2009).
- The Transit Rail Advisory Committee for Safety (TRACS) defines safety culture as “the product of individual and group values, attitudes, perceptions, competencies, and patterns of behavior that can determine the commitment to and the style and proficiency of an organization’s safety management system” (Transit Rail Advisory Committee for Safety, 2011).
- The Federal Railroad Administration defines organizational culture as “shared values, norms, and perceptions that are expressed as common expectations, assumptions, and views of rationality within an organization and play a critical role in safety.” It notes that organizations with a positive safety culture are characterized by “communications founded on mutual trust, shared perceptions of the importance of safety, and confidence in the efficacy of preventive measures” (U.S. Federal Register, 2012).

## Safety Culture Theories and Models

Safety culture is complex and multidimensional, and there are numerous theoretical models of safety culture. In the literature review (Appendix A), the research team details the Westrum, Reason, Hudson, Guldenmund, and Cooper models. Also described are the Fleming safety culture maturity model, the DuPont Bradley curve model, the systems view model, and the high-reliability organization model.

Of these models, two are of particular interest to the public transportation industry.

- **Reason’s safety culture model:** The most elaborate and sophisticated of these models is the Reason model, which is grounded in Reason’s practical experience. It is this model that the research team believes has the most general application to the public transportation industry.
- **High-reliability organization (HRO) model:** The research team believes that larger transit authorities operating heavy rail should consider adoption of the HRO model normally

employed in high-risk industries such as aviation, nuclear operations, and offshore petroleum operations. Two subway trains operating under communications-based train control (CBTC) at rush hour in the tunnels of New York carry up to 5,000 passengers. The results of a head-on collision due to a CBTC failure and a subsequent fire at rush hour would lead to a total number of casualties that would exceed most high-risk industry accidents and could cripple all transportation within New York City for weeks.

### **Components of Safety Culture in the Literature**

The research team found that no single set of components of safety culture exist in the literature. The number of components in a set and the identity of those components vary significantly from one source to another. The sets found in the literature also differ significantly in terms of which components are included and which are excluded.

The lack of a common set of components in the literature might be best interpreted to indicate that (a) safety culture is a multifaceted phenomenon consisting of scores of contributing components, (b) the prominence of any given component in a specific safety culture is dictated by the dominant circumstances of the environment in which that culture exists, and (c) the safety culture phenomenon accordingly presents many different faces, thereby making promulgation of a universal definition and description difficult.

The most common components of safety culture identified in the literature review, in descending order of frequency, are:

1. Maintaining safety as a core value;
2. Requiring strong leadership and management commitment;
3. Enforcing high performance standards;
4. Providing adequate resources for safety;
5. Empowering individuals at each organizational level to be responsible for safety;
6. Involving unions continuously in the safety process (where employees are unionized);
7. Emphasizing learning, education, and training;
8. Ensuring open, honest, and effective communication within the organization and encouraging a questioning environment;
9. Maintaining an effective reporting system, with visible action taken on issues reported, and ensuring timely responses to concerns and issues;
10. Using leading and lagging safety indicators to gauge the effectiveness of safety programs on employee behavior;
11. Demonstrating leadership behaviors that encourage mutual trust between management and employees;
12. Monitoring performance continuously; and
13. Treating employees fairly.

### **Safety Culture Within Public Transportation**

The research team's approach to collecting data from the public transportation industry was designed to learn how transit stakeholders understand safety culture and its components and the strategies they use to make improvements within transit organizations. The research methodology included:

1. A research-team–developed transit stakeholder survey to identify the key components of transit safety culture and those transit agencies that are perceived as having a positive safety culture;

2. Selection of transit agencies for mini–case studies based on stakeholder recommendations, leading and lagging performance indicators, and other measures; and
3. Mini–case studies of nine transit agencies considered to be on the road to a positive safety culture, involving interviews with employees at all levels and analysis of relevant documentation.

### **Transit Stakeholder Survey**

From the results of the transit stakeholder survey, the 15 factors listed in the following were ranked in order of importance as components of safety culture:

1. Safety is recognized as the highest organizational priority, and both management and employees are committed to it.
2. Adequate training is provided so that employees have an understanding of how to perform their jobs in a safe manner.
3. There is open, frequent, and effective communication on safety.
4. Adequate financial and human resources are dedicated to ensure the safety and health of employees.
5. Management and employees are willing to interrupt schedules and service for safety reasons.
6. There is competence within the organization to draw appropriate conclusions from safety information.
7. The organization takes action visible to employees on all reported safety issues.
8. The organization collects and analyzes relevant data and actively disseminates safety information.
9. There is significant employee involvement in the continuous improvement of safety policies and rules.
10. The culture of safety is deeply ingrained within the organization, and no leadership transition within either management or union will likely change that commitment.
11. Accidents are reviewed from the perspective of future prevention rather than focusing exclusively on finding someone to blame.
12. There is a high level of trust between management and frontline staff.
13. Employees are encouraged to report near misses and other safety events without fear of blame or retribution.
14. Where there is union representation, the union is continually involved in the safety processes as a full partner, including in joint safety data collection, analysis, and problem solving. Where there is not, the same result is sought—shared ownership with and responsibility by employees.
15. Employees are rewarded for reinforcing safety at work.

Note that the results were an overall aggregation of data from different groups who ordered the components differently and that the overall aggregation's results could have been influenced by the different proportion of respondents from each group.

### **Transit Agency Mini–Case Studies**

The research involved mini–case studies of those transit agencies identified by industry stakeholders in the survey as possessing a positive safety culture. Stakeholders were asked to identify up to three large, three medium, and three small public transit agencies that have positive safety cultures. Based on stakeholder recommendations, nine transit agencies were selected.

A list of top-level management and union contacts was compiled, and the research team e-mailed or phoned the individuals from these selected agencies, and—in some cases—visited them in person, seeking their participation in the case study research. Interviews were sought at all levels of the organization—with chief executive officers (CEOs), safety directors and officers, mid-level managers from operations and maintenance, local union presidents and safety representatives, and frontline employees. Most of the contacts responded positively.

Where possible, the first interviews at each location were scheduled with the CEOs/general managers (GMs) and the local union presidents; they, in turn, provided a list of additional candidates. Interviews were recorded when consent was granted. To allow candid opinions to be expressed, participants were assured of confidentiality.

Based on the literature review and the survey results, the research team developed a questionnaire to guide and provide a common structure for the interviews.

The results of the nine mini-case studies on safety culture are summarized in Table S-1.

## **Safety Culture Outside Public Transportation**

The research team conducted structured interviews on safety culture with nine companies outside the public transportation industry. The interviews were held with top safety managers and senior executives within these companies. The interviews reinforced findings from previous research in the literature and within public transportation in identifying the key components of safety culture, as presented in Table S-2.

The following themes appeared again and again in the interviews:

- The CEO is clearly the leader of the organization for safety culture. While methods vary from company to company, each interviewee expressed the importance of the CEO's role in shaping and leading safety culture. A CEO's emphasis on safety and repetition of key values when interacting with employees, boards of directors, and stakeholders sends a clear message that safety is front and center and is a principle that drives the other performance factors of the organization.
- This group of companies empowers employees to communicate freely and to champion safety values. Methods differ—one company encourages employees to contribute to and receive safety culture information through their real-time reporting system; another sends out daily safety e-mails to keep all employees abreast of safety incidents and activities. In all of these organizations, employees are the core of the culture; they are recruited, trained, retained, and empowered to play an essential role in safety. Since they are regarded as the most valuable asset in these profit-driven companies, maintaining a safe work environment is not only the right thing to do, it also is the best way to keep productivity and profits high.
- The practice of reporting and investigating in an environment that is free from fear is common to all, the importance of near-miss reporting is unanimously supported, and employees are willing to waive anonymity to place their names on a report or safety document, which indicates a high degree of trust.

## **Definition and Key Components**

The research team prepared a definition of safety culture for public transportation drawing on the literature review, the stakeholder survey, the case studies, and the interviews from outside the transit industry described previously. While many options and concepts

**Table S-1. Key elements of safety culture observed in nine mini-case studies.**

Key Elements	Agency Code										Agencies Total***
	A (S)	B (M)	C (S)	D (L)	E (L)	F (M)	G (S)	H (L)	I (M)		
1. Safety as a core value that management and employees are committed to (updated using stakeholder survey comments)	√	√	√	√	√	√√	√√	√√	√√		9
2. Adequate safety training provided	√√	√	√	√	√	√	√√	√	√		9
3. Open and effective safety communication	√	√	+	√	√	√	√	√	√√		8
4. Adequate resources dedicated to safety	√	√	√	□	√	√	√	√	√		8
5. Management and employees willing to interrupt service for safety	√	√√	√	√	√	√	√√	√√	√√		9
6. Organizational safety competence	√	√	√	√	√	√	√	√	√		9
7. Visible action on all reported safety issues	√	+	+	√	√	+	√	□	√√		5
8. Significant employee involvement	√√	√	+	√√	√√	√	√√	√	√√		8
9. Using safety metrics and leading and lagging indicators to gauge safety performance	√√	√	√	√	√√	√√	√	√	√		9
10. Safety culture stable through leadership transitions	√	√	+	□	√	√	√	√	√√		7
11. Accident focus is preventing recurrence	√	√	+	√	√	+	□	□	√		5
12. High level of trust between management and workers	√	+	+	√	√*	+	√	√	√√		6
13. Near-miss accident reporting in place (and data collected)	**	√	**	**	√√	**	**	√	√√		4
14. Union involvement in safety process	n/a	√	+	√√	√√	+	√√	√	√√		6
15. Employee safety performance rewards	√	√	√	√	√	√	√	√	√		9
Total Count ***	13	13	7	12	15	10	13	13	15		

Legend: √ = key element implemented; √√ = key element emphasized; + = missing element linked to trust; □ = missing elements not linked to trust; S = small; M = medium; L = large.

\* High trust only in transit rail division.

\*\* These agencies do not directly operate commuter rail and are thus not regulated by the Federal Railroad Administration (FRA) to have a near-miss reporting system.

\*\*\* Double checks are counted as one, and row 13 (near-miss accident reporting in place) is not counted because this is implemented mostly in rail divisions that are regulated by the FRA.

were considered, the research team believes that a modified Uttal definition is the best alternative:

*Safety culture is shared values (what is important to all public transportation system members who are responsible for safe, efficient revenue service) and shared beliefs and attitudes (how the transportation system works and what individual roles should be) that interact with all system members, safety policies, procedures, and rules to produce behavioral norms (the way we do our jobs, whether observed or not).*

The definition was reviewed by an expert safety culture panel, formed to vet key findings and recommendations from this research. The safety culture panel, which was composed of

**Table S-2. Key components of safety culture.**

<b>Strong leadership, management, and organizational commitment to safety</b>
<b>Employee/union shared ownership and participation</b>
<b>Effective safety communication</b>
<b>Proactive use of safety data, key indicators, and benchmarking</b>
<b>Organizational learning</b>
<b>Consistent safety reporting and investigation for prevention</b>
<b>Employee recognition and rewards</b>
<b>High level of organizational trust</b>

individuals recognized for promoting positive safety culture within public transportation and other industries, generally concurred with this definition.

## **Assessing the State of Safety Culture**

Various methods can be used to assess an organization's safety culture. Among the most common and frequently employed are direct observation, interviews, focus groups, surveys, and performance indicator tracking.

### **Direct Observation**

Direct observations of workplace behavior may provide objective information regarding safety culture pertaining to the effectiveness of training, management, accountability, and behavior expectations. Direct observation of employees at work can also provide valuable information on involvement, attitude, and willingness to confront perceived unsafe behavior. However, observations cannot be quantified and used for statistical purposes, and there is always the risk of overgeneralization from too few observations (EFCOG/DOE, 2009). Conducting sufficient observations to produce an accurate assessment of the state of safety culture will be time-consuming and expensive.

### **Interviews**

Interviews can play a significant role in the assessment of culture. They can be used to develop information directly on the state of safety culture in an organization, or they can be used as a means of providing input to survey design or to explore issues in greater depth that have emerged from a survey. An advantage of interviews is that the respondents are not limited by the wording or structure of a written survey. The greater flexibility in an interview allows the interviewer to drill down until an opportunity or problem is fully clarified and ambiguities are addressed. However, generalization of findings from interviews to an entire organization is risky if the interviews are limited in number. As with direct observation, interviews to assess an organization's safety culture can be time-consuming and expensive.



## Focus Groups

Focus groups are more efficient but less flexible than individual interviews to assess an organization's safety culture. One interviewer can elicit the views of multiple employees in a single session. Valid focus groups are conducted by skilled, experienced facilitators who bring all participants into the discussion. Well-designed focus groups can provide great sources of insight beyond surveys. Flexibility is somewhat reduced because the interviewer generally uses a set of prepared questions to bring basic organization and direction to the discussion.

## Surveys

Surveys have been useful and effective tools to assess safety culture. They have an advantage over other assessment methods with respect to efficiency. The views of large numbers of employees can be obtained with a fraction of the resources required to obtain the same amount of information using observation, interviews, and focus groups. Individuals may also feel more comfortable addressing an organization's safety culture in a survey in that their responses are provided anonymously and held in confidence. The most significant limitations are that surveys are somewhat inflexible and may not necessarily yield high response rates (introducing potential bias). The only information that can be obtained is that in the direct responses to each specific question posed. The elicitation of subtle distinctions is generally difficult to obtain from a survey.

## Performance Indicator Tracking

Performance indicators can be used to monitor safety culture performance over time within an organization and to make peer comparisons among similar organizations. In either case, it is important that the performance measures be consistently defined so that meaningful time-series analyses and peer comparisons can be made. The public transit industry would benefit from having a common set of publicly published safety performance and safety culture indicators. The lack of such indicators precludes meaningful comparisons and benchmarking of safety performance and safety culture across the transit industry.

There are two types of indicators used to monitor and manage safety performance and safety culture in public transportation and other industries.

- **Lagging indicators** measure past performance. Examples are customer injuries per 100,000 customers or customer injuries per 100,000 passenger miles traveled. The primary utility of lagging indicators to safety culture is that a positive safety culture, *ceteris paribus*, should produce positive safety performance. Therefore, superior safety culture ultimately results in superior safety performance, as measured by lagging indicators.
- **Leading indicators** have the distinctive and defining property of predicting future performance. Currently, the U.S. transit industry falls short of the aviation industry in terms of the number of leading indicators tracked and the use of those indicators to flag developing safety problems and vulnerabilities. Consequently, important opportunities for improvement exist in the use of leading indicators by U.S. transit agencies.

Blair and O'Toole (2010) quote Part 6.1 of ANSI Z10-2005:

*Organizations should develop predictive or "leading" performance measures or indicators. The organization can use these measures to identify and correct problems and identify opportunities for risk reduction before injuries or illnesses occur. The leading indicators can be used in combination with carefully collected*

*injury and illness rates to measure performance. Some examples of indicators of potential problem areas are human factors risks, near-miss incidents, and non-conformances found during inspections.*

A significant finding of the research team, however, is that U.S. transit agencies generally fall short of the aviation industry in terms of the number of leading indicators tracked and the use of those indicators to flag developing problems and vulnerabilities in the area of safety culture.

There are exceptions to this rule. For example, one transit agency uses statistics such as the number of signal violations by train operators and red light violations by bus operators as leading or predictive indicators. A significant increase in signal violations, for example, could be interpreted as indicating deterioration in the observance of critical rules or the existence of technical problems, which could be a harbinger or predictor of serious accidents.

Scandinavian Airlines System (SAS), however, reports having more than 50 indicators based on flight abnormalities for which a significant increase also could predict a serious accident about to happen. The SAS leading indicators, therefore, might be seen as precursors to near misses.

Such flagging by leading indicators allows the taking of appropriate corrective action on a timely basis and prior to the occurrence of a serious incident/accident.

### **Developing a Plan for an Assessment of Safety Culture**

Assessments of safety culture can be initiated in various ways, ranging from a full-scale review to periodic performance indicator checks. Full-scale assessments require a significant investment of resources for the review itself and, possibly, a far greater investment to remedy problems found. Such full assessments, therefore, are most often launched by a transit agency board or a CEO committed to the development/improvement of a positive safety culture. After making the decision to proceed, an important step is to engage management and union leadership teams to explain the purpose and mechanics of the assessment. Supervisors and hourly workers need to be similarly engaged and involved.

An abbreviated and less time-consuming approach involves the combination of a standard survey to provide general information followed by a series of interviews and focus groups to develop specific and in-depth information on issues emerging from the survey. This combination has the advantage of using the survey to identify the issues as perceived by employees at all levels of the organization in the most economical manner possible and then concentrating the interviews and focus groups on obtaining detailed information on those issues. A plan of action could be drawn up based on the results. This is a more efficient process.

The research team believes that the development and full validation of a safety culture survey and associated confidential database for the public transit industry would contribute to the industry's pursuit of improved safety culture. In the meantime, transit agencies wanting to conduct a safety culture assessment survey may use the Reason survey or a commercially available, copyrighted safety culture assessment survey.

### **Best Practices for Improving Safety Culture**

The research team identified 34 best practices that will likely result in improvements in safety culture. The expert safety culture panel rated the practices in terms of their value to a transit agency using a five-point Likert scale, with 5 being extremely valuable and 1 being not very valuable. The ranked list of best practices is discussed in greater detail in Chapter 7. These 34 practices fall into the safety culture categories in Table S-3.

**Table S-3. Categories of safety culture practices recommended.**

Safety Culture Category	Number Recommended
Employee involvement	5
Organization	5
Reporting	5
Safety rules and procedures	4
Safety training	3
Key safety performance indicators	2
Management commitment	2
Recruitment	2
Safety communications	2
Safety culture survey	2
Planning	1
Recognition and rewards	1
<b>Total</b>	<b>34</b>

It is essential to understand that all 34 best practices will not be appropriate for every transit agency. For example, a practice will not work in a given agency unless the necessary foundation already exists to support that particular practice. Therefore, transit agencies should consider the list of best practices as a menu from which to choose a few practices that appear to be appropriate for their agency and that potentially would remedy a deficiency in current safety culture. Before implementation, the practices being considered should be discussed with all stakeholders and implemented on a trial basis. After a suitable period, the efficacy of each practice should be evaluated and a decision made as to whether the practice is to be retained in its present form, revised, or discarded.

## Improving Safety Culture—Four Case Studies

The research team conducted case studies of four transit agencies that have made significant improvements in their safety cultures. The case studies considered transit agencies whose efforts to improve safety culture were a reaction to a major accident or incident and transit agencies that improved safety culture without the spur of such an incident or accident. The components of safety culture revealed in the research and first specified in Table S-2 appear in each of the four case studies.

An analysis of these four case studies produced important cross-cutting themes that might be considered by transit agencies undertaking a program to improve their safety culture:

- **Strong Leadership, Management, and Organizational Commitment to Safety.** Without truly committed leadership, there is no hope of improving safety culture. In transit agencies with representation by union employees, truly committed union leadership is as essential as truly committed management leadership. If only with respect to the issue of safety, management and unions must establish an effective working partnership. Cooperation is essential. A “my way or the highway” approach does not work.
- **Employee/Union Shared Ownership and Participation.** Even the most committed leadership will not succeed in improving safety culture without significant employee involvement and buy-in.
- **Effective Safety Communication.** Without effective safety communication, employees will not understand the hazards inherent in their jobs and will not appreciate any progress being made.
- **Proactive Use of Safety Data, Key Indicators, and Benchmarking.** All transit agencies must aggressively collect and use the best data that they can collect to guide their actions.

- **Organizational Learning.** Organizational learning is very important to improved safety culture. Employees will not have confidence in organizations that do not learn from their mistakes.
- **Consistent Safety Reporting and Investigation for Prevention.** Employees must have full confidence in the integrity of the reporting and investigating systems. If something is reported, it will be investigated, and appropriate action will be taken. Also, a willingness by management to grant disciplinary immunity to employees who voluntarily report near misses will result in significantly more near misses being reported.
- **Employee Recognition and Rewards.** Employees must be recognized for their contributions to safety culture. At the same time, the disciplinary system must be widely recognized as just and effective.
- **High Level of Organizational Trust.** This cannot be established overnight. It must be earned by all members of the organization (managers, supervisors, and hourly employees) through consistent performance.

Beginning a safety culture improvement process requires a determination as to where the transit agency stands with respect to the various components of safety culture.

### Steps on the Path to Improved Safety Culture

While the specific steps for implementing a safety culture improvement plan will vary by transit agency, the steps listed in the following will benefit most transit agencies:

1. Secure preliminary commitment from management and union leadership at the highest level.
2. Identify, consult with, and secure the preliminary commitment of all other key stakeholders.
3. Jointly determine the problems to be addressed, subject to regular revision as more information is continuously received.
4. Identify any outside professional help needed to navigate the process.
5. Identify the assessment tools to be used to determine the existing state of safety culture.
6. Secure commitment of the necessary resources to solve identified problems and make required changes.
7. Jointly create a road map for rollout and implementation of the plan.
8. Meet with employee leaders (supervision and hourly) at all levels and secure buy-in.
9. Jointly determine the mechanisms for engaging the target population.
10. Jointly implement outreach to the target population to explain the program, obtain input in return, and act on that input in a highly visible manner.
11. Ensure that senior leaders are noticeably involved and leading by example.
12. Jointly implement changes.
13. Strive for cooperation, avoid imposition, and discipline only as a last resort.
14. Jointly exert constant oversight, anticipate problems, and give special attention to problem areas.
15. Jointly establish litmus tests for success, including ensuring that employees are remaining engaged, key safety problems are being tracked, progress is being made, and leaders are constantly recalibrating the program.
16. Report back to employees on a regular basis and obtain additional feedback.

To better illuminate these steps, Chapter 9 uses a hypothetical general manager in a hypothetical transit agency following these steps to illustrate and provide context for this path.

## Using This Report

The research team suggests that transit agencies take the following approach in using this research report to develop a plan for improving safety culture:

- Use this Summary to understand the overall direction of the project and its major conclusions.
  - Use Chapter 5 to develop an approach for assessing the current state of safety culture in the transit agency.
  - Ensure that the transit agency's key performance indicators are adequate for measuring ongoing progress.
  - Compare the transit agency's current employee communications plan to the scale of the SAS plan outlined in Chapter 7 and determine if sufficient resources are currently being devoted to safety communication.
  - Consider adopting some of the best practices identified in Chapter 7 to pursue specific safety culture improvements that the assessment indicated are needed.
  - Develop a set of guidelines for improving the state of safety culture in the transit agency based on the results of the assessment and the experiences of the four transit agencies outlined in Chapter 8.
  - Repeat the assessment of the current state of safety culture every 2 or 3 years in order to measure progress made in improving safety culture.
-

## CHAPTER 1

# Literature Review Highlights

## Introduction

Little has been written about the role of safety culture in public transportation. The research team, therefore, was limited to the literature on the theory of safety culture and its application to aviation, nuclear power operations, natural resource extraction, and related fields. In deciding which material to include in the review, the researchers fell back on their experience in improving safety culture to assess the applicability of prior research to public transportation, the degree to which the material has stood the test of time or holds promise for the future, the rigor with which the material was produced, and the extent to which the conclusions reached appear to be reasonably supported.

There is a great deal of literature in these areas, the most important of which is presented in the research team's complete literature review, which may be found at Appendix A. In this chapter, the purpose is to present only the highlights of that review.

The first step in the literature review was to examine the theoretical foundations of safety culture. Then the researchers:

- Addressed the challenges of defining safety culture, one of which is to distinguish it from safety climate;
- Examined various competing theories and models;
- Detailed the various components of safety culture included in these theories individually and combined into sets that varied significantly in terms of individual components included in or excluded from different theories and models; and
- Discussed the various methods of assessing the state of safety culture in a given organization.

## Theoretical Foundation

In looking at the theoretical foundations that underlie the research, the researchers found a distinct and traceable path for safety climate; however, this was not the case for the theory of safety culture, which developed differently.

## Background

Early accident investigations and discussions of safety science focused on technical failures and human error. There were some exceptions: A few studies focused on organizational and social factors. For example, Turner (1978) used accident case studies to produce a theory of socio-technical accidents. However, most of the earlier literature revolved around hardware or human failure.

In searching for a theoretical foundation, the research team discovered two separate research streams that turned out to provide almost all of the theoretical foundation for the research. These are the fields of safety climate research and safety culture research.

## Origins of Safety Climate Research

The concept of organizational climate is grounded in psychological research. It is a line of study that goes back to Lewin et al. (1939), who examined social relations and interactions in boys' groups. The next significant step was a work by Argyris, *Personality and Organization* (1957). Argyris's contention was that employees were infantilized by industry practices and reacted by behaving as children, as management expected them to do. Shortly thereafter, McGregor (1960) developed his Theory X and Theory Y, a construct that posits that managerial behavior has a direct bearing on employee behavior. Likert (1961) introduced four systems by which organizations might function, ranging from completely autocratic to completely participative. In a later book, Likert (1967) called these System 1 (exploitative autocratic), System 2 (benevolent authoritative), System 3 (consultative), and System 4 (participative). Argyris, McGregor, and Likert each focused on how people were treated by organizations and how they responded as a means of understanding organizational effectiveness. Katz and Kahn published *The Social Psychology of Organizations* in 1966. It looked at a wide array of factors that determined behavior, emphasizing "the total

social situation encountered by employees rather than a more focused leadership perspective” (Schneider et al., 2010).

Schein’s *Organizational Psychology* (1965) summarized most of the conceptual work that had been accomplished up to that point. The essence of this work was its analysis of the human issues surrounding organizational effectiveness. Schein studied perception, motivation, and attitudes toward work, but “the focus was on the design of organizations that were effective through collective human attitudes and action and not on individual employees as the unit of theory or analysis” (Schneider et al., 2010).

For many years, however, research bogged down over whether the climate in an organization could be adequately represented by the aggregate responses of individual employees. The impasse was mitigated when James and Jones (1974) coined the term “psychological climate”; it referred to studies in which the individual, rather than the organization, was examined: “the unit of data collection as well as the unit of analysis was the individual” (Schneider et al., 2010). This gave rise to the study of organizational climate. As Kuenzi and Schminke (2009) noted, three times as many articles on organizational climate were published between 2000 and 2008 than were published in the 1990s.

Safety climate research effectively began when Zohar (1980) took the organizational/social factors derived from the theory of organizational climate and devised a safety climate questionnaire to examine how these factors were perceived by the workforce. When collecting safety data from various Israeli manufacturing organizations, Zohar found that scores developed from safety climate data significantly correlated with company accident rates and ratings by safety inspectors: higher safety climate scores were associated with lower company accident rates and higher ratings by safety inspectors. Additional safety climate studies involving a formal quantitative approach (“quantitative” defined as measures of attitudes and empirical relationships to other variables, versus a qualitative approach, which is characterized by conclusions derived from case studies) followed in different industries and cultural contexts. These studies generally support a relationship between safety climate scores and safety performance.

## Origins of Safety Culture Research

The roots of organizational culture are found in anthropology and sociology. Pettigrew (1979) originally introduced the construct of culture to the study of organizational behavior so that organizational researchers would become familiar with the language and concepts of social anthropologists. By 1990, Pettigrew’s focus had become the study of processes of leadership, commitment building, and change and the nexus of culture, strategy, and change. “Practitioners and management consultants loved the concept of organizational cul-

ture, and it caught on quickly as a key variable in trying to distinguish more effective from less effective organizations” (Schneider et al., 2010). Several popular management trade books, among them *In Search of Excellence* by Peters and Waterman (1982), used the study of culture and concepts such as myth and taboo to examine organizations. A significant problem in the study of organizational culture was that researchers were unable to establish a relationship between their qualitative case study results and organizational effectiveness. And, just as climate researchers bogged down in the morass of statistical levels of analysis, culture researchers became obsessed with the variety of ways in which culture might be conceptualized instead of studying how it related to organizational effectiveness (Smircich, 1983). It was not until culture researchers began to switch to quantitative methods (e.g., surveys) that relationships between culture and organizational effectiveness were demonstrated (Kotter and Heskett, 1992; Sorenson, 2002).

A series of serious accidents—Three Mile Island (1979), Bhopal (1984), Chernobyl (1986), Zeebrugge Ferry (1987), King’s Cross Underground (1988), Clapham Junction (1989), and Piper Alpha (1990)—highlighted the significant role played by organizational and social factors (Zhang et al., 2002). The International Nuclear Safety Advisory Group (INSAG) first introduced the term “safety culture” in the aftermath of the nuclear disaster at Chernobyl. It was used in a number of subsequent accident inquiries as an umbrella term for a combination of managerial, organizational, and social factors that were seen as causally contributing to the accident. In this way, the concept of safety culture—unlike that of safety climate—initially sprang into existence without benefit of being theoretically derived. Instead it was practically derived from a series of detailed accident analyses. Clarke (2000) noted that some academics had attached the concept to the existing literature on safety climate. She called safety climate theory the “adoptive” parent of safety culture. Organizational culture is the “natural” parent, but she asserted that the necessary theoretical framework had never been established. Clarke noted further that safety culture—while it was not derived from organizational culture—does share many of its features. For instance, it is of a social nature and is expressed in behavior.

Researchers are divided over how difficult it is to transform a safety culture. The interpretive view is that culture cannot easily be altered because it is not a “simple thing that can be bolted onto an organization” (Turner et al., 1989). The functionalist view is that safety culture in fact can be “socially engineered” by “identifying and fabricating its essential components and then assembling them into a working whole” (Reason, 1997) and that it is a critical variable that can be manipulated so as to influence safety and reliability (Frost et al., 1991). In short, functionalist theory says that companies

**Table 1. Comparison of culture and climate concepts (Krause, 2005).**

CULTURE	CLIMATE
Common values that drive organizational performance	Perceptions of what is expected, rewarded, and supported
Applies to many areas of functioning	Applies to specific areas of functioning
“How we do things”	“What we pay attention to”
Unstated	Stated
Background	Foreground
Changes more slowly	Changes more rapidly

can change their existing safety culture to one that will result in improved safety performance primarily by changing safety practices, while interpretive theory says that such changes are very difficult to achieve and cannot simply be imposed by fiat. It is therefore the functionalist perspective that provides a conceptual bridge between organizational behavior and strategic management interests (Wiegmann et al., 2004). In other words, functionalists believe that organizational behavior can be manipulated in the interests of achieving strategic business objectives.

Unfortunately, the theoretical framework for safety culture, which should be based on organizational culture, remains immature in comparison with that for safety climate, and progress toward operationalizing safety culture has also been slow. There is also still no convergence toward a universal definition of safety culture or even agreement as to what major components are necessary to produce a positive safety culture.

### Theoretical Foundation Findings

Theoretical foundation findings from the literature review are as follows:

- There is a distinct and traceable theoretical foundation for safety climate; safety culture theory, however, has only progressed from “atheoretical” to “immature.”
- Safety climate and safety culture are two closely associated but distinct concepts.
- Safety climate studies generally use formal quantitative methods, while safety culture studies historically have used mainly qualitative case study techniques. However, the number of safety culture quantitative studies is increasing.
- Safety climate studies generally support a relationship between safety climate scores and safety performance, and recent quantitative safety culture studies have demonstrated a similar relationship between safety culture scores and organizational effectiveness.

### Safety Culture Versus Safety Climate

Is there really a difference between safety culture and safety climate? There are two diametrically opposed views. Schein (1985) defined organizational culture as “a pattern of basic assumptions—invented, discovered, or developed by a group as it learns to cope with its problems of external adaptation and internal integration—that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems.” He said that climate is reflective of organizational culture but that the term “culture” has a deeper meaning that implies basic assumptions and beliefs that are shared by members of the organization. Ekvall (1983) described culture as beliefs and values about people, work, the organization, and the community that are shared by most members within the organization; organizational climate, he said, stems from common characteristics of behavior and expression of feelings by organizational members. Table 1 presents the differences between culture and climate in organizations as defined by Krause (2005).

For purposes of this project, the research team treats safety climate as a snapshot in time of the organization’s safety culture (Krause, 2005). This view is consistent with that of Wiegmann et al. (2002), who concluded that safety climate is “a temporal indicator of a more enduring safety culture.”

### Definition of Safety Culture

The literature contains scores of different definitions of safety culture. Many of these are cited in the full literature review (Appendix A). Dr. James Reason, whose model of safety culture is outlined later in this chapter, endorsed two in lieu of formulating a definition of his own.

- The Uttal definition is: “shared values (‘what is important’) and beliefs (‘how things work’) that interact with an organization’s people, structures, and control systems to produce behavioral norms (‘the way we do things around here’)” (Uttal, 1983). The Uttal definition has been echoed in a number of fairly recent federal government definitions.



- The UK Health and Safety Commission definition is: “the product of individual and group values, attitudes, competencies, and patterns of behaviour that determine the commitment to, and the style and efficiency of, an organization’s health and safety programs. Organizations with a positive safety culture are characterized by communications founded on mutual trust, by shared perceptions of the importance of safety, and by confidence in the efficacy measures” (Health and Safety Commission, 1993).

The Uttal definition has recently been echoed in a number of federal government definitions.

- The Energy Facilities Contractor Group of the Department of Energy (EFCOG/DOE) definition says a safety culture is “an organization’s values and behaviors, modeled by its leaders and internalized by its members, which serve to make safe performance of work the overriding priority to protect the public, workers, and the environment” (EFCOG/DOE, 2009).
- The Transit Rail Advisory Committee for Safety (TRACS) defines safety culture as “the product of individual and group values, attitudes, perceptions, competencies, and patterns of behavior that can determine the commitment to and the style and proficiency of an organization’s safety management system” (Transit Rail Advisory Committee for Safety, 2011).
- The Federal Railroad Administration (FRA) defines organizational culture as “shared values, norms, and perceptions that are expressed as common expectations, assumptions, and views of rationality within an organization and play a critical role in safety.” It notes that organizations with a positive safety culture are characterized by “communications founded on mutual trust, by shared perceptions of the importance of safety, and by confidence in the efficacy of preventive measures” (U.S. Federal Register, 2012).

## Models and Theories of Safety Culture

Safety culture is complex and multidimensional, and there are numerous theoretical models of safety culture in the literature. In the full literature review (Appendix A), the research team details the Westrum, Reason, Hudson, Guldenmund, and Cooper models. Also covered are the Fleming safety culture maturity model, the DuPont Bradley curve model, the systems view model, and the high-reliability organization model.

Of these models, the most elaborate and sophisticated is the Reason model, which is grounded in Reason’s extensive practical experience.

### Reason Model (1997)

Reason asserted that a safety culture can be engineered. Figure 1 provides a schematic of the Reason model.



**Figure 1. Reason’s safety culture model (research team modified version).**

The various elements of Reason’s model are driven by underlying perceptions, attitudes, and behaviors. According to Reason, four of the elements (learning, reporting, flexible, and just) feed into and support the fifth element (informed). As Reason said, “The preceding . . . have identified four critical subcomponents of a safety culture: a reporting culture, a just culture, a flexible culture, and a learning culture. Together they interact to create an informed culture which, for our purposes, equates with the term safety culture as it applies to the limitation of organizational accidents” (Reason, 1997). Note that many depictions of the Reason model incorrectly portray informed culture as being separate and distinct from the learning, reporting, flexible, and just cultures. Reason said clearly that both the Westrum and Reason models have the processing of information as their primary focus.

In an informed culture, the organization collects and analyzes relevant data and actively disseminates safety information. Individuals who manage and operate the organization’s safety system know the human, technical, organizational, and environmental factors that determine the safety of the system. All members of the organization understand and respect the hazards of operations and are alert to the system’s potential vulnerabilities. In a reporting culture, an environment is cultivated that encourages employees to report safety issues without fear of punishment. Employees know that confidentiality will be maintained and that, when they disclose safety information, management will act to improve the situation. Reason’s model particularly communicates the importance of maintaining a reporting culture within an organization. This reporting culture, which must be initiated and supported wholeheartedly by management, is necessary in order for management to get an accurate picture of the status of an organization’s safety culture. For example, Wiegmann et al. (2004) similarly supported a claim by Eiff (1999) that “one of the foundations of a true safety culture is that it is a reporting culture” by identifying an effective and systematic reporting

system as the keystone to identifying breaches before accidents happen.

In a just culture, unintentional errors or unsafe acts are not punished. Deliberate, reckless, and indefensible acts that are considered unjustifiable and that place the organization and individuals at risk are subject to disciplinary action. A just culture in turn promotes mutual trust. In a flexible culture, the organization and employees are able to adapt effectively to changing needs and demands. For example, the organization may shift from a hierarchical structure to a flatter, or more horizontal than vertical, structure for more decentralized problem-solving capability. A learning culture encourages use of safety information to draw conclusions about necessary changes and incorporate a willingness to implement major reform when change is required (Civil Air Navigation Services Organisation, 2008). Management is able to take direct action in the areas pertaining to each subculture to move the organization from its present practices toward the ideal and thereby engineer a positive safety culture. The success of the new practices affects underlying employee perceptions, attitudes, and behaviors. For example, the changing of practices having to do with reporting and just treatment of employees can create a state of mutual trust in an organization, which in turn results in a much greater flow of useful information throughout the organization.

It is important to note that Reason's primary focus was on what he termed "organizational accidents" as opposed to "individual accidents." He defined "organizational accidents" as the "comparatively rare, but often catastrophic events that occur within complex modern technologies such as [those in] nuclear power plants, commercial aviation, the petrochemical industry, chemical process plants, marine and rail transport." Individual accidents, on the other hand, are "ones in which a specific person or group is often both the agent and the victim" (Reason, 1997).

### DuPont Bradley Curve Model (1999)

The DuPont Bradley curve model is impressive because of the extensive amount of empirical data that was employed to verify the inverse relationship between the degree of strength of safety culture and the Occupational Safety and Health Administration (OSHA) recordable injury rate.

The DuPont Bradley model places companies and organizations in the following four sequential categories:

1. **Reactive:** These companies handle safety issues by natural instinct, focusing on compliance instead of a solid safety culture. Responsibility is delegated to the safety manager, and there is generally a lack of management involvement in safety issues.
2. **Dependent:** While there is some management commitment, supervisors are generally responsible for safety control, emphasis, and goals. Attention to safety is made a condition of employment but with an emphasis on fear and discipline, rules, and procedures. Such companies do value all their people and will provide safety training.
3. **Independent:** These companies stress personal knowledge of safety issues and methods as well as commitment and standards. Safety management is internalized and stresses personal value and care of the individual. These companies engage in active safety practices and habits and recognize individual safety achievements.
4. **Interdependent:** These companies actively help others conform to safety initiatives—they become others' keepers, in a sense. They contribute to a safety network and have a strong sense of organizational pride in their safety endeavors.

In the DuPont Bradley curve model, the three elements of safety management are (1) leadership, (2) structure, and (3) processes and actions.

DuPont has administered its safety perception survey since 1999 and has a database available for benchmarking. The database contains more than 632,000 responses from 96 industries, 41 countries, and over 3,383 locations. It is used to rate companies on the basis of their relative cultural strength (RCS). These ratings are "weak" (RCS less than 40), "average" (40–60), "good" (60–80), and "world-class" (greater than 80). RCS is then plotted on the  $x$ -axis of the DuPont Bradley curve against each company's 3-year average OSHA total recordable injury rate (TRIR) on the  $y$ -axis.

The results are as follows: 19 organizations with a "weak" RCS had a mean TRIR of 4.6, 57 companies with an "average" RCS had a mean TRIR of 2.7, 164 companies with a "good" RCS had a mean TRIR of 1.1, and 106 companies with a "world-class" RCS had a mean TRIR of 0.61. This comparison shows a very strong correlation between relative culture strength and safety performance. No proof of causality, however, is offered (Hewitt, 2011).

While DuPont's behavior-based safety work in the public transportation industry has some detractors (Lessin, 2000), the DuPont Bradley curve model (in Figure 2) has no obvious weaknesses or internal contradictions, is based in part on credible empirical data, and demonstrates a strong relationship between safety culture and safety performance.

What is lacking in most theories and models is a systems view. These theories and models do not consider influences outside of the affected organization. As shown in the Roberts (2010) schematic of David Gaba's "Arrow" in Figure 3, regulators and government frequently have a significant effect on outcomes. The Arrow might be further expanded to include

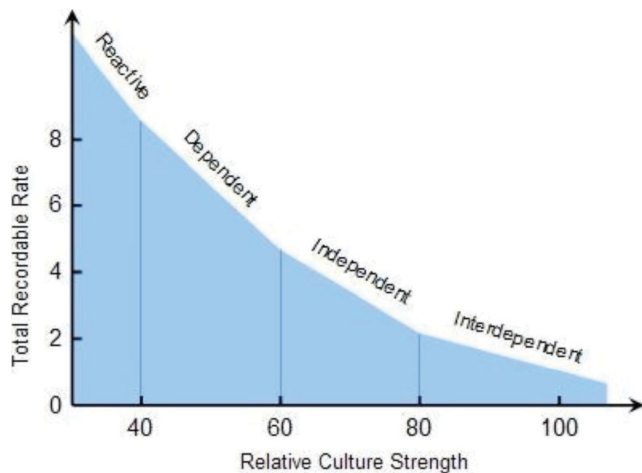


Figure 2. DuPont Bradley curve.

the individual involved in the accident, peers, management, board, stockholders, regulators, legislatures, and the public. Research has shown that the general public is reactive regarding safety—that is, willing through its legislators to provide resources after a dramatic accident rather than before, even though the best predictors and risk assessments indicate that proactive interventions are far more effective at reducing risk. This comports with the observations made by Reason (1997) about the role that regulation plays: “if regulators are to be other than convenient scapegoats, they will have to be provided with the legislation, the resources, and the tools to do their jobs effectively. As we have seen, safety legislation is enacted in the aftermath of disasters, not before them.” He went on to note that, while there is no obvious political gain to be had from preventing accidents, in the long run that effort is more rewarding. This applies throughout the “system chain” of prevention responsibility.

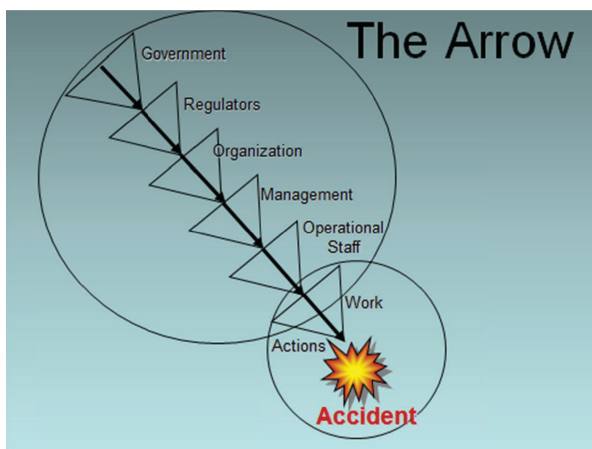


Figure 3. David Gaba's Arrow systems view model (Roberts, 2010).

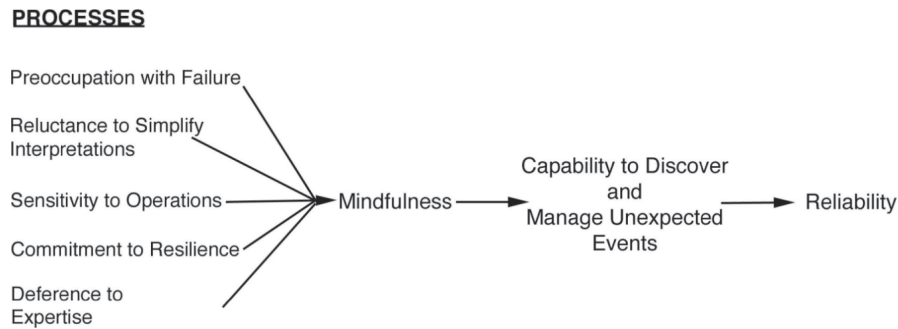
## High-Reliability Organization Model

The research team believes that, given the potentially catastrophic consequences of an unanticipated event and the subsequent loss of critical transportation functions, larger transit authorities might consider adoption of the high-reliability organization (HRO) model. Two subway trains operating under communications-based train control (CBTC) at rush hour in the tunnels of New York carry up to 5,000 passengers. The results of a head-on collision due to a CBTC failure and a subsequent fire at rush hour would lead to total casualties that exceed most aviation crashes, offshore platform accidents, and other high-profile accidents and incidents and could cripple all transportation within New York City for days, if not weeks. This model is therefore described in great detail because the research team believes its adoption by large, heavy-rail operations could be a prudent step as the technology and complexity of these operations are rapidly advancing.

An HRO is generally defined as an organization that repeatedly accomplishes its mission while avoiding catastrophic events, despite significant hazards, dynamic tasks, time constraints, and complex technologies (Hartley, 2010). B&W Pantex has published several books on HRO implementation in the nuclear weapons industry, including Hartley et al., *High Reliability Operations: A Practical Guide to Avoid the System Accident* (2008), and Hartley et al., *Causal Factors Analysis: An Approach for Organizational Learning* (2008).

The HRO model places a special premium on positive safety culture and possesses special attributes that help those who use it identify potentially dangerous safety behaviors. HROs are recognized as having extraordinary technical competence, flexible decision-making processes, sustained high technical performance systems, and processes that reward the discovery and open reporting of errors or potential errors. These organizations value safety as much as they prize production demands and organizational commitment to sustaining institutional culture. They place a substantial value on organizational learning, expertise, and the promotion of a questioning environment in which the revelation of potential safety issues can be recognized and appreciated. HROs tend to be preoccupied with failure and share a collective mindfulness that leads to learning from mistakes and the continual analysis of information gained from near misses and other leading indicators that have proven to be predictive of potential safety issues. They believe that complacency leads to vulnerability and puts the organization at risk.

HROs are generally regarded as ranking high in the safety hierarchy. The *Columbia* Accident Investigation Board was critical of NASA's safety culture and, as a result, adopted the high-reliability organization as a standard. Its conclusion was that, had the principles of HRO organizations been followed, the *Columbia* would not have disintegrated (Boin and Schulman, 2008).



**Figure 4. A mindful infrastructure for high reliability (Muhren et al., 2008).**

HROs create processes and systems that reduce the possibility of unexpected events, allowing for containment and speedy recovery if one occurs. In the HRO infrastructure, small failures are tracked meticulously. Personnel are engaged in collective problem solving through inquiry, which allows HROs to maintain a high level of proficiency at identifying gaps in system continuity and understanding warnings of potential catastrophes. Operations personnel are trained to react to even weak signals and to address the cause of failure prior to initiation of a series of events that can lead to disaster. The interactions of HRO processes are illustrated in Figure 4.

## Components of Safety Culture

In the course of conducting its literature review, the research team found no convergence in the literature on a single set of components of safety culture. The number of components in a set and the identity of those components varied significantly from one investigation to another. The sets differ significantly in terms of which components are included and which are excluded. See the numerous sets of components proposed by various researchers in Appendix A for examples.

One source of confusion in dealing with the components of safety culture is the fact that, in the literature, components are also variously referred to as attributes, dimensions, elements, and indicators. Generating perhaps even greater confusion, however, is the considerable overlap that exists in the composition of sets of components in the literature. For example, organizational commitment is sometimes understood to be made up of management commitment, company policies and procedures, and the provision of adequate resources. At other times, management commitment and organizational commitment are considered separate and equal components.

The most common threads in the literature review are:

- Maintaining safety as a core value;
- Requiring strong leadership and management commitment;
- Enforcing high performance standards;
- Providing adequate resources for safety;

- Empowering individuals at each organizational level to be responsible for safety;
- Involving unions continuously in the safety process (where employees are unionized);
- Emphasizing learning, education, and training;
- Ensuring open, honest, and effective communication within the organization and encouraging a questioning environment;
- Maintaining an effective reporting system, with visible action taken on issues reported, and ensuring timely responses to concerns and issues;
- Using leading and lagging safety indicators to gauge the effectiveness of safety programs on employee behavior;
- Demonstrating leadership behaviors that encourage mutual trust between management and employees;
- Monitoring performance continuously; and
- Treating employees fairly.

## Assessment Methods

Numerous methods are available for assessing an organization's safety culture. The most common include direct observation and audits, surveys, interviews and focus groups, and performance indicator tracking.

## Direct Observation and Audits

Direct observations of workplace behavior may provide objective information regarding the aspects of safety culture, including effectiveness of training, management, accountability, and behavior expectations. Direct observation of employees at work can provide valuable information on employee involvement, attitude, and willingness to confront perceived unsafe behavior. The observer can watch the culture at work and can confirm results obtained from interviews and surveys. Observations can provide new information on cultural phenomena. However, observations—even if scored on a checklist—cannot be precisely quantified, and there is always the risk of overgeneralization from too few observations

(EFCOG/DOE, 2009). Conducting sufficient observations to produce an accurate assessment of the state of safety culture in an organization of any size is necessarily time-consuming and expensive.

Safety audits are a form of direct observation and can provide the basis for improving performance. Blair and O'Toole (2010) noted that several large organizations with which they were familiar "report anecdotally that . . . audit results correlate strongly with reductions in injury rates." They recommended Manuele's risk score formula as a suitable tool to estimate risk levels and establish measurement priorities. The three-dimensional matrix assesses risk on the basis of probability, frequency of exposure, and severity of accidents or incidents. "Measuring safety performance is about developing the safety management systems and the related safety culture" (Blair and O'Toole, 2010). Petersen's caveat (that there is little correlation between audit reports and injury records in large companies because audits are generally as much about paperwork and regulatory compliance as they are about the effectiveness of a safety program) applies (Petersen, 1996).

## Surveys

There are numerous benefits to assessing safety culture using safety surveys. Blair and O'Toole (2010) state that "surveys provide a snapshot of an organization's culture and can be a useful tool in developing measures to drive culture." They argue that well-designed surveys provide benefits to an organization. They are:

- Practical. They address the primary safety issues. Even if the issue is one of perception, perceptions are real to those who hold them and must be addressed.
- Predictive. They fulfill the definition of what a leading indicator is supposed to do.
- Prescriptive. The results generally indicate clearly what needs to be addressed.
- Proactive. They are preferable to accident investigation, which is a reactive measure (Blair and Spurlock as cited in Blair and O'Toole, 2010).

The most significant limitations are that surveys are somewhat inflexible and may not necessarily yield high response rates (introducing potential bias). The only information that can be obtained is the direct response to each specific question posed. The elicitation of subtle distinctions is difficult to obtain from a survey.

Safety culture assessments can be tools to detect management blind spots. Research has shown that the views of management and frontline staff members at times tend to vary dramatically. The differences can be instructive. Ques-

tionnaires can be designed to explore a specific dimension of safety culture. Other advantages of safety culture surveys include their ability to reach large numbers of employees at a relatively low cost, the retention of anonymity by responders, the identification of problems and issues, and the ability to track progress over time using successive surveys.

## Interviews and Focus Groups

Interviews can also play a significant role in the assessment of safety culture. They can be used to develop information directly on the state of safety culture in an organization. Alternatively, they can be used as a means of providing input to survey design or to explore issues in greater depth that have emerged from a survey. An advantage of the interview is that respondents are not limited by the wording or structure of a written survey. The greater flexibility in an interview allows the interviewer to drill down until an issue or problem is fully clarified and any ambiguity resolved. However, generalization is risky over the whole organization if the interviews are limited in number. Also, as with direct observation, interviews are time-consuming and expensive if done in large numbers (EFCOG/DOE, 2009).

Focus groups are more efficient but less flexible than individual interviews. The efficiency comes from the ability of one interviewer to elicit the views of multiple employees in a single session. Flexibility is somewhat reduced because the interviewer generally uses a set of prepared questions to provide basic organization and direction. A significant downside to focus groups is that, without a skilled facilitator, a minority of participants can dominate a discussion and provide input that might differ significantly from the results obtained from individual interviews with all members of the group (Cox and Cheyne, 2000).

## Performance Indicator Tracking

Many aspects of safety culture are not visible, so assessment is not a simple task (Ahmed, 2011). Metrics must be directional, hold individuals accountable, relate to injury reduction, and be highly motivational (Blair and O'Toole, 2010). The Blair and O'Toole research shows that lagging indicators alone do not address or contribute to improvements in safety culture (Blair and O'Toole, 2010). (Lagging indicators are measures of past performance; leading indicators indicate future performance.) Metrics used to assess safety and safety culture should include a combination of leading and lagging measures; lagging or trailing measures alone are not effective indicators. As previously noted, Blair and O'Toole (2010) maintain that "leading indicators serve as a catalyst for change, meaningful metrics are motivational for both employees and management, and leading

indicators ultimately drive safety performance” (Blair and Spurlock, 2008).

In an interview with *Safety + Health*, Harold Yoh III, listed among the magazine’s “2011 CEOs who get it,” said that his company, which does engineering, construction, and maintenance of nuclear plants, “religiously measures and reports our safety results as we work toward our goal of zero injuries and safety incidents. One of our most important measurements is tracking off-the-job injuries, which helps determine how well we are building a robust safety culture that is 24/7, not just on the job. We believe the true challenge is to go beyond the standard regulatory requirements and track the leading indicators that determine the ultimate success of our safety program” (Froetscher, 2011).

There are a number of accepted means of measuring and assessing progress in safety management systems, both qualitative and quantitative. Many sources cite employee surveys and questionnaires and face-to-face interviews as ways to capture information. Wiegmann et al. (2004) suggested that combining qualitative and quantitative methods will yield a comprehensive understanding of safety culture, but go on to say that “quantitative approaches, especially surveys of individuals’ responses, are often more practical in terms of time and cost effectiveness.” While surveys and interviews are widely used, specific metrics are being developed in some industries to measure safety in a more quantitative way. In the aviation industry, for example, the Volpe Center is working with the FAA to create a runway incursion severity calculator that will categorize the outcome severity of runway incursions (Volpe Center Highlights, 2009). In the chemical industry, the Center for Chemical Process Safety recommends that “all companies and trade associations collect and report the three lagging metrics: Process Safety Incidents Count, Process Safety Incident Rate, and Process Safety Severity Rate” (Center for Chemical Process Safety, 2011).

“While many safety executives understand trailing measures, such as trend analysis, control charts, and evaluating

the effectiveness of safety initiatives, these measures often-times do not provide feedback for continuous safety process improvement, nor do they contribute to the development of safety culture. Positive safety culture remains unaffected when the above measures are the primary focus for metrics in an organization” (Blair and O’Toole, 2010). The practice of developing leading measures and concurrent measures using qualitative metrics for system and employee behaviors was noted by Toellner (2001), who studied the oil industry. Five specific measures were scored for quality and quantity: safety meetings, housekeeping, barricade performance, job safety analysis, and safety walks. Employee engagement is important to any safety management process, and Blair and O’Toole provide an example of a large brewery where employees use individual score-carding activities such as:

- Observation cards,
- Job safety analysis (training and auditing),
- Safety meetings and safety audits,
- Maintenance walkthroughs, and
- Pre-shift stretching.

Safety culture assessment is a critical component of safety culture improvement. Measures should be well thought out and relate to industry standards. Blair and O’Toole (2010) offer six critical and effective guidelines for implementing safety measures:

1. Customize measures specifically for individual sites.
2. Use risk assessment to prioritize safety measures by severity.
3. Simplify by limiting the total number of safety measures used at any time.
4. Engage employees meaningfully in the development of safety measures and related safety goals.
5. Use a thoughtfully chosen mix of performance and outcome measures.
6. Design measures to specifically influence the safety culture.

## CHAPTER 2

# Safety Culture Within Public Transportation

### Introduction

Examining the state of safety culture within the public transportation industry was accomplished using a multilayer, multistep research methodology that included:

1. A transit stakeholder survey to identify key components of transit safety culture and transit agencies perceived as having a positive safety culture for further investigation;
2. Selection of transit mini–case studies based on stakeholder suggestions, leading and lagging indicators, and other measures; and
3. Mini–case studies of nine transit agencies considered to have a positive safety culture, involving interviews with employees at all levels and analysis of relevant documentation.

This chapter summarizes the research design, methodologies, and findings that each of these research steps yielded.

### Industry Stakeholder Survey

#### Survey Design

The transit safety culture industry stakeholder survey was designed to identify:

- Industry stakeholder perceptions of key factors that contribute to a positive safety culture within public transportation organizations, and
- Transit organizations perceived by stakeholders to have an overall positive safety culture.

The stakeholders surveyed hold key positions in the transit industry and represent public transportation agencies of a variety of sizes and modes, including fixed-route buses, light rail, heavy rail, commuter rail, and paratransit. The stakeholders' positions give them important knowledge of and insight into transit safety and safety culture. The following

organizations were contacted to identify stakeholders for the survey:

- The American Public Transportation Association (APTA) and its online member directory, which were used to identify urban transit system chief executive officers (CEOs), board members, and members of safety committees.
- The Community Transportation Association of America (CTAA) list of Certified Safety Professionals, which provided a broad roster of safety specialists at small and rural transit providers.
- The two largest national transit unions, Amalgamated Transit Union (ATU) and Transport Workers Union (TWU), which identified and distributed surveys to union representatives.
- APTA, state safety oversight agencies, the National Transportation Safety Board (NTSB), the FTA, the FRA, and CTAA, which were contacted to identify oversight agency and industry association representatives.

To limit the sample to a manageable size, participants were randomly selected from two groups, safety professionals and board member committees, which could be expected to have multiple representatives from individual transit agencies, especially larger transit agencies. The transit CEO and local union president groups, although large, contain one representative from each transit agency or union and, therefore, were not further scaled down. Using a stratified random sampling method provided a good balance of transit agency size and the number of transit agencies and unions involved.

Surveys were mailed to a total of 718 stakeholders from among the ranks of transit agency CEOs, board members, transit agency safety professionals, national and local unions representing transit employees, federal agency and transit industry association representatives (such as APTA), state oversight agencies, NTSB, FTA, FRA, and CTAA.

Data from this survey allowed researchers to gain a sense of the state of safety culture and practices across the transit

industry. The survey also identified public transportation systems recognized by peers for their positive safety culture that could be further examined through case studies and interviews. The survey did not solicit participants' perceptions of the effectiveness of safety culture within their own organizations; rather, it inquired about peer transit agencies thought to have positive safety cultures.

The initial draft of the survey instrument was sent to the project panel for review and was revised based on panel recommendations. The survey was carried out as an Internet survey through SurveyGizmo. Once the contact list was complete, the link to an online survey site was distributed to 718 potential respondents by e-mail. Multiple e-mail and phone reminders were conveyed to the stakeholders in the months that followed.

## Response Rate and Sample Description

By the conclusion of the survey period, 137 complete responses had been received, representing a 19.1% overall response rate. Another 102 contacts, or 14.2%, responded to a number of the introductory questions without completing the survey, yielding a total response rate (complete and incomplete) of 33.3%. All analysis, figures, and tables are based on complete responses only. This 19.1% response rate was lower than was hoped for, but it is within the expected range for online surveys found in *TCRP Synthesis 69: Web-Based Survey Techniques* (Spitz et al., 2006).

Figure 5 shows the number and percentage of complete responses. National and local labor representatives account for 26% of the responses; transit CEOs, 25%; safety professionals, 22%; safety oversight agency and industry association representatives, 11%; and transit board members, 4%. Figure 6 displays the number of respondents by transit mode, with some indicating more than one mode. Fixed-route bus and paratransit represent the two largest groups. Of the 122

respondents who indicated any transit agency affiliation, 98 (80%) represent multimodal agencies. Of the 118 respondents who indicated the ridership category of their transit agencies, 45 (38%) represent transit agencies with less than 20 million in annual ridership.

The statistical confidence limit for the overall population is plus or minus 7.61%, which means that it is 95% likely that the results from the survey are within plus or minus 7.61% of reality. Statistical confidence limits for the seven constituent subgroups, however, are much wider and therefore much less useful: CEOs, 14.9%; transit board members, 39.0%; safety professionals, 15.8%; labor representatives, 15.9%; and safety oversight agency and industry representatives, 17.2%. The drop in confidence limits is because of the much smaller target populations and correspondingly smaller number of completed survey responses within each subgroup. As a result, the recorded differences in perspective between these subgroups are not statistically significant enough to support any conclusions from the survey results alone. To be credible, such differences have to be supported by interviews, surveys, and other sources of information.

With these considerations in mind, the research team decided to use the initial survey results subject to confirmation from the transit agency mini-case studies and in-depth interviews. In determining key components of safety culture in transit, the transit stakeholder survey and the case study interviews turned out to be mutually reinforcing. This mutual reinforcement confirms the value of combining different methodological approaches in social science research, particularly the value of combining quantitative and qualitative methodologies to address related questions from different perspectives. Social science researchers have long held the consensus that this type of “integration leads to maximizing the strengths of the quantitative and qualitative data and minimizing their weaknesses” (Creswell et al., 2011).

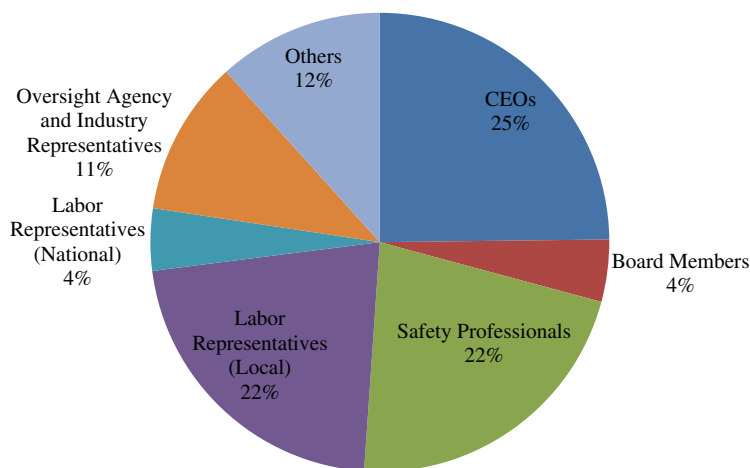
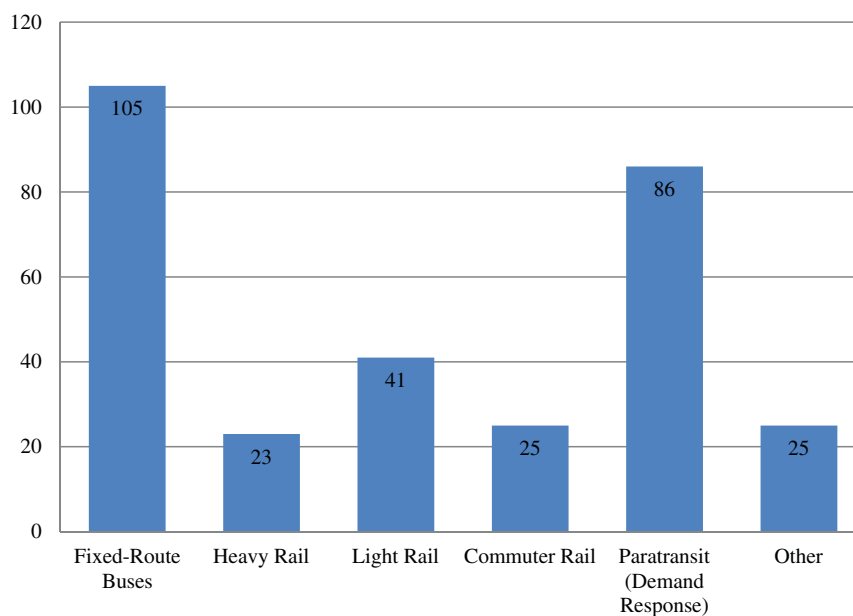


Figure 5. Number and percent of respondents by role.





**Figure 6. Number of respondents by mode.**

## Key Elements of Positive Safety Culture

Survey respondents were asked to rate the importance of 15 potential key elements or components (see full text in Table 2) of a positive safety culture, particularly within the transit environment. The list of key elements was generated based on preliminary findings from the literature review and additional project panel input. As the literature review progressed, a number of key elements also evolved. Many of these changes are also suggested by the survey respondents in their open-ended comments.

Table 2 shows the 15 key elements ranked from most important to least important as rated by the survey respondents. There were 13 components of safety culture listed in this section of the survey, with the respondent allowed to add up to four more. Each statement was ranked as “very important,” “important,” “moderately important,” “of little importance,” “unimportant,” or “don’t know.” Numerical scores were assigned, with 1 for “very important” through 5 for “unimportant.” The smaller the average score, the higher the ranking, with an average of 1 representing a perfect score. As the chart demonstrates, the three factors considered most important to a positive safety culture in this survey are:

- Management and employee commitment to safety as the top priority;
- Adequate training; and
- Open, effective communication.

The standard deviation column in Table 2 gives some indication of disagreement among respondents to each question.

In statistics and probability theory, the standard deviation measures the amount of variation or dispersion from the average score. A low standard deviation indicates that the data points tend to be very close to the mean; a high standard deviation indicates that the data points are spread out over a large range of values. The largest differences in ranking concern three elements: the importance of accident investigation focusing on preventing recurrence instead of blame, reporting near misses without fear of blame, and the effectiveness of employee safety reward programs. These rankings were used, in conjunction with literature search results, to draft mini-case study interview questions.

## Additional Key Elements or Components

At the end of the survey, participants were asked to write in as many as four additional key elements of safety culture. These additional comments confirm, improve on, and enrich many of the original 15 key elements and were later built into the case study interview questions. Common themes are listed here in the order of the frequency of related comments:

- **Employee and union involvement**, through mechanisms such as safety committees, peer communication, joint problem solving, and joint determination of training (four management, five union, and four unidentified comments).
- **Systems for accountability that emphasize procedural justice**, reinforced by organizational structure, employee evaluations, and rewards (four management, one safety oversight agency, and two unidentified comments).

**Table 2. Survey respondents' ranking of key safety culture elements.**

Key Elements Ranked by Total Average Importance	Total Responses	
	Average Ranking	Standard Deviation of Ranking
(1) Safety is recognized as the highest organizational priority, and both management and employees are committed to that priority.	1.32	0.64
(2) Adequate training is provided so employees have an understanding of how to perform their job duties in a safe manner.	1.66	0.92
(3) There is open, frequent, and effective communication on safety.	1.71	1.00
(4) Adequate financial and human resources are dedicated to ensure the safety and health of employees.	1.81	0.88
(5) Management and employees are willing to interrupt schedules and service for safety reasons.	1.82	1.02
(6) There is competence within the organization to draw appropriate conclusions from safety information.	1.83	1.00
(7) The organization takes action visible to employees on all reported safety issues.	1.87	1.04
(8) The organization collects and analyzes relevant data and actively disseminates safety information.	1.90	0.96
(9) There is significant employee involvement in the continuous improvement of safety policies and rules.	1.90	0.98
(10) The culture of safety is deeply ingrained in the organization, and no leadership transition from either management or union will likely change that commitment to safety.	1.90	1.07
(11) Accidents are reviewed from the perspective of future prevention rather than the focus being exclusively on finding someone to blame.	1.96	1.14
(12) There is a high level of trust between management and frontline staff.	1.99	1.09
(13) Employees are encouraged to report near misses and other safety events without fear of blame.	2.00	1.18
(14) Where there is union representation, the union is continually involved in safety processes, including joint safety data collection, analysis, and problem solving.	2.03	1.04
(15) Employees are rewarded for reinforcing safety at work.	2.23	1.14
<b>Average for all elements</b>	<b>1.86</b>	<b>1.01</b>

- **Safety as an organizational value** consistently emphasized by leadership and recognized as everyone's role and responsibility (four management, one safety oversight agency, and one union comment).
- **Risk reduction** through a systematic approach to identify, analyze, control, monitor, and report hazards, rather than legal compliance or discipline (five management, one safety oversight, and one union comment).
- **Training and retraining**, including mentoring (retraining following an accident is integral to progressive discipline) and educating the public (4 management and 2 union comments).
- **Effective information or data management** to measure performance and track goals, using key performance indicators (two management and two union comments).
- **Improve safety communication** using a myriad of technologies and tools (three management and one union comment).

Based on these additional comments, the top-ranked key element was modified to read "Safety as a core value to which management and employees are committed." The updated key elements can be found in Table 3.

Some respondents used this section to voice particular concerns with how safety is perceived and carried out within their

**Table 3. Mapping of 15 key elements against eight categories.**

Mini-Case Study Reporting Categories	Corresponding Key Elements in Rank Order from Transit Stakeholder Survey
A. Strong leadership, management, and organizational commitment to safety	1. Safety as a core value to which management and employees are committed 4. Adequate resources dedicated to safety 5. Management and employees willing to interrupt service for safety 10. Safety culture stable through leadership transitions
B. Employee/union shared ownership and participation	9. Significant employee involvement 14. Union involvement in safety process
C. Effective safety communication ( <i>informed culture</i> )	3. Open and effective safety communication
D. Proactive use of safety data, key indicators, and benchmarking ( <i>informed/learning/flexible culture</i> )	8. Using safety metrics and leading and lagging indicators to gauge safety performance
E. Organizational learning ( <i>learning/flexible culture</i> )	2. Adequate safety training provided 6. Organizational safety competence (recruitment and succession planning)
F. Consistent safety reporting and investigation for prevention ( <i>informed/reporting/learning/just culture</i> )	7. Visible action on all reported safety issues 11. Accident focus is preventing recurrence 13. Near-miss accident reporting in place (and data collected)
G. Employee recognition and rewards ( <i>just culture</i> )	15. Employee safety performance rewards
H. High level of organizational trust ( <i>just/informed culture</i> )	12. High level of trust between management and workers

own organizations or the organizations they oversee. For example, an oversight agency representative said that “transit agencies are selective, not transparent in regard to information sharing with state safety oversight,” “transit agencies are more focused on achieving minimum compliance,” and “transit agencies realize that there are no mandates that keep them systematically accountable.” Several union representatives expressed concerns about the lack of effective involvement of the union and rank-and-file employees when it comes to safety training, implementation of safety procedures, and employee discipline. One union respondent observed that the safety department is constantly overruled by the operations department in that transit agency.

### Identification of Transit Agencies with Positive Safety Cultures

At the end of the stakeholder survey, respondents were asked to identify transit agencies that they believed had a positive safety culture. This identification process was used to help

select transit agencies for follow-up interviews and mini-case studies. Respondents were not allowed to nominate their own transit agencies.

A list of 20 agencies was generated from those that were mentioned most frequently. To complement information provided by industry stakeholders, key performance indicators of safety culture were investigated at these 20 transit agencies. Anecdotal evidence, such as existing industry information collected through presentations at APTA and other industry conferences, and industry safety award entry documents (such as APTA’s Bus Safety and Security Excellence Award), were entered into a database. Much of this evidence pertains to indicators such as organizational safety communication and learning, safety training, labor and management cooperation around safety problem solving, and safety reporting practices. To gauge transit agency safety performance using publicly available indicators, safety statistics from the National Transit Database (NTD) were extracted, including annual fatalities minus suicides, accidents minus

suicides, and incidents from 2008 to 2010. Consideration was also given to the size and geographic distribution of the transit agencies. Using a combination of these factors, the list was narrowed down to 11 potential mini–case study candidates.

## Transit Industry Mini–Case Studies

### Mini–Case Study Design

A major focus of the research involved mini–case studies of transit agencies identified by industry stakeholders as possessing a positive safety culture. Interviews were sought with CEOs, safety directors and officers, mid-level managers from operations and maintenance, local union presidents and safety representatives, and frontline employees. Based on the literature review and the earlier survey results, a semi-structured questionnaire was developed to collect the perspectives of those interviewed.

Two agencies were not responsive after several attempts, and therefore mini–case studies were not pursued for these agencies. The final mini–case study locations were:

- Three large transit agencies: two on the West Coast and one on the East Coast,
- Three medium-sized transit agencies: two on the West Coast and one on the East Coast, and
- Three small transit agencies: one on the West Coast and two in the Midwest.

A list of top-level management and union contacts was compiled, and the research team e-mailed or phoned the individuals from the selected transit agencies, and in some cases visited them in person, seeking their participation in the mini–case study research. Most of the contacts responded positively. Where possible, the first interviews for each mini–case study were scheduled with the CEOs/general managers (GMs) and the local union presidents; they, in turn, provided a list of additional contacts. Interviews were recorded when consent was granted. To allow candid opinions to be shared, participants were assured of the confidentiality of the mini–case studies and their statements.

Beyond the background materials previously collected on each mini–case study, interviewers requested specific documentation of safety performance records, quarterly or annual safety reports, strategic plans that related to safety, safety committee meeting minutes, safety journals or newsletters, and so forth. As interviews were being completed, research team members analyzed transcripts and documents in preparation for writing the mini–case study reports.

By February 2012, a total of 64 individuals had participated in interviews, including 43 management representatives and 21 union representatives and frontline workers from

nine locations. Input by union representatives and frontline employees was used either to confirm or qualify the substance of information provided by management representatives.

### Overview of Findings

Detailed mini–case study reports were prepared for each of the nine locations for confidential internal use and for possible identification of potential best practices. Due to the confidentiality of the mini–case studies, the detailed mini–case study reports containing transit agency names and identifying persons interviewed are not included in this report. Additional information using transit agency code names is found in Appendix B. Instead, anonymous summaries and comparisons are presented here to establish major findings. Transit agencies are coded from “A” to “I.” The following sections present (1) an overview of the current safety culture status at the nine mini–case study locations, drawing from views of the diverse groups of management, employee, and labor representatives interviewed, and (2) a summary analysis of transit agency characteristics across the key elements identified from the literature review and the stakeholder survey.

### Safety Culture in the Mini–Case Studies

Safety culture is a journey, not a destination. Although those managers and union representatives interviewed generally considered the safety culture within their own organizations to be positive or somewhat positive, all agreed that there was ample room for improvement. One person said of the journey to safety culture: “It’s a way of life. Maintaining a safety culture requires vigilance and stick-to-itiveness and an ongoing commitment and realization that your work will never be done.”

In a number of locations, tragic accidents involving passengers and the public were the prime motivators for a renewed focus on safety and safety culture improvements. The memory of these events serves as a constant reminder of the paramount importance of safety in public transportation for everyone in the organization, from top management, the board, and union leadership to supervisors, operators, and shop-floor mechanics. All have come to realize that safety needs to be more deeply rooted in the organizational culture and supported by initiatives such as safety stand-downs, more effective communication, training and retraining, public awareness campaigns, vehicle redesign, and new technologies that help alert pedestrians and operators. Within these transit agencies, there is a sense of vulnerability, as is frequently the case in high-reliability organizations—the sense that, even if the current safety culture has reached its highest historical level, it is an ongoing effort, and they can never assume they are done.

Labor representatives generally rated the current status of their agency's safety culture somewhat lower than did their management counterparts. Union responses emphasized that safety culture and safety results were sometimes compromised by the pressure for on-time performance, the growing frequency of assaults on operators, and the lack of sufficient or effective involvement by employee representatives in problem solving and decision making.

## Safety Culture Mini-Case Studies Conclusions

Themes arising from analysis of the mini-case study materials can be summarized by the eight components or elements of safety culture:

- Strong leadership, management, and organizational commitment to safety;
- Employee/union shared ownership and participation;
- Effective safety communication;
- Proactive use of safety data, key indicators, and benchmarking;
- Organizational learning;
- Consistent safety reporting and investigating for prevention;
- Employee recognition and rewards; and
- High level of organizational trust.

Detailed mapping of the 15 key elements taken from the survey against these eight categories is provided in Table 3. The first two components can be considered key underlying perceptions, attitudes, and behaviors that drive safety culture, and, as shown in the parentheses in the first column of the table, the last six correspond to the five subcultures in Reason's model. The eight categories also sum up the 15 key elements and additional stakeholder comments from the stakeholder survey, with some categories covering multiple key elements. For example, safety as a core value, management and employee commitment, and adequate resources have been clustered under the "strong leadership, management, and organizational commitment to safety" category.

## Mini-Case Study Analysis

A comparative analysis of operating characteristics identified at the mini-case studies is presented in a series of tables in Appendix B. This analysis, which shows the range of implementation found across these nine transit agencies, is summarized in the following.

## Common Themes

Transit safety culture is multifaceted, integrating many elements, and has many available points of entry and initial

tion. Comparing operations across locations, transit agencies demonstrate varying degrees of emphasis and focus on the 15 key elements of safety culture that were identified in the transit stakeholder survey.

- **Recognizing safety as a top priority and core organizational value** is a common theme in all these examples of positive transit safety culture. Safety as a core value is ingrained throughout these transit agencies' organizational cultures, is largely unaffected by changes on the management or union leadership, and is reflected in practices such as putting safety resource needs at the top of the list of priorities and being willing to halt services for safety reasons.
- **Open and frequent communication and feedback** is a widespread practice in all the mini-case studies, except for one transit agency where communication still tends to be top-down.
- **Hiring and training to promote safety.** These transit agencies focus on hiring employees with a safety mind-set and continue to cultivate their competence in safety behaviors and decision making through training and retraining. Transit agencies A and G excel in safety training provided to employees throughout their organizations.
- **Labor management cooperation.** Transit agencies D, E, G, and I use joint labor-management safety committees as the primary platform for safety problem solving. According to most of the management and labor respondents at these mini-case study locations with joint safety committee experience, actively involving rank-and-file employees contributes to identifying day-to-day safety deficiencies and improving safety awareness and safety procedures.
- **Performance indicators.** Analysis of lagging indicators is conducted frequently at all the case study transit agencies and shared among different groups of employees to identify trends and pinpoint problems. Some of these agencies have just started using leading indicators such as internal safety inspections/audits and employee attitude surveys to gauge the level of safety culture and drive proactive changes. Transit agencies A, E, and F lead in their continuous effort to monitor and analyze safety data for problem solving.
- **Trust.** A relatively high level of trust between management and workers is found in five of the nine mini-case study transit agencies. Several of these transit agencies reported varying degrees of trust across different modes, divisions, and organizational functions.
- **Near-miss reporting.** In about half of the case studies, accident investigation is focused on prevention of recurrences rather than finding the party to blame or discipline. When unsafe conditions are reported, these transit agencies take actions visible to employees to rectify the situation or provide full explanation if no action can be taken. Near-miss reporting systems are being implemented at

four agencies (B, E, G, and I), all of which operate FRA-regulated commuter rail service, but near-miss reporting is fully embraced by managers and employees only in agencies E and I. These near-miss reporting systems have produced exceptional results. Individuals interviewed at these agencies mentioned open, frequent, and effective communication of safety messages, issues, and data analysis throughout the organization as the backbone supporting their safety culture.

- **Reward and recognition systems** for employees with outstanding safety performance are used at many of the case

study transit agencies. However, some transit managers see the value of these rewards systems as limited in positively affecting day-to-day safety awareness and performance.

### Cross-Cutting Themes

Review of the mini-case studies reveals important cross-cutting themes. For example, in all of the mini-case studies, transit agencies demonstrated most of the 15 key elements from the stakeholder survey listed in Table 4. In fact, with the exception of one location (C), which implemented only

**Table 4. Key elements of safety culture observed in nine mini-case studies.**

Key Elements	Agency Code										Agencies Total***
	A (S)	B (M)	C (S)	D (L)	E (L)	F (M)	G (S)	H (L)	I (M)		
1. Safety as a core value that management and employees are committed to (updated using stakeholder survey comments)	√	√	√	√	√	√√	√√	√√	√√	√√	9
2. Adequate safety training provided	√√	√	√	√	√	√	√√	√	√	√	9
3. Open and effective safety communication	√	√	+	√	√	√	√	√	√	√√	8
4. Adequate resources dedicated to safety	√	√	√	□	√	√	√	√	√	√	8
5. Management and employees willing to interrupt service for safety	√	√√	√	√	√	√	√√	√√	√√	√√	9
6. Organizational safety competence	√	√	√	√	√	√	√	√	√	√	9
7. Visible action on all reported safety issues	√	+	+	√	√	+	√	□	√√	√	5
8. Significant employee involvement	√√	√	+	√√	√√	√	√√	√	√√	√√	8
9. Using safety metrics and leading and lagging indicators to gauge safety performance	√√	√	√	√	√√	√√	√	√	√	√	9
10. Safety culture stable through leadership transitions	√	√	+	□	√	√	√	√	√	√√	7
11. Accident focus is preventing recurrence	√	√	+	√	√	+	□	□	√	√	6
12. High level of trust between management and workers	√	+	+	√	√*	+	√	√	√√	√√	5
13. Near-miss accident reporting in place (and data collected)	**	√	**	**	√√	**	**	√	√√	√√	4
14. Union involvement in safety process	n/a	√	+	√√	√√	+	√√	√	√√	√√	6
15. Employee safety performance rewards	√	√	√	√	√	√	√	√	√	√	9
Total***	13	13	7	12	15	10	13	13	15		

Legend: √ = key element implemented; √√ = key element emphasized; + = missing element linked to trust; □ = missing elements not linked to trust; S = small; M = medium; L = large.

\* High trust only in transit rail division.

\*\* These agencies do not directly operate commuter rail and are thus not regulated by the FRA to have a near-miss reporting system.

\*\*\* Double checks are counted as one, and row 13 (near-miss accident reporting in place) is not counted because this is implemented mostly in rail divisions that are regulated by the FRA.

seven of the 15 elements, all the mini–case study locations implemented at least 10 elements. Seven of the elements were found at all nine transit agencies, and another three elements were found at eight of the transit agencies.

Just as there are different points of entry for building a transit safety culture (for example, through emphasizing, training, partnerships, or systematically reducing risks), the mini–case studies show that these transit agencies have tied together and integrated safety culture concepts and practices. The key is sustained integration with a distinctive narrative that brings together multiple elements within the organization in a self-reinforcing culture. The specific language can vary, but the coherence of the message with mutually reinforcing practices needs to be sustained over time to generate a deeply embedded safety culture.

It is noteworthy that the labor representatives interviewed in the mini–case studies generally had a more skeptical and even at times negative view of transit agency safety culture compared to transit agency managers and executives. The absence of a high level of trust between management and employees was found in three of these nine mini–case studies—B, C, and F—and is associated with the following three related elements:

- Visible action not being taken on all reported safety issues (three of three cases);
- Accident investigation not focused on preventing recurrence (two of three cases); and
- Absence of union involvement in safety processes (two of three cases).

Low trust, inconsistent accident follow-up aimed at preventing future recurrences, and low employee and union involvement are the most significant negative factors detracting from truly outstanding safety culture in these transit agencies.

Numerically, this cluster accounts for 13 of the 18 missing features (72%) out of the total of 135 total matches in Table 4’s matrix of 15 safety culture elements mapped across the nine transit agencies. (The element of near-miss reporting is excluded from this analysis because it is relatively new, an innovation most frequently implemented today in FRA-regulated commuter rail operations that are found in only a minority of the nine transit agencies). The other five missing features occur across four agencies. They are a lack of accident investigation focused on prevention at two agencies (G and H), visible action not being taken on all reported safety issues at one agency (H), and a lack of adequate resources dedicated to safety and lack of stability in safety culture across leadership transition at another agency (D).

These patterns indicate that the largest group of missing features at these transit agencies is a complex that appears to link trust between labor and management with under-

lying objective conditions: visible action being taken on all reported safety issues, accident investigation focused on prevention, positive worker and union involvement, open and effective safety communication, and stable leadership over time. While mini–case study interviews show a greater skepticism among frontline workers and union representatives, the strongest safety cultures produce a stronger convergence of perceptions between labor and management. How do they do this? The answer can be seen in further analysis of the interplay among trust and the factors that generate trust—most fundamentally, visible action consistently being taken on all reported safety issues, a steady focus on preventing future accident risk, and union and workforce involvement in the agency safety process. This trust-centered complex accounts not only for differences in labor perception but also for the bulk of the recorded missing elements of safety culture in these nine transit agencies—16 out of 18, or 88%.

## Conclusions

This project’s research revealed consistent results between the literature review, the quantitative survey of transit stakeholders, and the mini–case studies and interviews. The three elements of transit safety culture identified receiving the greatest consensus were:

- Management and employee commitment to safety as a core value,
- Adequate training, and
- Open, effective communication.

The stakeholder survey found the greatest divergence of stakeholder rankings on three topics: the importance of accident investigation focusing on preventing recurrence instead of on blame, the role of a near-miss reporting system, and the effectiveness of employee safety reward programs. Survey data indicate that perceptions of safety culture are weaker at smaller agencies.

The selection of transit agencies for mini–case studies was based in part on stakeholder survey peer nominations and anecdotal supporting evidence, such as industry recognition for outstanding safety performance. However, transit agencies that did not rank well in the safety statistics from the NTD (annual fatalities minus suicides, accidents minus suicides, and incidents from 2008 to 2010) were eliminated.

Mini–case studies that focused on safety culture at nine large, medium, and small transit agencies revealed a number of leading areas for developing a positive safety culture, including:

- Leadership and organizational commitment,
- Organizational learning,
- Open and frequent safety communication,

- A systematic approach to safety reporting and accident investigation,
- Active involvement of union and rank-and-file employees, and
- Data-driven safety problem solving.

The most important of these features are found at all of the nine transit agencies and provide several distinct points of entry for safety culture initiatives.

Union representatives and workers interviewed expressed less sanguine views than others about the general status of safety culture within their workplaces, particularly in agencies where safety culture fell short on a complex of elements

linked to trust. In the interviews, they expressed the opinion that safety is sometimes compromised by the pressure for on-time performance. The degree of labor skepticism is greatly reduced by a complex of practices that generate trust, including, most prominently, taking consistent action on all identified risk factors, focusing on prevention rather than blame, and workforce and union involvement in safety processes.

This survey and these mini-case studies help define safety culture in transit. They have also led to the design of a draft self-assessment survey instrument. Finally, this research process identified a number of innovative best practices for possible future adoption by other transit agencies.



## CHAPTER 3

# Safety Culture Outside Public Transportation

### Introduction

An important part of this research was to examine industries and companies outside public transportation that have created positive safety cultures and identify lessons that can benefit safety culture at transit agencies.

### Identifying Interview Candidates

Companies to be interviewed were recognized industry leaders that have made significant and sustained improvements to their safety cultures. The primary goals of the interviews were to determine how these improvements were made to their safety cultures and to identify key findings that might benefit public transportation systems.

The research team compiled a list of 21 candidate companies, drawing from the literature review; National Safety Council, OSHA, and various industry and trade organization awards and honors; and panel recommendations. Diverse candidates were sought, including companies that were large and small, union and nonunion, and singular and plural in services offered—much like transit agencies of various sizes and with various services.

Following panel approval of the list of candidate companies and of the interview protocol, the research team began to contact senior safety executives and managers from the list of candidate organizations for interviews. Nine of the organizations agreed to interviews and to provide pertinent materials. Each interview was approximately 1 hour long. This chapter presents the key findings from these interviews and the materials received.

### List of Interview Companies and Participants

The individuals interviewed represent a cross-section of industries, and each interview contributed valuable information on safety culture that will benefit transit agencies. The list of those interviewed is shown in Table 5.

### Summary of Current Safety Cultures in Nine Companies

The interviewees all take pride in their companies as safety leaders within their industries. When most interviewees discussed the priority given to safety within their company's culture, they said safety is a principle rather than just a priority. To label safety a priority suggests a possible lack of permanence; while principles are deeply ingrained in a corporate culture and seldom change, priorities may shift by the hour.

Overwhelmingly, positive safety cultures were described as being deeply ingrained at every level of the organization, and each interviewee expressed a belief that employees are the company's most valuable assets; keeping the workplace safe and protecting employees from safety incidents make the workplace and the company more productive. Interviewees also stated that all their employees are champions of safety culture and that, while it's important that top-level executives exhibit positive safety practices and demonstrate a commitment to safety, the real responsibility for safety in day-to-day operations must rest with each employee.

The research team compared and contrasted performance at the nine companies against the same set of safety culture components or elements that emerged during the nine transit agency case studies in Chapter 2:

- Strong leadership, management, and organizational commitment to safety;
- Employee/union shared ownership and participation;
- Effective safety communication;
- Proactive use of safety data, key indicators, and benchmarking;
- Organizational learning;
- Consistent safety reporting and investigation for prevention;
- Employee recognition and rewards; and
- High level of organizational trust.

**Table 5. Completed interview contact list.**

Company	Title	Industry
AA	Safety Coordinator	Manufacturing
BB	Vice President (VP), Risk Management	Construction/equipment rental
CC	Director of Capability and Compliance	Aviation manufacturing
	VP, Environment, Health and Safety	
DD	General Manager, Safety	Railroad
	VP, Safety	
EE	Director, Environment, Health, and Safety	Chemical manufacturing
	Director, Safety Programs	
FF	Director, Global Employee Safety Practice	Multiple products
	Senior Public Affairs Specialist	
GG	Safety Programs Manager	Oil/gas production and distribution
HH	Corporate Safety Director	Construction
	Corporate VP, Business Development and Marketing	
II	Head of Safety Office	Airline
	Senior VP, Quality Manager, and Head of Operation Management and Supply	

Key findings from the interviews with companies outside public transportation are presented in the following, and more detailed information may be found in Appendix C.

### **Strong Leadership, Management, and Organizational Commitment to Safety**

All the interviewees consider the CEO and the board of directors as vital to their safety culture, but employees at the field and supervisory levels are overwhelmingly acknowledged to be the key players in keeping the workplace safe and making safety the most fundamental component of day-to-day work.

Some companies create opportunities for the CEO to interact with employees through site visits or webcasts and make safety the first item on the agenda for all of these encounters. Safety is a key point in all corporate meetings and correspondence, from board meetings to daily worksite meetings.

### **Employee/Union Shared Ownership and Participation**

Companies with positive safety cultures include employees at every level in the definition and execution of their primary processes.

Most of the companies interviewed employ union workers, and all of these companies agree that the key to safety success is a joint labor–management relationship and management–union cooperation. With the exception of one company, where most business is done in the Midwest and unions are typically less active than in other areas of the country, all companies agree that lesser distinction between union and corporate employees leads to higher-functioning safety culture results. A common thread among the companies with significant union representation and successful safety programs and cultures is the ability to work with union representation on safety committees and councils. More detailed information on the aspects of employee/union shared ownership and participation may be found in Appendix C.

### Effective Safety Communication

The nine companies use a wide range of methods to communicate with their employees. They each communicate frequently and allocate significant resources to communication. Many companies use message devices, such as LED (light-emitting diode) screens in facilities and mounted on equipment to reinforce the safety message.

Weekly management conference calls at one company are conducted and led by the CEO and begin with a review and discussion of safety performance and safety incidents. The company also conducts quarterly meetings in which all employees are invited to participate. Key performance indicators, goals, and objectives, and any training needs that might be unmet, are discussed in an open forum. After all safety issues are addressed, other teams, such as sales and operations, are given the opportunity to address any issues they deem necessary. While the company is union organized, and attendees at the meetings are not paid for this time (meetings are after-hours, typically lasting from 4:30 p.m. to 6:30 p.m.), the attendance rate is approximately 85% of the available workforce in any region.

Another company communicates safety points and investigation results at morning stand-up meetings at a local level. These meetings are typically conducted in manufacturing facilities and include reviews of safety issues or activities that are relevant from the preceding 24 hours. The company believes that the best way to communicate safety information is employee to employee. Supervisor–employee discussions are viewed as a positive tool to communicate safety information.

Supervisors in a third company conduct a weekly locker-room talk that uses actual case studies of past safety incidents.

Several companies believe that open and available information is key to safety success and communicate with employees regularly and share safety concerns, issues, and solutions in frequent e-mail correspondence. One of these companies

worked with a development company to create a smart-phone application that puts crisis management flowcharts at people's fingertips.

Another company uses 55 leading safety culture indicators and monitors them in real time. When the numbers indicate that there is a problem, the issues are identified collaboratively and discussed, and all parties work together toward addressing the problem. The CEO informs the board of directors monthly of all safety issues addressed. The board of directors monitors the degree of accountability in the field as well as at the management level.

### Proactive Use of Safety Data, Performance Indicators, and Benchmarking

Because the size of the companies interviewed varied, processes that monitor safety culture and safety performance vary as well. These processes produce both quantitative and qualitative results. Some companies express the importance of measuring themselves against organizations in their industry. One company, however, believes that benchmarking against other companies is not as rigorous a process as establishing the highest possible standards internally and measuring itself against those standards. Overwhelmingly, all companies interviewed expressed the importance of being open and honest with all employees about information gained from performance measurement practices and allowing employees to play an active role in the process by providing feedback and suggesting ways to improve safety performance.

Various means are employed to ensure continuous improvement in safety culture. All companies interviewed expressed the importance of periodic surveys and interviews with employees and management to gauge their perceptions of safety culture and safety culture improvement. One company surveys employees annually, while others believe that it is more beneficial to gather this information every 2 years or more; this allows employees more direct experience with any changes or adjustments to safety programs. Another company gathers focus group data every 18 months.

Previously, one company had used employee safety culture survey data as a gauge for climate and culture in its plants. However, at the time of the interviews, this company was making an effort to use near misses, incidents, and other leading indicators to design enhancement programs. Another company tracks dozens of leading and lagging metrics through its management system and uses these data to improve safety programs and performance.

### Organizational Learning

According to Senge (1990), learning organizations are those in which “people continually expand their capacity to

create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning to see the whole together.” Each of the organizations interviewed uses reporting systems analysis to gauge organizational learning/safety training needs. Most of these companies make a great effort to make safety information and the lessons learned from that information available to all employees across the business and/or across industries. This access to information allows the culture to remain open and allows employees to actively engage in the safety process. Company AA posts safety information on an online safety bulletin board; Companies DD and EE employ company-wide intranets to disseminate safety facts and information; Company DD produces a monthly safety DVD that is distributed to every division, allowing every employee an opportunity to review with a supervisor; and Company II maintains its safety tracking system online using 55 factors developed specifically for the organization.

## Training and Education

Most companies delineate the qualifications and responsibilities for each job and include detailed training requirements. For example:

- Company II mandates a certain number of annual training hours for each position and uses its real-time safety data system to monitor positions for additional training needs and to adjust schedules based on that information.
- Company HH monitors employee progress and gauges retention of information based on safety performance, and when employee performance indicates a need for additional training, it is provided.
- Company GG’s training and compliancy insurance needs are monitored through the management system. Measurement tools and solutions to training needs are tailored to fit the person and the position.
- Company CC bases training needs and programs on OSHA requirements and results from internal reporting.
- Company DD uses company-paid union officers as safety trainers; these trainers are responsible for sharing a message that the “symptoms” that indicate that safety may be compromised are ambiguity, distraction, fixation, and complacency.
- Company BB makes training employee-centered, training a “handful” of employees on new equipment when it arrives and allowing those employees to train others in the workforce who will be using that equipment; employees who are training others are compensated for their time. The company believes that this process encourages a self-directed and empowered workforce.

- Company EE has online training resources that are available to employees all over the world in their native languages. These programs are available any time of day, increasing the likelihood that employees will take advantage of them.
- Each company shared a belief that while management-led training programs can be beneficial, the most effective form of training and performance improvement is employee-to-employee interaction. Company BB views mentorships and coaching as being essential both to its success and to building its craft. While there may be only one person assigned to a specific role on a job site, he or she is responsible for ensuring that an equally capable, safety-minded employee can take over in an absence or emergency. Company CC believes that strong mentoring and succession planning around safety and safety culture leadership enhance organizational learning.
- While Company GG recognizes the value of mentorship and coaching programs, a company-wide mentorship and coaching program does not exist. Some regions have a support system in place within smaller segments of the company to ensure that safety is a focus in each and every position.
- Company HH considers it a priority to engage the CEO and corporate safety director in mentorship and coaching opportunities. They interact regularly with area safety directors and visit job sites and area offices to connect with employees on a regular basis. Specialty groups get together and mentor and coach each other in different areas; each office has distinct areas of expertise. Some might build skyscrapers and others might build medical offices. Each group is viewed as having valuable contributions to make to the other. The opportunity to share information is valued.

## Recruitment and Succession Planning

Senge states that only those organizations able to adapt quickly and effectively will be able to excel in their field or market and that two conditions are essential: (1) the ability to design the organization to match the intended or desired outcomes, and (2) the ability to recognize when the initial direction of the organization will not lead to the desired outcome and adjust accordingly (Senge, 1990). Part of designing an organization to match desired outcomes and adjusting as necessary has to do with the recruitment of new employees and succession planning.

Each interview participant believes that recruiting employees who are safety-centered and who think in alignment with corporate philosophy makes the organization a better place. The large organizations believe that employees can be taught specific skills but that alignment with corporate philosophy (especially safety) is a more essential criterion. At the time of the interviews, Company DD was in a unique position to improve culture, with 50% of its workforce having been

with the company for 5 years or fewer. This has afforded the company the opportunity to recruit a large percentage of its workforce for safety through a process that includes safety messaging on advertisements for open positions and a set of 10 to 20 key interview questions about candidates' safety experience on the job—such as the extent of past involvement in safety committees. Companies that use subcontractors place great emphasis on those subcontractors' safety practices and philosophy. Company GG's safety program manager shared his concern that incorporating safety and safety culture considerations into the recruiting process may be fraught with potential legal issues. At the same time, he said that the company is looking into ways to do just that.

Company BB and Company GG have formal succession planning in place, allowing employee mentorship programs to feed this process. While Company BB certainly prefers to operate with a “grow-your-own” philosophy, they are not hesitant to provide positive recommendations to employees who have opportunities for growth in other companies before something is available for them in-house. The only positions for which Company BB regularly recruits outside the company are in senior financial and sales/marketing management. Candidates are recruited with safety in mind. Regardless of the length of time a person has served or the qualifications he or she has, safety is a key part of the succession planning process.

### **Consistent Safety Reporting and Investigation for Prevention**

In the majority of interviews with companies outside the public transportation industry, employee involvement and open reporting environments were found to be common threads in discussions of safety reporting and investigation. Each interviewee made it a point to say that, since employees are a company's most valued assets, their participation in safety reporting and issue resolution is vital. Several companies expressed pride in the fact that, while anonymous reporting mechanisms are available, incidents and near misses are almost always reported openly. One company attributes an increase in incident reporting to active union representation on safety committees. Many interviewees shared the belief that, when employees are engaged and interested in finding resolutions to safety issues, they are more enthusiastic than apprehensive about reporting and more likely to contribute to creating solutions and resolutions. They also become more engaged in the safety process.

One company places great emphasis on ensuring that safety investigations are not fault-finding processes. In most cases, when incidents are investigated, employees are kept on the job—not because the company is driven by production, but because it recognizes that employees need to work. Engaging in a nonthreatening process leads to greater cooperation and better fact finding. There is no punishment associated

with the fact-finding process; rather, there are opportunities to remain engaged in the work environment and engaged in safety issue resolution. This company and three other companies specifically mentioned their use of a root cause analysis process that involves employees at various levels within the company. These fact-finding processes and root cause analyses are clearly delineated and create a sense of progress around what might otherwise be a demoralizing event. Employees at every level, often up to and including the CEO, examine near misses and incidents to identify key facts and contributors, create reports, implement processes for improving safety, and analyze the effectiveness of such fact-finding processes and root cause analyses. Across the board in the companies interviewed, one of the most important elements of root cause analysis is that results and findings are shared with all employees.

Another company stated that it is vigilant when investigating near misses, which are entered into a company-wide database. While there is little punitive action taken, a close eye is kept on those involved, allowing the company to address any trends in risk-taking behavior that might arise.

### **Employee Recognition and Rewards**

Views on incentives and rewards varied significantly among the interviewees. While some companies believe that incentivizing safety performance leads to improvement, others are wary that the unintended consequence of the incentives would be employees not reporting accidents and incidents in order to secure rewards. One company offers employees with strong safety records added vacation days and sporting event tickets, while another offers monetary rewards to corporate employees and safety-related gear to field employees who demonstrate a commitment to safety excellence.

One company's safety program manager expressed a concern about the balance of incentivizing safety versus the risk of inhibiting reporting of near misses and incidents. The company is trying to steer leadership away from offering incentives tied to measuring lagging indicators. A revised approach seeks a more balanced incentive program that includes analysis of leading indicators such as hazard reports, near-miss reports, and participation in inspections, surveys, and risk assessments.

### **Conclusions**

Following are conclusions regarding safety culture outside public transportation.

- Each participating company emphasized the importance of strong leadership. The companies with the strongest safety cultures consistently noted the role and level of involvement of the CEO. One company said that safety consciousness should be “in the DNA” of the CEO.

- All organizations with positive safety cultures empower employees to champion safety values.
  - The companies interviewed employ many different ways to communicate with their employees. What is common to all is the intensity of communications and the significant amount of resources allocated to that purpose.
  - All of these companies accumulate and analyze data and use it to great advantage; most use employee surveys.
  - The benefits realized in the areas of retention, recruitment, and return on investment that stem from the significant training expenditures characteristic of the private sector are frequently not fully appreciated by public transportation organizations.
  - The practice of reporting and investigating in an environment free from fear is common to all companies interviewed, and there is unanimous agreement on the importance of near-miss reporting.
  - Employee recognition and rewards is the area in which there is the greatest diversity of practice within the group of companies interviewed; some use employee rewards, but others are concerned that the unintended consequence of such rewards could be employees not reporting accidents and incidents in order to win the awards.
  - Each interviewee expressed the need for a trusting environment, which encourages open reporting of near misses or unsafe actions, potentially forestalling disaster; a good indication of a successful safety culture is the willingness of employees to waive the option of anonymity to place their names on a report or safety document; such a level of trust clearly demonstrates a positive safety culture.
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## CHAPTER 4

# Definition and Key Components of Safety Culture for Public Transportation

### Introduction

Culture is a set of learned behaviors, attitudes, customs, and beliefs; it is reinforced by ritual and endures from generation to generation. However, defining safety culture is not and never has been an easy task, as our literature review has revealed.

To arrive at a definition of safety culture for the public transportation industry, the research team identified and prioritized key components from the literature, examined the mini-case studies, surveyed and interviewed industry representatives, and established an expert safety culture panel (ESCP) to assist in the task. The research team also considered the work of other industries and federal agencies.

### Definitions from the Literature

Of the many definitions of safety culture in the literature, the research team considers the following seven definitions to be the most compelling. These definitions also have considerable support in many industries and federal agencies:

- **INSAG:** “That assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance” (International Nuclear Safety Advisory Group, 2002).
- **Uttal:** “Shared values (what is important) and beliefs (how things work) that interact with a company’s people, organizational structures, and control systems to produce behavioral norms (the way we do things around here)” (Uttal, 1983).
- **Eiff:** “Shared values, norms, behaviors about minimizing risk, respect toward safety, and technical competence shared by individuals and groups of individuals who place a high premium on safety as an organizational priority” (Eiff, 1999).
- **UK Health and Safety Commission:** “The product of individual and group values, attitudes, competencies, and patterns of behaviour that determine the commitment to,

and the style and efficiency of, an organization’s health and safety programs. Organizations with a positive safety culture are characterized by communications founded on mutual trust, by shared perceptions of the importance of safety, and by confidence in the efficacy measures” (Health and Safety Commission, 1993).

- The DOE says a safety culture is “an organization’s values and behaviors, modeled by its leaders and internalized by its members. These values and behaviors serve to make safe performance of work the overriding priority to protect the public, workers, and the environment” (EFCOG/DOE, 2009).
- TRACS defines safety culture as “the product of individual and group values, attitudes, perceptions, competencies, and patterns of behavior that can determine the commitment to and the style and proficiency of an organization’s safety management system” (Transit Rail Advisory Committee for Safety, 2011).
- The FRA defines organizational culture as “shared values, norms, and perceptions that are expressed as common expectations, assumptions, and views of rationality within an organization and play a critical role in safety.” It notes that organizations with a positive safety culture are characterized by “communications founded on mutual trust, by shared perceptions of the importance of safety, and by confidence in the efficacy of preventive measures” (U.S. Federal Register, 2012).

While there is some commonality, these definitions tend to emphasize different aspects and components of safety culture; there is no convergence toward a universal definition.

### Expert Safety Culture Panel

In order to assist in understanding safety culture, the research team convened the ESCP. The research team identified likely candidates and submitted their names to the project

panel for review. All of the nominees were from organizations identified as having positive safety cultures. The research team thereby chose a group of individuals with experience working in a positive safety culture that was available to vet key findings and recommendations. Members who accepted their nominations represented the organizations and held the positions shown in Table 6.

In a conference-call discussion, the ESCP considered safety culture definitions and components drawn from the literature review conducted by the research team. Major points made by members of the ESCP are included in the following comments:

- “In most important respects, as Reason says, a safety culture is an informed culture as well as a reporting culture, a flexible culture, a learning culture, and a just culture.”
- Another participant pointed out that Thadden and Gibbons believe that “safety culture is defined as an enduring value in prioritization of worker and public safety by each member of each group and every level of an organization.”
- “In addition to the textbook definition, there needs to be a layman’s definition; one that I have seen is ‘safety culture is what employees do when no one is looking.’”
- “I firmly believe that ‘what you do is much more important than what you say.’”
- “It is absolutely essential to enforce adopted rules and perhaps equally important to eliminate rules if they are not

going to be enforced. In my view, the latter actually breeds unsafe practices.”

- “The demonstrated belief that all tasks can be completed free of harm and/or incident. An entire organization truly devoted to the health and well-being of each individual on and off the job through the dedication of resources. Behaviors and mind-sets which convey the utmost value of caring and focusing on protecting oneself and others.”
- “Safety culture means the product of individual and group values, attitudes, perceptions, competencies, and patterns of behavior that determine the commitment to and the style and proficiency of an organization’s health and safety management.”
- “Safety is our first priority, and the System Safety Program Plan is the vehicle by which this priority is incorporated into all aspects of the operation and the performance of every employee.”
- “. . . each employee is responsible and accountable for accident prevention, for maintaining safe standards, and for creating an atmosphere of cooperation and commitment that continues to place the highest attention on safety.”
- “Beyond the definition, if there is something to be built (it takes 4 or 5 years to develop a safety culture), there has to be a foundation level at which everyone begins. As you go along, the training, orientation, identification of participants in culture development—that is the most successful

**Table 6. Expert safety culture panel.**

Organization	Title
Orange County Transportation Authority (OCTA)	Executive Director, Human Resources and Organizational Development
OCTA	Director, Health, Safety, and Environmental Compliance
LA Metro	Corporate Safety Officer
SamTrans	GM/CEO
SamTrans	Deputy CEO, Finance and Administration
ATU Local 1574 (SamTrans)	Local President
New Jersey Transit	Deputy General Manager, Safety and Training
United Transportation Union (UTU) Local 60 (NJ Transit)	General Chairman
King County Metro	Safety Supervisor
ATU Local 587 (King County)	Local President
Champaign-Urbana Mass Transit District	Safety and Training Director
AmQuip Crane/Rental, LLC	VP, Risk Management
CSX Transportation	VP, Safety
CSX Transportation	General Manager of Safety



way to achieve it. . . . you have to train everyone from the bottom up. One way of achieving a positive safety culture is to empower the people involved to agree to it, to buy into it, and to share their values with the upper-level people.”

- “If we are going to establish safety culture in any organization, leadership by personal example starting at the top has to occur. That has to be the catalyst that gets everything else going. From that, the training, tactics, and procedures can evolve. If you don’t have buy-in from the get-go, the project is doomed.”
- “There will be some resistance and a paradigm shift from jump-street; so there has to be an epiphany from those resisting or someone has to be made an example or be removed because they are not fostering the principles that you are trying to establish.”

Some common themes received strong, empathic, and recurring expression, reflecting both transit agency experience and industry expertise:

- Safety culture is the result of embedded values and attitudes that produce behavior patterns; it is what it is and not just what anyone says it is.
- Keeping the audience in mind, communicating the message, and choosing appropriate language are important: KISS (keep it simple, stupid).
- Getting to a positive safety culture requires strong, committed, and decisive leadership.
- Employee buy-in, ownership, and empowerment from the outset are critical.
- The work never ends; safety culture “is a journey, not a destination.”

## Components of Safety Culture in Transit

This report has examined the literature to identify components of safety culture and has shown the difficulty of arriving at a widely accepted definition of safety culture suitable for public transportation. As previously detailed in the review, the literature also offers many different sets of components of safety culture.

## Cross-Referencing the Literature Review with the Stakeholder Survey

To identify the components of safety culture that are most often cited, Table 7 shows safety culture components that were present in the literature review and selected in the transit industry survey of executives and safety professionals.

As previously established and supported by all aspects of the team’s research into safety culture in the literature, the public transportation industry, and companies outside public transportation, the components of safety culture in public transportation can be reduced to:

- Strong leadership, management, and organizational commitment to safety;
- Employee/union shared ownership and participation/empowerment;
- Effective safety communication;
- Proactive use of safety data, key indicators, and benchmarking;
- Organizational learning;
- Consistent safety reporting and investigation for prevention;
- Employee recognition and rewards; and
- High level of organizational trust.

## Defining Safety Culture

### Alternatives

Sharing from his direct experience at New York City Transit (NYCT) dealing with problems associated with safety culture, research team member Roger Toussaint states:

*Positive safety culture entails structured and verifiable employee buy-in and shared ownership in the safety process. This is very different from just being invited to a management meeting or even just being asked to participate in a union leadership initiative. Safety must be integral to the core mission of the organization and not just a cliché. The level and degree of CEO and management hands-on, boots-on-the-ground, leadership-by-example, and commitment throughout the organization must be measurable. Safety culture must be built in to all facets of the operation that impact safety and overall employee morale. A safety system with positive culture runs on data-driven evaluations and decision making for every situation, with appropriate metrics and measurement tools, early warning systems, fail-safe measures, and redundant systems.*

The research team drafted several alternative definitions for possible application to public transportation:

- Safety culture is the sum of all attitudes, values, and behaviors related to safety, which are common or shared within a public transportation organization and jointly determine how work is performed and how the agency operates.
- Safety culture strives to establish and maintain enduring root values and attitudes, with policies, standards, procedures, and behavior arising thereof that bind and commit all members and facets of the operation to the transference of the priority of safety to all current and future participants and to all elements that affect the operation.

**Table 7. Frequency of inclusion of various safety culture components.**

Component of Safety Culture	Zohar	ICAO	Hudson	Fleming	INEEL	Task 2 Survey	Survey Rank
Learning culture/emphasis on education and training	x	x	x	x	x	x	2
Informed culture/good management–worker communications	x	x	x	x		x/x	3/8
Management commitment	x	x		x	x	x	1
Organizational commitment/adequate resources				x	x	x	4
Staff understands hazards/shared perceptions of hazards/competence in handling hazards		x		x		x	6
Viable reporting system/visible action taken			x			x/x	13/7
Employee involvement/participation in safety matters				x	x	x	9
Flexible culture/senior management open to opposing views and encourages feedback		x	x				
Just culture/assigning blame not first priority			x			x	11
Productivity versus safety—employees can stop work/interrupt schedules for safety				x		x	5
Trust				x		x	12
Industrial relations/positive union involvement				x		x	14
Job satisfaction				x	x		
Accountability/reward systems					x	x	15
Safety rules are realistic and workable		x					
Stable leadership transitions						x	10
Environmental control and good housekeeping	x						
Stable workforce/older workers	x						
Distinctive ways of promoting safety	x						
Performance management					x		
Coworker support					x		

Notes: Double entries, such as “x/x” or “3/8,” signify the presence of two elements being separately cited within a single component—for example, “viable reporting system” and “visible action taken.” ICAO = International Civil Aviation Organization; INEEL = Idaho National Engineering and Environmental Laboratory.

- Safety culture is a sustained set of attitudes and behaviors that combine to deliver safe, efficient transportation services to the public.
- Safety culture is a collaboration among management, supervision, and workers to create and maintain a sustained and unwavering attitude and set of behaviors designed to deliver consistently safe, efficient transportation services to our agency’s customers.
- Another alternative can be derived from the Uttal definition, which is: “Safety culture is shared values (‘what is

important’) and beliefs (‘how things work’) that interact with a company’s people, organizational structures, and control systems to produce behavioral norms (‘the way we do things around here’)” (Uttal, 1983). The strength of the Uttal definition is that it captures and portrays the dynamic interaction among values, beliefs, employees, organizational structures, and control systems that combine to produce behavioral norms. Other definitions tend to be one-dimensional in comparison. Modifying the Uttal definition to tailor it more specifically to public

transportation would produce: “Safety culture is shared values (what is important to all public transportation employees who are delivering safe, efficient revenue service) and shared beliefs and attitudes (how the transportation system works and what individual employee roles should be) that interact with employees, safety policies, procedures, and rules to produce behavioral norms (the way we do our jobs, whether observed or not).”

The research team provided a preliminary draft of this chapter to the ESCP for feedback and discussion. A number of suggestions and clarifications were provided. The ESCP and research team members agreed that a balance must be struck between complexity and simplicity in any definition adopted. Complex definitions may be difficult to grasp and remember. The simplest definitions, however, fail to portray the essence of safety culture and its distinguishing characteristics. Safety culture is not a simple phenomenon.

The challenges that those in the industry face in moving toward a more positive safety culture must be made clear, and employees must be motivated to make the necessary changes. While these efforts are grounded in the literature and in industry experience, getting to a generally accepted industry-wide definition will require marketing and art.

In that regard, this definition needs an imperative. The research team suggests:

- Safety is doing the right thing, even when no one is looking.
- Safety is the core value we all share.
- Safety takes priority over other competing goals.
- Safety is how we work and how we do everything.

## Conclusions

There are many possible definitions of safety culture for the public transportation industry. However, the research team believes a modified Uttal definition is the best alternative:

*Safety culture is shared values (what is important to all public transportation employees who are delivering safe, efficient revenue service) and shared beliefs and attitudes (how the transportation system works and what individual employee roles should be) that interact with employees, safety policies, procedures, and rules to produce behavioral norms (the way we do our jobs, whether we are being observed or not).*

In conclusion, the Uttal definition is one of two that Reason has endorsed (Reason, 1997). Also, there are strong similarities between our proposed definition and those adopted by the U.S. DOE, the FRA, and TRACS.

## CHAPTER 5

# Methods/Tools for Assessing Safety Culture

## Introduction

Assessing the state of safety culture in an organization is as important as measuring on-time performance or equipment reliability. In order to improve the state of safety culture in an organization, it is essential to establish a baseline and then periodically measure progress. It is therefore the research team's opinion that transit agencies need to have the expertise necessary to assess and reassess their safety cultures.

This chapter will discuss:

- Methods for assessing safety culture,
- Assessment planning, and
- Survey design.

The chapter will then:

- Provide an example of the development of a survey,
- Discuss the testing of that survey at two transit agencies,
- Provide examples of how such results can be used, and
- Explain the process for survey validation and reliability testing.

Finally, the chapter will present the team's conclusions about safety culture assessment.

## Methods for Assessing Safety Culture

Various individual methods may be used to assess an organization's safety culture. Among the most common and frequently used are direct observation, interviews, surveys, focus groups, and performance indicator tracking.

Safety culture assessments require a significant investment of resources to gather information and, sometimes, a far greater investment to remedy problems found. Such full assessments are therefore most often launched by a transit agency board

and/or a CEO committed to the improvement of the state of safety culture in the organization. After making the decision to proceed, the first and most important step is to engage management and union leadership teams to explain the purpose and mechanics of the assessment. Supervisors and hourly workers need to be similarly engaged and involved.

## Direct Observation

Direct observations of workplace behavior may provide objective information regarding the aspects of safety culture, including effectiveness of training, management, accountability, and behavior expectations. Direct observation of employees at work can provide valuable information on employee involvement, attitude, and willingness to confront perceived unsafe behavior. The observer can watch the culture at work and can confirm results obtained from interviews and surveys. Observations can provide new information on cultural phenomena. However, observations—even if scored on a checklist—cannot be precisely quantified, and there is always the risk of overgeneralization from too few observations (EFCOG/DOE, 2009). Conducting sufficient observations to produce an accurate assessment of the state of safety culture in an organization of any size is necessarily time-consuming and expensive.

## Interviews

Interviews can also be used to develop information on the state of safety culture in an organization. One advantage of interviews is that the respondents are not limited by the wording or structure of a written survey. The greater flexibility inherent in an interview allows the interviewer to drill down until an issue or problem is fully clarified and all ambiguity resolved. As with direct observation, generalization of findings to the entire organization is risky if the interviews are limited in number and if interviewees do not accurately represent the overall

workforce. As with direct observation, interviews can be time-consuming and expensive. Interviews can also be used to provide input to the design of a safety culture survey or to explore safety culture issues in greater depth that have emerged from a survey.

## Focus Groups

Focus groups are more efficient but less flexible than individual interviews in assessing safety culture. One interviewer can elicit the views of multiple employees in a single focus group. Valid focus groups are conducted by skilled, experienced facilitators who bring all participants into the discussion. Well-designed focus groups can provide great sources of insight beyond surveys. Flexibility is somewhat reduced because the facilitator generally uses a set of prepared questions to bring basic organization and direction to the discussion. A significant downside to focus groups is that, without a skilled moderator, a minority of participants can dominate a discussion and provide input that might differ significantly from the results from individual interviews of each member of the group. Ideally, focus groups allow the facilitator to see a microcosm of the organization's culture in real time as participants talk among themselves, influence one another's responses and insights, and compare ideas.

## Surveys

Surveys are useful and effective tools to assess safety culture. They have the advantage of greater efficiency over other assessment methods. The views of large numbers of employees can be obtained with a lower expenditure of resources than required for direct observation, interviews, and focus groups. Individuals may also feel more comfortable taking a survey because their individual responses are anonymous and treated as confidential. The use of cross-tabulation of survey results also offers insights into similarities and differences among subcultures—operators, mechanics, managers, and so forth—within a transit agency. A significant limitation is that surveys are somewhat inflexible: the only information that can be elicited is the direct response to each specific question posed. The elicitation of subtle distinctions is difficult to obtain from a survey. Also, the outcomes can be affected by poor or slanted construction of the questions.

A frequent problem that occurs with surveys is a low response rate. This is particularly true for bus and train operators, whose work schedules can span 24 hours per day and 7 days per week. If the response rate is very low, the results will not be representative of the survey population. The problem with low response rates is often exacerbated if the survey is both voluntary and confidential. Increasing response rates is possible by such methods as keeping surveys short; making

a response mandatory; offering completion incentives, such as payment of overtime to operators taking the survey; and following up with potential respondents. Perhaps the most influential step that can be taken, however, is to make taking the survey as easy and convenient as possible for all employees. Maintenance employees can be assembled in a lunchroom or a conference room prior to the start of work, operators can complete a web-based survey on a bank of computers in the dispatcher's office, and so on.

## Performance Indicator Tracking

Performance indicator tracking can also be used to provide information on the state of an organization's safety culture. While there appears to be no single indicator sufficient for accurate measurement of the overall state of safety culture in an organization, monitoring trends in leading performance indicators as a function of time may provide insight into the strengths and weaknesses of a particular safety culture and may show the direction in which the state of safety culture is going. For example, if the number of signal violations suddenly doubles in an organization, that could constitute a red flag with respect to the state of safety culture.

## Assessment Planning

Assessments must be carefully planned and organized. Essential elements of such a plan include who is to be interviewed and how many focus groups covering which topics need to be organized. Based on the input from the interviews and focus groups, a customized survey could then be constructed to focus on the problems and issues specific to a particular transit agency. The survey can then be administered, the results tabulated, and perceived problems and issues either be confirmed or not. A series of interviews and focus groups could then be conducted in order to provide more specific information on the issues identified. Management can then formulate a plan of action to deal with the highest-priority problems and issues. The specifics of this plan and periodic updates on progress need to be distributed to all employees.

An abbreviated approach involves the use of a standard survey to provide general information followed by a series of interviews and focus groups to develop specific and in-depth information on issues emerging from the survey. This combination has the advantage of using the survey to identify the issues as perceived by employees at all levels of the organization in the most economical manner possible and then concentrating the interviews and focus groups on obtaining detailed information on those issues. A plan of action could be drawn up based on the results. This is a more efficient process. However, as standard surveys are proprietary, using them can still be fairly expensive, although not nearly as expensive

as designing a customized survey. A standard public transportation instrument maintained by APTA or the FTA and available to the industry at no cost could help, especially as the survey process should be repeated to measure progress every 2 or 3 years or so.

## Survey Design

If the decision is made to use a survey customized for a specific organization, the following process needs to be followed. Transit agencies should thoroughly understand this process whether the design is accomplished with in-house resources or outside professional assistance.

## Safety Culture Components or Dimensions to Be Measured

The first decision to make is what components of safety culture are to be measured. In the draft safety culture survey, the researchers used Reason's taxonomy ("informed culture, reporting culture, learning culture, flexible culture, and just culture") augmented by the Reason dimension entitled "underlying perceptions, attitudes, and behaviors."

## Sources of Possible Survey Questions

Possible sources for questions abound in published surveys. In aviation, examples are "Controlled Flight into Terrain: A Study of Pilot Perspectives in Alaska" (Bailey et al., 2000); "Development and Initial Validation of a Safety Culture Survey for Commercial Aviation" (Wiegmann et al., 2003); and "Toward Measuring Safety Culture in Aviation Maintenance: The Structure of Trust and Professionalism" (Taylor and Thomas, 2003). A significant amount of surveying has also been done for offshore petroleum operations, with a good example contained in "Assessing Safety Culture in Offshore Environments" (Cox and Cheyne, 2000). In nuclear operations, "Assessment of Safety Culture at a Nuclear Reprocessing Plant" (Lee, 1998) is a good source. In mining and construction, Michael O'Toole demonstrated the use of surveys in "The Relationship Between Employees' Perceptions of Safety and Organizational Culture" (O'Toole, 2002). Questions from previous surveys used by members of the research team in New York and Los Angeles were also considered.

The next step is to choose proposed questions for each of the proposed dimensions to be measured.

## Pilot Test

The survey can now be put into various commercially available formats so that it can be taken online by individual employees anonymously. The major motivation for using Internet-based survey instruments is to simplify administra-

tion and analysis and reduce the cost required to conduct the survey. The research team reduced the effort required to complete the survey by eliminating fill-in-the-blank responses and streamlining all Likert scales to four points. Ideally, if all survey respondents at a transit agency had access to the Internet, there would be no need for manual input or analysis outside the capabilities of SurveyGizmo. Unfortunately, at most transit authorities not all operating employees have Internet access at work. This is particularly true of vehicle operators. In order to arrive at reasonably representative response rates, the use of paper surveys for employees who do not have Internet access is required. Results from completed paper surveys were manually entered.

The research team's next step was to send the survey to management at two of the nine transit agencies for which mini-case studies were done in Chapter 2 (Transit Agencies A and I). These two transit agencies were asked to review the wording of the questions and proposed procedures. Comments were received from both transit agencies, and modifications were made. The revised survey was then administered at both transit agencies.

Appendix D contains the safety culture survey developed by the research team using the Reason taxonomy as the source of the dimensions and the results of that survey. **Please note that the research team was unable to validate this survey instrument for the U.S. transit industry, as discussed in the next section, and it is therefore not suitable for general use in the transit industry.**

The survey response rate for Transit Agency A was 28%; the response rate for Transit Agency I was 35%. Scores were calculated by assigning weights to responses, ranging from 4 to 1, with a weight of 4 assigned to both "strongly agree" for positively phrased questions and "strongly disagree" for negatively phrased questions. The overall Likert-based score was then calculated by averaging the individual scores for each question.

The results suggest the following:

- The overall Likert average score for Transit Agency A was 3.06, and for Transit Agency I it was 3.10. This means that the average response to Likert scale questions for both surveys was better than "agree" for positively phrased questions and stronger than "disagree" for negatively phrased questions. Having ratings that average between the highest possible rating and the next highest, particularly for a survey measuring something as difficult and complicated as the state of safety culture, likely equates to high marks for both transit agencies.
- The survey results for each transit agency highlight possible areas of strength and possible areas for improvement. A few examples are as follows:
  - Transit Agency A's highest score is 3.74, for the question "It is important to me that there is a continuing empha-

sis on safety.” Its lowest score is 2.19, for the question “How much of a factor is ‘Too few workers to get the work done’ in potentially affecting whether all of the safety rules are followed all of the time in your immediate workplace?” The latter may indicate a staffing problem that needs further examination.

- Transit Agency I’s highest score is 3.65, for the question “Do you personally closely follow your immediate workplace safety rules and procedures?” Its lowest score is 2.32, for the question “Do you agree that management takes a no-blame approach if workers report ‘near misses?’” The latter suggests that Transit Agency I should review its near-miss disciplinary policy.

Comparisons between transit agencies can also be instructive. For example:

- In response to the question “How would you rate the overall quality of the initial safety training you received in the first few months on the job?” Transit Agency A received a score of 3.48; Transit Agency I scored a 3.04. This result implies that Transit Agency I might have room for improvement in terms of initial safety training. The fact that Transit Agency A is rated high in quality of safety training confirms findings from the mini-case study in Chapter 2.
- In response to the question “Do your coworkers closely follow your immediate workplace safety rules and procedures?” Transit Agency I scored a 3.45; Transit Agency A scored a 3.18. This result implies that Transit Agency A should devote additional effort to rule compliance.

Cross-tabulations of survey results can be used to sharpen the focus of the analysis by determining if a strength or weakness is spread evenly across a transit agency or is primarily concentrated in one part of the organization, in a particular group of employees, or in longer- or shorter-service employees.

These brief examples suggest the potential value that a public transportation database from an industry-wide standardized safety culture survey would have. Transit agencies could assess their overall state of safety culture compared to their peers, the state of safety culture within each of their major functions, and areas of comparative strength and weakness in the various aspects of their operations that affect safety culture, as well as the personnel who affect it. Such a survey and associated database could become the equivalent of DuPont’s safety perception survey, which is described in the literature review. And, if DuPont can effectively use such a database to compare and contrast its diverse customer base, then certainly the public transportation industry could use a similar database made solely up of public transportation survey results.

## Survey Validation and Reliability Testing

Of the thousands of surveys administered every week by reputable organizations, few are subjected to validation and reliability testing. However, the additional effort required to conduct such testing would be justified for a survey that is going to be used to compare and contrast the state of safety culture throughout the public transportation industry.

Survey validation and reliability testing normally begins with analyzing content validity, a priori scale reliability, and factor analysis.

Achieving content validity requires determining that the questions or items included in the survey are appropriate to the components that are being measured; a priori scale reliability determines internal consistency. As explained by Morrow and Barnes (2012), this determines whether items in a factor or component “are consistently measuring the same underlying construct. For example, if a respondent expresses agreement with items in a measure such as ‘I like running’ and ‘I have enjoyed running in the past,’ and disagreement with the item ‘I dislike running,’ then a factor created from these items would be said to demonstrate good internal consistency.” The most widely used statistical test of internal consistency is Cronbach’s coefficient alpha.

Factor analysis determines which of the components intended to be measured are actually being measured by the survey. The factor analysis technique employed in this research is called principal components analysis (PCA). PCA is performed by computing the correlations between all of the items and sorting the items into factors such that:

1. Items within each factor have the highest correlations with each other,
2. Each factor accounts for as much variance in the data as possible, and
3. The factors are maximally distinct from each other.

Those factors that account for a significant amount of variance and consist of items that appear to represent an interpretable theme in the data are retained in the final factor solution (Morrow and Barnes, 2012).

The research team provided the survey results to an outside consulting firm to perform validation and reliability testing.

## Content Validity

An outside firm determined that the survey as written had acceptable content validity—that is, based on their transit experience, they determined that the questions included in the survey were appropriate to the components being measured.

## Scale Reliability Analysis

Standard practice is to judge scales with Cronbach alpha coefficients of 0.70 or greater as reliable (internally consistent). For the pilot survey, two of the scales (informed culture and underlying perceptions, attitudes, and behaviors) achieved a reliability of 0.70 or greater, which indicated internal consistency. Three of the scales (reporting culture, learning culture, and flexible culture) had alpha coefficients of 0.67 to 0.68, which indicated marginal internal consistency. Only one scale (just culture), which had an alpha coefficient of 0.45, demonstrated inconsistent results.

## Factor Analysis

Principal components factor analysis was performed on all questions using a four-point Likert response scale. The results revealed a seven-factor solution. The seven factors, however, did not conform to the Reason taxonomy (informed culture, reporting culture, learning culture, flexible culture, just culture, and underlying perceptions, attitudes, and behaviors).

To summarize, the Reason taxonomy was acceptable with respect to content validity and marginally acceptable with respect to a priori scale reliability analysis but unacceptable with respect to factor analysis. It therefore would be necessary to reconstruct the survey using a component framework that is much more specific than the Reason taxonomy.

A good example would be:

- Leadership commitment;
- Adequacy of resources;
- Development and communication of safety information;
- The reporting system (reporting and visible action taken on reports);
- Accountability (recognition and discipline);
- Organizational learning;
- Training and education;
- Organizational flexibility (openness to opposing views and willingness to adjust to changing circumstances);
- Degree of employee involvement and ownership;
- The appropriateness of safety policies, procedures, and rules; and
- The degree of mutual trust.

Compared to the Reason taxonomy, these components are separate and distinct from each other to a greater extent and therefore involve less overlap. Overlap among components creates a situation in which different survey respondents may associate specific items with different components, thereby corrupting the factor analysis.

## Conclusions

The research team believes that a fully validated safety culture survey and associated confidential database would be a major contribution to the public transportation industry's pursuit of improved safety culture.

Other assessment possibilities include:

- Using the matrix developed in the article “A Framework for Understanding the Development of Organizational Safety Culture” (Parker et al., 2006). As noted in Appendix A, this matrix can be used to rank how each organization rates in incident/accident reporting, causes of accidents, purpose of procedures, and so forth, locating it on the scale between pathological and generative in each of 18 categories. The average of the results for all of the categories can be used to determine where on the scale, from pathological to generative, the organization being evaluated rests.
- Employing checklists—for instance, the Transport Canada safety culture checklist ([http://www.tc.gc.ca/media/documents/railsafety/sms\\_checklist.pdf](http://www.tc.gc.ca/media/documents/railsafety/sms_checklist.pdf)) or the Reason checklist (<http://www.tc.gc.ca/eng/civilaviation/publications/tp13844-menu-275.htm>). Such checklists may be helpful but generally are much more subjective than surveys. (The Reason checklist, however, has on occasion been administered as a survey.)

The Parker matrix and such checklists can be helpful in a qualitative review of a transit agency's safety practices, programs, involvement, and so forth. It is possible that the practices an organization uses are ultimately more enlightening than quantitative scores, so a comparison—even if qualitative and subjective—may have great value. Quantitative scores could only show inter-organizational comparisons, which to become useful would have to be analyzed for how particular scores were generated, which then might be determined by the presence or absence of actual practices.



## CHAPTER 6

## Key Performance Indicators

**Introduction**

This chapter discusses the research on safety performance indicators used in public transportation and in the aviation industry, in particular, at Scandinavian Airlines System (SAS). The findings address their importance for improving safety performance and safety culture. There are two types of indicators used to monitor and manage safety performance and safety culture in public transportation and other industries.

- **Lagging indicators** measure past performance. Examples are customer injuries per 100,000 customers or customer injuries per 100,000 passenger miles traveled. The primary utility of lagging indicators to safety culture is that a positive safety culture, *ceteris paribus*, should produce positive safety performance. Therefore, superior safety culture ultimately results in superior safety performance, as measured by lagging indicators.
- **Leading indicators** also measure past performance but have the distinctive and defining property of predicting future performance. Currently, the U.S. transit industry falls short of the aviation industry in terms of the number of leading indicators tracked and the use of those indicators to flag developing safety problems and vulnerabilities. Consequently, important opportunities for improvement exist in the use of leading indicators by U.S. transit agencies.

Performance indicators used to assess safety and safety culture should include a combination of leading and lagging performance indicators. As detailed in the literature review (Appendix A), research shows that lagging indicators (i.e., past performance) alone do not address or contribute to improvements in safety culture (Blair and O’Toole, 2010). Furthermore, Blair and Spurlock maintain that “leading indicators serve as a catalyst for change; meaningful metrics are motivational for both employees and management,

and leading indicators ultimately drive safety performance” (Blair and Spurlock, 2008).

Blair and O’Toole (2010) quote Part 6.1 of ANSI Z10-2005:

*Organizations should develop predictive or “leading” performance measures or indicators. The organization can use these measures to identify and correct problems and identify opportunities for risk reduction before injuries or illnesses occur. The leading indicators can be used in combination with carefully collected injury and illness rates to measure performance. Some examples of indicators of potential problem areas are human factors risks, near-miss incidents, and non-conformances found during inspections.*

**Transit Agency Reporting**

Transit agencies are required to report a few safety-related lagging indicators in the FTA’s National Transit Database, including average incidents per million unlinked passenger trips, fatalities per million unlinked passenger trips (excluding suicides), and average injuries per million unlinked passenger trips (excluding suicides). Beyond these indicators, there is considerable variation in reporting and use of safety indicators by transit agencies. While there is an industry-wide concern for safety, the performance measures vary from place to place. This variation occurs, in part, because transit agencies use a wide variety of measures with different numerators and denominators to formulate indicators—for example, injuries per 100,000 boardings versus injuries per 1,000,000 passengers, or accidents per 100,000 vehicle hours versus accidents per million vehicle miles. This lack of common indicators precludes easy and accurate comparisons of safety performance across transit agencies.

Additionally, although several transit agencies were identified in this research that currently use leading indicators to manage safety performance, the research team identified infrequent use of leading indicators by transit agencies. Transit lags behind airlines in terms of the scope and variety of leading indicators used to assess safety performance because of

a historical lack of emphasis on leading indicators and because airline industry technology currently has a much greater capability for capturing and measuring data for leading indicators on a near- or real-time basis.

Important opportunities exist for transit agencies to add leading indicators to improve safety culture and performance. For example, the research identified a transit agency that uses statistics such as signal violations by train operators, red light violations by bus operators, improper door operation by train operators (e.g., opening doors on the wrong side) to represent valid identification and use of leading or predictive indicators. A significant increase in signal violations, for example, could be interpreted as indicating deterioration in the observance of critical rules or the existence of technical problems, which could be a harbinger or predictor of one or more serious accidents. Two transit agencies were identified that make more extensive use of leading indicators. In doing so, these transit agencies distinguish themselves and more closely resemble the airline industry.

As shown in the following, current transit industry practice is primarily to report lagging safety indicators, and the lagging indicators vary widely. The lists of indicators illustrate the variety of performance indicators used by transit agencies contacted during this project (note that leading indicators are identified with an asterisk).

### Small Midwest Bus Transit Agency

- Bus accidents\*
- Passenger injuries
- Bus miles

### Large West Coast Bus and Rail Transit Agency

- Bus accidents per 100,000 hub miles
- Heavy-rail accidents per 100,000 train miles
- Light-rail accidents per 100,000 train miles
- Passenger accidents per 100,000 boardings
- OSHA injuries per 200,000 exposure hours (OSHA recordable injuries per 200,000 exposure hours)
- Lost work days paid per 200,000 exposure hours
- New workers' compensation injuries per 200,000 exposure hours
- Rail signal violations on main line\*
- Rail signal violations in yard\*
- Broken gate—no stop\*
- Open door—wrong side\*
- Improper berthing—door opened\*
- Stop order violation\*
- Worker right-of-way protection plan violation\*
- Manual block violation\*

- Unauthorized change in operating mode [automatic, manual, automatic train protection (ATP) bypass, and stop and proceed]\*
- Number of internal safety reviews findings and open items\*
- Number of triennial California Public Utilities Commission review findings and open items\*
- Number of California Public Utilities Commission inspection findings and open items\*
- Number of people reached by rail safety education and outreach programs\*
- Instances of operator seat-belt noncompliance\*
- Instances of all passengers behind safety line non-compliance\*
- Instances of operators using cell phones or other electronic devices\*
- Instances of bus operators running red lights\*

### Large East Coast Bus and Rail Transit Agency

- FRA reportable injury frequency rate per 200,000 hours worked
- Total injury tracking
- On-duty injury event types by department
- Comparisons of employee on-duty FRA injury frequency rate with other major carriers
- Number of employee safety committee meetings\*
- FRA efficiency testing (monthly)
- FRA passenger injury frequency rate per 100,000,000 passenger miles
- Total passenger injury frequency rate per 100,000,000 passenger miles
- Passenger injuries tracking by rail line
- Passenger injury trends analysis
  - Passenger gap injuries
  - Multilevel rail equipment–related injuries
  - Boarding/detraining injuries
  - Passenger onboard train injuries
- Rail equipment accidents analysis
  - Total and FRA reportable accidents
  - Human factor cause accidents
  - Run through switch accidents tracking (monthly)
  - Confidential Close Call Reporting System (C<sup>3</sup>RS)—A voluntary, confidential demonstration program for railroad carriers and their employees to report close calls without receiving disciplinary action
    - Un-commanded side door openings
- Trespasser fatalities, including suicides, possible suicides, and accidents
- Trespasser activity along the right-of-way
- Near misses\*

### Large East Coast Bus and Rail Transit Agency

- Subway customer accidents per million passengers
- Subway customer injuries per million customers
- Subway collisions per month and year\*
- Subway derailments per month and year\*
- Subway fires per month and year\*
- Subway employee on-duty lost-time accidents per 100 employees
- Bus collisions per million miles
- Bus collision injuries per million miles
- Bus customer accidents per million customers
- Bus customer accident injuries per million customers
- Bus employee lost-time accidents per 100 employees

### Medium-Sized West Coast Bus Transit Agency

- OSHA recordable cases (treatment only) per total hours worked
- OSHA recordable cases (restricted duty) per total hours worked
- OSHA recordable cases (lost time) per total hours worked
- OSHA recordable cases (fatality) per total hours worked
- OSHA recordable cases (total) per total hours worked
- Instances of first aid administered per month and year
- Near misses (non-contact) per month and year
- Traffic accidents per hub miles per month and year
- Customer incidents per 100,000 boardings
- Number of regulatory violations per month and year
- Number of fitness center users per month and year\*
- Number of wellness consultations per month and year\*

### Medium-Sized West Coast Bus and Rail Transit Agency

- Number of vehicle accidents per month and year
- Number of preventable vehicle accidents per month and year
- Miles between preventable vehicle accidents
- Preventable vehicle accidents per 100,000 miles per year
- Lost time injuries per month and year
- Lost work days per month and year

### Medium-Sized Western Bus and Rail Transit Agency

- Number of total accidents per month and year
- Number of major accidents per month and year
- Number of preventable accidents per month and year
- Accidents per 100,000 miles
- Number of injuries per month and year
- Number of fatalities per month and year

- Safety committee meetings per month and year\*
- Number of education/outreach efforts per month and year\*
- Number of safety interviews per month and year\*
- Number of rides/observations per month and year\*
- Average days on hazard log\*
- Number of high open hazards per month and year\*
- Hazards closed year to date\*
- Number of broken gates per month and year\*
- Instances of emergency braking per month and year\*
- Open number of audit findings per month and year\*

### Large East Coast Bus and Rail Transit Agency

- Rail customer injury rate per million passengers
- Bus customer injury rate per million passengers
- Rail transit facilities injury rate per million passengers (stations, escalator, parking facilities, etc.)
- Paratransit customer injury rate per million passengers
- Employee injury rate per 200,000 hours

Note that one large, multimodal bus and rail transit agency reports a few indicators (the absolute number of collisions, derailments, and fires for given time periods) that could be considered to be leading indicators, while another reports none. The researchers found this to be the dominant pattern for the industry.

The research team has found it useful to distinguish between what might be called “hard” and “soft” leading indicators. An example of a hard leading indicator would be a red signal violation by a train operator; a sudden upsurge of these might foreshadow an imminent train collision. An example of a soft indicator would be the number of employees attending annual safety classes. A drop in attendance might signal a general relaxation in the emphasis on safety in a transit agency’s safety program. That development in turn might or might not indicate that serious safety problems lie ahead.

### Airline Reporting: SAS Example

SAS reports a total of 55 leading indicators. The other airlines in the Star Alliance report at least 10. A private company assists SAS in displaying these indicators in as close to real time as airline technology allows. SAS leading indicators include:

- Air operations cost/aircraft: the relation between the total cost forecast for SAS operations in relation to the number of aircraft. An increased value indicates more resources available per aircraft
- Report rate: shows how many reports are generated within SAS operations per 1,000 cycles
- Safety survey: performed on a yearly basis

- Rejected takeoff, high speed: rejected takeoff at high speed (>100 kts) per 1,000 cycles
- Emergency declaration: number of emergency declarations and other emergency incidents per 1,000 cycles
- Takeoff warning: aircraft not properly configured for takeoff per 1,000 cycles
- Runway/taxiway incursion: measured per 1,000 cycles
- Runway/taxiway excursion: measured per 1,000 cycles
- Altitude penetration: deviation of more than 300 ft from cleared altitude per 1,000 cycles
- Hard landing: g-force of more than 2.0 g or vertical rate of more than 600 fpm at touchdown per 1,000 cycles
- Ground proximity warning system (GPWS) mode 1–4: ground proximity or bank angle warnings per 1,000 cycles
- Stick shaker: low-speed warnings per 1,000 cycles
- Tail strike: tail strikes during takeoff per 1,000 cycles
- Bird strike damage: bird strikes resulting in damage to aircraft per 1,000 cycles
- Wake turbulence: wake turbulence encountered per 1,000 cycles
- Significant weather: significant weather encountered (wind shear, severe turbulence, etc.) per 1,000 cycles
- Cabin safety: occurrences per 1,000 cycles
- Line check: line check remarks per line check
- Cabin safety monitoring: percentage of correctly performed procedures
- Unstabilized approaches at 500 ft: all fleet percentage of flights not stabilized at 500 ft above ground level
- Flight data monitoring (FDM), 200/2: percentage of flights with a speed of 200 kts or more 2 minutes before touchdown (all fleets)
- FDM, g: 1.5 to 2.0 g landings (all fleets); above 2.0 g is defined as a hard landing and is monitored and displayed separately
- Engine: incidents caused by engine-related failures per 1,000 cycles
- Landing gear: incidents caused by gear-related failures per 1,000 cycles
- Flight controls: incidents caused by flight control failures per 1,000 cycles
- Electrical power: incidents caused by electrical failures per 1,000 cycles
- Fuel: incidents caused by fuel system–related failures per 1,000 cycles
- Fire/smoke events: incidents that have caused fire or smoke (or likewise) per 1,000 cycles
- Maintenance variations: number of maintenance variations
- Cannibalizations: number of cannibalizations (item removed from one aircraft to be used on another) compared to total number of aircraft
- Maintenance requirement (MR) exceedances: number of MR exceedances per 1,000 cycles
- Airworthiness directive (AD) exceedances: number of AD exceedances per 1,000 cycles

The SAS set of 55 leading indicators includes a number of combinations of the individual indicators listed previously. When reviewing the SAS indicators, the research team saw that many of the leading indicators tracked could be considered precursors of specific types of near misses—for example, engine failures.

## Conclusions

Both leading and lagging performance indicators should be used to monitor and improve safety culture and performance over time within an organization and to make peer comparisons among similar organizations. It is important that performance indicators be consistently defined so that meaningful time-series analyses and peer comparisons can be made. The public transit industry would benefit from having a common set of leading and lagging safety performance and safety culture indicators. The lack of such indicators precludes meaningful comparisons and benchmarking of safety performance and safety culture across the transit industry.

The public transportation industry would particularly benefit from greater use of leading safety indicators. Leading indicators currently in use by some U.S. transit agencies are good starting points, with separate sets of indicators being tailored for bus, rail, paratransit, ferry, and other pertinent operations. The transit industry would also benefit from exploration of possible adoption of airline industry–type technologies for capturing data for leading safety performance indicators in real time.

## CHAPTER 7

# Best Practices

### Introduction

This chapter presents capsule descriptions of 34 practices that transit agencies may consider for adoption to improve safety culture. These practices were initially identified during the mini–case studies on safety culture within and outside public transportation. The 34 practices are presented in rank order as rated by the ESCP. Not all of these safety culture improvement practices are expected to be appropriate for every transit agency since most require pre-establishment of certain conditions to support the practice.

The capsule descriptions also include contact information at the originating transit agency and the reference documents that can be obtained from that agency. These documents define and promulgate the specific practice. Transit agencies considering adoption of a practice are encouraged to contact the originating transit agency for additional information.

### Role of Expert Safety Culture Panel

The research team asked the transit managers on the ESCP to rate each of the safety culture improvement practices in terms of its value to a transit agency, using a five-point Likert scale, with 5 being extremely valuable and 1 being not very valuable. The combined average ratings are the basis for ranking the 34 practices.

The participating transit agencies on the ESCP included:

- Champaign-Urbana Mass Transit District (CUMTD) [100 buses],
- San Mateo County Transit District (SamTrans) [300 buses],
- Orange County Transportation Authority (OCTA) [550 buses],
- King County Metro Transit Division (KCMTD) [1,500 buses and electric trolleys],
- Los Angeles County Metropolitan Transportation Authority (LACMTA) [100 subway cars, 150 light-rail vehicles (LRVs), 2,200 buses], and

- New Jersey Transit (NJT) [200 locomotives, 1,000 passenger rail cars, 45 LRVs, 2,030 buses].

### Best Practices in Rank Order

#### SAFE-7 Report of Unsafe Condition or Hazard and Near-Miss Program

ESCP RANKING—SCORE: #1—4.67

AGENCY: LACMTA

CONTACT: Executive Officer, Corporate Safety

#### BRIEF DESCRIPTION

Metro's SAFE-7 Report of Unsafe Condition or Hazard and Near-Miss Program encourages LACMTA employees to complete a report on potential safety problems such as hazards and near misses. The report can be submitted anonymously. Upon receiving a completed report, department or division managers are required to analyze the reported hazard or near miss, identify all of the factors involved, develop recommendations for timely elimination or mitigation of the hazard or near miss, ensure that appropriate corrective action is taken within established time limits, track the status of corrective actions taken or planned, and maintain records of the reports. The mitigation and corrective actions may include, for example, modifications of equipment or facility design, maintenance schedules or practices, operating rules and procedures, employee training, bus stop locations, rail station layout, traffic control devices, road design, traffic signs, and markings. After a report is submitted, management informs other employees of the existence of and circumstances surrounding the hazard or near miss by posting a summary tracking form listing all open SAFE-7 reports on the safety bulletin board. Hazards or near misses involving more than one department, which cannot be resolved by a single department, will be reported to the LACMTA corporate office to resolve by working with all departments that are involved. The responses to SAFE-7s are distributed to the individual

involved and to the appropriate local safety committee (LSC), including union representatives.

### IMPACT ON SAFETY CULTURE

This practice improves safety culture in many ways. It requires management commitment to safety and safety culture, it allows significant employee involvement in safety management, it contributes significantly to creation of an informed culture, and it demonstrates that LACMTA has the essential elements of an effective reporting culture.

### REFERENCE DOCUMENTS

LACMTA Injury and Illness Prevention Program, Revision 3, March 2010  
SAFE-7 Form

### “Good Catch” Recognition Program

**ESCP RANKING—SCORE:** #2—4.6

**AGENCY:** OCTA

**CONTACT:** Executive Director, Human Resources and Organizational Development

#### BRIEF DESCRIPTION

This program has three criteria for award:

- (1) *A good catch* can occur through intervention in an unsafe act or condition, such as:
  - Successfully using the stop-work authority,
  - Identifying an unsafe condition and proactively eliminating or controlling a hazard, or
  - Identifying and intervening in an unsafe act through assisting or coaching an employee.
- (2) *Safety above and beyond* can be demonstrated by:
  - Successfully managing an emergency response effort, or
  - Personally pursuing non-compulsory safety training to further comprehend program requirements.
- (3) *Safety program improvement* may include:
  - Identifying a safety program deficiency and assisting in developing an improvement,
  - Proposing an idea for process improvement and assisting OCTA in its full implementation.

Awards for a “good catch” consist of immediate recognition—a \$25 gift card awarded to the employee in a public forum (for example, a tailgate or pre-shift safety meeting) and a quarterly drawing in which 10% of the total number of approved “good catch” forms are randomly selected for a \$100 gift card.

### IMPACT ON SAFETY CULTURE

This practice demonstrates a strong management commitment to safety, encourages employee ownership of safety,

drives employee involvement through action and intervention, and contributes to the creation of an informed and flexible safety culture.

### REFERENCE DOCUMENTS

OCTA “Good Catch” Recognition Form

### Confidential Close Call Reporting System

**ESCP RANKING—SCORE:** #3 Tie—4.5

**AGENCY:** NJT

**CONTACT:** Deputy GM, Rail Safety and Training

#### BRIEF DESCRIPTION

NJT participates voluntarily in FRA’s Confidential Close Call Reporting System demonstration project along with three freight railroads. The program is designed to increase hazard reporting and reduce hazardous conditions by addressing employees’ concerns about punishment or discipline related to close-call reporting. NJT implements the pilot system-wide in main tracks and yards. A contractual agreement with its unions establishes the terms of the pilot project, including a labor and management peer review team and a senior management support team. Rail workers report minor incidents or close calls to the federal Bureau of Transportation Statistics (BTS) by telephone or electronically. After removing information that might identify the employee, BTS passes the information to NJT management. Corrective actions are recommended independently and then jointly by the peer review team and senior management support team. The C<sup>3</sup>RS improves safety conditions by allowing for non-punitive reporting and better data collection and analysis. Its implementation and evaluation across the pilot locations is allowing the FRA to refine the program before rolling it out nationwide to public and private railroads.

### IMPACT ON SAFETY CULTURE

The use of C<sup>3</sup>RS exemplifies a reporting culture based on employee involvement through action and intervention that strives to be just and informed.

### REFERENCE DOCUMENTS

C<sup>3</sup>RS Concept and Process

### Recruitment Screening Battery

**ESCP RANKING—SCORE:** #3 Tie—4.5

**AGENCY:** SAS

**CONTACT:** Head of Safety

#### BRIEF DESCRIPTION

SAS hires for attitude and trains for skill. There are multiple rounds of interviews for all positions, with the first round focusing on attitude and the second round focusing on skill.

Airplane pilots are given a very long test battery. The crew test is a shorter version of the pilot battery. SAS also uses a psychologist to test flight crew candidates, to include attitudes toward safety. Ground crew candidates are also asked a series of questions during their interviews to assess their attitudes toward safety. Executives and managers undergo internal interviews and are typically also interviewed by external consultants for a second opinion. There are separate processes for hiring internal and external candidates.

### IMPACT ON SAFETY CULTURE

This recruitment selection process demonstrates the organization's commitment to maintaining a safety culture.

### REFERENCE DOCUMENTS

Recruitment screening tool for ground and flight crew members.

## Safety Captain Program

**ESCP RANKING—SCORE:** #3 Tie—4.5

**AGENCY:** OCTA

**CONTACT:** Executive Director, Human Resources and Organizational Development

### BRIEF DESCRIPTION

OCTA safety captains are union employees appointed by management to represent their fellow employees in the maintenance and transportation departments.

- *Maintenance.* In the maintenance department, each base manager appoints a safety captain for each shift for each of the following job titles: mechanic, service worker, parts, and facility maintainer. The base manager also appoints a safety coordinator, who is responsible for chairing the maintenance safety committee at each base.
- *Transportation.* In the transportation department, each base manager appoints a minimum of two bus operators to the agency-wide operations safety committee. This committee is chaired on a rotating basis by a base operations trainer.

Safety captains represent employees on the safety committees. They address employee safety concerns, requests, and questions; recommend corrective actions for identified safety deficiencies; develop and recommend safe practices and procedures for specific tasks; assist and guide fellow employees in complying with safety and health rules; and conduct safety inspections and campaigns as coordinated by the Health, Safety, and Environmental Compliance (HSEC) Department.

### IMPACT ON SAFETY CULTURE

The safety captain program affects and contributes to numerous key components of safety culture at OCTA. It demonstrates

management commitment to safety and safety culture, it represents major employee involvement in safety management, it contributes significantly to creation of an informed culture and provides a platform to demonstrate that OCTA has a flexible culture, and, finally, it could not work without the prevalence of mutual trust throughout the organization.

### REFERENCE DOCUMENTS

OCTA Policy # HROD-HSEC Safety Captain Committee, dated 1/26/2004 and revised 11/05/2012

## Non-Disciplinary Safety Ride Check—Rail and Bus

**ESCP RANKING—SCORE:** #6—4.42

**AGENCY:** Greater Cleveland Regional Transit Authority (GCRTA)

**CONTACT:** Manager of Safety

### BRIEF DESCRIPTION

A supervisor arrives unannounced and rides a bus or train anonymously to observe and evaluate, using a comprehensive checklist, the vehicle operator. The detailed and comprehensive rail and bus checklists cover the pre-trip and terminal activities, practices en route, and safety hot spots; the checklist also includes room for open-ended comments.

The purpose of the non-disciplinary safety ride check is instructional and not disciplinary. The supervisor, who is a trained road instructor, provides suggestions on how to properly do certain things, trying to improve performance. After the observation, the trainer reviews the checklist with the operator.

### IMPACT ON SAFETY CULTURE

This safety observation and feedback program demonstrates an informed and learning culture. By separating training and improvement from discipline, the practice supports a just culture that enhances mutual trust.

### REFERENCE DOCUMENTS

GCRTA Bus and Rail Safety Ride Check Forms

## Joint Safety Task Force

**ESCP RANKING—SCORE:** #7—4.33

**AGENCY:** SamTrans

**CONTACT:** Manager, Transit Operations Training

### BRIEF DESCRIPTION

The SamTrans Joint Safety Task Force is chaired by the director of bus transportation and includes the deputy CEO of operations, transportation superintendents, the director of maintenance, the safety officer, the training manager, the

route planner, the union president or secretary-treasurer, and several bus operators as members.

The forum addresses route planning, time points along the routes, road hazards, equipment, and operator safety concerns. It is a hands-on committee that drives concrete decision making and actions. The task force helps managers gain a practical perspective on the demands faced by bus operators. Photos of task force members are posted at the bases so operators and mechanics know to communicate with them when safety issues arise.

### IMPACT ON SAFETY CULTURE

The Joint Safety Task Force shows leadership, management and organizational commitment, employee involvement, and mutual trust. It reflects a reporting, informed, and learning culture.

### REFERENCE DOCUMENTS

Joint Safety Task Force Policy Statement

## Fifty-Five Leading Safety Indicators

ESCP RANKING—SCORE: #8 Tie—4.25

AGENCY: SAS

CONTACT: Head of Safety

### BRIEF DESCRIPTION

SAS developed 55 leading indicators in 2009 and 2010. The list was created with input from various areas of the company: ground crews, operations personnel, flight crews, and so forth. Representatives were asked to provide their most important indicators. Included are indicators of potential problems, such as “aircraft not properly configured for takeoff per 1,000 cycles,” “runway or taxiway incursions per 1,000 cycles,” “deviation of more than 300 ft from cleared altitude per 1,000 cycles,” and “bird strikes resulting in damage to aircraft per 1,000 cycles.” Representatives were also asked to suggest what acceptable standards might be for each indicator. For example, the ground department proposed that an acceptable number of ground damage incidents would be five for 22,000 departures per month. When a safety performance indicator (SPI) exceeds the acceptable standard, it is reported as being “in the red.” When selecting SPIs, SAS considers the following questions: What is measurable? What are we measuring today? What would we like to be able to measure? The indicators are not prioritized—they are seen as carrying equal weight, but they are grouped by area of responsibility. SAS also averages various indicators into what it calls risk indexes.

SAS has considerable baseline data because there is a significant amount of recording equipment in the airline industry. Trend movements among the indicators draw attention to a

particular area that warrants greater scrutiny. While having an indicator “in the red” signifies a potential problem, great emphasis is also put on significant movement of indicators toward being “in the red.”

The company has begun reviewing the system and considering what changes might need to be made based on experience thus far. SAS may need to adjust the levels of acceptability (for example, five ground incidents per month). When SAS notes indicators moving in the wrong direction, it determines whether processes need to be changed to address the trend or whether the performance indicator needs adjustment; SAS is careful not to make changes to a process just for the sake of making changes. There is a lot of thought put into the effectiveness of the indicators and their impact on safety culture.

### IMPACT ON SAFETY CULTURE

The use of these leading indicators demonstrates the organization’s commitment to maintaining a safety culture. It demonstrates a commitment to a reporting culture, an informed culture, and a learning culture.

### REFERENCE DOCUMENTS

SAS List of Fifty-Five Leading Indicators

## Recruitment Screening for Safety Mind-Set

ESCP RANKING—SCORE: #8 Tie—4.25

AGENCY: CSX

CONTACT: Senior Vice President (VP) and Chief Administrative Officer

### BRIEF DESCRIPTION

When hiring, CSX looks for a safety mind-set. The company uses a series of 10 to 20 interview questions for all potential new hires directed at determining the applicant’s safety attitudes. Examples of such questions are:

1. Safety is a way of life at CSX. You have to be extremely safety conscious when working in the field for a railroad. Tell us of any common safety practices you have used (or would use) to avoid accidents. How would you influence someone who is practicing unsafe behaviors?
  - Follow-up probes:
    - Can you think of ways in which you might make your environment safer while you work?
    - Have you influenced others to adopt those safety practices you speak of?
    - What other safety practices or principles can you think of?
    - Have you ever been part of a safety committee or been a safety officer?
    - What would you do if one of your team members was violating a safety practice?



2. Tell us about your safety record. How do you feel about safety in the workplace and the use of safety equipment, including personal protective equipment (PPE)? Have you ever been required to wear PPE?

- Follow-up probes:
  - What safety practices or principles can you think of?
  - Have you influenced others to adopt those safety practices you speak of?
  - What would you do if one of your team members was violating a safety practice?

#### **IMPACT ON SAFETY CULTURE**

This standard operating procedure demonstrates strong management and organizational commitment to safety.

#### **REFERENCE DOCUMENTS**

CSX questionnaire used for rank-and-file employees and supervisors. The management questionnaire is proprietary.

### **Actively Caring and Approaching Others Who Are at Risk**

**ESCP RANKING—SCORE:** #10 Tie—4.17

**AGENCY:** ExxonMobil

**CONTACT:** Safety Programs Manager

#### **BRIEF DESCRIPTION**

In 2011, ExxonMobil adopted a philosophy that encourages workers to freely intervene when another worker is doing something that puts him- or herself or others at risk. Global safety efforts are oriented around this philosophy; workers are trained in how to intervene and in how to react if someone intervenes. It is more of a philosophy that is designed to make intervention more acceptable than it is a program. The idea is “if everyone is looking out for everyone, you’re almost there.” The company conducts workshops and holds toolbox sessions where people discuss this philosophy. This philosophy is implemented using a key tool in their safety toolkit, which is the safety observation. These observations are based on an objective standard. In addition to the direct intervention, these observations are aggregated and analyzed to determine if any trends can be detected. The company currently has more than two million observations collected. This program provides individual observations, which are immediately helpful to workers at the time, and valuable insights, which flow from analyzing data over time.

#### **IMPACT ON SAFETY CULTURE**

This philosophy demonstrates strong management and organizational commitment to safety, encourages employee involvement, and supports an informed culture. By training employees to intervene and by creating this mechanism to

reduce unsafe behavior without having to resort to discipline, this practice supports a just culture and enhances mutual trust.

#### **REFERENCE DOCUMENTS**

Observation tool used by employees.

### **Green Card Safety Concerns Reporting Process**

**ESCP RANKING—SCORE:** #10 Tie—4.17

**AGENCY:** KCMTD

**CONTACT:** Transit Safety Unit Manager

#### **BRIEF DESCRIPTION**

In addition to standard reporting forms and verbal reporting, the green cards offer an alternate way to report concerns or suggestions for safety improvements. Maintenance and operations staff give the cards to their chief or safety committee representative. They are asked to identify the problem, explain proposed improvement, include photographs, and describe methods to achieve the desired improvement. Green cards are discussed in safety committee meetings. These cards are in use throughout the transit division, and operators are reminded to report any unsafe conditions that they observe on the road as well as in the base. A response is expected within 30 days of receipt of the suggestion. If this is not possible, the transit safety officer will update the originator or safety committee representative about the status of the suggestion. After resolution, green cards are returned to the supervisors, who return them to the originator. Suggestions made anonymously are kept in the safety committee meeting binder. If the submitter does not accept the response, he or she can resubmit a card with more detailed information. Employees can also convey safety concerns directly to the joint safety committees monthly or bring up concerns to the union that, in turn, introduces them at a joint committee.

#### **IMPACT ON SAFETY CULTURE**

The green card system reflects a reporting and informed culture. The process contributes to employee involvement and organizational trust and is an indication of management commitment.

#### **REFERENCE DOCUMENTS**

Safety Information Report (Green Cards); Safety Suggestion Program

### **Management Commitment to Safety Culture Statement**

**ESCP RANKING—SCORE:** #10 Tie—4.17

**AGENCY:** Des Moines Area Rapid Transit (DART)

**CONTACT:** Director of Paratransit

**BRIEF DESCRIPTION**

A safety culture statement was developed by the leadership team, signed by the GM, and posted and distributed to all employees. It is based on safety as “the major consideration in all operations, including planning design and maintenance of our transit system.” The statement sets the guiding principles of a commitment to safety at all levels, safety as the top priority, appropriate resources and incentives, a responsible and accountable environment with free reporting of safety breaches, and analysis of actions and establishment of individual accountability. Employees were asked to sign a pledge to support the safety culture process.

**IMPACT ON SAFETY CULTURE**

A clear statement of management commitment makes explicit management’s intention to support continuous improvement of safety culture.

**REFERENCE DOCUMENTS**

DART Safety Culture Statement

**Effective Employee Safety Communication Plan**

**ESCP RANKING—SCORE:** #13 Tie—4.08

**AGENCY:** SAS

**CONTACT:** Head of Safety

**BRIEF DESCRIPTION**

SAS uses multiple communication networks to reach decentralized locations and personnel. Access to so many employees in so many classifications is a challenge. Modes of communication include:

- Weekly bulletins and e-mails to flight crews,
- “Safety corners” on crew bases, with posted reports and computer terminals for accessing safety information,
- Weekly visits from safety representatives at selected sites,
- A comprehensive and professionally prepared safety magazine entitled *Safety Feedback* distributed to crew bases two times per year, and
- Additional safety briefings prior to shifts given to ground crews by supervisors.

**IMPACT ON SAFETY CULTURE**

The considerable resources devoted to safety communication demonstrate the organization’s commitment to maintaining a safety culture and facilitate achievement of a learning culture and an informed culture.

**REFERENCE DOCUMENTS**

*Safety Feedback*, 2012 Volumes 1 and 2 and 2013 Volume 1

**Hazard Reporting and Management Procedure**

**ESCP RANKING—SCORE:** #13 Tie—4.08

**AGENCY:** GCRTA

**CONTACT:** Manager of Safety

**BRIEF DESCRIPTION**

This detailed operating procedure was established to create a standardized method for identifying, tracking, and resolving hazards. It covers data provided by hazard report forms; hazard hotline telephone calls; hazard reporting e-mails; hazard reporting in person; loss prevention audits conducted by agency insurance carriers; internal and external audits conducted by federal, state, and local jurisdictional authorities; vehicle defect reports; audits and inspections from safety and various other departments; audit results and suggestions of safety committees; findings and suggestions of an incident review committee; incident investigations; and root cause and effect analysis. It describes the procedures to be carried out through the safety committee and management process. The policy affirms that the agency will not take action against employees reporting safety conditions or concerns; illegal or intentionally negligent actions are not protected. It includes reporting forms, process flowcharts, and tracking forms. The policy has been extensively revised in recent years.

**IMPACT ON SAFETY CULTURE**

This detailed standard operating procedure demonstrates strong management and organizational commitment to safety. It creates the mechanisms for a reporting and informed culture that ensures consistent safety reporting and investigation for prevention. By limiting discipline related to safety reporting, the policy supports a just culture that supports mutual trust. The ongoing revision process is part of the learning culture.

**REFERENCE DOCUMENTS**

Hazard Reporting & Management Procedure SOP 8.1 and Non-Punitive Reporting Policy

**Joint Accident Review Committee Pilot**

**ESCP RANKING—SCORE:** #13 Tie—4.08

**AGENCY:** SamTrans

**CONTACT:** Manager, Transit Operations Training

**BRIEF DESCRIPTION**

The Joint Accident Review Committee grades accidents involving workers represented by the union. The committee includes two union members, an instructor, the district’s safety officer, and a mutually agreed-upon neutral party. Committee members and alternates are trained in accident

investigation. After presentation by the chief safety officer, the committee votes anonymously on whether the accident was preventable. This produces a rating that is accepted by both sides in arbitration hearings.

### IMPACT ON SAFETY CULTURE

The Joint Safety Task Force shows leadership, management and organizational commitment, employee involvement, and mutual trust. It reflects a reporting, informed, and learning culture.

### REFERENCE DOCUMENTS

Accident Review Committee Charter

## Reason Safety Culture Survey

**ESCP RANKING—SCORE:** #13 Tie—4.08

**AGENCY:** GCRTA

**CONTACT:** Safety Manager

### BRIEF DESCRIPTION

GCRTA used the 20-question questionnaire developed by Dr. James Reason as a survey to assess executives' and supervisors' perceptions of their safety culture. Upper management, managers, and supervisors rate the organization most highly for the degree to which reporting is encouraged and the frequency with which staff attends safety meetings. Executives feel that the organization is data-driven, and managers and supervisors highlight the level of commitment. An updated survey will be distributed to employees and to management again to determine the differences between the groups and then to arrange safety improvement teams to address the gaps and needs identified. The agency has arranged for a professional evaluator to carry out the survey and analysis.

### IMPACT ON SAFETY CULTURE

Defining the current safety culture as seen from the inside is a sign of a learning and informed culture. The expanded survey process demonstrates a proactive use of indicators.

### REFERENCE DOCUMENTS

Reason Questionnaire

## Employee Safety Survey

**ESCP RANKING—SCORE:** #17—4.0

**AGENCY:** SAS

**CONTACT:** Head of Safety

### BRIEF DESCRIPTION

SAS gives employees a 25-question survey to gauge impressions of safety culture and to assess attitudes. The questions are based on a reporting culture, just culture, management attitude toward safety, employees' attitudes toward safety, and

the follow-up on any safety reporting. SAS is interested in what respondents view as the biggest threats to safety within the company, the effectiveness of their safety communications, and what employees view as the most positive factors related to safety.

The safety survey was conducted annually to measure employees' safety attitudes, but in 2012 SAS changed the frequency to every 18 months. SAS uses a commercial Internet survey service to administer the survey. During the 4-week survey period, SAS sends a direct e-mail to crew and staff on the ground that includes a link to the survey. The link is also featured on the intranet and on other staff communication tools (newsletters, lounge postings, etc.). There is an approximately 40% response rate, and of respondents, 80% to 85% complete the survey. The response rate is slightly lower among flight crews and slightly higher among ground staff.

### IMPACT ON SAFETY CULTURE

This tool demonstrates the organization's commitment to maintaining a safety culture and demonstrates that it is a reporting culture. Results of the survey demonstrate whether employees agree that SAS has a just culture. The organization's continued review of the tool and its application demonstrate a learning culture and an informed culture.

### REFERENCE DOCUMENTS

SAS Employee Safety Survey

## Local Safety Committee Program

**ESCP RANKING—SCORE:** #18—3.92

**AGENCY:** LACMTA

**CONTACT:** Executive Officer, Corporate Safety

### BRIEF DESCRIPTION

The primary vehicle for employee participation in safety is the LSC meeting. LSCs provide the primary means of coordinating safety activities at the local level at LACMTA. LSCs are responsible for:

- Reducing the number of injuries and incidents within a given division or department,
- Verifying, through observation, the degree of compliance with established safety policies and guidelines and implementing appropriate corrective action,
- Reducing the number of lost workdays due to injuries, and
- Analyzing and mitigating hazards or near-miss incidents reported by employees.

The role of chairperson of the LSC rotates every 6 months between the transportation division and maintenance division managers. Other LSC members include the transportation and maintenance assistant managers; a senior safety specialist from corporate safety; division safety coordinators;

employees representing the bargaining units of the United Transportation Union (UTU), ATU, and the American Federation of State, County, and Municipal Employees (AFSME); the subcommittee chairpersons; the return-to-work coordinator; a sheriff's representative; and other local staff as needed. Non-division departments, such as rail wayside systems, have an equivalent membership structure.

LSCs and their subcommittees normally meet once per month to review the status of local safety performance and safety programs and activities at a regularly scheduled date, time, and place. Meeting minutes are e-mailed to LSC members and posted on division bulletin boards to inform employees of LSC activities. LSCs use data analysis to:

- Review reported hazards/near misses and accident and occupational injury data, and implement strategies and programs to reduce workplace incidents,
- Ensure that the subcommittees are analyzing all appropriate data/metrics and key performance indicators, and
- Review subcommittees programs and recommendations for improvements.

The three standing subcommittees are the Injury/Accident Reduction Sub-Committee, the Hazard Identification & Correction Sub-Committee, and the Program Activities & Recognition Sub-Committee. Subcommittee chairpersons are normally assistant managers.

#### **IMPACT ON SAFETY CULTURE**

This practice affects and contributes to numerous key components of safety culture. It could not have been created without management commitment to safety and safety culture, it represents significant employee involvement in safety management, and it contributes significantly to creation of an informed culture and provides a platform to demonstrate that LACMTA has a flexible culture.

#### **REFERENCE DOCUMENTS**

Local Safety Committee Charter 2-10-11

### **Rail System Safety Program Plan**

**ESCP RANKING—SCORE:** #19—3.9

**AGENCY:** NJT

**CONTACT:** Deputy GM—Rail Safety and Training

#### **BRIEF DESCRIPTION**

The rail division has established a comprehensive safety program plan addressing the hazard management process, accident investigation and analysis, inspections and maintenance, training and certification, emergency planning and response, environmental management, security, workplace

safety, passenger and public safety, loss prevention, system change management, and internal assessment. The plan is supported by a detailed annual statement of initiatives, goals, and practices.

#### **IMPACT ON SAFETY CULTURE**

This detailed and comprehensive plan, and the ongoing initiatives undertaken to support it, demonstrate commitment to safety on the part of leadership, management, and the organization overall. It describes an informed, reporting, and flexible culture that uses incident data and other indicators to improve the safety environment. The dedication to system change management and assessment contributes to a learning culture, involving safety planning with operations and procurement.

#### **REFERENCE DOCUMENTS**

System Safety Program Plan 2011

Rail Safety Program 2012

### **Chief Safety Officer Reports Directly to General Manager**

**ESCP RANKING—SCORE:** #20 Tie—3.83

**AGENCY:** Utah Transit Authority (UTA)

**CONTACT:** Chief Safety Officer

#### **BRIEF DESCRIPTION**

The chief safety officer is one of seven executives in the organization reporting directly to the GM (along with planning, capital, communications, technology, operations, and finance). The recently established office was designed to improve safety coordination throughout the organization, enhance the safety culture, and comply with regulatory requirements. The office now includes the construction safety element (previously in capital development), the UTA police department, and emergency management. This consolidated many of the safety, security, and emergency responsibilities of the organization into one reporting structure. The reorganization has gained affirmation from the state safety oversight and FTA headquarters and region staff. It has also facilitated the audits and reviews conducted in the activation of several new rail lines. The reorganization anticipated changes that agencies might need to make under MAP-21 (Moving Ahead for Progress in the 21st Century).

#### **IMPACT ON SAFETY CULTURE**

Direct report to the GM demonstrates strong leadership and management and organizational commitment. It reflects the high priority accorded to safety.

#### **REFERENCE DOCUMENTS**

UTA System Safety Program Plan 2013

## Collaborative Design and Procurement Process

**ESCP RANKING—SCORE:** #20 Tie—3.83

**AGENCY:** KCMTD

**CONTACT:** Manager, Transit Safety Unit

### BRIEF DESCRIPTION

A collaborative design process links ergonomics and safety needs with procurement procedures to identify, design, buy, install, and improve on equipment and systems, not just rely on what is currently available. The Transit Fleet Contract Management Group and Bus Procurement Team rely on wide and deep involvement across all key internal stakeholders, including operations, maintenance, safety, paratransit, and customer service and sales. One tool for facilitating this is the vehicle component change request process and form. The on-site ergonomics process has led to many improvements, including enhanced bus seat and mirror designs, improved repair procedures to accommodate mechanics of different sizes and strength levels, and the efficient reallocation of funds away from pedestrian safety devices that did not address the observed cause of accidents and fatalities to more effective solutions. Hourly workers in maintenance, trades, and operations, along with safety and operations supervisors and managers, have contributed.

### IMPACT ON SAFETY CULTURE

The informal ergonomics process relies on proactive use of safety data, effective safety communication, and an informed culture. By procuring equipment that suits local needs, based on employee involvement through action and intervention, the agency demonstrates a flexible and learning culture. The process contributes to organizational trust and is an indication of management commitment.

### REFERENCE DOCUMENTS

Transit Fleet Contract Management Group and Bus Procurement Team; Vehicle Component Change Request Trolley 2012

## Regional Sharing of Safety Information and Expertise

**ESCP RANKING—SCORE:** #20 Tie—3.83

**AGENCY:** CUMTD

**CONTACT:** Safety and Training Director

### BRIEF DESCRIPTION

The agency is part of an insurance consortium with other regional properties. To control costs and reduce risk, the broker organizes meetings for safety personnel from all involved agencies to meet twice a year, in person or virtually, to discuss safety concerns. Topics include driver selection, drug testing, training, and loss analysis. Consortium participants describe what they

are doing to advance safety and brainstorm as to what would help consortium members keep pool costs down and improve safety conditions at each agency. A current task is to find solutions to onboard passenger accidents. Participation is voluntary.

### IMPACT ON SAFETY CULTURE

Sharing data among colleagues at other agencies demonstrates a strong commitment to an informed culture. It is also a sign of a flexible and learning culture.

### REFERENCE DOCUMENTS

None; there is no formal policy governing this practice.

## Tailoring Training and Policy for Improved Pedestrian Safety in a Campus Setting

**ESCP RANKING—CORE:** #20 Tie—3.83

**AGENCY:** CUMTD

**CONTACT:** Safety and Training Director

### BRIEF DESCRIPTION

Because of the challenges of a dense pedestrian environment on campus, the agency commissioned an in-depth study of the problems with pedestrian and bicycle traffic, and initiated changes to improve communications, traffic planning, and operations. The agency's Smith system defensive driving program was expanded beyond new-hire training to an extensive summer review program for all operators, and included a safety-focused roadeo. Data analysis had shown that accident or incident risk is highest at 6 months following employment and overall during the first year. New drivers are restricted from driving campus routes in their first 6 months. A mentoring program for first-year operators consists of a minimum of six safety ride evaluations and follow-up if necessary. The director also conducts random safety ride evaluations on an ongoing basis.

### IMPACT ON SAFETY CULTURE

Responding to a hazardous environment by providing specific training and tailoring policy to address those hazards is a sign of an informed and learning culture and an organizational commitment to safety.

### REFERENCE DOCUMENTS

Training qualifications class.xls; mentoring program.pdf; 6-month review

## Ri2 Safety Reporting Program

**ESCP RANKING—SCORE:** #24—3.8

**AGENCY:** OCTA

**CONTACT:** Executive Director, Human Resources and Organizational Development

**BRIEF DESCRIPTION**

Ri2 (route input two) is a computer-based communication system directly linking OCTA coach operators with parties responsible for resolving issues relating to schedules, bus stops, transit security, operations supervision, maintenance, and health and safety problems. Operators enter their input using drop-down boxes in which they summarize the issue or issues of concern. Ri2 was originally developed to improve communication between coach operators and schedule analysts when the original paper-based input process was found to be unreliable. Since inception in 2005, the program has been expanded to include links to the other entities described earlier in this paragraph. All issues entered into the system receive formal answers and are available in the system to all operators, and a Ri2 report containing all issues and answers for that month is posted in the operators' room.

**IMPACT ON SAFETY CULTURE**

This system significantly enhances the maintenance and continuation of an informed culture among OCTA operators.

**REFERENCE DOCUMENTS**

OCTA Quick Tips for Using Ri2

**Operations Integrity Management System (OIMS)**

**ESCP RANKING—SCORE:** #25—3.75

**AGENCY:** ExxonMobil

**CONTACT:** Safety Programs Manager

**BRIEF DESCRIPTION**

After the *Valdez* oil spill in 1989, ExxonMobil committed itself to conducting business in a manner compatible with the environmental and economic needs of the communities in which the corporation operates and in a way that protects the safety, security, and health of its employees, its customers, and the public. Its commitments are documented in its safety, security, health, environmental, and product safety policies. These policies in turn are put into practice through a disciplined management framework called OIMS. This framework, which influences every operational decision, consists of 11 elements. These elements are:

1. Management leadership, commitment, and accountability;
2. Risk assessment and management;
3. Facilities design and construction;
4. Information/documentation;
5. Personnel and training;
6. Operations and maintenance;
7. Management of change;
8. Third-party services;
9. Incident investigation and analysis;

10. Community awareness and emergency preparedness; and
11. Operations integrity assessment and improvement.

Each of these elements contains an underlying principle and a set of expectations, which are the same for all employees regardless of their positions in the organization. Business segments are responsible for supplementing the OIMS framework by establishing and maintaining guidelines relevant to their specific activities. Local management systems provide additional guidance, including processes and procedures, responsible and accountable parties, resources, and feedback mechanisms for continuous improvement.

As part of enhanced leadership training, ExxonMobil is piloting a series of new OIMS leadership academies.

ExxonMobil also employs Lloyd's Register Quality Assurance, Inc. (LRQA) to conduct an annual third-party validation audit of OIMS.

**IMPACT ON SAFETY CULTURE**

This standard operating procedure demonstrates strong management and organizational commitment to safety. It creates the mechanisms for a reporting and informed culture that ensures consistent safety reporting and investigation for prevention. The ongoing revision process, supported by approximately 50 to 70 assessments annually, LRQA audits, and leadership academies, is part of the learning culture.

**REFERENCE DOCUMENTS**

OIMS Framework Brochure

**Extension of 10-Hour Rest Guideline to All Operators**

**ESCP RANKING—SCORE:** #26—3.7

**AGENCY:** GCRTA

**CONTACT:** GM/Operations

**BRIEF DESCRIPTION**

APTA's "Standard for Train Operator Hours of Service Requirements" calls on rapid transit systems to limit the hours of service for train operators to no more than 16 per shift, with no more than 14 hours active time (allowing for swing), and to include at least 10 hours in between scheduled shifts. In 2011, GCRTA extended the 10-hour rest guideline to bus and paratransit operators as well as rail operators. The absolute length of the day is restricted by the collective bargaining agreement, which states that regular 5-day runs must be completed within 13 hours of platform time and that 4-day runs at 10 hours per day must be completed within 14 hours of platform time. A minimum of 10 hours between work assignments within a 24-hour period was implemented for rail and bus operators effective with the summer 2011 service change. The 10-hour rest rule came

into effect for paratransit operators with the January 2012 service change.

### IMPACT ON SAFETY CULTURE

Voluntarily extending a safety policy from rail to bus at additional operating expense in order to support improved operator health and system safety demonstrates a strong management and organizational commitment to safety.

### REFERENCE DOCUMENTS

2011 Operations Division Initiatives/Projects: Year End Status January 10, 2011

## Board Involvement in Safety and Safety Culture

ESCP RANKING—SCORE: #27 Tie—3.58

AGENCY: LACMTA

CONTACT: Executive Officer, Corporate Safety

### BRIEF DESCRIPTION

On October 27, 2011, the LACMTA board of directors affirmed the board's oversight responsibility for safety culture and system and organizational safety by approving a motion regarding various elements to promote and sustain safety at the highest levels of the organization. This motion called for:

- “Reviewing thoroughly the safety culture of our organization,”
- “Clarifying our organizational values to support safety as our primary value,”
- “Reorganizing our committee structure to highlight and centralize the Board's fundamental responsibility to oversee safety,” and
- “Developing frequent and comprehensive reports and agenda items regarding system safety for Board discussion and action.”

### IMPACT ON SAFETY CULTURE

This practice directly and thoroughly demonstrates the requirement of management commitment.

### REFERENCE DOCUMENTS

LACMTA Board of Directors Minutes: Antonovich Motion, October 27, 2011

## Service Change Request

ESCP RANKING—SCORE: #27 Tie—3.58

AGENCY: SamTrans

CONTACT: Manager, Transit Operations Training

### BRIEF DESCRIPTION

The electronic service change request allows an operator to provide data and request a service change to improve

scheduling and report route problems, including safety hazards. It provides for recording, tracking, and evaluating issues that operators see on the road and that may affect schedule demands and vehicle, passenger, or operator safety. It must be processed within 10 days.

### IMPACT ON SAFETY CULTURE

The service change request shows leadership, management, and organizational commitment to safety, employee involvement, and mutual trust. It is a flexible culture tool and also reflects a reporting, informed, and learning culture.

### REFERENCE DOCUMENTS

Service Change Request SOP T-43

## Safety Resolution Process

ESCP RANKING—SCORE: #29—3.5

AGENCY: KCMTD

CONTACT: ATU Local 587 Safety Committee

### BRIEF DESCRIPTION

The safety resolution process is defined by a joint safety committee clause in the collective bargaining agreement and by Washington State code. Metro employees attempt to solve disagreements about work safety rules at the lowest level possible, initially through the section safety committee. If that fails, the problem is forwarded to the joint safety committee for resolution. KCMTD also has a policy delegating accident and incident investigation by the GM to the safety department. Recommendations made as a result of these investigations must be discussed and reviewed with the section supervisor. If there is disagreement, the recommendations are then forwarded to the deputy general manager for resolution.

### IMPACT ON SAFETY CULTURE

This practice ensures employee involvement, indicates management commitment, and represents both an informed and a flexible culture.

### REFERENCE DOCUMENTS

Section 8: ATU Local 587 and King County Metro Labor Contract and State of Washington Administrative Code 296-800-130

## Life-Changing Index

ESCP RANKING—SCORE: #30—3.4

AGENCY: CSX

CONTACT: VP, Safety

### BRIEF DESCRIPTION

Beginning June 1, 2012, after having five employees seriously injured in 2011, an additional safety measurement was

introduced at CSX. The life-changing index is a measure of *potential* incident severity. The life-changing index is a predictive model to gauge safety performance based on what might have happened or the potential severity of the event—for example, a track worker is brushed on the shoulder by a locomotive. This has the potential to lead to great injury/fatality, so it gets a high score on the life-changing index, whereas it would not register on the OSHA scale because the outcome was not fatal and did not result in a serious injury.

The life-changing index provides a numerical value for the incident's potential for injury and for the risk to which it may expose the public. The measures that are currently used rely simply on numbers of injuries and fatalities. The new measure allows managers to refine and tailor preventive actions that target behaviors.

Key Points:

- All injuries are measured on a scale from 0 to 2.
- Only FRA reportable and non-reportable incidents are reviewed.

Severity levels are important:

Levels:

- Level 0—A non-reportable injury with no severity implications to the employee—for example, an insect bite.
- Level 0.5—An injury with minor severity implications to the employee. For example: a strain/sprain while dismounting equipment or minor auto accident.
- Level 1—An injury with moderate implications—for example, struck by a sliver of metal.
- Level 1.5—An injury with potentially severe injury implications—for example, a fall from a stationary railcar.
- Level 2—An injury with potentially catastrophic or fatal implications—for example, a fall from a moving railcar or a head-on collision in a motor vehicle.

Evaluation:

- The total amount of each injury's weighted value is defined as the weighted severity value.
- The safety department is responsible for the ranking of incidents.

The weighted severity value is then plugged into the FRA frequency index equation:  $\text{weighted severity value} * (200,000) = \text{injury severity index actual man-hours}$ .

#### IMPACT ON SAFETY CULTURE

This standard operating procedure demonstrates strong management and organizational commitment to safety. It creates the mechanisms for a reporting and informed culture

that ensures consistent safety reporting and investigation for prevention.

#### REFERENCE DOCUMENTS

CSX Life-Changing Index Standard Operating Procedure

#### Peer Bus Operator Training

ESCP RANKING—SCORE: #31—3.33

AGENCY: Des Moines Area Rapid Transit

CONTACT: Training Manager

#### BRIEF DESCRIPTION

Behind-the-wheel trainers are experienced working operators with exemplary records who have applied for these positions and have been interviewed, selected, and trained. These trainers receive a pay differential while training and wear distinctive uniform badges so other drivers will know who they are and reach out to them for support. They meet in quarterly roundtables. These meetings facilitate maintenance of a shared vision. A standard training manual is used.

#### IMPACT ON SAFETY CULTURE

Relying on experienced employees to train new drivers is an excellent example of employee involvement.

#### REFERENCE DOCUMENTS

Behind the Wheel Trainers Performance Standards and Interview Questions

#### Railroad Educational Development Institute (REDI)

ESCP RANKING—SCORE: #32 Tie—3.3

AGENCY: CSX

CONTACT: VP, Safety and Field Career Development

#### BRIEF DESCRIPTION

CSX personnel are trained at the REDI center for approximately 6 weeks when they join the company. Employees are randomly selected for retraining. Alternatively, employees identified as needing support are rotated through programs that address the supervisors' concerns.

Since its opening in 2005, more than 12,000 students have gained professional training as conductors, locomotive engineers, management trainees, yardmasters, communications and signal workers, track workers, and more. Courses are available for customers, subsidiaries, vendors, short-line partners, and other rail-based companies. The curriculum is tailored to meet the specific needs of those attending the institute, but each program includes a thorough course in rail safety. Training opportunities include:

- Ethics training,
- Annual rules certification,



- Safety training,
- Safety training for non-operating employees,
- CPR,
- Diversity training,
- Management trainee program,
- SkillPort eLearning,
- Associate development program,
- Annual management training workshops, and
- Leadership excellence training.

### IMPACT ON SAFETY CULTURE

This standard operating procedure demonstrates strong management and organizational commitment to safety. Training programs demonstrate a learning culture through employee engagement.

### REFERENCE DOCUMENTS

Department of Transportation (DOT) Training, Customer Rail Safety Guidebook, Customer Rail Safety Guidebook—Car Handling Safety, Training Playbook, Sample Personal Injury Report

### Safety Job Briefing Reference Card

**ESCP RANKING—SCORE:** #32 Tie—3.3

**AGENCY:** NJT

**CONTACT:** Deputy General Manager, Rail Safety and Training Department

#### BRIEF DESCRIPTION

The safety job briefing reference card was developed by the labor and management peer review team in response to concerns about safety and reporting that arose during the confidential close-call reporting process. The card, distributed to all train and engine employees, defines what points must be discussed during every safety job briefing. It covers train movement, safety issues, employee responsibilities, and passenger issues, and it provides critical close-call rules and important phone numbers. This job aid enhances the safety job briefing process and promotes a safer workplace.

### IMPACT ON SAFETY CULTURE

This portable information source and reminder supports the agency's strong reporting culture. Its development in direct response to concerns identified through the confidential close-call reporting process indicate a learning and flexible culture that calls on employee involvement.

### REFERENCE DOCUMENTS

T&E Safety Job Briefing

### Improved Rule Format

**ESCP RANKING—SCORE:** #33—3.0

**AGENCY:** CSX

**CONTACT:** VP Safety

#### BRIEF DESCRIPTION

CSX followed the military and airline industry in adopting a checklist format rather than the traditional narrative-style rule description. This format makes employees more likely to review the information and also more likely to retain it. For example, Rule 104-C formerly read:

“104-C. Employees lining switches must ascertain that:

1. No conflicting movement is approaching,
2. The route is lined for the movement,
3. The switch points fit properly,
4. The lever is secured, and
5. Target if so equipped corresponds with switches.

A switch that provides access to a controlled track must not be opened unless authorized by the train dispatcher. This may only be authorized by signal indication or by permission of the train dispatcher. A switch must not be lined for a diverging movement of an approaching train until the employee attending the switch has contacted the crew of the train affected to ensure the movement is to use the turnout or crossover, understanding the switch will be lined for their movement, and movement will approach the switch location under control to prevent operating through an improperly lined switch. When kicking cars, a switch must not be lined for a following car going to another track, until it is known that the proceeding car will clear the route.”

In checklist format, the rule reads as follows:

“104.1 *A switch or derail that provides access to a controlled track must not be unlocked or operated unless authorized by:*

- a. Verbal authority from the train dispatcher, or
- b. Signal indication.

104.2 *A switch must not be lined for a diverging movement for another train until the employee operating the switch contacts the approaching train and confirms:*

1. Train intends to make a diverging movement,
2. Crew understands the switch will be lined for the diverging movement, and
3. Train will approach the switch prepared to stop.

104.3 *Before lining a switch or derail, the employee must ensure:*

1. There are no conflicting movements,
2. Any preceding movement has passed the clearance point,

3. The device is not locked, clamped, spiked, or tagged out of service, and
4. No obstructions will interfere with normal movement of the switch points or the handle.

104.4 *After operating a switch or derail, the employee must make certain the:*

1. Device is properly lined,
2. Switch points fit properly,
3. Target, if equipped, corresponds to the position of the device,
4. Lever is secure, and
5. Device is locked, if equipped with a lock.”

#### **IMPACT ON SAFETY CULTURE**

This standard operating procedure demonstrates an emphasis on achieving higher levels of an informed culture at CSX. It also indicates a strong management and organizational commitment to safety.

#### **REFERENCE DOCUMENTS**

None available.

## **Conclusions**

There are many practices that promote safety and safety culture within and outside the public transportation industry. The research team has identified 34 such practices from a relatively small group of companies and transit agencies. It is important that readers understand that not all of these practices are appropriate for all transit agencies. In many cases, a practice will not work in a given transit agency unless the necessary foundation exists to support it. For example, OCTA's safety captain program will not work in a transit agency if management does not trust the hourly employees designated as safety captains to use the power delegated to them responsibly or those hourly employees do not trust their managers to accept and value their input.

Transit agencies should consider the list of practices in this chapter as a menu from which to choose a few practices that appear appropriate for them—practices that would remedy a deficiency in safety operations and help improve safety culture. Before a practice is implemented, it should be discussed with all stakeholders within the transit agency and implemented on a trial basis. After the trial period, the efficacy of each practice should be evaluated, and a decision should be made whether to retain, revise, or discard the practice.

## CHAPTER 8

# Improving Safety Culture at Four Transit Agencies

### Introduction

This chapter uses four success stories to reinforce the identification of elements that improve safety performance and safety culture in public transportation systems so that they may be considered for application throughout the transit industry. These elements were previously identified in Chapters 1, 2, 3, and 4 and Appendices A, B, and C. Their application, however, is best shown in accounts of transit agencies that have made significant improvements in safety culture. Please note that having “made significant improvements in safety culture” is not synonymous with having achieved a perfect state of safety culture.

The research team examined two categories of transit agencies that made significant improvements in safety culture:

- **Safety culture improvement in response to a major accident or incident.** The first category consists of transit agencies whose efforts to improve safety culture were undertaken in reaction to a major accident or incident. Examples of transit agencies in this category are NYCT and the Washington Metropolitan Area Transit Authority (WMATA).
- **Safety culture improvement without a major accident or incident.** The second category includes transit agencies that have improved safety culture without the spur of an incident or accident. Examples of transit agencies in this category are LACMTA and OCTA.

### A New York City Transit Case Study

#### Background

On April 24, 2007, a New York City Transit track worker, while setting up flags on the IRT Line express tracks just north of Columbus Circle Station, was struck and killed by a southbound train. Five days later, on April 29, 2007, another track worker was struck and killed by a train proceeding eastbound on the IND Line while he was moving equipment across the tracks within the bounds of Hoyt-Schermerhorn

Station. His partner was also struck but ultimately survived serious injuries.

Fatalities were not uncommon at NYCT, as indicated in Figure 7. From 1950 to 1959, an average of 6.7 employees were killed per year. From 1970 to 2009, a 40-year period, the average dropped to 1.7 deaths, which still amounted to five fatalities every 3 years.

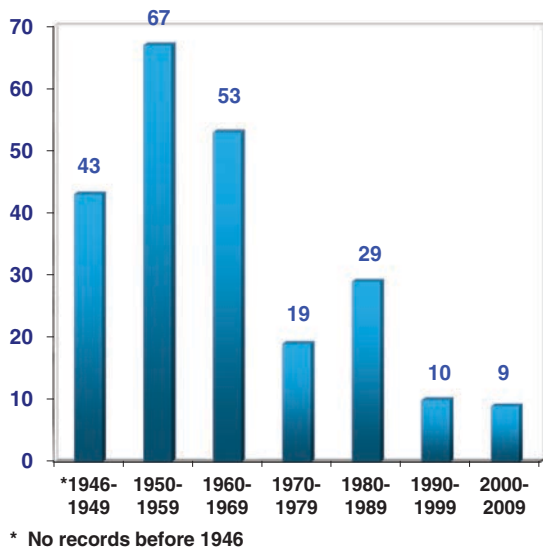
The higher number of average annual fatalities from 1946 through the 1960s resulted from less emphasis on employee safety as reflected by safety rules, faster train speeds, training deficiencies, and failure to delineate safe areas adequately. (In many tunnel stretches, there is insufficient space between the tunnel walls and the track to prevent employees from being struck by trains.) Fatalities dropped significantly as improvements were made in these areas. However, track fatalities continued at a rate of roughly three every 2 years for the last two decades. These fatalities continued to occur despite the establishment of:

- An office of system safety, which reported directly to the NYCT president;
- Separate safety units reporting to the vice presidents of the Department of Buses and Department of Subways;
- An elaborate longstanding system safety program plan with defined responsibilities and investigative, reporting, and tracking systems;
- A longstanding practice of weekly and monthly safety meetings; and
- Relatively detailed contractual provisions for joint labor-management cooperation to monitor and resolve safety problems and disputes.

### Immediate Executive Action

#### *Letter to All Employees*

Immediately after an employee’s death on one of its lines, the NYCT president sent a message to all employees, discussing



**Figure 7. NYCT employee track fatalities by decade, 1946 to 2009.**

the recent fatality, other fatalities and injuries, and strategies, such as an emergency stand-down, to be taken to improve safety.

### Emergency Safety Stand-Down

The emergency safety stand-down at NYCT for all employees who worked on the tracks lasted from April 30 to May 10, 2007. In conjunction with the president of TWU Local 100, the NYCT president also added labor representatives to the boards of inquiry investigating the fatalities. This was the first time in NYCT history that labor had been included in the formal investigation process.

A number of changes in rules, regulations, and procedures were instituted on an interim basis subject to review and further revision. The first major initiative undertaken by the NYCT and TWU Local 100 presidents was to establish a Joint Track Safety Task Force (JTSTF). Management and labor representatives were named to the JTSTF representing all personnel involved in any way on the track. The chair of this task force was the vice president of system safety for NYCT. The task force was charged with answering five key questions:

1. To what extent are rules/procedures ignored?
2. Is risk taking inherent in the maintenance-of-way culture?
3. Have measures following previous fatalities or serious injuries positively changed the culture and employee behavior?
4. Is the workforce invested in the safety mission?
5. What short- and long-term changes are needed?

The TWU Local 100 and NYCT presidents recognized early on that the response to these tragedies required challenging both the existing formal system and the prevailing culture. They enlisted individuals with background and expertise in specialized labor environments to inform their leadership approach. Presentation briefings were conducted for top NYCT managers and TWU representatives, and the science, complexity, and enormity of tackling systems and culture simultaneously were discussed. They decided that a survey would be the quickest and most reliable way to gain meaningful insights into the culture at NYCT.

### Safety Culture Survey

A consultant was hired to design, conduct, analyze, and summarize the safety culture survey in conjunction with NYCT task force members. In June 2007, focus groups were conducted with groups of train operators, maintenance-of-way workers, and supervisors. The purpose of the focus groups was to identify issues for inclusion in the survey. The task force then developed the survey with the consultants' assistance. It included questions about participants' assessments of the work culture, safety conditions, training and safety measures, and communications. The survey contained 105 questions and took an average of 37 minutes to complete.

The target population for the safety culture survey was approximately 11,000 employees. NYCT and TWU records were reviewed to obtain home telephone numbers. Between July 12 and August 2, 2007, at least five attempts were made to contact each individual. In addition, flyers were distributed to prospective survey participants, informing them about the survey and providing a toll-free phone number to call.

### Survey Findings

Of the 756 completed surveys (margin of error  $\pm 3.6\%$ ), 114 were supervisors, 247 were train operators, 361 were maintenance-of-way workers, and 34 were construction flaggers. The margin of error means that it is 95% likely that the results from the survey were within plus or minus 3.6% of reality. The surveys were designed to get behind the ideas verbalized by responders to underlying perceptions and base thinking about safety behavior. The cross-tabulations of the survey results revealed the various subcultures embracing different titles and groups of workers. This survey proved critical in formulating NYCT's comprehensive response to the employee fatalities of April 2007.

The results of the survey revealed that, while rules, regulations, and procedures needed revising, the major problem was the existing safety culture at NYCT. That, in turn, meant dealing with multiple subcultures that defined atti-

tudes and accepted norms of behavior for that particular part of the organization. At NYCT, the subcultures were distinguished by:

- Organizational role (e.g., board, management, supervision, hourly employee),
- Operating mode (e.g., rail, bus, paratransit), and
- Specific functional specialties within the organization (e.g., rail transportation superintendent, bus maintenance foreman, rail dispatcher, bus driver, train operator, track worker, signal maintainer, bus mechanic).

The interactions of all of these elements representing different safety subcultures are affected by the imperatives and constraints inherent in the physical operation of each specific mode and drive overall organizational behavior, which behavior defines safety culture in the organization.

Further investigation revealed that:

- Safety culture was expressed only by behavior.
- Attitudes and norms of behavior were not necessarily uniform even within single subcultures.
- A safety subculture existed within every part of the organization; it might be unified and extraordinarily effective, or it might be disorganized, non-uniform, and completely ineffective at preventing accidents, incidents, and/or injuries, but it existed.

## Actions to Improve Safety Culture at NYCT

### *JTSTF*

Wide-ranging initiatives were undertaken to improve the safety culture at NYCT. The JTSTF implemented the following actions:

- **Stand-down reform.** The traditional method of assessing safety problems and general safety conditions for public transit track workers is the safety stand-down, during which all but emergency work is suspended and management, supervision, and hourly workers gather together for an off-site seminar on track safety. In the past, these sessions had largely consisted of supervisors reading the rulebook to hourly employees. However, in 2007, a major effort was undertaken to transform these sessions into active discussions of safety issues involving managers, supervisors, and hourly workers.
- **Analysis of past accidents and responses as a whole.** While thorough investigations had been conducted of NYCT accidents and incidents as each occurred, no one had done an analysis of all accidents and incidents that had occurred in the previous 20 years. Such an analysis

was performed in 2007 and was very useful in highlighting recurring factors that were not evident in the individual investigations.

- **Joint union/system safety on-site inspections.** Unannounced inspections were instituted for all three shifts on a weekly basis using a safety checklist covering 21 areas. Inspections covered in-house track construction projects, track maintenance and cleaning, capital construction projects, signal maintenance, and lighting. The NYCT and TWU presidents tracked the results closely on a weekly and monthly basis. The number of unsatisfactory findings declined steadily.

## Joint Presidential Actions

The NYCT president and the president of TWU Local 100 used numerous strategies to influence safety culture and subcultures positively within the organization. These included:

- **Priorities:** Establishing safety as highest priority by board, management, and union leadership and evidencing commitment to that priority by support for and dedication of sufficient resources to safety;
- **Rules:** Developing realistic rules, regulations, and procedures with involvement of all levels of the organization;
- **Training:** Improving the quality of initial and refresher training;
- **Communications:** Allocating significant additional resources to effective communications; and
- **Oversight:** Dramatically increasing oversight of all track-related operations by managers, supervisors, and joint union–management teams.

## Other Actions

Other actions included:

- **Near-miss investigations:** The System Safety Department received an additional headcount to accomplish a number of previously unfunded functions, to include the thorough investigation of near-miss incidents.
- **Inspections:** Frequent inspections were instituted both by the System Safety Department and joint management–labor teams of all aspects of system operation.
- **Performance indicators:** An accurate system of metrics to track safety-related incidents and to determine and reveal emerging patterns and trends was instituted.
- **Follow-up surveys:** A periodic, anonymous survey to track changes in attitudes and norms of behavior within the separate NYCT subcultures and for the organization as a whole was planned.

- **Legislation:** Joint agreement was reached on New York State legislation that established a New York State Track Safety Task Force consisting of two state commissioners (transportation and labor) and the presidents of NYCT and Local 100 with oversight over any “material modifications” in the track safety program, and that legislation was passed.

## Changing Behavior

### *Basic Approach*

Understanding how to bring about positive improvements in safety-related behavior was critical to improving the safety culture at NYCT. John Law, an earlier TWU Local 100 president, was fond of an ancient Irish saying that “paper never refused ink.” In this context, what that meant was that the greatest safety experts in the world could write a book containing the best set of rules, procedures, and regulations ever devised, but unless the employees for whom the book is written completely absorb, internalize, and live by those rules, procedures, and regulations on a daily basis, that effort is worth nothing.

The NYCT president and the president of TWU Local 100 facilitated the process of bringing about translating the written word into changed behavior by stressing:

- Employee involvement in developing revised rules, regulations, and procedures;
- Continual refinement of that set of rules, regulations, and procedures;
- Development of a “marketing plan” for selling NYCT employees on the merits of following the rules, to include use of “commercials” made by family and friends, an idea borrowed from New York City’s Consolidated Edison (which has successfully improved its safety climate), on the importance of employees coming home safely every night; and
- Direct involvement by senior management and union leaders in carrying the message that change is essential.

### *Using Communication and Training to Foster Changes in Behavior*

The JTSTF developed 63 recommendations, of which 13 were rule changes and 50 were process and procedural changes. The necessity for significant changes in attitudes and norms of behavior and the rationale for these changes being implemented were the subject of training sessions conducted from May through July of 2008.

All maintenance-of-way personnel who worked in the right-of-way and on road car inspection and all construction

flaggers (a total of 7,852 people) attended one of 51 training sessions lasting 8 hours that were presented for employees. Each session consisted of a 2-hour auditorium presentation conducted by the NYCT and TWU Local 100 union presidents and a 6-hour small group discussion on implementation of the 63 JTSTF recommendations. In the auditorium session, the NYCT and TWU Local 100 presidents reviewed the results of the survey with an emphasis on the dangerous attitudes and norms of behavior revealed and made the case for continuous refinement of a set of applicable rules, regulations, and procedures until all employees embraced that set and lived it on a daily basis or faced censure from their coworkers. Rapid-transit operating personnel attended a similar program, with 4,540 people attending 3-hour sessions. The fact that these sessions were personally led by the NYCT and TWU Local 100 presidents captured the attention of the participants, conveyed the necessary sense of urgency and shared management and labor commitment, and underscored the message that nothing was more important to leadership than safety.

## Safety Culture Improvements

About 3 years after an employee’s death, a track supervisor was killed on the NYCT tracks. This represented the second longest period between track deaths in recorded NYCT history. About 6 years after his death, another hourly worker was killed on the tracks at NYCT. This is by far the longest period between hourly worker deaths.

The steps taken to bring about this improvement in safety culture at NYCT represented an instinctive application of Reason’s principles by the presidents of TWU Local 100 and NYCT, neither of whom happened to have any previous knowledge of Reason’s work.

## A Washington Metropolitan Area Transit Authority Case Study

### Background

WMATA had experienced 10 serious accidents in the previous decade, which resulted in 17 employee and passenger fatalities and nearly 100 passenger injuries.

Two of the most serious accidents occurred on WMATA’s Red Line rail service. On November 3, 2004, 20 passengers were injured when an out-of-service Red Line train rolled backward into the Woodley Park station and hit an in-service train that was at the platform servicing the station. On June 22, 2009, two Red Line trains collided when a southbound train stopped on the track and another southbound train hit the rear of the first train. The lead car of the second train telescoped into the rear of the stopped train, killing nine

passengers and injuring more than 70. The train operator of the second train was killed.

In addition, there also were eight fatal accidents involving track workers during this decade.

- In October 2005, an employee was struck and killed at the Braddock Road station on the Blue and Yellow Lines.
- In May 2006, another employee died after being hit by a Red Line train at the Dupont Circle station.
- On November 30, 2006, two employees were struck and killed while performing routine track maintenance on the Yellow Line near the Eisenhower Avenue station.
- On August 9, 2009, an employee was struck and killed by a ballast regulator between the Dunn Loring–Merrifield and Vienna/Fairfax–GMU stations on the western end of the Orange Line.
- On September 10, 2009, another employee was struck between the Braddock Road and Ronald Reagan Washington National Airport stations and subsequently died from his injuries.
- On January 26, 2010, two workers were killed when they were struck by a piece of track equipment at the Rockville station.

## Board Initiatives

### *Evaluation*

In response to this series of accidents and mishaps, the WMATA board asked several separate consultants to examine WMATA operations. The general consensus of these consultants was that WMATA rail in particular suffered from a poor safety culture. Management was not emphasizing safety sufficiently; existing safety and operating procedures were frequently ignored, and employees were often establishing their own procedures; operations were dominated by organizational silos; train operators were not sufficiently mindful of the safety of maintenance workers on the roadway; the rail transit system was physically in poor condition (with track conditions being particularly bad); and communications within the organization were poor.

## Board Responses

The WMATA board was criticized by the NTSB for lack of safety oversight in a July 27, 2010, report.

**Board organizational change:** In response, the board created a Safety and Security Subcommittee on September 30, 2010.

The board also took the following specific actions:

- **Management changes:** hired a new general manager and chief safety officer.

- **Safety as a priority:** added safety to the WMATA mission statement.
- **Reorganization:** moved the safety department to under the general manager.
- **Resource allocation:** increased the number of employees and resources committed to the safety department.

## General Manager Initiatives

### *First Steps*

#### **Focus on Operations Department**

The new general manager's efforts to improve WMATA's safety performance and safety culture initially focused on the Operations Department.

- **Clarification of responsibilities:** The Operations Department was assigned primary responsibility for safety.
- **Operations manager experience:** The new general manager hired additional experienced managers for both bus and rail operations.
- **Worker Protection Program:** This program, which defines procedures for protecting all employees who work on the track, was completely overhauled, with employee buy-in and involvement incorporated and extensive initial training administered and periodic refresher training required.
- **Organizational learning:** The general manager established a formal lessons-learned program ("Looking back to effectively move forward"). All departments are required to prepare a lessons-learned bulletin for any significant safety incident. The bulletin is to contain an incident summary, lessons learned (what happened versus what should have happened), a root cause analysis, and recommendations for further action. These bulletins are distributed to all affected employees by e-mail and by the chain of command.
- **Oversight:** Safety officers were assigned to the field to provide greater oversight of operations. Rather than sit behind desks and manage safety operations through their in-baskets, these officers are constantly observing field operations.

### *Safety Culture Survey*

The general manager initiated an employee safety culture survey. The initial survey had a 97% participation rate.

- The survey was contemporaneous with initiation of the upgraded Worker Protection Program.
- The results reaffirmed disconnectedness and fear of reporting because of peer pressure and possible management action.
- Respondents, however, were not convinced that the changes that had been made were permanent.

### *Additional Actions to Improve Safety Culture at WMATA*

Additional actions taken to improve the safety culture are discussed in the following:

- **Feedback:** The general manager set up a safety hotline to serve as a feedback channel. All employees, contractors, and patrons can contact the safety hotline by e-mail, telephone/voice mail, or in person. Approximately 43% of the calls in the first year of operation concerned facility problems, 20% were employee personal safety issues, 9% were vehicle defects and problems, and 7% concerned environmental issues.
- **Reporting:** The general manager also established a WMATA non-punitive close call program.
  - The BTS takes calls while protecting the confidentiality of the caller.
  - The BTS conducts a confidential interview of the reporting employee or employees.
  - The BTS provides a report to a joint Metro/Local 689 group on the cause of the close call and recommends appropriate action to the deputy general manager for operations (DGMO).
  - The DGMO reviews and accepts the recommendations and provides oversight of the implementation.
  - Agreements to implement the system were signed with BTS and the ATU.
- **Employee involvement:** The previous general manager had brought DuPont onto the property and set up LSCs. The performance of these committees was uneven. The new general manager and safety officer have reinvigorated the LSC program by empowering the LSCs to make changes and by providing effective oversight of LSC activities:
  - The LSC motto is “Identify locally; solve locally.”
  - Department Safety Committees oversee the LSCs.
  - The Executive Safety Committee oversees the Department Safety Committees.
  - The WMATA approach is to “listen, say what we are going to do, do it, and solicit feedback.”
- **Infrastructure:** A major problem at WMATA had been the deterioration of the infrastructure, with no resources provided for a return to a state of good repair. The supporting jurisdictions have significantly increased capital support: FY 2010: \$400 million, FY 2011: \$600 million, FY 2012: \$770 million, and FY 2013: \$900 million.
- **Availability:** Major improvements made in track and car availability: FY 10: 836 cars on average available; FY 11: peak requirement is 896. There are now 940 to 950 cars available, on average.
- **Engineering support:** WMATA has hired back car engineers and integrated them into operations, making engineering support directly available to operations managers.

- **Parts availability:** There was a major parts problem for both buses and rail that took 2 years to fix. Employees can see that parts are available and get the message that things have changed.
- **Radio system:** A major problem with the radio system has been fixed.
- **Communications:** The general manager does a weekly employee message. It always has a safety component.
- **NTSB backlog:** There were 400 NTSB open items when the new general manager arrived; only a few now remain.
- **Accident investigation backlog:** There were 220 backlogged accident investigations when the new safety officer arrived; few remain. The goal is to close out most investigations within a 72-hour limit or to explain to the general manager why they were not closed out.
- **Tri-State Oversight Commission (TOC) relationship:** There was a poor relationship between the TOC and WMATA; that relationship has improved.

### **Results of Initiatives**

After 3 years:

- Employees say that things are better.
  - Key statistics have improved.
  - There has been only one serious injury to a WMATA employee; it occurred in a maintenance shop on May 29, 2012.
  - An FTA review found “considerable progress.”
  - WMATA has completed another employee survey (64% participation) in which 85% of respondents reported that they were no longer afraid to report close calls.
  - WMATA has implemented a Good Faith Challenge Program under which employees can stop work.
  - Employees can get rules changed through:
    - LSCs,
    - A safety hotline, and
    - An operator group, which has been working on red signal violation rules.
  - Single tracking train speed has been reduced to 15 mph, thereby increasing available reaction time for employees working on the adjacent track and reducing braking distance for trains.
  - The general manager’s greatest fear going forward is complacency.
- Looking to the future, the following initiatives are under way:
- The safety officer is setting up a safety measurement system (SMS), which will resemble the New York City police department COMSTAT system.



- All accidents and incidents are investigated in a timely fashion.
- WMATA's biggest current safety effort is fatigue management.
- The safety office elicits regular feedback from management and union personnel.
- The general manager and safety officer are not satisfied with current accomplishments because pockets of employees still remain unconvinced in the changes.
- The safety officer reports monthly to board safety and security committees (safety one month, security the next).

WMATA has shifted capital work from midday on weekdays almost entirely to weekends: 8:00 p.m. Friday to 5:00 a.m. Monday. This minimizes the number of employees working on the track during weekdays. Operations uses bus bridges paid by capital funds to replace rail service on the affected tracks.

The safety department:

- Has increased from 28 to 61 positions,
- Provides coverage for 20 hours per day,
- Is involved in project planning from its inception,
- Makes hazard management a priority, and
- Participates in the daily operations call, which starts with a safety report.

## Safety Culture Improvements

Since the arrival of the new general manager and safety officer, there has been only one serious employee accident; it occurred in a shop on May 29, 2012. There have been no rail collisions, and no track workers have been hit by trains. On October 6, 2013, however, there was an explosion in a Red Line tunnel that killed a contractor's employee. No WMATA employees were reported as being seriously injured.

## A Los Angeles County Metropolitan Transportation Authority Case Study

### Background

LACMTA (Metro) has not experienced significant accidents similar to those that led to initiatives to improve the safety culture at the NYCT and WMATA. The process of improving safety and safety culture at LACMTA was started in 2001 when DuPont was hired to assist in reducing workers' compensation accidents, injuries, and costs. More recently, further progress has been made as a result of determination by the Metro board and senior management to improve safety performance and safety culture in order to reduce the likelihood of accidents on the order of those that had occurred at NYCT and WMATA.

## Recent Board Initiatives

### Safety Culture Assessment

In 2012, the LACMTA board commissioned an evaluation of safety culture, which included a safety culture survey and group discussions with hourly operations employees. The results of the survey and the discussions indicated the presence of a positive safety culture. However, it also was clear that there was room for improvement in many departments.

### Board Resolution

The LACMTA board passed a resolution requesting the evaluation and making it clear that the board endorsed safety as its highest priority for public transportation in Los Angeles County. The board recognized the importance of a positive safety culture in avoiding the safety problems that have beset other transit agencies. The resolution specifically cited the criticism of another transit agency board by the NTSB for not taking a sufficiently active leadership role with respect to safety and safety culture:

*The top priority for the MTA Board of Directors has been and must always be exercising vigilant oversight of MTA's bus and rail system to ensure the safety and integrity of our transit system for every one of our 38 million monthly passengers. As a Board we must remain committed to this priority and continually strive to improve the safety culture at MTA in a proactive manner, rather than in a reactive manner after suffering a major accident, such as the one on June 22, 2009, that claimed [deleted] lives and injured [deleted] other passengers on the [deleted] subway system. In its report on this tragic accident, the National Transportation Safety Board (NTSB) determined that this accident was not just the result of operator error or faulty equipment, but rather served as "an example of a quintessential organizational accident." In short, the NTSB directly called into question [deleted] safety culture and the effectiveness of the [deleted] Board's oversight responsibility for system and organizational safety.*

### Organizing for Safety

The safety champions at LACMTA include the board; the CEO; the chief operating officer (COO); the executive officers of corporate safety, maintenance, and transportation; and the local safety committee and subcommittee chairs. Since being hired in 2009, the CEO has consistently emphasized the importance of safety performance and a positive safety culture.

At LACMTA, the chain of command (the CEO, the COO, managers, and supervisors) has primary responsibility for safety and safety culture. The executive officer of corporate safety acts as the eyes and ears for and provides direct staff support to the CEO in all matters pertaining to safety and safety culture, thereby assisting the CEO in discharging his command responsibility for safety.

The union leadership at LACMTA also promotes safety as the first priority. The general chairman of the United Transportation Union confirmed that, in his opinion, safety is the highest priority for the Metro board, management, supervision, and hourly employees, and that priority is communicated constantly to the workforce. The importance of safety is emphasized to employees through initial safety training, refresher safety training, letters, bulletins, “rap sessions” with managers, and the local safety committees and subcommittees.

### *Importance of Training*

LACMTA effectively conveys the risks and rationale of its safety rules. This is primarily accomplished by training, starting with initial safety training and continuing through refresher training and training in the field. Employees interviewed at LACMTA agreed that workers would not hesitate to stop work if they perceived a hazardous situation; however, they could not cite a formal procedure to that effect.

### *Employee Involvement*

As previously detailed in Chapter 7, the primary vehicle for employee participation in safety is their membership on local safety committees. These LSCs were established during an earlier successful intervention by DuPont to control rapidly escalating workers’ compensation costs. LSCs provide the primary means of coordinating safety activities at the local level at LACMTA. LSCs are responsible for:

- Evaluating the number and type of injuries and incidents within any given division or department and identifying measures for mitigating them;
- Verifying, via measurement, the degree of compliance with established safety policies and guidelines and implementing appropriate corrective action; and
- Reducing the number of lost workdays due to injuries.

The chairperson of the LSC rotates every 6 months between the transportation division and maintenance division managers. Other LSC members are the transportation and maintenance assistant managers, a senior safety specialist from corporate safety, division safety coordinators, representatives of three different unions, the subcommittee chairpersons, the return-to-work coordinator, a sheriff’s representative, and other local staff as needed. Non-division departments, such as rail wayside systems, have an equivalent membership structure.

LSCs normally meet once per month to review the status of local safety performance and safety programs and activities at a regularly scheduled date, time, and place. Meeting minutes

are e-mailed to LSC members and posted on division bulletin boards to inform employees of LSC activities.

LSCs use data analysis to:

- Review accident and occupational injury data and implement strategies and programs to reduce workplace incidents,
- Ensure that the subcommittees are analyzing all appropriate data/metrics and key performance indicators, and
- Review subcommittees’ programs and recommendations for improvements.

The LSCs therefore provide a vehicle for direct employee involvement in matters pertaining to safety and safety culture.

### *Mutual Trust*

The degree of mutual trust within the organization is relatively good. However, it varies from department to department, with employees in some departments much less trusting of their management than those in other departments. The United Transportation Union general chairman describes it as more of a state of mutual understanding than one of mutual trust.

### *Reporting*

LACMTA does have an effective system for encouraging employees to report safety issues and concerns and is relatively successful at doing so. It is called the SAFE-7 Report of Unsafe Condition or Hazard and Near-Miss form (also described in Chapter 7). This form is one of the primary means by which employees can report hazards and near misses. It can be submitted anonymously and without fear of reprisal. Departments and divisions are required to maintain records of these reports of hazards or near misses, track the status of corrective actions taken or planned, and ensure that appropriate corrective action has been taken within established time limits. SAFE-7 tracking is accomplished using a SAFE-15 form. Upon receiving a completed SAFE-7 form, department or division management is required to analyze the reported hazard or near miss, identify all of the factors involved, and develop recommendations for timely elimination or mitigation of the hazard or near miss. These recommendations may include modifications of equipment or facilities design, maintenance schedules or practices, operating rules and procedures, employee training, bus stop locations, rail station layout, traffic control devices, road design, traffic signs, and markings. Management must inform all other involved employees of the existence of and circumstances surrounding the hazard or near miss. Hazardous or near-miss situations involving more than one department

that cannot be resolved by the department working by itself will be reported to corporate safety, and corporate safety will resolve the situation by working with all involved departments. The responses to SAFE-7s are distributed to the individual submitting the report and to the appropriate LSC. In the opinion of the research team, the only improvement that could be made to the reporting system would be to implement disciplinary immunity for employees reporting near misses.

### *Investigations*

LACMTA has a detailed procedure for investigating accidents and incidents. Investigations are initiated at the supervisory level, with support from other staff as necessary. The corporate safety department is involved if the severity of the accident warrants investigation by accident reconstruction experts. The Accident Review Board reviews the reports and determines if the accident was avoidable. Labor representatives do not play a significant role in accident investigations.

### *Other Ongoing Actions*

**Leading indicators:** LACMTA reports 17 leading performance indicators. In doing so, it reports far more leading indicators than most public transportation agencies and more closely resembles the airline industry. Deterioration in these leading indicators could provide specific warnings about given areas of operation and a general warning about the overall state of safety culture in the organization as a whole.

**Technology:** LACMTA also leverages technology, such as video camera recording systems on its buses, to screen out risk-taking employees who exhibit unsafe behaviors.

**Training:** The appropriate levels of training and retraining have been determined by years of trial and error. Based on the independent safety culture evaluation referenced earlier, safety training is rated as being very good.

**Safety in performance appraisals:** Appreciation of safety culture is not a factor in performance appraisals at LACMTA. Safety performance, however, is an evaluation factor for managers and supervisors.

**Assessing safety culture:** Until the safety culture survey, there was no attempt to gauge safety culture on an annual basis or otherwise.

### *Recent Changes*

- In terms of improvements, the new board initiatives lead the way.

- An executive committee on safety initiatives has also been established. This committee focuses on the “3 Es”: engineering improvements, educating the public, and enforcement.
- Special emphasis is also being placed on “controllable collisions.” Hitting fixed objects, hitting pedestrians with the front of the bus, and running red lights are classified as events that should never occur.
- There is an understanding at LACMTA that while there is a positive safety culture at work, there is always room for improvement.

### *Safety Culture Improvement*

LACMTA continues to operate with no major accidents similar to those that have occurred at NYCT and WMATA.

## **An Orange County Transportation Authority Case Study**

### **Background**

OCTA has had a positive safety culture for over two decades. Its culture has improved incrementally and become increasingly stronger as a result of dedicated leadership and a commitment to safety that permeates the entire workforce of represented and non-represented employees.

### **OCTA Approach to Safety Culture**

#### *Priority*

A recently retired CEO told the research team that safety was accorded the highest priority at OCTA by himself and by the board. The new CEO has proven to be as dedicated to safety as the former CEO. The first thing he did, upon assuming the CEO position, was to request an APTA peer review of OCTA’s overall safety programs. The executive director of human resources and organizational development indicated that OCTA has a strong and positive safety culture because safety starts at the top. He indicated that both the past and present CEOs made safety paramount and allowed nothing regarding safety to be sacrificed for other priorities. He said that OCTA is a highly functional organization with a low accident rate and a good union–management relationship. He noted that the unions work hard on safety and distribute union-generated safety initiatives. When the president of Teamsters Local 952 was asked if safety was the highest organizational priority at OCTA, she replied, “absolutely.” Its value has been recognized and embraced for over 20 years, as seen through a dedicated staff of safety representatives and the entire employee base.

A former CEO told a story about answering his cell phone while touring a maintenance yard and being told by an hourly worker that it was against OCTA rules and regulations to use

a cell phone in the yard. He said that when a mechanic corrects the CEO on a matter of safety, you know safety culture is alive and well.

### *Assessing Safety Culture*

With respect to measuring safety culture, OCTA has conducted an employee survey, with positive results. OCTA also looks at trends in hours lost and other metrics and puts 99% of its focus on a proactive approach.

### *Employee Involvement*

The CEO emphasized the importance of establishing a positive safety culture by including managers and employees, resulting in a strong and sustainable culture over time. He stated that encouraging and welcoming input and communicating on a regular basis are essential to maintaining OCTA's safety culture.

OCTA employees are deeply and actively involved in all aspects of safety and safety culture. The three main structures for this involvement are:

- **Accident reduction teams:** These teams are made up of management, supervisory, and represented hourly employees. The teams focus on determining the root cause of bus and passenger incidents. The team's goal is to analyze all the facts pertaining to an accident and to recommend steps to prevent a recurrence or, if recurrences cannot be absolutely prevented, to reduce frequency.
- **Configuration Control Committee:** This committee is made up of department directors, managers, engineers, and base representatives from both the operations and maintenance departments. The committee assesses all proposed OCTA bus service configuration changes prior to implementation. In doing so, it reviews proposed changes for potential hazards and possible threats to OCTA employees or patrons.
- **Safety captain program:** Captains are selected by OCTA management to represent fellow employees on the committees at each base (depot). There are separate safety committees for maintenance and for operations (transportation). Base managers appoint a minimum of two operators to the operations safety committee and appoint a separate representative from each shift for mechanics, service workers, parts clerks, and facility maintainers. Safety committees meet monthly to address problems. A representative from the Health, Safety, and Environmental Compliance Department attends each of these meetings, reviews the meeting minutes, and ensures that all outstanding issues are addressed. The safety committee chairpersons are elected from the membership of each committee. According to

a maintenance supervisor who serves as a safety captain, any employee can use the safety captain program to get a procedure changed that needs to be changed. A machinist and safety captain confirmed this. Another machinist who serves as a safety captain said that OCTA is much more serious about safety than where he used to work. He said that employee well-being is very important to OCTA.

### *Stop-Work Procedure*

OCTA has an informal procedure that directs employees to stop work or interrupt service if an unsafe condition arises. The executive director of human resources and organizational development said, "Anyone and everyone can say 'stop.'"

The procedure is covered in training. It also was covered in a video by the CEO that was made as part of the recent Rededication to Safety campaign. Examples are taking buses out of service because of a threat of fire and closing down fueling operations because of suspected faulty equipment.

### *Organizing for Safety Culture*

The CEO, deputy CEO, executive directors, general manager for transit, base managers, and safety captains all regard themselves as safety champions.

The CEO, general manager for transit, and the base managers have line/program responsibility for safety. The chief safety officer (the manager of the Health, Safety, and Environmental Compliance Department) provides oversight and staff support.

### *Communication*

Most of the conventional methods for communication with employees are used, including formal training programs, labor-management meetings, safety committee meetings, videos in the drivers' room, tailgate meetings, and bulletin boards. The former CEO approved the introduction of a Rededication to Safety campaign video. Teamsters Local 952 also uses newsletters and flyers and holds a safety fair each year.

In order to ensure that effective and open communications are maintained between all organizational levels and all employees, OCTA has what is called the Ri2 system. It is a computerized system accessible to transportation employees at each base. Employees can submit any concern or any issue at any time, and management must respond in a timely manner. The Ri2 system was originally designed for operators to enter route-specific information based on daily experience, but its use has been expanded to all employees to deal with safety problems and issues. It is an effective and innovative approach to employee safety communication and participation.

## Reporting

The Ri2 system successfully encourages employees to report problems and raise issues. It is easy for employees to use and to track responses with. The problems and issues raised and the actions taken are also visible to all employees.

OCTA has a near-miss program, which it calls the Good Catch Program. It is described in Chapter 7. This program has no discipline associated with honest self-reporting. OCTA is looking for feedback from people who are involved in an incident in which they experienced a near miss and from anyone who observes an unsafe condition or act.

The accident reduction team program also ensures that all of the relevant issues are addressed, that all levels of employees, including union representatives, are engaged in problem solving, and that the workforce understands the basis for any new process or procedure.

## Importance of Training

The primary method used to ensure that employees understand the risks and the rationale behind OCTA's safety rules is training.

## Mutual Trust

According to both the executive director of human resources and organizational development (HROD) and the president of Teamsters Local 952, there is a strong state of mutual trust among managers, supervisors, and employees at OCTA. The HROD executive director said that, because OCTA has significant employee involvement and because management is open to questions and criticism, the system works with a high degree of mutual trust and respect. The union president said that OCTA management always handles safety matters professionally. One of the safety captains said that there was too much at stake for there not to be mutual trust and respect.

## Other Ongoing Actions

Other ongoing safety actions are:

- **Safety assistance:** Resident trainers are also available for employees to approach with safety problems.
- **Accident investigation:** In investigating accidents or other safety and health problems, discipline and prevention of recurrences are balanced by dealing with prevention first.
- **Leading indicators:** OCTA includes, as leading indicators, the degree of employee participation in programs, the percent closure of Ri2 safety entries, and the number of outstanding inspection and audit findings.
- **New-hire screening:** OCTA attempts to screen out risk-taking employees by reviewing department of motor vehicle (DMV) and criminal records prior to employment and continuously thereafter.
- **Training:** The factors used to determine the appropriate levels of training and retraining for employees are experience and the recommendations of accident reduction teams and the safety committees. OCTA ensures that employees are adequately trained on safety matters by constantly reviewing performance and mounting frequent safety campaigns. There is annual safety refresher training after initial orientation safety training.
- **Safety incentives:** Incentives include presenting safety awards to deserving employees at awards ceremonies. The only safety-related financial incentives at OCTA are contractual bonuses for reduction in annual workers' compensation costs.
- **Safety outside the workplace:** OCTA also focuses on safety as a complete employee experience. Factors outside the work environment, such as safety at home, are treated as equally important.

## Safety Culture Improvement

OCTA continues to operate with no major accidents. The improvements with respect to safety and safety culture that OCTA is attempting to make include developing more measurable leading indicators, enhancing the agency's safety training program, and further formalizing an industrial hygiene exposure control program.

OCTA rates its approach to safety culture compared with that of other transit organizations as outstanding and probably in the top 10% of the industry. That said, OCTA is aware that improvements need to be made and that continuous refinement of the safety program is a never-ending pursuit.

## Comparison with Previous Research

Table 8 compares the four case studies to the eight components of safety culture developed in this project.

## Strong Leadership, Management, and Organizational Commitment

All of the team's research suggests that the process of improving safety culture begins and is driven by top leadership that is fully committed and willing to bring the necessary resources to bear on problems and to lead by example. Intelligent, strong, decisive, and persevering leadership is required to resolve or remove obstacles and to stay the course. Such leadership is demonstrated in all four case studies.

**Table 8. Components of safety culture evidenced in case studies.**

COMPONENTS	NYCT	WMATA	LACMTA	OCTA
Strong leadership, management, and organizational commitment	Yes***	Yes***	Yes***	Yes***
Employee/union shared ownership and employee participation	Yes**	Yes**	Yes**	Yes***
Effective safety communication	Yes**	Yes**	Yes**	Yes***
Proactive use of safety data, key indicators, and benchmarking	Yes**	Yes**	Yes***	Yes**
Organizational learning	Yes**	Yes**	Yes**	Yes**
Consistent safety reporting and investigation for prevention	Yes**	Yes**	Yes**	Yes***
Employee recognition and rewards and just disciplinary system	Yes*	Yes*	Yes*	Yes*
High level of organizational trust	Yes*	Yes*	Yes*	Yes***

Notes: The number of asterisks assigned to each component is based on the research team's interpretation of information provided by the individual transit agencies. \*\*\* Exceptional \*\* Achieved \* In progress

### Employee/Union Shared Ownership and Employee Involvement

When a safety culture improvement program is being introduced, it is essential that every effort be made and specific processes be implemented to enlist the active participation, involvement, and shared ownership of all key stakeholders, including labor union representatives; employees; governing boards; lower, middle, and upper management; and funding partners and funding sources. The more challenging and difficult the transformative change required, the more important will be the buy-in required, and the more likely the process will encounter and have to overcome barriers—including problems of cynicism, suspicion, distrust, and lack of enthusiasm—and will be imperiled by grudging compliance or even noncompliance. Even with strong leadership, progress cannot be sustained without buy-in by all levels of management and employees; it must be evident up and down the organization. The degree of shared ownership and employee participation varied from case study to case study but existed in all four organizations.

### Effective Safety Communication

The emphasis given to communication and the methods employed varied somewhat from case study to case study. However, communication was more than adequate in every

case, affirming Reason's dictum that informed culture is synonymous with safety culture.

### Assessing Safety Culture

The starting point of any safety culture improvement process is determining where the transit agency stands—both with regard to its existing safety culture and in comparison to other agencies.

A transit agency needs to be able to answer the following questions:

- What are managers and employees actually saying and doing when no one is looking?
- What are the areas and special problems that require work?
- Which particular processes and assessment methods yield the greatest information and allow the best view inside the organization, and which simultaneously contribute the most to shared ownership and buy-in among stakeholders?

Obviously, employing unthreatening methods that are free of any threat of retaliation and that promote candor and encourage shared responsibility and accountability is the preferred, necessary, and most productive approach. In this regard, it is better to have more rather than less information to go on.

Gathering perceptions as well as factual data is important. While perceptions are not conclusive, they are valuable—especially those of affected employees and other key stakeholders. For a trained observer or data analyst, the following are all potentially important clues and information that can be extracted from anecdotal and empirical information: understanding the relevance or efficacy of rules on the books; gauging the gap between rules and behavior; understanding degrees of differentiation that might exist within the workforce and among line employees, supervisors, and managers; fully grasping the level of cynicism, trust, or distrust; and discerning the underlying beliefs and values of key players.

Which tools best meet the actual requirements? What degree of anonymity should be provided? Interviews, surveys, focus groups, and role-playing exercises are all possible tools. Combined with raw data, all contribute to painting an accurate picture of the situation and existing conditions.

It is hardly coincidental that safety culture surveys have been used at all four of the transit agencies discussed in this chapter.

## **Organizational Learning**

Organizational learning clearly contributes significantly to improved safety culture. Joseph Carroll (1998) defined organizational learning as taking place “through activities performed by individuals, groups, and organizations as they gather and digest information, imagine and plan new actions, and implement change.” All of these transit agencies have institutionalized such activities. WMATA’s lessons-learned program is a good example, as is NYCT’s analysis, as a group, of all accidents and incidents that had occurred in the previous 20 years.

## **Consistent Safety Reporting and Investigation for Prevention**

All four transit agencies have effective reporting systems, and prevention of a recurrence is a high priority. Only one of these agencies, however, provides disciplinary immunity for employees reporting near misses or close calls. As might be expected, that agency has the highest percentage of near misses reported.

## **Employee Recognition and Rewards and Just Disciplinary System**

The great majority of employees must feel that they are recognized and appreciated for their contributions to safety efforts and that the disciplinary system will treat employees fairly. In that respect, the safety culture surveys implemented

at each of these transit agencies indicated that the inherent conflict and tension between maintaining privacy and providing sufficient transparency in the administration of the disciplinary system make it difficult to demonstrate to employees that the disciplinary system in fact is generally just.

## **High Level of Organizational Trust (Mutual Trust)**

Within one of the transit agencies studied in this chapter, the level of trust was exceptional. This was probably due to the number of years that a positive safety culture has existed at the agency. In the other three, building trust is a work in progress. Our research indicates that trust must be earned by consistent performance over a long period of time. Employees will not begin to trust based on the rollout of a flashy new safety program and vague promises of reform. They will not begin to trust management until they have observed management “walk the walk” through good times and bad. And it is equally important for management to trust employees to do the right thing at all times.

## **Conclusions: Guiding Principles**

An analysis of the similarities among these four case studies produces the following essential elements for transit agencies seeking to improve their safety cultures.

### **Strong Leadership**

Truly committed leadership is essential to building a positive safety culture. There is no hope of improving safety culture without top management commitment, direction, and support. Leaders must “walk the walk,” fight for adequate resources to be budgeted to support safety and safety culture programs, hire and promote managers and supervisors who are similarly minded, and be willing to support innovative ideas that occur within the organization that will positively affect safety culture.

### **Employee/Union Shared Ownership and Employee Involvement**

Truly committed union leadership and significant employee involvement and buy-in are equally essential to building a positive safety culture at any transit agency with represented employees. Management cannot go it alone. Even the most committed CEO will not succeed in improving safety culture without the support and involvement of union leadership and the represented employees. Management and union leadership, as well as represented and non-represented employees

throughout the transit agency, must establish an effective working partnership with regard to all aspects of safety culture. Cooperation is essential. A “my way or the highway” approach will not work.

### **Communication**

Effective safety communication is needed so that all employees fully understand the hazards inherent in their jobs and will appreciate any progress being made. Failure to communicate sufficiently about safety is a common problem in the public transportation industry. Too often the assumption is made that communication can be handled as an unfunded additional duty. That assumption is false and guarantees poor communication.

### **Organizational Learning**

Organizational learning is very important to improved safety culture. Transit agencies must learn from their experience and adjust to changes in environment; failure to do so can be catastrophic.

### **Reporting and Investigating**

Employees must have full confidence in the integrity of the reporting and investigating systems. If something is reported, they must be confident that it will be investigated and that appropriate action will be taken.

### **Employee Recognition and Rewards**

Employees must be recognized for their contributions to safety culture, including contributions such as identifying of

hazards and near misses. Reporting near misses and developing strategies to reduce or eliminate these problems are integral to a positive safety culture. Recognizing employees represents a change from blaming employees for safety problems to respecting them and acknowledging that they understand the day-to-day hazards of their work. It will greatly improve safety performance, as has been demonstrated in other industries. Consistent and appropriate recognition and reward must be balanced by a fair and just disciplinary system. “Just,” however, is not a synonym for “lax.” Good employees know that employees not meeting the standards of the organization will face appropriate correction and, if unable to come up to standard, will be fired. Appropriate discipline administered swiftly and surely is important to everyone’s morale and well-being. In too many transit agencies, months or even years may elapse between charges and disposition of those charges.

### **High Level of Organizational Trust (Mutual Trust)**

Mutual trust cannot be established overnight. It must be earned by all members of the organization (managers, supervisors, and hourly employees) through consistent performance. Employees must trust their managers and supervisors to do the right thing, and managers must trust their employees and each other to do the same.

In order to begin a safety culture improvement process, it is mandatory to determine where a transit agency stands with respect to the components outlined. This requires a concentrated effort, involving some combination of data collection and analysis, observations, interviews, focus groups, and surveys. In a world of generally limited resources, it is essential to first know what problems need fixing.



## CHAPTER 9

# Guidelines for Improving Safety Culture and Recommendations for Additional Research

### Guidelines for Improving Safety Culture

#### Introduction

To better illuminate the steps of improving safety culture, what follows is a hypothetical example of a general manager in a transit agency following these steps.

Once upon a time, a new general manager named Charlotte Trueheart arrived to take over the Central State Transit Authority (CSTA). Charlotte had begun her career at a smaller transit agency in the Midwest that only operated buses and paratransit vehicles. She had, however, made such significant improvements in safety, on-time performance, efficiency, reliability, customer satisfaction, and employee morale that she had rapidly gained recognition within the transit industry as an outstanding talent and was eventually recruited and selected to head CSTA. CSTA, however, was much larger than her former transit agency. It had three times as many employees and operated heavy- and light-rail lines as well as bus and paratransit services. It therefore represented a much greater set of management challenges in terms of number, scope, scale, and complexity than Charlotte had previously experienced. Of these challenges, the most urgent was the reality that CSTA had been plagued with a continuous series of accidents, resulting in a significant number of employee and passenger injuries and two employee and three passenger fatalities in the previous 10 years.

Luckily for CSTA, Charlotte was not only an avid practitioner of what is known as managing by walking around but had also recently participated in a transportation industry seminar on safety culture.

In her frequent visits to maintenance shops, crew rooms, and other employee facilities, Charlotte found that many hourly workers and supervisors felt that CSTA's dominant management philosophy was one of "my way or the highway." Many with whom she talked were concerned with CSTA's poor reputation within the local area because of its

less than stellar safety record and numerous operational problems, such as poor on-time performance, faulty heating and air conditioning, equipment breakdowns, and so forth. As she talked to more and more people, she began to suspect that CSTA's safety problems might be related to the lack of a strong, positive safety culture. She resolved to investigate this possibility as part of a safety initiative that she intended to launch as one of her highest priorities.

#### Steps To Improve Safety Culture

##### Step 1: Secure preliminary commitment from management and union leadership at the highest levels to improve safety culture

As she had learned during the safety culture seminar, she first needed to meet with her senior managers and solicit their views on the sources and causes of their safety problems. Her primary purpose in these meetings was not to seek immediate solutions but to build a consensus among the managers that something needed to be done and an understanding that her managers had to be actively involved in crafting and implementing the proposed solutions. These meetings took considerable time since many of the managers were fixed in their ways and unaccustomed to innovation.

She also met individually with the president (Roger Johnson) and vice presidents of the union that represented CSTA's hourly employees. The union meeting was far more difficult than the management meetings because union-management relations had never been very good at CSTA, and Charlotte's sincerity with respect to wanting to solicit union views with respect to the sources and causes of CSTA's safety problems was suspect. At the end of these sessions, however, she had largely convinced Roger that there was much to gain and little to lose in putting her sincerity to the test. As she said to him and later reiterated to her managers, "listening to union views in no way compromises management's control of this transit agency. Decision making remains entirely management's

prerogative. If we can make better decisions, however, by incorporating union concerns and input into those decisions, we would be fools not to do so.”

She ended these sessions by explaining that “everyone will benefit from improving the safety culture of this transit agency—the customers, the community, and all of the transit employees.”

And, in fact, Roger soon became convinced that Charlotte in fact was completely sincere about enlisting the union as a full partner in improving safety culture and safety at CSTA.

### **Step 2: Identify, consult, and secure the preliminary commitment of all other key stakeholders to improve safety culture**

In CSTA’s case, key stakeholders included the CSTA board, the county political structure, the FTA regional office, the state oversight agency, and three separate organizations representing rail, bus, and paratransit riders. All appropriate meetings were held, and Charlotte was surprised that the significant consensus was that something had to be done.

### **Step 3: Collectively determine the problems to be addressed (subject to regular revision as more information is received)**

It then was time to collectively determine the problems to be addressed, subject to regular revision as more information was received. To implement this process, Charlotte created a joint task force (JTF) headed by the CSTA chief safety officer. Other members of this task force were senior representatives of all of the major operating and supporting departments and representatives of the union. Departments were represented by deputy department heads or above, and the union by vice presidents and shop stewards.

### **Step 4: Identify outside professionals and assessment tools to evaluate the transit agency’s current safety culture**

Since CSTA did not have the expertise necessary to design and implement a safety culture assessment survey, the JTF’s first order of business was to identify outside professionals and assessment tools to evaluate the transit agency’s current safety culture. Under the JTF’s oversight, a safety culture survey was prepared and administered to all operations employees.

The survey results were a surprise to management and even to Roger, who had been considerably more negative about CSTA operations than representatives of any other stakeholder group. Roger was quoted as saying: “I knew things were bad, but I had no idea how bad.” The results, organized in accordance with the eight components of safety culture as initially set forth in Table S-2, can be summarized as follows:

- Leadership, management, and organizational commitment to safety: 60% of all employees agreed or strongly agreed

with the statement “management talks the talk about safety but does not walk the walk.”

- Employee/union shared ownership and participation: 75% of all hourly employees agreed or strongly agreed with the statement “management’s primary philosophy is ‘my way or the highway’” and 68% with the statement “employees cannot get rules and procedures changed no matter how strong their case is for doing so.”
- Safety communication: 80% of hourly employees agreed or strongly agreed with the statement “there is no effective communication within CSTA about safety problems and issues” and 90% with the statement “employees are kept in the dark about the results of accident investigations.”
- Proactive use of safety data, key indicators, and benchmarking: 78% of all hourly employees agreed or strongly agreed with the statement “management’s analysis of safety data is not shared with hourly employees.”
- Organizational learning: 65% of all employees agreed or strongly agreed with the statement “too many of the same kind of accidents occur over and over again.”
- Consistent safety reporting and investigation for prevention: 61% of all hourly employees agreed or strongly agreed with the statement “employees never report near misses because those who do are usually subjected to discipline” and 85% with the statement “management is not interested in determining the real cause of an accident in order to prevent recurrence; they only want to find someone to blame and impose discipline.”
- Employee recognition and rewards: 73% of all hourly employees agreed or strongly agreed with the statement “there are employees in the organization who have safely performed hazardous duties for 20 years or more who have never been recognized for their achievements.”
- High level of organizational trust:
  - 55% of managerial employees agreed or strongly agreed with the statement “hourly employees cannot be trusted to do their jobs properly unless they are closely watched and 32% with the statement “supervisors cannot be trusted to see that the necessary rules and procedures are followed at all times.”
  - 40% of supervisory employees agreed with the statement “managers cannot be trusted to see that supervisory employee decisions are supported” and 15% with the statement “hourly employees cannot be trusted to follow instructions from their supervisors.”
  - 45% of hourly employees agreed or strongly agreed with the statement “managers cannot be trusted to ensure hourly workers are adequately protected when working in hazardous locations” and 25% with the statement “supervisors will not protest when a manager orders a group to do something that is inherently unsafe.”

### **Step 5: Create a road map for improving safety culture and estimate the necessary financial resources to solve identified problems and make required changes**

In response to the survey results, Charlotte called a meeting of the JTF and asked that they prepare a plan within 90 days for her consideration, to include assigning a priority to each element of the plan and determining the resources required for implementation.

While waiting for the plan to be developed, she shared the results with her board and the other stakeholder groups. It was clear to all that the problems were too pervasive to continue to be ignored or to be resolved without a serious and long-term commitment.

### **Step 6: Jointly create a road map for rollout and implementation of the safety culture improvement plan and secure commitment of the necessary resources**

After 90 days, the JTF presented its plan. Included in the plan was implementation of a comprehensive review of CSTA's safety rules and procedures. The plan also called for an overhaul of the CSTA safety performance indicators, to include incorporation of more leading indicators. There was also a call for identification of all current CSTA safety practices and a determination as to how those practices might be improved and amplified in order to improve the state of safety culture at CSTA. Possible adoption of practices from transit authorities with reputations for positive safety cultures was also contemplated. Over the next 2 weeks, Charlotte conducted an intensive series of consultations with her senior management team, the board, and Roger and the union leadership. The result was a 3-year plan, with the highest-priority elements to be funded in the current budget and the remaining elements to be funded in the second and third years of the plan. Charlotte was pleasantly surprised at how much input by Roger and the union had strengthened the plan. This satisfied the need to create jointly a road map for rollout and implementation of the plan and to secure commitment of the necessary resources to solve identified problems and make required changes.

### **Step 7: Meet with employee leaders (supervision and hourly) at all levels and secure their buy-in for the safety culture improvement plan**

In a series of meetings, Charlotte and Roger met with the formal and informal leadership at all levels of CSTA, explained the safety culture improvement plan, encouraged honest feedback, and discussed how to best communicate the plan to all employees. Despite the huge investment of their time that would be required, she and Roger decided that a series of meetings, which they would personally lead and which every CSTA operations employee would attend, would be the optimal way to kick off the program.

### **Step 8: Implement outreach to all appropriate employees to introduce the safety culture improvement program, obtain input, and act on that input in a highly visible manner**

Charlotte and Roger presented the safety culture improvement plan to every CSTA operations employee. They accomplished this in a series of meetings small enough for group discussion and generated a great deal of feedback. As a result of this feedback, several substantial amendments to the plan were made. Immediately after the meetings were concluded, Charlotte summarized the changes to the plan that had been made as a result of employee input at the meetings in a letter sent to all employees.

### **Step 9: Ensure that management and union leaders collaborate to carry out safety culture improvements and serve as organizational role models**

She and Roger were able to ensure that senior leaders were noticeably involved by assigning responsibility for implementation of each element of the plan to a two-person team composed of one manager and one union leader. Their guidance to these two-person teams was:

- Strive for cooperation, avoid arbitrary imposition of changes if at all possible, and use discipline only as a last resort;
- Exert constant oversight, anticipate problems, and give special attention to problem areas; and
- Jointly establish litmus tests for success, including ensuring that employees are remaining engaged, key safety problems are being tracked, progress is being made, and leaders are constantly recalibrating the program.

### **Step 10: Report back to employees on a regular basis and continuously obtain feedback**

As the 3 years passed, she first noticed some improvements in CSTA's leading indicators and then, gradually, the lagging indicators, which initially had moved in a negative direction because of more accurate reporting, began to move in the right direction.

At the end of the 3-year plan, Charlotte and Roger repeated the original safety culture survey. The results did show solid improvement across the board. However, significant problems remained in a number of departments, and mutual trust, while somewhat improved, was far from ideal. More years of "management walking the walk" were clearly going to be required before virtually every employee would be convinced that change had come to stay.

Table 9 summarizes the steps that Charlotte and Roger took and outlines a possible path for others.

**Table 9. Steps to improving safety culture.**

1. Secure preliminary commitment from management and union leadership at the highest levels to improve safety culture
2. Identify, consult, and secure the preliminary commitment of all other key stakeholders to improve safety culture
3. Collectively determine the problems to be addressed (subject to regular revision as more information is received)
4. Identify outside professionals and assessment tools to evaluate the transit agency's current safety culture
5. Create a road map for improving safety culture and estimate the necessary financial resources to solve identified problems and make required changes
6. Jointly create a road map for rollout and implementation of the safety culture improvement plan and secure commitment of the necessary resources
7. Meet with employee leaders (supervision and hourly) at all levels and secure their buy-in for the safety culture improvement plan
8. Implement outreach to all appropriate employees to introduce the safety culture improvement program, obtain input, and act on that input in a highly visible manner
9. Ensure that management and union leaders collaborate to carry out safety culture improvements and serve as organizational role models
10. Report back to employees on a regular basis and continuously obtain feedback

### Recommendations for Additional Research

The research team believes that there are three areas in which further research could provide important additional tools for the improvement of safety culture in public transportation.

The first is an econometric study (a practical application of mathematics and statistical methods) of the benefits and costs of improvements in safety culture. Such a study would require extensive collection of data that currently is not routinely available. However, the effort would be justified in that a demonstration that improvements in safety culture

produce strong bottom-line results would provide a significant incentive for improving safety culture across the public transportation industry.

The second is development of a fully validated safety culture survey and establishment of an associated confidential public transportation industry database.

The third is development of a proposed standardized set of key performance indicators for the transit industry. The advantages and disadvantages of such a set of indicators could be determined. Both leading and lagging indicators could be proposed for standardization. The use of technology to produce real-time leading indicators, such as those found in the airline industry, could be explored.

## APPENDIX A

# Literature Review

### Introduction

Little has been written about the role of safety culture in public transportation. The research team was therefore limited to the literature on the theory of safety culture and its application to aviation, nuclear power operations, natural resource extraction, and related fields. In deciding which material to include in our review, the research team used its experience in improving safety culture to assess the applicability of prior research to public transportation, the degree to which the material has stood the test of time or holds promise for the future, the rigor with which the material was produced, and the extent to which the conclusions reached appear to be reasonably supported.

The first step was to examine the theoretical foundations of safety culture. Then the team:

- Addressed the challenges of defining safety culture, one of which is to distinguish it from safety climate,
- Examined various competing theories and models,
- Detailed the various components of safety culture included in these theories individually and combined into sets that varied significantly in terms of individual components included or excluded in different theories and models, and
- Discussed the various methods of assessing the state of safety culture in a given organization.

### Theoretical Foundation

#### Background

Early accident investigations and discussions of safety science focused on technical failures and human error. There were some exceptions: a few studies focused on organizational and social factors. For example, Turner (1978) used case studies to produce a theory of socio-technical accidents. However, most of the literature revolved around hardware or human failure. In searching for a theoretical foundation, the

research team discovered two separate research streams that turned out to provide almost all of the theoretical foundation for the research. These are the fields of safety climate research and safety culture research.

### Origins of Safety Climate Research

The concept of organizational climate is grounded in psychological research. It is a line of study that goes back to Lewin et al. (1939), who examined social relations and interactions in boys' groups. The next significant step was a work by Argyris, *Personality and Organization* (1957). Argyris's contention was that employees were infantilized by industry practices and reacted by behaving as children, as management expected them to do. Shortly thereafter, McGregor (1960) developed his Theory X and Theory Y, a construct that posits that managerial behavior has direct bearing on employee behavior. Likert (1961) introduced four systems by which organizations might function, ranging from completely autocratic to completely participative. In a later book, Likert (1967) called these System 1 (exploitative autocratic), System 2 (benevolent authoritative), System 3 (consultative), and System 4 (participative). Argyris, McGregor, and Likert each focused on how people were treated by organizations and how they responded as a means of understanding organizational effectiveness. Katz and Kahn published *The Social Psychology of Organizations* in 1966. It looked at a wide array of factors that determined behavior, emphasizing "the total social situation encountered by employees rather than a more focused leadership perspective" (Schneider et al., 2010).

Schein's *Organizational Psychology* (1965) summarized most of the conceptual work that had been accomplished up to that point. The essence of this work was its analysis of the human issues surrounding organizational effectiveness. Schein studied perception, motivation, and attitudes toward work, but "the focus was on the design of organizations that were effective through collective human attitudes and action

and not on individual employees as the unit of theory or analysis” (Schneider et al., 2010).

For many years, however, research bogged down over whether climate could be adequately represented by the aggregate responses of individual employees. The impasse was mitigated when James and Jones (1974) coined the term “psychological climate”; it referred to studies in which the individual, rather than the organization, was examined: “the unit of data collection as well as the unit of analysis was the individual” (Schneider et al., 2010). This gave rise to the study of organizational climate. As Kuenzi and Schminke (2009) note, three times as many articles on organizational climate were published between 2000 and 2008 than were published in the 1990s.

Safety climate research effectively began when Zohar (1980) took the organizational/social factors derived from the theory of organizational climate and devised a safety climate questionnaire to examine how these factors were perceived by the workforce. When collecting safety data from various Israeli manufacturing organizations, he found that scores developed from safety climate data significantly correlated with company accident rates and ratings by safety inspectors: higher safety climate scores were associated with lower company accident rates and higher ratings by safety inspectors. Additional safety climate studies involving a formal quantitative approach followed in different industries and cultural contexts. These studies generally support a relationship between safety climate scores and safety performance.

## Origins of Safety Culture Research

A series of serious accidents—Three Mile Island (1979), Bhopal (1984), Chernobyl (1986), Zeebrugge Ferry (1987), King’s Cross Underground (1988), Clapham Junction (1989), and Piper Alpha (1990)—highlighted the significant role played by organizational and social factors (Zhang et al., 2002). INSAG first introduced the term “safety culture” in the aftermath of the nuclear disaster at Chernobyl. It was used in a number of subsequent accident inquiries as an umbrella term for a combination of managerial, organizational, and social factors that were seen as causally contributing to the accident. In this way, the concept of safety culture—unlike that of safety climate—initially sprang into existence without benefit of being theoretically derived. Instead it was practically derived from a series of detailed accident analyses. Clarke (2000) noted that some academics had attached the concept to the existing literature on safety climate. She called safety climate theory the “adoptive” parent of safety culture. Organizational culture is the “natural” parent, but she asserted that the necessary theoretical framework had never been established. Clarke noted further that safety culture—while it was not derived from organizational culture—does

share many of its features. For instance, it is of a social nature and is expressed in behavior.

Organizational culture’s roots are found in anthropology and sociology. Pettigrew (1979) originally introduced the construct of culture to the study of organizational behavior so that organizational researchers would become familiar with the language and concepts of social anthropologists. By 1990, Pettigrew’s focus had become the study of processes of leadership, commitment building, and change and the nexus of culture, strategy, and change. “Practitioners and management consultants loved the concept of organizational culture, and it caught on quickly as a key variable in trying to distinguish more effective from less effective organizations” (Schneider et al., 2010). Several popular management trade books, among them *In Search of Excellence*, by Peters and Waterman (1982), used the study of culture, and concepts such as myth and taboo, to examine organizations. A significant problem in the study of organizational culture was that researchers were unable to establish a relationship between their qualitative case study results and organizational effectiveness. And, just as climate researchers bogged down in the morass of statistical levels of analysis, culture researchers became obsessed with the variety of ways in which culture might be conceptualized instead of studying how it related to organizational effectiveness (Smircich, 1983). It was not until culture researchers began to switch to quantitative methods (for example, surveys) that relationships between culture and organizational effectiveness were demonstrated (Kotter and Heskitt, 1992; Sorenson, 2002).

Researchers are divided over how difficult it is to transform a safety culture. The interpretive view is that culture cannot easily be altered because it is not a “simple thing that can be bolted onto an organization” (Turner et al., 1989). The functionalist view is that safety culture in fact can be “socially engineered” by “identifying and fabricating its essential components and then assembling them into a working whole” (Reason, 1997) and that it is a critical variable that can be manipulated so as to influence safety and reliability (Frost et al., 1991). In short, functionalist theory says that companies can change their existing safety culture to one that will result in improved safety performance primarily by changing safety practices, while interpretive theory says that such changes are difficult to achieve and cannot simply be imposed by fiat. It is therefore the functionalist perspective that provides a conceptual bridge between organizational behavior and strategic management interests (Wiegmann et al., 2004). In other words, functionalists believe that organizational behavior can be manipulated in the interests of achieving strategic business objectives.

Unfortunately, a theoretical framework for safety culture, which is based on organizational culture, remains immature in comparison with that for safety climate, and progress

toward operationalizing safety culture has also been slow. There still is no convergence toward a universal definition of safety culture or even agreement as to what major components are necessary to produce a positive safety culture.

### Safety Culture Versus Safety Climate

Is there really a difference between safety culture and safety climate? There are two diametrically opposed views. Schein (1985) defined organizational culture as “a pattern of basic assumptions—invented, discovered, or developed by a group as it learns to cope with its problems of external adaptation and internal integration—that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems.” He said that climate is reflective of organizational culture but that the term “culture” has a deeper meaning that implies basic assumptions and beliefs that are shared by members of the organization. Ekvall (1983) described culture as beliefs and values about people, work, the organization, and the community that are shared by most members within the organization; organizational climate, he said, stems from common characteristics of behavior and expression of feelings by organizational members. Table A-1 presents the differences between culture and climate in organizations as defined by Krause (2005).

Krause (2005) also defined safety climate as “the prevailing influences on a particular area of functioning safety in our case at a particular time.” Safety climate, according to Krause, differs from safety culture in that it can be described as a snapshot of perceptions of culture. Climate lacks permanence and often is regarded as being more superficial than culture. According to Glendon and Stanton (1998), climate involves the current position of the company and is seen as an indicator of the organization’s safety culture as perceived by employees at a certain point in time.

Glick (1985) distinguished culture and climate by research discipline: climate evolving from a social psychological framework and culture being rooted in anthropology. Climate, according to Glick, has traditionally been assessed

differently than culture in that climate uses a more formal quantitative approach, while culture uses mainly qualitative techniques.

De Cock et al. (as translated from “Organisatieklimaat: En opdracht voor het personeelsbeleid?” and cited in Guldenmund, 2000) asserted that organizational climate refers to the overall perception of a number of organizational processes, and that culture is the underlying meaning of those processes, which forms a pattern of significance and value. Schein (1992) maintained that climate preceded culture, and that climate is culture in the making; climate is a reflection and manifestation of cultural assumptions. Ultimately, Schein believed that climate is replaced by culture, as culture conveys a broader, more profound, and more comprehensive meaning.

Others, however, have argued emphatically that there is no real difference between safety culture and safety climate. Examples are:

- Kennedy and Kirwan (1995), who stated that the “real difficulty lies in the atheoretical roots of safety culture,” and who believed that it is only a matter of convenience that researchers “have conveniently attached the concept to an existing literature on safety climate,” and
- Clarke (2000), who observed that there is “no universal agreement on the definition of safety culture” but rather “an ongoing academic debate about the difference between safety climate and safety culture and little theoretical underpinning for much of the empirical work in this area.”

For purposes of this project, the research team treats safety climate as a snapshot in time of the organization’s safety culture (Krause, 2005). This view is consistent with that of Wiegmann et al. (2002), who concluded that safety climate is “a temporal indicator of a more enduring safety culture.”

In terms of possible future reconciliation or melding of the concepts, Schneider et al. (2010) stated: “In the 1978 edition of their book, Katz and Kahn used each of the following terms to capture the essence of the organization as a social psychological enterprise: norms, values, roles, climate, culture, subculture, collective feelings and beliefs, atmosphere,

**Table A-1. Comparison of culture and climate concepts (Krause, 2005).**

CULTURE	CLIMATE
Common values that drive organizational performance	Perceptions of what is expected, rewarded, and supported
Applies to many areas of functioning	Applies to specific areas of functioning
“How we do things”	“What we pay attention to”
Unstated	Stated
Background	Foreground
Changes more slowly	Changes more rapidly

taboos, folkways, and mores. To our mind, this is a useful listing because it points to ways in which terminology from both climate research and culture research literatures might be simultaneously used to capture a broad range of related phenomena.”

## Theoretical Foundation Findings

Theoretical foundation findings from the literature review are as follows:

- There is a distinct and traceable theoretical foundation for safety climate; safety culture, however, to date remains immature.
- Safety climate and safety culture are two closely associated but distinct concepts.
- Safety climate studies generally use formal quantitative methods, while safety culture studies historically have used mainly qualitative case study techniques. However, the number of safety culture quantitative studies has been increasing.
- Safety climate studies generally support a relationship between safety climate scores and safety performance; recent quantitative safety culture studies have demonstrated a similar relationship between safety culture scores and organizational effectiveness.

## Defining Safety Culture

INSAG defined safety culture as “that assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance” (International Nuclear Safety Advisory Group, 2002).

This INSAG definition, however, is just one of many, and there is little evidence of any momentum toward a universally accepted definition. In “Safety Culture: A Concept in Chaos?” Zhang et al. (2002) reviewed a number of studies conducted in high-risk industries and concluded that there is “considerable disagreement among researchers as to how to define safety culture.”

The literature contains a multitude of definitions. Guldenmund (2000) cited 16 that appeared from 1980 through 1997 alone. The research team, based on its experience in public transportation, found the following to be the most compelling and relevant to public transportation:

- Uttal (1983) defined safety culture as “shared values (‘what is important’) and beliefs (‘how things work’) that interact with a company’s people, organizational structures, and control systems to produce behavioral norms (‘the way we do things around here’).”

- Cooper (2000) called safety culture a subset of organizational culture because individual attitudes and behaviors are reflective of the organization’s ongoing health and safety performance.
- Eiff (1999) described safety culture as “shared values, norms, behaviors about minimizing risk, respect toward safety, and technical competence shared by individuals and groups of individuals who place a high premium on safety as an organizational priority. Safety culture exists in an organization in which individual employees, regardless of their position, assume an active role in error prevention—and that role is supported by the organization.”
- The UK’s Health and Safety Commission called safety culture “the product of individual and group values, attitudes, competencies, and patterns of behavior that determine the commitment to, and the style and efficiency of, an organization’s Health and Safety programs. Organizations with a positive safety culture are characterized by communications founded on mutual trust, by shared perceptions of the importance of safety, and by confidence in the efficacy measures” (Health and Safety Commission, 1993).
- EFCOG/DOE said a safety culture is “an organization’s values and behaviors, modeled by its leaders, and internalized by its members, which serve to make safe performance of work the overriding priority to protect the public, workers, and the environment” (EFCOG/DOE, 2009).
- TRACS defined safety culture as “the product of individual and group values, attitudes, perceptions, competencies, and patterns of behavior that can determine the commitment to and the style and proficiency of an organization’s safety management system” (Transit Rail Advisory Committee for Safety, 2011).
- The FRA defined organizational culture as “shared values, norms, and perceptions that are expressed as common expectations, assumptions, and views of rationality within an organization and play a critical role in safety.” It notes that organizations with a positive safety culture are characterized by “communications founded on mutual trust, by shared perceptions of the importance of safety, and by confidence in the efficacy of preventive measures” (U.S. Federal Register, 2012).
- The Volpe Center has done a great deal of work for the U.S. DOT and the FRA. A white paper by Joyce Ranney (2011) defined safety culture (short version), relying on Cooper, as “shared values, actions and norms that demonstrate a commitment to safety over competing goals and demands,” with the 10 “most critical elements” [relying on Reason’s “Managing the Risks of Organizational Accidents” (1997) and the Health and Safety Commission (1993)] being: leadership commitment, open communication, shared responsibility, continuous learning, safety-conscious work environment, non-punitive reporting, safety as a pri-



ority in decision making, mutual trust, fair and consistent responses, and training and resources. Ranney noted that “the extent to which attitudes, behaviors and policies align to prioritize safety indicates the strength of an organization’s safety culture.” Ranney (2003) cited the following safety culture definitions:

- The safety culture of an organization is the product of individual and group values, attitudes, competencies, and patterns of behavior that determine the commitment to, and the style and proficiency of, an organization’s health and safety programs (Health and Safety Commission, 1993).
- “Shared values (‘what is important’) and beliefs (‘how things work’) that interact with an organization’s structures and control systems to produce behavioral norms (‘the way we do things around here’)” (Reason, 1997).

These definitions, however, operate at different levels of abstraction and emphasize different aspects of safety culture. There is no convergence toward a universal definition.

## Safety Culture Theories and Models

The following safety culture theories and models are presented roughly in the order in which they appeared in the literature. Also presented are significant contributions by several researchers that do not rise to the level of an independent theory or complete model.

### Westrum Model

Westrum (1993) created one of the first models. In his model, there are three stages of safety culture—pathological, bureaucratic, and generative—which display the characteristics shown in Table A-2.

Pathological safety cultures limit information between the lines of the organization, preventing valuable information from flowing that may benefit the safety culture; learning

from mistakes is unlikely, new ideas are rejected in an environment in which accountability is low, and documentation is discouraged. Bureaucratic safety cultures address issues in terms of regulations, laws, and rules. The environment is reactive rather than proactive and is centered on governance. While new ideas are entertained, they are rarely implemented because strict adherence to rules and regulations discourages innovation and creativity. Generative safety cultures are based on a proactive model of problem solving. Information is actively sought and collected when an informed culture of safety exists (Reason, 1997). Messengers are trained to be effective, failures and near misses are scrutinized, and open reporting of safety concerns is welcomed. As Reason has noted, the Westrum model is therefore concerned primarily with how organizations process and share information: Westrum “has distinguished organizational cultures according to the way that they deal with safety-related information” (Reason, 1997).

### Reason Model (1997)

Reason asserted that a safety culture can be engineered. Figure A-1 provides a schematic of his model.

The various elements of Reason’s model are driven by underlying perceptions, attitudes, and behaviors. According to Reason, four of the elements (learning, reporting, flexible, and just) feed into and support the fifth (informed). As Reason said, “The preceding . . . have identified four critical subcomponents of a safety culture: a reporting culture, a just culture, a flexible culture, and a learning culture. Together they interact to create an informed culture which, for our purposes, equates with the term safety culture as it applies to the limitation of organizational accidents” (Reason, 1997). Note that many depictions of the Reason model incorrectly portray informed culture as being separate and distinct from learning, reporting, flexible, and just cultures. Reason said clearly that both the Westrum and Reason models have the processing of information as their primary focus.

**Table A-2. Westrum’s original safety culture model (Hudson, 1999).**

	Pathological	Bureaucratic	Generative
Information	Hidden	Ignored	Sought
Messengers	Shouted	Tolerated	Trained
Responsibilities	Shirked	Boxed	Shared
Reports	Discouraged	Allowed	Rewarded
Failures	Covered up	Merciful	Scrutinized
New ideas	Crushed	Problematic	Welcomed
Resulting organizations	Conflicted organization	Red-tape organization	Reliable organization



**Figure A-1. Reason's safety culture model (research team modified version).**

In an informed culture, the organization collects and analyzes relevant data and actively disseminates safety information. Individuals who manage and operate the organization's safety system know the human, technical, organizational, and environmental factors that determine the safety of the system. All members of the organization understand and respect the hazards of operations and are alert to the system's potential vulnerabilities. In a reporting culture, an environment is cultivated that encourages employees to report safety issues without fear of punishment. Employees know that confidentiality will be maintained and that, when they disclose safety information, management will act to improve the situation. Reason's model particularly communicates the importance of maintaining a reporting culture within an organization. This reporting culture, which must be initiated and supported wholeheartedly by management, is necessary in order for management to get an accurate picture of the status of its organization's safety culture. For example, Wiegmann et al. (2004) supported a claim by Eiff (1999) that "one of the foundations of a true safety culture is that it is a reporting culture" by identifying an effective and systematic reporting system as the keystone to identifying breaches before accidents happen.

In a just culture, unintentional errors or unsafe acts are not punished. Deliberate, reckless, and indefensible acts that are considered unjustifiable and that place the organization and individuals at risk are subject to disciplinary action. A just culture in turn promotes mutual trust. In a flexible culture, the organization and employees are able to adapt effectively to changing needs and demands. For example, the organization may shift from a hierarchical structure to a flatter, or more horizontal than vertical, structure for more decentralized problem-solving capability. A learning culture encourages use of safety information to draw conclusions about necessary changes and incorporate a willingness to implement major reform when change is required (Civil Air Navigation Services Organisation, 2008). Management is able to take direct action in the areas pertaining to each subculture to move the

organization from its present practices toward the ideal and thereby engineer a positive safety culture. The success of the new practices affects underlying employee perceptions, attitudes, and behaviors. For example, the changing of practices having to do with reporting and just treatment of employees can create a state of mutual trust in an organization, which in turn results in a much greater flow of useful information.

It is important to note that Reason's primary focus was on what he termed "organizational accidents" as opposed to "individual accidents." He defined "organizational accidents" as the "comparatively rare, but often catastrophic, events that occur within complex modern technologies such as [those in] nuclear power plants, commercial aviation, the petrochemical industry, chemical process plants, marine and rail transport." Individual accidents, on the other hand, are "ones in which a specific person or group is often both the agent and the victim" (Reason, 1997).

### Hudson Model

Hudson proposed a safety culture model that is a refinement of Westrum. It portrays the evolution of safety culture from the pathological to the generative stage while expanding the model to include five stages, replacing "bureaucratic" with "calculative" and adding "reactive" and "proactive" phases (Hudson, 1999) (See Figure A-2). The primary drivers, from "pathological" to "generative," are increased trust and increased dissemination of information and (as with Westrum and Reason) sharing of information.

In "A Framework for Understanding the Development of Organizational Safety Culture," Parker et al. (2006) demonstrated a useful application of the Hudson model. They interviewed 26 oil and gas executives, creating a matrix that showed how each organization handles incident/accident reporting, causes of accidents, purpose of procedures, and so forth, locating it on the scale between pathological and generative in each category. The average of the results shows where on the scale, from pathological to generative, the organization as a whole rests.

Hudson, like Westrum and Reason, said that improvement in information flow leads to improved safety culture. Reason and Hudson also saw increased levels of trust as a primary driver of that improved flow of information.

### Guldenmund Model

Guldenmund (2000) likened safety culture to an onion. The core contains basic assumptions about safety culture that are implicit, taken for granted, subconscious, and shared by the entire organization. The next layer, espoused values, refers to the attitudes of members of the organization. Four broad groups of espoused values represent attitudes about hard-

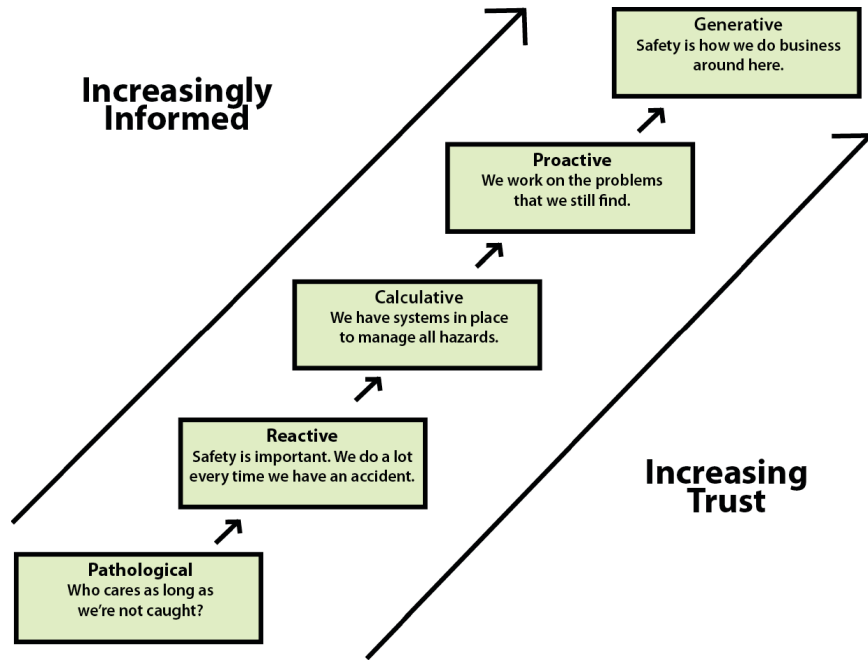


Figure A-2. Hudson's 1999 model (Hudson, 1999).

ware (facilities/plant design), management systems (safety and other), people (from senior management to lower-level employees), and behavior (risk taking and so on). The outer layer consists of artifacts or the outward expression of safety culture. Examples include behaviors, safety performance, and physical signs of safety awareness (see Figure A-3).

As Guldenmund noted, this model incorporates the concepts of both safety climate and safety culture and "also does justice to the integrative, holistic concept of culture as advocated by . . . cultural anthropologists." He went on to say that change within an organization should only be undertaken with detailed knowledge of a company's basic assumptions.

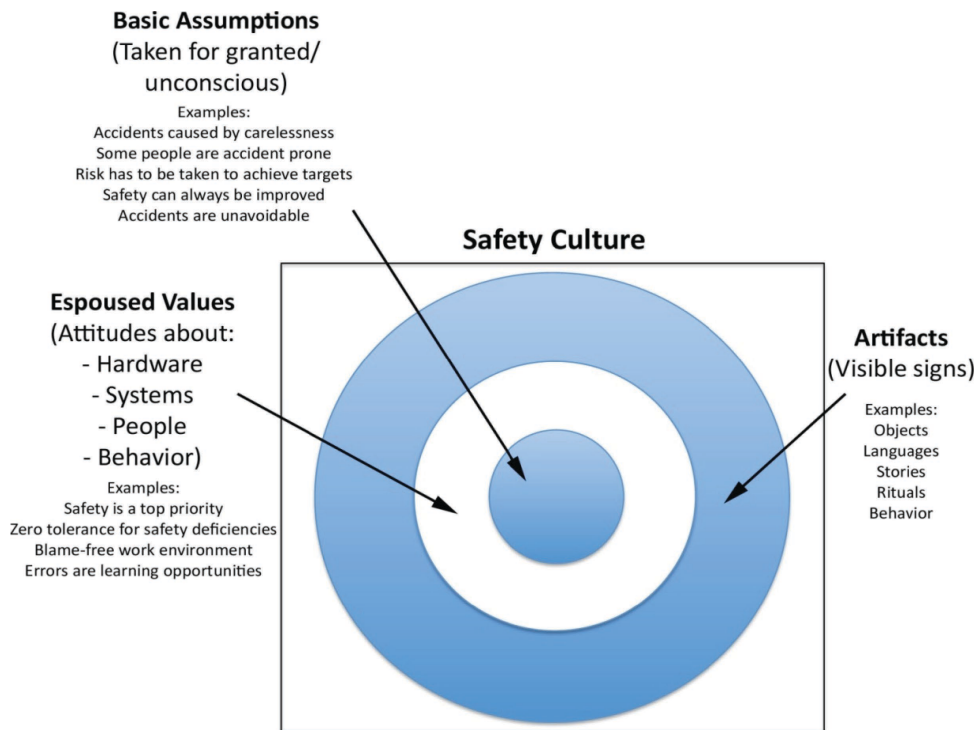


Figure A-3. Guldenmund's model (Fleming, 2000).

He offered two alternatives for initiating the desired change—(1) change the organization’s basic assumptions and (2) change the organization’s safety attitudes—and considered the second to be more likely to work.

### Fleming/Keil Centre Safety Culture Maturity Model

Mark Fleming of the Keil Centre in Edinburgh, Scotland, developed a safety culture maturity model that is used in the aviation, rail, petrochemical, offshore oil and gas, health, steel-making, and manufacturing industries. The model is intended to help organizations identify and establish actions that will improve safety culture. It has five levels and includes 10 distinct elements of safety culture maturity (see Figure A-4). Organizations move from the first to the fifth level by developing and advancing the degree of maturity of the 10 elements.

The five levels are:

1. Emerging: “Safety is defined in terms of technical and procedural solutions and compliance with regulations.

Safety is not seen as a key business risk, and the safety department is perceived to have primary responsibility for safety. Many accidents are seen as unavoidable and as part of the job. Most frontline staff are uninterested in safety and may only use safety as the basis for other arguments, such as changes in shift systems.”

2. Managing: “The organization’s accident rate is average for its industrial sector but they tend to have more serious accidents than average. Safety is seen as a business risk and management time and effort is put into accident prevention. Safety is solely defined in terms of adherence to rules and procedures and engineering controls. Accidents are seen as preventable. Managers perceive that the majority of accidents are solely caused by the unsafe behavior of frontline staff. Safety performance is measured in terms of lagging indicators such as lost time injuries (LTIs), and safety incentives are based on reduced LTI rates. Senior managers are reactive in their involvement in health and safety (i.e., they use punishment when accident rates increase).”

3. Involving: “Accident rates are relatively low, but they have reached a plateau. The organization is convinced that

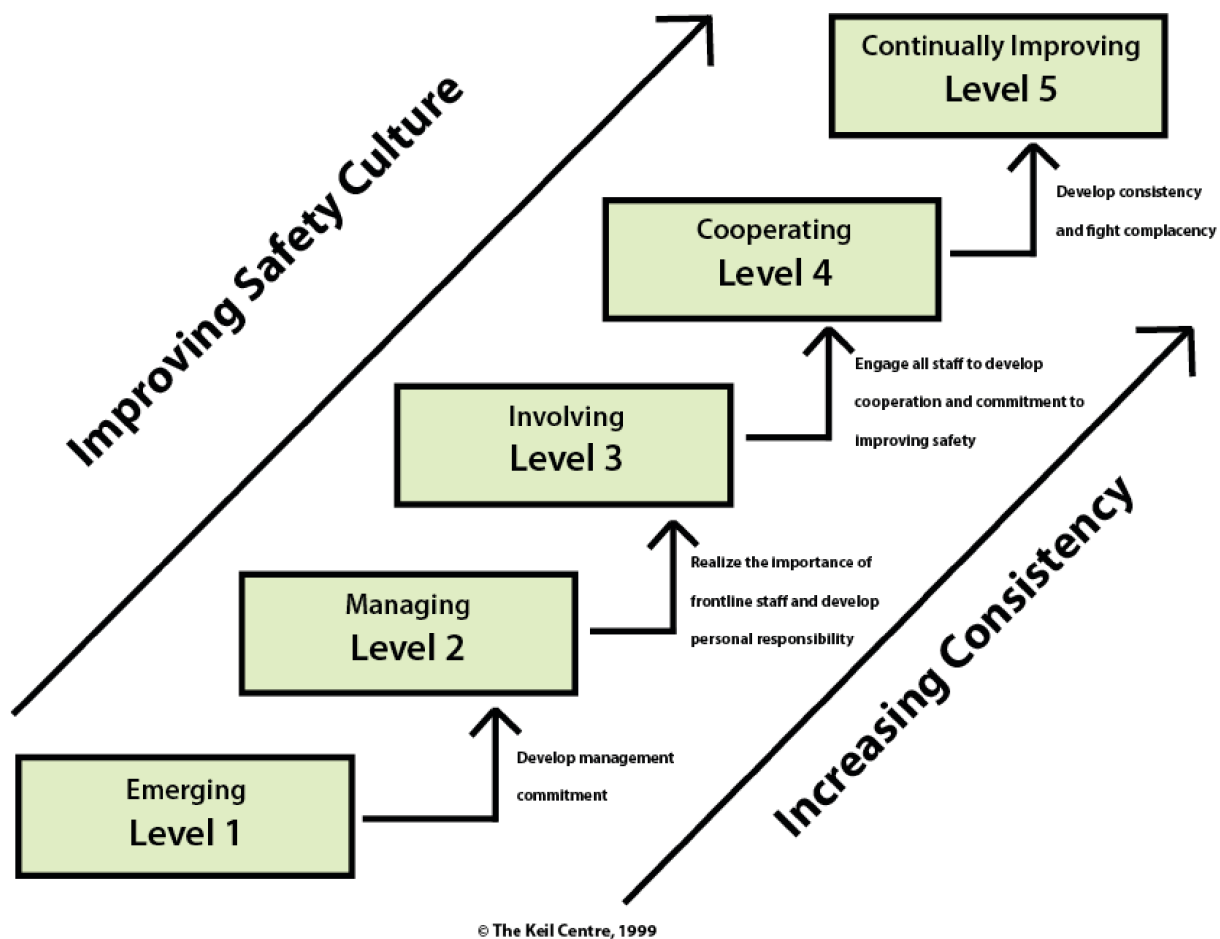


Figure A-4. Fleming Safety Culture Maturity model (Fleming, 2000).

the involvement of the frontline employee in health and safety is critical if future improvements are going to be achieved. Managers recognize that a wide range of factors cause accidents and the root causes often originate from management decisions. A significant proportion of frontline employees are willing to work with management to improve health and safety. The majority of staff accept personal responsibility for their own health and safety. Safety performance is actively monitored and the data is used effectively.”

4. Cooperating: “The majority of staff in the organization are convinced that health and safety is important from both a moral and economic point of view. Managers and frontline staff recognize that a wide range of factors cause accidents and the root causes are likely to come back to management decisions. Frontline staff accept personal responsibility for their own and others’ health and safety. The importance of all employees feeling valued and treated fairly is recognized. The organization puts significant effort into proactive measures to prevent accidents. Safety performance is actively monitored using all data available. Non-work accidents are also monitored and a healthy lifestyle is promoted.”
5. Continually improving: “The prevention of all injuries or harm to employees (both at work and at home) is a core company value. The organization has had a sustained period (years) without a recordable accident or high potential incident, but there is no feeling of complacency. They live with the paranoia that their next accident is just around the corner. The organization uses a range of indicators to monitor performance but it is not performance-driven, as it has confidence in its safety processes. The organization is constantly striving to be better and find better ways of improving hazard control mechanisms. All employees share the belief that health and safety is a critical aspect of their job and accept that the prevention of non-work injuries is important. The company invests considerable effort in promoting health and safety at home” (Fleming, 2000).

The 10 elements of the Safety Culture Maturity model are:

1. Management commitment and visibility,
2. Productivity versus safety,
3. Learning organization,
4. Safety resources,
5. Shared perceptions,
6. Communication,
7. Participation,
8. Trust,
9. Industrial relations and job satisfaction, and
10. Training.

## DuPont Bradley Curve Model (1999)

The DuPont Bradley curve model places companies and organizations in the following four categories:

1. Reactive: These companies handle safety issues by natural instinct, focusing on compliance instead of a solid safety culture. Responsibility is delegated to the safety manager, and there is generally a lack of management involvement in safety issues.
2. Dependent: While there is some management commitment, supervisors are generally responsible for safety control, emphasis, and goals. Attention to safety is made a condition of employment but with an emphasis on fear, discipline, rules, and procedures. Such companies do value their people and will provide safety training.
3. Independent: These companies stress personal knowledge of safety issues and methods as well as commitment and standards. Safety management is internalized and stresses personal value and care of the individual. These companies engage in active safety practices and habits and recognize individual safety achievements.
4. Interdependent: These companies actively help others conform to safety initiatives—they become others’ keepers, in a sense. They contribute to a safety network and have a strong sense of organizational pride in their safety endeavors.

In the DuPont Bradley curve model, the three elements of safety management are: (1) leadership, (2) structure, and (3) processes and actions.

DuPont has administered its safety perception survey since 1999 and has a database available for benchmarking. The database contains more than 632,000 responses from 96 industries, 41 countries, and over 3,383 locations. It is used to rate companies on the basis of their relative cultural strength. These ratings are “weak” (RCS less than 40), “average” (40–60), “good” (60–80), and “world-class” (greater than 80). RCS is then plotted on the *x*-axis of the Bradley curve against each company’s 3-year average OSHA total recordable injury rate on the *y*-axis.

The results are as follows: 19 organizations with a weak RCS had a mean TRIR of 4.6, 57 companies with an average RCS had a mean TRIR of 2.7, 164 companies with a good RCS had a mean TRIR of 1.1, and 106 companies with a world-class RCS had a mean TRIR of 0.61. This comparison shows a strong correlation between relative culture strength and safety performance (see Figure A-5). No proof of causality is offered (Hewitt, 2011).

While DuPont’s behavior-based safety work in the public transportation industry has some detractors (Lessin, 2000), the DuPont Bradley curve model has no obvious weaknesses

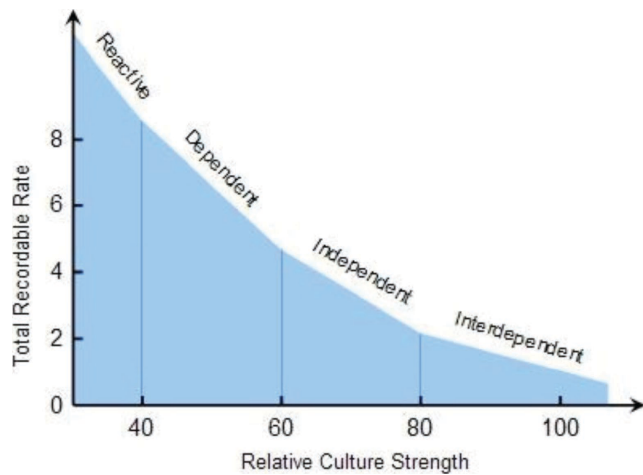


Figure A-5. DuPont Bradley curve (Hewitt, 2011).

or internal contradictions, is based in part on credible empirical data, and demonstrates a relationship between safety culture and safety performance.

### Cooper Model

Cooper (2000) initially developed a model based on three interrelated aspects of safety culture: psychological, behavioral, and situational (see Table A-3). Psychological aspect shows “how people feel,” behavioral is indicative of “what people do,” and situational is “what the organization has.”

The psychological aspects in Cooper’s model refer to individual feelings surrounding safety culture and safety management systems. These include safety climate, defined as a snapshot of the values, attitudes, and perceptions of individuals and groups. Therefore, this particular safety culture model subsumes safety climate as one of its three aspects. The behavioral aspects reflect those safety-related actions demonstrated by individuals when performing work. Situational aspects reflect the structure of management systems within an organization and the interaction of the different hierarchical levels in terms of accountability for safety culture. When

safety becomes a priority for management, resources are allocated to improve safety culture. Cooper said that safety culture can be evaluated by using safety climate surveys to measure psychological aspects, operational audits to measure behavioral aspects, and safety management system audits to measure situational aspects. The model also predicts that an intervention directed at improving any one of the three components will exert a reciprocal effect on the other two.

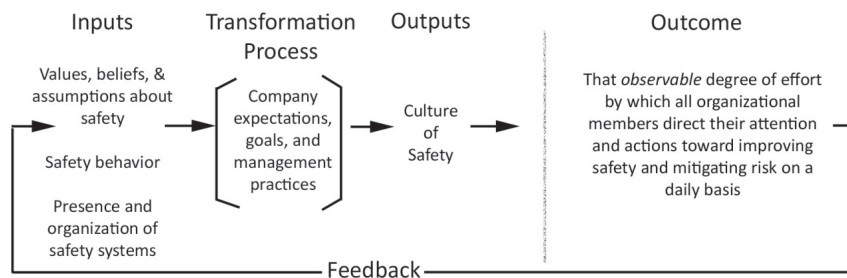
Cooper’s business process model of safety culture (Figure A-6), published in 2002, essentially recasts Cooper 2000 to make it clear that how a company manages safety “inputs” determines the extent to which employees commit themselves to safety. This formulation highlights the significant role that management plays in cultivating safety culture.

Values, beliefs, assumptions, and behaviors are shown in the model as inputs, which are transformed, when combined with organizational expectations, goals, and management practices, into a safety culture. Safety culture affects outcomes when commitment to safe operations and practices is evident in daily operations and when safety aspects are acted on by management and continually improved (Carelse, 2011).

What is lacking in most of the preceding theories and models is a systems view. Most theories and models do not look at influences outside the affected organization. As shown in the Roberts (2010) schematic of David Gaba’s Arrow (Figure A-7), regulators and government frequently have a significant effect on outcomes. The Arrow might be further expanded to include the individual involved in the accident, peers, management, board, stockholders, regulators, legislatures, and the public. Research has shown that the general public is reactive regarding safety—that is, willing through its legislators to provide resources after a dramatic accident rather than before, even though the best predictors and risk assessments indicate that proactive interventions are far more effective at reducing risk. This conforms to the observations made by Reason (1997) about the role that regulation plays: “if regulators are to be other than convenient scapegoats, they will have to be provided with the legislation, the resources, and the tools to do their jobs effectively. As we have seen, safety legislation is

Table A-3. Cooper’s safety culture model (Civil Air Navigation Services Organisation, 2008).

Psychological Aspects	Behavioral Aspects	Situational Aspects
“How People Feel”	“What People Do”	“What the Organization Has”
Can be described as the safety climate of the organization, which is concerned with individual and group values, attitudes, and perceptions about safety.	Safety-related actions and behaviors, management commitment to safety.	Policies, procedures, regulation, organizational structures, and management systems.



**Figure A-6. Cooper's business process model of safety culture (Cooper, 2002).**

enacted in the aftermath of disasters, not before them.” He went on to note that, while there is no obvious political gain to be had from preventing accidents, in the long run that effort is more rewarding. This applies throughout the “system chain” of prevention responsibility.

### High-Reliability Organization Model

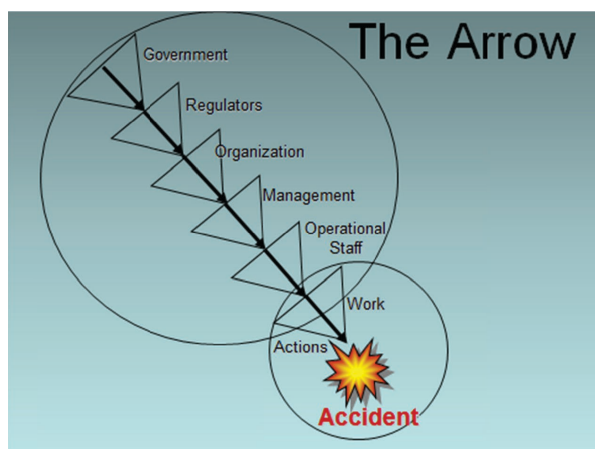
The research team believes that, given the potentially catastrophic consequences of an unanticipated event and the subsequent loss of critical transportation functions, larger transit authorities might consider adoption of the HRO model described here. Two subway trains operating under CBTC at rush hour in the tunnels of New York carry up to 5,000 passengers. A head-on collision due to a CBTC failure and a subsequent fire at rush hour would lead to total casualties that exceed those resulting from most aviation crashes, offshore platform accidents, and other high-profile accidents and incidents. A sequence of events of this kind could cripple all transportation within New York City for days, if not weeks. This model is described in great detail because the research team believes that its adoption by large heavy-rail properties

would be a prudent step. As these operations become more complex and technology-dependent, the need to adhere to such a model increases sharply.

An HRO is generally defined as an organization that repeatedly accomplishes its mission while avoiding catastrophic events, despite significant hazards, dynamic tasks, time constraints, and complex technologies (Hartley, 2010). B&W Pantex has published several books on HRO implementation in the nuclear weapons industry, including Hartley et al., *High Reliability Operations: A Practical Guide to Avoid the System Accident*, and Hartley et al., *Causal Factors Analysis: An Approach for Organizational Learning*.

HROs are generally regarded as ranking high in the safety hierarchy. The *Columbia* Accident Investigation Board was critical of NASA's safety culture and, as a result, adopted the high-reliability organization as a standard. Its conclusion was that, had the principles of HRO organizations been followed, the *Columbia* would not have disintegrated (Boin and Schulman, 2008).

The term “high-reliability organization” was popularized through research conducted by a group of UC-Berkeley scholars who noticed that, while much had been written about organizations experiencing disasters, little attention had been devoted to organizations that operated in a technologically complex environment—one in which the potential for mishap is great but whose records indicated that the organizations had avoided catastrophe. These researchers focused on the U.S. air traffic control system, the Diablo Canyon Power Plant, and U.S. Navy nuclear aircraft operations. The first emerging definition came from Roberts (1990): “Within the set of hazardous organizations there is a subset which has enjoyed a record of high safety over long periods of time. One can identify this subset by answering the question, ‘How many times could this organization have failed, resulting in catastrophic consequences, yet did not?’ If the answer is on the order of tens of thousands of times, the organization is highly reliable.” Ongoing criticism of this definition (Marais et al., 2004) was that such an organization could undergo a major accident every day and still qualify as highly reliable.



**Figure A-7. David Gaba's Arrow systems view model (Roberts, 2010).**

Indeed, Marais et al. (2004) say that, by this criterion, “it is difficult to think of any low reliability organizations.”

HRO researchers, led by La Porte (1996), refined the definition by saying that high-reliability organizations are hazardous systems that produce “nearly accident-free performance” or function in a “nearly error-free fashion.” High-reliability organizational theory surfaced from field studies conducted by researchers investigating low accident and human error rates in three high-risk organizations (Weick et al., 1999). HRO theory assumes that an organization’s people, processes, and technology, when properly structured, can handle complex and hazardous activity (Singer et al., 2003). In contrast to conventional accident theory that posits that accidents are impossible to prevent in highly complex organizations, the theory of high reliability is based on a belief that organizational design and good management practices can in fact prevent accidents and control error rates. High-reliability organizations generally use the following techniques (Marais et al., 2004):

1. Redundancy,
2. Simulation,
3. Strict organizational structure,
4. Decentralized decision making,
5. Learning from mistakes,
6. Mindfulness,
7. Training, and
8. Use of highly skilled individuals.

Perrow (1999) believed that a tightly coupled complex organization’s cascading effects can quickly spiral out of control before operators are able to understand the situation and perform corrective action. Perrow’s beliefs fed the argument that, in complex, interactive, tightly coupled organizations, the need for further complexity will become more pressing, thereby increasing the likelihood of more accidents. In order to create safer systems, organizations must reduce interactive complexity and decouple systems because functionality and efficiency can be achieved through systems that are more simply designed.

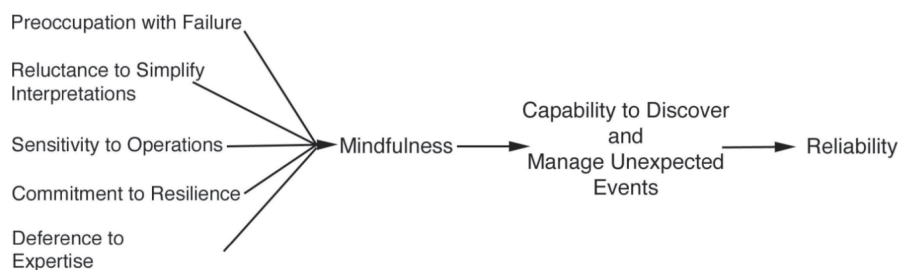
Turner (1978), however, had noted that simplification was dangerous because it could limit the precautions people would take and the number of undesirable results they could envision. Naevestad (2009) discussed Turner’s findings in terms of the meanings that members of an organization might attribute to warnings and signals of danger in ill-structured situations. Weick et al. (1999) argued that HRO researchers understand culture in organizations. Drawing on the work of Turner (1978), they believed, further, that simplification, rigid safety views, and a limited opinion of the role of safety induce ignorance to hazards and signals of danger.

HROs create processes and systems that reduce the possibility of unexpected events, allowing for containment and speedy recovery once such an event occurs. In the HRO infrastructure, small failures are tracked meticulously. Personnel are engaged in the process of collective problem solving through inquiry, which allows HROs to maintain a high level of proficiency in identifying gaps in system continuity and understanding warnings of potential catastrophes. Operations personnel are trained to react to even weak signals and to address the cause of failure prior to a series of events that can lead to disaster. The interactions of HRO processes are illustrated in Figure A-8.

According to Weick et al. (1999), the following five characteristics create an HRO mind-set and guide HRO behaviors and operational thinking:

- Preoccupation with failure: HROs are focused on indicators that may predict possible catastrophic consequences. Near misses are viewed as opportunities to improve systems by analyzing strengths and identifying weaknesses, as well as allocating necessary resources to address and correct issues. In HROs, near misses are used to illustrate to employees the weaknesses within systems. This constant vigilance results in a broader understanding of processes.
- Reluctance to simplify: HROs acknowledge the complexity of the work environment and are apprehensive about accepting simple solutions. Individuals are encouraged to analyze all of the potential root causes of a problem and to draw on the diverse experiences of staff to refine pro-

#### PROCESSES



**Figure A-8. A mindful infrastructure for high reliability (Muhren et al., 2008).**



cesses, systems, and decision making. While HROs work to simplify processes, they do not apply simplistic solutions to complex problems that arise as a result of the nature of their work.

- Sensitivity to operations: HROs are flexible. Implicit is an acknowledgment that circumstances change. The element of constant change in complex systems requires HROs to identify anomalies and recognize problems quickly. This process is referred to as “maintaining situational awareness.”
- Commitment to resilience: Containing errors and creating new methods to prevent future errors are top priorities. The organization assumes that, in spite of training, information sharing, and numerous built-in safeguards, the system may fail. To this extent, teams in high-reliability organizations prepare to respond to system failure through consistent operational procedure drills.
- Deference to expertise: HROs maintain a culture of respect for knowledge and experience. Team members look to the individual who is most knowledgeable about an issue regardless of tenure/seniority or position within the organization. Hierarchy is deemphasized in favor of an open transfer of knowledge and an atmosphere that encourages information sharing, which can prevent problems.

Rochlin (as cited in Roberts, 1993) states that what separates HROs most distinctly is their adherents’ ability to run nearly error-free complex operations while incurring few, if any, accidents and avoiding major catastrophes. The capacity to sustain good performance is enhanced by a preoccupation with avoiding major system setbacks and an ability to question and analyze processes, defer to knowledge and expertise, exchange information constantly, and create environments for decentralized decision making. High-reliability organizations are defined as organizations that have not just avoided failure through good fortune or the vagaries of probability but have actively managed to control and reduce the risks of technical operations whose inherent hazards make them prone to catastrophic failure. Roberts (1993) identified the basic elements of such organizations:

- People within an organization must be helpful to and supportive of one another;
- People must trust one another;
- People must have friendly, open relationships emphasizing credibility and attentiveness; and
- Work environments must be resilient, must emphasize creativity and goal achievement, and must provide strong feelings of credibility and personal trust.

HROs share a number of traits that sustain their safety cultures. In designing safety culture around the following fundamental principles, high-reliability organizations strive to

mitigate risk and to reduce or eliminate factors that lead to high-risk events.

- Goal prioritization and consensus exist in HROs because leaders gain support from employees by prioritizing performance and safety as organizational goals (La Porte and Consolini, 1991). Making safety the number-one priority is verbalized but also demonstrated in decision-making processes and resource allocation.
- Simultaneously decentralized and centralized operations represent an organizational principle in HROs. Trained field-level staff respond to a specific crisis, while the primary chain of command maintains control of centralized operations. One example is the operation of aircraft carriers in the U.S. Navy—the carrier is subject to the navy’s chain of command, yet the lowest-level seaman can abort landings and address safety concerns as necessary (La Porte and Consolini, 1991).
- Extensive use of redundancy is defined as the ability to provide for secondary-unit execution of a task if the primary unit falters or fails (La Porte, 1996). According to Roberts (1990), this includes technical redundancy (backup computers are used) and personnel redundancy (functions are duplicated, and more than one person is assigned to perform a given check).
- Organizational learning takes on particular importance in high-reliability organizations as a result of the impracticality of trial-and-error learning (Weick, 1987). Role playing, simulated experience, storytelling, and other creative forms of sharing information are often used. Resources are appropriated to encourage development of technical skills and competencies. While accidents are certainly used as learning experiences in high-reliability organizations, trial-and-error learning is not viewed as an effective way to reduce risk when the accident could have catastrophic consequences.

HROs have demonstrated the ability to adapt, change, and be flexible in complex environments, and Weick et al. (1999) see this as a primary reason for moving high-reliability practice more into the mainstream. HROs focus on failure through adaptive learning and reliable performance. Hannan and Freeman (1984) thought that organizational reliability could be achieved through the development of highly standardized routines. HRO theory deviates from that definition. Inherent in the concept of high reliability is variation in learning and questioning and exploring, as well as using collective evaluation tactics to increase cognition and sustain understanding of probable issues. The best HROs are not sitting and waiting for an error to occur before responding. Instead they are preparing for extraordinary events through an expansion of knowledge and the use of technology (Weick et al., 1999). Adoption of the HRO model, however, is no guarantee of catastrophe avoidance. As the Fukushima nuclear accident

reminded the world, organization culture and system complexity can combine to produce disaster if assumptions are not constantly questioned and complex systems hazards not fully anticipated (Pidgeon, 2012).

## Other Significant Contributions

Dan Petersen and E. Scott Geller have also made contributions to the safety culture literature. While neither has produced a fully developed theory or model, their work has gone a long way toward stimulating discussion of safety culture concepts and has ignited useful discussions.

### Petersen

Petersen (1996) has argued that “safety is just another management function and should be managed in the same way.” He believes that five widely held safety beliefs are wrong:

1. Accidents are caused by unsafe acts and conditions. Petersen says that accidents are in fact caused by “a combination of a management system and a culture or environment that leads to human error.”
2. There are certain essential elements to a safety program. Petersen says that this is not true in all cases, and that instead it is environment and culture that control and determine which elements work and which do not.
3. Accident statistics tell us something. He says that, for most organizations, particularly smaller ones, recordable injury rates “have no statistical validity and very little meaning whatsoever.” They neither diagnose problems nor direct organizations in the direction of improvement.
4. Audits predict results in safety. He says that there is little correlation between audit reports and injury records in large companies because audits are generally as much about paperwork and regulatory compliance as they are about the effectiveness of a safety program.
5. Regulatory compliance ensures safety results. He argues that being in compliance with OSHA and having a safe workplace are totally different things; to support his hypothesis, he cites injury statistics since the institution of OSHA.

### Geller

Geller (2008) sees people-based safety as an extension and evolution of behavior-based safety, of which he is a leading proponent. He uses the acronym ACTS (act, coach, think, see) to describe the process. “Specifically in a total safety culture, people act to protect themselves and others from unintentional injury; coach themselves and others to identify barriers to safe acts and provide constructive behavior-based feedback; think in ways that activate and support safe behavior; and focus and scan strategically to see hazards and

at-risk behaviors.” Geller believes that people-based leadership means more than just holding individuals accountable; it requires employees to inspire others to be accountable for injury prevention and to care actively for the safety and health of coworkers. Behavior-based safety, another of Geller’s precepts, has come under attack from labor unions. The unions argue that this concept can be perverted to maintain that it is not hazards on the job that cause injuries and illnesses but the behavior of those exposed to the hazards (victims). They see this concept as a useful tool for a management that is intent on shifting blame and focus from employers (and hazardous conditions) to workers (and unsafe acts). They are particularly critical of the DuPont STOP program, which they maintain posits that 96% of all accidents are caused by unsafe acts and focuses on worker behavior, discipline, and safety incentive programs (Lessin, 2000).

## Models Compared and Contrasted

Of the fully developed safety culture theories or models that have been presented, four (Westrum, Hudson, Fleming, and the DuPont Bradley curve) might be called dynamic models in that they define three, four, or five progressive levels of safety culture maturity in an organization. The dynamic models are therefore much more definite with respect to where an organization is on the negative-to-positive safety culture scale. Conversely, a shortcoming of dynamic models is that many organizations’ characteristics fall into more than one model level, which makes the specification of different levels seem somewhat artificial and arbitrary.

- Westrum: This model progresses from the “pathological” through the “bureaucratic” to the “generative” stages. In the pathological stage, reports are discouraged, failures covered up, and new ideas crushed. In the generative stage, reports are rewarded, failures scrutinized, and new ideas welcomed. The primary driving force is how the organization processes and shares information.
- Hudson: This model, which is a refinement of the Westrum model, also progresses from the pathological to the generative stage, but in five steps instead of three: pathological, reactive, calculative, proactive, and generative. The primary goals in Hudson on the path from pathological to generative are that the organization become increasingly better informed and experience higher levels of trust.
- Fleming: This model progresses in five levels, from emerging through managing, involving, and cooperating to continuous improvement. At the emerging level, safety is perceived in terms of technical and procedural solutions, compliance with regulations is the primary driver, safety is not seen as a key business risk, and the safety department is perceived to have primary responsibility for safety.

Accidents are frequently seen as unavoidable and just part of the job. At the continuous improvement level, the prevention of injuries is a core company value; there is no feeling of complacency, despite the many years that have gone by without a serious accident; employees are alert to the fact that an accident could conceivably be just around the corner; the organization is constantly striving to be better and to find ways of improving hazard control mechanisms; and all employees share the belief that health and safety are critical aspects of their jobs.

- **DuPont Bradley curve:** This model has four levels: reactive, dependent, independent, and interdependent. At the reactive level, companies handle safety issues by natural instinct, focus on compliance, delegate responsibility for all safety matters to the safety manager, and exhibit a general lack of management involvement in safety issues. At the interdependent level, companies actively help employees conform to safety initiatives, contribute to a safety network, and have a strong sense of organizational pride in their safety endeavors.

Two of the dynamic models (Westrum and Hudson) start at a much lower point on the negative-to-positive safety culture scale than the Fleming and DuPont models. Westrum and Hudson are therefore more useful for organizations that are at or near the bottom of the scale. In fact, such organizations might have a hard time finding a level in the Fleming and DuPont models that seems familiar.

The Fleming model, however, provides more practical detail at each level because it consists of five steps spread over a shorter scale and therefore has somewhat greater utility in the aviation, rail, petrochemical, offshore oil and gas, health, steelmaking, and manufacturing industries—for which it was in fact developed.

The DuPont model has the advantage over the other models presented in its firm empirical grounding. DuPont has administered a safety perception survey since 1999, creating a database containing more than 632,000 responses from 96 industries and 41 countries, which rates companies on the basis of their relative cultural strength. The RCS for a company is plotted on the  $x$ -axis against the company's 3-year average OSHA total recordable injury rate on the  $y$ -axis. The result is the DuPont Bradley curve, which establishes a strong correlation between higher cultural strength scores and lower injury rates.

Six of the models (Reason, Guldenmund, Cooper 1999, Cooper 2002, systems view, and HRO) might be called static: levels of safety culture maturity are not delineated but are implicit in the degree to which different components are developed at any given point in time.

Of these six, the Reason model is perhaps the most highly developed in terms of its theoretical depth and grounding in practical realities. If other than the largest rail transit agencies could look at and learn from only one safety culture model, Reason is clearly the first choice. The Reason model offers

a menu of tremendous detail and complexity in its learning, reporting, flexible, and just subcultures driven by underlying perceptions, attitudes, and behaviors. The genius of the model lies in Reason's recognition that the essence of all that detail and complexity is how effectively an organization develops, disseminates, and uses safety information. In Reason's words, "an informed culture is a safety culture." A transit agency can draft an action plan based on Reason that, if properly executed, will surely move it toward a more positive safety culture.

The Guldenmund model incorporates concepts from both safety climate and safety culture. It focuses to a greater extent than the other models on the assumptions and values that underlie and drive the artifacts or visible signs of the state of safety culture in an organization. Its major contribution is its detailed exploration of the influence of assumptions and values on safety culture.

The Cooper 1999 model's focus on how psychological, behavioral, and situational aspects interact to produce a safety culture in an organization is a major contribution. Its prediction that an intervention directed at improving any one of the three components will exert a reciprocal effect on the other two is unique, as is its insistence that safety culture can only be evaluated by using safety climate surveys to measure psychological aspects, operational audits to measure behavioral aspects, and safety management system audits to measure situational aspects.

The Cooper 2002 business process model is a reformulation of Cooper 1999 that makes it clear that how a company manages the safety inputs initially defined in Cooper 1999 determines the extent to which its employees commit themselves to safety.

The major contribution of the systems view model, of course, is to point out that significant influences are exerted by entities external to the affected organization.

Finally, there is the HRO model. It is clearly the most advanced and probably the most effective safety culture model. It also has had more practical application than most—if not all—of the others presented. It is the established universal model for industries such as nuclear power, commercial aviation, and offshore energy extraction. It is demanding, difficult, and comparatively expensive to implement. Transit agencies that exclusively operate buses or light rail may well find that the marginal cost of the HRO model outweighs the marginal benefit. However, as noted before, transit agencies operating heavy rail might consider its adoption.

## Sets of Components of Safety Culture

Given the elusiveness of a universal definition of safety culture, it is instructive to look at what uniformity exists in the literature with respect to the sets of components that combine

to produce safety culture. (Note that the terms attributes, elements, dimensions, and indicators are synonymous with the word “components” in the literature.) What the literature provides is a multitude of different sets of components. Examples include those in the following.

Zohar (1980) said that the dimensions that make up safety climate are:

- Strong management commitment to safety,
- Emphasis on safety training,
- The existence of open communication links and frequent contacts between workers and management,
- A general environment control and good housekeeping,
- A stable workforce and older workers, and
- Distinctive ways of promoting safety.

The International Civil Aviation Organization (2005) noted that a good safety culture has the following attributes:

- Senior management placing a strong emphasis on safety,
- Staff having an understanding of hazards within the workplace,
- Senior management’s willingness to accept criticism and an openness to opposing views,
- Senior management’s fostering a climate that encourages feedback,
- Emphasis on the importance of communicating relevant safety information,
- The promotion of realistic and workable safety rules, and
- Ensuring that staff are well educated and trained so that they understand the consequences of unsafe acts.

Hudson (2001) suggested using the Reason (1997) dimensions of:

- An informed culture,
- A reporting culture,
- A flexible culture,
- A learning culture, and
- A just culture.

Fleming (2000) noted 10 elements of a safety culture maturity model:

- Management commitment and visibility,
- Communication,
- Productivity versus safety,
- Learning organization,
- Safety resources,
- Participation,
- Shared perceptions about safety,
- Trust,

- Industrial relations and job satisfaction, and
- Training.

The Idaho National Engineering and Environmental Laboratory (2001) noted eight core components of total safety culture:

- Management commitment to safety;
- Job satisfaction;
- Training, equipment, and physical environment;
- Organizational commitment;
- Worker involvement;
- Coworker support;
- Performance management; and
- Personal accountability.

As noted previously, the literature provides numerous definitions of safety culture, with no consensus on a single one. There is a corresponding lack of agreement on components. Numerous sets of components have also been proposed, ranging from as few as two components to as many as 19 (Flin et al., 2000). The Aviation Research Lab (Wiegmann et al., 2002), for example, identified the following as primary indicators that influence how safety culture is prioritized in the organization: (1) organizational commitment, and (2) leadership and management commitment. In general, the literature cited emphasizes organizational and leadership commitment, management involvement, management communications, employee engagement and rewards, learning, flexibility, justice, and reporting systems as key components.

In her comprehensive analysis “Safety Culture: Under-specified and Overrated?” Clarke (2000) noted: “A major theme in empirical studies has been defining the dimensions or components of safety climate/safety culture. . . . an overview of 16 empirical studies . . . involved development of the architecture of safety attitudes. There is much variation in the number of dimensions; these vary from global measures of safety climate to 16 distinct components. The content of the dimensions also varies considerably between studies. However, from the studies . . . five dominant themes seem to emerge: work task/work environment, personal involvement and responsibility, management attitudes, safety management system, and management actions.”

Williamson et al. (1997) noted that different approaches to determining the components of safety climate are partially responsible for the differences in components found in empirical studies. They identified two differing approaches: first, asking workers for their perceptions of actual workplace characteristics (Zohar, 1980), and second, asking more general questions about safety (Cox and Cox, 1991). Additionally, many studies construct their measurement tools solely by selecting items from previous questionnaires, although some studies

demonstrate a systematic approach to item generation (Cox and Cox, 1991; Donald and Canter, 1994).

## Individual Components of Safety Culture

As previously noted, there are many individual components of safety culture included in the sets described so far. The sets differ in terms of which components are included and which are excluded. What follows are brief descriptions of the most common of the components cited.

### Accountability and Reward Systems

The Oregon Chapter of OSHA defined accountability as it relates to safety: performance is measured against standards and evaluated, and there are natural and/or system consequences when standards are not met. Further, the process is outlined within an accountability system including establishing formal standards, providing adequate resources, evaluating employee performance, applying effective consequences, and evaluating the accountability system (Occupational Safety and Health Administration, Oregon Chapter, 2005).

Accountability and blame are two separate concepts. Paul (1997) made a useful distinction between the two. He said that accountability refers to assigning responsibility for tasks in advance and requires clear communication to discuss common difficulties. Inherent in making individuals accountable is recognition of the fact that everyone makes mistakes and that mistakes are opportunities for learning and growing. He said that blame is the process of shaming others and searching for something wrong in them. While the presence of a blame culture has many negative effects on learning and employee motivation, Whittingham (2004) acknowledged that there are some cases in which an individual making an error deserves to experience repercussions. Blame should be assigned when it is deserved—for instance, when there is evidence of gross negligence, misconduct, or deliberate rule violation.

Sidney Dekker encourages organizations to clearly define who is responsible for drawing the line between appropriate and inappropriate consequences, and recommends impartial third-party reporting, so that employees will not feel apprehensive about filing reports. Research has shown that a just culture is defined not by the absence of blame but by the processes in place to ensure its appropriateness (Dekker, 2007).

Beyond strict accountability, the pros and cons of reward systems are extensively debated in the literature. E. Scott Geller believes that it is best to direct rewards to employees whose intention or demonstrated behavior is leading toward change (Geller, 2008). While reward systems are one way of recognizing performance, Williams (2002) questions the value of pub-

lic recognition and monetary incentives. Research has shown that incentive programs that foster competition (employees competing to win or gain a safety incentive) may lead to a failure to report actual safety issues, leaving an organization vulnerable to catastrophe. When employees are competing for recognition, the possibility of not reporting injuries and other events increases. In a memorandum dated March 12, 2012, entitled “Employer Safety Incentive and Disincentive Policies and Practices,” OSHA noted that Section 11(c) of the Occupational Safety and Health Act prohibits an employer from discriminating against an employee because the employee reports an injury or illness (29 CFR 1904.36). Further, it noted that employers who establish programs that intentionally or unintentionally provide employees an incentive to not report injuries are probably in violation of Section 11(c) if the incentive involved is of sufficient magnitude that failure to receive it “might have dissuaded reasonable workers from” reporting injuries (U.S. Department of Labor, Occupational Safety and Health Administration, 2012).

Geller advised against the public recognition/safety contest approach and encouraged private personal recognition. His emphasis was on delivery of the message to the employee in a sincere, simple, timely manner that supports desirable behavior (Geller, 2008). According to Joshua Williams, “Effective safety leaders provide high-quality recognition to work groups as well as individuals. This involves sincere, personal praise with pro-social behaviors, as well as nonthreatening corrective feedback when job behaviors are less than ideal” (Williams, 2002).

Eiff (1999) claimed that a fair evaluation and reward system is essential to promoting safety in the workplace and discouraging unsafe conduct. Wiegmann and von Thaden (2007) claimed that an organization’s safety culture depends on the extent to which management rewards employees for reinforcing safety at work (monetarily or through rewards such as plaques or public recognition) and discourages unsafe behavior. Consistency is important: “an organization’s safety culture is signified, not only by the existence of such reward systems, but also by the extent to which the reward systems are formally documented, consistently applied, and thoroughly explained and understood by all of its employees” (Wiegmann et al., 2004).

Williams (2002) suggested that leaders should consider some guidelines when rewarding employees:

- Safety rewards should focus on proactive, process-oriented behaviors and activities instead of outcome numbers (e.g., OSHA accidents as recorded).
- Rewards should be symbolic of safety achievement. Safety shirts, plaques, and certifications may hold more meaning for safety than financial incentives. Employees should help select the rewards. (Rewards like these, including award dinners and lunches, might be more appropriately called “reinforcers” than “rewards.”)

- Financial incentives may create a sense of entitlement among employees, making the incentives difficult to eliminate.

Williams also pointed out that providing incentives based on injury data may lead to underreporting and suggested that it is “best to reward positive safety performance, rather than reporting negative information” (Williams, 2002).

## Development of Safety Information and Communications

Reason encouraged working toward creating an informed culture, one in which managers and employees are aware of the status of safety initiatives. In “most important respects,” he wrote, “an informed culture is a safety culture.” He advised that “in the absence of frequent bad events, the best way to induce and then sustain a state of intelligent and respectful wariness is to gather the right kinds of data. This means creating a safety information system that collects, analyzes, and disseminates information from incidents and near misses, as well as from regular proactive checks on the system’s vital signs” (Reason, 1998).

Management may communicate with employees through a variety of media and use delivery mechanisms such as e-mail and intranet communication. Others might use large employee gatherings or meetings to deliver important messages about safety. Regardless of scale or media, it is essential for management to communicate with employees to maintain a positive safety culture (Short et al., 2007).

“Effective communication also involves active listening, where leaders genuinely empathize with employee concerns” (Williams, 2002).

## Employee Involvement

All parties—management and employees—must participate in the creation of a positive safety culture. “The degree to which the safety culture is positive or negative will depend entirely upon the collective amount of energy visibly expended in the pursuit of excellence by organizational members” (Cooper, 2002). In the *Manual for the Development of Bus Transit System Safety Program Plans*, APTA stated, “The most valuable resource any transit system has is its employee workforce” (American Public Transportation Association, 1998). As the most valuable resource in transit systems, employees must be encouraged to voice their opinions and concerns and contribute to the creation of a positive safety culture. Furthermore, “it is essential from an employee consideration perspective and from a good management perspective to ensure as much as possible the safety of employees. An Employee Safety Program must be designed to have the best possible input from all necessary units, including the

employees themselves” (American Public Transportation Association, 1998).

While management is typically charged with taking the lead in initiating improvements to safety programs within the organization, Ludwig et al. stated that “employees must fully trust that they will have management support for decisions made in the interest of safety, while also recognizing that intentional breaches of safety will not be tolerated. The result is a non-punitive environment that encourages the identification, reporting, and correction of safety issues” (Ludwig et al., 2007). When employees trust that safety is the top organizational priority and are able to report safety concerns and successes based on that priority and without fear of retaliation or harassment, the safety culture of the organization improves. “Employees (e.g., [truck] drivers) must be, over the long term, part of an organization—both developing and learning its culture. Likewise, an organization must have a culture in place to teach new members its norms, attitudes, values, and beliefs. If this culture-building process is not in place due to labor instability, then a driver may hold only the industrial subculture of the driving profession as he moves from carrier to carrier, which will undermine the safety culture of those carriers that are the driver’s past, present, and future employers” (Short et al., 2007).

## Expectations

One way that organizations can clearly communicate expectations to employees is through an organizational or safety mission statement. In its “Best Practices Guide to Developing Your Safety Policy Mission Statement,” the Maine Municipal Association (2005) stated, “one of the key elements that many employers fail to include in their workplace safety program, when it is first being developed, is a safety policy mission statement. This critical document should set the tone for the whole safety program. It lets all employees know that management has set the safety and health of that organization’s workers as one of its top priorities.” One of the crucial steps in developing this statement is to include clear expectations of employees and managers to ensure that they “know what specific performance is expected of them.”

Between 2003 and 2006, Georgia Ports Authority cut incident rates in half and increased productivity by more than 300,000 person-hours as a result of implementing a safety culture initiative (Bloess, 2007). A vital part of this initiative was clearly communicating management expectations to all employees. A safety policy statement was issued, and employees were engaged in the following programs:

1. Audits, inspections, and investigations;
2. Job safety procedures;
3. Job safety analysis;

4. Safety training;
5. Employee safety orientation;
6. Safety communications; and
7. Safety recognition.

Georgia Ports Authority began with the overarching policy conclusion that it is important to have a safety strategy that becomes a natural way of conducting business. “World-class organizations do have a compelling safety vision that is documented, known by all, displayed, and cascades into personnel action” (Taylor, 2010).

## Flexibility

The International Atomic Energy Agency (2002) recognized that the design of internal processes “must remain flexible to allow the organization to adapt to a changing environment.” It stipulated that it is essential to maintain “open and frank dialogue” with regulatory bodies, “especially when the dialogue concerns safety objectives.” Such dialogue is “vital to enhancing safety culture” (International Atomic Energy Agency, 2002).

## Management Commitment and Oversight

Safety must be identified by top management as a core value and a top priority. Management must clearly communicate expectations to employees, demonstrate a commitment to safety in their own roles, and clearly define safety as a priority for all departments within the organization. “An organization’s commitment to safety is . . . ultimately reflected by the efforts put forth to ensure that every aspect of its operations, such as equipment, procedures, selection, training, and work schedules, [is] routinely evaluated and, if necessary, modified to improve safety” (Wiegmann et al., 2002). Safety culture “flows from top to bottom, with senior management being essential to an organization’s safety culture, and official policies and objectives regarding safety being a critical indicator of an organization’s safety culture” (Short et al., 2007).

In many cases, management is cited as having the greatest influence over an organization’s safety culture. Though experts agree that all levels of an organization must participate in creating a cohesive and positive safety culture, such participation in most cases begins with leadership. “Experts in the field of organizational change affirm that no substantive transformation will take place within an organization without the skill, visible commitment, and guiding example of leadership” (Marais et al., 2004). In setting the tone, management must also provide a walking, talking example of the culture for which they want their organization to strive. “If there is visible commitment to safety within the organization that is evident in the actions of its leaders, in the work environment,

and in the behaviors of its members, it is more likely that a safety mind-set will be established and safe work practices will be followed” (Marais et al., 2004). According to Gill and Shergill (2004), “this commitment must be demonstrated not only through written and verbal communication from management to employees, but also by management’s actions. One of the most important things management can do to promote positive safety culture is to reinforce an ‘informed culture’ by encouraging reporting on safety and ensuring that reported information is used to improve safety rather than to punish employees—fostering a ‘just culture’” (Gill and Shergill, 2004).

If management commitment plays an important role in determining organizational and safety culture, effective internal oversight plays a key role in maintaining it. Citing Schein, Clarke noted that “the way in which senior managers instruct, reward, allocate their attention and behave under pressure” is a key determinant in organizational culture formation. As management observes employees and their attitudes toward safety in the workplace, it is imperative that positive conduct is rewarded and negative conduct is dealt with in order to maintain the integrity of the system (Clarke, 1999).

The Ladbroke Grove Rail Inquiry formulated recommendations to ensure safety’s position at the top of the list of an organization’s priorities. Four factors were listed as having a positive effect on workers’ perception that safety was important:

1. Valuing subordinates,
2. Visiting worksite frequently,
3. Workers’ participation in decision making, and
4. Effective communication (Health and Safety Executive, 2001).

It was suggested that managers spend time touring frontline locations informally, as such visits were seen as more meaningful than formal inspections. The Ladbroke Grove Rail Inquiry recommended that at least one hour a week be scheduled into the diaries of senior executives for these walkabouts, while middle-ranking managers should schedule one hour per day and first-line managers 30% of their time. Other recommendations included prominently placing safety information in workplace communication materials and developing an effective communications plan that includes staff at all levels of the organization (Health and Safety Executive, 2001).

Wiegmann et al. (2004) defined “management involvement” as “the extent to which both upper- and middle-level managers get personally involved in critical safety activities within the organization.” Managers should attend and contribute to safety seminars and training, demonstrate active oversight of critical operations, and be aware of the risks involved in everyday operations. Further, they should understand the chain of communication not only among fellow management but “up and down the organizational hierarchy.”

## Organizational Commitment

Commitment is established when an organization's board and senior management prioritize safety in decision making and ensure the allocation of adequate resources to safety.

## Adequate Resources

The Oregon OSHA safety accountability process addresses the issue of resources. Oregon OSHA's belief is that it is imperative for management to support safe working conditions and positive attitudes toward safety culture by allocating time and money to "tools, equipment, machinery, materials, personal protective equipment, chemicals, workstations, air quality, noise, lighting, and other environmental conditions" (Occupational Safety and Health Administration, Oregon Chapter, 2005). In addition to physical resources, management also needs to provide psychosocial resources to foster a supportive environment in which employees can gain the knowledge and skills they need to contribute in a meaningful way to a positive safety culture. This component is sometimes subsumed under organizational commitment.

## Organizational Learning

"One of the greatest challenges in changing a culture is to develop a learning organization that will be able to make its own continual diagnosis, and self-manage whatever transformations are needed as the environment changes" (International Atomic Energy Agency, 2002). Peter Senge gained widespread popularity with *The Fifth Discipline: The Art and Practice of the Learning Organization* (1990). According to Senge, learning organizations are those in which "people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning to see the whole together." He said that only those organizations able to adapt quickly and effectively will be able to excel in their field or market. Two conditions are essential: (1) the ability to design the organization to match the intended or desired outcomes, and (2) the ability to recognize when the initial direction of the organization will not lead to the desired outcome and adjust accordingly (Senge, 1990).

Meacham (1983) noted, "organizations with a greater capacity for learning are those that maintain an open mind and a sense of curiosity, accepting that there is always something to learn because of the uncertainties, complexities, and fluidity of their environment. These organizations are neither overly confident nor overly cautious in their pursuit of knowledge, since the former implies they have learned all there is to learn and the latter does not lend itself to innovation. Flexible thinking is important in understanding error causation, since

the confluence of factors creating error-prone situations can continuously reconfigure itself" (Meacham, 1983).

Joseph Carroll (1998) defined organizational learning as taking place "through activities performed by individuals, groups, and organizations as they gather and digest information, imagine and plan new actions, and implement change." Levitt and March (1988) presented the concept of organizational memory in their work on organizational learning. They explained that repetition and documentation of learning processes maintain consistency "despite the turnover of personnel and the passage of time. Rules, procedures, technologies, beliefs, and cultures are conserved through systems of socialization and control. Such organizational instruments not only record history but shape its future path, and the details of that path depend significantly on the processes by which the memory is maintained and consulted" (Levitt and March, 1988).

Chris Argyris and Donald Schön have also made significant contributions to organizational learning with their work on theories of action and single-loop and double-loop learning. With respect to theories of action, they made a distinction between "theories-in-use," which are those implicit in what we actually do, and "espoused theories," which are those on which we call to describe our actions to others (Argyris and Schön, 1974). With respect to single-loop and double-loop learning, Argyris and Schön posited that learning involves the detection and correction of error. When there is an error, most people will initially look to fix the problem within the same "governing variables"—norms, policies, and objectives. This is single-loop learning. An example often used is a thermostat that reads the actual temperature, compares it to the desired temperature, and turns the furnace on or off accordingly. Double-loop learning involves seeking solutions by questioning the original governing variables (Argyris and Schön, 1978). Argyris focused on how organizations can increase their capacity for double-loop learning, which he argued is necessary if practitioners and organizations are to make informed decisions in rapidly changing and often uncertain contexts (Argyris, 1990). Argyris and Schön created and manipulated two models that describe features of theories-in-use that either inhibit or enhance double-loop learning (Argyris and Schön, 1996).

Argyris (1976) provided two examples of double-loop learning: the first is that of a teacher who believes that she has a class of "stupid" students and who will communicate expectations such that the children behave stupidly. She confirms her theory by asking them questions and eliciting stupid answers or puts them in situations in which they behave stupidly. The theory-in-use is self-fulfilling. Similarly, a manager who believes that his subordinates are passive and dependent and require authoritarian guidance rewards dependent and submissive behavior. He tests his theory by posing challenges for employees and eliciting outcomes that exhibit the employees' dependency. In order to break this congruency, the teacher or manager would



need to engage in open-loop learning in which they deliberately disconfirm their theory-in-use of stupid students or passive and dependent subordinates. Instead they might change their theory-in-use expectations to intelligent students and active, independent, and self-starting subordinates and observe the results. This would be double-loop learning. A more practical example is the kind of divergent thinking and action that led scenario-planning teams at Royal Dutch Shell to anticipate both the demise of the Soviet Union and the resulting fall of oil prices during the mid-1980s well before the rest of the world could even imagine them. Shell saved huge amounts of money by reducing the capital required to develop a large North Sea oil field in order to stay competitive when oil prices fell by waiting until the price drop occurred to go forward with its North Sea oil field acquisitions. The Shell planners happened upon this strategy by asking questions such as, “What would have to be true for the Soviet Union to begin increasingly to sell its oil in Europe?” One answer was that such an event could occur if a political unknown named Mikhail Gorbachev became premier. Shell managers had noticed the rise of Gorbachev and had begun to see possibilities further down the road. This enabled them to solve the problem of how to make extracting expensive oil from the North Sea good business (Dooley, 1999).

In the work of Aase and Nybø (2002), two perspectives on organizational learning were presented: (1) the model-based perspective, and (2) the human inquiry perspective. Table A-4

illustrates characteristics of model-based and human inquiry perspectives on organizational learning.

### Reporting System (Reporting and Visible Action Taken on Reports)

As Reason (1997) said:

*On the face of it, persuading people to file critical incident and near-miss reports is not an easy task, particularly when it may entail divulging their own errors. Human reactions to making mistakes take various forms, but frank confession does not usually come high on the list. Even when such personal issues do not arise, potential informants cannot always see the value in making reports, especially if they are skeptical about the likelihood of management acting on the information. Is it worth the extra work when no good is likely to come of it? Moreover, even when people are persuaded that writing a sufficiently detailed account is justified and that some action will be taken, there remains the overriding problem of trust. Will I get my colleagues into trouble? Will I get into trouble?*

Of particular importance is having near misses or close calls formally reported to the organization. A near miss or close call is an incident that could have caused the organization to suffer serious injuries or fatalities but by chance did not. Such an incident may reveal a vulnerability that has not been adequately addressed. It may be considered a free pass to prevent a future catastrophic event. Near misses and close

**Table A-4. Perspectives on organizational learning for high reliability (Aase and Nybø, 2002).**

MODEL-BASED PERSPECTIVE	HUMAN INQUIRY PERSPECTIVE
Focus on information processing and dissemination	Focus on participation and collaboration
Syntactic information	Semantic information
“Simple” information	“Sticky” information
Lean information	Rich information
Explicit knowledge	Tacit knowledge
Closeness (individually based)	Socialization (sharing of tacit knowledge)
Internalization (tacit remains tacit)	Externalization (from tacit to explicit)
FORMAL MEANS	INFORMAL MEANS
Focus on codified knowledge	Focus on knowledge in practice
Procedure and requirement handbooks	Informal contacts/personal networks
Knowledge/experience databases	Personnel rotation
Written experience reports	Seminars/courses/meetings/forums
Formalized networks	Professional networks
Systematic experience-collecting efforts	Dialogue-based case studies
Job descriptions	Training programs

calls, however, are frequently not reported in organizations without a strong reporting culture.

### **Safety Policies, Procedures, and Rules**

Safety policies, procedures, and rules must be practical, realistic, and appropriate to the environment in which they are applied. They must reside in the minds of a transit agency's employees instead of just in books sitting on shelves. There should be no bureaucratic or unnecessary rules (International Civil Aviation Organization, 2005).

### **Training**

Training may be seen as the means by which the sum total of what an organization has learned from the date it was founded to the present day may be conveyed to succeeding generations of employees. Too often, however, training requirements are not fully understood. Also, it is not uncommon to have training budgets cut when financial pressures are severe simply because the results of such cuts will not become evident until a few years after the cuts are made. In many transit agencies, on-the-job training is the primary method of training, with little thought or discipline injected into the process. There are no job analyses defining required competency levels and the necessary path to them. Adequate training is essential to safety and safety culture in an organization (International Civil Aviation Organization, 2005).

### **Trust**

The Institute of Nuclear Power Operations recognizes that in order to maintain a positive safety culture, a "high level of trust is established in the organization, fostered, in part, through timely and accurate communication. There is a free flow of information in which issues are raised and addressed. Employees are informed of steps taken in response to their concerns" (McConnell, 2010).

### **Union–Management Relations**

In organizations in which there is union representation, the union's involvement in the safety processes—both initially and continually—is "an absolute critical success factor" (Galloway, 2010). One example of a union/management success story is Hamilton Standard's aerospace manufacturing division's joint union/management task force, created in 1995 to achieve ambitious safety goals. The task force conducted a series of joint meetings and perception surveys and undertook to build trust between the two parties. As the initiative proceeded, the organization was divided into safety teams that became the heart and soul of the safety process. Culture Change Consultants (2006)

stated that, from 1995 to 1997, the lost workday case rate went from 18.8 to 5.17, total recordable accidents went from 6 to 4.3, and the lost workday injury rate went from 1 to 0.68.

Another example of successful union–management collaboration leading to significant safety progress was at Alliance Energy (AE) in the Midwest. Management from AE and leadership from the International Brotherhood of Electrical Workers locals collaborated to create a campaign to work toward 100% fall protection. Union and management leadership involved employees from the start, creating teams to evaluate safety harnesses and straps. Once the equipment was selected, and after researching rollout strategies from other, similar companies, teams recruited volunteer employees who would communicate with and train workers in the use of the new equipment. A safety official at AE said, "the success of this program has a direct relationship to the company and union's commitment to employee safety" (Severson, 2011).

### **Union and Management Leadership Changes**

A difficult test in maintaining an organization's safety culture is leadership transition. If the culture is strong and deeply ingrained, deterioration is less likely. Although extensive research on this topic as it relates to transit does not exist, there are examples in non-peer industries that demonstrate successful transitions with retention of established core values and culture.

Companies such as Southwest Airlines demonstrate that when a culture is ingrained in the people and processes of the organization, changes in leadership can occur with minimal long-term effects on that culture. Southwest Airlines incorporates "relational coordination" in the systems approach, which enables employees to more effectively coordinate their work with one another and encourages shared goals, shared knowledge, and mutual respect. Because the culture is accepted and institutionalized by employees, new leaders in management and in the union have embraced it. As a result, the organization continues to benefit, being the only airline in the industry to achieve profits for 37 consecutive years and being named one of the best places in the country to work year after year (Gittell, 2005). Organizations like Southwest, however, have to guard against complacency, as Southwest's recent fuselage rupture problems have illustrated. (Southwest Airlines was fined for continuing to fly dozens of Boeing 737s that had not been inspected for fuselage cracks; FAA, 2008).

At Hamilton Standard, the management team changed following a corporate merger (to Hamilton Sundstrand). Throughout that transition, safety teams maintained the integrity of the system, which produced positive results for the organization. For years after the leadership change, the company continued to improve its safety performance and maintain adopted safety practices (Culture Change Consultants, 2006).

In order to sustain a positive safety culture, a company needs to focus collectively on vision, policy, and individual and organizational roles. These roles are essential to the systems being executed and implemented. “A strong feature of positive safety culture over time lies in the integration of safety culture into the business. This promotes the independence of culture from individuals or personality. Culture is then supported by system activities owned and shared by all employees and develops into something larger than the sum of the individual culture” (Taylor, 2010). It is this process that Taylor believes sustains safety culture regardless of personnel or structural changes at any level within the organization.

### Component Confusion

Components are also referred to as attributes, dimensions, elements, and indicators. Moreover, considerable overlap exists—for example, organizational commitment is sometimes understood to be made up of management commitment, company policies and procedures, and the provision of adequate resources. In other contexts, management commitment and organizational commitment are considered to be separate and equal components. Union–management relations and employee involvement also have obvious overlap, as do the concepts of recognition and reward. Recognition and reward are categorized variously as organizational learning and accountability. With reference to disciplinary systems, accountability overlaps with just culture. Training is sometimes considered to be part of organizational learning and sometimes stands on its own (Clarke, 2000).

### Assessing Safety Culture

Numerous methods are available for assessing an organization’s safety culture. The most common are direct observation or audits, surveys, interviews and focus groups, and performance indicator tracking.

### Direct Observation and Audits

Direct observations of workplace behavior may provide objective information regarding the effectiveness of training, management, accountability, and behavior expectations. Direct observation of employees at work can also provide valuable information on involvement, attitude, and willingness to confront perceived unsafe behavior. However, observations cannot be quantified and used for statistical purposes, and there is always the risk of overgeneralization from too few observations. (EFCOG/DOE, 2009). Conducting sufficient observations to produce an accurate assessment of the state of safety culture will be time-consuming and expensive.

Safety audits are a form of direct observation and can provide the basis for improving safety performance. Blair and O’Toole (2010) noted that several large organizations “report anecdotally that . . . audit results correlate strongly with reductions in injury rates.” They recommended Manuele’s risk score formula as a suitable tool to estimate risk levels and establish measurement priorities. The three-dimensional matrix assesses risk on the basis of probability, frequency of exposure, and severity of accidents or incidents. “Measuring safety performance is about developing the safety management systems and the related safety culture” (Blair and O’Toole, 2010). Petersen’s caveat (that there is little correlation between audit reports and injury records in large companies because audits are generally as much about paperwork and regulatory compliance as they are about the effectiveness of a safety program) applies (Petersen, 1996).

### Surveys

There are numerous benefits to safety surveys; Blair and O’Toole (2010) stated that “surveys provide a snapshot of an organization’s culture and can be a useful tool in developing measures to drive culture.” They argued that well-designed surveys provide benefits to an organization. They are:

- Practical. They address the primary safety issues. Even if the issue is one of perception, perceptions are real to those who hold them and must be addressed.
- Predictive. They fulfill the definition of what a leading indicator is supposed to do.
- Prescriptive. The results generally indicate clearly what needs to be addressed.
- Proactive. They are preferable to accident investigation, which is a reactive measure (Blair and Spurlock as cited in Blair and O’Toole, 2010).

Safety culture assessments are considered tools to detect management blind spots in safety culture. Research has shown that views of management and frontline staff vary. The differences can be instructive. Questionnaires can be designed to explore a specific dimension of safety culture. Other advantages of safety culture surveys are their ability to reach large numbers of employees at relatively low cost, the retention of anonymity by responders, the identification of problems and issues, and the ability to track progress over time using successive surveys.

### Interviews and Focus Groups

Interviews also can play a significant role in the assessment of safety culture. They can be used to develop information directly on the state of safety culture in an organization.

Alternatively, they can be used as a means of providing input to survey design or to explore issues in greater depth that have emerged from a survey. An advantage of interviews is that respondents are not limited by the wording or structure of a written survey. An interviewer is flexible and can drill down until an issue or problem is fully clarified and ambiguity resolved. However, generalization becomes a problem if the interviews are limited in number: it must be remembered that the employees interviewed do not necessarily speak for the whole organization. It is generally prohibitive to gather a large sample; as with direct observation, interviews grow to be time-consuming and expensive (EFCOG/DOE, 2009).

Focus groups are more efficient but less flexible than individual interviews. The efficiency derives from the fact that one interviewer can elicit the views of multiple employees in a single session. Flexibility is somewhat reduced because generally the interviewer uses a set of prepared questions to provide basic organization and direction. A significant downside to focus groups is that, without a skilled facilitator, a minority of participants can dominate a discussion and provide input that might differ significantly from the results obtained from individual interviews with all members of the group (Cox and Cheyne, 2000).

## Key Performance Indicators

While management practices can promote positive safety practices, safety indicators can also help leaders determine other organizational goals and objectives. For example, the “General Manager of the Bahrain National Gas Co. uses safety performance indicators to develop corporate objectives, ensuring financial resources and manpower are available to meet or exceed safety standards” (Froetscher, 2011).

Many aspects of safety culture are not visible, so assessment is not a simple task (Ahmed, 2011). Metrics must be directional, hold individuals accountable, relate to injury reduction, and be highly motivational (Blair and O’Toole, 2010). The Blair and O’Toole research shows that lagging indicators alone do not address or contribute to improvements in safety culture. (Lagging indicators are measures of past performance; leading indicators indicate future performance.) Metrics used to assess safety and safety culture should include a combination of leading and lagging measures; lagging or trailing measures alone are not effective indicators. As previously noted, Blair and O’Toole (2010) maintain that “leading indicators serve as a catalyst for change, meaningful metrics are motivational for both employees and management, and leading indicators ultimately drive safety performance” (Blair and Spurlock, 2008).

In an interview with *Safety + Health*, Harold Yoh III, listed among the magazine’s “2011 CEOs who get it,” said that his company, which does engineering, construction, and maintenance of nuclear plants, “religiously measures and reports

our safety results as we work toward our goal of zero injuries and safety incidents. One of our most important measurements is tracking off-the-job injuries, which helps determine how well we are building a robust safety culture that is 24/7, not just on the job. We believe the true challenge is to go beyond the standard regulatory requirements and track the leading indicators that determine the ultimate success of our safety program” (Froetscher, 2011).

There are a number of accepted means of measuring and assessing progress in safety management systems, both qualitative and quantitative. Many sources cite employee surveys and questionnaires and face-to-face interviews as ways to capture information. Wiegmann et al. (2004) suggested that combining qualitative and quantitative methods will yield a comprehensive understanding of safety culture, but they went on to say that “quantitative approaches, especially surveys of individuals’ responses, are often more practical in terms of time and cost effectiveness.” While surveys and interviews are widely used, specific metrics are being developed in some industries to measure safety in a more quantitative way. In the aviation industry, for example, the Volpe Center is working with the FAA to create a runway incursion severity calculator that will categorize the outcome severity of runway incursions (Volpe Center Highlights, 2009). In the chemical industry, the Center for Chemical Process Safety recommends that “all companies and trade associations collect and report the three lagging metrics: Process Safety Incidents Count, Process Safety Incident Rate, and Process Safety Severity Rate” (Center for Chemical Process Safety, 2011).

“While many safety executives understand trailing measures, such as trend analysis, control charts and evaluating the effectiveness of safety initiatives, these measures oftentimes do not provide feedback for continuous safety process improvement, nor do they contribute to the development of safety culture. Positive safety culture remains unaffected when the above measures are the primary focus for metrics in an organization” (Blair and O’Toole, 2010). The practice of developing leading measures and concurrent measures using qualitative metrics for system and employee behaviors was noted by Toellner (2001), who studied the oil industry. Five specific measures were scored for quality and quantity: safety meetings, housekeeping, barricade performance, job safety analysis, and safety walks. Employee engagement is key to any safety management process. Blair and O’Toole provided an example of a large brewery where employees use individual score-carding activities such as:

- Observation cards,
- Job safety analysis (training and auditing),
- Safety meetings and safety audits,
- Maintenance walkthroughs, and
- Pre-shift stretching.

Safety culture assessment is a critical component of safety culture improvement. Measures should be well thought out and relate to industry standards. Blair and O'Toole (2010) offer six critical and effective guidelines for implementing safety measures:

1. Customize measures specifically for individual sites,
2. Use risk assessment to prioritize safety measures by severity,
3. Simplify by limiting the total number of safety measures used at any time,
4. Engage employees meaningfully in the development of safety measures and related safety goals,
5. Use a thoughtfully chosen mix of performance and outcome measures, and
6. Design measures to specifically influence the safety culture.

## Major Conclusions

The review of the relevant safety culture literature led to the following conclusions:

### Definition

The literature contains scores of different definitions of safety culture. Of those cited in this review, Reason endorsed two in lieu of formulating a definition of his own.

The Uttal definition: “safety culture is shared values (what is important) and beliefs (how things work) that interact with an organization’s people, structures, and control systems to produce behavioral norms (the way we do things around here).”

The UK Health and Safety Commission definition, which says safety culture is “the product of individual and group values, attitudes, competencies, and patterns of behaviour that determine the commitment to, and the style and efficiency of, an organization’s health and safety programs. Organizations with a positive safety culture are characterized by communications founded on mutual trust, by shared perceptions of the importance of safety, and by confidence in the efficacy measures.”

The Uttal definition is echoed in current federal government definitions.

- The Department of Energy says a safety culture is an “organization’s values and behaviors, modeled by its leaders, and internalized by its members, that serve to make safe performance of work the overriding priority to protect the public, workers, and the environment” (EFCOG/DOE, 2009).
- TRACS defines safety culture as “the product of individual and group values, attitudes, perceptions, competencies, and patterns of behavior that can determine the commitment to and the style and proficiency of an organization’s safety management system” (Transit Rail Advisory Committee for Safety, 2011).

- The FRA defines organizational culture as “shared values, norms, and perceptions that are expressed as common expectations, assumptions, and views of rationality within an organization and play a critical role in safety.” It notes that organizations with a positive safety culture are “characterized by communications founded on mutual trust, by shared perceptions of the importance of safety, and by confidence in the efficacy of preventive measures” (U.S. Federal Register, 2012).

## Theories and Models

Safety culture is complex and multidimensional. And while there are numerous theoretical models of safety culture in the literature, there was no consensus arrived at as to the quality or effectiveness of any one model. Of the models discussed, the most elaborate and sophisticated is the Reason model, which benefits from Reason’s practical experience. This model’s best fit in terms of guidance and explanatory power is probably bus and light-rail transit agencies.

The DuPont model is also impressive because of the extensive amount of data that was employed to verify the inverse relationship between the degree of strength of safety culture and the OSHA recordable injury rate. It is of interest to note that the Reason and DuPont models differ in that Reason is primarily concerned with frequently catastrophic “organizational accidents,” whereas the DuPont model is directed at “individual accidents” as reflected by the OSHA recordable injury rate. The research team has reconciled this seeming difference by concluding that most of the measures employed to protect against organizational accidents would also contribute to the reduction of an excessive number of individual accidents.

In terms of the use of a model to obtain a “quick-and-dirty” evaluation of the state of safety culture in an organization, the Parker matrix, which is based on the original Hudson model, is an interesting, if not exacting, approach and probably has value for preliminary assessments.

The HRO model places a special premium on positive safety culture and possesses special attributes that help identify potentially dangerous safety behaviors. HROs are recognized as having extraordinary technical competence, flexible decision-making processes, sustained high technical performance systems, and processes that reward the discovery and open reporting of errors or potential errors. These organizations value safety equally with production demands and organizational commitment to sustaining institutional culture. They place a substantial value on organizational learning, expertise, and the promotion of a questioning environment in which the revelation of potential safety issues can be recognized and appreciated. HROs tend to be preoccupied with failure and share a collective mindfulness that leads to learning from mistakes and the continual analysis of information gained from near misses and other leading indicators that have proven to be predictive of potential safety issues. They believe that complacency leads to vulnerability

and puts the organization at risk. Given that the potential for disaster, the potential loss of a critical societal function, and the extent of reliance on advanced heavy-rail technology at the largest U.S. transit agencies is similar to circumstances found at HROs, adoption of the HRO model by the large transit agencies that operate heavy rail might be considered. Several presenters suggested this idea at the NTSB February 25, 2010, hearing on the WMATA 2009 accident (Hartley, 2010; Roberts, 2010).

### Safety Culture Versus Safety Climate

For purposes of this project, the research team has treated safety climate as a snapshot in time of an organization's safety culture (Krause, 2005). This view is consistent with that of Wiegmann et al. (2002), who conclude that safety climate is "a temporal indicator of a more enduring safety culture."

### Sets of Components of Safety Culture

As is the case with safety culture and safety climate, there is no convergence in the literature on a single set of components of safety culture. The number of components in a set and the identity of those components vary significantly from one example to another. Previous attempts to establish a universal set (e.g., Clarke, 2000) have not been successful.

Based on the research, the most common threads are:

- Maintaining safety as a core value;
- Requiring strong leadership and management commitment;
- Enforcing high performance standards;
- Providing adequate resources for safety;
- Empowering individuals at each organizational level to be responsible for safety;
- Involving unions continuously in safety process (where employees are unionized);
- Emphasizing learning, education, and training;
- Ensuring open, honest, and effective communication within the organization and encouraging a questioning environment;

- Maintaining an effective reporting system, with visible action taken on issues reported, and ensuring timely responses to safety concerns and safety issues;
- Using leading and lagging safety indicators to gauge the effectiveness of safety programs on employee behavior;
- Demonstrating leadership behaviors that encourage mutual trust between management and employees;
- Monitoring performance continuously; and
- Treating employees fairly.

The lack of a common set of components could be interpreted to indicate that (a) safety culture is a multifaceted phenomenon consisting of scores of contributing components, (b) the prominence of any given component in a specific safety culture is dictated by the dominant circumstances of the environment in which that culture exists, and (c) the safety culture phenomenon accordingly presents many different faces, thereby making promulgation of a universal definition and description difficult.

### Assessment

There are many ways to assess the state of safety culture in an organization. Direct observation over a long period of time by a team of individuals who are safety culture experts is certainly an excellent method. However, this approach is time-consuming and expensive. The experts, for example, have to remain on-site long enough for their presence on the property to be taken for granted and for behavior to revert to the norms that obtained when agency personnel were unobserved. Also, unless performed by the same group of experts at successive properties, direct observation does not lend itself to accurate agency comparisons. The standard safety audit usually does not last long enough to produce the equivalent of unobserved behavior. Some mix of interviews, focus groups, and surveys is likely to be more economical in terms of time and expense. The least expensive but also least effective method would be the use of leading performance indicators.

## APPENDIX B

# Transit Agency Mini–Case Study Detail

### Transit Agency Descriptions

#### Transit Agency A (No Union; Small)

Safety culture is on a positive track and probably now at its highest point.

Safety is the number-one emphasis, even if it means that employees and supervisors have to interrupt schedules.

Management believes safety is a “moving target”—“the only way you are going to keep up with it is to continue to move with it.”

The current positive safety culture is attributed to:

- A comprehensive training program emphasizing safety,
- Top leadership commitment,
- Employee involvement through joint safety and training committee work,
- Using data for safety decision making,
- An operator review program,
- New technologies that enhance safety, and
- External safety audits.

After a series of pedestrian accidents, the focus on safety assumed new urgency. Employees still remember these accidents as shocking experiences that affected “everyone, from serviceperson to operations to the top managers.” Some operators stopped working for a while, and some simply quit. “That really started the great emphasis on safety at all times,” a manager said. “It’s in the back of my mind when someone is not following the safety procedures.” Employees started to brainstorm how they could prevent such accidents.

Since then, drivers have been retrained, strobe lights for turning movements installed on the entire fleet, and audible signals sounded during right-turn movements on 60-foot buses. A campaign encouraging pedestrians to use crosswalks and look both ways before crossing the street was also implemented.

On the maintenance side, the safety culture is considered to be very strong. Maintenance employees identify safety hazards on a daily basis. Management maintains an open-door policy on safety issues and addresses issues immediately.

#### Transit Agency B (Medium)

Following a series of pedestrian collisions, the agency launched a renewed effort to advance its safety culture in order to arrive at lower customer and employee injury rates.

A recent internal survey shows that safety culture is considered by management to be positive. Contributing to building this culture are:

- Top leadership commitment,
- A no-blame culture,
- Employee participation,
- Extensive safety training,
- Near-miss reporting system in rail,
- Data-driven safety decision making,
- Implementation of new technologies, and
- A sense of vulnerability about safety and the importance of being diligent at all times is conveyed throughout the organization.

The union sees a significant deficiency in the agency’s handling of operator safety issues. Assaults on operators are up, especially around holidays, resulting in a high volume of operator absences.

#### Transit Agency C (Small)

There is an overall positive safety culture that struggles to balance pragmatic considerations of operations and cost, a history of mistrust, and an expressed desire to improve conditions and outcomes.

In the organizational work environment and on the part of leadership, there is an open commitment to safety as a top priority; “no conflict on operations—safety trumps everything, even if a customer complains.”

On the whole, management and labor agree that, while not perfect, the safety culture has improved compared with its state a few years earlier, when there was a notable lack of willingness to take personal responsibility.

Key factors contributing to this positive safety culture include:

- Top management commitment and especially openness on the part of the COO;
- Reduction of blame and liability as motivators for safety, with less intimidation of operators; and
- The role of key individuals in spearheading aspects of the program and thinking creatively about communications, metrics, and incentives.

The current safety culture incarnation was generated following a series of serious accidents involving pedestrians. In response to public scrutiny, top management stepped up to identify problems and improve conditions. When assessing and responding to public concern about the accidents, with the input of a community advisory board, the agency identified more than 60 initiatives to improve the safety of workers and the public.

There is still a need for “reiterating the basic safety culture principles and reinvigorating the program.” Some initiatives are seen as having lost momentum.

Not all are on board, and, by playing down safety, they may influence others. This may be attributed to a history of conflict and mistrust at the agency.

To some the organization is safety-minded “almost to a fault.” Hourly workers may feel that some initiatives go overboard and ignore practical aspects of operations. Less attention is paid to worker health, including ergonomics and musculoskeletal disorders, and conditions that might affect vehicle and passenger safety, such as fatigue, lack of sleep, and the impact of split shifts.

### **Transit Agency D (Large)**

Management considers safety to be ingrained in organizational culture, especially in operations. Safety receives significant support from top executives in the form of policies and resources.

The commitment to safety is reflected in the continuing operation of joint safety committees at all operating bases when a number of other joint committees had to be eliminated due to declining funding.

The safety program is a bottom-up program driven by the employees, primarily transit operators. According to a safety

officer, employees “make great use of the safety incident reports, and they have always been vocal through communication channels on what they feel is safe and unsafe. One of the strengths of this agency is this bottom-up leadership from the drivers about safety.”

Constrained budgets continue to pose a dilemma. It “makes it harder for companies to keep the necessary investments in things that don’t pay off instantly but surely have a long-term payoff like safety and training.”

The union’s perception of safety culture is mixed. Some feel that vehicle safety is recognized as an organizational priority and that operator safety training is strong. Others say that safety culture has been “difficult and challenged” and that “there is a level of laissez-faire where rules are not enforced due to fear of stepping on toes.” Management is sometimes seen as not providing adequate responses to operators who express concerns and not sympathetic to union concerns—for example, on vehicle design. Another problem union representatives identified is that when the budget gets tight, the agency tends to hire more part-time employees with a higher turnover rate and higher accident rate. Efficiency sometimes takes precedence over safety and service, and the personal safety and health of operators can be compromised when the pressure to be on time is high. The operators hope to receive better training on customer relations, especially in dealing with difficult customers who may create hazardous situations. Recently, however, the union has seen some improvement in management’s approach to safety issues, and the union’s concerns are taken more seriously with the installation of a new safety officer.

### **Transit Agency E (Large)**

Managers feel that safety is taken exceptionally seriously in bus and rail operations and in maintenance. Top management shows a commitment to safety by “making it clear at the beginning of the day that safety is at the top of the list of priorities.”

Senior managers from rail consider the safety culture in their divisions to be very strong. The rail operation is trying to steer away from “the command-and-control environment.” Relentless safety training, frontline worker participation through open feedback and joint committees, and a recently implemented confidential near-miss reporting system bringing together labor and management interests are cited as key contributors to the positive safety culture.

Labor representatives view the culture of safety in rail as “in the middle” but say that it “has come a long way.” Before, safety policies and rules were seen as forced on workers, and primarily as a tool for disciplinary actions. In more recent years, “[management has] been more inclusive in form-



ing safety committees. Employees can bring issues up to management.”

The union representatives rank safety culture in the bus division as “pretty strong,” particularly in terms of management encouraging union members to participate in safety activities. However, management senses a general lack of trust between labor and management, which may have deterred employees from reporting certain unsafe behaviors of their peers, such as using a cell phone while driving.

### **Transit Agency F (Medium)**

Safety is an important organizational priority—built into all levels of training and reinforced by systems of safety committees, periodic safety reporting and reviews at all levels, and employee surveys.

Leadership is strong on the part of agency executives and union leaders. The priority of safety is reinforced in interactions with all employees.

Safety statistics are required as part of periodic reports (monthly, quarterly, annual) and internal reviews. There are system-wide safety committees for bus, rail, and maintenance that include union representatives.

Employees are expected to interrupt work to ensure that safe conditions are in effect. In practice there is pressure for service schedules to be maintained, particularly in rail operations, where holding up one vehicle can result in holding up an entire line. That pressure is less evident in bus operations and in maintenance.

Union leaders see the need for a greater emphasis on safety and for greater engagement by frontline employees in identifying and correcting actual or potentially unsafe conditions. Union leaders report that safety problems identified by union members may or may not be addressed. They see the system as needing to be more oriented to identifying hazards and improving risk profiles in advance of incidents. They claim that frontline worker input is not sought out in developing safer procedures and practices. They see the safety committees as operating at a high organizational level but not always responding to issues identified by frontline workers. In rail operations in particular, the union feels that maintaining the schedule often takes precedence over solving safety problems. The union reports that frontline workers can sometimes resolve safety hazard issues directly with their supervisors, although this is reported to be more likely in maintenance than in rail or bus operations.

### **Transit Agency G (Small)**

Management considers safety culture generally positive but in need of improvement. Maintaining a safety culture

requires vigilance and ongoing commitment. The work will never be done.

Safety culture is transparent to all employees. Initiatives are driven top down and bottom up to help reinforce various aspects of the safety culture. Emphasis is not just on vehicle operation safety but also on workplace safety in maintenance, facilities, and administrative functions.

Top management believes that safety campaigns are necessary but that safety culture runs much deeper than campaigns, slogans, and posters.

Following a serious pedestrian accidents, the agency responded immediately to address system problems revealed by the accident investigation and implemented a number of measures to make operators more aware of surroundings, particularly pedestrians at intersections and crosswalks. It focused on annual operator retraining, onboard messages to provide safety tips, and message boards at dispatch to scroll safety metrics, messages, and statistics on performance. The idea is that operators can see them when they pick up their information.

The union rates the safety culture as fair. Scheduling of service and operator involvement in problem solving are cited as two major areas of improvement the union hopes to see.

According to some union members, drivers constantly feel caught between the pressure of on-time performance and the emphasis on safety, especially when budget cuts result in tighter schedules.

In maintenance, the union and management concur that the safety culture is strong, and that belief is confirmed by an excellent record. The top operations manager conducts semi-annual base inspections and believes that safety starts with the employees. Ample lighting, proper tools, and an emphasis on preventive maintenance all contribute to keeping the shop and employees safe.

### **Transit Agency H (Large)**

The general consensus is that a positive safety culture exists in the organization but that there are areas that need improvement.

A recent board resolution endorsed the concept of safety being the highest priority and recognized the importance of a positive safety culture—among other reasons, to help avoid the problems experienced by other transit agencies. That priority is communicated constantly to the workforce.

The new board initiatives lead the way in effecting safety culture improvements. An executive committee on safety initiatives has also been established, focusing on engineering improvements, educating the public, and enforcement. Special emphasis is also being placed on “controllable collisions.” Hitting fixed objects, hitting pedestrians with the front of the

bus, and running red lights are classified as events that should never occur.

The agency has traditionally used indicators such as the quality and quantity of safety reporting by employees and the results of safety audits and unannounced bus rider checks to estimate the state of safety culture.

A safety culture survey and regular group discussions with hourly operations employees indicate the presence of a positive safety culture.

Unsafe conditions, hazards, and near misses can be reported by employees using a standard form, which can be submitted anonymously. Upon receiving a completed near-miss form, department or division management is required to analyze the reported hazard or near miss, identify all of the factors involved, and develop recommendations for timely elimination or mitigation of the hazard or near miss.

All agree that workers would have no hesitation with respect to stopping work if they perceived that there was a hazardous situation, but no one could cite a formal procedure to that effect.

### **Transit Agency I (Medium)**

Safety is accorded the highest priority by top executives, the board, and the union. A separate board safety committee is planned to get the board more directly involved in safety.

The agency is a highly functional organization with a low accident rate and a good union–management relationship, but it does not pretend to be a zero-defects organization. The agency recognizes that people make mistakes but says, “just don’t make the same mistake twice.” Ninety-nine percent of the focus is on a proactive approach to safety.

The commitment to safety is organized from both the top down and the bottom up. Hourly employees take great pride in the quality of vehicles and are actively involved in all aspects of safety through joint teams.

Employees are deeply and actively involved in all aspects of safety and safety culture. The three main structures for this involvement are:

- Teams made up of management, supervisory, and hourly employees to determine root causes of vehicle and passenger accidents/incidents and to recommend steps to prevent a recurrence;
- Safety committees in each base with employee representatives; and
- Designation of an employee on each shift as the “safety captain” who assists management and supervision in ensuring a safe workplace and sits on safety committees.

The agency has a near-miss reporting program; there is no discipline associated with honest self-reporting.

There is a formal written procedure that directs employees to stop work or interrupt service if an unsafe condition arises. The procedure is part of general work practices and is covered in training. It also was addressed in a video by the CEO that was made as part of the recent safety rededication program and campaign. Examples are buses being taken out of service because of a threat of fire and fueling operations being closed down because of suspected faulty equipment.

## **Transit Agency Components**

### **Strong Leadership, Management, and Organizational Commitment to Safety**

Top leadership and mid-level management at the nine agencies are strongly committed to ensuring that safety is emphasized at all times. This is reflected not only in constant communication of safety messages but also in the dedication of adequate personnel and financial resources to ensure safe operations. Most CEOs and GMs at these organizations are personally involved in reviewing key safety indicators with safety and other senior managers on a regular basis. When it comes to managing safety responsibilities, larger agencies have a dedicated safety staff, while smaller agencies tend to have safety officers who also have other tasks, including training, risk management, and health. Board members, for the most part, serve a supporting role that helps reinforce safety culture. Employees are recognized as the ultimate safety champions across the case study locations. Table B-1 summarizes responses.

### **Employee/Union Shared Ownership and Participation**

Employee participation and engagement are pervasive among the best-practice agencies. The most commonly used structure for employee participation is a joint safety committee involving managers, supervisors, and frontline employees. In the agencies where there is union representation and where safety committees exist, all but one has union representatives on the committee. Many times, the committee chairperson and employee members are either appointed by the union leadership or elected by union membership. Other than the regular safety committees, ad hoc joint labor–management task forces have been established to address particular safety concerns, such as in the event of a significant safety failure. Even though labor is not typically involved in the initial accident investigation, a joint accident review committee is sometimes in place to validate findings. At the only nonunion agency, the employee–management committee structure has become a well-established norm. Employees participate in multiple committees, including safety and training, and their

**Table B-1. Leadership, management, and organizational commitment.**

Transit Agency	Leadership, Management, and Organizational Commitment
A	<p>Commitment to safety starts with the CEO and board and moves throughout the organization. It is demonstrated not only in “spoken words and posters, but also budgetary commitment.”</p> <p>The CEO and top safety and training manager assume distinct yet complementary roles in cultivating a positive safety culture. The CEO “cheerleads” and encourages the staff to keep safety at the forefront. The safety and training manager is provided with resources and tools and works directly with supervisors and frontline employees to ensure system safety.</p> <p>The company holds safety banquets and award dinners each year to recognize safety champions among employees.</p>
B	<p>The CEO and executive management team employ actions and practices to set the tone and climate for a visible commitment to safety through candid and consistent communication.</p> <p>Initiatives at the leadership level include:</p> <ul style="list-style-type: none"> <li>• Safety leadership training;</li> <li>• Quarterly management meetings;</li> <li>• An executive safety committee that meets monthly to review various statistics, including leading and lagging indicators and logs from hazard reports and the safety hotline; near misses (rail only) are submitted by employees and are also discussed, with an emphasis on addressing reported issues and implementing recommendations satisfactorily; and</li> <li>• Quarterly safety updates to the board and regional leader, with comprehensive data, including vehicular and employee injury rates.</li> </ul>
C	<p>The COO maintains a strong interest in and commitment to safety. The safety director was also recognized by management and labor as a key champion. Other staff in human resources and administration contribute ideas for improving safety communication.</p>
D	<p>Safety starts at the top, with the CEO, deputy GM, and senior managers, as well as the executive board members of the union. The CEO makes sure to keep communication open with the chief safety officer (CSO), who oversees a relatively large department.</p> <p>The rail side has additional safety personnel.</p> <p>The risk management unit is actively involved when problems arise and helps with passenger awareness campaigns using grant programs.</p>
E	<p>Safety responsibilities are embedded in the two modes. There is no corporate CSO. A director of risk management oversees any corporate-level safety initiatives.</p>
F	<p>The CEO is clearly seen as the top advocate for safety and safety culture. Since a serious pedestrian accident, the agency has moved to upgrade the CSO position and have that officer report directly to the CEO rather than to the COO, and the safety department is being reorganized. The agency’s goal for the new CSO will be for the officer to work him- or herself out of a job “by integrating safety into every person’s responsibilities.”</p> <p>The CEO receives and reviews quarterly safety statistics with all senior staff. There are weekly meetings with top bus and rail managers, and every month business unit managers meet with the CEO and COO and report on safety statistics, safety problems, and best practices.</p>

*(continued on next page)*

**Table B-1. (Continued).**

Transit Agency	Leadership, Management, and Organizational Commitment
G	<p>The agency has a check-and-balance system organizationally when it comes to safety.</p> <p>Reporting to the CEO are two deputy CEOs. While the vast majority of the operators and mechanics work under the deputy CEO for operations, engineering, and construction, where every employee's job is safety, the hard-line safety and security functions are the responsibility of the deputy CEO for safety. The deputy CEO for safety is given the authority to call a service stop when unsafe conditions are detected.</p> <p>The CEO and deputy CEO for operations advocate for a safety culture by providing tools, resources, and training—for example, making investment in bus simulators for annual recertification of operators. The safety officer is more conversant with the details, looking at specific cases or examples and grading accidents or examining the workplace for unsafe conditions.</p> <p>Top management stresses the need for “commitment throughout the organization from all levels—entry-level to the boardroom—and everybody has to be committed to safety.” This belief is carried out in the structure of a joint safety task force that meets every month and addresses safety issues primarily related to bus operations.</p> <p>The board is considered as playing a supporting role in creating a positive safety culture. It understands that safety is critical, and that is important in its deliberation of policies, particularly if resources are scarce. The board and CEO celebrate safety, conferring awards on deserving workers from both operations and maintenance.</p>
H	<p>The safety champions include the board, the CEO, the COO, the CSO, the executive officers for maintenance and transportation, and the local safety committee and subcommittee chairs.</p> <p>The CEO, the COO, and the chain of command have primary responsibility for safety and safety culture. The CSO acts as the eyes and ears for and provides direct staff support to the CEO in all matters pertaining to safety and safety culture.</p> <p>The chain of command and union leadership all understand and promote safety as the first priority.</p> <p>The board has exhibited strong leadership by passing a resolution that makes it clear that board members intend to play a significant role with respect to safety and safety culture.</p>
I	<p>The CEO and other top executives, the senior managers from each base, and the employee safety captains all regard themselves as safety champions.</p> <p>The CEO, the COO, and the senior managers in the bases have line/program responsibility for safety. The corporate safety officer provides oversight and staff support on safety but also oversees other functions, such as health and environmental compliance.</p>

voices are not only heard but also given serious consideration by management. In these organizations, employees become the frontline champions of the safety culture. By actively engaging in problem identification, fact finding, and problem resolution with their managers, employees feel empowered and motivated to take on personal responsibilities to ensure the safety of the system (see Table B-2).

### Effective Safety Communication

The best-practice cases demonstrate that communication is the principal means through which safety culture norms and expectations are transmitted to all employees and reinforced throughout the organization, thus establishing safety culture as an informed culture. The most successful communication of safety culture is consistent, frequent, and pervasive. As found in these best-practice cases, safety culture

communication is conveyed across multiple media—written, oral, and electronic. Successful communication is embedded in training, management directions, problem solving, and analysis of lagging and leading indicators. In this case, aligned safety communication is built into annual, quarterly, monthly, weekly, and daily interactions among employees at all levels. Safety is deeply embedded in general organizational interactions and in specific structures such as dedicated committees and through well-defined safety captain roles (see Table B-3 for summary of comments).

### Proactive Use of Safety Data, Key Indicators, and Benchmarking

Agencies with positive safety cultures use a variety of methods to improve safety performance for all employees, fostering an informed, learning, and flexible culture. Traditional

**Table B-2. Employee/union shared ownership and participation.**

Transit Agency	Employee/Union Shared Ownership and Participation
<b>A</b>	<p>A safety and training committee is in place to ensure employee participation in safety decision making. The committee is made up of full-time and part-time operators and supervisors who meet once a month with the director of safety and training.</p> <p>In maintenance, mechanics hold monthly safety meetings with the director. The committee members are elected by their peers to serve a 1-year term.</p> <p>Several committees operate much like the safety and training committee to engage employees. They include the route schedule committee, the policy and procedures committee, the social committee, the newsletter committee, the fitness committee, and the sustainability committee.</p> <p>Both managers and frontline workers believe that this type of structure is helpful. As a manager puts it, “communication within a transit system is very difficult because of the different schedules. Having that interaction with the employees is a good way to communicate.” Since the agency is a nonunion shop, this structure puts more emphasis on management to listen to and adopt feedback from rank-and-file employees.</p>
<b>B</b>	<p>Safety committees in each service district meet on a monthly basis to discuss any concerns. Hourly employees are included in these meetings and are encouraged to provide input. Items discussed during the district meetings are referred to the executive committee that meets once a month with a large number of participants. Each committee has a log of safety issues that it tracks, and one measure of achievement is the speed with which issues get resolved and taken off the log. Union representatives have been invited to both district and executive council safety meetings.</p> <p>There have also been ad hoc joint safety task forces when major safety problems were identified. For example, a union–management task force was convened to evaluate and reduce bus–pedestrian collisions that resulted from similar causes.</p> <p>A joint labor–management committee reviews performance statistics for 1 year and sets goals for the next year. Every employee can get a bonus if safety goals for preventable vehicle accidents and on-the-job injuries are achieved on a semiannual or annual basis.</p>
<b>C</b>	<p>Under the direction of the COO, bus operators were recruited for a period of 7 hours to assess the internal ergonomics of a new bus design. The union was not formally or systematically involved.</p>
<b>D</b>	<p>The agency institutes several layers of formal structures for employee participation in safety. At the top leadership level, a joint labor–management committee meets quarterly, bringing together senior local union officials and executive management. This is the opportunity for management and the union to raise broad issues, such as changes to vehicle design, to improve operator health and safety.</p> <p>Each operations base has a safety committee primarily staffed by a handful of bus operators elected by the union membership. Operators get paid time off to perform committee work. Representatives from base management, including one of the chiefs, attend the safety meetings. These committees are tasked with reviewing accidents and safety performance data and with being part of the process for making recommendations for corrective actions. Vehicle maintenance also has a labor–management committee within which safety issues are discussed.</p> <p>The base security committee meetings are structured much like those of the safety committee, the difference being that the transit police attend. These meetings are active and instrumental in helping communicate the concerns of the operators, and they provide an opportunity for police to offer drivers tips on making themselves safer operators.</p> <p>When specific problems arise, special committees or work groups are formed with representatives from the union and discrete sections within the agency to address and solve them.</p> <p>With recent accidents potentially caused by poor sight lines from the driver’s seat and other design issues, management and labor have mounted an intensified effort to address concerns about safety defects in equipment. Procurement of nonrevenue vehicles will soon follow the same process. “[Operators] will have a lot more input in safety.” The union helps push for solutions to many of these design and procurement problems and is actively involved in the discussion and fact-finding process.</p> <p>The agency holds an annual safety summit—“an effort to try to drive safety from the bottom up, with leadership from the top.” It is a self-managed work group, and the mission is to “excite colleagues and empower them to start thinking safety-wise.” Participants engage in role-playing games using subjects such as route qualifications and safety rules.</p>

*(continued on next page)*

Table B-2. (Continued).

Transit Agency	Employee/Union Shared Ownership and Participation
E	<p>At the corporate level, the top safety officer holds regular update meetings with the two safety managers as well as their union counterparts.</p> <p>In the bus division, each garage has safety committees for operators and mechanics. The business agent at each bus local union appoints the safety committee chairpersons, and management usually agrees to those choices. The chairpersons run the meetings on safety every month and are paid by the company for their time. Minutes are shared with management with regard to safety issues to be addressed. Certain concerns, such as operator safety and bathroom breaks, then go through negotiation. This structure has worked effectively for more than 10 years.</p> <p>On the rail side, cross-functional joint labor–management safety committees are used to identify and correct hazardous conditions and unsafe work practices. The committee members identify possible safety hazards at maintenance facilities, rail yards, terminals, and stations, along with rights-of-way and equipment.</p> <p>The committees also conduct monthly on-site inspections following the committee meetings and recommend corrective actions as required. The committee structure and process are detailed in the agency’s FRA-mandated Rail System Safety Program Plan. Any safety issue that cannot be rectified at the committee level is pursued through the senior manager of the division and the rail safety department. Senior management also makes a commitment to attend “at least one safety committee meeting (round-robin) just to make sure that things don’t get lost in translation.”</p>
F	<p>Bus and rail have safety committees that deal with problems as they come up. Membership on these two broad committees includes labor representatives.</p>
G	<p>The joint safety task force is chaired by the director of bus operations and consists of the top executive of operations, the transportation superintendents from both bases, the maintenance director, the safety officer, the training manager, the route planner, the union president or secretary-treasurer, and four to five bus operators.</p> <p>This joint forum was established over 15 years ago and continues to follow a congenial and rigorous process. Topics discussed include route planning, time points, road hazards, equipment, and any type of operator safety concerns. The process is taken seriously by managers and is considered by management to be a real part of the culture. It is a hands-on committee that drives concrete decision making and actions.</p> <p>The union considers the task force an effective way to involve employees in safety discussions: “Each party is given an opportunity on how to resolve issues. It is because of the cooperation and joint effort to bring the union in and have discussions relating to safety issues [that we have] created an environment where our issues are addressed.” To encourage employees to report safety issues and concerns, photos of individuals who are part of the task force are posted at the bases so that operators and mechanics know how to communicate with them when safety issues arise.</p> <p>Management considers the union to be its partner in safety. A manager describes the union role in the joint task force: “They encourage operators to report accidents immediately. We don’t have many conflicts in terms of safety. They are on the accident review committee to determine preventability of the accident and also on the joint training committee.” The union president also has access to data related to changes in training subjects or methods or safety concerns.</p> <p>In between the task force meetings, the agency encourages employees to report route and other related problems using a service change request form. According to a union representative, it is “a way to document those issues and get them to management so that those issues can be addressed.”</p>

**Table B-2. (Continued).**

Transit Agency	Employee/Union Shared Ownership and Participation
H	<p>The primary avenue for employee participation in safety is the local safety committee. The committees provide the primary means of coordinating safety activities at the local level. They are responsible for:</p> <ul style="list-style-type: none"> <li>• Reducing the number of injuries and incidents within the division or department; and</li> <li>• Verifying, via measurements, the degree of compliance with established safety policies and guidelines, implementing appropriate corrective action, and reducing the number of lost workdays due to injuries</li> </ul> <p>The chair of the committee rotates every 6 months between the transportation and maintenance division managers. Other members include the division assistant managers, corporate and division safety specialists, representatives of the local unions, the subcommittee chairpersons, and other local staff as needed. Non-division departments have an equivalent membership structure.</p> <p>The committees normally meet once per month at a regularly scheduled date and time and at a fixed location to review the status of local safety performance and safety programs and activities. Meeting minutes are e-mailed to members and posted on division bulletin boards to inform employees of committee activities.</p> <p>Committees use data analysis to:</p> <ul style="list-style-type: none"> <li>• Review accident and occupational injury data and implement strategies and programs to reduce workplace incidents,</li> <li>• Ensure that the subcommittees are analyzing all appropriate data/metrics and key performance indicators, and</li> <li>• Review subcommittees' programs and recommendations for improvements.</li> </ul> <p>The three subcommittees deal with injury and accident reduction, hazard identification and correction, and program activities and recognition. The chairpersons are normally assistant managers.</p>
I	<p>Teams are established to determine the root cause of bus and passenger incidents. The teams are made up of management as well as supervisory and hourly employees. The team goal is to analyze all the facts pertaining to the accident and to recommend steps to prevent a recurrence or, if recurrences cannot be absolutely prevented, to reduce frequency.</p> <p>Employee representatives are selected by management to represent fellow employees on the safety committees at each base. There are separate safety committees for maintenance and operations. Base managers appoint a minimum of two operators to the operations safety committee and appoint a separate representative from each shift for mechanics, service workers, parts clerks, and facility maintainers. Safety committees meet monthly. A representative from the health and safety department attends each of these meetings, reviews the meeting minutes, and ensures that all outstanding issues are addressed. The safety committee chairpersons are elected from the membership of each committee at each base. They may be coach operators, maintenance employees, or management. There are no restrictions. Any employee can initiate a review of rules that need to be changed by working through a safety employee representative.</p>

lagging indicators are used across the board and are vigorously analyzed and reported on throughout the agencies. Many are also used for standardized reporting to the NTD. They include:

- Preventable and nonpreventable accidents,
- Vehicle collisions (left or right turn, fixed object, vehicle, passenger, and pedestrian),
- Incidents, including near misses in several agencies, and
- Employee on-the-job injuries.

Some agencies consider leading indicators to be as important as the lagging ones, if not more so. However, there are

no consistent standards as to specific measures. The types of leading indicators used by such agencies include:

- Degree of employee participation in programs,
- Employee opinions on safety culture through stand-alone or integrated surveys,
- Quality and quantity of employee safety reporting,
- Percent closure of safety entries in reporting system,
- Walk-through and on-site inspections, and
- Safety audits—internal and external.

Many managers expressed frustration with industry benchmarking for safety performance because of ill-defined

**Table B-3. Effective safety communication.**

Transit Agency	Effective Safety Communication
<b>A</b>	<p>Safety expectations are communicated via a company intranet, bulletin boards, monthly newsletters, e-mails, and safety meetings at different levels of the organization, including weekly management meetings, monthly safety and training committee meetings, and quarterly all-hands meetings chaired by the GM.</p> <p>Management maintains an open-door policy and encourages employees to walk in any time safety issues arise.</p> <p>Safety is a focus during initial training and is reinforced through annual employee reviews and retraining.</p>
<b>B</b>	<p>Safety is communicated through quarterly management meetings, executive committee meetings, updates to the board, and monthly committee meetings at each district involving hourly workers.</p>
<b>C</b>	<p>The safety program began with monthly meetings to establish the concept of “safety first.”</p> <p>A safety culture statement was posted and disseminated, setting the guiding principles of commitment at all levels, safety as the top priority, adequate resources and incentives, a responsible and accountable environment with free reporting of breaches, and analysis of actions and establishment of individual accountability.</p>
<b>D</b>	<p>Frequent communication is perceived as the number-one factor leading to a positive safety culture. Safety personnel attend the GM’s staff meetings and monthly staff meetings at the base operations level.</p> <p>A series of weekly posters displayed throughout the operations building, including on the backs of bathroom stall doors, is seen by both management and union as an effective channel through which to communicate safety to employees at all levels.</p> <p>New electronic bulletin boards have a section dedicated to safety and are programmed by the bases and the transit control center to display customized messages.</p> <p>The local union also contributes to spreading safety by placing messages and articles in its newsletter or on its website.</p> <p>Employees attempt to resolve disagreements about work safety rules at the lowest level possible, initially through the section safety committee. If that fails, the issues are forwarded to the joint safety committee for resolution.</p>
<b>E</b>	<p>In addition to the employee safety rulebook, every operator bulletin or communication sent to bus operators stresses safety. Monthly safety meetings are held at each bus facility. The meeting time is changed from month to month to give most people the opportunity to fit the meetings into their schedules.</p> <p>In rail, the safety department publishes a quarterly newsletter that includes news; a spotlight on employee safety champions; announcements of safety-related training, improvements to station and equipment safety, and safety incidents; and performance data for the past quarter, such as total injuries and descriptions of injuries.</p> <p>Rail employees have an opportunity to raise concerns through a safety hotline. Rail safety contacts appropriate departments immediately to resolve issues and maintains a monthly log to track calls and corrective actions.</p> <p>Rail safety also uses safety alerts, advisories, informational brochures, job briefings, and safety meetings to issue weekly areas of focus and quarterly themes.</p>
<b>F</b>	<p>The agency makes a special effort to solicit safety procedures around new rail and bus services. All employees are urged to identify any problems they see and bring them up for discussion. This can lead, for example, to new signage, curbs, and changes to the physical environment.</p> <p>In the maintenance shops, there are daily stand-up meetings with safety as a component.</p> <p>The safety committees deal with wide-ranging issues in a process managed by administrators in each mode. They review performance against goals. The committees identify problems and deal with them, often proposing solutions that combine engineering improvements and people issues—new rules or procedures.</p>



Table B-3. (Continued).

Transit Agency	Effective Safety Communication
G	<p>New technologies are used to announce affirmative safety messages to drivers based on their real-time locations. The messages are recorded by trainers or superintendents and are triggered by the onboard GPS system. Managers feel that the system has received strong favorable reactions from the operators since its implementation.</p> <p>Clear procedures and policies also contribute to safety culture communication. An operations manager said, “the first thing you want to eliminate in safety culture is ambiguity.” Standard operating procedures (SOPs) and rulebooks are rigorously maintained and regularly updated. Serialized operational notices are issued to advise operators of particular safety concerns and can be incorporated into an SOP or rulebook.</p> <p>Union officers provide a regular newsletter and e-mails to drivers and also use social networking sites such as Facebook to help communicate safety to members. If an operator or maintenance person has a concern, he or she will bring it to the union, and a union representative will contact the operations manager to try to resolve the issue.</p>
H	<p>The board’s commitment that board members intend to play a significant role with respect to safety and safety culture has been delivered by the CEO consistently throughout the organization.</p> <p>The message is transmitted to employees through initial training, refresher training, letters, bulletins, quick review sessions with managers, and the local safety committees and subcommittees.</p> <p>Risks of and rationale behind safety rules are effectively conveyed. This is primarily accomplished as part of training, starting with initial training and continuing through refresher training and informal training in the field.</p>
I	<p>Methods for communication with employees range from labor-management meetings to safety committee meetings, videos in the driver’s room, tailgate meetings, and bulletin boards. The CEO recently did an introduction to a “rededication to safety campaign” video.</p> <p>In order to ensure that effective and open communication is maintained among all organizational levels and all employees, the agency implemented a computerized system accessible to employees at each base. Employees can submit any concern on any issue at any time, and management must respond in a timely manner. The system was originally designed for operators to enter route-specific information based on daily experience, but its use has been expanded to all employees to deal with safety problems and issues. It is an effective and innovative approach to employee safety communication and participation.</p> <p>The local union also uses newsletters and flyers and holds a safety fair each year.</p>

data or lack of data-sharing across various transit systems and in vastly different operating environments. Agencies have instead resorted to using their own past performance as the benchmark. Several transit CEOs and safety officers interviewed expressed interest in a forum for similarly situated agencies (by mode and size) in which safety experience and practices might be compared (see Table B-4 for summary of comments).

### Organizational Learning

Organizational and individual learning is deeply ingrained in the everyday operations of these transit agencies. Recruitment strategies and practices to seek employees with a safety mind-set and filter out high-risk individuals help the organizations establish the technical competence required to

achieve safety. Initial and continuing safety-focused training and education keep employees vigilant and build up their technical knowledge and skills to ensure safety.

More broadly, these organizations constantly learn from information collected and are willing to implement changes to procedures and equipment based on their learning.

**Recruitment.** Identifying potential new hires who are likely to make safety a personal priority is an important emerging development in the transit industry. Many agencies review DMV records of applicants for operator positions, looking for accidents and traffic violations. This is a continuation of the practice commonly applied to current operators. Following best practices in other industries and countries, a few of these nine transit agencies are beginning to use personality test profiles to identify high-risk individuals

**Table B-4. Safety data, key indicators, and benchmarking.**

Transit Agency	Safety Data, Key Indicators, and Benchmarking
<b>A</b>	<p>In the previous 8 years, the agency went from no analysis of accidents at all to performing monthly and annual analysis of all accidents using a centralized database. Measures tracked include collisions and injuries (fixed object, vehicle, passenger, and pedestrian) and associated costs. The monthly safety performance reports are not only shared among managers but are also the basis for safety awareness programs for operators (bulletin board, newsletter, etc.), communicating constant information about how the agency is doing.</p> <p>When data analysis identified a high collision rate among first-year operators, for example, the information was immediately brought to the attention of the CEO, and a series of measures were implemented, including the institution of a 6-month review of new operators and a new mentoring program. Another analysis revealing a high rate in right-side and fixed-object collisions led to targeted training to address these issues. These data-driven safety measures have had dramatic effects on safety records and overall safety climate.</p> <p>The agency participates in APTA's bus safety audits. This initiative was begun after a spate of serious accidents.</p> <p>The agency is also part of an insurance consortium; there are three other properties in the region. It is critical to ensure safety in order to keep the premium in check. Safety personnel from all four agencies meet quarterly to make sure that things are done properly and to learn from each other.</p>
<b>B</b>	<p>The agency places great emphasis on conducting regular safety performance data tracking and root cause analysis when issues arise. For example, following a period of concentrated bus-pedestrian collisions, the safety department and training department conducted thousands of field observations and evaluations on left-hand and right-hand turns. The analysis report was presented at the executive safety committee, and the following actions were taken:</p> <ul style="list-style-type: none"> <li>• Continue observations—play video in the employee lounge,</li> <li>• Continue covert ride checks—place video on the agency intranet, and</li> <li>• Refreshers on left-hand turns using training video.</li> </ul> <p>Like most transit agencies, the agency performs benchmarking against its own past performance, but it does so more frequently than other agencies, exceeding the industry average. Statistics from the NTD are sometimes but not regularly analyzed.</p>
<b>C</b>	<p>The agency is trying to go beyond on-street accidents and events to assess and analyze other accident rates, as well as injury, illness, and workers' compensation costs. It returned to a basic assessment of accidents—what is an accident, what makes it preventable rather than what is the liability.</p> <p>Management credits the human resources manager, who focuses on costs and benefits of safety. The agency's health claims and insurance brokers provide advice to help lower rates and premiums. To achieve better OSHA compliance, especially in the shops, the agency did a safety audit based on a walk-through, which showed where improvements were needed.</p>
<b>D</b>	<p>Success is measured using a number of lagging performance indicators, such as preventable and unpreventable accidents, industrial injuries, and delays in reporting. The CEO reviews safety performance indicators weekly. There are monthly reports from the safety section on the basic statistics as well as comparisons to the industry standards for each base. The agency holds an annual safety breakfast for whichever base has reduced its accident rates the most.</p> <p>Agency conducts safety audits internally and externally through APTA and the state safety oversight agency.</p>
<b>E</b>	<p>The bus division measures safety performance based on OSHA reportable incidents and NTD required reporting in categories such as vehicle collisions per 100,000 miles and employee injuries per 200,000 hours. Safety statistics are also analyzed to target specific issues such as high frequency of collisions due to similar causes. Data from onboard cameras are used to assist with the analysis.</p> <p>Rail operation establishes the yearly injury reduction goals by department based on a 5-year average. These goals are published in the Rail Safety Program at the beginning of the year. A monthly report is published no later than 10 days after the end of the month. Reports are also produced to reflect trends, type, and location of rail accidents/incidents/injuries. When specific safety concerns arise, relevant parties such as rail operations and mechanical managers, representatives of the federal and state safety oversight agencies, and equipment manufacturers are engaged in extensive data collection and root cause analysis to resolve issues.</p> <p>The joint labor-management safety committees in rail operations conduct monthly on-site inspections following the committee meetings and recommend corrective actions as required.</p>

**Table B-4. (Continued).**

Transit Agency	Safety Data, Key Indicators, and Benchmarking
F	<p>The agency has thorough tracking and reporting of safety incidents and a good system for analyzing and responding to incidents as they occur.</p> <p>With the exception of safety attitude questions on periodic all-employee surveys, the safety statistics used are mostly backward-looking.</p>
G	<p>Top management conducts a monthly safety review, which includes operations, maintenance, administrative, and workers' compensation data. When the monthly chargeable accidents are considered too high, a mini-stand-down is initiated to "make sure everyone makes a recommitment of safety."</p> <p>The maintenance department keeps a performance matrix. Superintendents are required to provide safety briefs to the maintenance director at least once a month. The top operations manager also conducts semiannual inspections at the maintenance base.</p> <p>The agency participates in APTA's annual bus safety audits. Six months after the safety audit, it performs an internal check on its progress to correct problems.</p> <p>Due to lack of consistent industry benchmarking standards or data, the agency considers its current best benchmark as being against its own past performance.</p>
H	<p>The leading safety indicators include corporate safety rule compliance checks, quality and quantity of safety reporting by employees, and internal unannounced audits on bus rides.</p> <p>Recently, the board commissioned an outside evaluation of safety culture, which included a survey of hourly operations employees and group discussions with those employees. The results of the survey and discussions indicated the presence of a positive safety culture at the agency.</p>
I	<p>The agency examines trends in hours lost and other metrics and puts 99% of its focus on a proactive approach to safety. This includes the degree of employee participation in programs, the percent of closure of safety entries in the computerized reporting system, and inspection and audit results as leading indicators.</p>

and exclude them from being hired as operators or in other safety-related occupations. Concern has been voiced, however, by union leaderships that such tests lead to an overemphasis on psychological testing and an underemphasis on (1) systems redesign and engineering efforts to eliminate or mitigate hazards, and (2) the importance of training and

retraining. In the real world, unions maintain that such testing can lead to problems of perceived or even actual discrimination. Somehow recruiting safe employees, however, is an important first step toward having a workforce that is consistently committed to safety (see Table B-5 for summary of comments).

**Table B-5. Recruitment.**

Transit Agency	Recruitment
B	<p>The agency evaluates points on drivers' licenses and reviews annual DMV/accident records to check for safety violations committed by new hires and existing operators. It provides annual safety certification for operators, and the safety department conducts ride-alongs to check for good habits and conduct.</p> <p>The human resources department is exploring predictive statistical modeling to determine if certain parameters have a high correlation with safety issues and to determine if any existing bus operators fit that model. It is hoped that the model can be used on a continuing basis to evaluate operators before and after hiring to identify high-risk behavior patterns.</p>
G	<p>The agency conducts a full background check and verifies DMV driving records when hiring new operators. It also uses an industry-qualified analysis from standardized tests that probes candidates' risk-taking attitudes.</p> <p>On the mechanical side, background checks are performed and potential employees are interviewed; questions are structured around safety. During the hands-on assessment that follows, the mechanical staff on the interview panel can observe the behavior of the mechanics to see if they are working safely.</p>

Note: No Table 5 input received for transit agencies A, C through F, H, and I.

**Training and education.** Training is the foundation of all knowledge and understanding underpinning safe operations and a culture of safety. It is how organizational learning is preserved and promulgated. With their strong leadership commitments to safety as a top priority, it is not surprising that these nine transit agencies invest heavily and effectively in workforce training. These agencies generally have strong technical training systems (instruction in how to do one's job correctly and safely) as well as training that emphasizes that safety always comes first. Many of these transit agencies have mandatory annual or biannual retraining in safety and for technical skills.

Such retraining is not generally carried out in most transit agencies (see Table B-6 for summary of comments received.)

## Consistent Safety Reporting and Investigation for Prevention

A reporting culture exists where workers feel free to contribute to the informed culture through various safety reporting mechanisms. Four of the nine case study agencies use a codified system for near-miss reporting, a relatively new practice in the transit industry based on success in aviation and

**Table B-6. Training and education.**

Transit Agency	Training and Education
A	<p>The director of safety and training conducted a full evaluation of the training process. The training program has been greatly expanded and lengthened. Standardized documentation was developed for classroom, equipment, commercial driver's license (CDL), and line instruction training.</p> <p>The agency has a relatively complex bus system; it takes a significant amount of time and effort to get new operators trained. Over the years, total training hours and drive hours have increased by roughly one-third. Several years ago the agency incorporated the Smith system of defensive driving into its new-hire training program and started a summer review program for all operators, later to include a roadeo, with emphasis on safety.</p> <p>Given safety concerns, new drivers are restricted from driving routes near schools in their first 6 months. The agency implemented a mentoring program for first-year operators, with a minimum of six safety ride evaluations and follow-up if necessary. The director also conducts random safety ride evaluations on an ongoing basis. Judging from the feedback during interviews, this comprehensive system of operator training is considered highly effective by managers and workers in boosting the culture of safety.</p> <p>The maintenance department prepares a training matrix for each employee, tracking training needs and completion status. Employees work with original equipment manufacturers to train on equipment and safety in the workplace. For PPE, outside experts are brought in to train employees. A certified forklift trainer provides in-house training. The maintenance department also provides a mentoring program; each new employee is partnered with an experienced mechanic, one for each subsystem.</p>
B	<p>Training is mentioned as a major contributing factor in ensuring a positive safety culture at the agency. A new left-hand-turn training module was completed recently. It focused on operator "inattentive blindness" and the need for operators to make a mental note of pedestrians in the crosswalk and on street corners. The module also described the importance of waiting 2 seconds before making a left-hand turn to search the corners and the crosswalk for pedestrians. The module further described the "rock-and-roll" technique to eliminate blind spots. The left-hand-turn training module was also added to the biennial refresher training. A talking bus reminds operators that they must be alert for pedestrians while making a turn while also alerting pedestrians about the oncoming bus.</p> <p>The safety department is the lead player for all safety training in the organization. According to a safety manager, "much of the root cause analysis will determine deficiencies in the procedures, and we will drive the training to that end. When we were doing an investigation and found an employee was not responding appropriately to an accident, we will drive the training. As part of the safety review process, departments have to send their training to us for review."</p> <p>The union considers some of the training to be effective, particularly the road instructor observation and training. This training is not based on discipline but rather is focused on improving driver skills and safety performance. The local union has started working with the safety department to develop a safety training video for brake rebuild mechanics. The business agents contribute by providing subject matter information such as a list of PPE and a description of the work environment. According to the union, this is part of the overall effort to ensure member safety.</p>

Table B-6. (Continued).

Transit Agency	Training and Education
C	<p>The Smith system is a cornerstone of the safety environment. It focuses on driver behavior and training, was provided to all staff, and is refreshed with periodic videos and quizzes. All hourly employees and supervisors are required to qualify for the CDL license and must meet training requirements, even if they do not operate vehicles on the road. Drivers need 10 hours of in-service training annually to stay on status. Trainers may be peer trainers or subject matter experts—state troopers to talk about winter driving, physical therapists to talk about wheelchairs. The special training needed for paratransit drivers recently included dealing with clients with developmental disabilities. Employees may also receive video-only training if their route schedules conflict, and roadeo participation may also qualify.</p> <p>Safety training includes biannual review of material safety data sheets and check-in on how to use equipment. Accidents are key indicators for retraining. A dedicated training department is being developed.</p> <p>Operator training is provided by a strong group of behind-the-wheel trainers who have a good safety record from all operating divisions. They are held to a high standard of performance and provided with uniforms and training, and they participate in quarterly training roundtables. Other drivers reach out to them since they are recognizable resources. Training is designed to allow drivers the freedom to challenge what they may see as nonsense. They do not use a top-down lecture format.</p>
D	<p>Beyond the initial training at hiring, drivers receive 8 hours of safety refresher training every 3 years. The safety department also designs and delivers special topic training, the most recent one being a pedestrian awareness session. Some base superintendents also established mentoring programs for employees working night shifts.</p>
E	<p>In the bus division, training programs are essentially driven by components of safety. The agency provides 19 days of training for new hires, covering all safety rules and regulations and defensive driving. It evaluates employee safety records at set intervals. When a part-time operator is converted to full-time, 1 additional day of training is offered. Incumbent operators also receive refresher modules of training on customer service, vehicle collisions, bus simulation, and so forth. The bus division has a state-of-the-art training facility and a joint training committee that periodically meets with the union, with safety being one of the topics.</p> <p>In the rail division, the training department typically focuses on technical training for maintenance and transportation employees, and safety is embedded in all its programs. The safety department provides 3 days of training to new hires on the basics of railroad safety and OSHA topics in both the classroom and field environment. The agency offers 6 hours of safety training on a quarterly basis for all supervisors hired or promoted during the previous year, or as requested by departmental supervision. In addition, rail safety developed a basic training program for foremen and other frontline supervisors on their safety responsibilities. It has three sections: how to properly conduct a safety job briefing, personal protective equipment, and injury reporting procedures. This training is provided on a monthly basis.</p> <p>The engineering department has a 2-day class every year for its employees that covers basic road-worker safety, bridge-worker safety, and OSHA requirements (fault protection, lockout/tag out, confined space, etc.) for which other employees are normally trained only once. For maintenance employees who work night and weekend shifts, the maintenance department also provides e-learning on various subjects.</p> <p>Labor is involved in making training recommendations through the joint labor and management fact-finding and problem resolution process of the accident/incident review team.</p>
F	<p>Agency officials emphasize the importance of well-designed safety training and training components in technical job training.</p> <p>Training of new hires and apprenticeship training (for those going through apprenticeships solely in maintenance occupations) are widely seen as exemplary.</p>

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**Table B-6. (Continued).**

Transit Agency	Training and Education
G	<p>The agency has an extensive training and retraining program for bus operators. A staff of full-time instructors performs about 4 hours of classroom instruction, including in SOPs and its rulebook. All instructors are certified by the National Safety Council, the Transportation Safety Institute, and the state DMV as examiners. Bus operators are put through 9 weeks of behind-the-wheel instruction that includes fundamentals and route training. They then spend the tenth week picking up passengers while the trainers are on the bus advising them. The student–instructor ratio is no more than three students per instructor. Union trainers are also used for peer training when new equipment is purchased. Peer-to-peer training facilitates the introduction of new equipment into the workforce.</p> <p>When operators are due for their annual recertifications as required by the state DOT, they are provided with more than the legally required minimum training. Simulator training is focused on skills and is complemented by ride checks, gate checks, and safety messages during the course of an operator’s work.</p> <p>In maintenance, labor and management established a joint maintenance training committee to direct a combination of classroom, on-the-job, and mentor training targeted to areas of greatest need, as identified through a skills gap analysis.</p>
I	<p>Joint accident reduction teams and safety committees recommend the appropriate levels of safety training and retraining for employees.</p> <p>The agency ensures that employees are adequately trained on safety matters by constantly reviewing performance and mounting frequent safety campaigns. There is annual safety refresher training for frontline employees after initial orientation safety training.</p>

Note: No Table 6 input received for transit agency H.

new FRA initiatives. Among these four agencies, three are large, one is medium-sized, and all operate rail transit. Within the agencies at which a near-miss reporting system has been fully implemented, it is perceived as an exceptionally effective tool to improve the organizations’ safety culture and safety performance. Agency E provides a good example in this area.

In other locations, even though employees are encouraged to report unsafe conditions or near misses, they may not be fully shielded from discipline due to lack of a completely no-fault, anonymous system. Employees sometimes consider the agency’s effort lacking in taking actions to resolve issues. Recognizing the potential value of employee safety reporting without fear of retribution or discipline, several agencies have started to explore experimenting with such systems.

Accident and incident investigation systems are robust across all nine agencies. These agencies in general put a heavier emphasis on identifying system failures, rectifying the problem, and retraining employees rather than blaming and disciplining. Unions are normally not involved in the initial investigation stage but are asked to review findings as part of an accident review committee. Root cause analysis is used in at least three agencies (B, E, and I). See Table B-7 for summary of comments received.

### Employee Recognition and Rewards

Safety recognition and reward systems play a role in virtually all these best-practice agencies. Recognition is much more

common than financial rewards for hourly employees, most of which are covered by union contracts that do not allow for individual financial awards. Positive individual safety evaluations can lead to public recognition, badges, and other nonfinancial symbolic awards, while in these agencies safety performance deficiencies generally lead to focused retraining. While exempt employees often have safety built in as a discrete element in their annual performance reviews, non-financial incentives for hourly employees are more typically (and more productively) focused on positive group performance and competition among teams, garages, depots, and so forth, leading to shared benefits such as paid days off or public recognition in the workplace and at awards banquets. In these transit agencies, rewards are generally not offered for reporting near misses or safe behavior (see Table B-8 for summary of comments).

### High Level of Organizational Trust

The transit best-practice cases illustrate a core finding that Reason and others have emphasized: mutual trust is an essential feature of a positive safety culture. Trust is built on a foundation of past performance. It cannot be given but only earned. This is accomplished when people consistently keep promises and act in good faith to solve problems rather than just assign blame. Transit agencies with positive safety cultures understand that trust is closely tied to what Reason calls a just and informed culture (see Table B-9 for summary of comments).

**Table B-7. Consistent safety reporting and investigation for prevention.**

Transit Agency	Safety Reporting and Investigation for Prevention
<b>A</b>	<p>When accidents or other safety problems occur, the agency sends frontline supervisors to assess the scene, take photos, conduct interviews, and get employees involved. Video cameras are installed on all buses. A real-time GPS system tracks vehicle speed. The safety and training committee is generally not involved in investigation. If an employee is subject to discipline due to wrongdoing, he/she can initiate an appeal process. The accident review board will then be assembled and will consist of two operators, two supervisors, and a representative from local law enforcement. This board is a subset of the safety and training committee and will make a final ruling.</p>
<b>B</b>	<p>The agency promotes and encourages all employees to identify and report hazards or potential hazardous conditions in the workplace and operating environment without fear of reprisals. Management considers it important to mold a positive safety culture that is non-punitive. Instead of blaming the last person who touched the equipment, management conducts root cause analyses to determine which organizational factors—procedures, human engineering, training, supervision, communications—may have contributed to the accident.</p> <p>The agency is among a handful of transit agencies that implement a near-miss reporting system in its rail operations. Unsafe activities or conditions can be reported immediately and anonymously via a safety hotline. This is followed by a thorough investigative process.</p>
<b>C</b>	<p>Management reports an open-door policy all the way to the top. The intent of accident assessment is to eliminate the blame process and replace it with a corrective-action approach. The program includes progressive discipline. To resolve conflicts with the union, this includes initial warnings, but second infractions can lead directly to discipline. If accident assessment indicates a need for retraining, the required training following incidents is paid overtime. Accidents (and appeals) are evaluated by a team of supervisors and operators who look at the facts, make their case, and vote. The process is educational for drivers and managers. Findings that an incident was preventable can be appealed.</p> <p>There is an anonymous comments box along with anonymous accident reporting forms, a general open-door policy, and state whistleblower regulations. On the street, incident reporting goes to the dispatcher. A safety director and risk manager go to accidents and work with supervisors who are trained to do scene-of-accident investigations. Incident reports are submitted on a page with room for comments in response; this is turned in to the dispatcher. Because of the no harm, no foul approach, people are encouraged to report even small property damage; this is used as information to direct improvements rather than as a club for punishment. If no response is received after 14 days, the employee can inquire about follow-up. For urgent safety issues, employees are encouraged to go to the safety manager. A near-miss reporting system has been discussed but is not yet fully in place.</p> <p>An onboard road observation form is used by all administrative staff when traveling on public transit; they may list positive and negative observations but are limited to commenting on areas in which they have experience. The categories are not limited to safety but include customer relations and other issues.</p>
<b>D</b>	<p>Employees use a system to tag a piece of equipment that is considered unsafe or report an unsafe condition. Once tagged, a machine is shut down. The base manager will then send a copy to the safety department to resolve the issue. Drivers can also convey concerns to the joint safety committees or bring up concerns to the union, which in turn introduces them at a joint committee.</p>
<b>E</b>	<p>A unique feature of the agency's safety system is the recent implementation of a near-miss reporting system in rail operations, modeled after a system used by the airline industry. This agency is the only one among the FRA pilots to implement a system-wide program to include all services (main tracks and yards). For the process to work, confidentiality must be maintained. The agency has a written agreement with all of its local unions to implement and maintain the process. This agreement provides for a joint labor-management peer review team and a senior management support team. Labor and management team members go through training on how to maintain confidentiality and on conducting root cause analysis. This training is facilitated by a third-party consultant who is paid by the agency to sit in on team meetings.</p> <p>Under this new system, employees can report any incidents they witness to a central data center where their data are combined with information from other railroads participating in the pilot. Information then passes to two federal agencies for technical analysis. Those agencies scrub the data of train numbers, locations, and information that could identify employees involved in mistakes. The data sheets are then returned to the joint peer review teams on each property. Each peer review team</p>

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Table B-7. (Continued).

Transit Agency	Safety Reporting and Investigation for Prevention
	<p>meets monthly to review incidents and recommends corrective action to the senior management support team. The support team meets independently to review these recommendations and makes a decision on final actions.</p> <p>The confidential near-miss reporting system “allows us to gather data that we need to hopefully improve what we never would have gotten unless there was a major incident, which is a positive for us. It’s a positive for [employees] because it allows them to report things without the fear of it affecting their certification. And it has strengthened the labor union relationship.” Union representatives see how this has brought management and labor closer together. Instead of discipline, what employees can expect when they report an incident is a veil of confidentiality and a promise of protection from retribution from the railroad or the union. They are thoroughly interviewed by investigators, who will elicit a description both of the circumstances leading up to the accident and of the employee’s frame of mind before, during, and after the incident.</p>
G	<p>When incidents occur, transportation and safety staff trained and certified in accident investigation and reconstruction conduct firsthand investigations. A joint labor–management accident review committee then grades the accident as either preventable or nonpreventable. The committee consists of two union representatives, two management representatives, and one mutually agreed-upon neutral party. If there are extenuating circumstances or a recurring issue, or if an operator brings up concerns that are not properly addressed, these factors are taken into consideration when determining whether to grade the accident as preventable or nonpreventable. Any concerns or issues that stem from daily operations may be referred to the safety task force for further action. The accident review committee can also make recommendations for system changes.</p> <p>The company provides accident review training to new union leadership to help them carry out their responsibilities as members of accident review committees. The training covers accident investigation, documentation, and evaluation. The union believes that it is to the agency’s benefit to have union officials involved because it cuts down the cost of arbitrations. Operators and mechanics can appeal the accident review committee decisions if they are not satisfied with the outcomes.</p> <p>If there are frequent customer complaints regarding an operator or if the operator is involved in an accident, management gives that operator 4 hours of retraining, regardless of the accident grading. Operators used to be automatically suspended pending investigation, and if the accident was deemed nonpreventable, it was removed from the operator’s record and lost wages were reimbursed. The new policies allow the operator to go back to the original post right after the retraining, even if the investigation results are pending.</p> <p>The commuter rail side of the operation has a formal near-miss reporting system, and the bus division is discussing how it might be adapted.</p>
H	<p>Employees use a standard form to report unsafe conditions, hazards, and near misses. It can be submitted anonymously. Divisions are required to maintain records of these reports of hazards or near misses, track the status of corrective actions taken or planned, and ensure that appropriate corrective action has been taken within established time limits.</p> <p>On receiving a completed near-miss form, department or division management is required to analyze the reported hazard or near miss, identify all of the factors involved, and develop recommendations for timely elimination or mitigation of the hazard or near miss. These recommendations may include modifications of equipment or facility design, maintenance schedules or common practices, operating rules and procedures, employee training, bus stop locations, rail station layout, traffic control devices, road design, traffic signs, and markings. Management must inform other employees of the existence of and circumstances surrounding the hazard or near miss.</p> <p>Hazardous or near-miss cross-departmental incidents that cannot be resolved will be reported to agency-wide safety staff, who will resolve the situation by working with the departments involved.</p> <p>Responses to near-miss reports are distributed to the individual involved and to the appropriate local safety committees.</p> <p>The agency has a detailed procedure for investigating accidents and incidents. Investigations are initiated at the supervisory level, with support from other staff as necessary. Agency-wide safety staff are involved if the severity of the accident warrants. The accident review board reviews the reports and recommends disciplinary action.</p>



**Table B-7. (Continued).**

Transit Agency	Safety Reporting and Investigation for Prevention
I	<p>The agency's computerized employee reporting system is successful in encouraging employees to report safety problems and raise issues. It is easy for employees to use and to track responses. The problems and issues raised and the action taken are also made known to all.</p> <p>The accident reduction team program also ensures that all of the relevant issues are addressed, that all levels of employees, including union representatives, are engaged in problem solving, and that the workforce understands the basis for any new process or procedure that results.</p> <p>In investigating accidents or other safety and health problems, discipline and prevention of recurrences are balanced by dealing with prevention first and "figuring out who is to blame later." The agency has a near-miss program, which has no discipline associated with honest self-reporting. The agency is looking for honest feedback from people who are involved in near misses as well as from those who observe an unsafe condition or act.</p>

Note: No Table 7 input received for transit agency F.

**Table B-8. Employee recognition and rewards.**

Transit Agency	Employee Recognition and Rewards
A	<p>All operators are involved in an annual summer review in which safety is a major component. Each operator goes through an obstacle course and gets rated for performance. The director of safety and training spends one-on-one time with operators to review safety issues, analysis, and actions.</p> <p>The company holds safety banquets and award dinners each year to recognize safety champions among employees.</p>
C	<p>Workers with injury-free periods are rewarded with badges, a safety banquet, and breakfasts prepared by management. Accolades are awarded for those who provide solutions to operations and safety problems. If a division achieves 90 days without an on-the-job reportable injury, supervisory staff prepare breakfast.</p>
D	<p>The agency has annual safety competitions wherein awards are given for bases with better records than others. Operators without preventable accidents for a certain number of years are also recognized.</p>
E	<p>For bus employees, safety culture is reinforced with safe worker awards; employees are recognized at annual award ceremonies for not causing preventable accidents (operators) or injuries (maintenance) for a certain number of years. System-wide in every division, awards are given for most safety improvements overall on three measures—customer safety, employee injuries, and vehicle collisions.</p> <p>The rail division has had safety programs tied to team performance where the team with the fewest reportable injuries would win incentives. However, budget constraints caused the program to end. The division also has an employee recognition program wherein employees can be nominated for "doing remarkable things," including contributing to the safety of operations. Workers are recognized in front of their peers. Employees are also recognized in the safety newsletter for being safety champions.</p>
F	<p>Safety is a distinct factor in performance appraisal at the agency, at all levels of the organization. Managers and supervisors are held accountable for the performance of their groups.</p> <p>For bargaining unit employees, there are no performance appraisals as such, but there are team incentives and campaigns designed to improve safety performance. Winning teams, for instance, can get a paid day off.</p> <p>The agency also has safety award programs for operators—insignia for uniforms based on annual and multiyear accomplishments. In maintenance there are awards for not having injuries on a team.</p>

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**Table B-8. (Continued).**

Transit Agency	Employee Recognition and Rewards
G	The safety culture is reinforced with safe worker awards for not having preventable accidents (operations) or workplace injuries (maintenance) for a certain number of years. There are also annual safety competitions between maintenance facilities. Awardees are invited to board meetings, and the board members present the awards. This underscores the importance of the investment made in training and equipment. Beyond the formal safety awards, employees are also given bonuses of \$50 to \$75 for meeting the yearly safety performance matrix.
H	Safety performance is an evaluation factor for managers and supervisors.
I	Employee incentives include presenting safety awards to deserving colleagues at award ceremonies. The only safety-related financial incentives are contractual bonuses for reduction in workers' compensation costs.

Note: No Table 8 input received for transit agency B.

**Table B-9. High level of organizational trust.**

Transit Agency	High Level of Organizational Trust
A	Managers and hourly workers believe that there is a good level of mutual trust when it comes to safety. A lot of that has to do with relationships developed through employee committees and an open-door policy. When employees see a genuine commitment from management, it makes it easier to achieve buy-in.
D	Top management considers there to be "a solid labor-management relationship" and "very good morale." The management respondent said, "generally speaking, the rank-and-file employees like their jobs, and they are treated with respect, and that works in the more structured labor-management approach. Negotiations tend to be interest-based and they tend to be collaborative at a very good level."
E	In rail, labor and management share a positive relationship that both enables and reinforces a range of joint activities, including safety committees and the near-miss reporting system. One of the managers said, "[The union] wants to change the culture, they want their employees to work safely, and they want their employees to go home the same way that they came here. That is a very strong positive for management to work with union effectively."  The rail union representative shared a similar sentiment: "Over time, [the agency] has realized the value. Years ago they gave me a safety award for working so long without accidents. Crews were acknowledged in public for protecting the property and people. The more we do that, the mutual suspicions we have with regard to each other can dissipate because safety is a mutual interest that benefits our members and the public."
G	Trust is established through multiple layers of interaction. Supervisors are asked to consistently follow the open-door policy and interact with employees so that the latter feel comfortable talking to their supervisors.  "Trust is established by being available, open, interacting, and doing what you say you are going to do. Even if the answer isn't what they want to hear, you have to make sure you get back with the employee and explain to them why it is not feasible and show them that you researched it and did what you said you were going to do."

Note: No Table 9 input received for transit agency B, C, F, H, and I.

## APPENDIX C

## Company Mini-Case Study Detail

**Strong Leadership, Management, and Organizational Commitment to Safety**

Table C-1 lists key points related to leadership, management, and organizational commitment to safety that were raised during the interviews with the organizations.

**Table C-1. Key leadership and organizational commitment points.**

Company	Key Points
AA	<p>Each employee performs safely and accepts responsibility for his or her role.</p> <p>A line of distinction is not drawn according to position or title; from the CEO to the rank and file, each person is responsible for safety. This practice has created a sense of company unity among all employees.</p>
BB	<p>The company believes that when safety is put in the hands of employees, and systems and tools for employee feedback are provided, feedback will come, and employees will be invested in company safety practices.</p> <p>Every year in an annual performance evaluation, safety criteria (which employees helped create over the years) are reviewed with individuals and managers.</p> <p>Employees are responsible for managing their own roles on the job site without close oversight, with safety being the core value.</p>
CC	<p>This company's positive safety culture stems from the chairman and executive council.</p> <p>Some years ago, the safety office was moved to work directly with manufacturing and engineering to ensure that the highest levels of standardization were being followed.</p> <p>Safety is under the purview of the chief technology officer, supporting a collaborative environment among technology, engineering, and manufacturing.</p>
DD	<p>Operates with five core values; safety is number one.</p> <p>Believes in developing a committed employee rather than a compliant employee.</p> <p>In 2004 there was a shift: safety was no longer the sole responsibility of the safety department; it became the responsibility of the supervisors, who use the safety department as a resource.</p> <p>A new emphasis has been placed on having no fatalities and lessening the severity of incidents.</p>

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**Table C-1. (Continued).**

Company	Key Points
EE	<p>The company believes that safety must be in the CEO's DNA.</p> <p>Accountability for safety concerns/incidents has to be placed front and center with corporate leadership.</p> <p>This company does not tolerate leaders putting production or quality above safety.</p>
FF	<p>The culture of safety is ingrained in its leadership, structure, and key processes.</p> <p>Ownership of an incident is assumed by all stakeholders, especially the CEO.</p> <p>Employees are encouraged to participate in behavioral observations, incident investigations, employee training, and the creation of safety policies and procedures.</p> <p>Accountability begins with the hiring process. Individuals are evaluated on risk taking through critical tasks and are weighted against key performance indicators.</p>
GG	<p>The chairman would say he is the chief safety officer; the plant manager in each town would say he or she is chief safety officer, and so forth. It is a role that everyone plays.</p>
HH	<p>The company has a cross-office functional group that includes eight offices, with safety people in each; the CEO interacts directly with this group.</p> <p>The company does not impose punitive sanctions on employees involved in near misses/safety incidents but instead encourages people to share information about them and use them as learning experiences.</p>
II	<p>The CEO is very visible and spends a minimum of 2 days in the field each month. He communicates regularly and often with the safety manager, who also has a regular and strong presence in the field.</p>

## Employee/Union Shared Ownership and Participation

Table C-2 lists key points related to employee/union shared ownership and participation that were raised during the interviews with some of the organizations.

**Table C-2. Key employee/union shared ownership and participation points.**

Company	Key Points
BB	<p>The organization takes great pains to ensure that employees hired from the union hall (which by contract is how the company is required to hire employees) choose to remain on their jobs. The company has made a significant investment in safety training. It recognizes that employees can choose to return to the union hall at any time to be reassigned to another job site at the same wage and benefit level. It is understandable that the company takes pride in high retention levels, which it attributes to its strong safety culture orientation. The interviewee highlighted two union hall employees, each retiring from the company with 36 years of continuous service. Those individuals were active members of the company community and played important roles training new employees and union members, and they felt great loyalty to the company and to its safety culture. The fact that so many employees choose to stay with the company supports the finding that a positive safety culture leads to improved retention. At the same time, the company is reaping a major return on its investment in safety training.</p> <p>The company uses joint safety committees to help monitor safety performance, improve safety programs, and generally promote safety.</p>

Table C-2. (Continued).

Company	Key Points
CC	Unions play a huge role in shaping safety culture at the company. The company negotiated separate agreements with unions based on their commitment to working together, creating the collaborative environment needed to achieve a zero-injury mind-set and to incorporate necessary safe standards to ensure consistency at all worksites. From these agreements, the company created numerous improvements and safety programs. The company's largest union, the International Association of Machinists, partners with the company on a joint health and safety institute, whose mission is "[t]o ensure continuous improvement of workplace health and safety for the IAM bargaining unit of employees of the company and to create an environment characterized by open-minded communication and mutual trust between workers and management on issues of health and safety." One example is a program called Safety with Technology, which uses technology such as iPads and handheld devices to accomplish tasks, allowing for real-time information to reach the labor force and real-time organizational learning to take place, improving safety records.
DD	<p>The company has developed its labor-management relationship to a point where 22 full-time union officers serve as safety officers and trainers. There is union involvement at every level, up to the international president of their largest union. Union officers conduct ride reports and respond to requests from the safety department to support employees with performance difficulties. The 22 full-time union officers are employed in the operations department.</p> <p>The company was forthright about the difficulty of improving labor-management relationships while working toward a just culture. Over time, the company's leadership acknowledged that safety improvements would only be made with increased participation from the union. The company's program was initially introduced by consultants and developed slowly. Consultant involvement unintentionally insulated management and union leadership, preventing them from accepting ownership of the program. Early union and management safety meetings were stressful and less than productive, but over the years the program evolved into real contributions and solutions from managers and union members at various sites working together one-on-one. This cooperation and progress grew into appointment of the 22 union officers as full-time safety officers in operations. Direct communication with employees, emphasizing safety training and elements, dramatically increased the program's credibility. The company uses joint safety committees.</p>
GG	The company uses joint safety committees to help monitor safety performance, improve safety programs, and generally promote safety.
II	The company also uses joint safety committees to help monitor safety performance, improve safety programs, and generally promote safety.

## Effective Safety Communication

Table C-3 lists key points related to effective safety communication that were raised during the interviews with some of the organizations.

Table C-3. Key safety communication points.

Company	Key Points
BB	<p>Many companies use messaging in facilities and on equipment to reinforce the safety message. At this company, all equipment, whether trucks, trains, or signs at facilities, displays the message "safety first." Employee input and feedback are key ingredients in message development, and many companies reported having safety programs that were created and are monitored by employees specifically.</p> <p>Weekly management calls at the company are conducted and led by the CEO and begin with a review and discussion of safety performance and safety incidents. The company also conducts quarterly meetings in which all employees are invited to participate. Key performance indicators, goals, and objectives, and any training needs that might be unmet, are discussed in an open forum. After all safety issues are addressed, other teams, such as sales and operations, are given the opportunity to address issues they deem necessary. While the company is union organized, and attendees at the meetings are not compensated monetarily for this time (meetings are after hours, typically lasting from 4:30 p.m. to 6:30 p.m.), the attendance rate is approximately 85% of available workforce in any region.</p>

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Table C-3. (Continued).

Company	Key Points
CC	The company communicates safety points and investigation results at morning stand-up meetings at a local level. These meetings are typically conducted in manufacturing facilities and include reviews of any safety issues or activities that are relevant from the preceding 24 hours. The company believes that the best way to communicate safety information is employee to employee. Supervisor–employee discussions are viewed as a positive tool to communicate safety information.
DD	Company supervisors conduct a weekly locker-room talk that uses actual case studies of past incidents.
GG	The company believes that open and available information is key to safety success. It communicates with employees regularly by e-mail and shares safety concerns, issues, and solutions in regular e-mail correspondence.
HH	<p>The company believes that open and available information is key to safety success. It communicates with employees regularly by e-mail and shares safety concerns, issues, and solutions in regular e-mail correspondence.</p> <p>The company worked with a development company to create a smart-phone application that puts crisis management flowcharts at people’s fingertips.</p> <p>From the company’s corporate safety director:</p> <p><i>My smart phone has all of our area office information on it, but if you’re the area safety director in our Albuquerque division, it has your protocol as the area safety director—what you need to do in a crisis. You can scroll down, all the numbers are live, our media statements are there, the protocol on how to handle an incident is right there at their fingertips so they know what to do in case of an emergency. The next stage of this should roll out within the next few months; it will be able to send out notifications, just like any other iPhone app, to everybody in the company, similar to our e-mail that we send at the end of the day to tell everybody something has happened, whether it is good or bad. . . . people will find out about something through YouTube quicker than we can get it through our company. Well, the reason it kind of started was, we had a job site and we had a very small crane rollover. Nobody was hurt, nothing like that, and actually our Corporate VP, Business Development and Marketing just stepped out for a second—she was at a meeting in Kansas City and this happened in Oklahoma City; and she heard about it from somebody else within ten minutes of it happening because they saw it on YouTube before we could even get to the job site to get it secured and see what happened. That’s how fast all of this stuff happens. . . . so, our crisis flowchart worked at the local level in that incident, but not at a corporate level. She should never be blindsided by something and neither should one of our division presidents around the country. So, we tried to streamline that process, which is why the app was invented and we’re going to expand on it over the next few years; right now it’s a tool that we hope that we never have to use.</i></p>
II	The company uses 55 leading safety culture indicators and measures them in real time, also monitoring them daily. When results warrant it, issues are identified collaboratively and discussed, and all parties work together toward addressing the problem. Each month, the CEO informs the board of directors of all safety issues addressed. Causation is explained, with the goal of monitoring for improvement and accountability in the field as well as at management levels. There are also open lines of communication, and this company is viewed as the industry leader in safety.

## Proactive Use of Safety Data, Key Indicators, and Benchmarking

Table C-4 lists key points raised related to the proactive use of safety data, key indicators, and benchmarking that were raised during the interviews with the organizations.

**Table C-4. Information, metrics, and benchmarking.**

Company	Key Points
AA	<p>The company measures progress against its own performance and the performance appraisals of its employees.</p> <p>It attributes much of its safety culture success to closing the gap between union and management.</p> <p>Employees are provided information about safety data, expectations, company targets, and milestones.</p> <p>The idea that performance can be improved through accountability serves as the foundation for its favorable position within the markets serviced.</p>
BB	The company does not perform individual performance evaluations since employees are unionized.
CC	The company benchmarks against internal facts and figures and against other industry leaders.
DD	<p>The company benchmarks against Class 1 railroads. It also benchmarks against the airline and trucking industries, which are viewed as competitors.</p> <p>Performance indicators are used in every manager's evaluation.</p>
EE	<p>The company is constantly looking globally at how standardized practices across businesses affect the drive to zero incidents.</p> <p>At the local level, facilities measure hazard causation and proactive or leading indicators to evaluate overall risk mitigation.</p> <p>It benchmarks against its own diverse business interests, other petrochemical companies, and other industries that face similar levels of potential hazards.</p> <p>Performance feedback is given to all employees, whether union or not; benchmarking and feedback have given employees the confidence to establish zero tolerance as an achievable goal for 2015.</p>
FF	<p>Benchmarks are established from the results of a safety perception survey.</p> <p>The company is large enough globally and varied enough in its industry involvement that it primarily benchmarks against its own business.</p>

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Table C-4. (Continued).

Company	Key Points
GG	<p>The company uses other industry safety incidents to learn more about what it needs to do to improve its culture.</p> <p>It is working on risk tolerance and on encouraging employees to actively care and to approach others, encouraging workers not to hesitate when intervening if someone is putting him- or herself at risk.</p> <p>The company benchmarks performance as well as best practices with oil and gas companies and trade groups (such as the American Petroleum Institute) at a minimum of annually, but ideally on a quarterly basis.</p> <p>At the corporate level, there are few leading metrics, because leading metrics tend to be process-specific. OIMS assessments provide ratings at the corporate level, but most leading metrics are at the local level, where there could be a dozen or more. Examples:</p> <ul style="list-style-type: none"> <li>• What is the percentage of employees who are on track for their training for the year?</li> <li>• What is the timeliness of follow-up on incident investigation findings?</li> <li>• What is your maintenance status versus your ongoing maintenance schedule?</li> <li>• What is the status of the number of drills you're supposed to have conducted versus your target for the year?</li> </ul>
HH	<p>Because the safety program and culture is so successful, it is being used as the model for other business areas (quality, schedule, budgeting, etc.).</p> <p>The company believes in educating subcontractors as well as employees, because it believes that creating a safer industry is the overall goal.</p> <p>Benchmarking includes annual award competitions and working with the Associated General Contractors of America, to which statistics can be submitted and analyzed for feedback about the position of the company in relation to peers and industry standards.</p> <p>Senior management is active on several peer group committees through various industry organizations.</p> <p>Since the company views itself as an industry leader in safety, its leadership focuses on continuously improving existing programs that work rather than developing new ones.</p> <p>With respect to information and data collection, the company relies on:</p> <ul style="list-style-type: none"> <li>• Orientations—get valuable information about how to better prepare workers to go out into the field.</li> <li>• Audits—not just conducted by safety directors but also by superintendents and employees.</li> <li>• Employee observations—What are they seeing out there every day that can help make the company better? Are they satisfied that they are working in a safe environment every day?</li> <li>• Communication within the company—open doors to all with no repercussions for reporting near misses or safety incidents.</li> </ul>
II	<p>The company is considered the industry leader in safety because for the previous 50 years no loss of life could be directly attributed to safety incidents.</p> <p>Strong emphasis on leading safety indicators in addition to a risk index. This company relies on more than 50 leading indicators, the largest number of leading indicators mentioned by any company interviewed.</p>



## Consistent Safety Reporting and Investigation for Prevention

Table C-5 lists key points about safety reporting and investigation that were raised during the interviews with some of the organizations.

**Table C-5. Key reporting and investigation points.**

Company	Key Reporting and Investigation Points
AA	<p>The company uses an open reporting system.</p> <p>Safety meetings provide an open and safe forum to voice and address safety issues.</p>
BB	<p>There is no such thing as loss-time action for the report of a safety issue. Safety reporting is not a fault-finding process. The reporting, investigation, and determination of preventability are separate from any consequence of a disciplinary finding.</p> <p>Employees are kept active during investigations, if at all possible, allowing them to continue in their roles while safety issues are investigated and addressed.</p> <p>When an incident happens before noon anywhere in the country, it is reported to corporate loss control no later than close of business; incidents that occur after noon must be reported no more than 24 hours after the fact.</p> <p>Root call analysis is employed to identify facts and suggest solutions. The members of the safety committees, which exist in each territory, participate in these root call analyses. When this process has been employed, 30, 60, or 90 days after the incident (depending on its severity), changes are analyzed to gauge effectiveness.</p>
CC	<p>Root cause investigation and analysis are used for safety incidents and near misses.</p> <p>Investigation teams are formed at a local level, steered by supervisors, and include key employees and staff who are knowledgeable about the incident and the techniques of root cause analysis.</p> <p>The company has a dedicated Internal Reporting System (IRS) that includes OSHA-demanded reporting and company standards for reporting near misses, accidents, and incidents.</p> <p>The IRS houses data collected daily, weekly, and monthly driven by leading and lagging indicators.</p> <p>The IRS also drives the analysis process and performs quality checks for corrective action.</p> <p>Specific safety professionals are brought in to assist investigations when necessary.</p>
DD	<p>The board will be dissatisfied with the company's having the most improved safety record in history if there is a single fatality.</p> <p>The company has developed a "potential for injury" assessment as a leading indicator to supplement "injuries per 100,000 miles of railroad."</p> <p>The CEO and VP of operations and engineering review every reportable accident investigation every Monday at 7:00 a.m.</p> <p>The CEO begins every earnings call with a review of the safety record for the quarter. Every board meeting begins with a report on the condition of the safety culture for the prior month.</p>

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Table C-5. (Continued).

Company	Key Reporting and Investigation Points
EE	<p>The company uses the Apollo Root Cause Analysis method and employs facilitators who have undergone specialty training.</p> <p>Formal reports are filed for each incident and are published and available to employees.</p> <p>The company encourages open reporting environments and benchmarks safety performance against peers in the industry.</p> <p>The company uses climate assessment tools to measure employee engagement and review global employee opinion every 2 years.</p> <p>The company uses a simple system (red, yellow, green) when asking employees to assess safety factors.</p>
FF	<p>The company employs a centralized reporting system across all continents and regions, with data entered monthly.</p> <p>The company documents major incidents involving a fatality or serious injury and reports them to the CEO immediately; lesser medical incidents are reported to the local president.</p> <p>The company values employee participation and encourages involvement and input for creation of policies, procedures, and investigation processes.</p>
GG	<p>The company's Operation Integrity Management System includes 11 key elements, one of which is incident reporting and analysis. This element lays out the expectations and processes involved for people to report safety incidents within their organizations.</p> <p>All incidents and near misses that are reported are investigated.</p> <p>Lower-level, less complex incidents are analyzed with a fairly simple root cause analysis flowchart that includes five or six key questions used to identify contributing factors.</p> <p>More complex and significant incidents are addressed using more complex tools, in particular Tap Root, a computer-based tool that drills down in very fine detail to find root causes and contributing factors.</p> <p>All information is entered into a database; each incident is assigned an "owner" and "follow-through due date" and is tracked until closed.</p>
HH	<p>Within 24 hours of any safety incident, there is a conference with all parties: leadership from that office, operations from that office, people involved in the incident, the CEO, and the corporate safety director.</p> <p>Daily e-mails are sent out to all staff at 4:05 p.m. to review and address relevant issues, allowing safety to be the last thing on people's minds each day. E-mails are a major tool; easy to read and graphically concise, they allow employees to identify key points easily.</p> <p>Every single employee, including upper management, is evaluated on safety performance in annual reviews. Safety is a part of every person's job description and goals for the year.</p>
II	<p>Fifty-five performance indicators are measured by the hour.</p> <p>Safety culture is measured using a survey developed by an Australian university; the survey uses open-ended questions, allowing employees to answer at length if so desired.</p> <p>The company has an open occurrence reporting system that is accessible to everyone in the organization. Reporting can be done anonymously or openly. Overwhelmingly, employees choose to report openly.</p> <p>All departments have a small safety cell that promptly investigates each occurrence. These cells make recommendations to resolve issues, change procedure, and/or change policy.</p>

## APPENDIX D

# Draft Transit Safety Culture Survey

## Respondent-Specific Information

1. What is your primary job responsibility?
  - Operate revenue vehicles
  - Repair revenue vehicles
  - Clean or service revenue vehicles
  - Maintain rail right-of-way
  - Supervise
  - Manage
  - Other
2. How many years have you worked for your transit agency?
  - 0–5
  - 6–10
  - 11–15
  - 16–20
  - More than 20
3. In what functional part of your transit agency do you work?
  - Bus
  - Rail
  - Operations management
  - Operations support
  - Paratransit
  - Other
4. How safe is your job?
  - Very safe
  - Somewhat safe
  - Not very safe
  - Not all safe

## **Informed Culture**

### **How well does your organization collect and analyze relevant data and disseminate safety information throughout?**

5. Do you agree that your manager or supervisor does not always inform you of everything you need to know about safety problems that might affect you?  
 Strongly agree  
 Agree  
 Disagree  
 Strongly disagree
6. Do you agree that the methods your transit agency uses to communicate changes to safety procedures and rules to all employees are effective?  
 Strongly agree  
 Agree  
 Disagree  
 Strongly disagree
7. Does your transit agency have a safety committee for dealing with safety issues?  
 Yes, management only  
 Yes, union (employee representatives for nonunion agencies) and management both on the committee  
 No safety committee
8. If yes to the previous question, how would you rate the effectiveness of the safety committee?  
 Very effective  
 Somewhat effective  
 Not very effective  
 Not at all effective

## **Understanding and Adhering to Safety Rules**

9. Do you agree that your transit agency ensures that you understand the risks you face and the rationale behind the safety rules that apply to your immediate workplace?  
 Strongly agree  
 Agree  
 Disagree  
 Strongly disagree
10. Do you personally closely follow your immediate workplace safety rules and procedures?  
 Very closely  
 Somewhat closely  
 Not very closely  
 Not at all closely
11. Do your coworkers closely follow your immediate workplace safety rules and procedures?  
 Very closely  
 Somewhat closely  
 Not very closely  
 Not at all closely

12. If safety rules are not always followed in your immediate workplace, what degree of impact does each of the following factors have on the lack of rule compliance?

	Heavy	Some	Little	None
Too few workers to get the work done	( )	( )	( )	( )
Pressure from above to ignore some safety rules and procedures to get the work done	( )	( )	( )	( )
Some safety rules and procedures do not need to be followed to get the job done safely	( )	( )	( )	( )

### Adequacy of Safety Training

13. How would you rate the overall quality of the initial safety training you received in the first few months on the job?
- ( ) Excellent
  - ( ) Good
  - ( ) Fair
  - ( ) Poor or no training
14. Other than new employee training, how would you rate the overall quality of any safety training you have received in the last 3 years?
- ( ) Excellent
  - ( ) Good
  - ( ) Fair
  - ( ) Poor or no training
15. Do you agree that your transit agency provides adequate refresher safety training on a periodic basis?
- ( ) Strongly agree
  - ( ) Agree
  - ( ) Disagree
  - ( ) Strongly disagree

### Reporting Culture

**Does your transit agency encourage employees to report safety issues and concerns without fear of punishment and with confidence that management will act on the situation?**

16. Do you agree that you are strongly encouraged to report unsafe conditions?
- ( ) Strongly agree
  - ( ) Agree
  - ( ) Disagree
  - ( ) Strongly disagree
17. Do you agree that in your immediate workplace, management, and supervision have an open-door policy on safety issues and act quickly to correct safety problems when identified?
- ( ) Strongly agree
  - ( ) Agree
  - ( ) Disagree
  - ( ) Strongly disagree

18. Do you agree that management is only concerned about safety after a serious accident or incident?
- Strongly agree
  - Agree
  - Disagree
  - Strongly disagree
19. Have you ever had a close call or near miss on the job during which someone came close to being seriously injured or killed?
- Yes
  - No
20. If yes to the previous question, was the most recent incident that happened to you formally reported?
- Yes
  - No
21. If no to question 19, was the incident not reported because of (check all that apply):
- Fear of discipline
  - No harm, no foul
  - Lack of near-miss reporting procedures
  - Nothing will be done anyway
  - No incentives for reporting near misses
  - None of the above
22. Do you agree that in your immediate workplace, workers can report near misses without fear of blame or punishment?
- Strongly agree
  - Agree
  - Disagree
  - Strongly disagree

## **Learning Culture**

### **Does your transit agency learn from its mistakes and continually react to feedback and new information?**

23. Do you agree with the statement that when accidents or incidents occur in your immediate workplace, agency procedures require management and supervision to conduct a thorough investigation, address all relevant issues, engage all employee levels in the analysis, and ensure that everyone in the workplace understands any new rule, process, or procedure that results from the investigation?
- Strongly agree
  - Agree
  - Disagree
  - Strongly disagree
24. Do you agree that your transit agency learns from accidents and incidents and uses what has been learned to prevent recurrences?
- Strongly agree
  - Agree
  - Disagree
  - Strongly disagree

## Flexible Culture

**Does your transit agency adapt in an effective manner to changing demands on the system?**

25. Do you agree that your transit agency adapts easily to changing conditions and demands on the system where safety is concerned?
- Strongly agree
  - Agree
  - Disagree
  - Strongly disagree
26. Do you agree that in your immediate workplace, a worker can get safety rules and procedures changed by making a good case for the change?
- Strongly agree
  - Agree
  - Disagree
  - Strongly disagree
27. Do you agree that in your immediate workplace, workers have full authority to stop service or work at any time if they observe a hazardous condition?
- Strongly agree
  - Agree
  - Disagree
  - Strongly disagree

## Just Culture

**Does your transit agency allow for maximum avoidance of major errors by differentiating disciplinary consequences resulting from unintentional unsafe acts from deliberate, reckless, unjustifiable, and indefensible acts that place the agency and its employees at risk?**

28. Has anyone in your immediate workplace ever been disciplined for his or her role in an accident or incident?
- Yes
  - No
29. If yes to the previous question, did you personally think the discipline was fair?
- Yes
  - No
30. Do you agree that when dealing with accidents or incidents, your transit agency almost exclusively focuses on disciplining individuals instead of preventing recurrences?
- Strongly agree
  - Agree
  - Disagree
  - Strongly disagree
31. Do you agree that employees receive just treatment in your immediate workplace, which helps create a state of mutual trust among managers, supervisors, and hourly employees?
- Strongly agree
  - Agree
  - Disagree
  - Strongly disagree

### Underlying Perceptions, Attitudes, and Behaviors

32. Do you agree that in your immediate workplace, management, supervision, and workers know what you are doing; you trust each other; you work together; you know how to work safely; and you do it?
- Strongly agree
- Agree
- Disagree
- Strongly disagree
33. Do you agree that in your experience, your transit agency and its employees have a shared set of values, attitudes, and behaviors that combine to make the agency a safer place to work?
- Strongly agree
- Agree
- Disagree
- Strongly disagree

34. Do you agree or disagree with the following statements?

	Strongly Agree	Agree	Disagree	Strongly Disagree
It is my responsibility to make sure my day-to-day work environment is safe.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is important to me that there is a continuing emphasis on safety.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is my supervisor's and/or my manager's responsibility to make sure my work environment is safe.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Upper management really does make safety the highest priority.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
When people ignore safety rules and procedures in my specific workplace, it is none of my business.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

35. How would you characterize union–management cooperation in dealing with safety matters at your transit agency? (Question for union represented agencies only)
- Excellent
- Good
- Fair
- Poor
36. Do you agree that you (or your union representatives) are involved in all important safety matters? (Question for union represented agencies only)
- Strongly agree
- Agree
- Disagree
- Strongly disagree



## APPENDIX E

## References

- Aase, K., and G. Nybø. 2002. "Organizational Knowledge in High-Risk Industries: What Are the Alternatives to Model-Based Learning Approaches?" Paper presented at the Third European Conference on Organizational Knowledge, Learning, and Capability, Athens, April 5–6.
- Ahmed, S. January 2011. Elements of an Effective Safety Culture. PowerPoint slides. Retrieved from [amonline.trb.org/167mm9](http://amonline.trb.org/167mm9).
- American Public Transportation Association. 1998. *Manual for the Development of Bus Transit System Safety Program Plans*. Washington, D.C.: APTA Bus Safety Management Program.
- Argyris, C. 1957. *Personality and Organization*. New York: Harper & Row.
- . 1976. *Increasing Leadership Effectiveness*. New York: Wiley-Interscience.
- . 1990. *Overcoming Organizational Defenses: Facilitating Organizational Learning*. Boston: Allyn and Bacon.
- Argyris, C., and D. Schön. 1974. *Theory in Practice: Increasing Professional Effectiveness*. San Francisco: Jossey-Bass.
- . 1978. *Organizational Learning: A Theory of Action Perspective*. Reading, MA: Addison Wesley.
- . 1996. *Organizational Learning II: Theory, Method, and Practice*. Reading, MA: Addison Wesley.
- Bailey, L. L., L. M. Peterson, K. W. Williams, and R. C. Thompson. 2000. "Controlled Flight into Terrain: A Study of Pilot Perspectives in Alaska." DOT/FAA/AAM-00/28. Office of Aviation Medicine, Washington, D.C.
- Blair, E., and M. O'Toole. 2010. "Leading Measures: Enhancing Safety Climate and Driving Safety Performance." *Journal of Professional Safety* 55 (8), pp. 29–34.
- Blair, E. H., and B. S. Spurlock. 2008. "Leading Measures for Safety Performance." Proceedings of the ASSE Safety 2008 Professional Development Conference, Las Vegas, NV.
- Bloess, J. 2007. Developing a Positive Safety Culture. PowerPoint slides. See [http://aapa.files.cms-plus.com/SeminarPresentations/07\\_OPSAFIT\\_Bloess\\_John.pdf](http://aapa.files.cms-plus.com/SeminarPresentations/07_OPSAFIT_Bloess_John.pdf).
- Boin, A., and P. Schulman. 2008. "Assessing NASA's Safety Culture: The Limits and Possibilities of High-Reliability Theory." *Public Administration Review* 68 (6), pp. 1050–1062.
- Carelse, V. 2011. *An Analysis of the Safety Practices at Sasol Polymers by Applying a Safety Culture Framework*. Research Report, University of Stellenbosch, Stellenbosch, South Africa.
- Carroll, J. 1998. "Organizational Learning Activities in High-Hazard Industries: The Logics Underlying Self-Analysis." *Journal of Management Studies* 35 (6), pp. 699–717.
- Center for Chemical Process Safety. 2011. Process Safety Metrics Reporting. <http://www.aiche.org/ccps/publications/psmetrics.aspx> (accessed June 14, 2011).
- Civil Air Navigation Services Organisation (CANSO). 2008. Safety Culture Definition and Enhancement Process Model. Hoofddorp, The Netherlands: CANSO Safety Standing Committee.
- Clarke, S. 1999. "Perceptions of Organizational Safety: Implications for the Development of Safety Culture." *Journal of Organizational Behavior* 20, pp. 185–198.
- Clarke, S. G. 2000. "Safety Culture: Underspecified and Overrated?" *International Journal of Management Review* 2 (1), pp. 65–90.
- Cooper, M. 2000. "Towards a Model of Safety Culture." *Safety Science* 36, pp. 111–136.
- . 2002. "Surfacing Your Safety Culture." Proceedings of the Major Hazard Commission at the Federal Ministry of Environment Human Factors Conference. Loccum, Germany.
- Cox, S., and A. Cheyne. 2000. "Assessing Safety Culture in Offshore Environments." *Safety Science* 34, pp. 111–129.
- Cox, S., and T. Cox. 1991. "The Structure of Employee Attitudes to Safety: A European Example." *Work and Stress* 8, pp. 93–106.
- Creswell, J. W., A. C. Klassen, V. L. Plano Clark, and K. C. Smith, for the Office of Behavioral and Social Sciences Research. August 2011. *Best Practices for Mixed Methods Research in the Health Sciences*. National Institutes of Health. See [http://obssr.od.nih.gov/mixed\\_methods\\_research](http://obssr.od.nih.gov/mixed_methods_research) (accessed November 6, 2012).
- Culture Change Consultants. 2006. "United Technologies Division Achieves Breakthrough Safety Performance Through Safety Culture Initiative." See [www.culture-change.org/HamStandard.pdf](http://www.culture-change.org/HamStandard.pdf) (accessed June 14, 2011).
- Dekker, S. 2007. *Just Culture: Balancing Safety and Accountability*. Farnham, Surrey, UK: Ashgate Publishing Company.
- Donald, L., and D. Canter. 1994. "Employee Attitudes and Safety in the Chemical Industry." *Journal of Loss Prevention in the Process Industries* 7, pp. 203–208.
- Dooley, J. 1999. Problem Solving as a Double-Loop Learning System. See [www.well.com/user/dooley/Problem-solving.pdf](http://www.well.com/user/dooley/Problem-solving.pdf).
- EFCOG/DOE. 2009. Assessing Safety Culture in DOE Facilities. EFCOG Meeting Handout. EFCOG/DOE Safety Culture Task Team. January 23.
- Eiff, G. 1999. "Organizational Safety Culture." Proceedings of the 10th International Symposium on Aviation Psychology 1–14, Columbus, OH, Ohio State University.

- Ekvall, G. 1983. "Climate, Structure, and Innovativeness of Organizations." Working paper, Swedish Council for Management and Organizational Behavior.
- FAA. 2008. "FAA Proposes \$10.2 Million Civil Penalty Against Southwest Airlines." Press release, March 6.
- Fleming, M. 2000. "Safety Culture Maturity Model." Offshore Technology Report 2000/049. HSE Books.
- Flin, R., K. Mearns, P. O'Connor, and R. Bryden. 2000. "Measuring Safety Climate: Identifying the Common Features." *Safety Science* 34 (1–3), pp. 177–193.
- Froetscher, J. 2011. "CEOs Who Get It." *Safety + Health*. See <http://www.nsc.org/safetyhealth/Pages/211CEOsWhoGetIt.aspx>.
- Frost, P., L. Moore, M. Reis, and C. Lundberg, eds. 1991. *Reframing Organizational Culture*. Newburg Park, CA: Sage Publications, Inc.
- Galloway, S. April 2010. "Assessing Your Safety Culture in Seven Simple Steps." *EHS Today*. See <http://ehstoday.com/safety/news/assessing-safety-culture-seven-simple-steps-9093/index1.html> (accessed June 14, 2011).
- Geller, E. 2008. "People-Based Leadership: Enriching a Work Culture for World-Class Safety." *Professional Safety*, March, pp. 29–34.
- Gill, G., and G. Shergill. 2004. "Perceptions of Safety Management and Safety Culture in the Aviation Industry in New Zealand." *Journal of Air Transport Management* 10, pp. 233–239.
- Gittell, J. 2005. *The Southwest Airlines Way*. New York: McGraw-Hill.
- Glendon, A. I., and N. A. Stanton. 1998. "Safety Culture: Top Down and Bottom Up Approaches." Paper presented at the International Association of Applied Psychology Conference, San Francisco, August.
- . 2000. "Perspectives on Safety Culture." *Safety Science* 34, pp. 193–214.
- Glick, W. 1985. "Conceptualizing and Measuring Organizational and Psychological Climate: Pitfalls in Multi-Level Research." *Academy of Management Review* 10 (3), pp. 601–616.
- Guldemund, F. 2000. "The Nature of Safety Culture: A Review of Theory and Research." *Safety Science* 34, pp. 251–257.
- Hannan, M., and J. Freeman. 1984. "Structural Inertia and Organizational Change." *American Sociological Review* 49, pp. 149–164.
- Hartley, R. 2010. High Reliability Organizations. PowerPoint presentation to the NTSB, February 25, hearing on the 2009 WMATA accident.
- Health and Safety Commission. 1993. *ACSNI Study Group on Human Factors. 3rd Report: Organising for Safety*. London: HMSO.
- Health and Safety Executive. 2001. "The Ladbroke Grove Rail Inquiry," Vienna, Austria.
- Hewitt, M. 2011. Relative Culture Strength: A Key to Sustainable World-Class Safety Performance. PowerPoint presentation, DuPont Safety Resources, Wilmington, DE.
- Hudson, P. 1999. "Safety Culture Theory and Practice." Center for Safety Science. RTO MP-032. Presented at RTO HFM Workshop, The Human Factor in System Reliability—Is Human Performance Predictable? Siena, Italy.
- Hudson, P. 2001. "Safety Management and Safety Culture: The Long and Winding Road." As presented to CASA, September 10, Canberra, Australia.
- Idaho National Engineering and Environmental Laboratory. 2001. Idaho National Engineering and Environmental Laboratory Voluntary Protection Program: Total Safety Culture. Retrieved December 10, 2011, from <http://www.inel.gov/vpp/total-safety-culture.shtml>.
- International Atomic Energy Agency. 2002. *Safety Culture in Nuclear Installations: Guidance for Use in the Enhancement of Safety*. Vienna, Austria: IAEA.
- International Civil Aviation Organization (ICAO). 2005. Safety Management Manual. Document 9859. See <http://legacy.icao.int/osg/isd/afi/Reference%20Material%5CSafety%20Oversight%20Manuals%5CSafety%20Management%20System%5CSMS%20Manual.pdf>.
- International Nuclear Safety Advisory Group (INSAG). 2002. "Key Practical Issues in Strengthening Safety Culture." International Atomic Energy Agency Publication INSAG-15. Vienna, Austria.
- James, L., and A. Jones. 1974. "Organizational Climate: A Review of Theory and Research." *Psychological Bulletin* 81 (12), pp. 1096–1112.
- Katz, D., and R. L. Kahn. 1966. *The Social Psychology of Organizations*. New York: Wiley.
- Kennedy, R., and B. Kirwan. 1995. "The Failure Mechanisms of Safety Culture." In A. Camino and G. Weimann, eds., *Proceedings of the International Topical Meeting on Safety Culture in Nuclear Installations*, Vienna, Austria: American Nuclear Society of Austria, pp. 281–290.
- Kotter, J. P., and J. L. Heskett. 1992. *Corporate Culture and Performance*. New York: Free Press.
- Krause, T. R. 2005. *Leading with Safety*. Hoboken, NJ: Wiley.
- Kuenzi, M., and M. Schminke. 2009. "Assembling Fragments into a Lens: A Review, Critique, and Proposed Research Agenda for the Organizational Work Climate Literature." *Journal of Management* 35 (3), pp. 634–717.
- La Porte, T. 1996. "High Reliability Organizations: Unlikely, Demanding, and At Risk." *Journal of Contingencies and Crisis Management* 63 (4), pp. 60–71.
- La Porte, T., and P. Consolini. 1991. "Working in Practice but Not in Theory: Theoretical Challenges of High Reliability Organizations." *Journal of Public Administration Research and Theory* 1 (1), pp. 19–47.
- Lee, T. 1998. "Assessment of Safety Culture at a Nuclear Reprocessing Plant." *Work and Stress* 12 (3), pp. 217–237.
- Lessin, N. 2000. Presentation made at Workplace Safety and Health in the Year 2000 and Beyond: Organizing for the Future, cosponsored by the New York State AFL-CIO and NYCOSH, June 12.
- Levitt, B., and J. March. 1988. "Organizational Learning." *Annual Review of Sociology* 14, pp. 319–38.
- Lewin, K., R. Lippitt, and R. K. White. 1939. "Patterns of Aggressive Behavior in Experimentally Created 'Social Climates.'" *Journal of Social Psychology* 10, pp. 271–301.
- Likert, R. 1961. *New Patterns of Management*. New York: McGraw-Hill.
- . 1967. *The Human Organization*. New York: McGraw-Hill.
- Ludwig, D., C. Andrews, N. Veen, and C. Laqui. 2007. *ACRP Report 1: Safety Management Systems for Airports, Volume 1: Overview*. Transportation Research Board of the National Academies, Washington, D.C.
- Maine Municipal Association. 2005. "Best Practices Guide to Developing Your Safety Policy Mission Statement." Augusta, ME: MMA Risk Management Services.
- Marais, K., N. Dulac, and N. Leveson. 2004. Beyond Normal Accidents and High Reliability Organizations: The Need for an Alternative Approach to Safety in Complex Systems. ESD Symposium. Massachusetts Institute of Technology, Cambridge, MA.
- McConnell, J. 2010. Safety Culture in High-Reliability Cultures. PowerPoint slides. See [www.hss.doe.gov/deprep/ftcp/NELT/2010\\_Module1-SafetyCulture.pdf](http://www.hss.doe.gov/deprep/ftcp/NELT/2010_Module1-SafetyCulture.pdf).
- McDonald, J., P. Worthington, and D. Compton. 2008. PowerPoint Presentation, EFCOG/DOE Safety Culture Task Status, September 16.
- McGregor, D. M. 1960. *The Human Side of Enterprise*. New York: McGraw-Hill.
- Meacham, J. 1983. "Wisdom and the Context of Knowledge." In D. Kuhn and J. Meacham, eds., *Contributions in Human Development* 8, pp. 111–134. Basel, Switzerland: Karger.
- Morrow, S., and V. Barnes. 2012. Independent Evaluation of INPO's Nuclear Safety Culture Survey and Construct Validation Study. Technical paper prepared for the Nuclear Regulatory Commission,

- June (ML12172A093). See <http://pbadupws.nrc.gov/docs/ML1217/ML12172A093.pdf>.
- Muhren, W., G. Van Den Eede, and B. Van de Walle. 2008. "Organizational Learning for the Incident Management Process: Lessons Learned from High Reliability Organizations." Retrieved from <http://is2.lse.ac.uk/asp/aspecis/20070116.pdf>.
- Naevestad, T. 2009. "Mapping Research on Culture and Safety in High Risk Organizations: Arguments for a Sociotechnical Understanding of Safety Culture." *Journal of Contingencies and Crisis Management* 7 (2), pp. 126–136.
- Occupational Safety and Health Administration, Oregon Chapter. 2005. "How to Develop Effective Safety Accountability." OR-OSHA Publication 119. Salem Central Office: Public Education Section, Department of Business and Consumer Business.
- O'Toole, M. 2002. "The Relationship Between Employees' Perceptions of Safety and Organizational Culture." *Journal of Safety Research* 33, pp. 231–243.
- Parker, D., M. Lawrie, and P. Hudson. 2006. "A Framework for Understanding the Development of Organizational Safety Culture." *Safety Science* 44, pp. 551–562.
- Paul, M. 1997. "Moving from Blame to Accountability." The Systems Thinker Newsletter. Pegasus Communications, Inc., Waltham, MA.
- Perrow, C. 1999. *Normal Accidents Living with High Risk Technologies*, 2nd ed. Princeton, NJ: Princeton University Press.
- Peters, T. J., and R. H. Waterman. 1982. *In Search of Excellence*. New York: Harper & Row.
- Petersen, D. 1996. *Analyzing System Safety Effectiveness*, 3rd ed. New York: Van Nostrand Reinhold.
- Pettigrew, A. M. 1979. "On Studying Organizational Cultures." *Administrative Science Quarterly* 24, December, pp. 570–581.
- . 1990. "Two Constructs in Search of a Role." In B. Schneider, ed., *Organizational Climate and Culture*. San Francisco: Jossey-Bass.
- Pidgeon, N. 2012. "Complex Organizational Failures: Culture, High Reliability, and the Lessons from Fukushima." National Academy of Engineering's *The Bridge on Social Sciences and Engineering Practices* 42, No. 3 (Fall).
- Ranney, J. 2003. Safety Culture. PowerPoint slides. See [www.fra.dot.gov/downloads/Research/SafetyCulture.pdf](http://www.fra.dot.gov/downloads/Research/SafetyCulture.pdf).
- Ranney, J. 2011. Volpe Center White Paper—Critical Elements of Safety Culture. Prepared for U.S. DOT Safety Council.
- Reason, J. 1997. *Managing the Risks of Organizational Accidents*. Farnham, Surrey, UK: Ashgate Publishing Company.
- . 1998. "Achieving a Safe Culture: Theory and Practice." *Work and Stress* 12 (3), pp. 293–306.
- Roberts, K., ed. 1993. *New Challenges to Understanding Organizations*. New York: Macmillan College Division.
- Roberts, K. 1990. "Some Characteristics of One Type of High Reliability Organization." *Organization Science* 1 (2), pp. 160–170.
- . 2010. Overview: Developing the Field of High Reliability Organizing. PowerPoint presentation to the NTSB February 25, 2010, hearing on the WMATA 2009 accident.
- Schein, E. 1965. *Organizational Psychology*. Englewood Cliffs, NJ: Prentice-Hall.
- . 1985. *Organizational Culture and Leadership*, 1st ed. San Francisco: Jossey-Bass.
- . 1992. *Organizational Culture and Leadership*, 2nd ed. San Francisco: Jossey-Bass.
- Schneider, B., M. G. Ehrhart, and W. H. Macey. 2010. "Perspectives on Organizational Climate and Culture." In S. Zedeck, ed., *APA Handbook of Industrial and Organizational Psychology*. See <http://www.apa.org/pubs/books/4311502.aspx>.
- Senge, P. 1990. *The Fifth Discipline: The Art and Practice of the Learning Organization*. New York: Doubleday.
- Severson, K. 2011. 100 Percent Fall Protection: A Joint Union Management Effort. Web log post, April 11. See <http://incidentprevention.com/component/k2/article/142.html>.
- Short, J., Boyle, L., S. Shakelford, B. Inderbitzen, and G. Bergoffen. 2007. *Commercial Truck and Bus Safety Synthesis Program (CTBSSP) Synthesis 14: The Role of Safety Culture in Preventing Commercial Motor Vehicle Crashes*. Transportation Research Board of the National Academies, Washington, D.C.
- Singer, S., D. Gaba, J. Geppert, J. Sinaiko, S. Howard, and K. Park. 2003. "The Culture of Safety: Results of an Organizational Wide Survey." *Quarterly and Safety Health Care*, April, pp. 112–118.
- Smircich, L. 1983. "Concepts of Culture and Organizational Analysis." *Administrative Science Quarterly* 28, pp. 339–358.
- Sorenson, J. 2002. "Safety Culture: A Survey of the State-of-the-Art." *Reliability Engineering and System Safety* 76, pp. 189–204.
- Spitz, G. M., F. L. Niles, and T. J. Adler. 2006. *TCRP Synthesis 69: Web-Based Survey Techniques*. Transportation Research Board of the National Academies, Washington, D.C. <http://www.tcrponline.org/bin/publications.pl?mode>.
- Taylor, B. 2010. *Safety Culture: Assessing and Changing the Behavior of Organisations*. Farnham, Surrey, UK: Gower Publishing.
- Taylor, J., and R. Thomas. 2003. "Toward Measuring Safety Culture in Aviation Maintenance: The Structure of Trust and Professionalism." *International Journal of Aviation Psychology* 13 (4), pp. 321–343.
- Toellner, J. 2001. "Improving Safety and Health Performance: Identifying and Measuring Leading Indicators." *Professional Safety* 46 (9), pp. 42–47.
- Transit Rail Advisory Committee for Safety. 2011. Implementing Safety Management System Principles in Rail Transit Agencies—Final. PowerPoint presentation.
- Turner, B. 1978. *Man-Made Disasters*. London: Wykeham.
- Turner, B., N. Pidgeon, D. Blockley, and B. Toft. 1989. "Safety Culture: Its Importance in Future Risk Management." Position paper for the Second World Bank Workshop on Safety Control and Risk Management. Karlstad, Sweden, November.
- U.S. Department of Labor, Occupational Safety and Health Administration. 2012. Memorandum, Employer Safety Incentive and Disincentive Policies and Practices, March 12.
- U.S. Department of Transportation, Federal Transit Administration. 2012. MAP-21 Fact Sheet, Transit Safety and Oversight, Section 5329. See [www.fta.dot.gov/map21](http://www.fta.dot.gov/map21).
- U.S. Department of Transportation, Federal Transit Administration. 2013. Advance Notice of Proposed Rule Making, September 25.
- U.S. Federal Register. 2012. Volume 17, No. 174, Part III, Department of Transportation Federal Railroad Administration, 49CFR Part 270, System Safety Program, Proposed Rule, September 7.
- Uttal, B. 1983. "The Corporate Culture Vultures." *Fortune*, October, pp. 66–72.
- Volpe Center Highlights. 2009. "Simulation Standard Targets Aviation Safety." April.
- Von Thaden, T., D. Wiegmann, A. Mitchell, G. Sharma, and H. Zhang. 2003. "Safety Culture in a Regional Airline: Results from a Commercial Aviation Safety Survey." Proceedings of the Tenth International Symposium on Aviation Psychology, Dayton, OH, Columbus Ohio Department of Aviation.
- Weick, K. 1987. "Organizational Culture as a Source of High Reliability." *California Management Review* 24 (2), pp. 112–127.

- Weick, K., K. Sutcliff, and D. Obstfeld. 1999. "Organizing for High Reliability." *Research in Organizational Behavior* 21, pp. 81–123.
- Westrum, R. 1993. "Cultures with Requisite Imagination." In J. Wise, V. Hopkin, and P. Stager, eds., *Verification and Validation of Complex Systems: Human Factors Issues*. New York: Springer-Verlag.
- Whittingham, R. 2004. *The Blame Machine: Why Human Error Causes Accidents*. Oxford, UK: Elsevier.
- Wiegmann, D., and T. von Thaden. 2007. "A Review of Safety Culture Theory and Its Potential Application to Traffic Safety." AAA Foundation for Traffic Safety.
- Wiegmann, D., T. von Thaden, A. Mitchell, G. Sharma, and H. Zhang. 2003. "Development and Initial Validation of a Safety Culture Survey for Commercial Aviation." Technical Report AHFD-03-3/FAA-03-1. University of Illinois at Urbana-Champaign.
- Wiegmann, D., H. Zhang, T. von Thaden, G. Sharma, and A. Gibbons. 2004. "Safety Culture: An Integrative Review." *International Journal of Aviation Psychology* 14 (2), p. 127.
- Wiegmann, D., H. Zhang, T. von Thaden, G. Sharma, and A. Mitchell. 2002. Aviation Research Lab. A Synthesis of Safety Culture and Safety Climate Research. Technical Report ARL-02-3/FAA-02-2. Savoy, IL.
- Williams, J. 2002. "Improving Safety Leadership: Using Industrial/Organizational Psychology to Enhance Safety Performance." *Professional Safety*, April, pp. 43–74.
- Williamson, A., A. Feyer, D. Cairns, and D. Biancotti. 1997. "The Development of a Measure of Safety Climate: The Role of Safety Perceptions and Attitudes." *Safety Science* 25, pp. 15–27.
- Zhang, H., D. Wiegmann, T. von Thaden, G. Sharma, and A. Mitchell. 2002. "Safety Culture: A Concept in Chaos?" Proceedings of the 46th Annual Meeting of the Human Factors and Ergonomics Society, Santa Monica, CA.
- Zohar, D. 1980. "Safety Climate in Industrial Organizations: Theoretical and Applied Implications." *Journal of Applied Psychology* 65 (1), pp. 96–102.
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*Abbreviations and acronyms used without definitions in TRB publications:*

A4A	Airlines for America
AAAAE	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	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
HMCRRP	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
MAP-21	Moving Ahead for Progress in the 21st Century Act (2012)
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