Many improvements in rail safety over the past century— such as warning lights and safer work practices—resulted from new technological and procedural approaches.

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Railroads and Research
Sharing Track

Evaluations of Demonstration Pilots Produce Change

Fourteen Years of Safety-Culture Improvement Efforts by the Federal Railroad Administration

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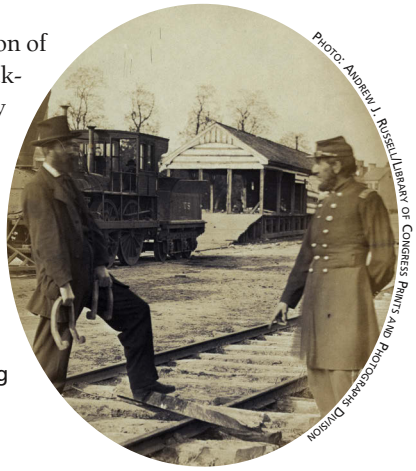
Railroading began in the 1830s with the invention of the steam engine. Reflecting the military backgrounds of its early managers, the industry adopted a command-and-control style that relied on punishment and discipline to maintain smooth operations. The style, however, also fit an enterprise that needed tight control to prevent widespread disruptions and uncertain operating conditions. The result was a reactive management style and adversarial relations between labor and management.



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U.S. Army railroad operations in northern Virginia during the Civil War. The military backgrounds of the rail industry's early managers set the tone for employee relations.

The industry was so dangerous that a workman's compensation model of support for injured employees was not viable; between 1888 and 1894, for example, more than 16,000 fatalities were associated with the joining or coupling of cars. The Federal Employers' Liability Act (FELA) of 1908 based compensation on the allocation of relative fault determined through legal proceedings.

This history prevented a culture of information-sharing and problem solving. No framework arose for understanding why railroad accidents occurred. Instead, simplistic, superficial explanations prevailed; today's view is that accident causes are rooted in systems—a complex of technology, business, human behavior, process, and operating environments (*1*). The railroad industry was not set up to be responsive to system-based safety approaches to minimizing risk.

As a result, the industry relied on technological and procedural approaches. Technological approaches deal with work-environment design, such as signals or personal protection equipment; procedural approaches address work practices, such as rules for sounding a horn when approaching a crossing.

These targeted approaches have proved successful—in the past 40 years, accidents have decreased and have remained at low levels. The same statistics, however, also indicate that technology and procedure approaches, considered individually, are limited in their ability to continue to improve safety. Analyzed in terms of employee hours and of train miles, the trends in accident reduction have slowed considerably since 1985 (*2*).

A combination of business conditions, federal policy, labor–management relations, accident statistics, evolving opinion, and research on the causes of accidents encouraged the Federal Railroad Administration (FRA), management, and labor to experiment with system-based safety culture interventions.

Safety Culture Approaches

To address the slow progress in reducing accidents, the FRA Office of Research and Development (ORD) implemented an evaluation program from 1998 to 2012 to identify and test system-based safety culture interventions: what would work and why, what benefits could be expected, and how those innovations could be maintained. The evaluation program produced four approaches to system-based safety culture change:

- Participative Safety Rules Revision,
- Investigation of Safety-Related Occurrences Protocol (ISROP),
- Clear Signal for Action (CSA), and
- The Confidential Close-Call Reporting System (C^3RS).

Photo: Harlan Holferty/Library of Congress Prints and Photographs Division

A major wreck on the T.P. & W.R.R. near Chatsworth, Illinois, in 1887, was labeled "the most appalling railroad disaster on the Continent." In the late 19th and early 20th centuries, the rail industry was so dangerous that workman's compensation was impossible to implement.

FRA was a major driver of CSA and C^3RS; the railroad industry initiated Participative Safety Rules Revision and ISROP. ORD evaluated the programs and analyzed what enhanced and what limited the success.

The programs encompassed six aspects of system-based safety approaches:

- Risk identification,
- Collaborative problem-solving,
- Root-cause determination,
- Peer-to-peer coaching and feedback,
- Implementation of corrective actions, and
- A mechanism by which dangerous and sensitive conditions could be openly discussed without fear of retribution.

In ISROP and C^3RS, the dominant themes were collective root-cause problem solving and implementation of corrective actions. CSA added the unique element of peer-to-peer coaching and feedback. Participative rules revision dealt exclusively with collaborative problem-solving by labor and management.

The testing and evaluations included 14 demonstration pilot sites; eight passenger and freight railroads; one barge line; and workers in the transportation, mechanical, track, signal, and passenger-service unions (Table 1, page 30). ORD's evaluation program aimed at determining whether any of these approaches would work in railroad settings.

ORD's Program

Evaluators at FRA and the Volpe National Transportation Systems Center examined the evaluations and impacts and incorporated industry perspectives on the lessons learned from each of the demonstration pilot sites. Safety improvements were seen as the approaches were implemented.

As a result, the industry was educated on the value not only of safety culture approaches but also of independent, objective evaluations. To ensure the rigor of the evaluations, FRA recruited and assembled a group of experts with the working relationships and technical capabilities to design and execute a range of rail-related evaluation projects (*3*).

Safety Rules Revision

Description of Approach

The many mergers in the railroad industry in the 1980s and 1990s led to a proliferation of operating rules, some overlapping and some conflicting. The rules are critical in directing safe behavior, but too many can be counterproductive, with disagreements about application and confusion about expectations. Moreover, in the industry's fault-based liability structure, rules violations can generate tension between labor and management (*4*–*6*).

In the traditional approach to rules revision, managers write rules without labor involvement. Stakeholder involvement, however, is a key element and strategy for evaluation; FRA therefore was interested in demonstrations that involved a joint effort of labor and management. Initially, the evaluations addressed four questions:

- Which rules should remain?
- Which rules should cover all employees and which should be craft-specific?
- What wording would make the new rules observable and enforceable?
- What wording would ensure that a rule is unambiguous and describes the *only* proper way to perform a work activity?

Actively involving labor, with the support of management, is meant to generate labor's ownership of the rules, encouraging compliance, improving the

TABLE 1 Chronology of ORD Pilots

Approach	Carrier	Start Year	Population
Participative Safety Rules Revision	CSX Transportation	1991	Mechanical, track, engineering, transportation, signal
	American Commercial Barge Lines*	1999	All operating departments
	Kansas City Southern	2000	Mechanical, track, engineering, transportation, signal
	Canadian National–Illinois Central	2001	Mechanical, track, engineering, transportation, signal
Root-Cause-Analysis Problem Solving	Canadian Pacific (3 sites)	2003	Three mechanical departments
Clear Signal for Action (CSA)			
EAGLES (Employee Alliance for Great Levels of Excellence in Safety)	Amtrak	2001	Baggage, Red Caps, ticket and gate agents, customer service
CAB (Changing At-Risk Behavior)	Union Pacific	2005	Road and yard crews
STEEL (Safety Through Employees Exercising Leadership)	Union Pacific	2006	Yard crews
Confidential Close-Call Reporting System (C^3RS)	Union Pacific	2007	Conductors, engineers
	Canadian Pacific	2008	Conductors, engineers
	New Jersey Transit	2009	Conductors, engineers
	Amtrak	2010	Conductors, engineers

* Not a railroad but a transportation carrier with workers subject to a rule structure similar to that of railroads.

labor–management relationship, and strengthening the safety culture.

The Participative Safety Rules Revision was applied in two phases. The first comprised activities that made clear management's willingness to involve labor in deciding which rules were worthy of retaining and which should be removed from the rulebook. In the second phase, labor and management collaborated to simplify and reduce the rules and to make them more objective and enforceable.

This project tested two hypotheses:

1. Labor involvement and collaboration with management would provide a better understanding of which rules could be observed and enforced and which could not, and
2. Collaboration would improve safety and safety culture.

Methods and Findings

The evaluation involved interviews of participants in the review and revision of the rules. The results suggested that a successful approach requires both safety leadership and collaborative problem solving by labor and management.

Respondents from carriers that used both safety leadership and participative rulemaking reported a positive shift in safety culture. The work force experienced a change in the value of rules—survey responses transitioned from "mostly not helpful" to "mostly helpful." This is a major accomplishment—an alteration in the way that labor historically had viewed railroad industry rules.

The interviews also suggested improvements in labor–management relations and in rule compliance. The number of rules dropped significantly at all four participating transportation carriers, as shown in Table 2 (above, right).

TABLE 2 Number of Safety Rules Before and After Revision

Railroad	Total Rules Before	Total Rules After	Craft Rules After	Core Rules After
American Commercial Barge Lines	400	125	101	24
Canadian National–Illinois Central	1,360	686		
CSX Transportation	900			17
• Transportation		36	19	
• Mechanical		105	88	
• Track and engineering*		105	88	
Kansas City Southern	742			17
• Transportation		110	93	
• Mechanical		259	242	
• Track and engineering		244	227	
• Clerical		115	98	

* Informed estimate; specific count not available.

An analysis of FRA incident data showed that at one railroad, the rules-revision approach resulted in a drop of approximately 30 percent in reportable injuries across all crafts. Two sites observed a decrease in liability claims. In addition, the rules revision approach added a previously unrecognized distinction between core rules and craft-specific rules.

Root-Cause Analysis

Description of Approach

Railroads were implementing different, innovative risk-management and safety culture approaches. Canadian Pacific (CP) Railroad, for example, had established a program for investigating incidents, Investigation of Safety-Related Occurrences Protocol

PHOTO: CANADIAN PACIFIC RAILROAD

Canadian Pacific Railroad allowed FRA to study its incident investigation program, which comprised safety leadership, root-cause analysis of close-call and incident investigations, corrective actions, and safety communication.

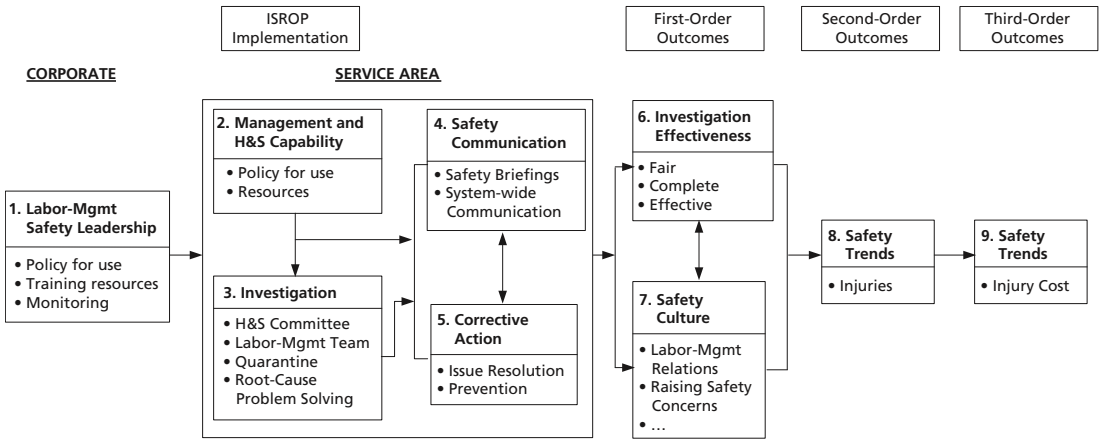


FIGURE 1 Logic of operations and impact: Investigation of Safety-Related Occurrences Protocol (ISROP). (Mgmt = management; H&S = health and safety

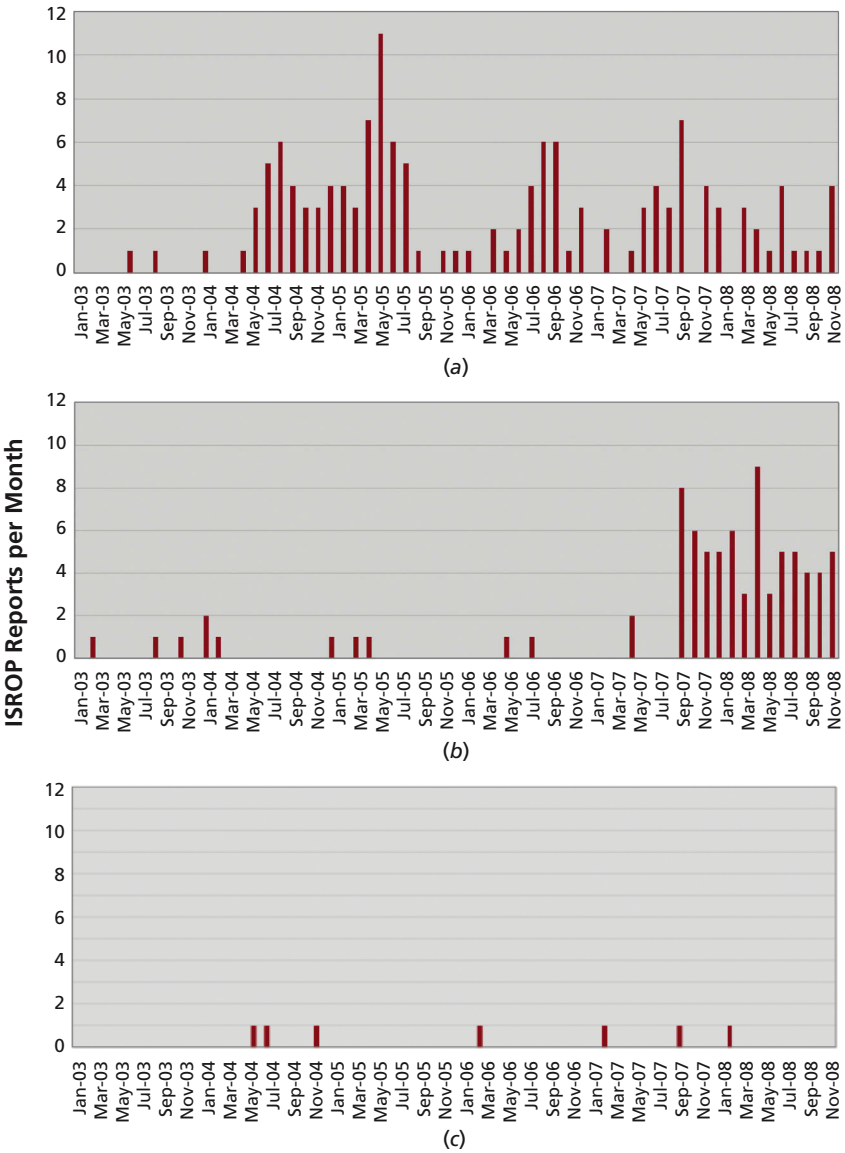


FIGURE 2 Injury reduction related to number of investigations: (*a*) Department 1: many investigations, 50 percent (significant) reduction in injury rate; (*b*) Department 2: later start, 43 percent (significant) reduction in injury rate; and (*c*) Department 3: few investigations, 4 percent reduction in injury rate.

(ISROP), which appeared to be influencing safety culture. Senior management at CP agreed to allow FRA to evaluate ISROP, which combines labor–management safety leadership, labor–management root-cause analysis of close-call and incident investigations, corrective actions, and safety communication. As the program was rolled out, senior management reviewed investigation reports to ensure that the list of contributing causes included such factors as company policy, procedures, and management practices.

FRA evaluated ISROP at three mechanical departments at three locations. One site was a high user of ISROP, one was a moderate user, and the third a low user. Figure 1 (above) depicts a model of the ISROP process (*7–9*).

Methods and Findings

Quantitative measures included the numbers of investigations and injuries, as well as the scores on a safety culture scale. Qualitative data included field notes, analysis of corrective actions, and baseline and follow-up interviews with workers and managers at the three sites.

ISROP produced many investigations and corrections of safety-related problems. Between April 2003 and January 2008, the site that used the protocol the most conducted 142 investigations; the site that used it slightly less, 114 investigations; and the site that used it the least, seven investigations. The highest-use site experienced a 50 percent decrease in injury rates; the sites that made less use of ISROP experienced correspondingly smaller changes (Figure 2, at left).

Clear Signal for Action

Description of Approach

CSA integrates three processes that have worked in other industries to improve safety:

- Peer-to-peer feedback (*10, 11*),

◆ Continuous process improvement (*10–13*), and
◆ Safety leadership (*14, 15*).

With strong labor–management cooperation, the three processes work together to address risks that are within workers' control, as well as systemic issues that only management can correct. Outcomes of the process include changes in worker practices, systemic conditions, and management practices. In turn, these changes result in improvements in safety and safety culture (*2, 16–21*). Figure 3 (below) illustrates the CSA process.

Methods and Findings

Three demonstration pilot sites were evaluated. Quantitative measures included railroad safety outcomes such as injuries, locomotive engineer decertifications, derailments, and a pre- and postperception survey. Qualitative measures included interview results and analyses of project records to assess the extent of implementation.

The first demonstration focused on baggage handlers at Amtrak in Illinois and resulted in a 76 percent reduction in injuries (*12*). The second demonstration was with Union Pacific road crews in Texas and resulted in a 79 percent decrease in locomotive engineer decertifications—considered a proxy for collisions, because running through a red signal risks crashing into another train. The third demonstration was with Union Pacific yard crews in Louisiana and recorded a 62 percent reduction in derailments and a resulting increase in productivity, with less time spent on repairs.

PHOTO: MATT JOHNSON

A pilot demonstration of the Clear Signal for Action approach with Amtrak baggage handlers led to a 76 percent reduction in injuries.

Interview and survey data suggested that safety culture improved, although the three sites varied in how effectively the local managers led the approaches. Pilot sites with strong leaders improved safety culture and had smoother implementations. The success of the pilot sites encouraged Union Pacific and Amtrak to expand CSA throughout their organizations.

Close-Call Reporting System

Description of Approach

C^{3}RS sends close-call reports through a neutral third party to remove sensitive information and then

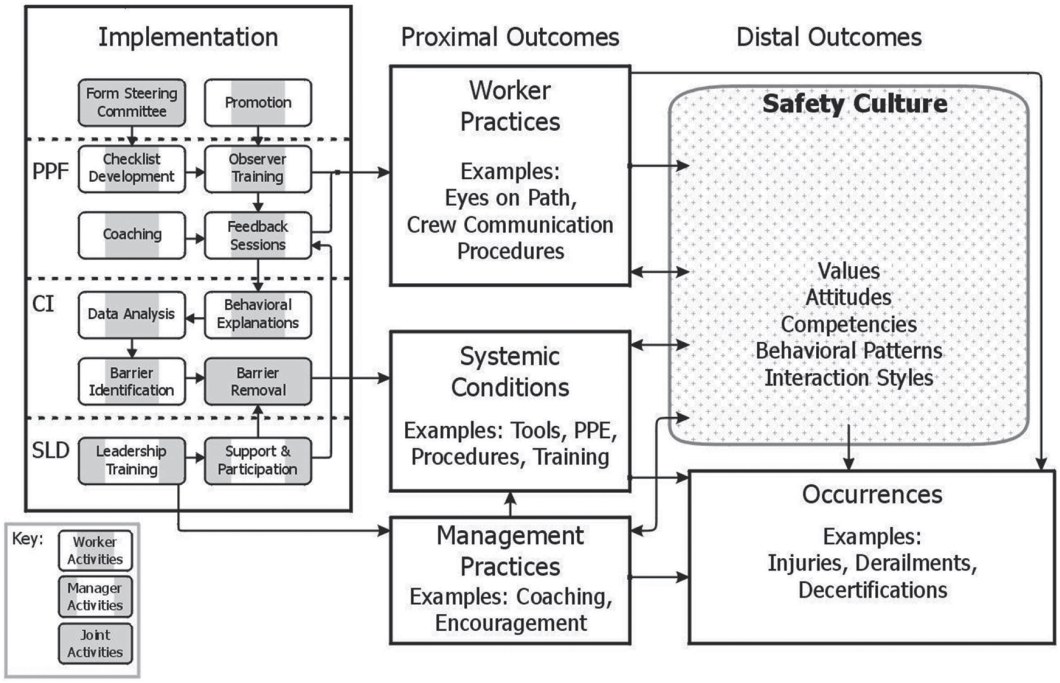


FIGURE 3 Logic of operation and impact: Clear Signal for Action (CSA) process. (PPF = peer-to-peer feedback; CI = continuous improvement; SLD = safety leadership development; PPE = personal protective equipment.)

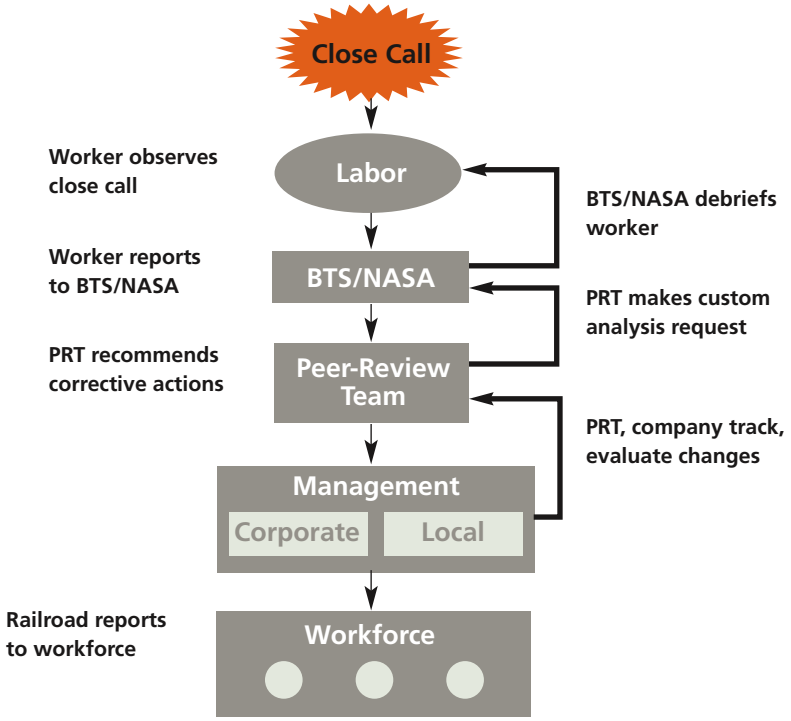
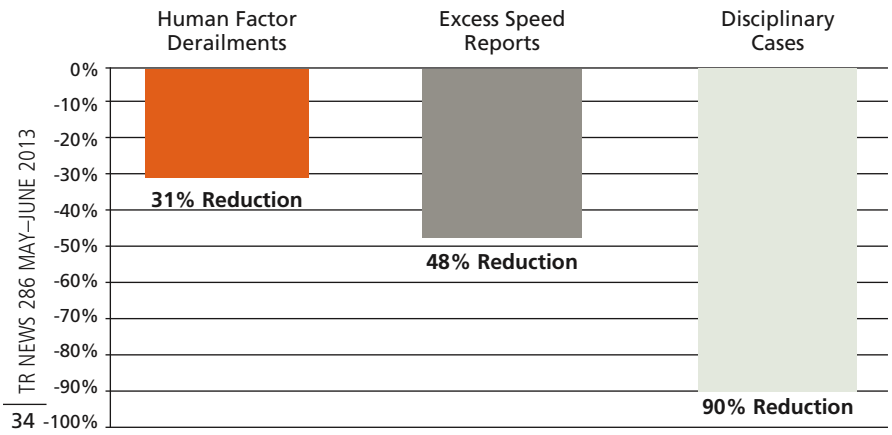


FIGURE 4 Confidential Close-Call Reporting System (C³RS) process. (BTS = Bureau of Transportation Statistics; NASA = National Aeronautics and Space Administration; PRT = peer-review team.)

transmits the case to a problem-solving peer-review team of labor, management, and FRA representatives. The reports allow railroads to learn more about risks and to mitigate risks, while protecting employees from blame (*22, 23*). Figure 4 (above) depicts the C³RS process.

With C³RS, the peer-review teams, trained in root-cause analysis and continuous-process improvement, analyze close-call events for the root causes of accidents and recommend corrective actions. Interposed between the worker and management is a neutral third party—either the Bureau of Transportation Statistics or the National Aeronautics and Space Administration, depending on the railroad involved—that collects event reports and communicates to the railroad, protecting employee identities.

FIGURE 5 C³RS impacts at one site (percent change).



Methods and Findings

Four pilot sites have implemented all elements of C³RS successfully, including third-party reporting, close-call case analysis by labor–management teams, and corrective actions. A commonly reported problem was excessive speed on the mainline track during "slow orders," when multiple orders to slow down because of track maintenance are grouped closely together. The recommended corrective action encouraged maintaining one speed—the lowest velocity—throughout all adjacent slow orders.

Quantitative analysis of these sites showed a 31 percent decrease in human factors–related derailments for one railroad (Figure 5, below left). At the same site, tests found positive changes in many validated survey scales of safety culture (Table 3, page 35). In interviews, knowledgeable respondents indicated that disciplinary cases decreased by approximately 90 percent. Data indicated a 48 percent decrease in C³RS reports related to excess speed.

Beyond the Pilots

ORD's evaluation program has affected the industry in many ways (Table 4, page 35). Many labor, management, and FRA personnel who were committed to the demonstrations became advocates for system-based approaches to reduce risk and to improve safety culture. Relationships among these advocates facilitated collaboration, coalitions, and gradual industrywide culture change.

Knowledge about the demonstrations spread within the industry through research briefs, conferences and presentations, efforts of the C³RS national steering committee, and other targeted meetings, events, and activities that included labor, management, and government stakeholders. The results from the demonstrations have precipitated a variety of changes within both the industry and the U.S. Department of Transportation.

Evaluations of FRA's 14-year evaluation program to test new approaches to improving safety and safety culture confirm that the approaches can be implemented successfully with (*a*) a high and sustained level of commitment and championship by the senior management of a carrier and (*b*) visible, active leadership from labor and management at all levels. Implementing the approaches required considerable effort, formative evaluations improved the implementations, and the success of the implementations was an accomplishment in and of itself.

The evaluations also confirmed significant positive results in improving safety and safety culture, as well as the value of change effected collaboratively by labor and management in these areas, as summarized in Table 5 (page 36).

Acknowledgments

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TABLE 3 Confidential Close-Call Reporting System: Safety Culture Change for Labor and Management

Safety Culture Scale	Significant Improvement	
	Management	Labor
Labor–management relations	X	X
Organizational fairness during change	X	
Supervisor fairness	X	X
Supervisor–employee relationships		X
Management safety	X	X
Raising concerns with supervisors		X
Work safety priorities		X
Helping behavior		X
Coworker safety	X	

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TABLE 4 Safety Culture Changes Influenced by ORD Program

Organization	Changes
Canadian Pacific	Systemwide policy change, with emphasis on systems instead of individuals
Toronto Transit	Systemwide safety culture program
Union Pacific Railroad	Systemwide total safety culture program
Federal Railroad Administration	Risk-reduction program
Congress	Rail Safety Improvement Act of 2008 requires railroads to develop risk-reduction programs that systematically evaluate risk. ("The Secretary may conduct behavior-based safety and other research, including pilots before promulgating regulations….")
Amtrak	Safe-to-Safer Program: $20 million effort aimed at organizational culture change, improved collaboration, and peer-to-peer safety
BNSF	Safety leadership development
Norfolk Southern	Peer-to-peer electronic distraction pilot
U.S. Department of Transportation Safety Council	Includes a safety culture action team to spread safety culture within the department

TABLE 5 Summary of Results Across All Pilots

Approach	Functions	Outcomes
Participative Safety Rules Revision	All operating	• 30% reduction in reportable injuries • Drop in liability claims
Root-Cause Analysis Problem Solving	Mechanical	• 50% drop in injury rates (all injuries)
Clear Signal for Action	Station services	• 76% drop in injury rates • 71% drop in reportable injuries
	Road crews	• 79% drop in locomotive engineer decertification rates • 81% drop in derailments
	Yard crews	• 62% drop in yard-derailment rates
Confidential Close Call Reporting System	Road and yard crews	• 31% reduction in derailments at one site • 90% drop in disciplinary cases • 48% drop in excess-speed reports

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The Sunnyside rail yard in Queens, New York, was the site of an Amtrak pilot test of the Confidential Close-Call Reporting System.

PHOTO: FLOWIZM, FLICKR