SJSU SAN JOSÉ STATE UNIVERSITY

MTI MINETA TRANSPORTATION INSTITUTE

Rail Safety and Opportunities for Progress

Project 2345
February 2026

Michael J. Rush and Brenda Moscoso, Association of American Railroads

Executive Summary

Over the past two decades, U.S. freight railroads have made major strides in safety. The train accident rate has fallen 31% since 2005, with the hazardous materials rate down 80%. Positive Train Control (PTC) is now deployed on 57,536 route-miles—just over 40% of the U.S. network—covering major Class I freight main lines that carry heavy tonnage or move PIH/TIH hazmat, effectively spanning the nation's primary freight corridors. Despite these achievements, further improvements are needed in areas such as grade crossing safety, deployment of technology, including automated track inspection, and continued workforce modernization.

- **Grade Crossing Safety.** The number of collisions at crossings has declined 37% since 2000 (the collision rate is down 25% since that time), but incidents remain too frequent. Demonstration projects show that four-quadrant gates and median barriers can cut violations by 98%. Public education campaigns like Operation Lifesaver have also proven effective. Next steps include maintaining Section 130 grant funding as well as the Grade Crossing Elimination (RCE) program, strengthening driver education, and piloting AI-powered monitoring at high-risk crossings.

- **Automated Technologies.** The track-caused accident rate is down 49% since 2005 thanks in part to consistent private investment and new inspection tools, but further reduction is slowed by a lack of regulatory innovation. Multiple Class I railroads use wayside detectors, machine-vision portals, and drones to spot defects in real time. Union Pacific has expanded its own network of advanced wayside detectors and machine-vision systems, integrating these tools into daily operations to identify equipment issues earlier and improve overall network reliability. To scale these tools, FRA should work with industry to modernize inspection requirements.

- **Private Investment**. Since 1980, railroads have invested more than $780 billion in their networks—funding major projects like CSX's Howard Street tunnel, BNSF's Sandpoint Junction Connector bridge, and CPKC's new international bridge in Laredo. Railroads have begun publishing forward-looking capital plans and participating in expanded public-private partnerships, which may contribute to long-term network reliability. Realizing planned investment more efficiently will require updates to federal permitting processes, including reforms to Section 106.

- **Workforce Modernization**. Employee injuries have fallen 62% since 2000, and the next frontier is preparing workers for a technology-driven rail network. Railroads are already training thousands of employees and first responders through simulators, virtual reality, and hazmat programs. To scale these efforts, the industry can deepen partnerships with technical colleges and universities and develop tiered certification pathways tied directly to career advancement.

U.S. freight rail safety remains historically strong, with employee injury rates near record lows. Continued improvement will require sustained industry leadership and consistent collaboration with government partners. By prioritizing grade-crossing upgrades, expanding the use of proven automated technologies, reinforcing long-term investment, and modernizing workforce training, the rail industry can build on this foundation and further enhance the safety and efficiency of the national network.

Introduction

Rail safety in the United States has significantly improved over the past two decades, with advancements in technology, infrastructure, and operations contributing to a safer and more efficient rail network. According to the latest data from the Federal Railroad Administration (FRA), the train accident rate per million train-miles has dropped 31% since 2005 and 13% since 2023, while the hazardous materials accident rate has declined 80% since 2005[1]. The implementation of Positive Train Control (PTC) since late 2020[2] has helped reduce the most catastrophic types of incidents. PTC is a federally mandated automated system that uses GPS, wireless communications systems, and computers to prevent collisions, movement over misaligned switches, overspeed derailments, and incursions into active work zones.

Despite these gains, safety performance varies by cause category, and some areas—particularly grade crossings and human-factor incidents—show less improvement. This issue brief identifies areas where continued progress is possible and outlines potential strategies across grade-crossing safety, automated inspections, investment processes, and workforce development. Together, these areas represent key opportunities for policymakers and railroads to further strengthen safety outcomes.

Opportunities for Grade Crossing Safety Improvements

While technology and operational advances have reduced many causes of train accidents, incidents at grade crossings, where roads intersect directly with railroad tracks, remain a persistent challenge, despite substantial progress over the past two decades. The grade crossing collision rate has declined 23% since 2000, but the frequency of incidents underscores the need for further intervention. The total number of public crossings has decreased by 12% since 2005, while crossings equipped with gates have increased by 42%—a clear indication of substantial investment in safety measures implemented in partnership among communities, railroads, and often federal funding. Additionally, crossing fatalities are down 34% since 2000, and recent technologies present opportunities to further reduce risks.

Demonstrations such as North Carolina's "Sealed Corridor" have shown that adding four-quadrant gates and median barriers can reduce driver violations by as much as 98%[3], with measurable reductions in fatalities at upgraded crossings. Rail safety education is also a key tool for reducing grade crossing accidents. Operation Lifesaver's outreach campaigns now reach more than 850,000 people annually[4], across 47 states and the District of Columbia, while national initiatives like Rail Safety Week help sustain long-term awareness.

Implementation Strategies for Grade Crossing Safety

- *Target infrastructure upgrades:* Maintain federal/state matching grants, including FRA Section 130 funds designed to address safety at grade crossings by implementing technology like gates and warning lights, and closing the most dangerous crossings.

- *Maintain the Rail Crossing Elimination Program*: Maintain authorized funding and eligibility under the FRA's Railroad Crossing Elimination program to include multi-jurisdictional projects and grade separations tied to freight corridors as part of future surface transportation reauthorization bills.

- *Expand public awareness efforts*: Partner with Operation Lifesaver, schools, and insurance providers to create standardized rail safety education modules for drivers. Leverage social media outreach and geotargeting near crossings.

Expanding Automated Track Technologies

Beyond grade crossings, a second major opportunity for safety improvement lies in the further deployment of automated inspection technologies that enhance detection and decision-making. The advancement of automated track inspection technologies has significantly contributed to rail safety by identifying track defects before they cause accidents. Since 2005, the track-caused accident rate has dropped by 49%, demonstrating the effectiveness of enhanced monitoring and maintenance practices. Additionally, the broken rail-caused accident rate is down 44% since 2000, and modern automated track inspection techniques have enabled more frequent and accurate assessments.

Class I railroads use track geometry technology to continuously collect geometry data during regular service, with locomotive-mounted geometry systems also widely deployed. They also deploy machine vision, ultrasound, and ground-penetrating radar[7] to find flaws invisible to traditional inspection. In one example, a Class I carrier's automated inspection portals flagged more than 25,000 mechanical defects in 2024—including 85 critical issues—and even identified a hairline wheel crack[6] that would have been nearly impossible to detect manually.

Challenges of Automated Track Inspection

- High upfront and ongoing costs for certain railroads.

- Integration and duplication challenges with legacy manual inspection requirements.

- Regulatory requirements designed around manual inspection practices.

Taken together, these challenges underscore that the primary barrier to wider adoption of automated inspection technologies is not technological capability, but the alignment of policy, regulation, and implementation pathways. Addressing these constraints requires a deliberate shift toward modernized, performance-driven oversight.

Implementation Strategies for Track Inspection

- **Regulatory Modernization**: Update FRA inspection regulations to allow automated inspections to substitute for some manual reviews where demonstrated performance and safety benefits clearly exceed those of traditional methods, while ensuring that overall inspection integrity is maintained.

- **Next-Generation Tools**: Explore federal partnerships with universities and national labs to advance emerging monitoring technologies—such as enhanced drones, satellite, and remote-sensing capabilities—and evaluate targeted pilot projects in areas where additional situational awareness could complement existing inspection practices.

The Need for Continued Investment

Complementing operational and technological tools, sustained capital investment forms the backbone of long-term rail safety and reliability. Private investment has been critical to the success of the U.S. freight rail system, allowing for modernization and safety enhancements without heavy reliance on public funding. The industry has invested more than $780 billion since 1980 to upgrade tracks, bridges, and safety systems.

Recent high-profile projects highlight the scale of needed investment: CSX's $566 million Howard Street Tunnel clearance program[9] is expanding double-stack service along the East Coast; BNSF's new 4,875-foot Sandpoint Junction Connector bridge[10] in Idaho (opened 2023) has relieved a key bottleneck; and Canadian Pacific Kansas City (CPKC) completed a $100 million second international bridge at Laredo in 2024[11], doubling cross-border freight capacity. Union Pacific has likewise advanced major network improvements, including multi-year capacity expansions across the Powder River Basin and key double-tracking and siding extensions that have strengthened fluidity across its western corridors. Meanwhile, Chicago's CREATE program is projected to eliminate more than 1.3 million hours of passenger delays annually[12], while preventing hundreds of vehicle-train collisions.

Implementation Strategies for Balanced Investments

- **Permitting Reform**: Support efforts to streamline federal permitting—including improvements to NEPA timelines and Section 106 review—to reduce delays, improve predictability, and ensure that private and public investment can reach construction more quickly while maintaining appropriate environmental and historic safeguards.

- **Public-Private Partnerships**: Railroads can continue to partner with federal and state governments on programs such as CRISI and INFRA, leveraging grant opportunities to accelerate projects that have broad safety and efficiency benefits.

- **Community Engagement**: By engaging local communities early on in capital projects, railroads can build public support and highlight the local economic and safety benefits of continued reinvestment. Positive local outcomes can in turn reinforce the case for sustained private spending.

Re-Tooling and Upskilling the Rail Workforce

Even with substantial capital and technology investments, safety depends on a workforce equipped to operate and manage a modernized rail system. As rail technology evolves, the industry must adapt by ensuring workers have the necessary skills to manage and operate advanced safety systems. Workforce training must shift from traditional roles to proactive safety management and predictive maintenance. The industry has already achieved a 47% reduction in employee injury rates and a 62% drop in the total number of injuries since 2000, underscoring the impact of improved training, technology adoption, and safety protocols.

Several large-scale training initiatives illustrate this shift. BNSF trains employees using more than 70 locomotive simulators[13] customized for terrain and weather conditions. CN's two "campus" facilities in Winnipeg and Homewood, Illinois, have trained more than 70,000 employees[13] since 2014 with hands-on labs for air brakes, fall protection, and slip prevention. Norfolk Southern's McDonough, Georgia, training center—celebrating 50 years in 2024—has integrated virtual reality[13] and a live signal park into its conductor and engineer programs. Finally, the MxV Rail/SERTC training center in Pueblo, Colorado, has provided immersive hazmat and emergency-response courses to more than 75,000 first responders since 1985[14].

Implementation Strategies for Workforce Modernization

- **Develop advanced training programs** that integrate safety fundamentals with modules on automation, predictive analytics, and cybersecurity.

- **Expand partnerships with educational institutions** to create certification pathways, apprenticeships, and specialized curricula.

Conclusion

The gains in U.S. rail safety over the past two decades demonstrate that data-driven regulation, sustained private investment, and technological innovation can materially reduce risk. The next phase of safety improvement, however, will depend less on new mandates and more on aligning policy, oversight, and implementation with proven performance outcomes.

Congress can modernize statute by prioritizing performance-based safety standards, expanding funding for grade-crossing elimination, and ensuring that federal programs incentivize the deployment of advanced inspection and monitoring technologies. Congress should also provide long-term, predictable funding streams that allow railroads and public partners to plan and execute multi-year safety investments.

For the Federal Railroad Administration, the priority should be regulatory modernization. This includes updating inspection rules to fully integrate automated and data-enabled technologies, expanding the use of pilot programs and waivers to evaluate emerging tools, and shifting oversight toward outcome-focused metrics that reward earlier detection and risk reduction. Clear guidance and consistency in implementation will be essential to accelerate adoption while maintaining public confidence in safety outcomes.

For railroads, continued leadership will be critical. This means sustaining private investment in infrastructure and technology and deepening collaboration with regulators and communities to ensure safety improvements translate into real-world risk reduction—particularly at grade crossings and in densely populated corridors.

For states and local communities, partnership remains essential. Grade-crossing safety, land-use planning, and emergency preparedness require coordination among railroads, public agencies, and local stakeholders to ensure that investments are targeted where risks are greatest and benefits are shared broadly.

Taken together, these actions build on what has worked, modernize what has not, and align incentives across government and industry to sustain and accelerate rail safety gains. With the right policy framework and continued collaboration, the U.S. freight rail system can remain one of the safest and most efficient in the world while meeting the demands of a growing and evolving economy.

Endnotes

1. Association of American Railroads, ‘Rail Safety Statistics,’ latest data on accident and hazmat trends.
2. Federal Railroad Administration, ‘Positive Train Control Implementation Status,’ 2020.
3. North Carolina DOT, ‘Sealed Corridor Grade Crossing Safety Program,’ results on four-quadrant gates.
4. Operation Lifesaver, Annual Report, outreach statistics and Rail Safety Week campaigns.
5. CSX Transportation, ‘Autonomous Track Assessment Cars (ATACs)’ fact sheet.
6. Norfolk Southern, ‘Automated Inspection Portals,’ safety results, 2024.
7. BNSF Railway, ‘Technology and Innovation,’ machine vision and GPR deployment.
8. Canadian National Railway, ‘AI Inspection Portals,’ Winter Plan, 2024–2025.
9. CSX, ‘Howard Street Tunnel Clearance Project,’ project details, 2024.
10. BNSF, ‘Sandpoint Junction Connector,’ project announcement, 2023.
11. Canadian Pacific Kansas City, ‘Second Laredo International Bridge,’ completion press release, 2024.
12. CREATE Program, Chicago Region Environmental and Transportation Efficiency Program, FHWA summary.
13. BNSF, CN, and Norfolk Southern training centers program descriptions, company websites.
14. MxV Rail/SERTC, ‘Hazardous Materials Training Programs,’ overview of responder training since 1985.

Acknowledgment

The authors thank Lisa Rose for editorial services, as well as MTI staff Project Assistant Cameron Simons and Graphic Designer Michael Virtudazo.

About the Authors

Michael J. Rush is the Senior Vice President for Safety and Operations at the Association of American Railroads (AAR), where he serves as the industry's chief liaison to federal regulators, including the U.S. Department of Transportation, the Environmental Protection Agency, and the Department of Homeland Security.

Brenda Moscoso serves as Assistant Vice President of Safety Policy and Analysis at the Association of American Railroads, where she has spent the past decade leading industry-wide safety data, policy development, and analytical initiatives.

This report can be accessed at transweb.sjsu.edu/research/2345

The Mineta Transportation Institute (MTI) is a university transportation center located within the Lucas Graduate School of Business at San José State University. MTI supports the advancement of safe, efficient, and innovative surface transportation through research, education, workforce development, and technology transfer.