

RAILROAD SAFETY RESEARCH

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The highest priority of the Federal Railroad Administration is the safety of the U.S. railroad system, which in 1997 comprised 143,000 route-miles of track, 20,000 locomotives, 6,500 passenger cars, 1,270,000 freight cars, and 252,000 employees. The demands on this system are continually growing, and technology developments provide an opportunity to improve system effectiveness and efficiency while also enhancing safety. FRA addresses safety concerns in all phases of railroad operations through research and development (R&D), as well as regulatory and enforcement activities.

Evolution of U.S. Railroad Industry

The changes that have occurred in the U.S. freight railroad industry in the past 3 years have been as dramatic as any that have taken place during the 175-year history of the industry. There are now only four major freight railroads—Burlington Northern Santa Fe, CSX, Norfolk Southern, and Union Pacific—each representing about 20 percent of the industry's business. In addition, there are midsize railroads—Illinois Central (recently merged with Canadian National), Kansas City Southern, Wisconsin Central, Guilford, Montana Rail Link, Florida East Coast, and Soo Line/CP—that serve regional markets, and a large and growing number of short-line railroads throughout the country that have emerged as the large railroads have sold off unprofitable branch lines to private operators with the ability to provide better service at lower cost. These structural changes in the railroad industry have been occurring as the market for railroad freight transportation has continued to reach record levels. The profitability of the industry was at an all-time high in 1997, but has since declined as the major railroads have encountered difficulties in implementing mergers and acquisitions.

The nature of freight railroad operations has also evolved. The freight railroad companies have responded to the growing demand for their services by running more, heavier, and faster trains. The

railroad industry's share of the intercity freight market has grown from less than 38 percent in 1990 to more than 40 percent today. For the first time since World War II, some railroads face capacity constraints on certain lines. Trucking companies, long viewed as competitors of the railroads, are now among the railroads' largest customers, as they contract for the long-haul transport of containers and trailers.

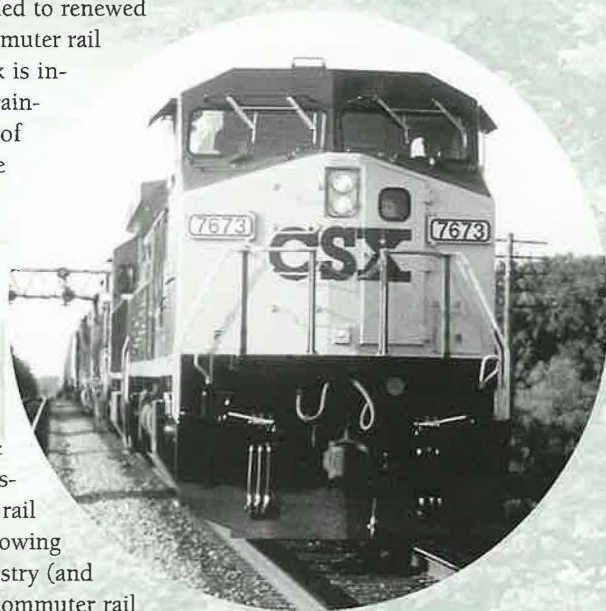
Passenger operations have been evolving rapidly as well. Congestion on highways in and between major urban areas has also led to renewed interest in intercity and commuter rail passenger services. Amtrak is investing in new electrified train-sets that will be capable of providing 150 mph service on the Northeast Corridor between Washington, D.C., and Boston by the year 2000. A number of states, including New York, Michigan, Illinois, Wisconsin, Ohio, Washington, Oregon, California, North Carolina, and Virginia, are establishing high-speed passenger corridors on existing rail lines. The most rapidly growing segment of the railroad industry (and the transit industry) is the commuter rail market; the number of commuter trips has grown by 27 percent during the past decade.

Finally, states are increasingly pursuing the use of new high-speed corridor services to reduce the pressures on highways and airports. The result is a greater commingling of freight and passenger trains on common tracks, which raises new safety concerns.

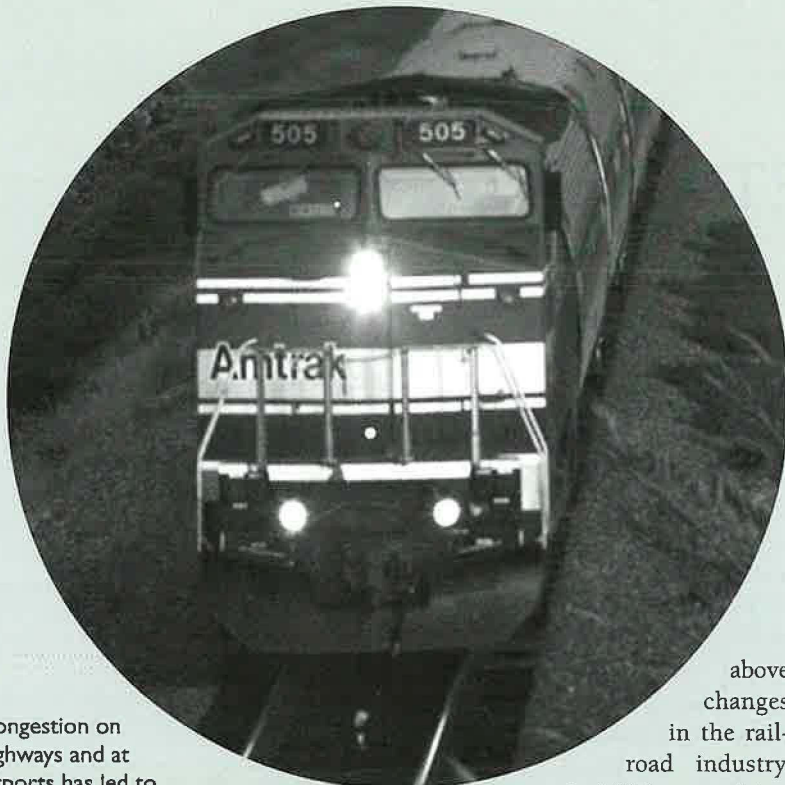
New Institutional Arrangements

Important changes in the institutional arrangements employed by FRA have occurred in parallel with the

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above changes in the railroad industry.

In 1996, recognizing that a major shift in its rule-making procedures was needed, FRA established the Railroad Safety Advisory Committee (RSAC). Under the new process of negotiated rulemakings, RSAC brings together representatives of the large, regional, short-line, and commuter railroads, as well as unions, states, suppliers, and other interested groups, so that agreement can be reached on new regulations in a fair and equitable manner. The various RSAC working groups also identify technological areas requiring further research before agreement on regulations can be reached. Those areas are then reflected in the FRA *Five-Year Strategic Plan for Research, Development, and Demonstrations*.

Despite record traffic levels in the freight railroad industry, consolidation within the railroad industry has meant that there are now fewer railroads with sufficient resources to undertake significant R&D programs. Furthermore, the large railroads have cut back significantly on their own R&D programs. An important emphasis of FRA's R&D activities is therefore on identifying and establishing public-public and public-private partnerships for research, development, and demonstration activities. The objective is to maximize limited resources by leveraging research findings and technological developments from a broad range of sources.

This approach is reflected in the extensive cooperation between FRA and the Association of American Railroads, railroad labor, the states, suppliers, universities, the American Public Transit Association, Amtrak, and the Federal Transit Administration.

Cooperation with AAR occurs primarily at the Transportation Technology Center (TTC) in the areas of track-train interaction, track safety research, bearing defect detection, braking systems, grade crossings, train control, and hazmat transportation (see article by Allen and Kalay in this issue). The Railway Progress Institute arranges for its supplier-members to provide material and equipment for the Facility for Accelerated Service Testing at TTC, and also participates in the Center's hazmat transportation projects. APTA, Amtrak, and FTA cooperate with FRA on projects aimed at improving protection for railroad passengers.

FRA representatives serve on AAR's Railway Technology Working Committee and on a number of other committees that are addressing engineering, mechanical, and signaling and communications issues. FRA staff also participate actively in committees of the Transportation Research Board and the American Railway Engineering and Maintenance of Way Association. Such participation further ensures that duplication of effort is avoided.

Railroad Safety Trends

The railroad industry has invested nearly \$40 billion in track and equipment in the past 10 years. This investment is reflected in the industry's dramatically improved safety record. During 1992 to 1997, the number of casualties decreased from 22,553 to 12,830; there was a slight reduction in the number of deaths from 1,170 to 1,063 and a significant reduction in the number of injuries from 21,383 to 11,767. This improvement is attributable not only to increased investment, but also to greater safety awareness on the part of railroad employees and management. The improvement is also due to a more productive relationship among FRA, railroads, rail labor, and the states that has come about through the Safety Assurance and Compliance Program, which was initiated in 1995 to address systemic rail safety issues. Yet despite these improvements in railroad safety, FRA believes there are still too many railroad accidents of all types. With a goal of zero tolerance for accidents and casualties, FRA has developed its *Five-Year Strategic Plan for Research, Development, and Demonstrations*, which addresses safety issues in every technological area offering promise for reducing the probability of accidents.

FRA's Five-Year Strategic Plan

FRA has established goals and associated objectives for the agency in eight areas: Safety, Customer Focus, Intermodalism, Empowerment and Excellence, Investment, Technological Advancement, Environ-

ment and Community, and Industry Structure. FRA's *Five-Year Strategic Plan for Research, Development, and Demonstrations* addresses two of these goals:

◆ **Safety:** Promote and improve the safety of our national rail transportation system.

Objectives: Reduce all rail-related incidents and casualties; minimize risks related to rail operations.

Supporting R&D Activities:

- Cooperate with the railroad industry on continued R&D initiatives, integration of advanced technologies, and new techniques for improved safety and risk reduction.
- Continue to implement and support programs aimed at upgrading or eliminating high-risk or redundant highway-rail grade crossings.
- Revise or develop regulations and legislation, as appropriate, consistent with statutory directives, pressing safety problems, and changing industry practices and technology.

◆ **Technological Advancement:** Advance technological innovation in rail transportation through leadership and partnership.

Objectives: Promote the use of technology to improve the safety, efficiency, and environmental soundness of rail transportation; in cooperation with public and private entities, invest strategically to advance the state of the art of rail transportation technology; enhance the efficiency of the U.S. railroad industry to improve domestic and international competitiveness.

Supporting R&D Activities:

- Develop and demonstrate new technologies designed to improve rail safety and efficiency in partnership with domestic and international technology innovators.
- Work with governmental and nongovernmental entities to optimize investment in rail technology advancement.
- Facilitate the integration and implementation of new technologies, such as global positioning systems, geographic information systems, technologically advanced train control systems, and electronic information exchange.
- Support the U.S. railroad industry's efforts to increase export opportunities for U.S. technologies and services.
- Promote the U.S. railroad industry's efforts in technological innovation through a variety of communication channels.
- Explore and advance technologies for safe and efficient high-speed ground transportation service for corridors throughout the country.

R&D To Improve Railroad Safety

FRA's R&D program addresses all aspects of the safety of freight, intercity passenger, and commuter railroad operations. The projects undertaken contribute vital inputs to the agency's safety regulatory processes, to railroad suppliers, to the railroads themselves, and to railroad employees and their labor organizations. AAR and FRA have had a long-term public-private partnership at TTC for conducting railroad R&D, and FRA's Five-Year Strategic Plan was developed on the assumption that this partnership will continue. The Board of Directors of AAR has established the Transportation Technology Center, Inc., as a wholly owned subsidiary to manage TTC. TTC provides the infrastructure necessary to conduct experiments and test theories, concepts, and technologies in a number of key areas related to railroad safety.

First, railroad safety depends on the reliability of people, as well as infrastructure, equipment, and control systems. Railroad operations are known to be a hostile, unforgiving environment. Those who operate the system need knowledge, training, and tools, as well as alertness, to do their jobs correctly and ensure their own and their coworkers' safety.

Second, railroad infrastructure comprises many elements, including soil in embankments, ballast, ties, rail, rail-fastening devices, turnouts, bridges,

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and tunnels, that must be designed, installed, maintained, and inspected properly if railroads are to be operated safely. The same is true of railroad equipment. Another major area of safety concern is train control systems, which have historically been very reliable, but still are subject to human error that can cause an accident. These systems need to incorporate new communications, computer, sensor, and display technologies designed to reduce significantly the likelihood of accidents caused by human, infrastructure, and equipment failures.

The transportation by railroad of both passengers and hazardous materials also demands special attention to ensure that a high level of safety is maintained. Finally, a significant safety risk for railroads, their employees, their passengers, and the public occurs at those locations where railroads intersect with streets, roads, and highways.

To address these safety concerns, the FRA Office of Research and Development has formulated the following objectives:

- ◆ Reduce accidents associated with human factors.
- ◆ Detect rolling stock defects and improve rolling stock performance.
- ◆ Detect and prevent track and structures defects.
- ◆ Enhance track–train interaction safety.
- ◆ Prevent train collisions and overspeed accidents.
- ◆ Prevent grade-crossing accidents.
- ◆ Improve the safety of hazardous materials transportation.
- ◆ Improve protection for train occupants.
- ◆ Improve railroad system safety.
- ◆ Improve R&D facilities and test equipment.

The FRA R&D program pursues these objectives through a combination of study, analysis, simulation, and laboratory and field testing.

Coordination with Other Modes

At the national level, there are a number of issues that cut across all modes of transportation. The FRA Five-Year Strategic Plan addresses these issues as they relate to the railroad system, working in collaboration with the other modal administrations of the U.S. Department of Transportation to ensure comprehensive solutions. For example, human factors represent a major cause of railroad accidents, as well as of aviation, maritime, and highway accidents. A major program on Human-Centered Transportation Systems, coordinated by the National Science and Technology Council (NSTC), has been undertaken to improve transportation safety through

enhanced understanding of human factors and ergonomics. A second example of a topic that crosses modal lines is the safe transportation of hazardous materials, whether by ship, truck, or train.

Increasing congestion on highways and greater safety risks on roads, together with the inability to construct new highways in many locales, led to another case of coordination among modes—the Intelligent Transportation Systems program, created by the Intermodal Surface Transportation Efficiency Act of 1991. FRA participates in the ITS program for two reasons: to ensure proper interfaces at grade crossings, where roads and railroads converge, and to facilitate the transfer of technologies developed under the ITS program to the railroad industry.

Finally, NSTC's *Transportation Science and Technology Strategy* and U.S. DOT's *Research and Development Plan* focus on several strategic partnership initiatives. One such initiative is the National Intelligent Transportation Infrastructure, which encompasses positive train control, nationwide differential Global Positioning System (GPS) capabilities, and various technologies needed to support ITS in metropolitan and rural areas and commercial vehicle operations. Other examples are Enhanced Transportation Weather Services and Next-Generation Surface and Marine Transportation Vehicles; the latter initiative includes locomotives for high-speed intercity passenger rail service, as well as automobiles, buses, trucks, and ships.

Peer Review

A 1999 report of the Committee on Science, Engineering, and Public Policy of the National Academy of Sciences and the National Academy of Engineering, entitled *Evaluating Federal Research Programs*, contains the recommendation that federal agencies use peer reviews in establishing the direction and content of their R&D programs. In accordance with this recommendation and at the request of the Senate and House Appropriations Committees, FRA contracted with the Transportation Research Board to establish a Committee To Review the FRA R&D Program. This committee, which includes representatives of the states, railroads, unions, universities, financial institutions, and research organizations, meets biannually and is providing important advice to FRA on the content, magnitude, and direction of its safety R&D agenda.

For more information visit the Federal Railroad Administration R&D website at www.fra.dot.gov/o/dev/index.htm or FRA's general website at www.fra.dot.gov/site/index.htm.