

FREIGHT RAIL TECHNOLOGY

- AI, drones, and sensors help keep the network safe and efficient.
 - Technology supports, instead of replaces, railroad employees.
 - MxV Rail provides research and testing; Railinc runs the industry's digital operations.
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Freight railroads lead in technological advancement. They integrate predictive analytics, automation, AI, and advanced inspection systems to enhance safety, efficiency, and sustainability. By investing billions in infrastructure and innovative tools, railroads are modernizing operations. This helps meet global supply chain demands while reducing environmental impact. This progress complements—not replaces—the expertise and ingenuity of the workforce. It ensures that technology enhances their vital role in delivering safe, reliable, and efficient rail service.

Empowering Employees

Freight rail employees work in a fast-paced environment where real-time data, automation, and digital tools are transforming safety and decision-making. Augmented and virtual reality training let workers practice safety procedures, train handling, and emergency responses in simulated environments. This reduces risk while improving readiness. [Remote-control locomotives \(RCL\)](#) in rail yards further enhance efficiency. They streamline switching operations and minimize employee exposure to hazardous conditions.

[Positive Train Control \(PTC\)](#) assists locomotive engineers by automatically preventing certain types of human-caused errors. Drones provide aerial inspections of tracks, bridges, and yards. This helps safeguard employees while also delivering real-time data that strengthens infrastructure assessments and maintenance planning.

Safeguarding Infrastructure & Equipment

To safeguard infrastructure and equipment, railroads use technology to monitor track, locomotives, and railcars in real time. This allows for proactive maintenance and early issue detection.

- **Train inspection portals** (aka TIPs) use high-speed imaging and AI to identify wheel damage, brake issues, and structural wear as trains pass through at speed. They replace manual inspections and reduce downtime.
- **Autonomous track inspection (ATI) systems**, including track geometry cars and drones with LiDAR imaging, continuously scan tracks for defects.
- **Wayside detectors** monitor wheel integrity, axle temperature, and track alignment to prevent derailments. Locomotive sensors track engine, brake, and fuel system performance. This helps identify potential failures before they happen.
- **Sonar technology** assesses bridge stability by detecting underwater erosion and structural weaknesses, ensuring the integrity of critical crossings.

Reducing Emissions

Even as the most fuel-efficient way to move goods over land, railroads are adopting new technologies to further cut emissions. This includes anti-idling systems that reduce locomotive idle time by 50% and fuel management systems. These systems optimize speed, spacing, and timing to boost efficiency by up to 14%.

Railroads are also testing battery-electric and hydrogen fuel cell locomotives, with some already in service in Canada. Additionally, they are exploring hybrid models that recharge during braking and could lower emissions by nearly 30%. Beyond locomotives, zero-emission intermodal cranes are eliminating a major source of yard emissions. They also reduce noise. Moreover, truck idling technologies—such as biometric scanners, video portals, and automated gate systems—are streamlining yard operations. These technologies cut wait times and improve efficiency.

Keeping Supply Chains Moving

Railroads, which move 40% of U.S. long-haul freight, are a critical link in global supply chains. They rely on technology to enhance efficiency and reliability. Real-time GPS and API-integrated tools give customers detailed shipment insights. These insights include locations and railcar availability. Smart dispatching software—similar to air traffic control—reevaluates schedules, speed restrictions, and crew assignments every two minutes. This enables rapid adjustments to delays, weather, and maintenance needs.

Researching & Innovating

The [AAR Strategic Research Initiatives \(SRI\) Program](#), led by [MxV Rail](#) and guided by industry experts, drives innovation in freight rail by developing practical, data-driven solutions. These solutions improve safety, reliability, and efficiency. As the industry's leading research and testing center, MxV Rail brings together more than 250 technical experts. They have decades of experience to tackle real-world challenges through engineering, data science, and field testing.

Recent focus areas include AI-powered inspection systems to spot defects before delays occur, track deflection monitoring tools that detect subgrade issues early, and updated vehicle-track interaction standards to reduce equipment stress. Climate modeling is also employed to help infrastructure withstand wildfires, floods, and extreme heat.

Managing Critical Data

[Railinc](#), an AAR subsidiary based in Cary, NC, serves as the freight rail industry's digital backbone. It manages critical data and software systems that ensure safe, efficient, and interoperable operations across North America. Powering real-time equipment tracking, proactive maintenance through systems like Umler® and EHMS, and financial transactions. Additionally, GIS-based location management is part of their process. Railinc handles over 300 million transactions daily to enable seamless communication, shipment visibility, and industry-wide innovation.

Among its most impactful tools is the [AskRail app](#), which provides emergency personnel with real-time information on railcars carrying hazardous materials. This helps them respond quickly and safely by delivering critical data where it's needed most.