At a Glance:

TECHNOLOGY & INNOVATION ON THE RAILS

The modern world is fast-paced, interconnected and competitive. So is freight rail.

Railroads apply cutting-edge technology across the entire freight rail network — from tracks to trains and everything in between — enabling a 200-year-old industry to deliver for the U.S. economy in the 21st century.

Privately owned freight railroads have invested more than $660 billion on upgrades to their infrastructure and equipment since 1980, making America's freight rail network the finest in the world. Much of these funds have been dedicated to the development, adoption and implementation of new technologies aimed at making freight rail safer, more environmentally friendly and more efficient.

Today's railroads rely on smart sensors that constantly monitor the health and integrity of railcars, locomotives and track, ensuring all parts of the network are at safe and optimal performance. Data and analytics identify maintenance needs, which helps railroads improve safety and better serve customers. Fuel management systems, improved fuel efficiency and cleaner locomotives also minimize rail's carbon footprint.

The benefits of these advances extend far beyond the 140,000-mile rail network. Automakers, energy producers, farmers and other important American industries have benefited from rail's use of technology, which allows them to move more products faster and more affordably than ever before.

QUICK LOOK: ADVANCING SAFETY & EFFICIENCY

- The train accident rate has fallen 28% over the past 10 years and 44% since 2000.
- Railroads can move a ton of freight 479 miles per gallon of fuel, double what was possible in 1980.
- If just 10% of the freight shipped by the largest trucks instead moved by rail, annual greenhouse gas emissions in the United States would decrease by about 17 million tons.
- Average rail rates were 45% lower in 2016 than in 1981, as measured by inflation-adjusted revenue per ton-mile.
- The volume of cargo moved by rail has nearly doubled over the past 35 years.

Big Data, Smart Sensors and the Safest Network Ever

Using a combination of smart sensors, industry-wide data sharing and advanced analytics software, railroads monitor the health of the rail network and equipment in real-time. This data enables railroads to spot patterns, predict problems and improve safety.

Ultrasound, radar and the foundation of rail safety — Tiny flaws imperceptible to the human eye can lead to accidents, so railroads rely on technology, such as ultrasound and radar, to look deep inside a track. Similarly, ground-penetrating electromagnetic radar allows railroads to assess the health of ballast and detect any abnormalities, such as water intrusion, which can cause erosion.

Data-sharing and the big picture — The Asset Health Strategic Initiative (AHSI) was launched by railroads to track the health of the nation's 1.6 million railcars. Thousands of smart sensors monitor the integrity of railcars and, as part of AHSI, this data is fed to Railinc, an industry-owned information technology and services company. Railinc uses software to glean insights, taking a big-picture view to identify patterns, predict problems and guide component manufacturing.

PTC, a high-tech solution to combat human error — Positive Train Control (PTC), a transformative technology designed to automatically stop a train in cases involving human error, will not only help to prevent some of the industry's most severe accidents, it will also serve as the foundation for future innovation to enhance the safety and efficiency of the network. By the end of 2018, Class I freight railroads will have all hardware installed, all spectrum in place, all employees trained and at least 80% of PTC-required route miles in operation, well beyond the 50% mandated by the federal government.

GORAIL

Rail Technology Lifts Other Industries

Rail technology allows railroads to move more goods faster and more-affordably than ever before, providing clear benefits to customers.

Software calibrates train trips by the minute — Freight rail dispatchers use advanced trip-planning software to develop ideal routes for trains traveling in a region. The software analyzes a train's schedule, the area's topology, speed restrictions, the crew's schedule and other factors, using an algorithm to determine the best plan for each train to follow over the next eight hours — and shares it with dispatchers.

Preventative maintenance keeps trains moving — With wayside detectors identifying problems on passing trains, railroads can react quickly, preventing bigger fixes or even accidents. By performing maintenance early, railroads are able to prevent disruptions in service and create a fluid, seamless system.

Maximizing efficiency minimizes costs — North American rail rates are the lowest in the world. U.S. freight rail rates (measured by revenue per ton-mile) are well below those in Europe, China and Japan. This gives U.S. industries a significant competitive edge in the global marketplace.

QUICK LOOK: RAIL TECH COMPONENTS

- **Wayside detectors** identify defects on passing rail cars before structural failure or other damage occurs. Some of the newest wayside detectors use machine vision and digitized images to perform high accuracy inspections of car safety features and car underframes.
- Advanced **track geometry cars** use sophisticated electronic and optical instruments to inspect track alignment, gauge, curvature, and other track conditions.
- Trackside **acoustic detector systems** use "acoustic signatures" to evaluate the sound of internal wheel bearings to identify those nearing failure. These systems supplement or replace existing systems that measure the heat bearings generate in order to identify those in the process of failing.
- Thousands of **new state-of-the-art locomotives** are now operating on U.S. railroads. These new locomotives are more reliable, stronger, more fuel efficient and greener. One locomotive can have 20 or more microprocessors to monitor critical functions and performance.
- In rail yards, **anti-idling technologies** minimize fuel consumption and pollution. **Start-stop systems**, for instance, turn off a locomotive — the train's engine — if they sense it has been idle too long.
- **Ground-penetrating radar** and **terrain conductivity sensors** are being developed that will help identify problems below the ground that hinder track stability.