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Data Driven Track Management Program: Integrating Autonomous & Advanced Inspection Technologies



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A Vision of Growth and Change



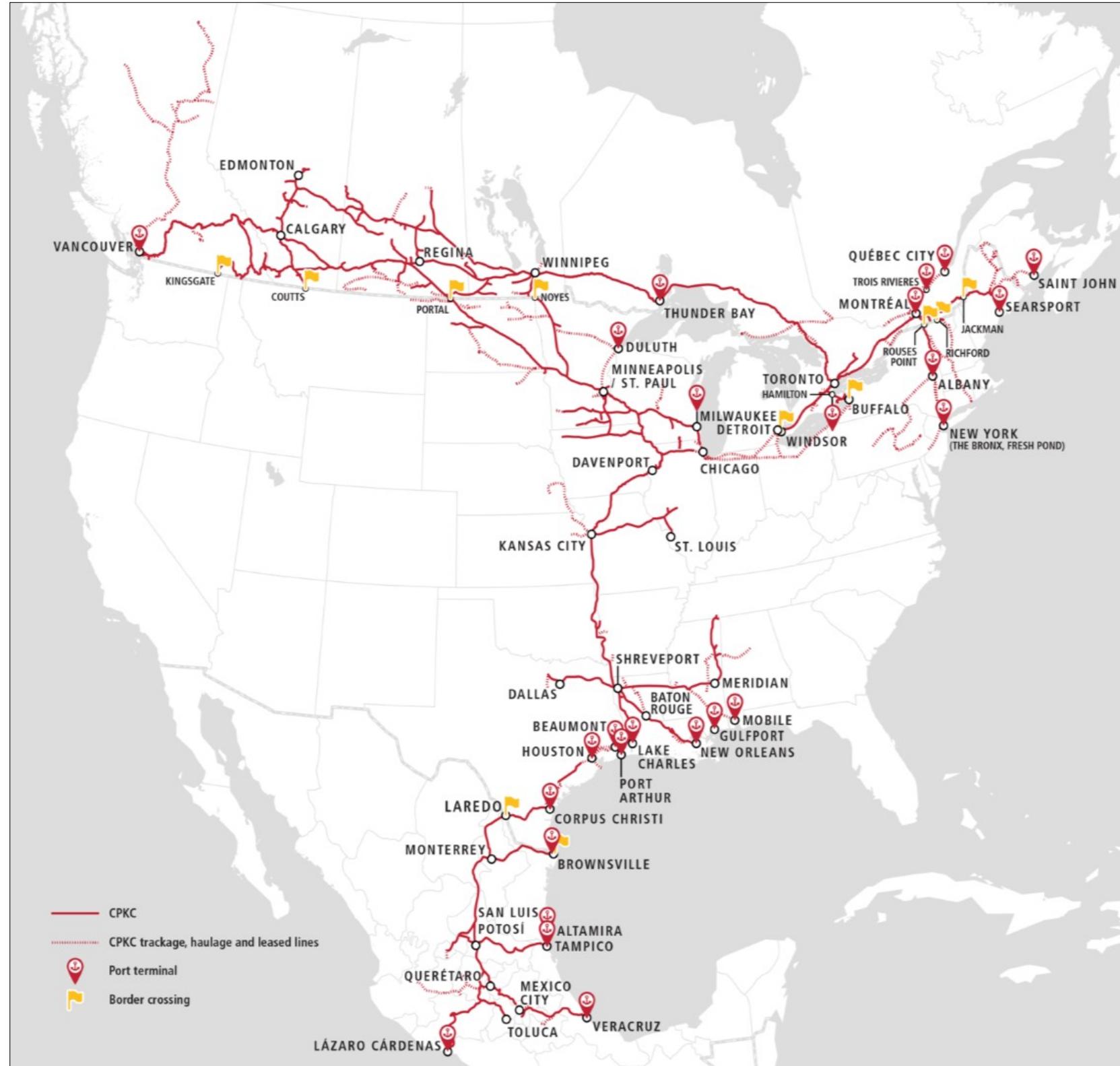
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CPKC Network



The consolidation of Canadian Pacific Railway, Kansas City Southern, and Kansas City Southern de México has created a unified rail network stretching from Vancouver and Saint John in Canada, south through the United States to Laredo, Texas, and deep into the heart of Mexico. **This extensive system now spans nearly 20,000 miles of track** a monumental network to manage, inspect, and maintain.



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Track Evaluation



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Five ATGMS Cars with a sixth coming online



Two Heavy Trucks with Four Light Trucks



One Occupied Track Evaluation Train



Combination of ENSCO, Holland, DMA, & Tetra Tech Technologies



Dedicated Team

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The Fleet



Occupied

Heavy Geometry Inspection Vehicle:

- TEC92 – Pull behind consist
 - Geometry / Rail Profile
 - Deployable Gauge Restraint
 - Rail Surface Imaging System
 - Joint Bar Imaging System
 - Track Component Imaging System
- 2 Heavy (Freightliner) Hi Rail Trucks
 - Geometry / Rail Profile

Light Geometry Inspection Vehicle:

- 4 Light / Regional Hi Rail Trucks
 - Geometry Only



The Fleet - Autonomous

4 Conventional Boxcars

- 3 with Geometry Only
- 1 with Geometry & Rail Profile

2 Total Track Assessment Boxcars

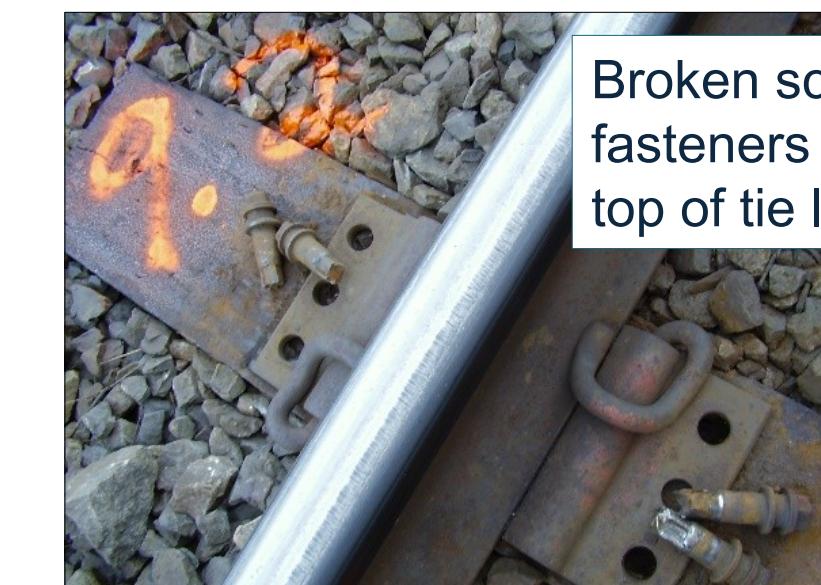
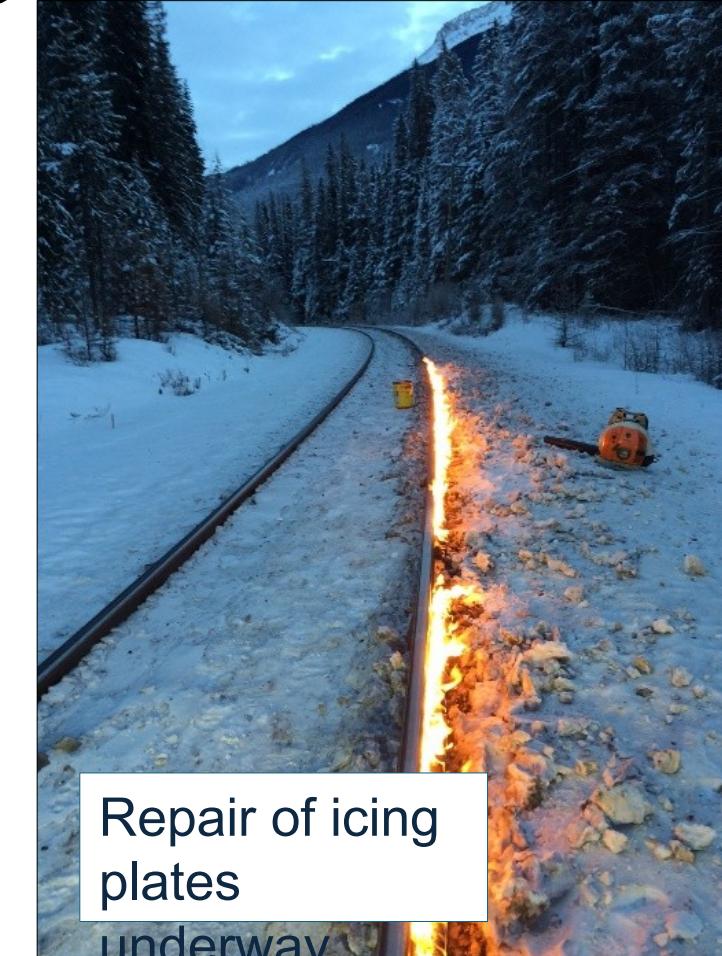
- 1 with Geo / Machine Vision / Lidar
- 1 Geo / Machine Vision (coming soon)

ATGMS program is used to supplement regulatory testing and compliance.





Deployable Gauge Restraint Measurement System





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2024 By The Numbers



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Test Miles - 2024

- TEC92: 25,757 Miles
- CP11: 11,803 Miles
- CP12: 1,835 Miles
- CP14: 907 Miles
- CP41: 930 Miles
- CP42: 1,689 Miles
- CP43: 734 Miles
- CP60: 75,901 Miles
- CP61: 39,935 Miles
- CP62: 102,457 Miles
- CP63: 4,523 Miles
- KCS112378: 45,083 Miles

Occupied
HGIV

Occupied
LGIV

ATGMS

Total: 311,554 Miles





2024 By The Numbers



Total Number of Defects Found

Urgent Defects

- 2024 – 13,254
- 2023 – 10,422

Urgent Defects per 100 Miles

- 2024 – 5.37
- 2023 – 9.03

Repeats Per 100 Miles

- 2024 – 0.58
- 2023 – 0.81

Repeat Index

- 2024 – 1.51
- 2023 – 1.41



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Data Management



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Data Storage Systems

Track Asset Management (TAM)

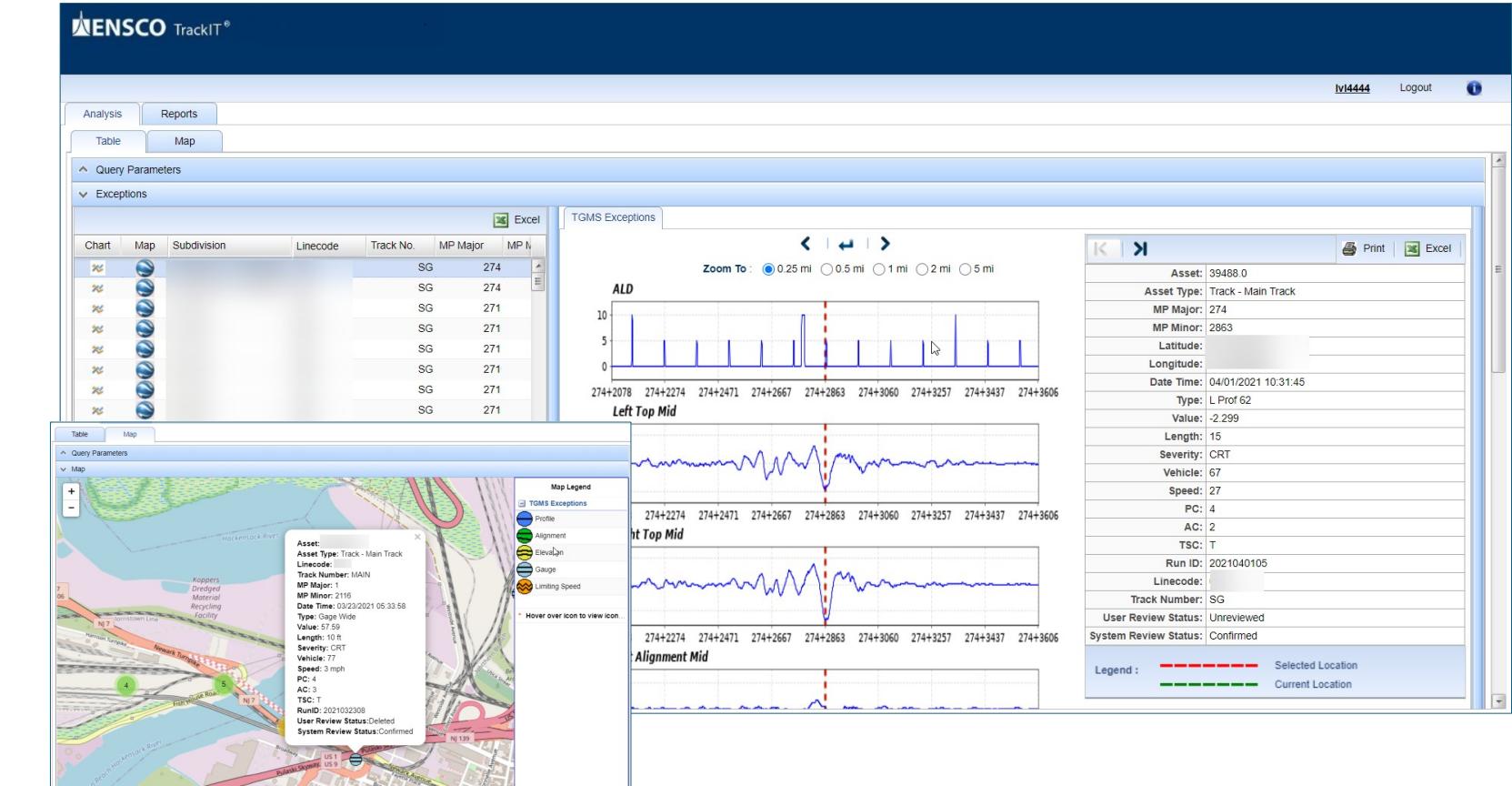
SAP Based. In-house developed electronic system of record for Scheduling and Recording visual inspection, defects, maintenance and repairs

Digital Track Notebook (DTN)

Streamlines inspection scheduling, defect logging, and maintenance tracking with real-time sync to a centralized system.

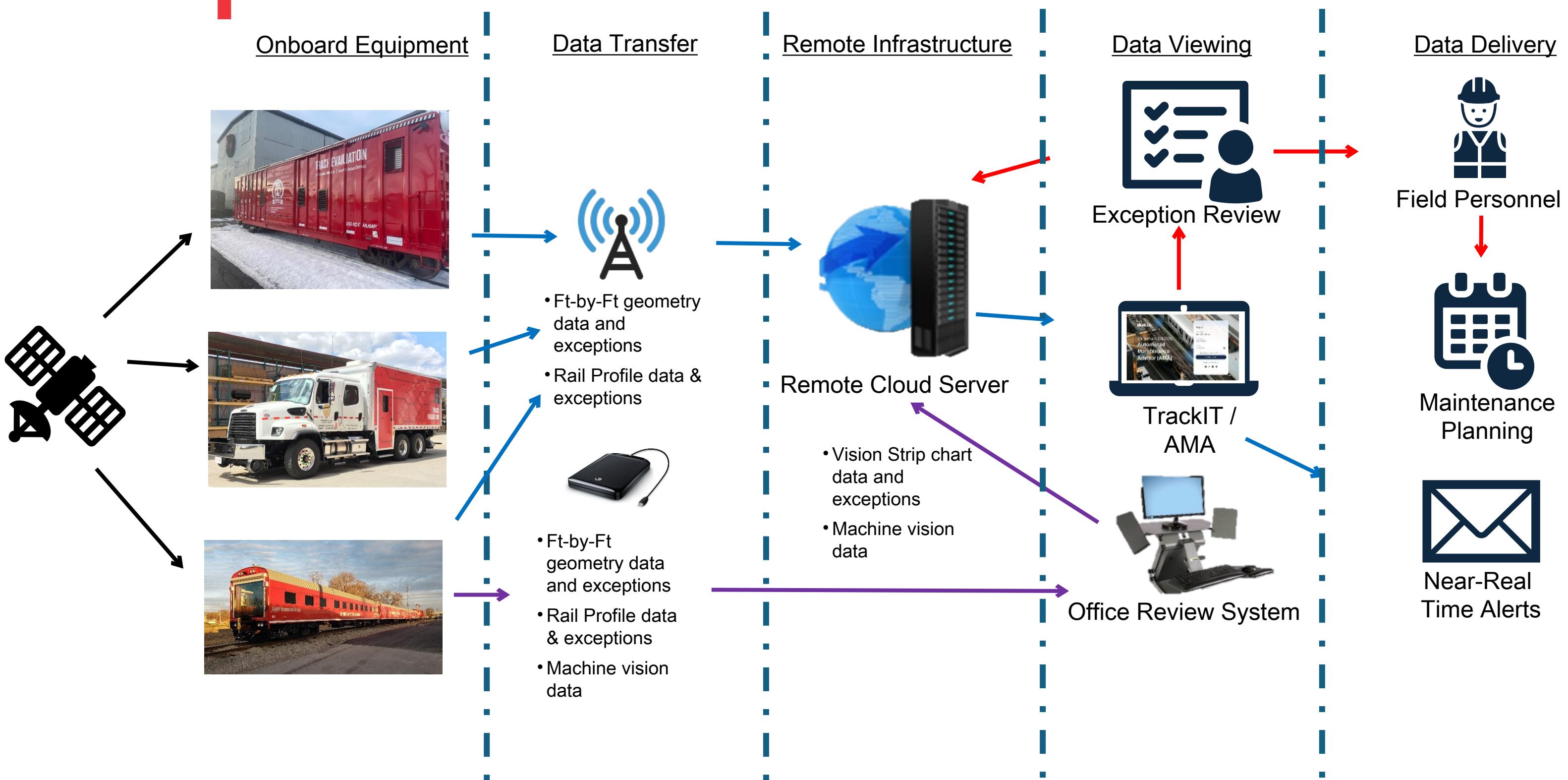
TrackIT

Cloud based platform storing inspection data (stripcharts, images, exceptions) from multiple systems, all aligned to a unified location.





Data Capture and Distribution





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Complementary Inspection Systems



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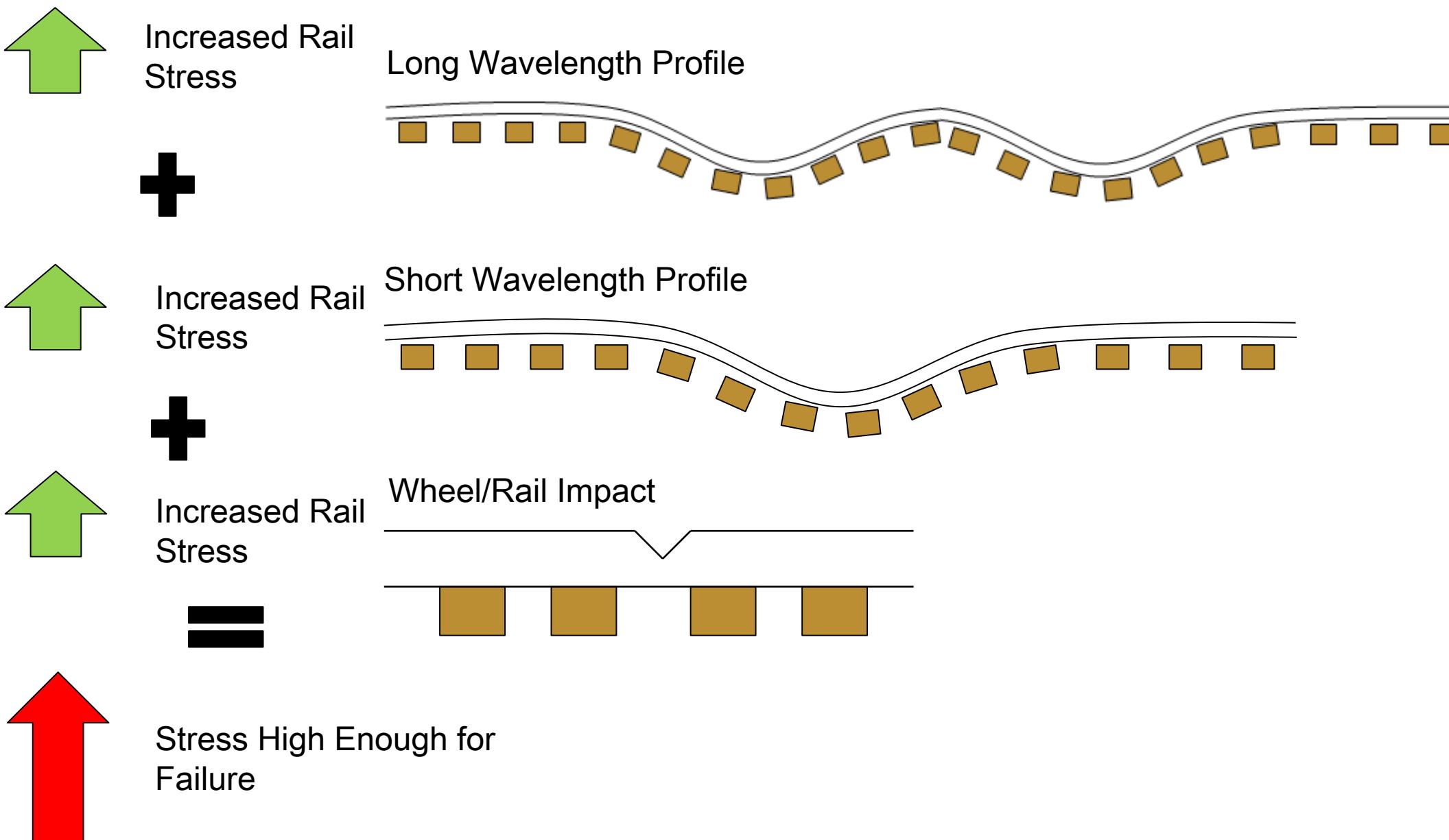
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Complementary Inspection Systems

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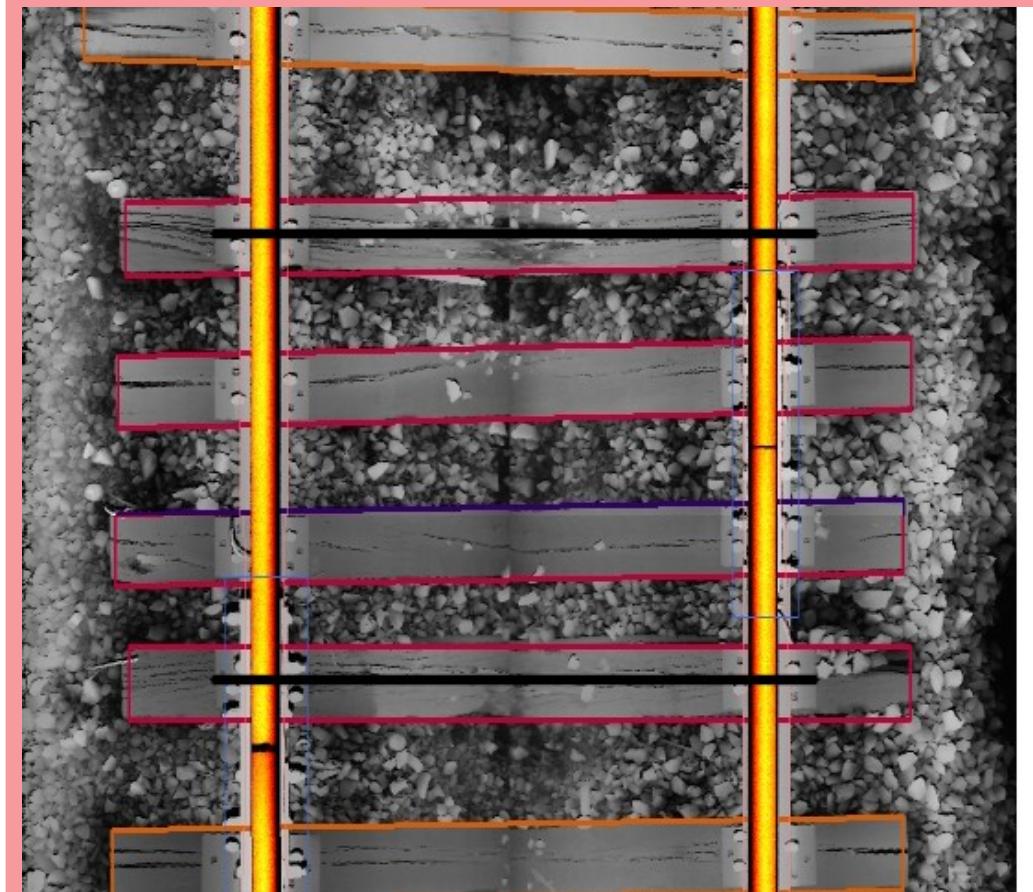
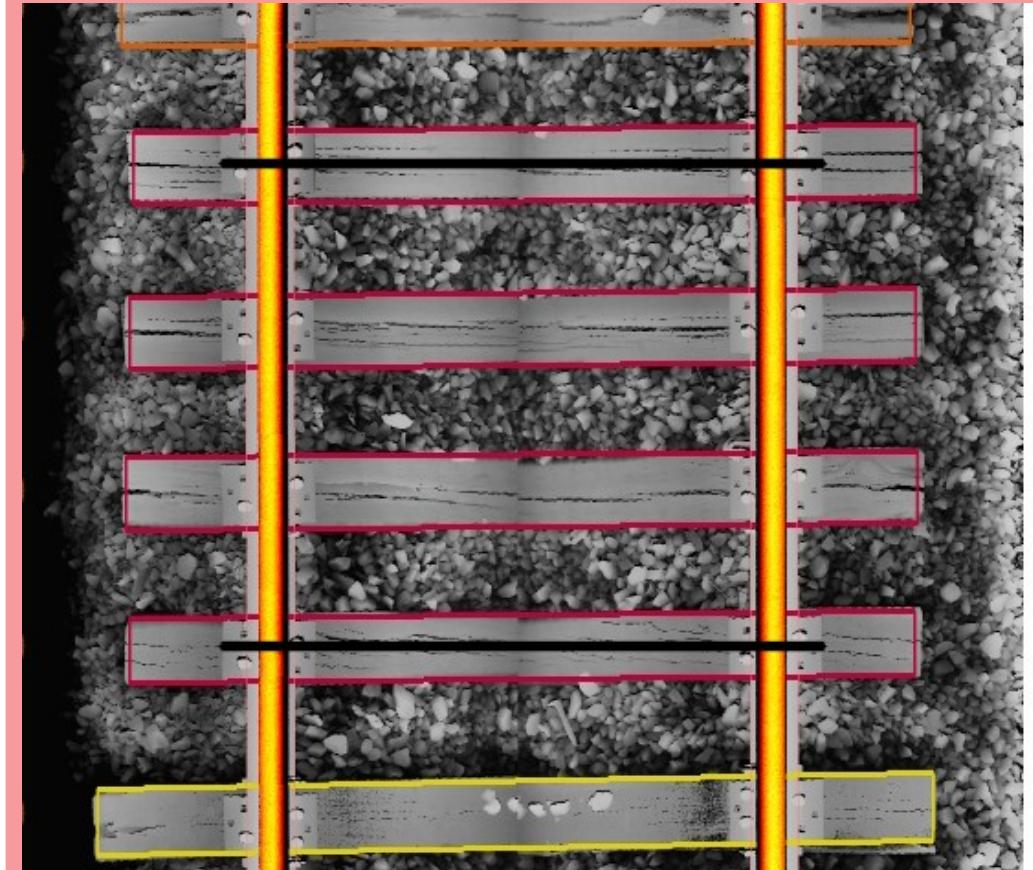


- 12 V/TI Monitors in operation
- Enrolled in data sharing program to maximize coverage
- Defined response protocols and implemented interim preventative measures pending site inspection.
- In early rollout of combo cluster algorithm to identify repeat patterns of low-level activity.



Tie Inspection

- **CPKC is piloting machine vision technology** to automatically identify and assess railroad tie conditions using advanced algorithms.
- **The system detects clusters of defective or non-compliant ties**, helping inspection teams take immediate action and plan future maintenance programs.
- **Major benefit:** Delivers consistent, objective evaluations—machine grading doesn't fluctuate over time like human judgment can.



MP: 27.673
Exception Start

MP: 27.672
Exception End

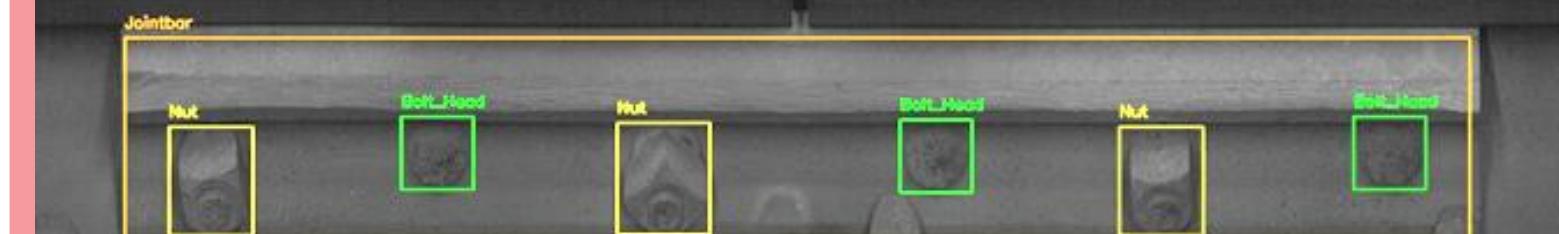
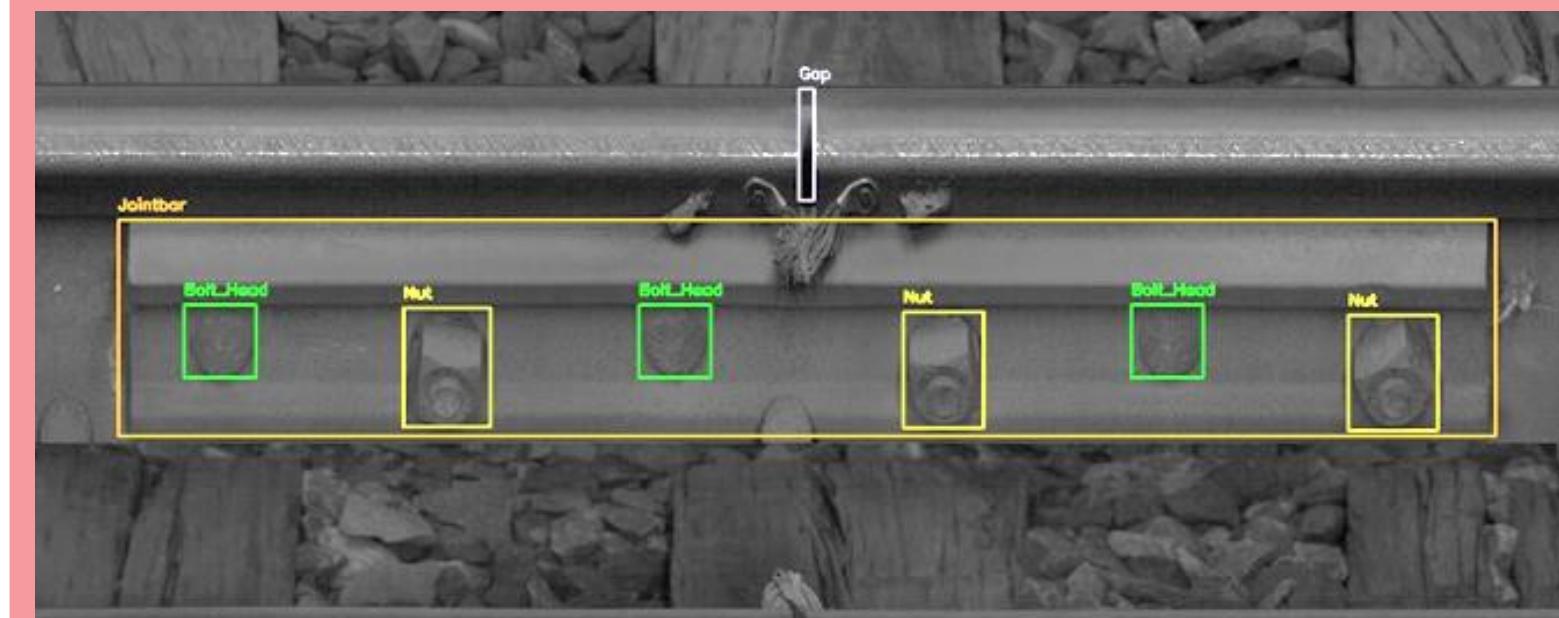
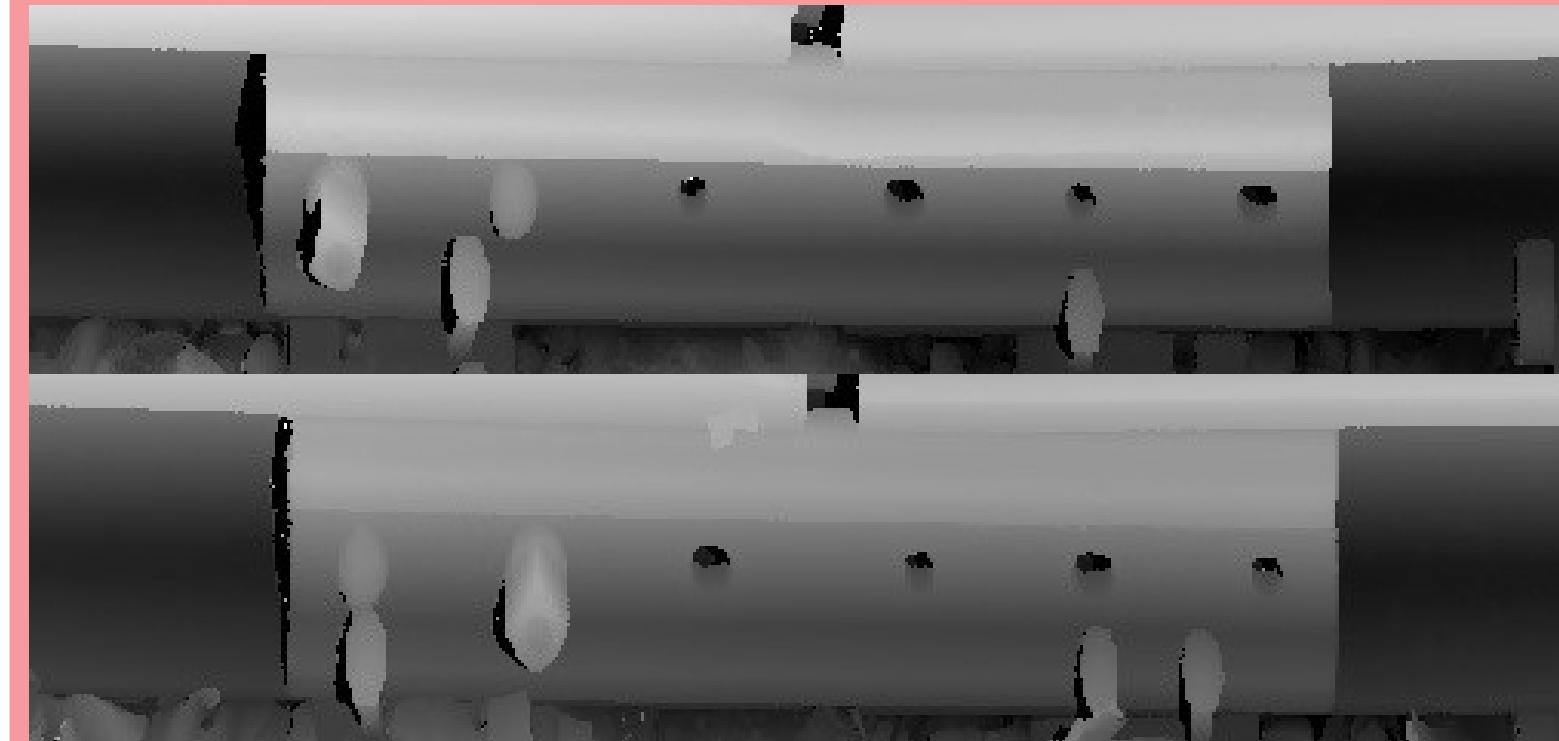
MP: 21.088
Exception Start

MP: 21.087
Exception End



Joint Bar Imaging

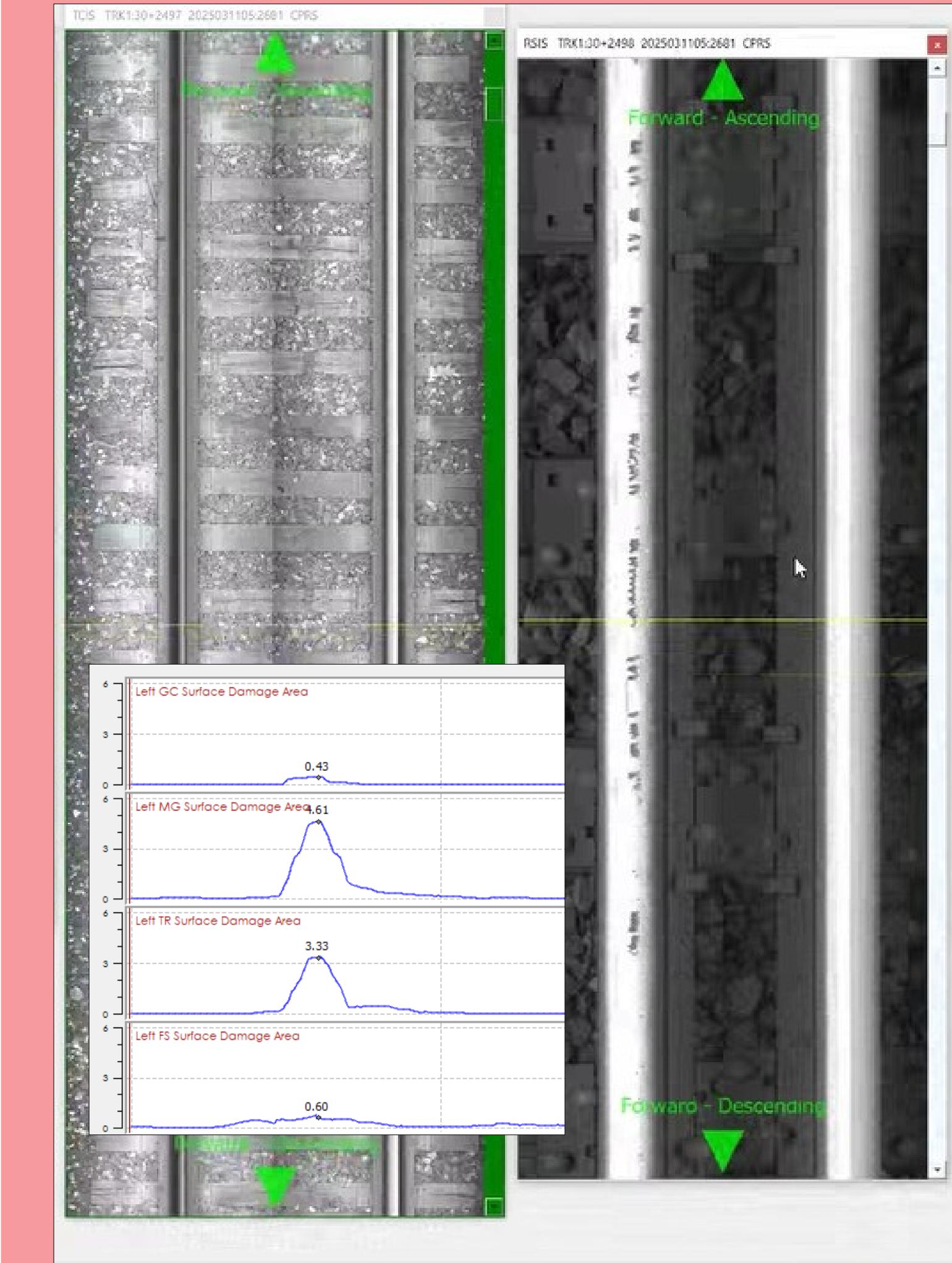
- **JBIS technology is deployed on both attended and autonomous CPKC vehicles**, with over a decade of proven reliability on attended systems and promising results from newer autonomous platforms.
- **Real-time defect detection (e.g., missing bolts, pull-aparts)** enables immediate safety actions, while collected data supports inventory management and joint bar classification.
- Built on robust, adaptable technology like continuous line-scan cameras, JBIS offers consistent, objective data with potential for broader applications including crack detection, weld evaluation, and more.





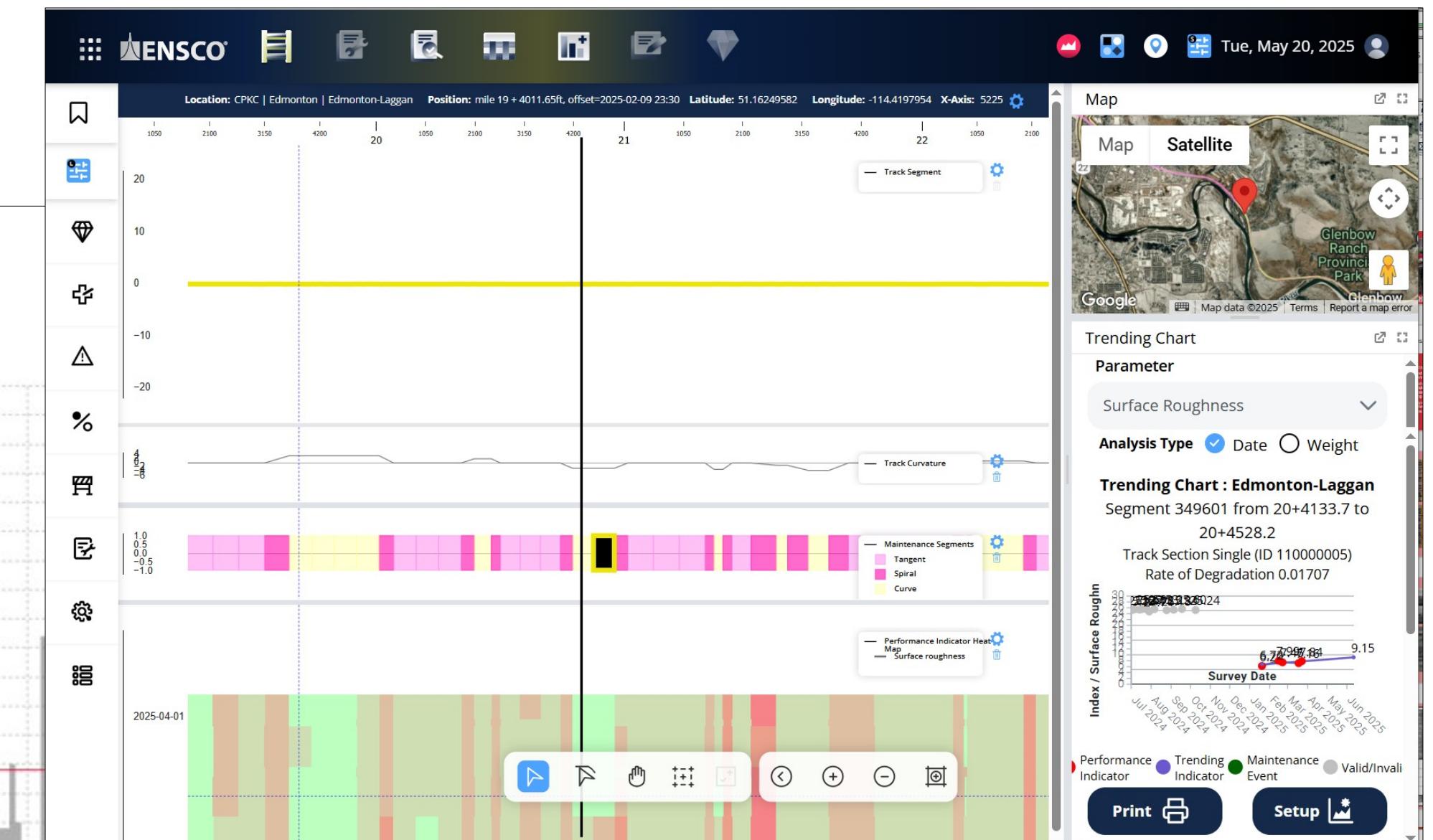
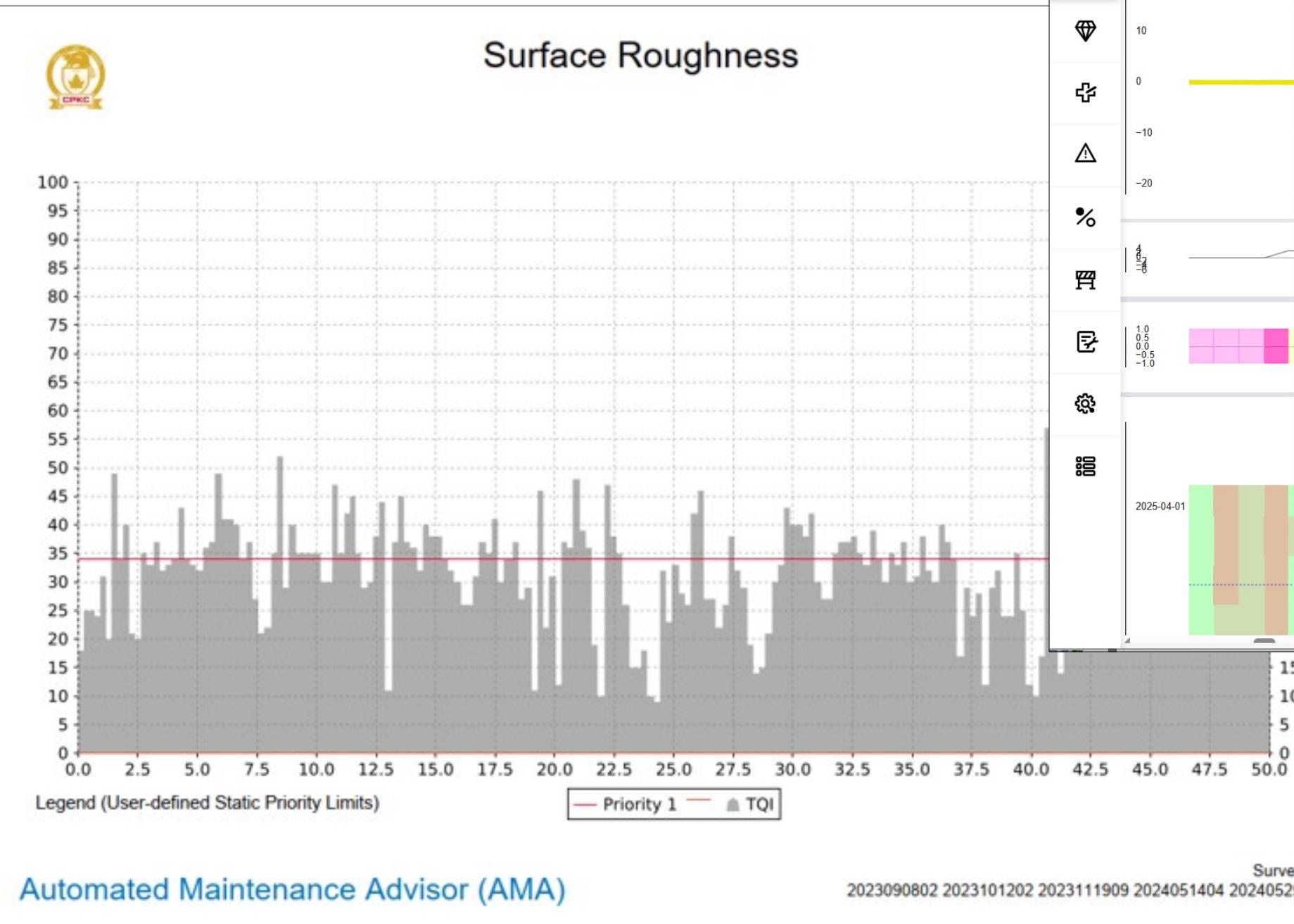
Rail Surface Imaging

- RSIS captures continuous linear images of the rail surface, using machine vision to segment the rail head and quantify surface damage like spalling.
- The system converts visual data into numerical values, enabling trend analysis and change detection through strip charts rather than relying solely on images.
- Provides consistent, objective, and robust results, supporting more reliable condition monitoring over time.





Track Quality Indices: Surface Roughness





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Challenges



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Operational Challenges

- ▶ **Regulatory Alignment**
Inspection systems must seamlessly adapt
- ▶ **Environment Variability & Performance**
Optical based systems are highly impacted by regional weather conditions
- ▶ **Big Data**
Strategic planning around Storage, Accessibility, and Transfer Mechanisms
- ▶ **Data Integration**
Multiple systems generating various data types
- ▶ **Location**
Common Location Referencing





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Closing Comments



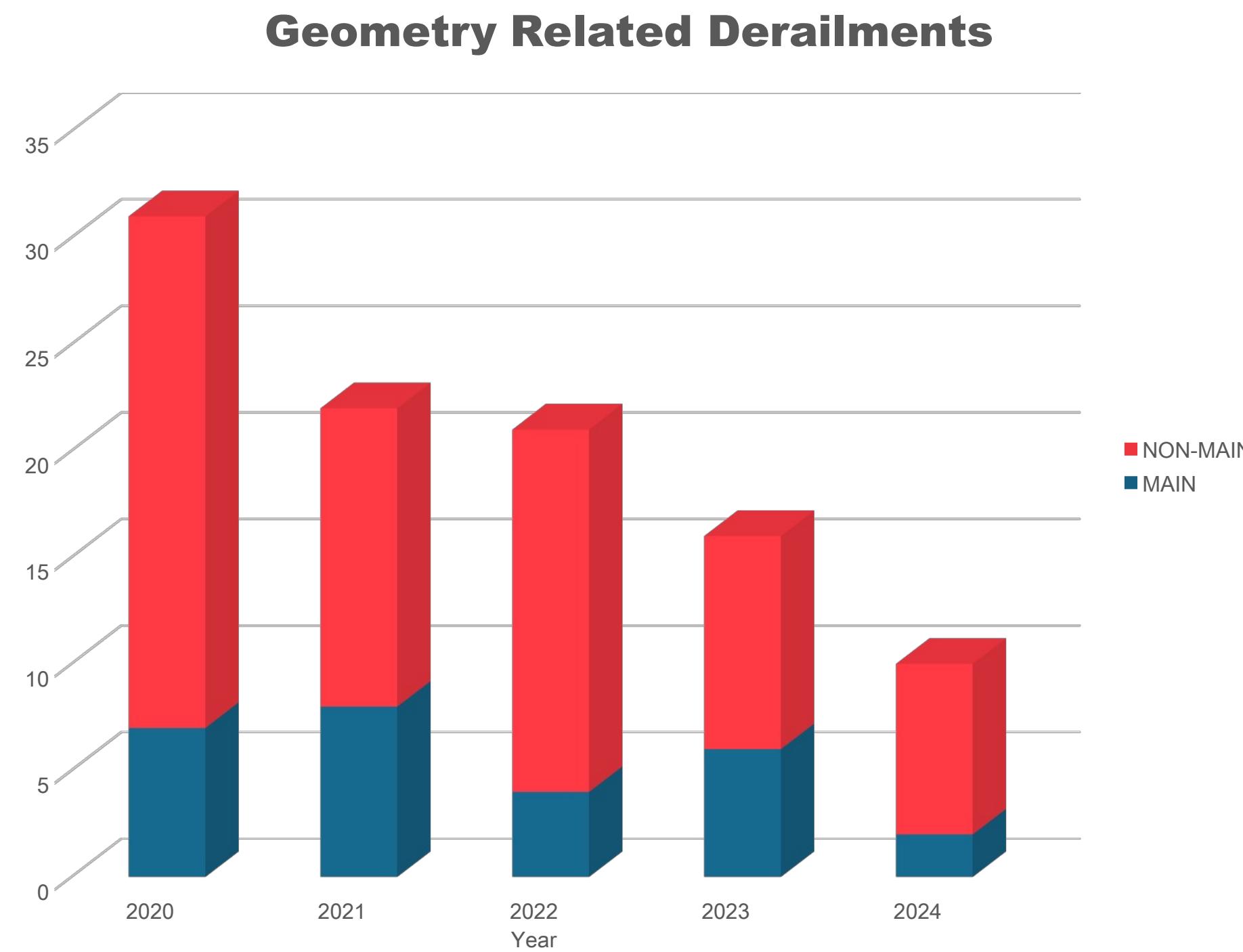
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Closing Comments



- Advanced inspection technologies like Track Geometry, Rail Profile, and Machine Vision are driving more consistent, data-informed decisions across the CPKC network.
- Objective data insights from these tools enable proactive maintenance and long-term planning.
- Results:** geometry-related derailments have dropped nearly 70%, from 31 in 2020 to just 10 in 2024



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Questions



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