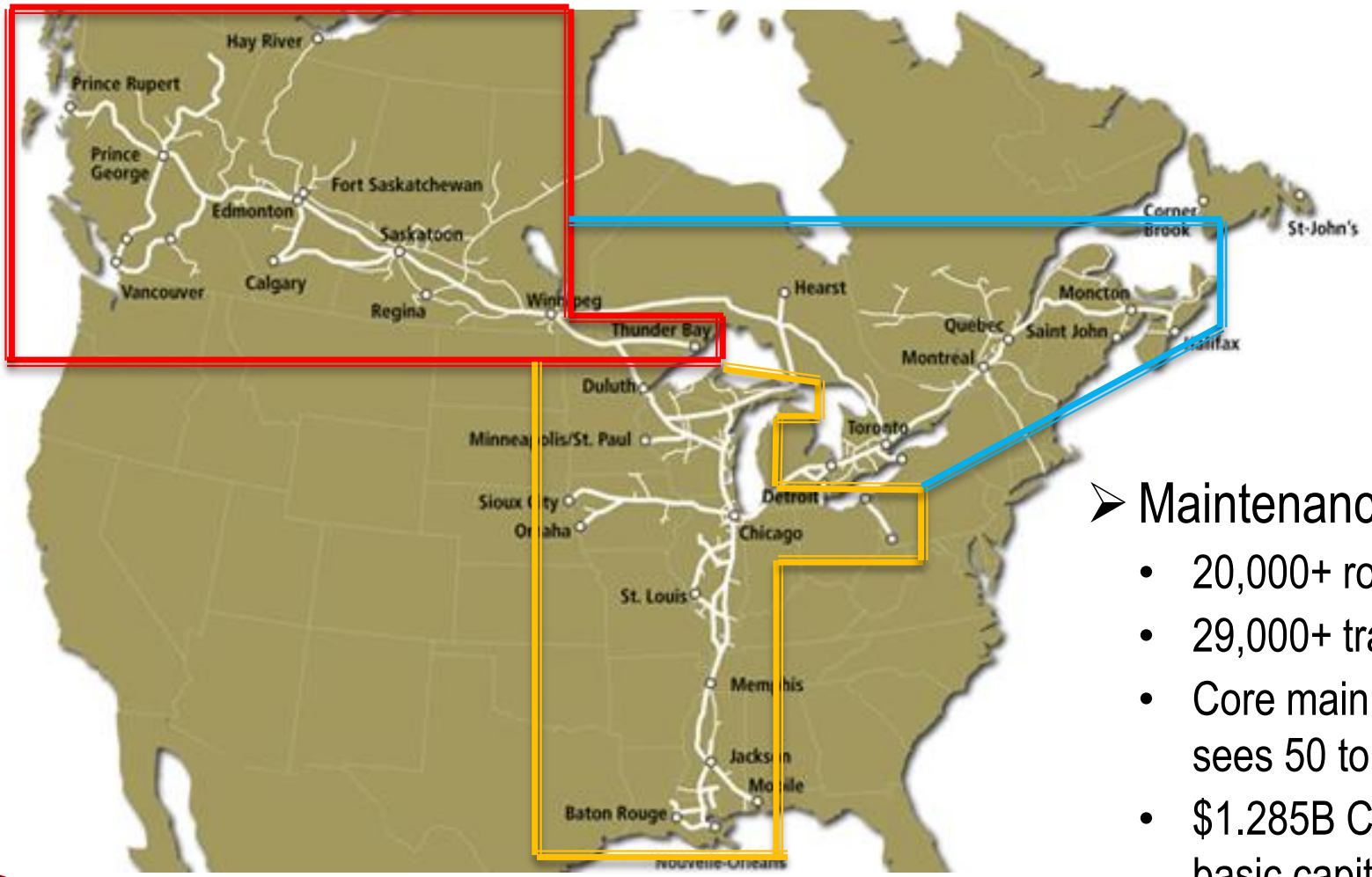
Mobile Assessment of Track Asset Data

Kevin R. Day
Assistant Chief Engineer
Technology, Testing & Standards

ÖSTERREICHISCHE VERKEHRS-WISSENSCHAFTLICHE GESELLSCHAFT
www.oevg.at
Arbeitskreis Eisenbahntechnik

September 16, 2015

CN Rail Information



- Maintenance Info
  - 20,000+ route miles
  - 29,000+ track miles
  - Core mainline route sees 50 to 100 MGT/M
  - $1.285B CAD/USD in basic capital programs

CN – Technology, Testing & Standards

- Testing and Rail Maintenance Team
  - Rail Flaw Detection (RFD)
  - Geometry and Optical Testing
  - Rail Welding Maintenance, Standards and Auditing
  - Rail Grinding

Technology Team

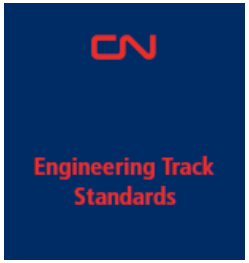
- Track Inspection System (TIS)
- New Technologies

Example Engineering Technology RFD Frequency Scorecard

Engineering Region	Engineering Territory	Sub-Division	Track ID	Next Inspection Date	Miles From	Miles To	Total Miles	Winter Frequency	Track Status
Eastern	Greater Toronto Area	BALA	AA55	2015/03/06	35.48	36.77	1.29	61	1
Eastern	Greater Toronto Area	BALA	AC31	2015/01/12	92.57	93.89	1.32	46	-1
Eastern	Northern Ontario East	BALA	AC35	2015/03/01	106.41	107.72	1.31	61	1
Southern	Wisconsin North	SUPERIOR	S105	2015/01/18	260.00	262.16	2.16	46	0
Southern	Wisconsin North	SUPERIOR	S112	2015/01/18	272.30	274.30	2.00	46	0
Southern	Wisconsin North	SUPERIOR	S115	2015/03/10	452.43	453.97	1.54	61	1
Western	Alberta Central	WAINWRIGHT	GA10	2015/02/24	155.90	158.20	2.30	46	1
Western	Alberta Central	WAINWRIGHT	GA38	2015/02/13	169.50	172.00	2.50	36	1
Western	Alberta Central	WAINWRIGHT	GA48	2015/03/07	183.50	184.70	1.20	61	1

Engineering Standards

- Transportation Technology Center Inc (TTCI) research committees
- Rail Safety Advisory Committee Participation
- Connection to Regulatory Agencies
- Owner of CN Engineering Track Standards



Rail Flaw Detection

- Rail Flaw Detection Platforms
  - Stop and Verify Testing
  - Non-stop Testing
  - Portable Hand Testing

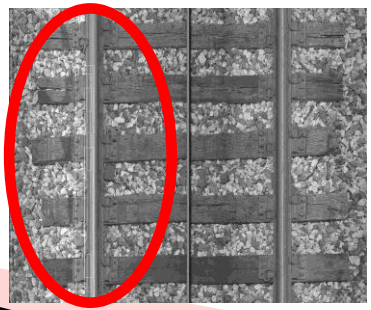
- Frequency of Testing
  - Generally test core mainline routes monthly
  - Risk based approach to frequency planning
  - CN owned yard tracks are tested based on usage and tonnage

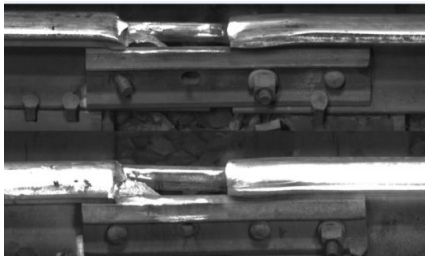
Geometry Testing

- Geometry Platforms
  - Utilize a variety of rail bound units and hi-rail trucks
  - Provides foot by foot track measurements (gauge, cross level and curvature) for understanding track condition
  - Provides rail profile data for estimating rail wear

Geometry and Optical Inspection

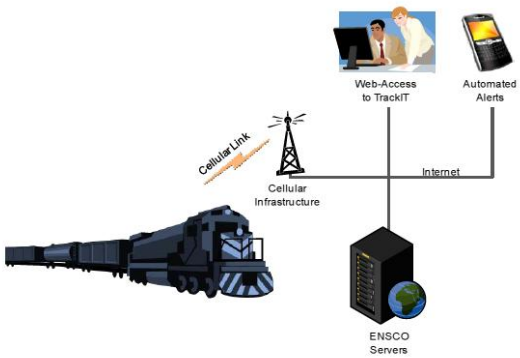
- Geometry Platforms
  - Optical track inspection system to identify missing track components
  - Joint bar (fish plate) inspection systems
  - Deployable gauge restraint measuring system (DGRMS)





Vehicle Track Interaction (V/TI) Units

- V/TI Testing Procedures
  - Accelerometers installed on locomotives that identify high impact and alignment locations
  - Alerts provided to field forces based on pre-determined thresholds
  - Utilizing low level alert clusters to identify areas of potential concern
  - Send alerts via email and utilize call outs depending on the severity of the alerts

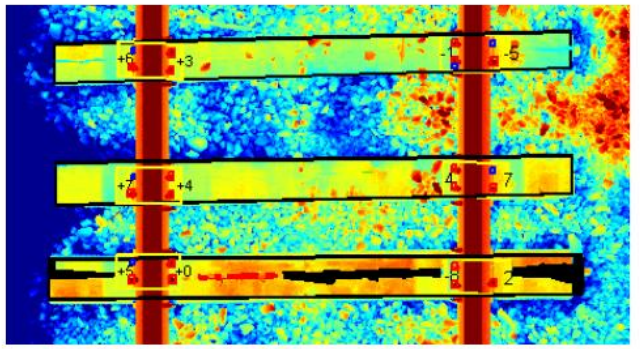


M-Rail Technology

- Loaded gondola rail car providing track deflection information
  - Measures vertical rail deflection
  - Data used in conjunction with other geometry testing platforms to identify areas with poor stiffness and support
  - Assists in pinpointing areas with poor drainage and excessive moisture

Tie Assessment Technology

- Tie Assessment Technology (TAT)
  - Provide an objective view of tie condition across the CN network
  - Better plan resources and capital programs based on need
  - Long term plan of utilizing the information to provide tie distribution and work gangs the exact locations for removal and installation

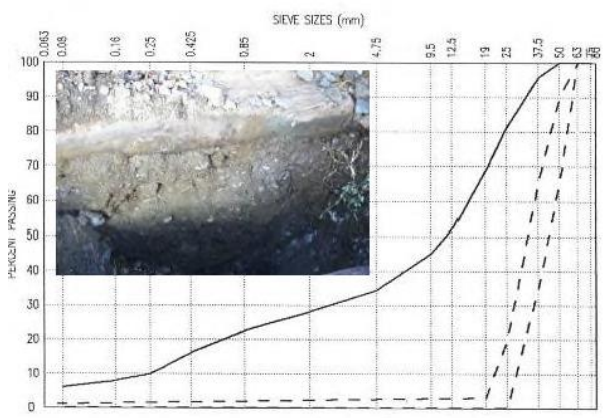


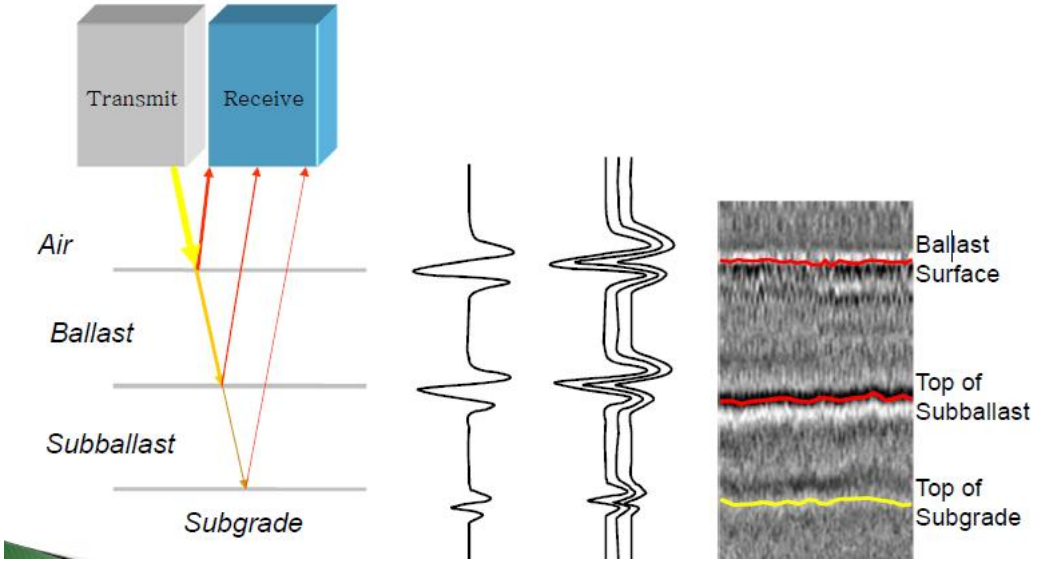
Rail Grinding

- CN utilizes multiple grinding platforms
  - Switch and crossing (S&C) grinders are used for smaller projects like turnouts and road crossings
  - Production grinders used for out of face grinding
  - Recently added the latest 120 stone production grinder to the fleet to increase production in limited track time windows.
  - Potentially consider rail milling in the future if operating speeds can be increased.

Ground Penetrating Radar (GPR)

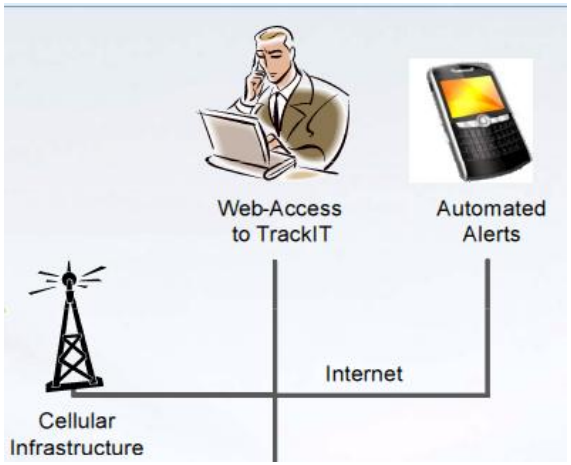
- A future technology at CN
  - Provide a detailed assessment of ballast and subgrade conditions
  - Better plan for undercutting programs
  - Develop a list of locations to monitor
  - Evaluation of supplier systems for moving forward on the right system for CN





Remote Monitoring of Assets

- Identifying trouble spots and monitoring from a central location
  - Utilizing information from hot journal detectors
  - Monitoring road crossing power status
  - Rock/stabilization areas
  - In the future, use cameras with remote access for areas of known concern



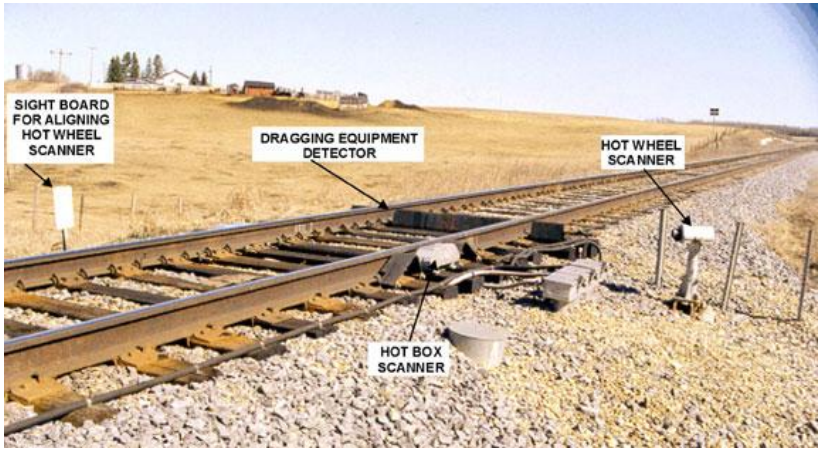
Future Technology – Drone Inspections

- Protecting the track from potential mechanical issues
  - Potentially use unmanned equipment to optically inspect bridges and track locations
  - Require regulatory approval to operate in the United States
  - Current waivers do not allow for drones to fly out of sight – this needs to be resolved for the technology to be useful

Wayside Detection Systems

- Protecting the track from potential mechanical issues
  - Hot bearing (journal) detectors
  - Dragging equipment detectors
  - Hot wheel detectors – 530+
  - Information sent back to a central location for reviewing of trending information and nothing found stops

Installed together – 800+



Signalized Sidings

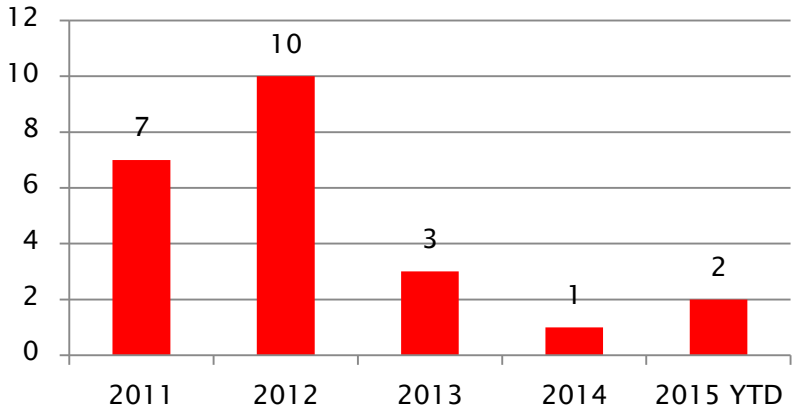
- Providing broken rail protection and operational capacity for high usage sidings
  - Created a three year plan in late 2013 to upgrade sixty sidings for signalized protection
  - Plan to complete 50+ by the end of 2015
  - Expect to see a reduction in incidents resulting from broken rails in future years as a result of these upgrades.

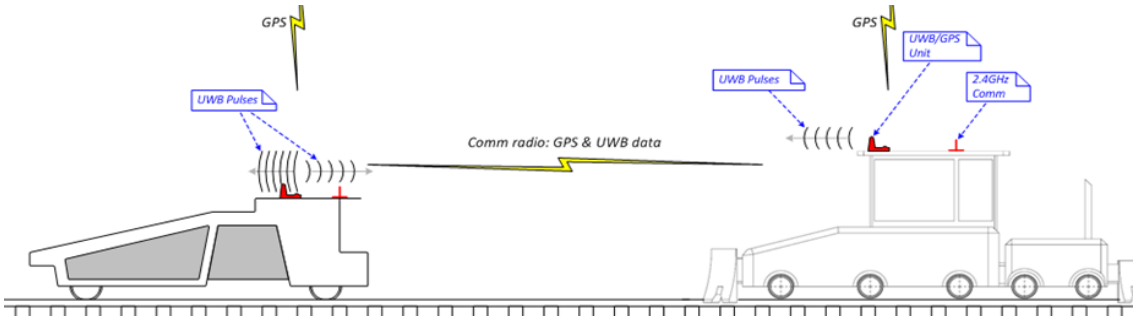
Collision Avoidance Systems

➢ Metrom Aura Project

- GPS/Ultra-Wideband signal system that warns operators prior to collisions
- Began installations in January 2013
- 940 installed on work equipment to date Plan to install 900 by year end

Number of collisions



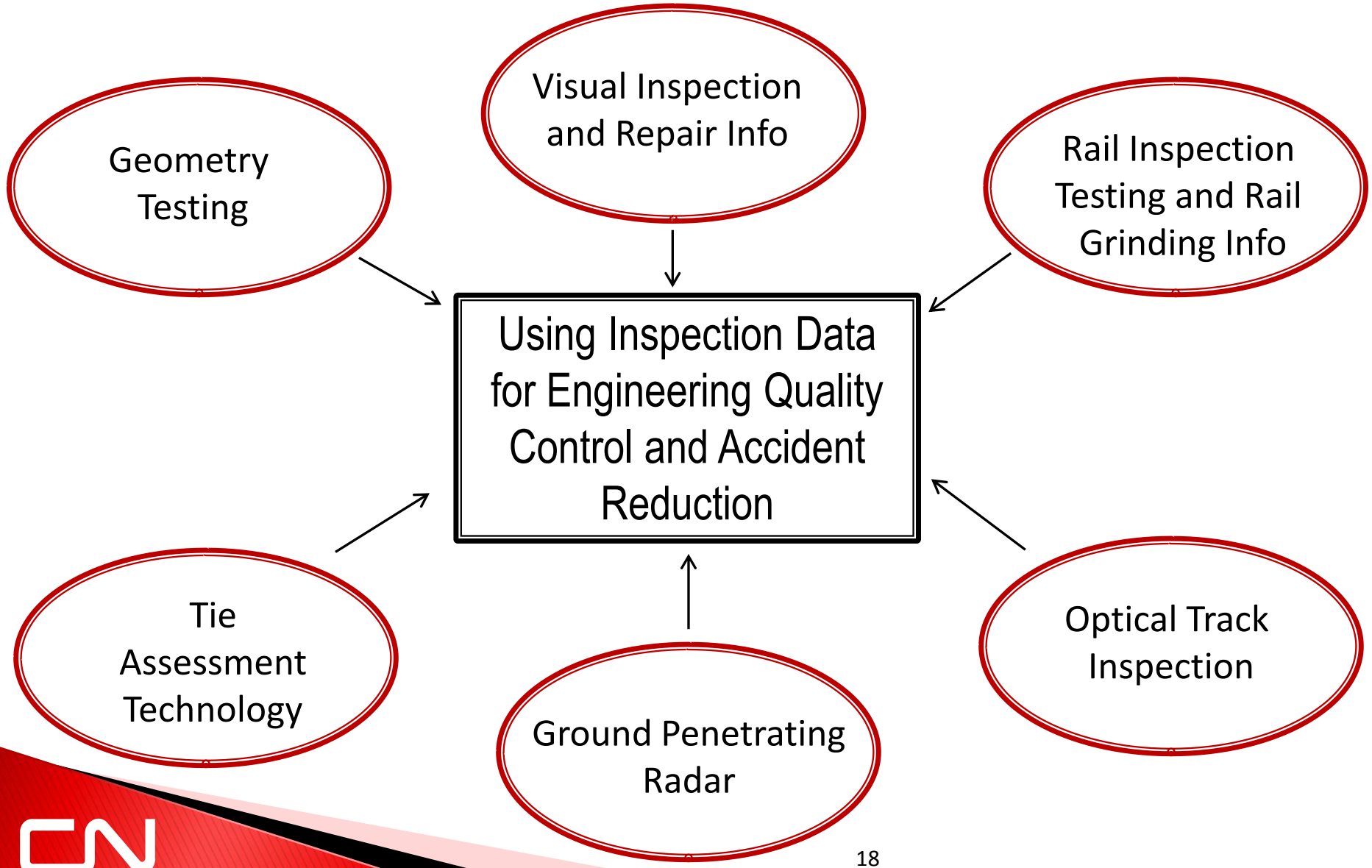


TTCI Northern Megasite Project

➢Northern Mega Site Testing

- Working with TTCI to test new materials and processes in extreme environmental conditions
- Located within 150 miles of Winnipeg, Manitoba, Canada
- High strength rails, insulated joints, subgrade/frost heaves and top of rail lubrication performance

Utilizing the Data



Engineering Risk Analytics

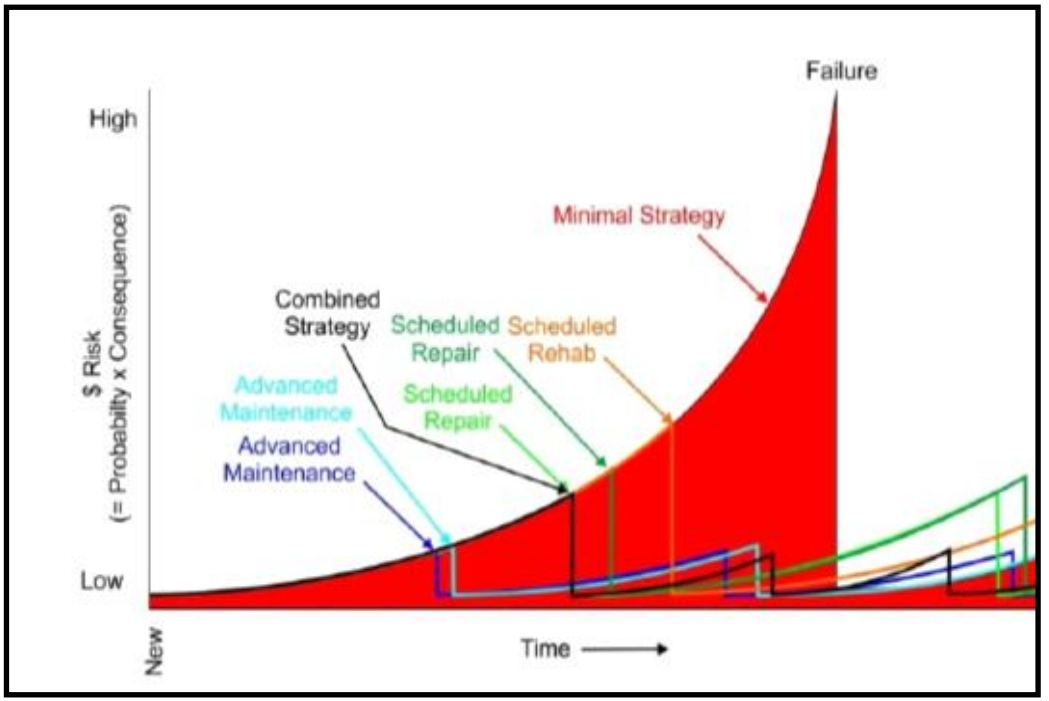
Inspect

Analyse

$$CoSD = \sqrt{w_{AL} * SD_{AL}^{\ 2} + w_{LL} * SD_{LL}^{\ 2} + w_{G} * SD_{G}^{\ 2} + w_{CL} * SD_{CL}^{\ 2}}$$

$$CoSDT = \sqrt{w_{AL} * SD_{AL}^{\ 2} + w_{LL} * SD_{LL}^{\ 2} + w_{CL} * SD_{CL}^{\ 2}}$$

Identify Risk Areas and Schedule for Repair

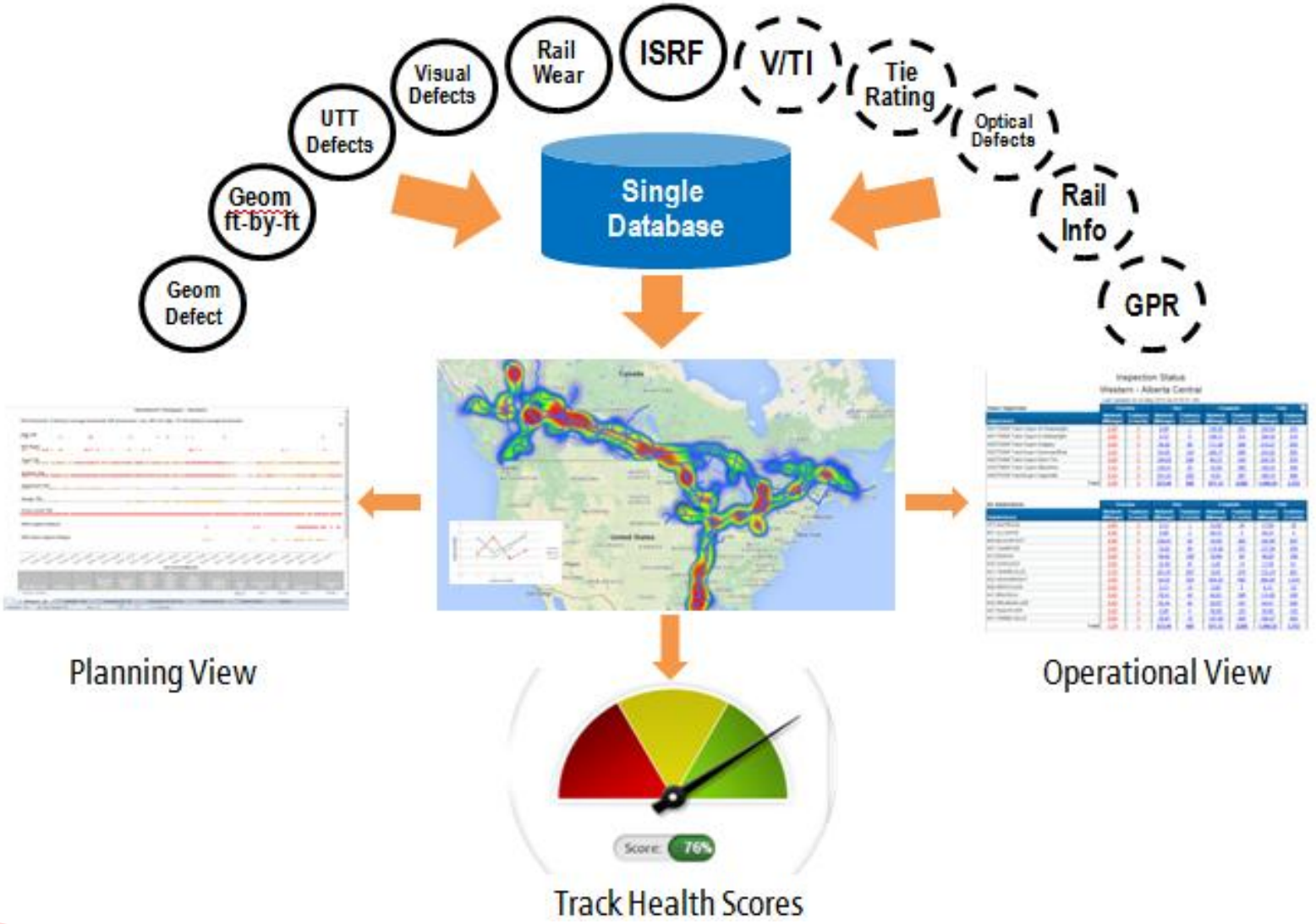


Use technology and data analytics to manage track quality and identify areas of higher risk

Engineering Rail Analytics

- Four Projects Currently Underway at CN
  - Geometry exception and foot by foot degradation analysis
  - Rail flaw defect and service failure pattern analysis
  - Development of a single database to store and analyze track inspection and exception information
  - Creation of a track health score by track location to identify areas that may be at more risk than others

Engineering Rail Analytics Tool



Questions