# Key Elements of the World's Most Successful Railways: Today and Into the Digital Future


*Michael Roney*

**Iron Moustache Consulting**

**Special Advisor to the International Heavy Haul Association**

**11 National Meeting for the Rail Transport Development**

**Sao Paulo, October 15-16, 2019**

# Agenda

- **Key Performance Indicators**
- Common Elements for Historical Success in Railroading
- New Learnings from Heavy Haul
- Freight Railway in the Digital Future: a convergence of views

# Key Performance Indicators

- Accident frequency
- Revenue tons delivered *or revenue ton-kms*.
- Average train speed *or cycle time*
- Average terminal dwell time *or loading/unloading time*
- Operating ratio *or cost per revenue ton delivered*

# Sample of Key Performance Metrics for Canadian Pacific

## WEEKLY KEY METRICS: OCTOBER 05, 2019


**2,781 M**

REVENUE TON MILES (MILLIONS)

Sep 28, 2019: 3,064
Sep 21, 2019: 2,863

**52,659 Cars**

CARLOADS

Sep 28, 2019: 56,042
Sep 21, 2019: 54,775

**22.6 MPH**

AVG TRAIN SPEED

Sep 27, 2019: 23.1
Sep 20, 2019: 23.0

**5.9 HRS**

AVG TERMINAL DWELL

Sep 27, 2019: 5.9
Sep 20, 2019: 5.8

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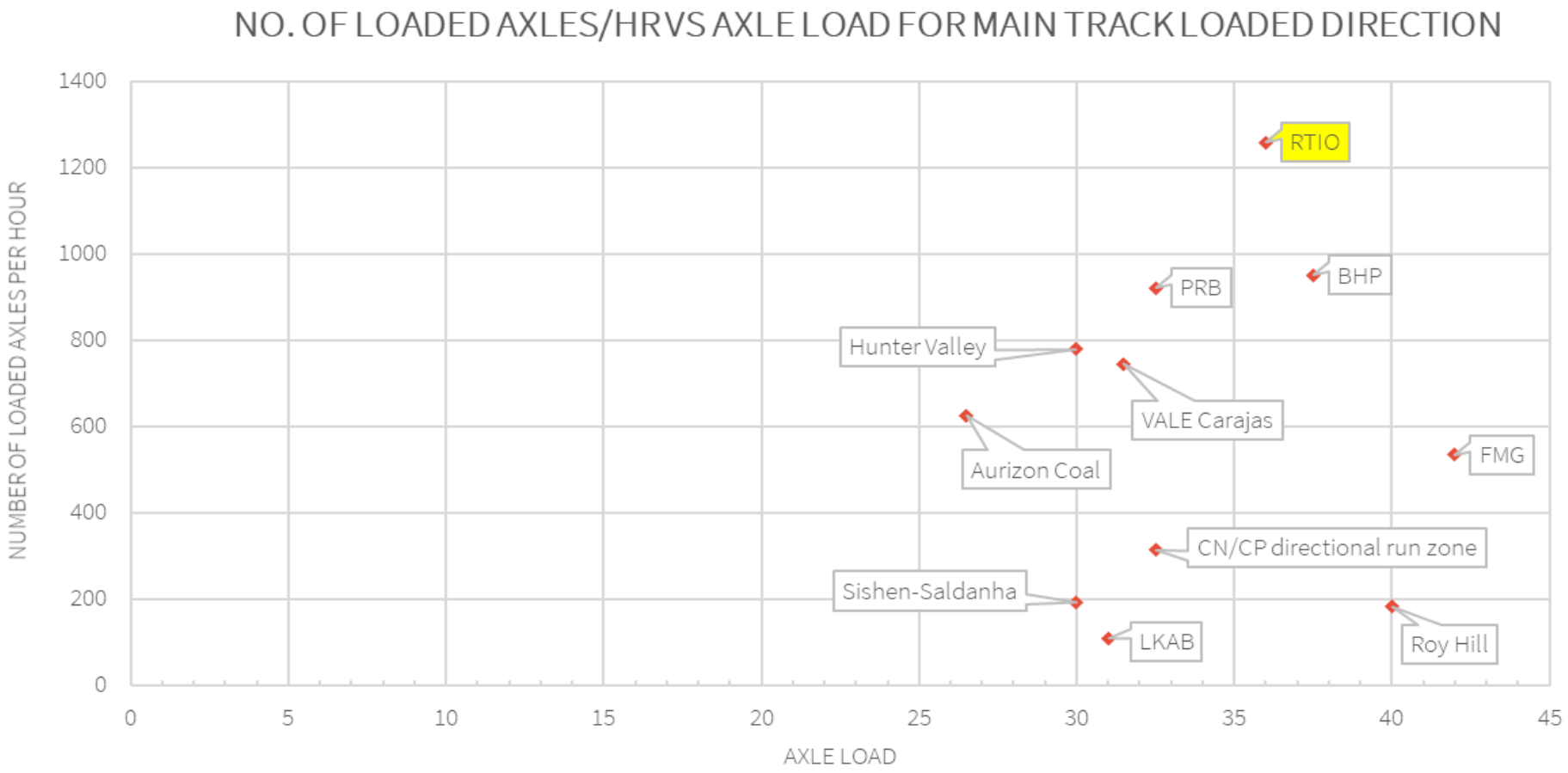
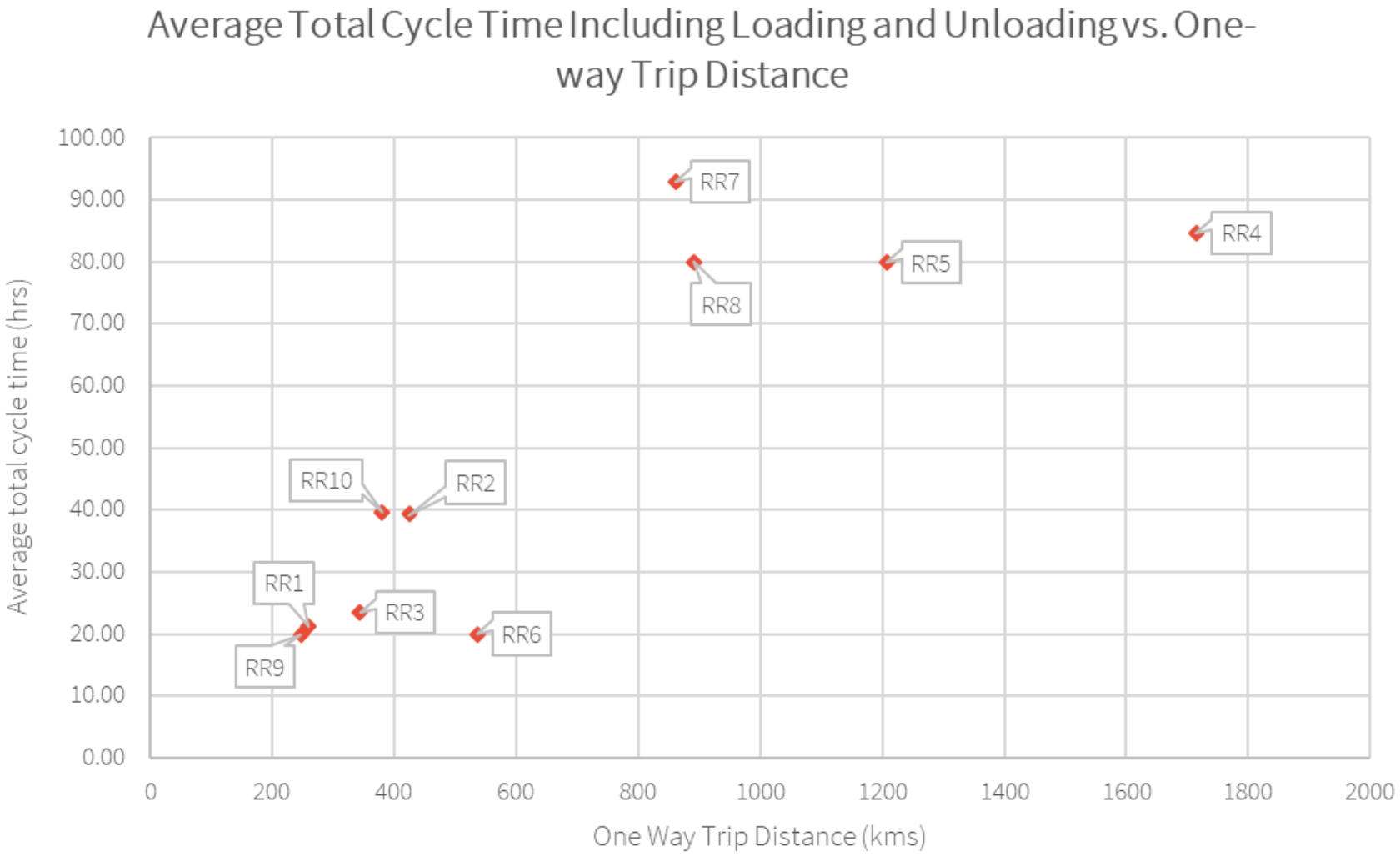
# Comparison of World's Best Heavy Haul Lines for Throughput (Revenue tons/day)



# Average Round Trip Cycle Time vs. Mine to Port Distance for World's Best Heavy Haul Railways



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- Freight Railway of the Digital Future: a convergence of views

8th International Heavy Haul Conference

2005 • RIO • BRAZIL

# Common Elements of Successfaul Heavy Haul Railways: A Worldwide Perspective

*Michael Roney GM Track and Structures*

*Canadian Pacific*

Rio de Janeiro, June, 14-16 , 2005

# Common Elements of Successful Railways (2005)

- Safety as good business
- The scheduled railway
- Market driven service
- Integrated operating plan
- Trains sized to capacity
- Rails and wheels as a system
- Control the stress state of the railway
- Quality is Built In
- Engaged and accountable employees
- Public support for rail

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# International Heavy Haul Technology Benchmarking

IHHA 2017
CAPE TOWN 02 – 06 September 2017

Michael D. Roney, Int PE

*www.iron-moustache.com*

*For*

INTERNATIONAL HEAVY HAUL ASSOCIATION

# New Perspectives for Success

## 2005

- Safety is Job 1
- The scheduled railway
- Market driven service
- Integrated operating plan
- Trains sized to capacity:
- Rails and wheels as a system
- Control the stress state of the railway
- Quality is Built In
- Employees engaged and empowered
- Public support for rail

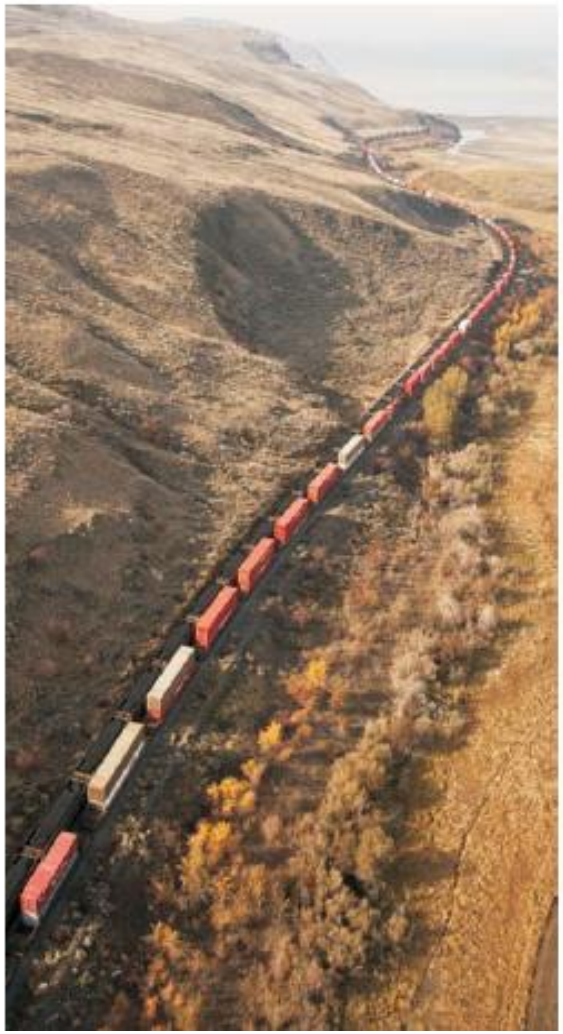
## 2017

- Safety Management Systems
- Precision scheduled railroading
- Customer centric sell-in to ops plan
- Integrated supply chain
- Trains sized to expand capacity
- Vehicle/track as a system
- Asset management systems
- Quality and lean production improvement drive built in
- Employees accountable
- Railway widely seen as sustainable and socially responsible choice.

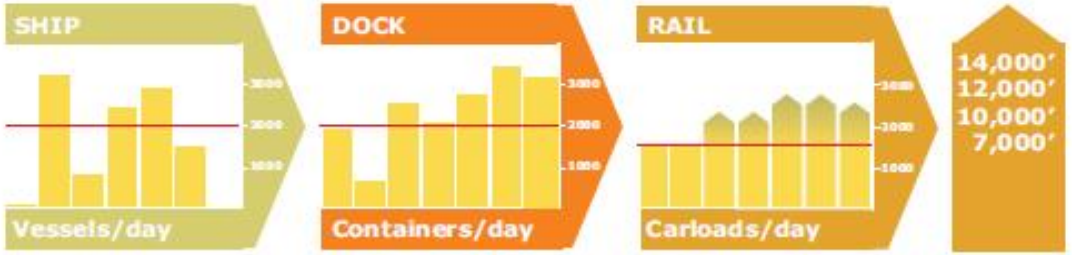
# What is Precision Scheduled Railroading ?

- Point to point delivery as opposed to “hub and spoke”
- Running fewer and heavier trains, faster and on a schedule.
- Removing surplus and unreliable locomotives and wagons from service, as well as redundant trackage.
- The coordination of all aspects of operations including train and crew scheduling, equipment availability, track and rail car repairs, as well as synchronization with other stakeholders, such as customers and supply chain partners. Employees must be constantly mindful of all aspects of the transportation process to ensure the safe, timely, and efficient arrival of a customer's freight.

# Long Trains with Distributed Power



Multiple remote train




CP can absorb some supply chain variability

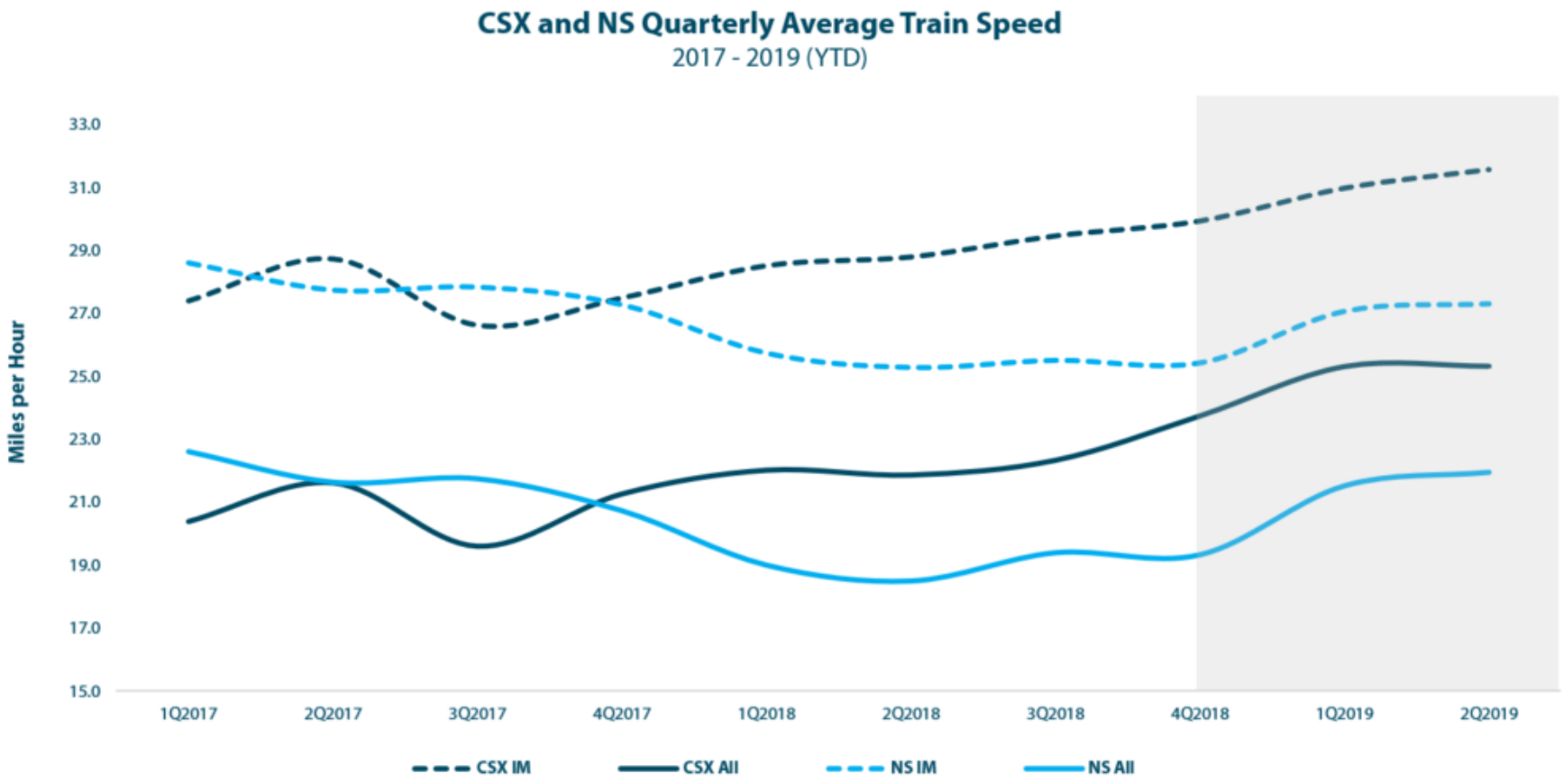
POTASH

COAL

INTERMODAL

GRAIN

# Effectiveness of Precision Scheduled Railroading on CSX (USA)



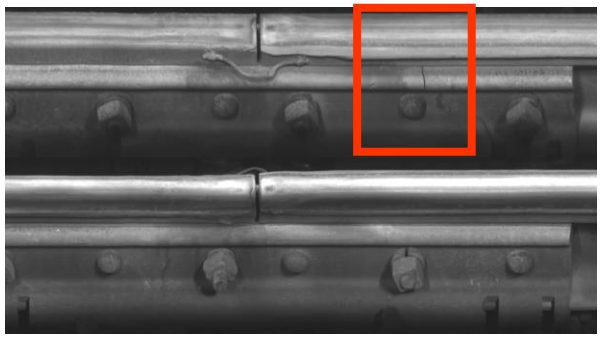

Breakthrough.

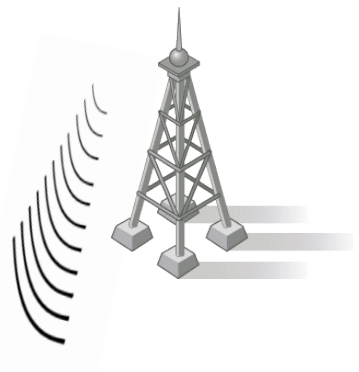
# What is asset management ?

Asset Management definition :

- *Systematic and coordinated activities and practices through which an organization optimally and sustainably manages its assets and asset systems, their associated performance, risks and expenditures over their life cycles for the purpose of achieving its organizational strategic plan (PAS55)*
- *the coordinated activities of an organization to realize value from assets" (ISO 55000)*

# Infrastructure and Rolling Stock Health Monitoring leads to predictive maintenance

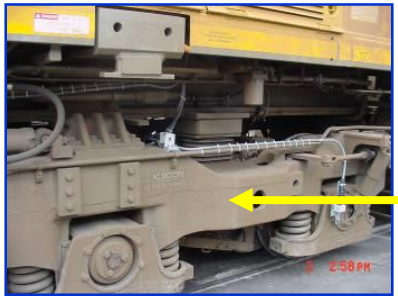




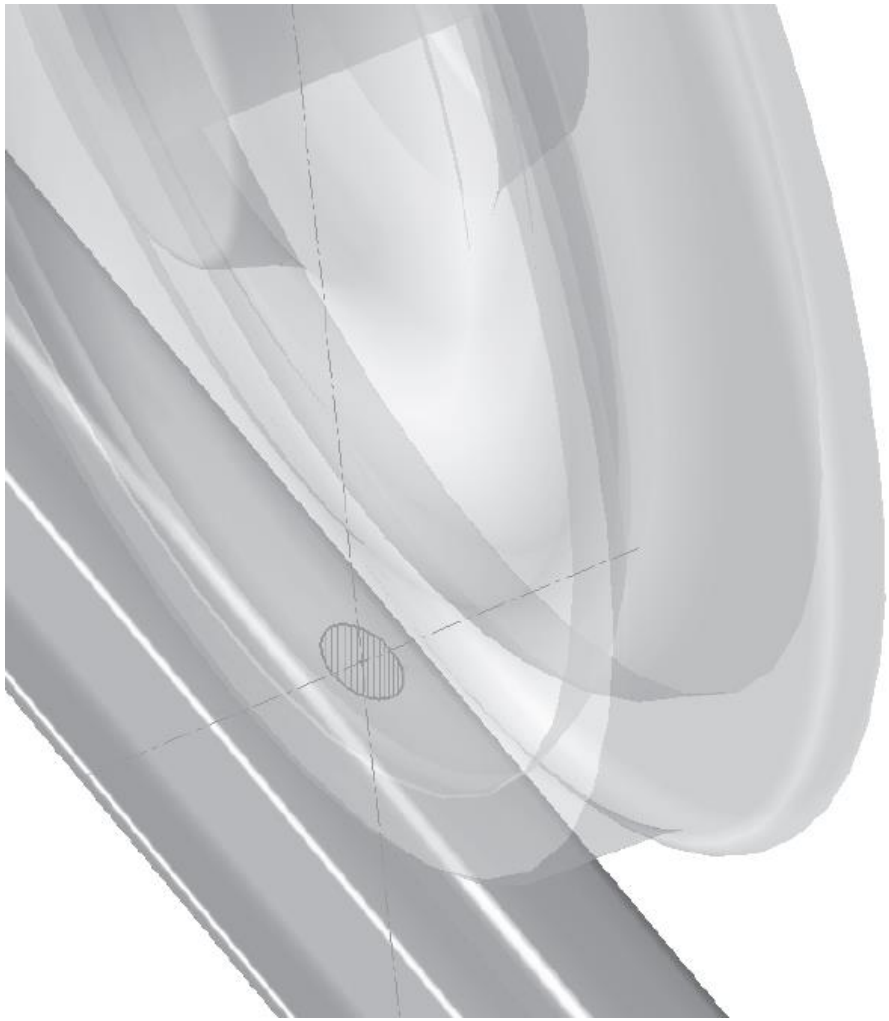
1970's 1980's 1990's 2004 2005 2008 2009 2010 2015 2020

***Improved Service Reliability***

Track geometry measure ment → Rail wear measure ment → GRMS → GPS reference → Joint bar imaging → V/TI equipped locos → Broken rail detection → Unattend-ed track geometry → Train-based inspection → "Finders" into "Fixers"



# Controlling forces in a train and friction management allows us to find the “sweet spot” in steel wheel on steel rail contact



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# Heavy Haul Vision for 2030 in the Digital Era of Rail 4.0

Michael Roney
Pierre Lombard

INTERNATIONAL HEAVY HAUL ASSOCIATION

IHHA NARVIK 2019

# Freight Railways 4.0

## 2017

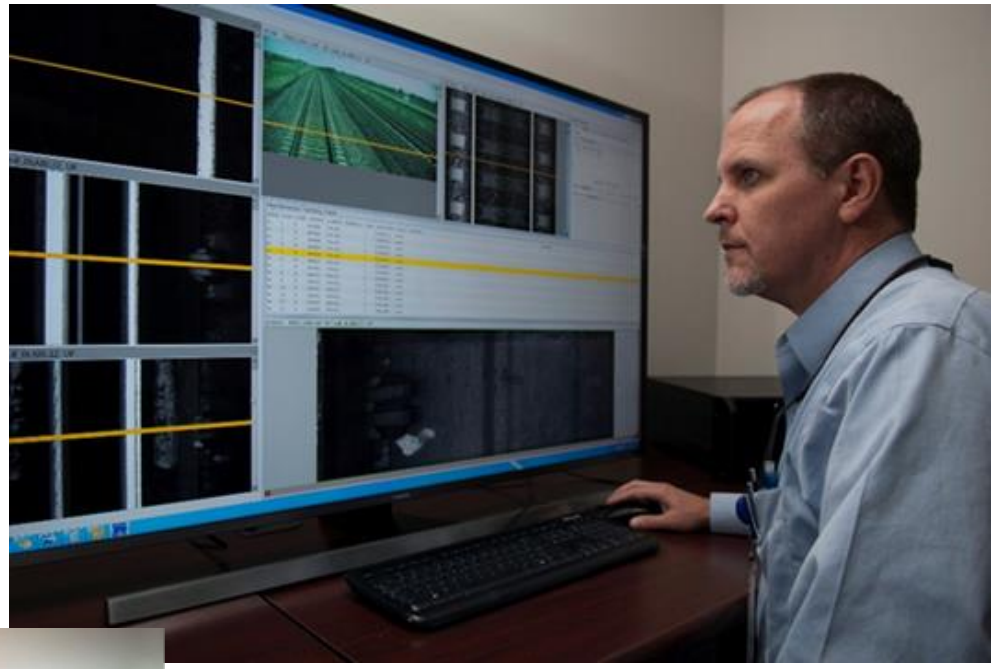
- Safety Management Systems
- Precision railroading
- Customer centric sell-in to ops plan
- Integrated supply chain
- Trains sized to expand capacity with driver assistance
- Vehicle/track as a system
- Asset management
- Quality and lean production improvement drive built in
- Employees accountable
- Railway widely seen as green choice

## 2019-2030

- Safety is engineered in
- Network centric precision railroading
- Precise shipment delivery projections on the web
- Block chain integrated supply chain
- Autonomous trains
- Vehicle/track as a system
- Proactively predict asset condition
- Quality and lean production improvement drive built in
- Employees want to learn new skills
- Railway widely seen as sustainable and socially responsible choice.

# Future Track and Wagon Inspections will Be Performed By Sensor-Assisted Displays and Logic

Office-based track inspector accessing digital imaging and onboard sensor displays



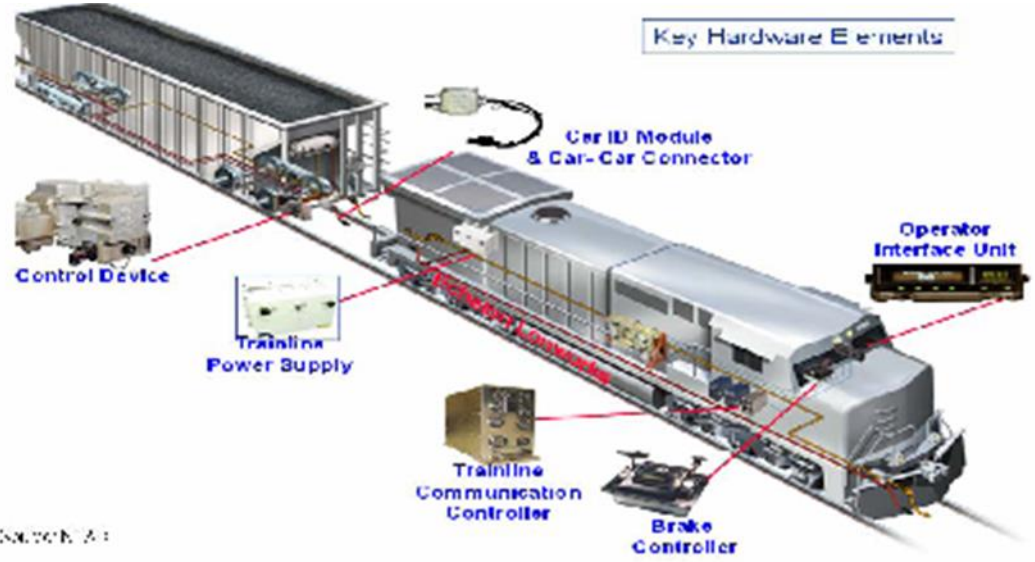
Technician is sent to exact location of potential track or wagon defect to perform repairs

# Building Blocks of the Digital Railway

# Communications-Based Train Control Holds the Key to Capacity Improvements

*With a true virtual moving block, train spacing can be set by braking distance algorithms.*

*… and they can be set tighter with ECP braking and further improvements in braking effectiveness.*



# Autonomous Trains are on the Horizon for 2019-2030


Rio Tinto autonomous driverless train

*But will they change our perception about running longer and heavier trains in virtual moving blocks? Or should we run more short driverless trains on double track with tight train spacing ?*

# Concluding Remarks

- The world's best freight railways have adopted common business practices and technologies to improve their key performance indicators.
- These practices have evolved over the past 2 decades, and continue to develop.
- Different railways do different things better. No one railway is the best at all measures.
- The digital railway of the future will look quite different.
- It will combine the best of human skills and artificial machine intelligence to run autonomously with human oversight..

# Questions ?