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Connecting Today's Freight Rail Landscape

ADB Transportation Forum 2016

September 15, 2016

What happened when **1B people** became connected?

[Social marketing emerged]

[Communications mobilized]

Consumer Internet

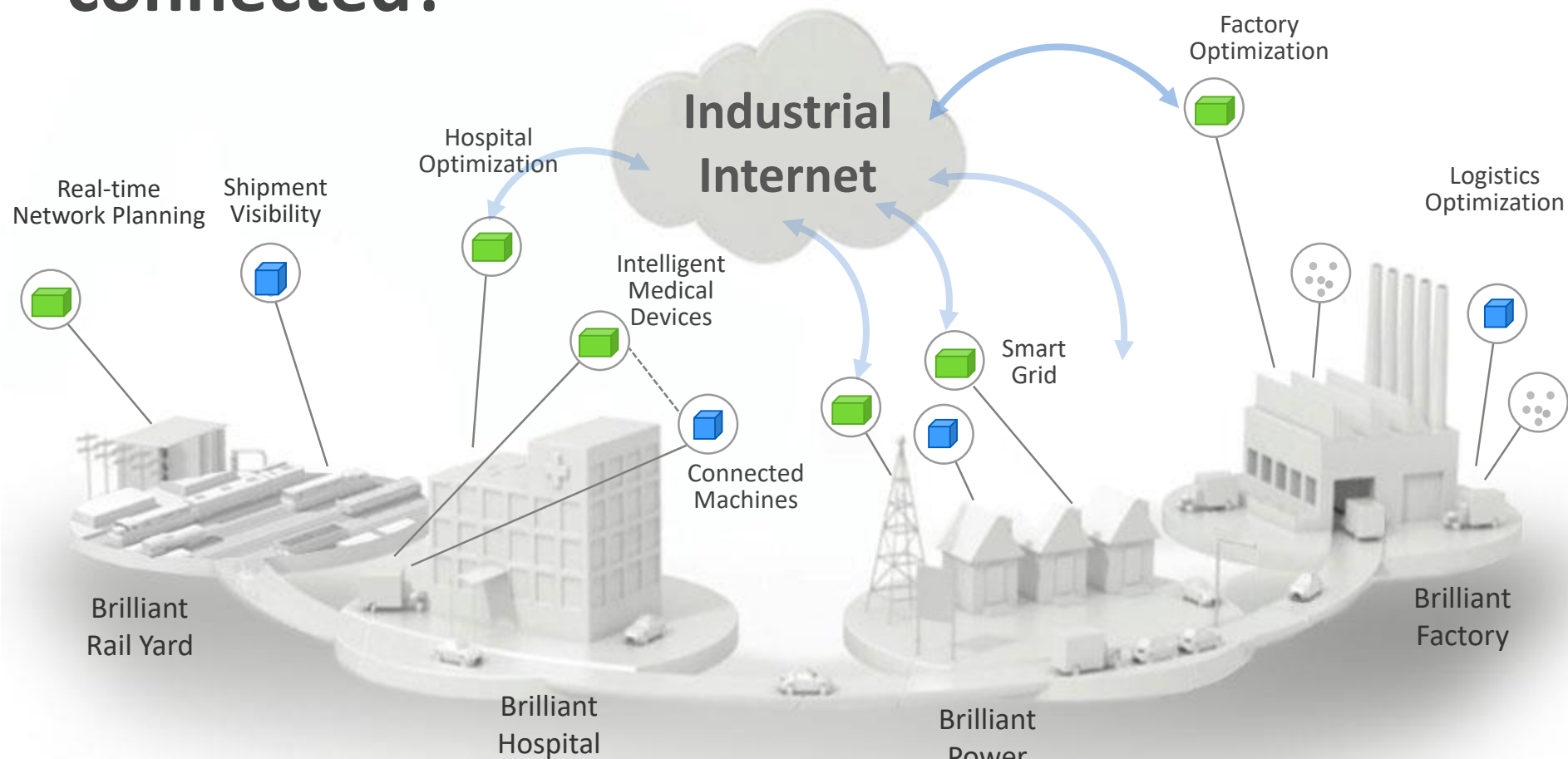
[IT architecture virtualized]

[Retail & ad transformed]

[Entertainment is digitized]



What happens when **50B Machines** become connected?



Analytics become predictive

→ Employees increase productivity

Machines are self healing & automated

→ Monitoring & maintenance is mobilized



Partner to drive new levels of performance


1% LOCOMOTIVE
PRODUCTIVITY
IMPROVEMENT
= **\$800**
MILLION




1% CAR
DWELL
IMPROVEMENT
= **\$2.2**
BILLION



1 MPH NETWORK
VELOCITY
IMPROVEMENT
= **\$2.5** BILLION



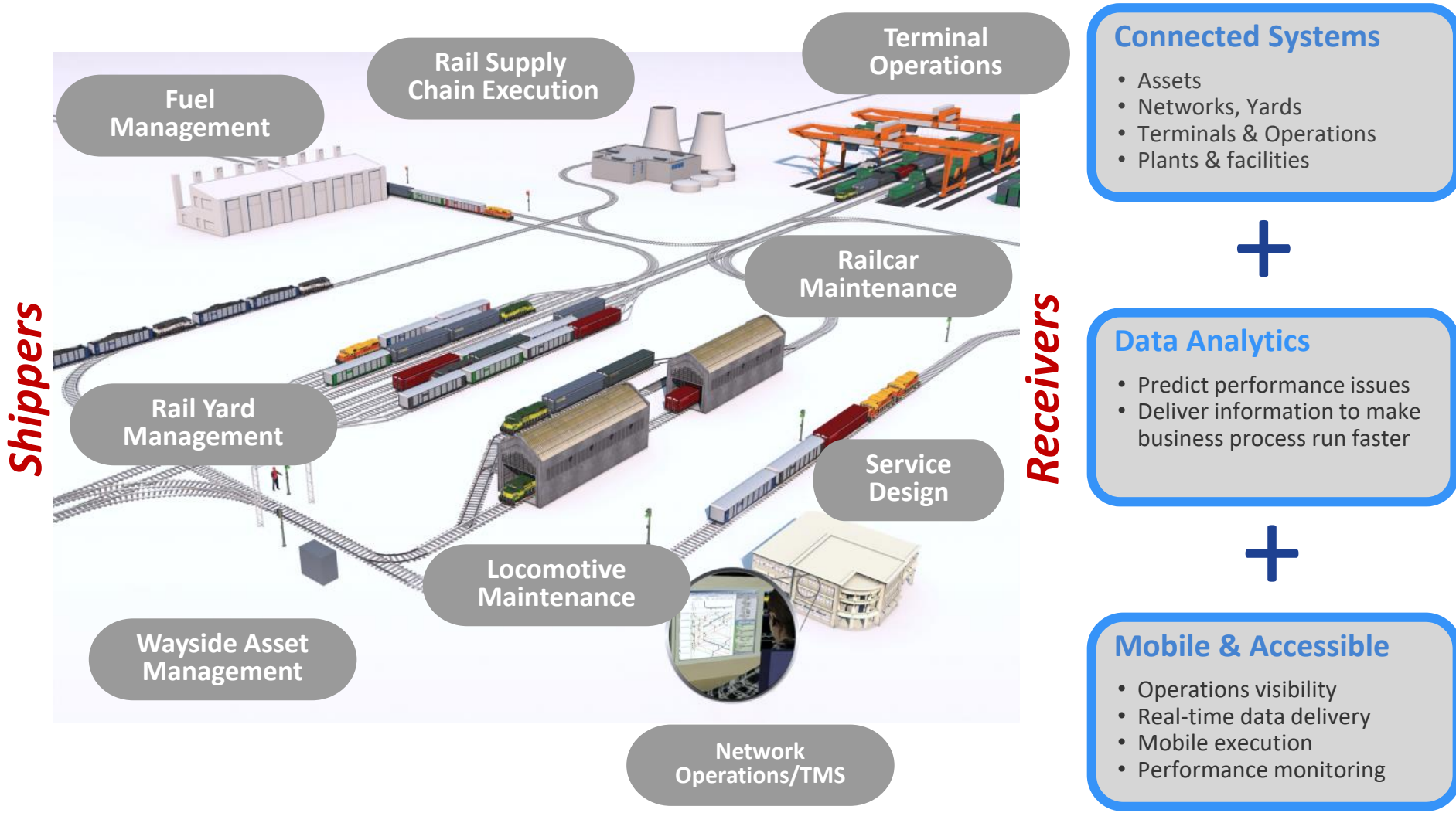
1% FUEL
EFFICIENCY
IMPROVEMENT
= **\$140** MILLION



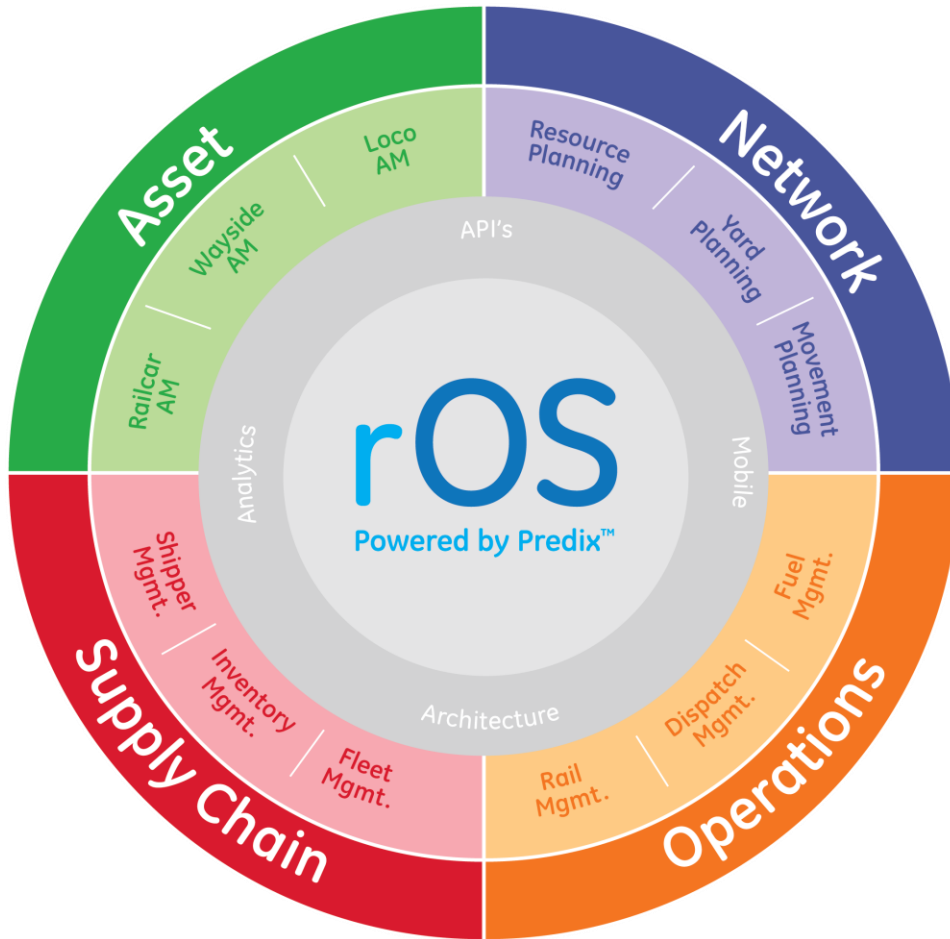
The path to optimizing outcomes is unlocking the exponential value of connection and data to solve systems problems.



Connecting today's freight rail landscape



RailConnect™ 360



A CONNECTED SUITE OF SOLUTIONS THAT PROVIDES DATA-DRIVEN INSIGHTS TO DRIVE KEY CUSTOMER OUTCOMES

FOCUS AREAS

ASSET, NETWORK, OPERATIONS, SUPPLY CHAIN

OUTCOMES

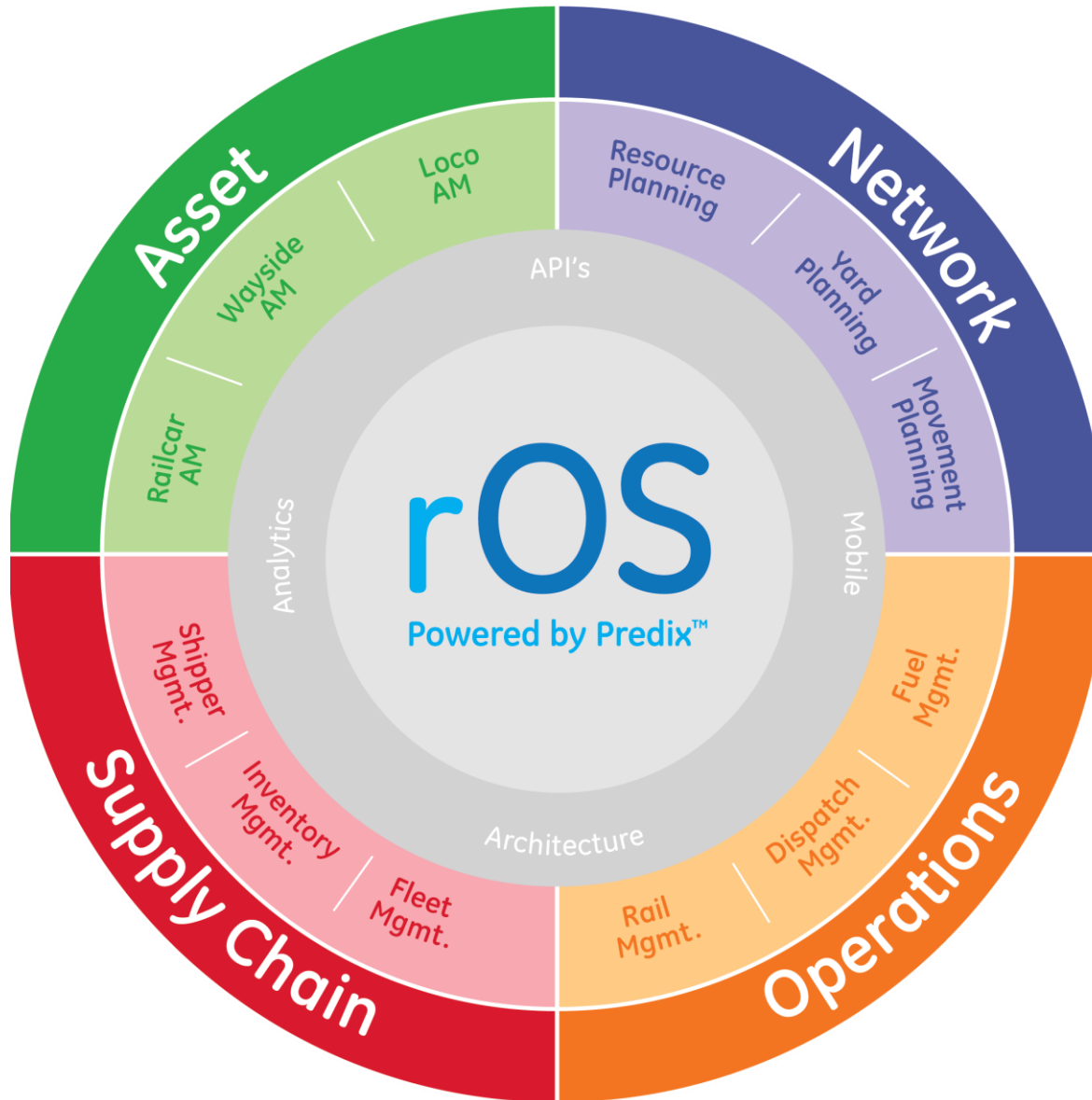
UTILIZATION, VELOCITY, DWELL, PRODUCTIVITY, FUEL EFFICIENCY



Connected suite of solutions



Customer IT Systems



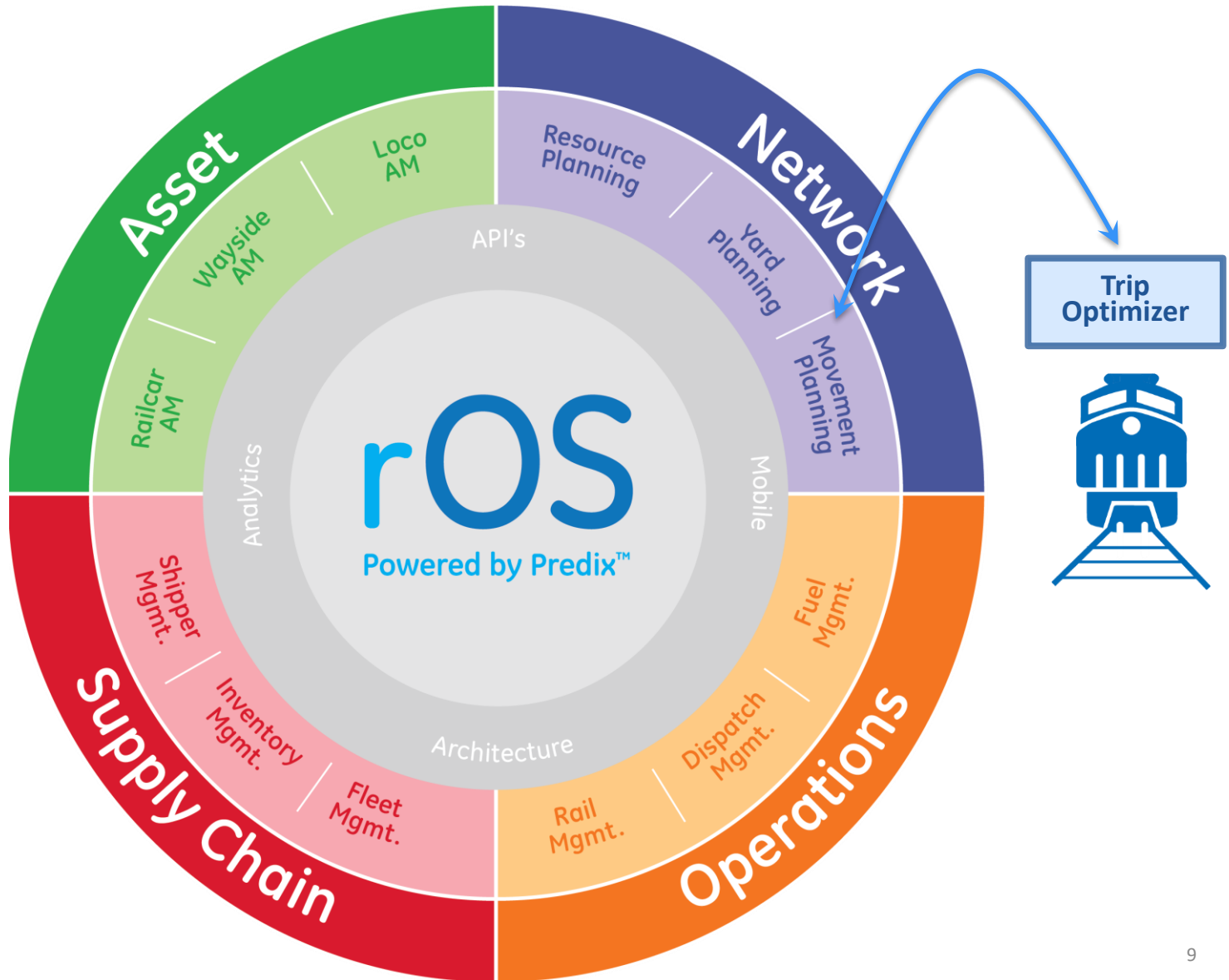
Onboard and Wayside Assets



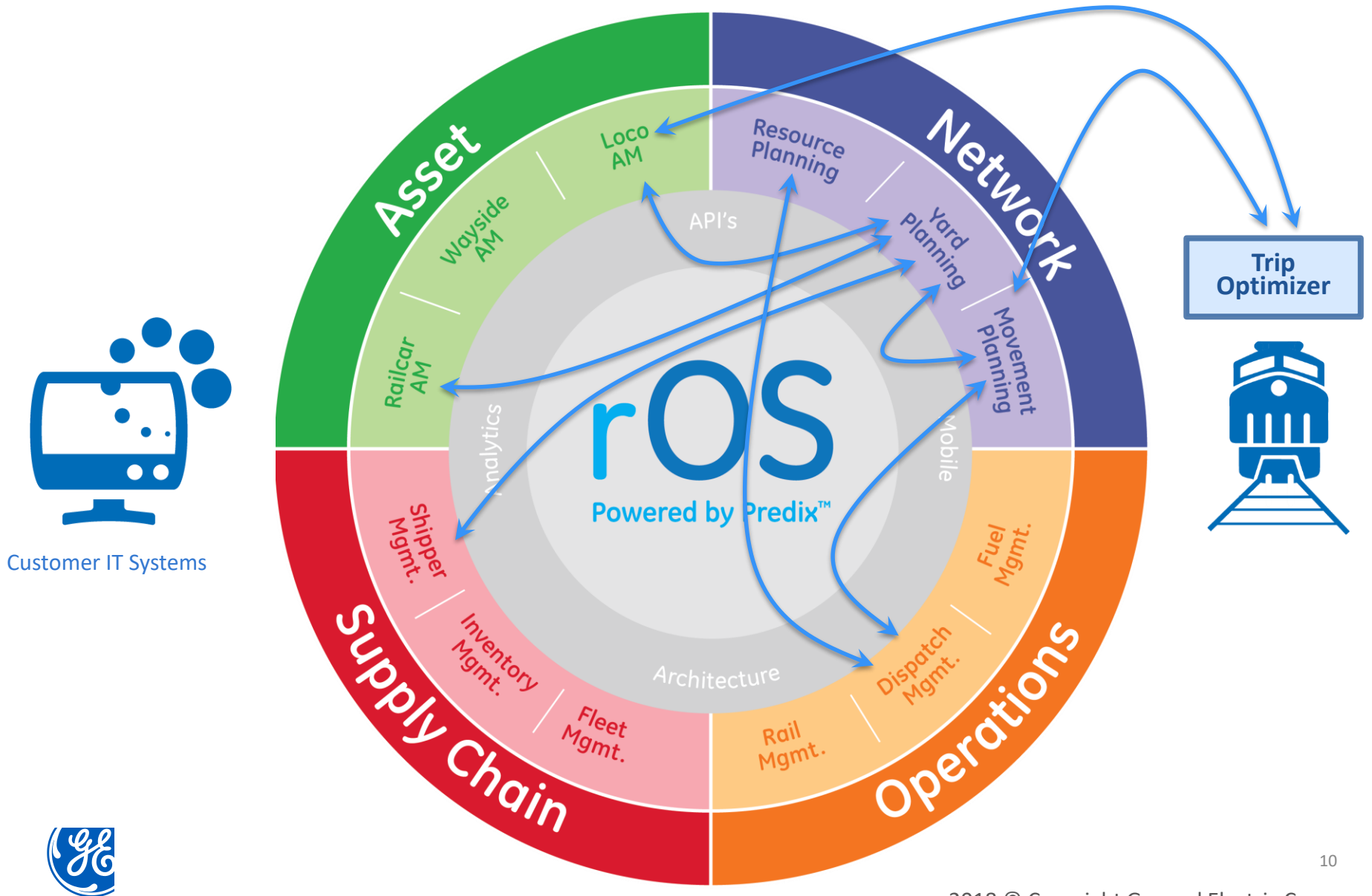
Connected suite of solutions



Customer IT Systems



Connected suite of solutions



Wheel example

Wheel usage (\$0.5B)

Problem: Excessive wheel truing and usage

Data sets



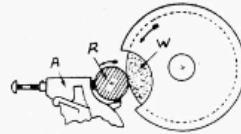
GE Locomotive
RM&D

+



Wheel Impact Load
Detection

+



Wheel True
Measurements



Wheel example

Wheel usage (\$0.5B)

Problem: Excessive wheel truing and usage

Data sets



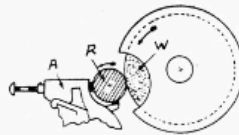
GE Locomotive
RM&D

+



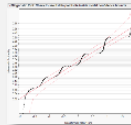
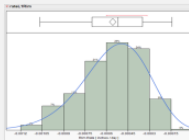
Wheel Impact Load
Detection

+



Wheel True
Measurements

What



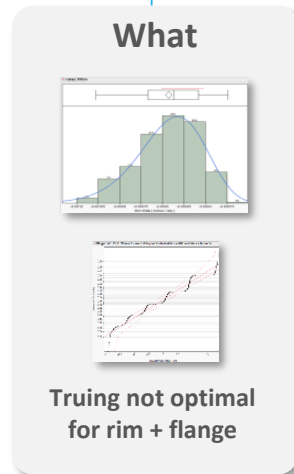
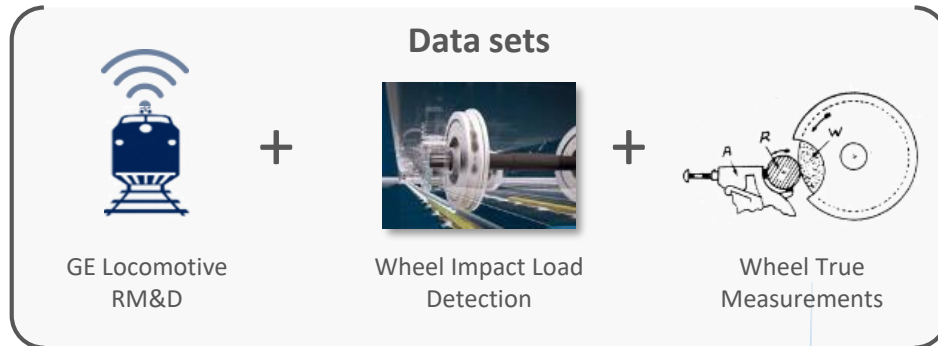
**Truing not optimal
for rim + flange**



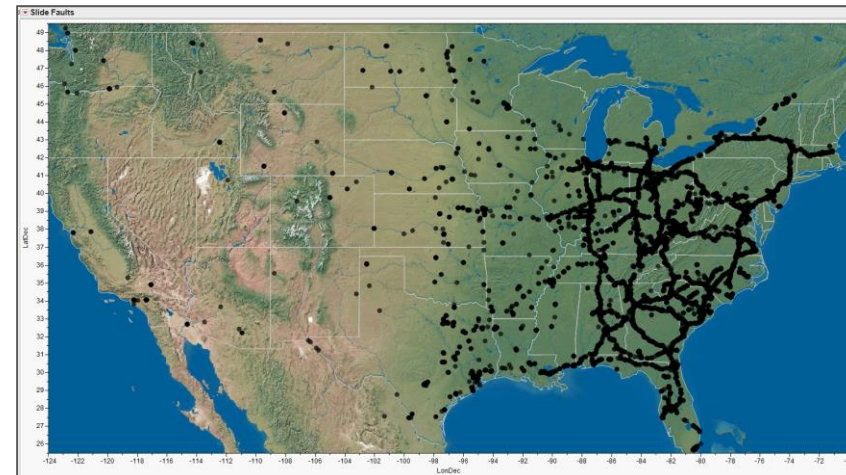
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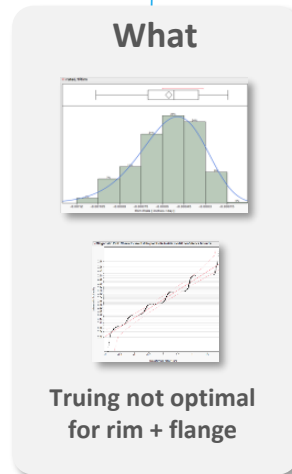
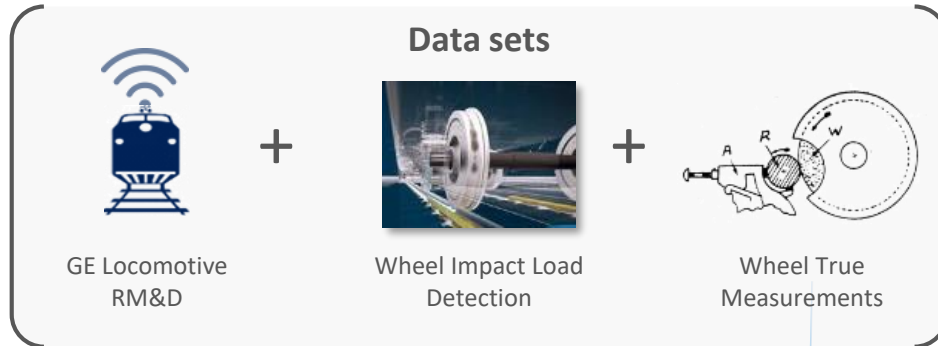
Location of network wide wheel slide faults - raw data



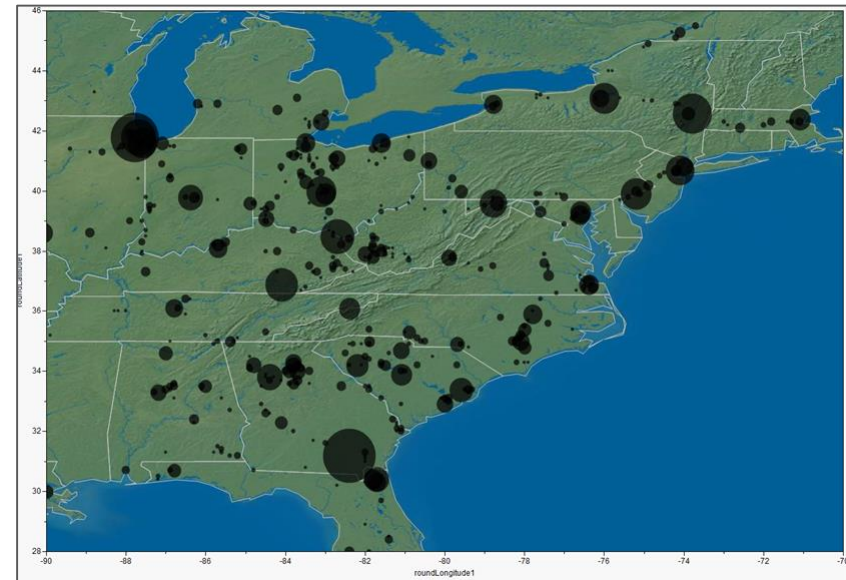
Wheel example

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Problem: Excessive wheel truing and usage



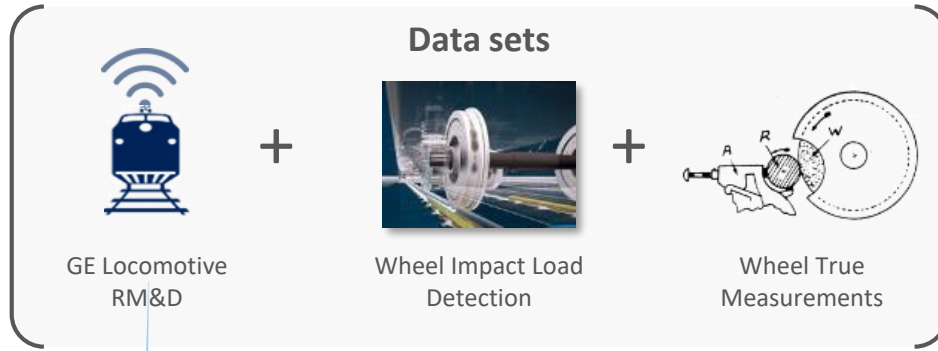
Concentration of network wide wheel slide faults concentration



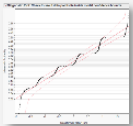
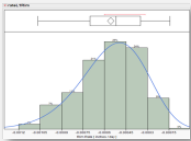
Wheel example

Wheel usage (\$0.5B)

Problem: Excessive wheel truing and usage

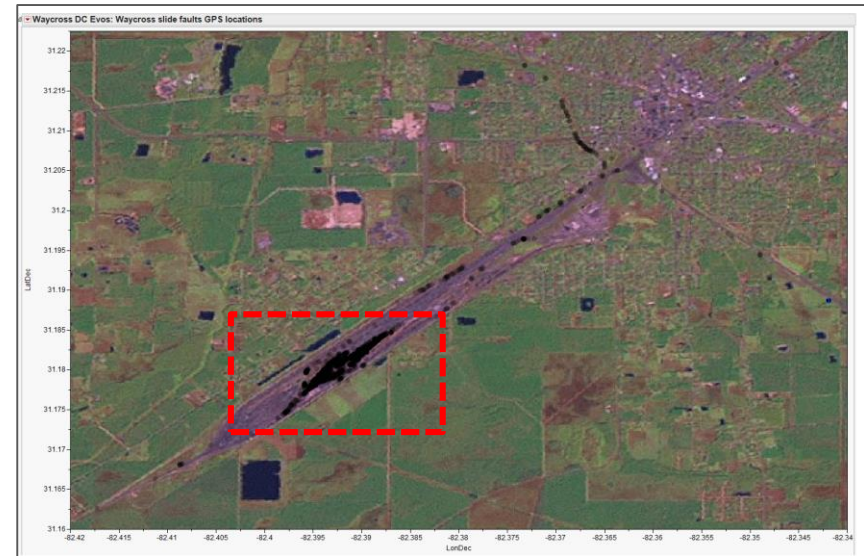


What



Truing not optimal for rim + flange

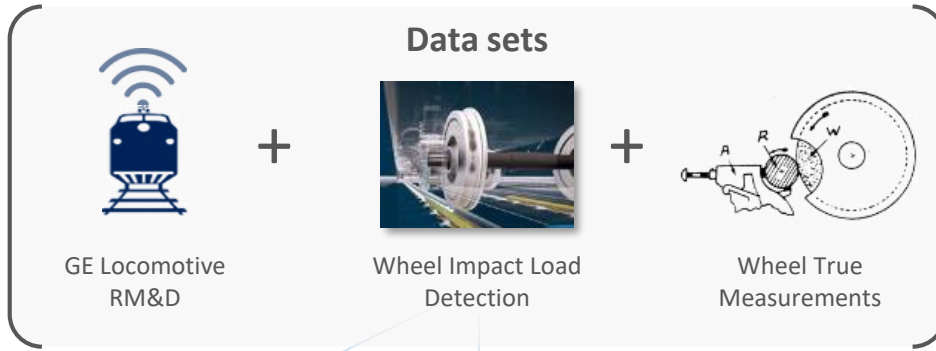
Pinpointing to specific location overlaying locomotive data



Wheel example

Wheel usage (\$0.5B)

Problem: Excessive wheel truing and usage



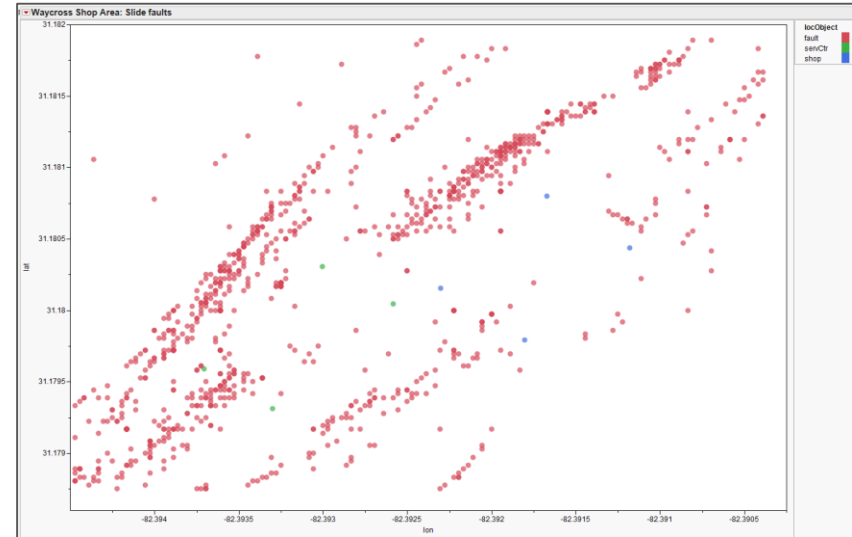
What

Truing not optimal for rim + flange

Where

Bad actors... rail service yards

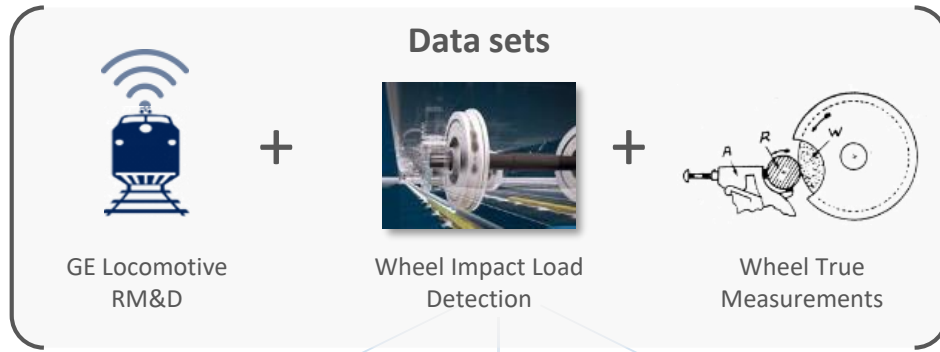
Refining location . . . Leveraging visualization tools



Wheel example

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Problem: Excessive wheel truing and usage



What

Truing not optimal for rim + flange

Where

Bad actors... rail service yards

Why

4th axle showing most flat spots

- Most wheel damage occurring in area under shop control
- Damage to axle 4 & 5 wheels
- 20+ people across 3 shifts responsible for moving locomotives in shop area

Learnings:

- Handbrake left on when shunting units
- Training implemented



✓ GE Transportation's Digital Industrial focus

- Connecting systems
- Driving big data analytics
- Creating Mobility & accessibility



Fueling Potential

✓ Connecting to what matters most to the customer

✓ Try it . . . Learn . . . Adjust





Thank You

Imagination at work

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Fuel Efficiency– *Trip Optimizer*

Train Performance

Customer Challenge



- How to reduce locomotive fuel consumption? Fuel accounts for 15-20% of OpEx for railroads
- Need to reduce driver-to-driver fuel consumption
- How to reduce over-speeding?

Trip Optimizer



- ✓ Trip Optimizer is installed on over 7,000 locomotives

- Trip Optimizer is an intelligent, fuel-saving cruise control for locomotive
- It optimizes fuel consumption based on a specific train's make up & the route traveled.
- Trip Optimizer calculates optimal speeds and automatically controls the throttle to achieve those speeds.

TRIP OPTIMIZER... 3-17% improvement in fuel efficiency



Network Optimization – *Movement Planner*

Opt Solutions

Customer Challenge



- 1000's of variables ...
- No Network Integration ...
- Manual decisions

Movement Planner



- ✓ Norfolk Southern
- ✓ Aurizon (Australia)
- ✓ BNSF (being implemented)

- Real-time train movement planning & opt.
- Route management & planning
- Conflict detection & resolution
- Interactive train graph, route setting

Delivering real CUSTOMER OUTCOMES* ...

- ✓ 10% ↑ in network velocity
- ✓ 50% ↓ in expired crews
- ✓ Significant improvement in on-time performance

Movement Planner – increasing network velocity, capacity

*Based on Georgia division results



Power Planning— *Power Advisor*

Perf. Analytics

Customer Challenge



- Locomotive road failure cause ~70 hrs. of train delays/day
- Industry need for a real-time decision support tool for railroad Power Planners
- Power Advisor helps make smarter, faster assignment decisions ... *select the right locomotive for the mission*

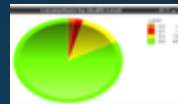
Power Advisor



Piloting at BNSF



Interactive Portal: Cloud-based portal displays locomotive fleet.



Real-time visibility: Health checks run every 15 min. monitoring 11 subsystems



Asset Health Index: Weighted ranking compares asset condition across fleet to find the highest performing locos



Right Loco Right Consist Match: Search & compare the history of locos against consist requirements

Using data insights to improve mission success & reduce road failures

