

Enterprise Application of Measurement Technologies

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Outline

- **Overview (WILD, HBD, WPD, Machine Vision)**
 - *Problems for UP*
 - Solutions Chosen
- **Guiding Principles**
- **Lessons Learned**

Enterprise Application:

- A well engineered machine.
- An organizational fit.

Finance , Train Operations, Maintenance, IT,
Labor, Industry, AAR/FRA, M&S



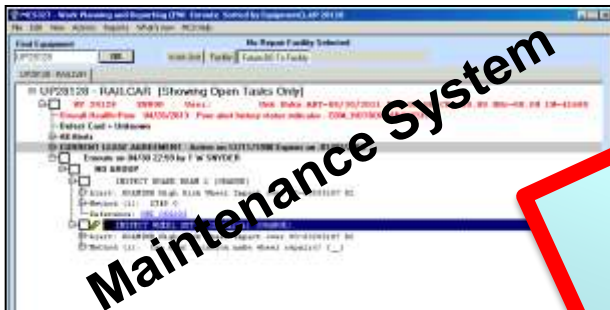
Life-Cycle Overview (the Age of ___)

JOB: R&D Lab – Derailments/Failure Analysis 1997-2008

... Maintenance 30,000 Cars/Locos per month 2002-2010

... Reduce Train Delays 2008-2012 (Red X)

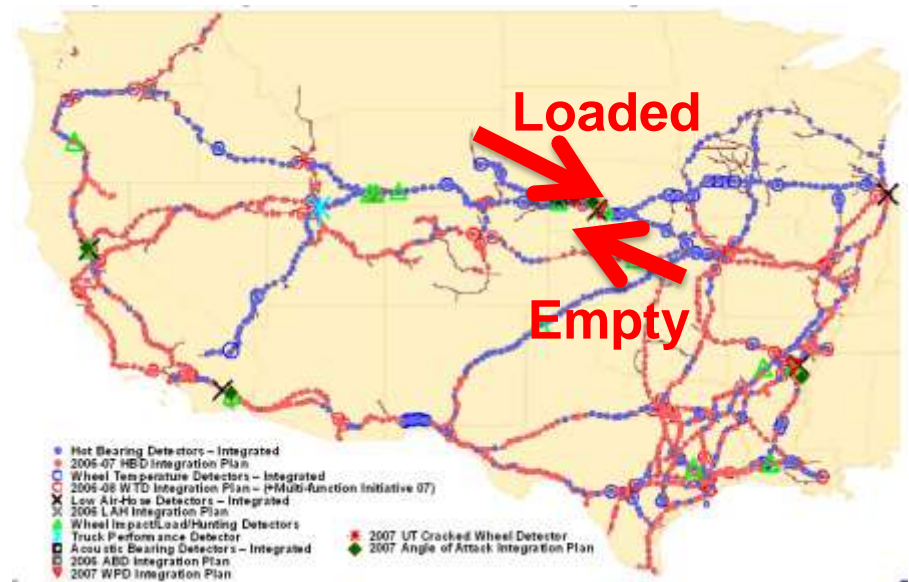
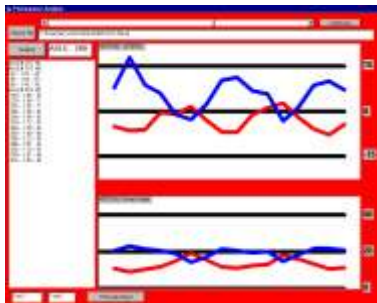
... R&D (Mobile & Fixed , Track& Equipment Health Systems) 2012-



WILD Overview

WILD – 10 wheels per day / 20k trains/year

-> 7500/mo +hunt +overload/imbalance / 150k trns/year



Reactive
Prioritized Removals
E/L, Train Service Type



More Problems (WILD – Operations)

Rules: **>90 kip (AAR repairable)**
 140 kip (Broken? Stop Train)

Seasonality



Wheel History Prioritization: Impact, Time past Threshold

Rules: 1 Must remove, 2 Can remove (financial alignment)

***Manual Verification* (0.070" OOR)**

AAR Rules (90 kips, WILD minimum standards)

***Repeat Setouts* (8000 cars / yr)**

AAR Rules: 80 kips on Repair Track, 90 kips on train

***Data Integrity* (AEI – Orientation & Axle Count)**

Field Verification: "Is wheel bad?"



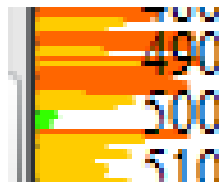
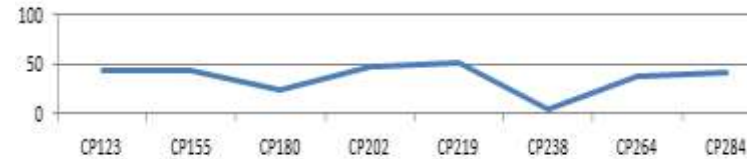
Hot Box Overview

HBD – 1MM trains/year -> 10MM trains/year

20/mo destroyed -> 1/mo / WTD-Brake Health

Rules: Hot Bearings (Abnormal)
Drastic Temperature Changes

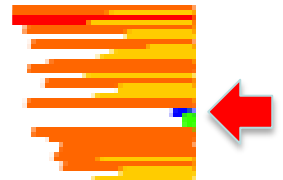
Calibration Temperature (mm, C, F)
Normalization (K value)



Wheel Temperatures

<=Left Side

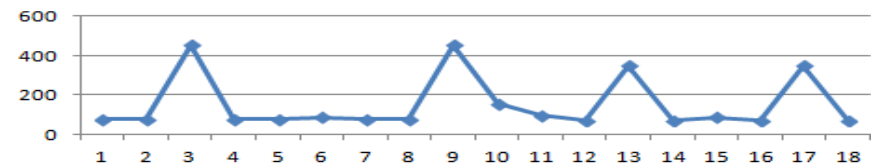
Right Side =>



More Problems (HBD – Maintenance)

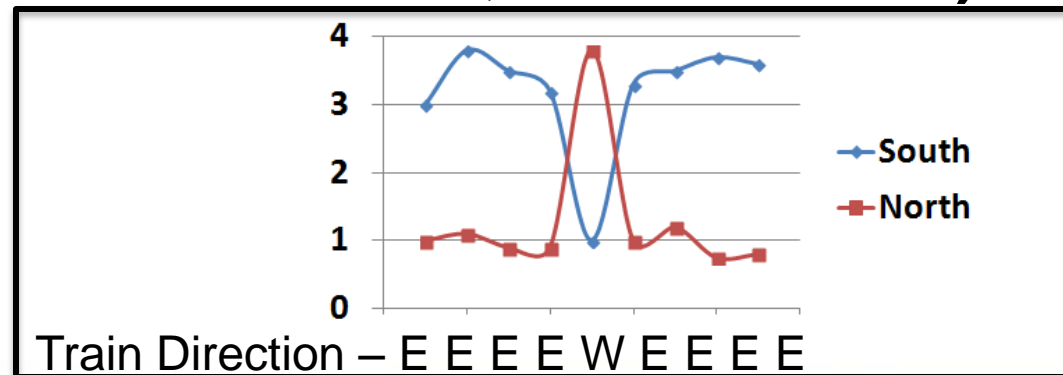
Reliability (Wheel Sensors)

Simple Patterns



Data Integrity (Train Direction, Sensor Side)

Connectivity Patterns



Wheel Profile Overview

WPD ->> 30MM wheels = 60 billion points/year



Rules: High / Thin Flange
Thin Rim

***Thousand Points of Light* (Explaining)**

Track Record – Because that's what we do

Database Technology – Separating JIT from Data Mining



More Problems (WPD – Real Life)

Reliability (Wheel Variation, Lighting, Timing)

a) False Positive (Not really bad – It's good)

b) False Negative (Not Really Good – It's Bad)

Data Integrity Indicator

“SEPARATION OF KNOWN GOOD and ?Questionable?”

READY TO PLOT

Input Axle Number

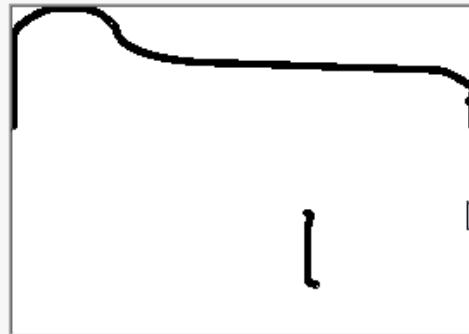
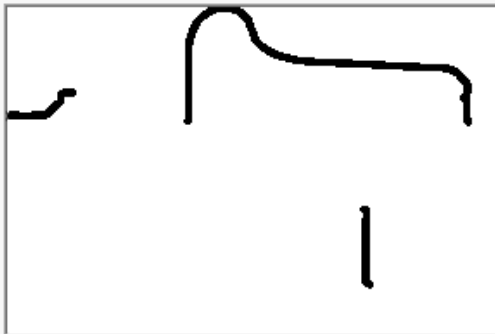
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TOTAL AXLE 274

Plot

NEAR WHEEL

FAR WHEEL



Imaging

Train Imaging Sites

->>> 1 TB/min (10^{12})

(AT&T [20 TB/min] Google[15 TB/min])

Rules: **Useful Photos (Historical)**
 Useful Analyses (Results)

Bandwidth

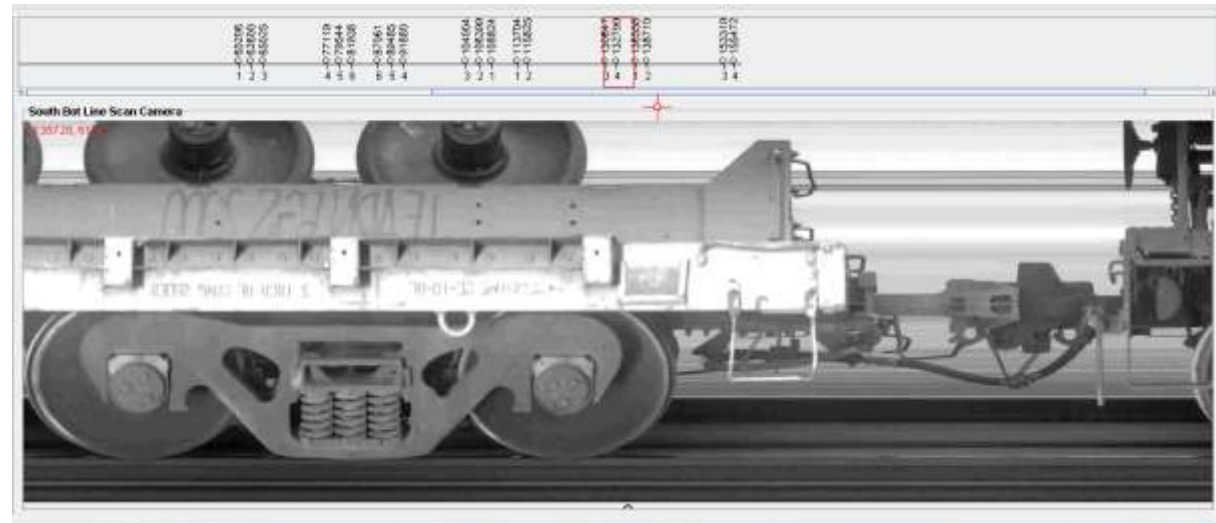
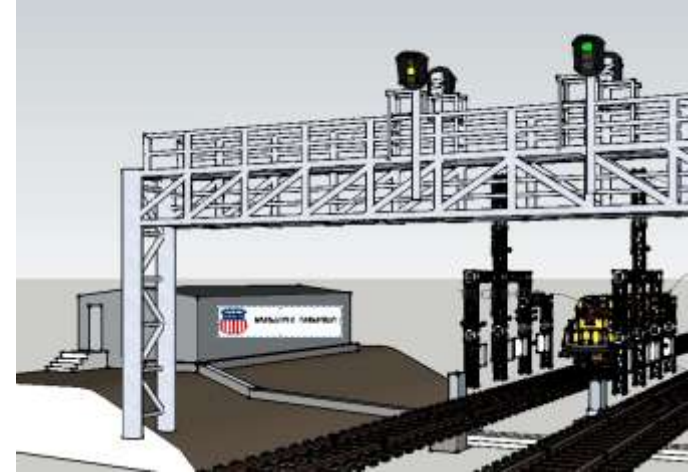
Remote Model

Integration

Axle Based

Time to Market

Standards



Real Problems Solved (Limited Resources)

***Rate of Progress* (Internal)**

Standard Designs / Integration Planning

10 yr WILD → 1 yr Machine Vision (MV)

What Problems to Solve

Full Utilization of each Technology

A Big problem → Many Small Problems (Big\$)

***Inaction* (Internal and External)**

AAR Standards Alignment

Financial Alignment

Critical Organizational Keys



Guiding Principles

Technology Evaluation

Financial: Widest footprint most benefit? (GPS-PTC/Eng/Mech)

Other possible technologies? Lifespan?

Business Fit Evaluation

Management Expertise (Internal Domain Expert)

Maintenance (Physical, IT)

Business Process, Use of data (Transparent to Organization)

Political Evaluation

Who Supports, Who Resists

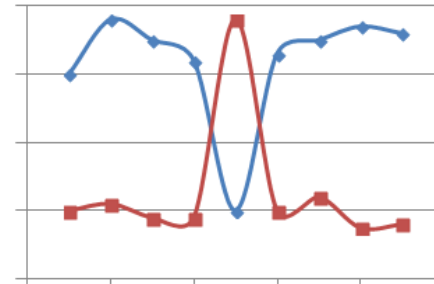
Who needs to understand

Timing – Testing the water, Planting Seeds, Strike while...



Lessons Learned:

Data Integrity



System / Detector Health

Understanding the Errors (Ability to Find/Fix/Handle)

Opening Alerts / Closing Alerts and the Gray Area

Error Handling vs \$10MM solution

#1 - Accurate Time / Time Zone (Integration)



Questions ?

Comments ?

