DESIGN FOR SAFETY IN RAILWAY TRACTION APPLICATIONS BY USE OF DATA ANALYTICS

THE EVOLUTION OF MOBILITY
USE OF DATA ANALYTICS FOR RAILWAY TRACTION APPLICATIONS

1. Challenges in the Railway Industry
2. Safe Data Transmission
3. Data Analysis Requirements
4. Examples on Data Mining
   a) Capacitor Lifetime
   b) Traction Dynamics
5. Conclusion
CHALLENGES AND OPPORTUNITIES IN RAILWAY INDUSTRY

Increasing demands to

• Improve availability
• Increase reliability
• Prove of safety
• Improve punctuality
• Increase operational efficiency
• Reduce maintenance costs
• Reduce energy consumption
• Need for secure data connections

Can no longer be solved by using isolated on-board solutions.
SAFE DATA TRANSMISSION OF $10^{12}$ DATA POINTS

Solely the computers (Drive Control Units) in the traction chain (from pantograph to the wheels) in fleet of 100 rail cars produce several billion data points every year.

Communications is the enabler. Collect and securely transmit data in both directions between the on-board train systems and wayside applications.
CHECK-UP ON THE HEALTH AND SAFETY OF YOUR TRAIN
ORBITA FLEET MONITOR

The Fleet Data stored in a central repository provides:

- Powerful visualisation tools to support:
  - Condition based maintenance
  - Preventive maintenance
  - Evaluation of modification effectiveness
  - Improving train reliability and reducing maintenance cost
- Alerting to support complex user defined scenarios
- Access to full diagnostic history
- Fleet health monitoring
TRAIN ENVIRONMENT REPRESENTED IN BIG DATA

Powerful and sophisticated data analysis tools

- Environment Time Series Graph
- Visualisation of environment variables over time for a vehicle
- Enables condition based analysis and root cause analysis

- We need smart algorithms to evaluate the sensor and environmental data from a wide variety of trains
DATA STRUCTURE FOR A LINE REPLACEABLE UNIT FACILITATE THE DESIGN TO COST AND DESIGN FOR SAFETY

• For each Line Replaceable Unit (LRU) a set of data is gathered and maintained
• Mandatory data, defining the configuration of the LRU
  • Unique identifier
  • Hardware identification (including Versions and Variants)
  • HW Serial number
  • Software identification (SW Built)

• Lifetime data (Subsystem Monitoring) which are defined during design stage of the LRU
  • Hours in operation or number of switching cycles
  • Power on hours (Hours under voltage)
  • Reset counter
  • Failure counter (counter for each failure)
  • Temperature -, Voltage - Histogram
DESIGN FOR SAFETY – SUPPORTED BY BIG DATA POWER CONVERTER ENGINEERING ON CAPACITOR

Counters

- On-train systems collect raw data regarding the usage of components (LRU)
- When the useful life of a component is reached then a maintenance event can be triggered
- Counter module enables the visualization of the usage of components installed on vehicles

• **Optimum dimensioning** of propulsion system to deliver the required performance and safety.
SLIP/SLIDE EVENTS HARM THE WHEELS AND BOGIES

Location of selected events using GPS mapping
- Identify hotspots
- Identify infrastructure issues
- Cluster events
KNOWLEDGE ADDS VALUE TO YOUR BUSINESS ANALYSIS AND INTERPRETATION OF SLIP/SLIDE EVENTS

Tracking of data that systematically influence torsional oscillation (e.g. environment, design) and building of Vehicle Data Base

Goals:
• Back calculation from database to predict average torques (however statistical variation)
• Support mechanical design of a new product
• Reduce the cost for prove of safety
CONCLUSION
BIG DATA ADDS VALUE TO THE TRAIN BUSINESS

Data Analytics improves
• Maintenance and warranty activities
• Engineering effectiveness
• Modification effectiveness

Using Bombardier's ORBITA FLEET MONITOR increases
• Train and fleet availability
• Train reliability
• Responsiveness - Fast on-time reaction
• Design for Safety

Opportunities for train builders
• Mining the data, extracting patterns to review physical dependencies
• Drive for performance increase