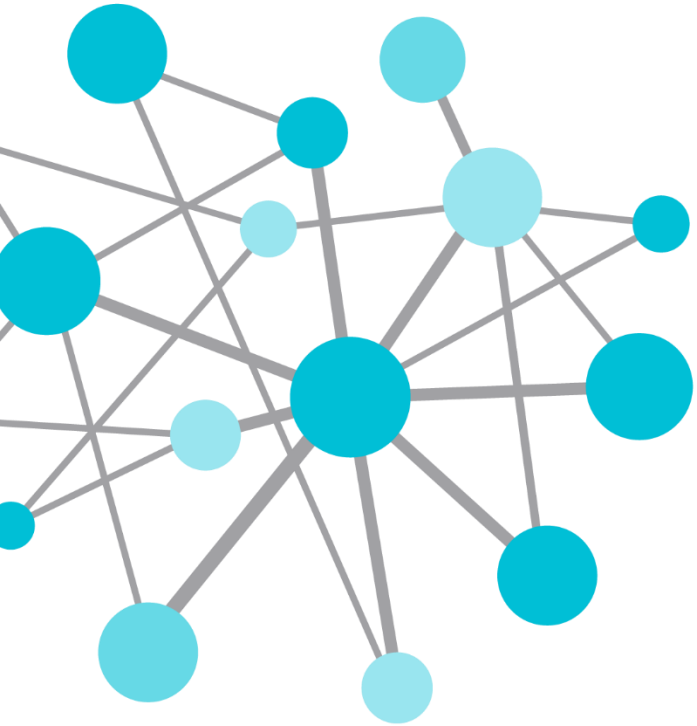

Industry Standard Approach for Remote Connectivity to Real-time Mobile Asset Information

Presented by **Peter Cunningham**
Solution Architect, Symboticware

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innovate ▪ integrate ▪ inspire

Agenda

About
- Industry/ Market
- Company

Industry Needs, Challenges and Solutions

Standards and Benefits

Integration of a Standards based Solution

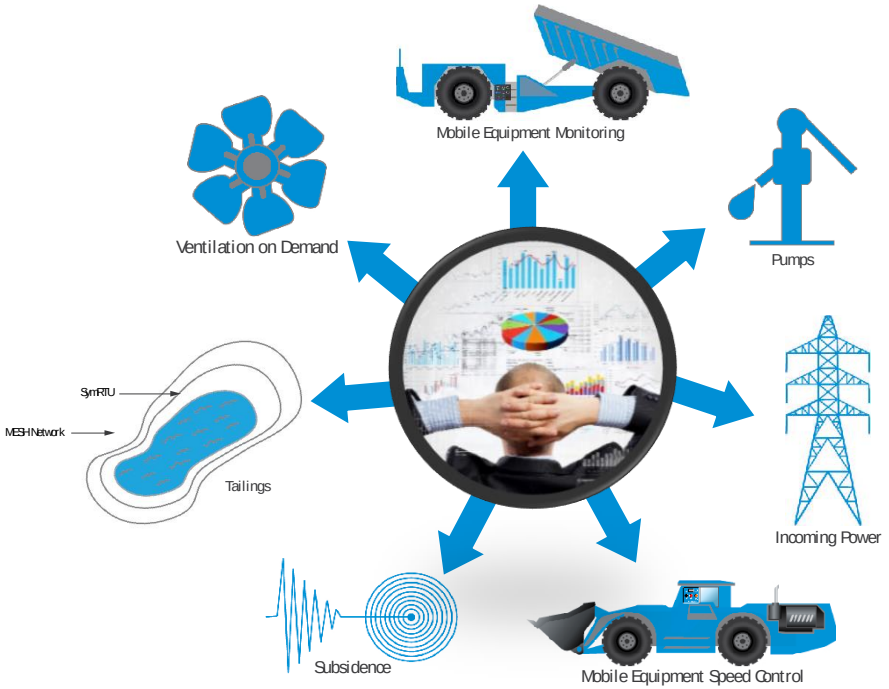
Example Installs and Reports

Summary

About Symboticware

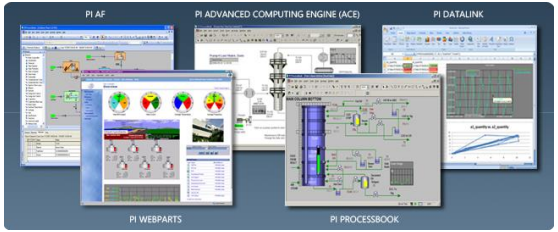
Our Mission	• Safety, production, asset utilization, environmental, and energy management
Standards	• Open standards-based data and control platform for mining from pre-construction to closure
Presence	• Sudbury, Ontario, Canada with presence in USA, Brazil, Chile and Peru.

Data Management and Safety Applications Fixed and Mobile Assets



Symboticware Data Management and Safety Solutions

- **SymBot**
  - Data collection and management solution for fixed and mobile assets



- **SymRTU**
  - Intelligent wireless SCADA solution for fixed asset monitoring

- **SpeedGuard**
  - Mobile equipment monitoring and control solution

Industry Needs

Safety

Reduce Exposure to Operating Risks

Monitor Conditions and Working Environment in Real-Time

Productivity

Reduce Margins of Error

Increase Personnel & Equipment Productivity

Real-time decisions

Efficiency

Improve Equipment Reliability and utilization

Reduce Maintenance Expenses

Industry Challenges

Process monitoring and control methods Underground

Industry Challenges

High exposure to **operational risks**, diminishing **margins** and increased **costs**, technology **adoption** and streamlining **integration**.

Technical Challenges

- **Data availability and interfacing with mobile assets**
- **Intermittent connectivity and data gaps**
- **Knowledge/ability with PI System at mine-site**

Behavioral Challenges

- **Decision making and influence within operator's structure**
- **Market Characteristics**
- **Maturity and acceptance of global mining standards and guidelines**

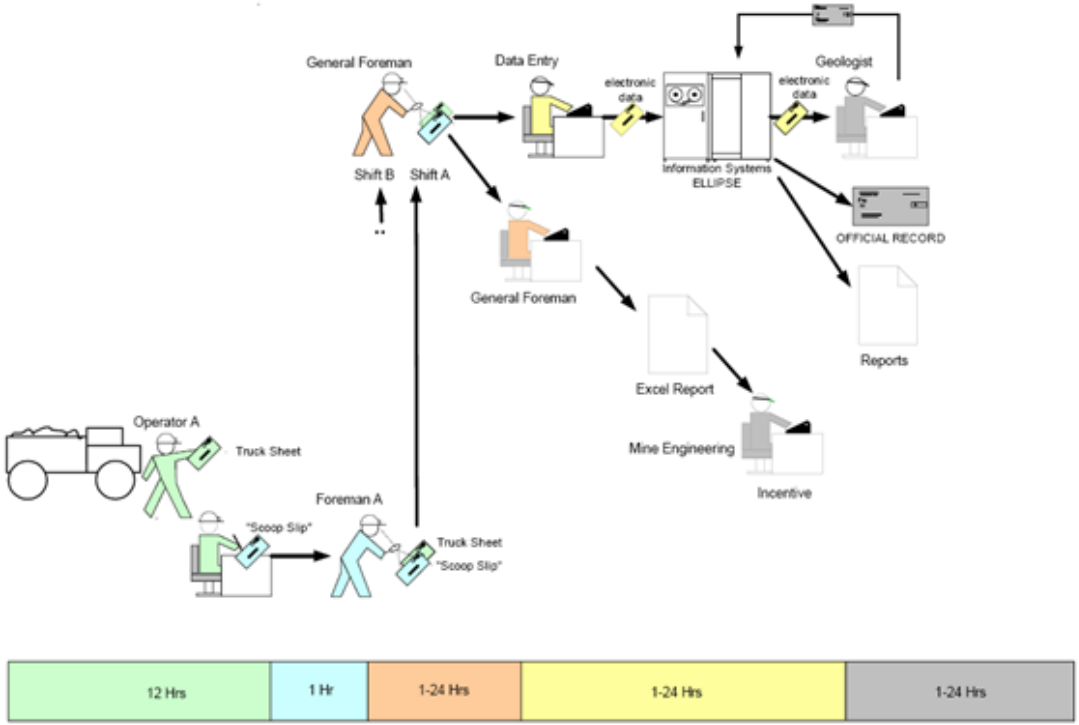
Challenge – Timely, Accurate Data

Current Paper Based Process

Collects safety, production and maintenance data

Issues

- Data from worker input only
- Many manual steps = labour intensive
- Prone to error = lack of trust in data to make business decisions
- Long delays in reporting data = poor response to process upsets



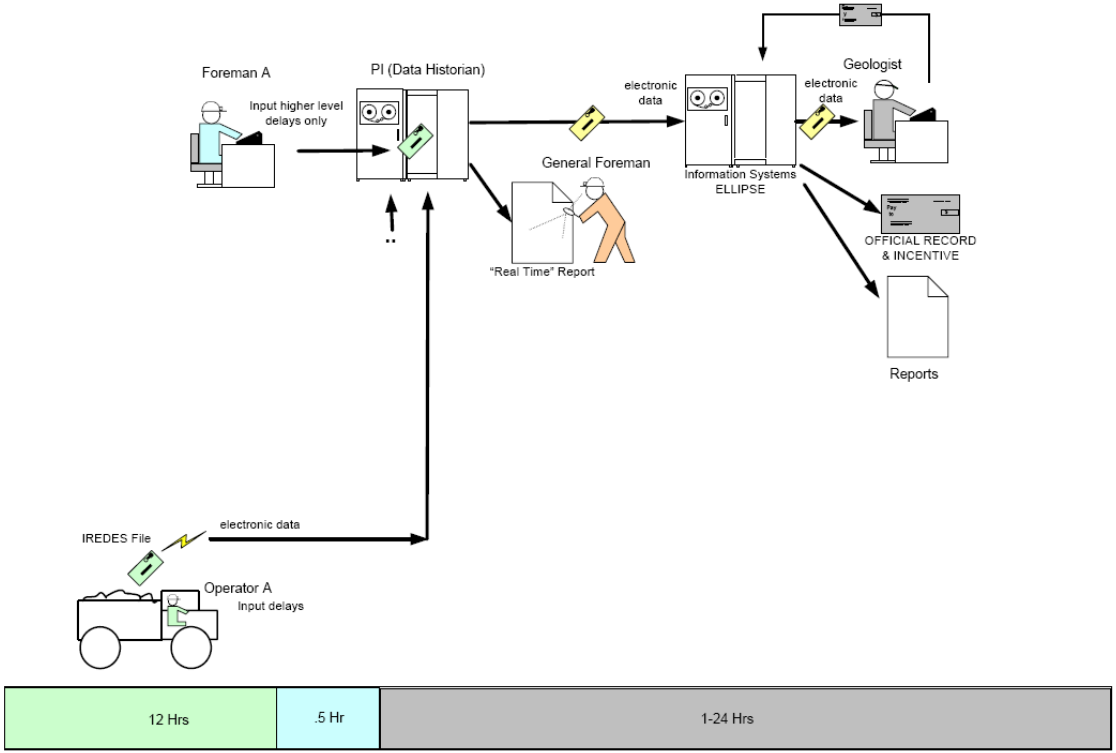
2-3 Days Delay in Reports!

Solution – Timely, Accurate Data

Collects safety, production and maintenance data

Issues Resolution

- Data - automatic collection
- Eliminates labour intensive data collection process
- Eliminates error
- Eliminates process delay
  - Reports production at end of each load cycle ~ 15 minutes



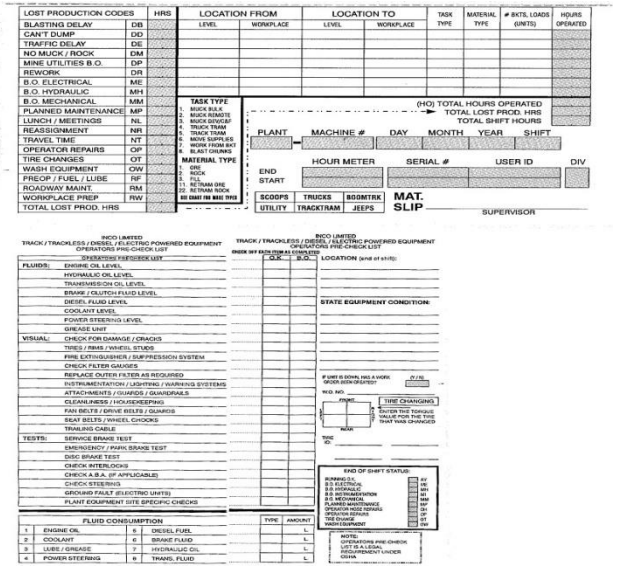
Solution – Timely, Accurate Data

The HMI replaces the paper slip and sent electronically

- **Operators Production Input**
  - Draw Point/Dump Point ID's*
  - Task Type
  - Material (Ore/Rock/Fill/Retram)
  - Number Of Buckets*
  - Load Weights*
  - Hours*
- **Operators Post Production Input**
  - Lost Time Codes
  - Location of Equipment*
  - Equipment Condition
- **Operators Pre-Check Input**

** Automatically collected by Symbot*

Onboard HMI



Paper "Scoop Slip"

Challenge – Environment

Issues

- Intermittent wireless connectivity
- Difficult RF environment
- Shock and Vibration
- Heat, Cold
- Water (Acidic)
- Access (for maintenance)
- Access to communications
- Automated location determination
  (600 story building on a 1 km x 2km block)

Solution – Environment

Issues

- Intermittent wireless connectivity
- Difficult RF environment
- Shock and Vibration
- Heat, Cold
- Water (Acidic)
- Automated location determination (600 story building on a 1km x 2km block)

Solution

Store and Forward

Hardened case IP67 with robust connectors

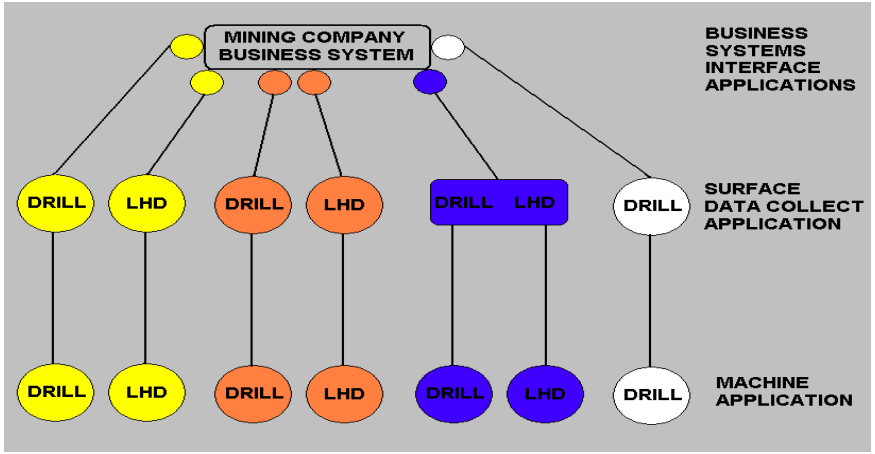
Can read WiFi Access Points ID or beaconing RFID tags

Challenge – Adoption of Standards

Issues

- Most mines have multivendor mobile fleet with each vendor using proprietary data sets and communications protocols. Requires complex array of comms drivers, software and disparate data sets.

- Slow adoption of industry standards that are used in surface processes maintains silos . OT vs IT



Solution – Adoption of Standards

Issues

- Slow adoption of industrial standards as used in surface processes maintains silos and impedes progress OT vs IT
- Most mines have multivendor mobile fleet with each vendor using proprietary data sets and communications protocols. Requires complex array of comms drivers, software and disparate data sets.

Solution

ISA

IEC International Electrotechnical Commission

Global Mining Standards and Guidelines Group

IREDES
INTERNATIONAL ROCK EXCAVATION DATA EXCHANGE STANDARD

SMART Surface Mining Association For Research & Technology

ISA Standards

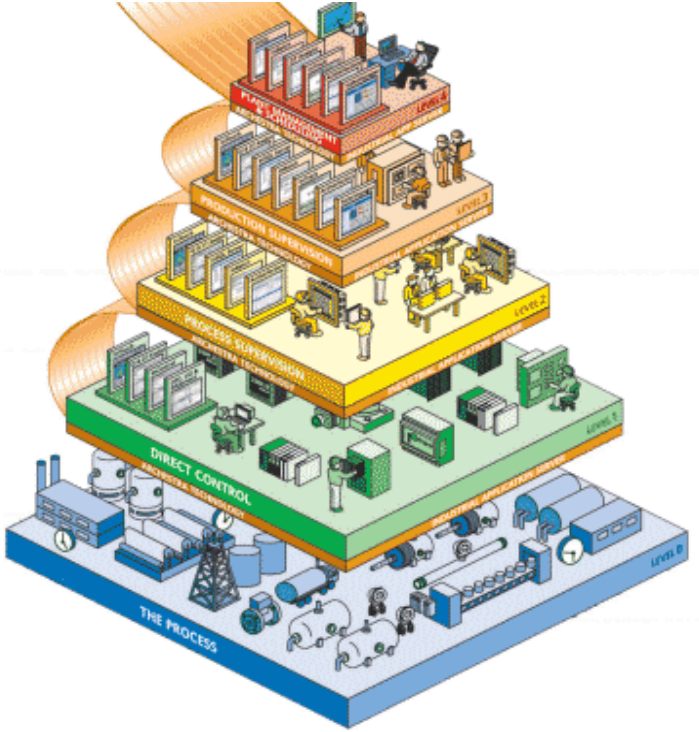
Relationship between OT and IT

ISA-95

- Reduce cost risk and errors associated with implementing interfaces between enterprise and production control systems
- Is a method to define the interfaces between enterprise and production control systems

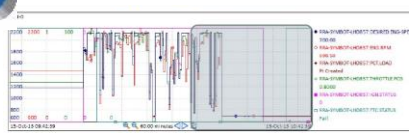
ISA-99

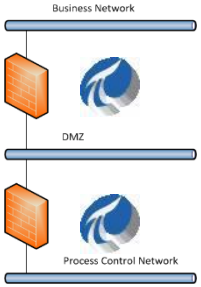
- Objective to ensure security of process control systems
- Set of technical requirements and processes



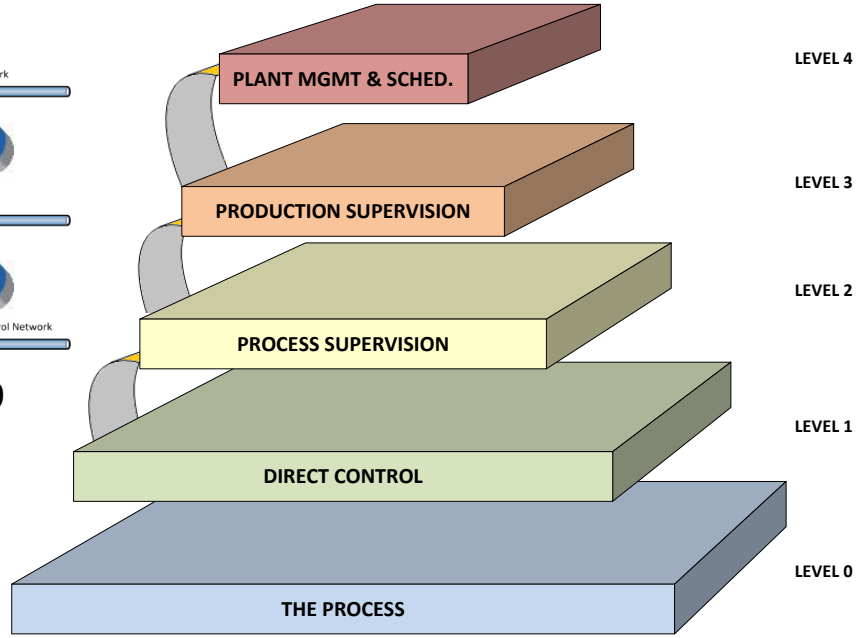
ISA-95 Layers

Industrial Standards – ISA 95 and ISA 99





ISA-99



ISA-95 Layers

Standards – View from machine

Interconnectivity of Devices

- Numerous engine and accessory interfaces
- Require own application and operator interface
- Produce data separately

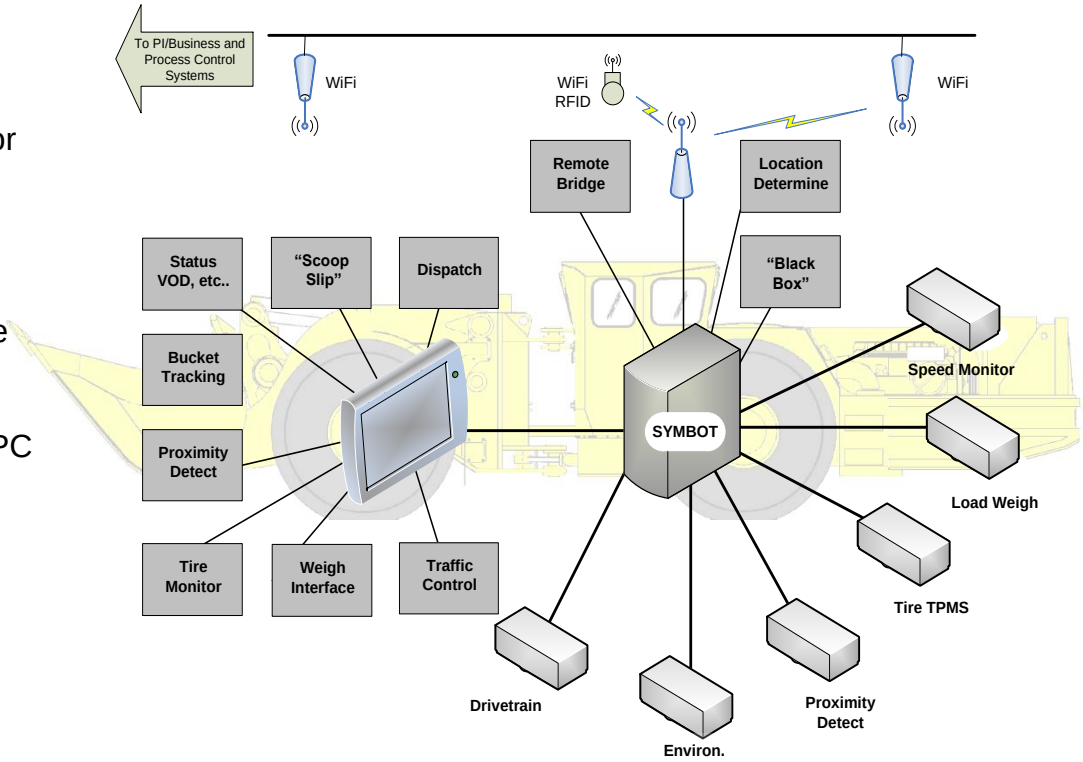
Data Exchange Standard

- Aggregates data from devices to one stream
- Standard data set
- Common interface to business and PC

Solution

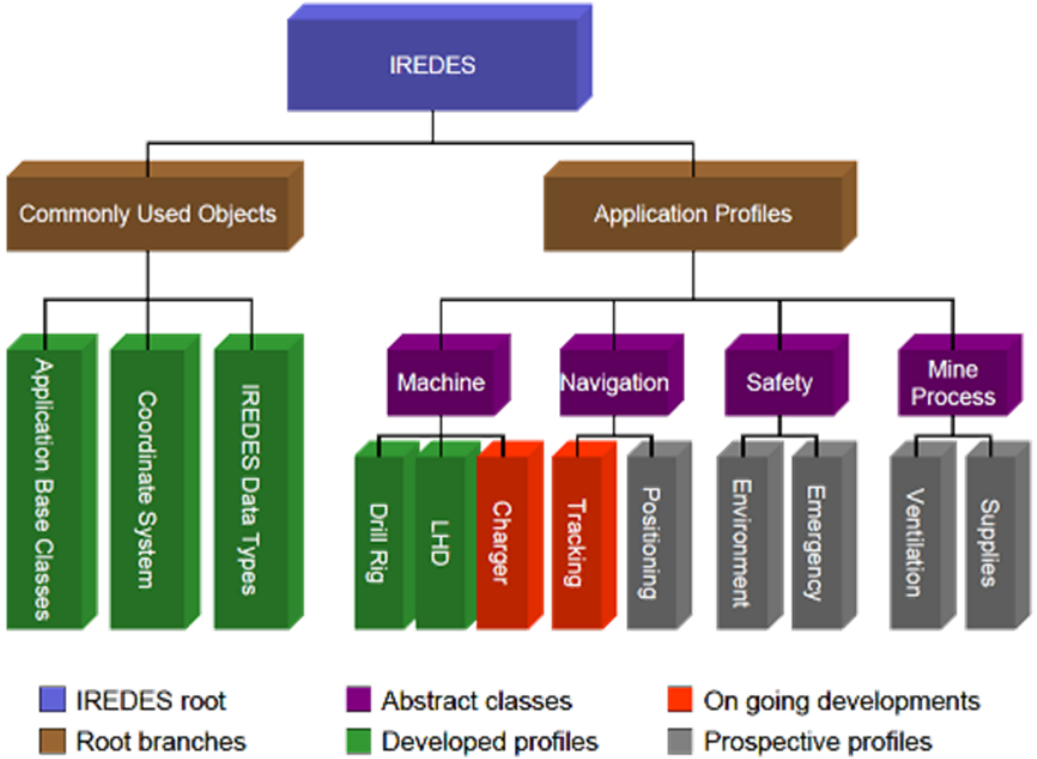
GMSG – Global Mining Standards Group

- Adopt SMART for interconnectivity
- Adopt IREDES for data exchange

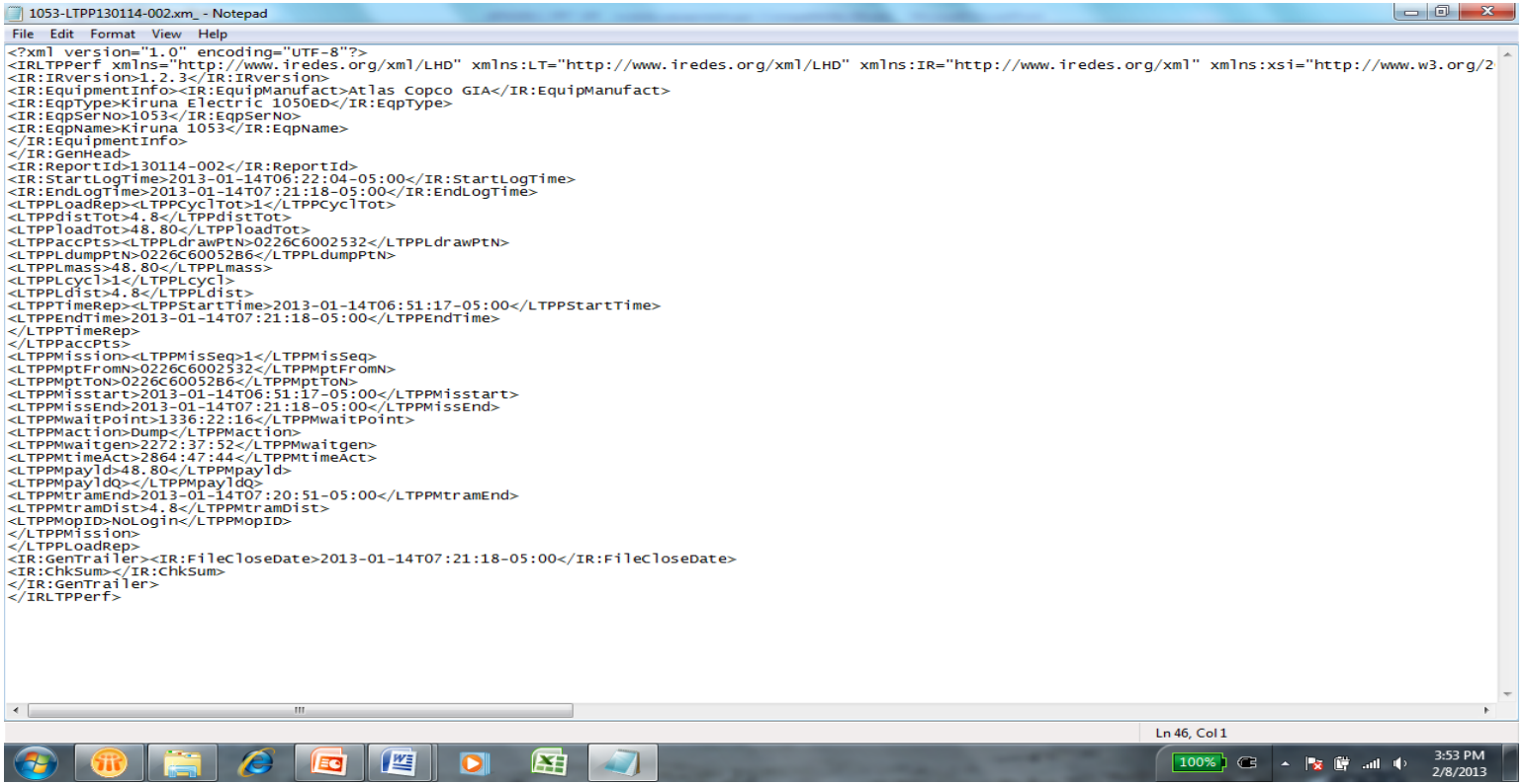


Mining Industry Standards – IREDES

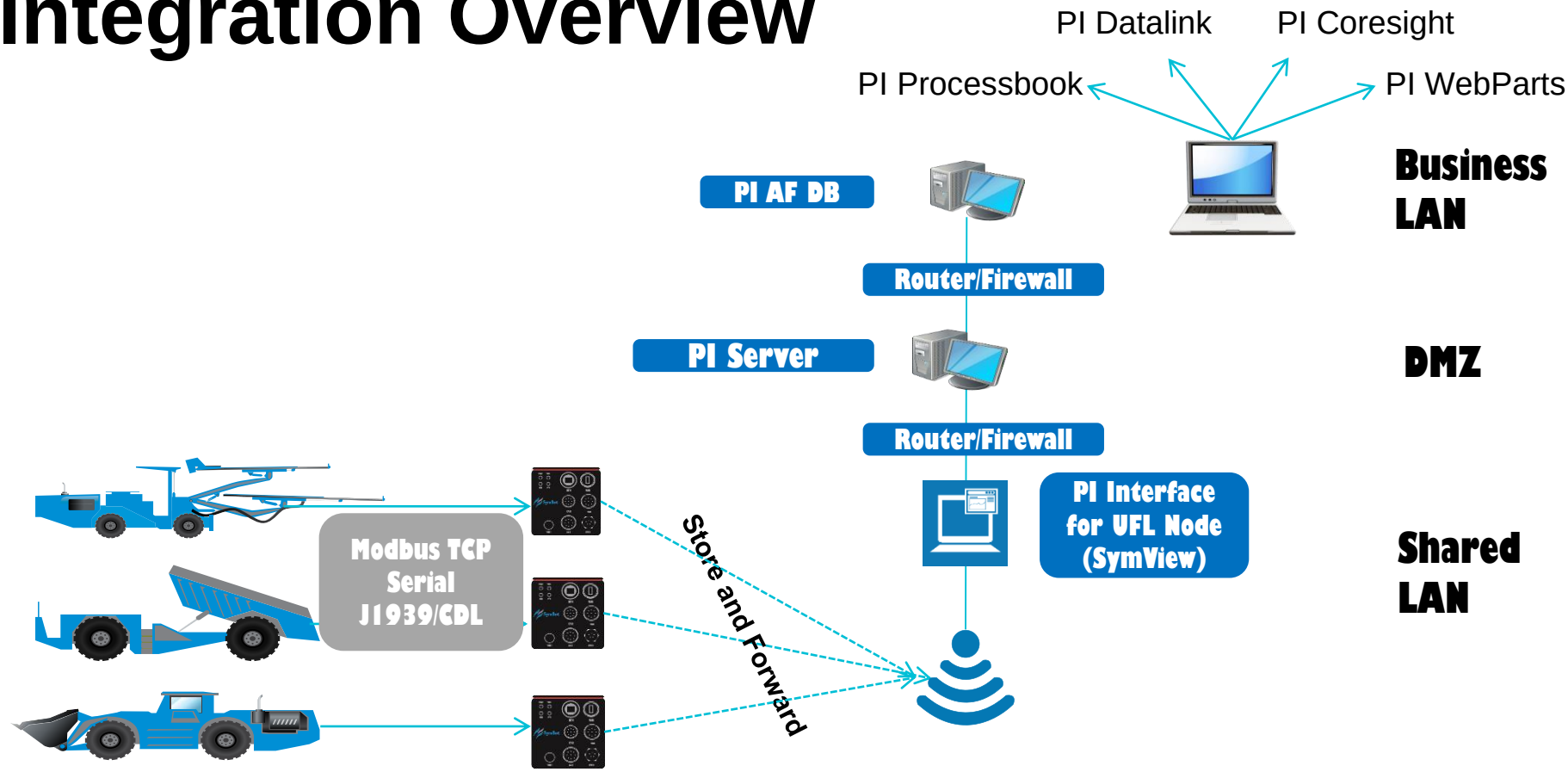
ISO certification in progress through the GMSG



Sample IREDES Data



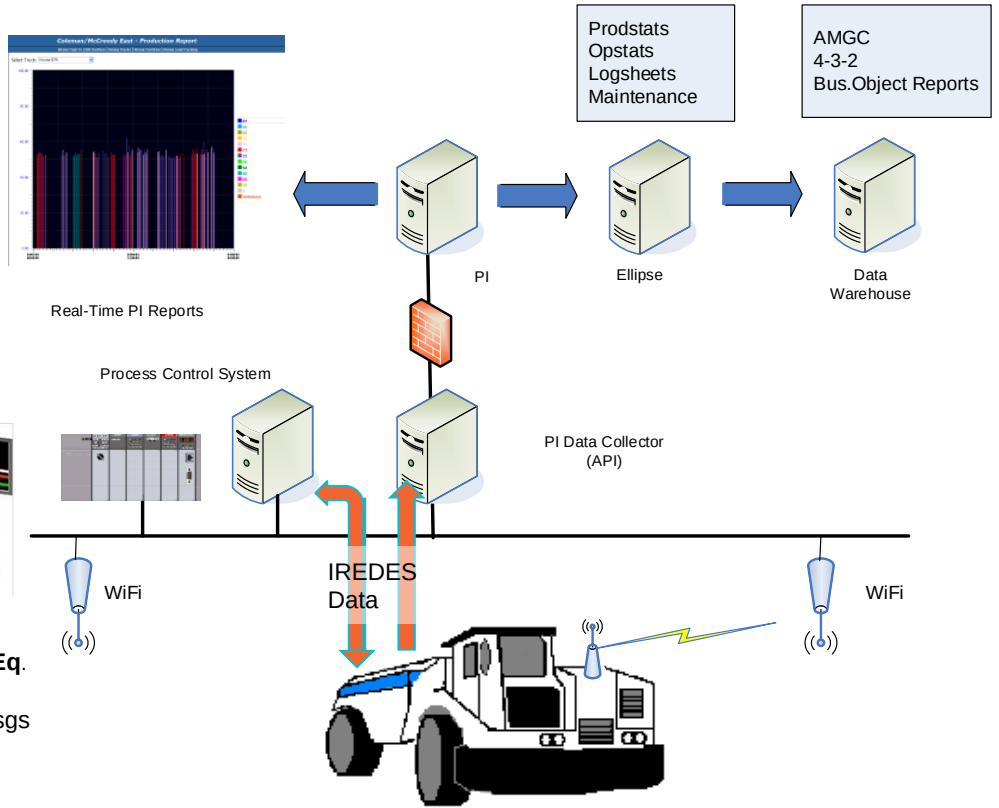
Integration Overview



Integration Overview

Process Control Data from Mobile Eq.
- Machine Status
- Production Info
- Alarms
- VOD – Gas levels, temp

Process Control Data to Mobile Eq.
Ore Pass Levels, Load stn status
Traffic Control, Missions, Safety Msgs
VOD Status



Example Installation

- CAT AD45 Diesel Trucks

  Ramp Application

  Collects Engine and Transmission Data

  - Engine and transmission data from J1939 port
  - Data transmitted via WiFi
  - Location information on-board and central tracking system
  - Central tracking system is Cisco MSE (Mobility Service Engine)

Example

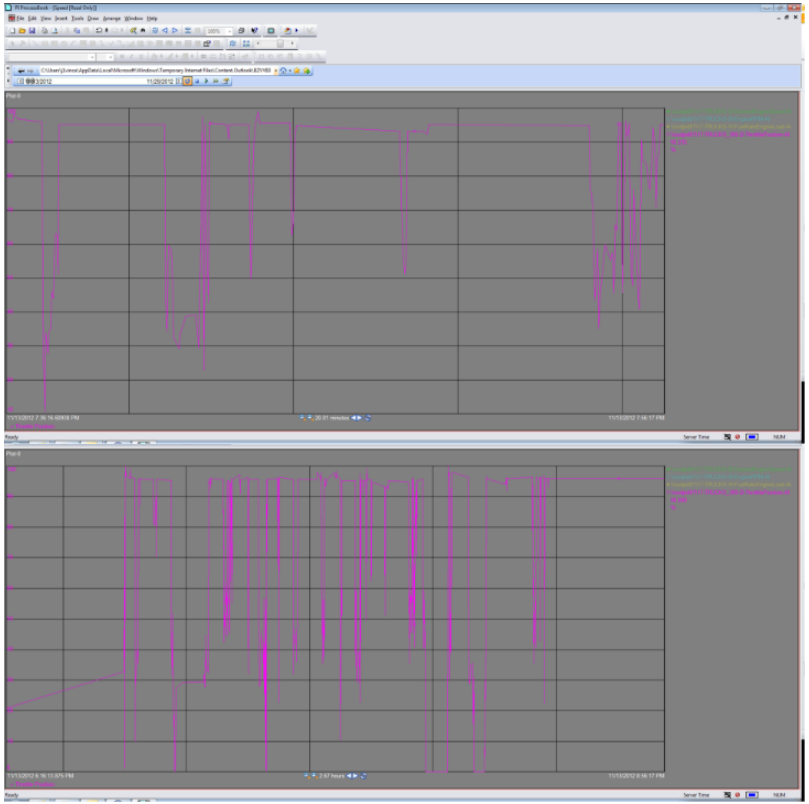
- CAT AD45 Diesel Trucks

  Mine Ramp

  Engine Data

  Example – Throttle Position

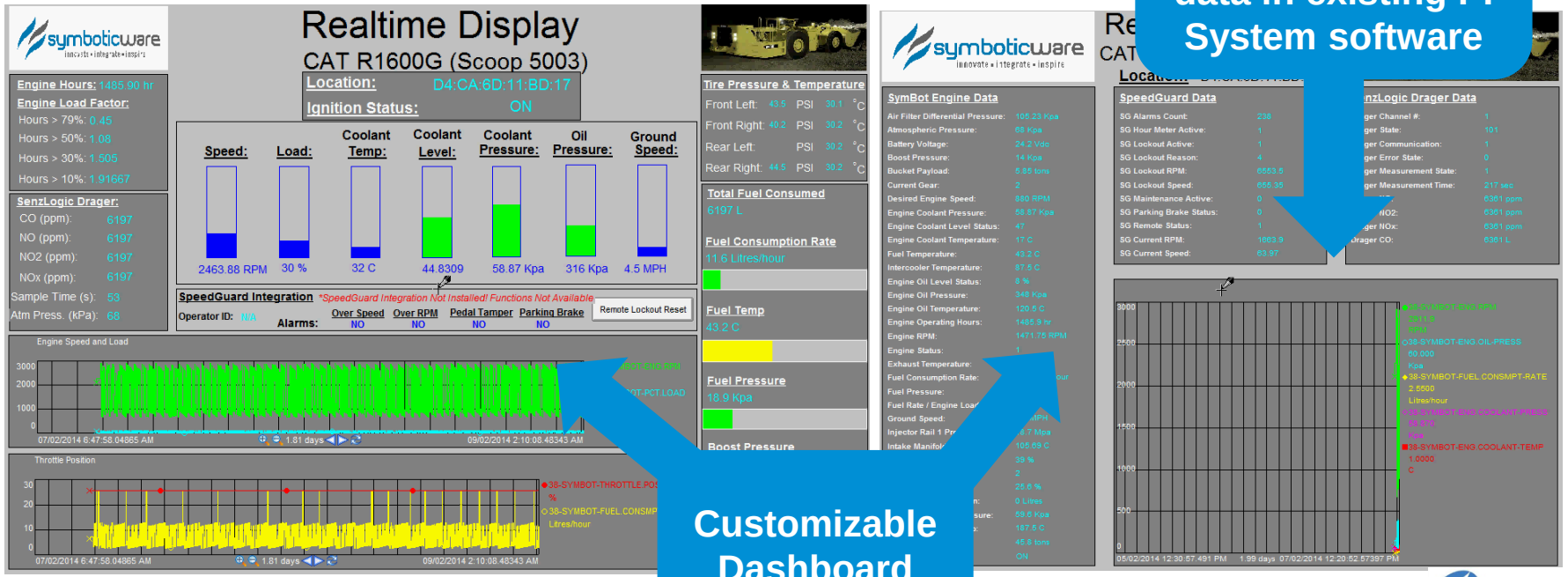
  Uses
  - Determine road roughness
    - Warn of possible injuries
    - Look at ramp delays



PI ProcessBook Trend of Throttle Position Truck 309 – Mine Ramp

OSIsoft PI ProcessBook Displays

View real-time and historical SymBot data in existing PI System software



Example

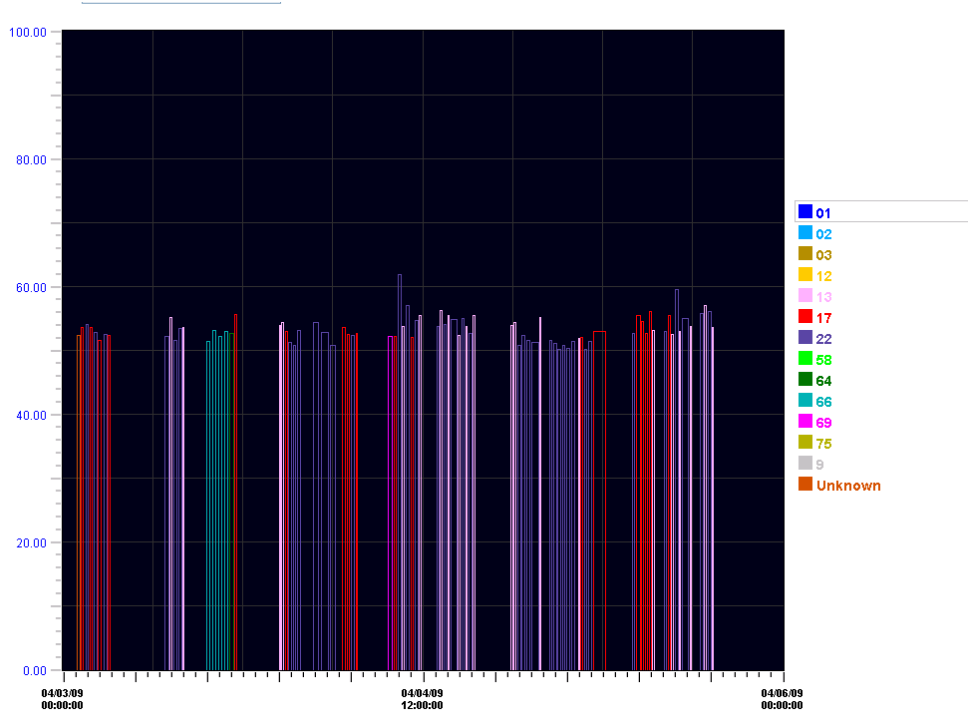
- Trucks

PI Run Chart
- y axis = Truck load tons
- x axis = time
- colour = loading location along ramp

Non productive time
- Bonus system was changed from tons to seat time

Load weights
- overloading was causing maintenance issues

Locations
- ensure “campaigns” are followed



Benefits – improved equipment utilization, reduced maintenance costs, improved blending

Tire Pressure Monitoring (TPMS)

Benefits

- Operator peace-of-mind, time and added safety
- Greater fuel economy
- Longer tread life and less premature wear
- Mitigate casing damage allows retreading
- Decreased tire maintenance costs
- Notification to stakeholders – maintenance, tire manager, supplier

ROI Case Example

- CAT R1700 tire price is $9k/tire
- Worn tire can be recapped @ $~3k/tire
  - But can only be recapped if casing is intact
  - Low pressure will destroy casing
- Within 3 months, customer saved 4 tires @ a savings of $36k

Tire Pressure Monitoring (TPMS)

SymBot integration with Valor TPMS

- Internal mounted sensor
  - Where tire pressure and temperature are meant to be checked
  - Battery powered (5-7 years)
  - Does not impede inflation
- Extreme reliability
  - signal strength (works through 60 ply with chains)
  - Sensor durability
- J1939 interfaces to SymBot from Valor transceiver in cab
- Integration with up to 24 external sensors
  - Exhaust
  - Axle temperature
- **Present TPMS data to those who need it!**

Customer ROI

- Direct savings in first 4 weeks of trial at customer site
- Savings directly attributed to the pilot program to date
  - ✓ Repair instead of replacement of 2 tires @ $900/tire
  - ✓ Versus Cost of replacing the tire @ $19,000 each
- 3 tires identified during TPMS audits as low on air and changed before reaching run flat state with a potential savings of $26,000.
- The report details potential savings of at least $150,000 per year if TPMS is implemented on all production equipment in the mines.

Quotes from Customer Trial

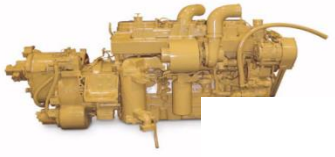
*"This system does have the potential to **save tires** from being scrapped due to Run Flat conditions."*

*"If the system is implemented in Manitoba on the rest of the production fleet, it should **reduce our Run Flats to at least half** of what we are seeing now. This TPMS program has the potential to **save the Manitoba Division at least $150,000 per year**."*

*"This one program would account for half of the **25% reduction in tire costs** that we are looking to achieve."*

Cost Savings and ROI Summary

Engine Replacement: $100,000 +



Axle Replacement: $90,000

The early detection of just one component failure can save you more then your initial investment

Tire Replacement: $6,000-$9,000 / tire

Benefits

- Improve Safety
  - Monitor safety related variables – load weights, speed, tire pressures
  - Future – brake test, operator qualifications, emissions, pre-op
- Reduce cost
  - Reduce data collection and reporting effort
  - Reduce maintenance costs
  - Improve reliability and utilization of fleet
  - Reduce component costs
- Improve productivity
  - Improve accuracy and timeliness of mobile equipment data.
  - Improve trust of business reporting systems using familiar corporate wide s/w tools provided by OSISoft

Summary

- Installation of a standards based data collection and reporting system benefits a mine by improving safety, reducing cost and improving productivity.
- Leveraging existing infrastructure and software tools such as the PI System keeps implementation costs down

Symboticware : Mine process intelligence to improve safety, asset utilization and production

Having timely accurate mobile fleet data available throughout a mine is a major step in improving a mine's safety, productivity and costs. Data that was previously missing, late and not trusted is now crucial to improving the mines "invisible" processes.

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Business Challenge

- Provide timely reliable production and maintenance data from a mobile process within a harsh environment and technology adverse workforce.

Solution

- Developed a mine hardened mobile equipment data hub based on open standards.
- Leverage existing infrastructure and software tools to provide timely accurate data and reports

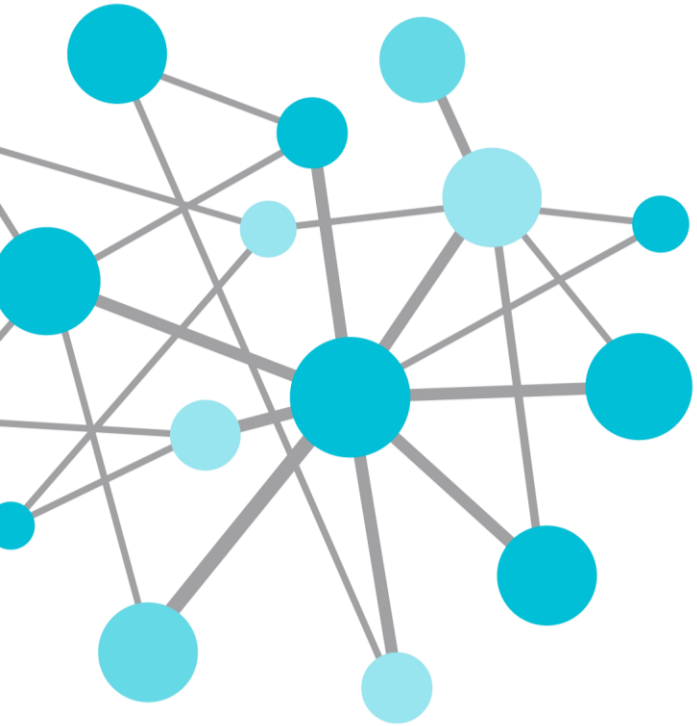
Results and Benefits

- Timely accurate mobile data and reports
- Reduced costs and improved utilization of equipment
- Improved safety

Questions

Please wait for the microphone before asking your question

Please state your name and your company



THANK YOU

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Peter Cunningham

pcunningham@symboticware.com

Solution Architect,
Symboticware