How Australia will lead the Future of Mining

Interoperability, autonomy and the connected mine

Eric Winsborrow
Executive VP Corporate Strategy
November 21, 2018
Source: Inmarsat Research/Mining IIoT; Hitachi/IDC IIoT Research; GMSG Primary research 2018
Data Interoperability

Data Intelligence
- Real-time Monitoring
- Predictive Analytics
- Machine Learning

IoT Platforms

Safety

Asset Health

Machine Guidance

FMS and Dispatch

IoT Platforms
Customer End-to-End View of Operations

- Data Intelligence
- Interoperability
- Safety
- Asset Health
- Machine Guidance
- FMS and Dispatch
- IoT Platforms
- Realtime Monitoring
- Predictive Analytics
- Machine Learning

- Geology
- Planning
- Pit and Operations
- Plant / Processing
- Transportation

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Gartner Industrial IoT Magic Quadrant – Wenco provides the “Edge”
Integrated Design - Edge to Core (IoT)

- E.g. Hitachi EX5600-6 Excavator
- Wenco ReadyLine Mobile Services
- Wenco ReadyLine Edge Client
- Wenco Avoca BI Line of Business Integration
- Excavator Advanced Analytics
- Excavator Solution Templates

- Asset
- Canbus
- Edge
- TCP/IP Database
- HTTPS

- Asset
- Wenco ReadyLine Mobile Services
- Wenco ReadyLine Edge Client
- Wenco Avoca BI Line of Business Integration
- Excavator Advanced Analytics
- Excavator Solution Templates

- Edge Visualization
- Edge Storage
- Edge Aggregation
- Cloud Ingestion
- Learning Correlation
- Anomaly Detection
- Dashboards
- Notifications
- Push to Edge

- Compression
- Computation
- Data Collection
- Edge Visualization
- Edge Storage
- Edge Aggregation
- Cloud Ingestion
- Learning Correlation
- Anomaly Detection
- Dashboards
- Notifications
- Push to Edge

HITACHI
CAT
KOMATSU
ETC.
Data Intelligence Example: Hitachi Excavator for Australian Customer

- 6 months of Readyline data sent to Lumada
- Data scientists analyzed correlation statistics
- Identified sensors that predicted overheating

<table>
<thead>
<tr>
<th>Sensors</th>
<th>Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>AfterCoolerTemp 2(Left)</td>
<td>0.222838354079</td>
</tr>
<tr>
<td>AfterCoolerTemp 3(Left)</td>
<td>0.221013598353</td>
</tr>
<tr>
<td>AfterCoolerTemp 4(Left)</td>
<td>0.199947838384</td>
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<tr>
<td>AfterCoolerTemp 1(Left)</td>
<td>0.184604932857</td>
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<tr>
<td>FuelGauge</td>
<td>0.18429909195</td>
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<tr>
<td>Exhaust temperature #3(Left)</td>
<td>0.132078696956</td>
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<tr>
<td>CoolantWaterTemp (Left)</td>
<td>0.127778</td>
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<tr>
<td>AmbientTemp</td>
<td>0.055071</td>
</tr>
<tr>
<td>EngOilTemp (Left)</td>
<td>0.010840</td>
</tr>
<tr>
<td>HydOilTankTemp</td>
<td>0.007541</td>
</tr>
</tbody>
</table>

Sensor moving average increase
Coolant Alarms next day

❖ 6 months of Readyline data sent to Lumada
❖ Data scientists analyzed correlation statistics
❖ Identified sensors that predicted overheating

*Coolant Alarms next day*
Data Intelligence Example: Virtual Sensors and Predictive Alarms

AfterCoolant Virtual Sensors and Alarms created to predict and avoid unplanned engine overheating maintenance event

❖ AfterCoolant Virtual Sensors created
❖ Predictive Rules and Alarms created
❖ Alarm Reports generated

❖ Alerts displayed on Dashboard
❖ All data available for transmission to Lumada IoT Core
Customer Investment in End-to-End Interoperability
Customer Investment in End-to-End Interoperability - Autonomy
ISO based interoperability approach

Fleet Mgmt

- Finance
- Human Resources
- Maintenance
- ERP Planning
- Database
- Run of Mine
- Blend Order
- ERP Ore Mgmt
- Autonomy Control Orchestrator
The Future of Mining – Interoperability, Data Intelligence, Autonomy

- Interoperability
- Data Intelligence
- Autonomy

Closed OEM Control Stack
- Safety
- Asset Health
- Machine Guidance
- FMS and Dispatch

FMS
- Geology
- Planning
- Pit and Operations

Plant / Processing
- Transportation

Realtime Monitoring
Predictive Analytics
Machine Learning

IoT Platforms

Autonomy

Planning

Data Intelligence

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