The State of Industrial IoT

Jayant Thomas (JT), Director of IoT Platform
GE Digital
The Predix Cloud

- Machine Connectivity
- Industrial Big Data
- Enhanced Security
- Service Interoperability
- Developer Insight
Today - Jet Engine (Genx) Sensors

* Simplified view of some of the sensors
Making “Sense” of the “Sensors”

- EGT = Exhaust Gas Temperature
- The temperature of the exhaust gases as they enter the tail pipe, after passing through the turbine
- A good indicator of the health of engine (just like human body temperature)
- Recording & interpreting the EGT can help to detect several jet engine problems.

[Diagram of jet engine lifecycle]
Predix

your cloud platform for the Industrial Internet
Connect ALL your OT / IT Systems

- ANY asset (GE, non-GE; new, old)
- ANY TIME, ANY PLACE connectivity
- EDGE analytics
- PUSH software updates
- SECURED device management
Digitize, Analyze, Monetize in the Cloud

- **ASSET DATA** models, from pipe to plant
- **ANALYTIC** modeling (R, Matlab, ...)
- Packaged **DATA SCIENCES** (GE, partners)
- Data at **SCALE** (fast, vast)
- **METERING** and **COSTING** (BizOps)
End-to-end platform, machine to cloud
An example use case...
<table>
<thead>
<tr>
<th>#</th>
<th>Alert Type</th>
<th>Description</th>
<th>Status</th>
<th>Disposition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Engine Oil Leak Alert</td>
<td>Mining Truck S504968, Wyoming Mining District</td>
<td>Jul 21</td>
<td>Ready</td>
</tr>
<tr>
<td>2</td>
<td>Fuel Inlet Issue</td>
<td>TURBINE, Combined Cycle Sites</td>
<td>Mar 03</td>
<td>Ready</td>
</tr>
</tbody>
</table>

**Alert Information**

- **Alert ID**: 3802
- **Event Time**: 07/21/2016 11:23 PM
- **Alert Source**: OrchestrationManager
- **Owner**: None

**Analysis**

- Standard View

**Notes**

- **Jayant Thomas** 7/21/16 4:56 PM
  - Potential engine oil leakage identified
  - Enter a note here

**Evidence**

- Evidence: borescope inspection result
  - Added 7/21/2016 by Jayant Thomas
<table>
<thead>
<tr>
<th>Case ID</th>
<th>Case Description</th>
<th>Status</th>
<th>Creator</th>
<th>Owner</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Engine Oil Leak Case</td>
<td>Open</td>
<td>Jayant Thomas</td>
<td>None</td>
</tr>
<tr>
<td>3</td>
<td>Rotor Journal Bearings V.B.</td>
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<td>None</td>
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</tr>
<tr>
<td>2</td>
<td>Performance - Recirc Issue</td>
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<td>None</td>
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<tr>
<td>4</td>
<td>Combustor Cold Spot</td>
<td>Closed</td>
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<td>None</td>
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<tr>
<td>5</td>
<td>Nacelle Temperature Increasing</td>
<td>Closed</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>6</td>
<td>Sticking PCV Valve</td>
<td>Open</td>
<td>None</td>
<td>None</td>
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<tr>
<td>7</td>
<td>Oil Pressure Low</td>
<td>Open</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>8</td>
<td>Mill Shaft Brg Temp</td>
<td>Open</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>9</td>
<td>High Blade Position Spread</td>
<td>Open</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Report

**Symptoms**: Failure mode - Engine oil leak.

**Diagnosis**: Please replace the parts

**Recommendation**: Replace parts as per the diagnosis

**ORACLE INVENTORY**

21 engine(s) in stock.

**EVIDENCE**
Extending Predix with Plug-able Analytics
Analytics

Predix provides analytics services as a framework for developing and embedding advanced analyses in business operations. This means you can better manage the execution of analytics through configuration, abstraction, and extensible modules.

ANOMALY DETECTION ANALYTICS

- **Trend Anomaly Detection**
  - Manage critical time series trend detection.

- **High-Dimension Anomaly Detection**
  - Check multiple sensors for key time series anomaly detection.

- **Low-Dimension Anomaly Detection**
  - Maintain machine health with this critical time series anomaly detection.

- **Shift Anomaly Detection**
  - Enable key time series shift detection.

- **Univariate Anomaly Detection**
  - Improve time series rates of change anomaly detection.

- **Temporal Anomaly Detection**
  - Assure accurate and highly detailed time series anomaly detection.
Text mining of work orders to identify subcomponent failure modes
Time-between-failure analysis for each subcomponent failure mode
Survival function estimation for each subcomponent failure mode
Text Mining

Survival Function Estimation

Custom Asset Analytic

Threshold based Alerting

Time between Sub-components

Failure Mode

Oracle BIWA Summit 2017
Predix
Your cloud platform for the Industrial Internet

Register for an Account

What is Predix?
The Predix platform-as-a-service (PaaS) helps you develop apps that connect industrial machines with people through data and analytics for better business outcomes.

- **CONNECT MACHINES**
  Get industrial data from any manufacturer equipment and push it to the Predix cloud remotely in real time.

- **DEPLOY APPS**
  Use Predix cloud, OIC, and microservices to quick apps effortlessly in secure environments.

- **APPLY INSIGHTS**
  Use machine data and analytics to reduce downtime and make faster, better decisions about assets.