Uniformance® Asset Sentinel for Intelligent Process Surveillance and Smarter Equipment Monitoring

Phil Millette, Honeywell
Today’s Presenter

Phil Millette
Principal Industry Consultant
Honeywell Process Solutions

• 36 years of experience – plant / facility information management solutions over 5 continents

• Provide lead consulting to clients & to Honeywell teams on all aspects of performance improvement – across process safety, process & asset surveillance, production efficiency, reliability, supply chain

• Chemical Engineer, B.Eng 1979 from McGill University, Montreal.
Agenda

• Industry Leadership

• What is Uniformance Sentinel
  – Product Overview
  – What it does
  – Benefits
  – Applications (breadth / depth)
  – Product / Solution Strategy
  – Examples

• Value

• Uniformance® Suite
Industry Leaders Are Doing It…

- Increasing Production / Utilization
  - Reduce downtime and rate loss

- Reducing Maint & Ops Costs
  - Minimize secondary damage and catastrophic failures
  - Reducing emergency work orders
  - Replacing preventative with condition based maintenance
  - Reducing troubleshooting time
  - Reducing incorrect repairs (parts, labor, lost production)

- Improve Reliability and Asset Life Extension
  - Minimize mis-operation of equipment

- Safety
... with Process and Equipment Surveillance

Digital Transformation – changing the way you operate
A Day In The Life Of…

• Process or Reliability Engineer
  – How do you know if compressor is limiting production?
  – How do you know if you are operating efficiently?
  – How do you know if you will make next turn-around?

• Status Quo
  – Process monitoring (DCS/Historain)
  – Instruments (DCS)
  – Control Loop Perf (stand-alone)
  – Efficiency Mon (Excel)
  – Vibration (3rd party)
  – Drive System – Engine / Electrical (stand-alone)
  – Lube system
  – Oil Analysis (standalone)

High Value Resources Spending Time on Low Value Activities
Complete Process & Equip Surveillance Solution

Performance Monitoring

Smart Instruments & Loop Health

Integrated Engineering Decision Support
Features

Asset Model
Advanced calculation engine
  • Scheduled & On-data Change
  • Embedded performance models
  • UniSim and Thermo package

Event Detection
  • Rules engine
  • Notifications

Visualization & Reporting
  • Asset dashboards, trends, reports
  • Graphics & Displays

Benefits

• Automated surveillance to predict and detect problems - free up resources for problem solving
• Ready access to information to address problems quickly
• Easy to configure and maintain with embedded content
• Consolidates multiple monitoring functions and applications in single location

Digital Transformation – How Do You Get There?
Asset Sentinel Capabilities - Asset Model

• Define Equipment Model
  – Flexible
  – Multiple Levels
  – Built from library of asset ‘templates’
  – Pre-defined Library of asset templates
  – Template defines ‘attributes’ for each asset type
  – Instance
    • Pump 1….n
    • Defines tag mapping
  – Plant Model
    • Where instance resides in plant
Asset Sentinel Capabilities - Calculations

- **Calculation Capability**
  - Data Driven & Scheduled
  - 4th Gen Scripting Language
  - Standard & Advanced Performance Library
    - Pump, Compressor, Turbine, Heat Exchanger
  - ECM Data Pre-processing
  - Thermo Calculation Package
  - UniSim Model
  - Custom Code (C#)
  - Excel Calculations

*Example Feed Rate Calc.*
*Example Column Calc.*
Asset Sentinel Capabilities - Event Detection

• Symptom / Fault Model
  – Rule logic for triggering event
  – Event Actions
    ✷ OPC A&E ‘Event’
    ✷ E-mail
    ✷ CMMS (SAP or Maximo) work request
  – Define Fault Severity
  – Define Recommended Action
  – Minimize Chatter
    ✷ ‘Contextualized’ – rule executes only when context is true i.e. pump running
    ✷ On-Delay & Off Delay

• Simple & Complex Rules
Asset Sentinel Capabilities – User Interface

- Tree-Map – Overviews  
  - Based on Fault Priority

- View Graphics

- Analyze Trends  
  - Baselines  
  - Performance Curves

- View Events

- Access Recommended Actions

- Access Linked Information
Tag based trends vs. Equipment Based

Tag Based
• Must know/find tag names

Equipment Based
• Select attribute of interest (no tag names needed)
Example – ESP surveillance
Capture the value of smart devices…

- **Experion ERDB Synchronization**
  - Import Adv Alarming or DD file definition

- **Define ‘Template’ for device types ONCE**
  - Organize diagnostic messages (per NAMUR 107)
  - Time delay to minimize chatter
  - Define ‘Severity’ of fault
  - Define Action (OPC, Email, CMMS)
  - Corrective Action

- **Instances ‘Auto Created’**
  - Define Criticality - (instrument on compressor vs back-up pump) to calculate priority

---

<table>
<thead>
<tr>
<th>Diagnostic</th>
<th>Criticality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failure</td>
<td>6-Critical</td>
</tr>
<tr>
<td>Out of Specification</td>
<td>5-Serious</td>
</tr>
<tr>
<td>Maintenance Required</td>
<td>4-Important</td>
</tr>
<tr>
<td>Function Check</td>
<td>2-Minor</td>
</tr>
<tr>
<td>Information</td>
<td>1-None</td>
</tr>
</tbody>
</table>
The Data Mgt Challenge...

Device Diagnostic Information

- Valve_Stuck_Sensor_Arm_Damage
- IP_Primary_Nozzle_Plugged
- Processor_Impaired
- IP_Latched
- Relay_Cross_Misadjusted
- Air_Line_Blocked
- Relay_Jammed
- Performance_Critical_Alert
- Press_Fallback_Alert
- Travel_Sensor_Alert
- Press_ABSensor_Alert
- Supply_Press_Sensor_Alert
- Temp_Sensor_Alert
- External_Relay_Ring_Leak
- External_Relay_Ring_Leak_Alert
- ... Etc...

Other Diagnostic Information

- Device off net (disconnected)
- C300 – redundancy / FTE state / soft fail state
- FIM – state / CPU / Memory
- Series C IO – channel status/ redundancy status / fail status
- Segment health (jitter/ variance/ noise...)
- Control loop – stiction / oscillation / bias / drift / hysteresis / deviation
# Alert Grouping (NAMUR 107 Example)

<table>
<thead>
<tr>
<th>Symptom Name</th>
<th>Fault Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software_Error</td>
<td>Failure</td>
</tr>
<tr>
<td>Sensor_DB_Error</td>
<td>Failure</td>
</tr>
<tr>
<td>Probe_Missing</td>
<td>Failure</td>
</tr>
<tr>
<td>Electronics_Failure</td>
<td>Failure</td>
</tr>
<tr>
<td>Software_Compatibility_Error</td>
<td>Failure</td>
</tr>
<tr>
<td>Memory_Failure</td>
<td>Failure</td>
</tr>
<tr>
<td>Com_Failure</td>
<td>Failure</td>
</tr>
<tr>
<td>Temp_Critical</td>
<td>Off Spec</td>
</tr>
<tr>
<td>Measure_Error</td>
<td>Off Spec</td>
</tr>
<tr>
<td>Level_Measure_Failure</td>
<td>Off Spec</td>
</tr>
<tr>
<td>Volume_Measure_Failure</td>
<td>Off Spec</td>
</tr>
<tr>
<td>Config_Error</td>
<td>Off Spec</td>
</tr>
<tr>
<td>Temp_Outof_Limit</td>
<td>Maintenance</td>
</tr>
<tr>
<td>Volume_Measure_Warning</td>
<td>Maintenance</td>
</tr>
<tr>
<td>Measure_Warning</td>
<td>Maintenance</td>
</tr>
<tr>
<td>Lost_SD_NV</td>
<td>Maintenance</td>
</tr>
<tr>
<td>Config_Warning</td>
<td>Maintenance</td>
</tr>
<tr>
<td>Data_Integrity_Error</td>
<td>Maintenance</td>
</tr>
<tr>
<td>Algorithm_Error</td>
<td>Maintenance</td>
</tr>
<tr>
<td>RB_SimAct</td>
<td>Function Check</td>
</tr>
<tr>
<td>AI_SimAct</td>
<td>Function Check</td>
</tr>
<tr>
<td>PWA_SimAct</td>
<td>Function Check</td>
</tr>
<tr>
<td>RB_OOS</td>
<td>Function Check</td>
</tr>
<tr>
<td>AI_OOS</td>
<td>Function Check</td>
</tr>
</tbody>
</table>
Cost of Unplanned Capacity Loss

- Unit Shutdown
- Critical Eq. Failure
- Non-Critical Eq. Failure
- Process Deviations
- Degraded Efficiency

<table>
<thead>
<tr>
<th>Reduced Capacity Loss</th>
<th>Mitigation Strategies</th>
<th>Original Capacity Loss</th>
<th>Leading Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health Mon.</td>
<td>Performance Mon.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Depth & Breadth of Capabilities

Industry
- Oil & Gas
- Refining & Chemicals
- Pipelines
- Power
- Mining

Monitoring Applications
- Process
- Health
- Efficiency
- Safety
- Energy

Type of Equip / Complexity
- Software
- Valve
- Pump
- Compressor
- Turbine
- Instrument
- Heat Exchanger
- Haul Truck
- Unit
Dolphin Energy Equip Cond Mon Solution

• Overview
  – Monitor over 1200 process and equipment assets
  – Combine electrical, mechanical, and process performance data in single health monitoring location
  – Measures equipment performance to improve energy utilization
  – Detect performance degradation as leading indicator of equipment health

• Benefits
  – Pro-active vs reactive (find problems early & eliminate preventative maint)
  – Smarter turn-around planning (eliminated bearing inspections)
  – Prevent mis-operation of equipment (extend asset life)
  – Energy monitoring – 15MgW savings per year

“Process changes have a significant impact on equipment behavior and reliability, which in turn show up in the process data. We can now see how the process parameters affect the asset performance. It is the missing link that Uniformance Sentinel provides.”

  – Reliability Mgr.
Shell Bridge – Exception Based Surveillance

Raw Bottom Hole Pressure (BHP) data noise, shutins, and data dropouts make it difficult to discern any long term trend through direct observation.

EBS Uses advanced alerting capabilities to improve data quality and apply condition / multi-variate functionality.

1. Raw data with noise and dropouts.
2. Alarm software removes data dropouts.
3. Alert software removes periods of shut-in.
4. Alert software removes data offsets.
5. Exponential smoothing and regression are applied to compare 4-week slope to 1-week slope. Software would generate an alert if the change in the rate of BHP decline exceeded a threshold set by the production engineer.

JX Nippon – Oil & Gas Producer

Project in progress
Is the overall performance and condition monitoring system
Is the “umbrella” for all other monitoring systems
Gathers all asset performance and condition data and make it available through the same user interface
Flags out any problem that occurs and indicates which Monitoring system to look for further investigations
Directly monitors the performance of the process assets
  – Pumps
  – Compressors
  – Heat exchangers
  – Filters
  – Choke valves
Valemon Scope

Process Assets Monitoring
- Heat Exchangers
- Pumps
- Compressors
- Filters
- Choke Valves

Electrical equip. Monitoring
- Motors
- Heaters
- UPS
- VSD

Honeywell Applications
- FDM
- Service Node
- OPC Data sources
- Data Servers

3rd Party Systems – e.g.
- Score V-MAP
- GE System 1
- ABB Asset Opt.
- Roxar Fieldwatch
- Dresser Envision
Valemon AMS Scope

- 131 Process Assets directly monitored by Asset Manager
  - 4 x Heat Exchangers
    - Shell and Tube
    - Plate
  - 42 x Pumps
    - Centrifugal - Fixed Speed
    - Centrifugal - Variable Speed
    - Centrifugal - Submerged
    - Reciprocating
  - 34 x Filters
    - Diesel
    - Gas
    - Sea Water
  - 9 x Compressors
    - Air Centrifugal – Constant Speed
    - Nitrogen Reciprocating
  - 18 x HVAC Air Fans
    - Air Centrifugal
  - 18 x Choke Valves
    - 2-phase/3-component Oil-Water-Gas
    - Single phase (Water)
  - 4 x Emergency Generators
    - Diesel Powered Electric Generators
Valemon AMS Scope

• Integration to PCC
  – 405 Valves (Safety and Manually Operated)
  – 200 Transmitter Pairs

• Integration to ABB - 124 Electrical Assets monitoring
  – Motors
  – Transformers
  – Variable speed drives (VSD)
  – Electric Switch Gear

• Integration to Roxar – 50 Instruments
  – Sand Production Monitoring
  – Corrosion Probes
  – Multiphase Meters

• Integration to FDM & Experion – 1,358 Smart instruments monitoring
  – 523 x HART devices
  – 835 x FF devices
Performance Calculations

• Centrifugal Gas Compressor and Air Compressor – implemented for each compressor stage
  – Compressor Stage Polytropic Head
  – Compressor Stage Load
  – Compressor Stage Actual Efficiency

• Centrifugal Pumps, Fire Pumps, Sea Water Pumps
  – Pump Actual Head, Expected Head
  – Pump Hydraulic Power, Load
  – Pump Actual, Expected Efficiency

• Diesel Electric Generators & Electric Motors
  – Load, Calculated Power
  – Actual, Expected Efficiency
Performance Calculations

• Cartridge Filters, Sea Water Filters
  – Filter Differential Pressure
  – Filter Relative Clogging Factor

• Heat Exchangers
  – Heat Exchanger Mean Temperature Difference
  – Heat Exchanger Duty
  – Actual Heat Transfer Coefficient
  – Heat Exchange Fouling Factor
  – Heat Exchanger Fouling Percentage
  – Heat Transfer Efficiency

• Choke Valves
  • Total mass Flow through the valve
  • Total volumetric flow through the valve
  • Mean Density of the fluid going through the valve
  • Corrected Suction Pressure
  • Identify if the valve flow is choked
  • Valve Actual Cv
  • Valve Expected Cv
  • Valve Cv Deviation
  • Valve Available CV Available
Asset Sentinel – Compressor Model

• **Type**
  – Axial or Centrifugal Compressors
  – Can accommodate following
    ✷ Side streams
    ✷ Anti-surge recycle streams
    ✷ Variable Inlet Guide Vanes

• Monitors efficiency, RPM, head and flow
• Tracks degradation in efficiency and capacity loss
• Determines anti-surge recirculation flow & power
• Calculates capacity loss or flow loss due to degradation
• Trend the performance outputs for monitoring the pump conditions
• Plot the performance and show the operating point on the curve
Lundin – Edvard Grieg project Asset Manager scope
87 Process Assets directly monitored by Asset Manager

- 11 x Heat Exchangers
  - Shell and Tube
  - Plate

- 37 x Pumps
  - Centrifugal - Fixed Speed
  - Centrifugal - Variable Speed
  - Centrifugal - Submerged
  - Reciprocating

- 8 x Filters
  - Diesel
  - Gas
  - Sea Water

- 14 x Compressors
  - Gas Centrifugal - Variable Speed
  - Air Centrifugal - Constant Speed
  - Nitrogen Reciprocating

- 17 x Choke Valves
  - 2-phase/3-component Oil-Water-Gas
  - Single phase (Water)
Integration to Experion - 212 Electrical Assets monitoring
- Motors
- Heaters
- Uninterruptible power supplies (UPS)
- Variable speed drives for high voltage motors (HV VSD)

Integration to FDM & Experion - 2,800 Smart instruments monitoring
- 2700 x HART devices
  - of which 550 Fire and Gas detectors
- 100 x FF devices

Input data health monitoring
- 4 x OPC data sources – more than 10,000 tags
- 5 x 3rd party servers

Integration to Honeywell Service Node for condition monitoring of network & nodes
- Service Node monitors the servers and nodes parameters and run diagnostics over the entire network
Lundin – Edvard Grieg - Asset Manager Scope

- Integration of data from 3rd party monitoring systems
  - Score V-MAP (Valve Monitoring for Analysis and Performance) – 68 assets
  - GE System One (Rotating Machinery Condition Monitoring) – 38 assets
  - ABB Asset Optimizer (Electrical Equipment Monitoring) – 12 assets
  - Roxar Fieldwatch (Multiphase Meters, Corrosion, Erosion) – 58 assets
  - Dresser-Rand Envision (Gas Turbine Performance Monitoring) – 2 assets

![Diagram showing integration of data from various monitoring systems]
Tracking Software for Liquids - Honeywell Americas Users Group Example slides

- Ericka Fisher, PMP, CBAP (Chevron)
- Doyle Veneralla (Chevron)
- Sai Yesanthalao (Honeywell)
- June 2015
Number of meter factors used to calculate average meter factor for alert conditions

Detail of meter selected along with the status of prover and transmitters associated with the meters.

Number of MF to be in same direction to generate MF failure alert
API calculations implemented to estimate when the prover needs to be recertified.

Ability to view the Waterdraw Certificate
Operational Reports – Prover Reports Detail

- Ability to review the prover report
- Comment and collaborate
- Image of report associated
Saudi Aramco - Jazan OAS Refinery & IGCC
OAS Overview

• Operations Advisory & Support (OAS) system provides
  – a collaborative framework to support daily operations and interactions amongst the Jazan staff.

• OAS consists of a collection of software applications
  – intended to advise the operations staff for managing plant operation in different situations.

• The applications that comprise the OAS system are:
  • Asset Manager system, application that performs the operator advisory function
  • Field Advisor system, application that supports the operator outdoor tasks function
  • OM Pro suite, a collection of applications which are intended to manage and inform Operators on Limits
  • On-line RIM is the Fileserver System
  • ProcOps (Procedural Operations), performs the Operating Procedures function
The asset count per plant is presented in the table below:

<table>
<thead>
<tr>
<th>Equipment Split</th>
<th>IGCC</th>
<th>Refinery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas Turbines</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Steam Turbines</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Compressors</td>
<td>3</td>
<td>35</td>
</tr>
<tr>
<td>Pumps</td>
<td>544</td>
<td>65</td>
</tr>
<tr>
<td>Fans</td>
<td>59</td>
<td></td>
</tr>
<tr>
<td>Electric Generators</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Heat Exchangers</td>
<td>480</td>
<td></td>
</tr>
<tr>
<td>Columns</td>
<td>54</td>
<td>49</td>
</tr>
<tr>
<td>Reactors</td>
<td>47</td>
<td>13</td>
</tr>
<tr>
<td>Furnaces</td>
<td>71</td>
<td>23</td>
</tr>
<tr>
<td>Boilers</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>1310</strong></td>
<td><strong>185</strong></td>
</tr>
</tbody>
</table>
Asset Sentinel Data Flow

OM Pro Web & Report Server
- Operation Instructions
- Operation Logbook
- Operation Monitoring

OM Pro Database & Application Server
- Oracle & App Svr

Asset Manager Server
- AM web client
- HTTP

DAHS/PI Corporate Server
- DAHS/PI data transfer

Field Advisor Server
- Historical Data (OPC HDA)
- USB

Field Advisor
- Historical Data (OPC HDA)
- DAHS/PI data transfer

DAHS/PI Collector
- Data diode (HOLD)
- DAHS/PI data transfer

Asset Manager
- Numeric Data (OPC DA)
- Alert Limits Synchronization (Webservice)

RIM Server
- Documents [hyperlinks]

ProcOps
- EPKS Server
- Numeric Data (OPC DA)

DAHS/PI Collector
- Historical Data (OPC HDA)

OM Pro Web & Report Server
- OI, OM, OL web client
- HTTP

Web Based reports
- HTTP

OI Targets
- Operational Data (OPC HDA)

OM Pro Database & Application Server
- DB & Reporting data transfer

Legend:
- OAS Handheld
- Honeywell OAS Server
- Honeywell DCS and DAHS PI servers
- OAS Application
- Data diode

FA Docking Station & Handhelds
- FA web client
- HTTP
- USB

fa Docking Station & Handhelds
- HTTP
- USB
Sources of Value

Increase Asset Utilization up to 10%
- Reduce unplanned downtime by predicting failures and providing proactive response
- Minimize rate and efficiency losses

Increase Operating Efficiency up to 10%
- Monitor energy usage to achieve up to 10% reduction in costs
- Improve engineering effectiveness with continuous monitoring, remote collaboration, and ready access to required information
- Increase engineering efficiency with an integrated decision support environment

Reduce Maintenance Costs up to 10%
- Pro-active response to minimize equipment damage and emergencies
- Optimize maintenance based on real asset conditions
- Improve reliability and extend equipment life

Increase Safety
- Minimize risks by ensuring normal and stable operations
- Eliminate production stops for safety system verification
The new face of Uniformance®

Adding Asset data and calculations as well as process KPI’s

The traditional Process Historian expanded with advanced asset based calculation capability as well as KPI visualization.

PHD
Capture and store real-time process and event data across the enterprise

Asset Sentinel
Monitor plant performance and equipment health with powerful analytics

KPI
Define, track, analyse & improve KPI’s for effective performance management

Insight
Visualize process conditions and investigate events from any web browser

Driving better and faster decision making
Uniformalnce Asset Sentinel

Features

Advanced calculation engine
- Scheduled & On-data Change
- Template calculations
- Embedded performance models
- UniSim and Thermo package

Event Detection
- Rules engine
- Notifications

Visualization & Reporting
- Asset dashboards, trends, reports
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- Automated surveillance to predict and detect problems - free up resources for problem solving
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Changing the way you do business with Digital Transformation