EXPLORE HOW AN IIOT ECOSYSTEM DRIVES POWERFUL PROCESS INDUSTRY IMPROVEMENTS
Addressing Core Industry Problems

Enterprise Intelligence Management

Production Efficiency
- Operator Effectiveness
- Reduce Off-Spec
- Optimize Process

Process Reliability
- Asset Surveillance
- Predictive Maintenance
- Expert Guidance

Supply Chain Optimization
- Planning & Scheduling
- Inventory and WIP Reduction
- Enterprise-Wide Real Time Supply Chain Execution

Gains not possible with conventional methods used today

Benefits from fully-deployed IIoT solution for typical 150k barrel / day refinery on the West Coast:

- **Proven impact $14-$18M per site per year**
- **Typical savings of $25-$26M per year**
- **Cost savings $26-$28M per site per year**
## Connectivity Is Transforming Our Offering

### End State Vision

<table>
<thead>
<tr>
<th>Connected Process</th>
<th>Connected Assets</th>
<th>Connected People</th>
</tr>
</thead>
</table>
| • Predictability in end-to-end process performance with licensor expertise  
  • Production optimization via advanced machine learning analytics  
  • Open and collaborative platform | • Superior equipment performance through connectivity  
  • Preventive and predictive maintenance  
  • Open and collaborative platform | • Knowledge transfer and competency management across generations  
  • Real time collaboration to improve productivity  
  • Worker safety & compliance at all times |

### Current Offering

<table>
<thead>
<tr>
<th>Process</th>
<th>Assets</th>
<th>People</th>
</tr>
</thead>
</table>
| • Regulatory Control  
  • Advanced Control / Optimization  
  • UOP Processes | • Control & Safety Systems  
  • UOP Process Units  
  • Devices (FI, burners, etc.) | • Operator Training  
  • Operator interaction with process  
  • Alarm Management  
  • Mobile Workers |

### Build on Our Installed Base Heritage and Create New Offerings

- Optimization from enterprise and industry level insights
- Optimization from plant level insights

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Honeywell Connected Plant: Delivering What No One Else Can

Delivering ROI Focused Solutions

For a medium sized refinery in the US...

- ~5% of production lost to unplanned shutdowns/yr...
- 1% improvement in plant availability & quality...
- +$26M increase in profit/yr

Connected Platform and “Offerings” for Operational Excellence
Connected Assets: Leveraging the Power of IIoT

We combine **asset** and **process** data, use **analytics** and **expert guidance** to provide actionable insight to avoid critical asset failure and unplanned shutdowns.

- **Asset Surveillance**
- **Predictive Maintenance**
- **Analytics**
- **Energy & Compliance Monitoring**

**SECURED DATA**

- Multiple OEM's
- Site Team
- Process Data
- Collaboration
- Analytics & Visualisation

**Connected Assets**

- Rotating Equipment
- Bearings, Vibration & Seals
- Air, Refrig. & Other Packaged Units
- Pumps
- Thermal Equipment
- Pipeline Monitoring
- Materials Handling
- Asset Tracking

**Knowledge Vendors**

- Honeywell

**INspire**

**Industry leading software, secure IIoT platform and collaboration through an ecosystem of partnerships with industry leading OEMs & Knowledge Vendors**
Connected Assets: Leveraging Domain Expertise

Bringing together collaborators to jointly develop IIoT solutions to solve operational challenges

- INspire™ Partner Program
- Connectivity enablement
- Open, Collaborative Ecosystem

Process, Software & Cyber Domain Expertise  
Customer Expertise  
Asset & Equipment Expertise
IIoT Connection Architecture

Inspire Service Platform
- Uniformance Insight©
- Asset Sentinel
- KPI Manager
- Pulse

Big Data Analytics
- Cognitive Learning
- Tableau, R, etc

Digital Twin
- UniSim®
- 3rd Party Models

3rd Party Cloud
- 3rd Party Apps
- iNspire™ Partners

3rd Party Vendors
- iNspire™ Partners
- Supply Chain
- Service Management Platforms

Stranded Assets

Asset Health and Diagnostic Data

SDX

IioT

Historian

DCS

ERP

LIMS

MES

Sentience™ Cloud Platform

3rd Party Apps
- iNspire™ Partners

Cloud Historian

Secure Data Exchange
New EDGE devices developed to meet data collection, transport and analytics needs.
HCP | Continuous Compressor Analytics

Data, Analytics, and Expertise

Asset data
- Vibration measurements
- Dynamic cylinder pressures
- Temperatures
- Windrock Expertise

Process Data
- Product molecular weight
- Process unit design
- Flows and velocity
- Pressure & valve settings
- Honeywell Expertise

Analytic Elements
- Rod loads
- Rod reversal
- Flow balance
- Power loads
- Feed systems
- Process KPIs
- Fault Models
- Notifications
- Production schedules

Economic Benefit through OEE

Availability & Efficiency
- Reduce Downtime
  - (1% improvement = 8hrs/month @5K hour) $ 4,320,000
- Energy and operational efficiency
  - (2% improvement process reliability & efficiency $ 838,000

Maintenance Costs
- Reduce maintenance costs (valves, rings, rider bands) $ 225,000
- Major cylinder rebuild (extend from 1 time per year) $ 270,000
- Other labor and maintenance cost reductions $ 90,000
- Totals $ 5,600,000
- Payback less than 3 months with ROI near 300%

* Benefit Examples based on 9 compressors in operation at PMT’s Orange Texas plant

Customers experience operational efficiency problems, adjust process and equipment settings to compensate, and degrade the reliability of the compressor. OEMs and Honeywell need to understand how the process and equipment are monitored & diagnosed to proactively optimize performance and availability.
Use Case: Poor compressor reliability & process efficiency

Symptoms
- Degraded compressor performance reducing throughput
- Operationally compensating for equipment issues
- Compressor wear is sacrificing the efficiency of the process
- Over maintaining compressors is decreasing uptime & reliability

Honeywell/Windrock Connected Service
- Continuously monitor asset condition and tune the process
- Analytics optimize performance & minimize invasive maintenance
- Avoid maintenance induced failures with the Right maintenance
## Continuous Rotating Machinery Health

### Expertise, Data and Analytics Required

<table>
<thead>
<tr>
<th>Asset data</th>
<th>Plant Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Bearing Temperatures</td>
<td>• Maintenance schedule data</td>
</tr>
<tr>
<td>• Bearing Vibration</td>
<td>• Associated area maintenance planning cycles</td>
</tr>
<tr>
<td>• Motor Speed</td>
<td>• Production Schedules / Delivery commitments</td>
</tr>
<tr>
<td>• Motor Vibration</td>
<td>• Asset location data</td>
</tr>
<tr>
<td>• Shaft Vibration</td>
<td>•</td>
</tr>
<tr>
<td>• SKF Expertise</td>
<td>•</td>
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</tbody>
</table>

### Process Data

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<tbody>
<tr>
<td>• Process Unit Design</td>
</tr>
<tr>
<td>• Motor Power</td>
</tr>
<tr>
<td>• Flows</td>
</tr>
<tr>
<td>• Pressure and valve settings</td>
</tr>
<tr>
<td>• Control system alarms</td>
</tr>
<tr>
<td>• Honeywell Expertise</td>
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</tbody>
</table>

### Analytic Elements

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<tbody>
<tr>
<td>• Vibration</td>
</tr>
<tr>
<td>• Electric Motor Related Failures</td>
</tr>
<tr>
<td>• Vulnerability index analytics</td>
</tr>
<tr>
<td>• Process KPIs</td>
</tr>
</tbody>
</table>

### Economic Benefit and OEE

#### Availability & Efficiency

<table>
<thead>
<tr>
<th>Availability &amp; Efficiency</th>
<th>Annual Estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Reduce Downtime</td>
<td>$ 298,000</td>
</tr>
<tr>
<td>- (40% improvement = 12hrs/month @2K hour)</td>
<td></td>
</tr>
<tr>
<td>• Energy and operational efficiency</td>
<td>$ 456,000</td>
</tr>
<tr>
<td>- (2% throughput improvements)</td>
<td></td>
</tr>
</tbody>
</table>

#### Maintenance Costs

<table>
<thead>
<tr>
<th>Maintenance Costs</th>
<th>$ 954,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Reduce maintenance costs 89%</td>
<td></td>
</tr>
<tr>
<td>• Totals</td>
<td></td>
</tr>
<tr>
<td>- Payback less than 6 months with ROI near 200%</td>
<td></td>
</tr>
</tbody>
</table>

* SKF and Honeywell need to understand how the process and equipment are monitored & diagnosed to proactively optimize performance and availability.

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## Actual Customer Monitoring / Diagnostics, Predictive Analytics Opportunity
Use Case: Electrostatic Precipitator blower motor vibration

Symptoms
- Frequent vibration alarms forcing shutdowns and inspections
- Trip costs approach $1M in machine damage & production losses
- Random alarms and shutdowns every 5 to 7 days
- Reduced yield

Honeywell/SKF Connected Service
- Continuous blower condition analytics identify vibration root cause
- Vibration caused by build up from firing malfunction in precipitator
- Action is to reduce vibration by slightly lowering blower speed
- Created analytics driven vulnerability index and maintenance plan

Results
- Shutdowns reduced by 40%, 75% reduction in stop duration
- Quarterly yield improvement 2%, and OEE improved by 5%
Use Case: Honeywell/SKF Rotating Machinery Health

Service: Analytics enabled continuous predictive reliability, maintenance and performance monitoring service

**Ecosystem Benefits / Approach**

**Customer**
- Increase OEE uptime and reliability
- Lower Maintenance Costs
- Safe and CyberSecure
- Benchmark equipment performance
- Benefits with Zero additional production system load or complexity
- Enterprise wide visibility

**Honeywell**
- Builds ecosystem
- Subscription revenue for HCP software
- Industry credibility from SKF expertise

**SKF**
- Better customer service with less cost
  - Constant monitoring with notifications
- More customer engagement
  - Proactive versus reactive

**Customer Site**
- Rotating equipment
- SKF IMX8 & Observer
- Honeywell SDX edge gateway

**Honeywell Sentience™ Platform**
- Uniformance® Insight
- Uniformance® Asset Sentinel
- Honeywell Pulse™
- SKF Analytics

**Honeywell Connected Plant applications used by both end-users & OEM**

**Always on continuous monitoring Supported by SKF & Honeywell experts**
Rotating Machinery Health

- Comprehensive & scalable solution for real-time performance management
- Built on Honeywell HCP and Sentience software
- Domain knowledge from Honeywell embedded into solution (e.g. standard KPI repository)
- Strong consulting, engineering and support organization that will ensure our clients get maximum, and quick value realization

Secure Enterprise Portal

Dashboard Visualization
Contextual Drilldowns
Collaboration
Performance Analysis

Mobile Access & Notifications

KPI Definitions standardized across sites

Production
Quality
Control
Maintenance
Process
Energy
Safety
Inventory
Financial

Cycle time
## Multiple INSpire Partners – One Secure Platform

<table>
<thead>
<tr>
<th>ASSET &amp; SENSORS</th>
<th>ASSET EDGE CONNECTOR</th>
<th>PLANT GATEWAY</th>
<th>ENTERPRISE HISTORIAN</th>
<th>KPI &amp; CALC ENGINE</th>
<th>ANALYTICS</th>
<th>VISUALISATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windrock Platinum</td>
<td>Universal Edge Connector</td>
<td>SKF IMX8</td>
<td><strong>CLOUD HISTORIAN</strong></td>
<td>UNIFORMANCE INSIGHT</td>
<td>UNIFORMANCE ASSET SENTINEL</td>
<td>PULSE</td>
</tr>
<tr>
<td>Honeywell</td>
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</table>

**Enterprise Information Management**

- **Enterprise Historian**
- **KPI & Calc Engine**
- **Analytics**
- **Visualization**

**Collaboration & Domain Expertise**

- **Collaboration & Domain Expertise**
- **Analytics**
- **Visualization**

**Customer Site**

- **Honeywell Secure Cloud**
- **Customer Site / Partner Office**

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To get there we will all have to **Think Differently**

- **Cyber Security** is the key **enabler** for IIoT buildout
- **Step change in digitization:** how we procure, how we provide support
- **Shift in employee skill sets** requires different support and approach
- **Change management** will be key to adoption
Connected Assets: Leveraging Expertise

Bringing together collaborators to jointly develop IIoT solutions for a myriad of operational challenges

- INspire™ Partner Program
- Connectivity enablement
- Open, Collaborative Ecosystem

Connected Assets

- Rotating Equipment
- Bearings, Vibration & Seals
- Package Units
- Pumps
- Thermal Equipment
- Pipeline Monitoring
- Specialty Valves & Material Handling
- Asset Tracking
- Energy & Compliance

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