Opportunities for Customers

- How do I ensure optimal plant designs?
- How do I accelerate operational readiness?

- How do I ensure safe and stable operations?
- How do I drive asset reliability?
- How do I optimize plant efficiency?
- How do I enable my workforce?

- How do I increase my agility with market opportunities?
- How do I better manage my assets?

DESIGN THE PLANT   OPERATE THE PLANT   MANAGE THE SUPPLY CHAIN
IIoT – Introduction to Industrial Analytics

IIoT Solves OLD problems in new and innovative ways

Leverages key developing technologies

- High bandwidth communications and massive cost-effective storage in the cloud
- Low-cost pervasive sensor technology
- Advanced analytics (big data) technologies and machine learning
- Device inter-operability standards

Changes the way of how and where work is done

- Remote collaboration (owner / vendor / OEM)
- Enables Center of Excellence
- Captures and applies knowledge
- Routine monitoring done by machines
The Analytics Challenge

How can we help close this GAP and deliver real value?

40 exabytes ($4.0 \times 10^{19}$) of unique new information will be generated worldwide this year.

A major manufacturer has over 40 Pbyte ($10^{15}$ or quadrillion) of data today and will increase 10X in coming years.

Subject Matter Expertise is Critical
The goal of analytics is to provide information for **improved decisions and actions** for economic benefit.

Note that maximizing automation and minimizing human input are *not* always the goals → analytics should be suited to the use case.
Honeywell Connected Plant, Unequalled Equation for Success

We connect processes, assets and people to continually redefine optimal performance

Connected Process
- Deep domain expertise
- Optimization & analytics via the digital twin

Connected Assets
- Broad ecosystem of expertise & capabilities
- Predictive asset performance, increase uptime, decrease downtime

Connected People
- Enhanced decisions via data analytics
- Worker safety & compliance

Connected Plant
- Unmatched industry offering
- Integrated solutions that span the entire enterprise

Maximize plant throughput and yields by 7%
Improve plant availability by 2%
Protect knowledge of retiring workforce

$26M+ increase in profit/year

Based on foundation of advanced software solutions

*Based on a medium sized refinery in the US
How Honeywell Connected Plant is Delivering Value

Deliver and Sustain Improvements in our Customers’ Profitability

<table>
<thead>
<tr>
<th>Process Safety &amp; Integrity</th>
<th>Optimized Supply Chain</th>
<th>Optimized Production</th>
<th>Improved Process Performance &amp; Reliability</th>
<th>Workforce Competency</th>
</tr>
</thead>
<tbody>
<tr>
<td>DynAMo® Suite</td>
<td>Symphonite™ Suite</td>
<td>Profit® Suite</td>
<td>Uniformance® Suite</td>
<td>UniSim® Suite</td>
</tr>
<tr>
<td>• Improved situational awareness</td>
<td>• Faster, better decision-making</td>
<td>• Increased yields and throughput</td>
<td>• Improved asset availability</td>
<td>• Accelerate knowledge transfer</td>
</tr>
<tr>
<td>• Minimize process deviations</td>
<td>• Accurate data reconciliation</td>
<td>• Maximizing value with future predictions</td>
<td>• Intuitive data management</td>
<td>• Elevate operator competency</td>
</tr>
</tbody>
</table>

Leaders in Industrial Software Solutions with Broadest Portfolio
Connected Process

We use real-time plant data with advanced software, analytics and plant process models to deliver operational improvements and increase reliability

Cloud-based Services:
- Process Reliability Advisor
- Unit-Specific Benchmarking
- Process Optimization Advisor
- Utilities Management
- Predictive Maintenance
Connected Assets

Industrial software, secure IIoT platform and collaboration through an ecosystem of partnerships with industry-leading OEMs & Knowledge Vendors

We combine asset and process data, with OEM analytics and expert guidance to improve asset reliability and avoid unplanned shutdowns
Connected People

We equip your workforce with new tools to do their jobs better and more safely, increasing their competency and collaboration enterprise-wide

- Cloud-based operator training simulator & augmented/virtual reality for seamless knowledge transfer and competency management across generations
- Cloud for Field Operations offering mobility solutions for field actions and safe work practices
- Prescriptive analytics for Operations Management to improve worker effectiveness and productivity
Big Data Analytics Myths

• Storing big data in the cloud is cheap or free

• Big Data / Analytics replaces the need for process knowledge / engineering experience

• Data Analytics is a replacement for fundamental models

• You don’t need GOOD data as long as you have a LOT of data

• You don’t need to change your work processes to get full value from big data

• All analytics software is about the same – it is all shareware downloaded from the internet

All Not True

Without Insight - Big Data Analytics is a solution looking for a problem to solve
Connected Plant (IIoT) 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 Apps
- INspire™ Partners

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

Cloud Historian

Secure Data Exchange

Asset Health and Diagnostic Data

IIoT

SDX

DCS

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Honeywell’s Integrated Layers of Secure, IIoT-Ready Solutions

**IloT Elements**

1. Smart & Connected Assets and Devices
2. Data Management and Onsite Control
3. Predictive Analytics
4. Smart and Secure Collaboration

**IloT Architecture**

- Predictive Analytics
- Prescriptive Decision Making
- Smart Collaboration

- Private, Public or Honeywell Secure Cloud

- OEMs
- Licensors
- COEs

- Enterprise History
- Asset Management
- Operations Management
- Planning & Scheduling
- Mobility Solutions
- Enterprise Dashboards

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<table>
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<th>IIoT Elements</th>
<th>IIoT Ready Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1</strong></td>
<td><strong>End to End Smart Metering Solutions</strong></td>
</tr>
<tr>
<td><strong>Smart &amp; Connected Assets and Devices</strong></td>
<td><strong>Cloud Link™ 4G Modem</strong></td>
</tr>
<tr>
<td>• Secure data connectivity edge to cloud</td>
<td>• Secure data connectivity edge to cloud</td>
</tr>
<tr>
<td>• Device imbedded capability</td>
<td>• Device imbedded capability</td>
</tr>
<tr>
<td><strong>2</strong></td>
<td><strong>Data Management and Onsite Control</strong></td>
</tr>
<tr>
<td><strong>Smart and Secure Collaboration</strong></td>
<td><strong>End-to-end smart metering solutions</strong></td>
</tr>
<tr>
<td>• IIoT serial gateway edge device</td>
<td>• End-to-end smart metering solutions</td>
</tr>
<tr>
<td>• Suitable for Class 1, Div 2 hazardous areas</td>
<td>• Integrated portfolio provides seamless connectivity and 24/7 access to critical data and diagnostics for remote meter monitoring</td>
</tr>
</tbody>
</table>
# Honeywell’s Integrated Layers of Secure, IIoT-Ready Solutions

## IIoT Elements

<table>
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<th>Step</th>
<th>IIoT Elements</th>
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<tbody>
<tr>
<td>1</td>
<td>Smart &amp; Connected Assets and Devices</td>
</tr>
<tr>
<td>2</td>
<td>Data Management and Onsite Control</td>
</tr>
<tr>
<td>3</td>
<td>Predictive Analytics</td>
</tr>
<tr>
<td>4</td>
<td>Smart and Secure Collaboration</td>
</tr>
</tbody>
</table>

## IIoT Ready Solutions

- **ControlEdge™ PLC**
  - Connectivity through all levels of process and business operations
  - Multi-site data gathering at centralized cloud enables asset performance analytic

- **Cloud Enterprise Historian**
  - Optimize enterprise data storage
  - Big data analytics
## Honeywell’s Integrated Layers of Secure, IIoT-Ready Solutions

<table>
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<tr>
<th>IloT Elements</th>
<th>IloT Ready Solutions</th>
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<tbody>
<tr>
<td><strong>1</strong></td>
<td><strong>1</strong></td>
</tr>
<tr>
<td>Smart &amp; Connected Assets and Devices</td>
<td>Visual Process Analytics</td>
</tr>
<tr>
<td><strong>2</strong></td>
<td><strong>2</strong></td>
</tr>
<tr>
<td>Data Management and Onsite Control</td>
<td>Remote System Asset Management</td>
</tr>
<tr>
<td><strong>3</strong></td>
<td><strong>3</strong></td>
</tr>
<tr>
<td>Predictive Analytics</td>
<td>Proactively Reduce Breakdowns and Sustain Plant Performance</td>
</tr>
<tr>
<td><strong>4</strong></td>
<td><strong>4</strong></td>
</tr>
<tr>
<td>Smart and Secure Collaboration</td>
<td>System KPI dashboards</td>
</tr>
</tbody>
</table>

### Uniformance® Suite
- Web based visualization and analytics
- Remote equipment diagnostics & process monitoring
- Scalable asset model
- KPI Performance Management

### Assurance 360
- Remote System Asset Management
- Proactively Reduce Breakdowns and Sustain Plant Performance
- System KPI dashboards
Honeywell’s Integrated Layers of Secure, IIoT-Ready Solutions

**IloT Elements**

1. **Smart & Connected Assets and Devices**
2. **Data Management and Onsite Control**
3. **Predictive Analytics**
4. **Smart and Secure Collaboration**

**IloT Ready Solutions**

- **Pulse Mobility**
  - Situational awareness and collaboration
  - Connecting people to the assets in real-time

- **Cyber Risk Manager**
  - System cyber security remote monitoring

- **KPI Performance Management**
  - Web based mobile KPI dashboards across the enterprise
Honeywell Connected Plant: Delivering Value Today

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

Industrial Software Solutions + Connected Platform for Operational Excellence
## Industrial Analytics Current Projects

**Operational Data**

<table>
<thead>
<tr>
<th>Operational Data</th>
<th>Analytics</th>
<th>EBS Alerts</th>
<th>Analysis</th>
<th>Advice/Plan</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Near / Real Time</td>
<td>Sentinel for Analytics</td>
<td>Event Management</td>
<td>Analyst</td>
<td>Specialist</td>
<td>Engineer</td>
</tr>
</tbody>
</table>

### Process Safety: Furnace Flooding
- **What is it:** Data analytics to develop early detection of furnace flooding condition to prevent unsafe operating conditions & reduce production losses
- **Technology:** Analytics for insight and modelling, on-line predictive analytics and alerts

### Predictive Compressor Faults
- **What is it:** Data analytics to gain insight on Compressor performance decline, On-line performance monitoring with predictive alerts
- **Technology:** Visual, Statistical, Big data, Analytics, performance models, on-line predictive analytics and alerts

### Aeroplane Brake Disc Manufacturing
- **What is it:** Data analytics to gain insight into unexplained and ongoing issues with batches on stopping distance tests.
- **Technology:** Visual, Statistical Analytics, predictive modeling

### Supply Chain Insights: Supplier Quality
- **What is it:** Data analytics to analyze yield and defect on key production line parameters in semiconductor fabs tied to upstream feedstock supplier
- **Technology:** Visual, Statistical, Big data, Analytics, Multi-variate Models.

### KPI linkage to Root Cause Analysis
- **What is it:** Visual process data analytics to gain rapid insights linking KPI parameters and process performance to operating variables
- **Technology:** Visual Process Analytics, Statistical Analytics, Predictive

### Process Surveillance
- **What is it:** Visual process data analytics to gain rapid insights into process conditions that can be rapidly converted into on-line Sentinel based analytics
- **Technology:** Visual Process Analytics, Sentinel rules, Predictive Analytics
Industrial Analytics Current Projects

Supply Chain Integration
- **What is it:** Three manufacturing sites in supply chain. Move data from sites to enterprise cloud and optimize the value chain using Data Analytics.
- **Technology:** Sentience Cloud / Analytics for insight and overall quality model and batch tracking, on-line predictive analytics and alerts.

Reactors Uptime Optimization
- **What is it:** Data Analytics to determine optimal reactor change out time to increase OEE and reduce CAPEX.
- **Technology:** Visual, Statistical, Big data, Analytics, performance models, on-line predictive analytics and alerts.

Heat Exchanger Optimization / Monitoring
- **What is it:** Online monitoring using process analytics, leading to event based maintenance of fouling.
  - Avoid excess corrosion events.
  - Optimize cost of lost HX performance vs maintenance/cleaning costs.
- **Technology:** UniSIM, Visual, Statistical Analytics, predictive modeling.

Shift Handover & Rounds Management
- **What is it:** Implement DynAMO & Movilizer for electronic records.
  - Future use of cognitive analytics / NLP for productivity improvement & knowledge capture.
- **Technology:** Visual, Statistical, Big data, Analytics, Multi-variate Models.
Future is the Connected Plant

Cloud, Mobility, Analytics

Data is changing the industrial landscape…and Honeywell is in key position as a software-industrial to help extract value