Shree Dandekar, VP
Honeywell Connected Plant

THE DIGITAL TWIN...REAL AND GAINING GROUND
WEDNESDAY | 14:05 | CAPITAL SUITE 4
## What is Honeywell

### 2016 sales

<table>
<thead>
<tr>
<th>Segment</th>
<th>Sales (billion)</th>
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</thead>
<tbody>
<tr>
<td>Aerospace</td>
<td>$14.7</td>
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<tr>
<td>Performance Materials and Technologies</td>
<td>$9.3</td>
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<tr>
<td>Safety and Productivity Solutions</td>
<td>$4.6</td>
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<tr>
<td>Home and Building Technologies</td>
<td>$10.6</td>
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</tbody>
</table>

**Total Sales**: $39.3B

- 1,300 sites, 70 countries
- 129,000 employees
- Morris Plains, NJ headquarters
- Fortune 100

53% sales outside U.S.
Honeywell, Software-Industrial

Honeywell is transforming into a Software-Industrial Company
How Honeywell Contributes in the Process Industries

Honeywell Technology Makes More than…

- **60%** World’s Gasoline
- **40%** World’s LNG
- **70%** Polyester
- **90%** Biodegradable Detergents

...and Honeywell technology is…

- INSTALLED IN ~50% world’s refineries
- HELPING REFINE ~40M barrels of oil/day
- MORE THAN 125 countries worldwide
- ~90M connected products AND SOLUTIONS
Honeywell Connected Plant…the Value

Delivering and sustaining improvements to customer profitability by increasing throughput & yield at a lower cost via:

- Integrated Safety & Cyber Security
- Increased Production Efficiency
- Improved Process Reliability
- Optimized Supply Chain
- Workforce Competency
Downstream Oil & Gas Value Chain

- Refineries process crude oil to make gasoline, diesel, jet fuel…
- Mature industry where productivity, operational efficiency and agility are key to profitability
Downstream Oil & Gas Value Chain

- Complex integrated value chain
- Molecule management critical to drive value
- Reliant on deep process expertise
How Have We Operated These Plants Historically?

This requires:
• Data to control the plant
• Data to manage reliability of key equipment
• Data to troubleshoot performance of the process
• Data for economic planning: defining products to make & feedstock to purchase

The average oil refinery generates 120 million data points every day!
What’s the Problem with All This Data?

Many purpose-built applications to accomplish many different tasks

- Siloed, limited scope data stores
- Challenging to connect
- Maintainability issues

...an alternative was needed

Siloed data is sad data
Why Now?

Critical to leverage this data now to address:

- Loss of expertise, retiring workforce
- New geographies without access to expertise
- Acceleration due to increased competition in the market
The Solution: The Digital Twin

- Unifies existing data silos into a virtual entity
- Federates data across different applications to drive end-to-end integration
- Leverages process simulation technology beyond current scope of process design
- Utilizes Cloud to overcome maintainability issues and enables 3rd party expertise

CAPTURING THE COMPLEXITY OF AN ENTIRE REFINERY INTO A SCALABLE DATA MODEL
Making Sense of Plant Data – Process Simulation

Process models represent plants

\[ \text{outputs} = f(\text{inputs}) \]

Mathematical abstractions to simulate plant operations
An IIoT Use Case for the Digital Twin

VIDEO
The Power of The Digital Twin

Disparate Data Across Enterprise

Plant Availability & Optimization

UOP Process Specialist

OEM Partner Ecosystem

Connected Plant

Digital Twin

Cyber Secured Data Stream

Decisions & Actions

Analytics Based Insight at Enterprise Level

Equipment Availability Utilizing Partnerships

UOP Process Specialist, ERP, Historian, etc.

Asset Data

Process Data

Sensors

ERP, Historian, etc.

UNCOVERING THE VALUE OF DATA TO DRIVE ACTION
Digital Twin Solution Architecture

Shared Data Store with Common Metadata model enables:

- Big Data / ML platform for continuous innovation
- Templated solutions for scalable deployments
## Where Industrial Analytics Meets Predictive Analytics

<table>
<thead>
<tr>
<th>Technique</th>
<th>Prescriptive Analytics</th>
<th>Predictive Analytics</th>
<th>Diagnostic Analytics</th>
<th>Descriptive Analytics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimisation:</td>
<td>“What’s the best action?”</td>
<td></td>
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<td>Random Testing:</td>
<td>“What if we try this?”</td>
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<tr>
<td>Predictive Modeling:</td>
<td>“What will happen next?”</td>
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<td>Statistical Modeling:</td>
<td>“What is the pattern?”</td>
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<tr>
<td>Discovery/Alerts:</td>
<td>“Where should we look?”</td>
<td></td>
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<tr>
<td>Query/Drill Down:</td>
<td>“Why did it happen?”</td>
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<tr>
<td>Ad Hoc Rpt/Scorecards:</td>
<td>“How many, when, where?”</td>
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<tr>
<td>Standard Reports:</td>
<td>“What happened?”</td>
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**First Principles Modeling**
- Uses known physics & chemistry
Use Case Example – Edge to Cloud Analytics Processing

- Combination of data analytics tools with industry heuristics to replace manual work processes
- Enabling customer to detect issue months earlier → $5M savings in yield loss

Customer Data Historian → Secure Encrypted Channel → Honeywell Cloud Historian

SPARK stream processing

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<tr>
<th>Pre-processing (data cleansing)</th>
<th>Digital Twin</th>
<th>Fault Model Processing</th>
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<tbody>
<tr>
<td>Industry computations</td>
<td>Tracking deviations from digital twin predictions to infer issues</td>
<td>Prescriptive Analytics</td>
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<tr>
<td>Outlier detection</td>
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<td>First order filtering</td>
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TSDB (streaming process data)

Overall Data Flow

- Trigger on KPI offset from Digital Twin
- Rate of change detection on moisture in system
- Proactive user recommendation to resolve issue

- Proactive recommendation to resolve issue
- Combination of data analytics tools with industry heuristics to replace manual work processes
- Enabling customer to detect issue months earlier → $5M savings in yield loss
The Challenges

- Secure Edge to Cloud data transfer
  - Ensuring protection of highly sensitive, critical infrastructure assets from cyber threats
- High frequency data access
  - Equipment reliability can be MHz with many streaming data streams
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Honeywell Connected Plant