SAP Predictive Maintenance and Service

Christian Baust,
Product Manager Service Industries
SAP Predictive Maintenance and Service

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PUBLIC
Agenda

Benefits Across the Maintenance Program

SAP Predictive Maintenance and Service
- Overview
- Asset Visualization
  - Insight Provider Catalog
  - Asset Health Control Center
  - Asset Health Fact Sheet
- Machine Learning Engine

Customers

Roadmap
Benefits Across the Maintenance Program

SAP Predictive Maintenance and Service

- Overview
- Asset Visualization
  - Insight Provider Catalog
  - Asset Health Control Center
  - Asset Health Fact Sheet
- Machine Learning Engine

Customers

Roadmap
Technology is changing our approach to maintenance

### Use of Maintenance Strategy – Today

<table>
<thead>
<tr>
<th>Maintenance Strategy</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reactive</td>
<td>40%</td>
</tr>
<tr>
<td>Preventive</td>
<td>30%</td>
</tr>
<tr>
<td>On-Condition</td>
<td>20%</td>
</tr>
<tr>
<td>Predictive</td>
<td>10%</td>
</tr>
</tbody>
</table>

### Use of Maintenance Strategy – Future

<table>
<thead>
<tr>
<th>Maintenance Strategy</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reactive</td>
<td>10%</td>
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<tr>
<td>Preventive</td>
<td>20%</td>
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<tr>
<td>On-Condition</td>
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</tr>
<tr>
<td>Predictive</td>
<td>40%</td>
</tr>
</tbody>
</table>

The Internet of Things is leading to increased use of on-condition and predictive maintenance strategies.

Although still relevant, reactive and preventive maintenance strategies do little to guard against unplanned equipment downtime and result in high cost.

The goal is to increase our use of more advanced maintenance strategies.
The correlation between asset age and reliability is low

Components exhibited age-related failure patterns.
A **preventive** strategy is the right approach.

Components exhibited random failure patterns.
An **on-condition** or **predictive** maintenance strategy is required.

**Source:** Reliability-centered Maintenance, Second Edition, John Moubray
Advances in on-condition and predictive maintenance strategies

- Potential Failure
  - Oil Analysis Program
  - Audible Noise
  - Hot to Touch
  - Mechanically Loose

- Functional Failure
  - Ancillary Damage

- Total Failure

Time to respond

Asset Condition vs. Time
Advances in on-condition and predictive maintenance strategies

More time to respond enables greater flexibility to dynamically plan maintenance events
Benefits Across the Maintenance Program

SAP Predictive Maintenance and Service

- Overview
- Asset Visualization
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  - Asset Health Control Center
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- Machine Learning Engine

Customers

Roadmap
SAP Predictive Maintenance and Service
Decision support across the ecosystem & asset lifecycle

**OEM**
- R&D: Improve asset reliability and up-time
- Procurement: Monitor quality of purchased components
- Production: Improve manufacturing processes
- Aftermarket: Comply with contract service level agreements

**Dealer**
- Sales: Increase customer satisfaction and loyalty
- Service: Deliver the value added service at the right price

**Service Provider**
- Service: Decrease maintenance costs

**Owner/Operator**
- Fleet: Increase asset up-time

**Decision support to ALERT, DISCOVER AND REMEDY**

**Machine Data**
Combining IT & OT data gives machine data **context**
SAP Predictive Maintenance and Service
Solution components and value drivers

- Available via cloud or on-premise
- Flexible extension concept for customers to build industry or customer specific models and analytics
- A scalable Machine Learning Engine that drives data science insights into our business processes
- Flexible visualizations across equipment structures
- End-to-end process integration… Alert, Discover, Remedy
SAP Predictive Maintenance and Service
System and component level visualizations

Insight Provider Catalog

SAP Predictive Maintenance and Service
SAP Predictive Maintenance and Service

Asset Health Control Center
Asset Health Fact Sheet

Machine Learning Engine

SAP Leonardo Foundation
SAP Leonardo for Edge Computing

Logistics & Maintenance Execution Systems

 Asset Health Control Center

Asset Health Fact Sheet

Machine Data
Business Data

Asset Explorer

Asset Explorer

Asset Explorer

Asset Explorer

Asset Explorer

Asset Explorer

Machine Data
Business Data

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<table>
<thead>
<tr>
<th>Derived Signals</th>
<th>2D Chart</th>
<th>Work Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provides a list of the current derived signals based on rules defined for sensor data, and a 2D chart for data visualization.</td>
<td>Provides data visualization across one or more measurements.</td>
<td>Provides a list of current work activities with details.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Components</th>
<th>Map</th>
<th>Asset Explorer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provides a hierarchical list of components of an asset, along with their attributes.</td>
<td>Provides a display of assets and their health status by geolocation and issue severity. Also allows spatial selection.</td>
<td>Provides a list of assets, as well as their attributes. It also enables you to set filters.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3D Chart</th>
<th>Key Figures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provides sensor data visualization across assets and time, and the ability to overlay derived signals.</td>
<td>Key Figures</td>
</tr>
</tbody>
</table>
SAP Predictive Maintenance and Service
Asset Health Control Center

Asset View

Houston Refinery

New Orleans Refinery

Asset View
SAP Predictive Maintenance and Service
Asset Health Control Center

Asset View
- Houston Refinery
  - Functional Location
    - Houston Refinery
    - Eagle Ford Field
      - West Field (P1)
      - South Field (P1)
    - North Field (P1)
      - Well Cluster 2 (P1-C4)
      - Well Cluster 3 (P1-C4)
      - Separators (P1-C4-U3)
    - Centrifugal Pump (P1-C4-U3)
    - Well Cluster 1 (P1-C4)
    - New Orleans Refinery
- New Orleans Refinery

Asset Hierarchy
SAP Predictive Maintenance and Service
Asset Health Control Center

Asset View
- Houston Refinery
- New Orleans Refinery

Asset Hierarchy
- Functional Location
  - Houston Refinery
    - West Field (P1)
    - South Field (P1)
  - Eagle Ford Field
    - North Field (P1)
    - Well Cluster 2 (P1-C4)
    - Well Cluster 3 (P1-C4)
    - Separators (P1-C4-U3)
  - Centrifugal Pump (P1-C4-U3)
  - New Orleans Refinery

Insight Provider Catalog
- Derived Signals
- Components
- Work Activities
- 2D Chart
- Map
- Asset Explorer
- 3D Chart
- Key Figures

Asset View Asset Hierarchy Insight Provider Catalog
SAP Predictive Maintenance and Service
Asset Health Control Center

Insight Provider Catalog

- **Derived Signals**: Provides a list of the current derived signals along with their status and time to failure for data visualization.
- **Components**: Provides a hierarchical list of components of an asset, along with their attributes.
- **Map**: Provides a display of assets and their health status, including location and severity, also allows spatial selection.
- **Asset Explorer**: Provides a list of assets, along with their attributes. It also enables you to set filters.
- **2D Chart**: Provides data visualization across one or more measurements.
- **3D Chart**: Provides advanced visualization across assets and time, also visualizes event-driven signals.
- **Key Figures**: Provides key figures for the asset view.

Asset View  Asset Hierarchy  Insight Provider Catalog
SAP Predictive Maintenance and Service
Asset Health Control Center

**Insight Provider Catalog**

- **Derived Signals**
  - Provides a list of all the current derived signals, their definitions, and their statuses. Helps in identifying signals that need attention.

- **Components**
  - Provides a hierarchical list of components of an asset, along with their attributes.

- **Map**
  - Provides a display of assets and their health status, allowing visualization and easy identification of issues.

- **3D Chart**
  - Offers a visual representation of assets and their relationships in three dimensions, aiding in spatial identification.

- **Work Activities**
  - Provides a list of current work activities with details.

- **Asset Explorer**
  - Provides a list of assets, as well as their attributes. It also includes filters to refine the view.

**Key Figures**

- **Critical Assets**
  - Today: 7

- **Critical Assets Eagle Ford**
  - Today: 5

- **High Priority Open Work Activities**
  - Today: 92

- **New Work Activities**
  - Last 2 Weeks: 59

- **Closed Work Activities**
  - Last 2 Weeks: 22

**Insight Providers**

- **Asset View**
- **Asset Hierarchy**
- **Insight Provider Catalog**
- **Insight Providers**
SAP Predictive Maintenance and Service
Asset Health Control Center

Insight Provider Catalog

- Derived Signals
  - 2D Chart: Provides data visualization across one or more measurements.
- Components
  - Map: Provides a display of assets and their health status in context and issue severity, also allows spatial selection.
- 3D Chart
  - Key Figures: Provides sensor data visualization across assets and time, and the ability to overlay derived signals.
- Work Activities
  - Provides a list of current work activities with details.
- Asset Explorer
  - Provides a list of assets, as well as their attributes. It also enables you to set filters.

Insight Providers

<table>
<thead>
<tr>
<th>Asset Explorer</th>
<th>Serial Number</th>
<th>Installation Year</th>
<th>Manufacturer</th>
<th>Model</th>
<th>Maximum Flow</th>
<th>Remaining Useful Life</th>
<th>Health Score</th>
<th>Health Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump-00354</td>
<td>SN-553259</td>
<td>2010</td>
<td>Pumps Ltd</td>
<td>200 Series</td>
<td>500</td>
<td>2</td>
<td>15</td>
<td></td>
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<tr>
<td>Pump-00309</td>
<td>SN-623847</td>
<td>2011</td>
<td>ACME P...</td>
<td>Prime M...</td>
<td>400</td>
<td>5</td>
<td>26</td>
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</tr>
<tr>
<td>Pump-00224</td>
<td>SN-590637</td>
<td>2010</td>
<td>Rotator SE</td>
<td>Model 35</td>
<td>300</td>
<td>8</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>Pump-00347</td>
<td>SN-865353</td>
<td>2012</td>
<td>ACME P...</td>
<td>HXT</td>
<td>800</td>
<td>10</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td>Pump-00518</td>
<td>SN-056146</td>
<td>2016</td>
<td>Pumps Ltd</td>
<td>700 Series</td>
<td>700</td>
<td>13</td>
<td>49</td>
<td></td>
</tr>
<tr>
<td>Pump-00488</td>
<td>SN-456521</td>
<td>2014</td>
<td>ACME P...</td>
<td>HXT</td>
<td>200</td>
<td>16</td>
<td>51</td>
<td></td>
</tr>
</tbody>
</table>
SAP Predictive Maintenance and Service
Asset Health Control Center

Insight Provider Catalog

Derived Signals
Provides a list of the current derived signals along with the component name, status, and type.

Components
Provides a hierarchical list of components of an asset, along with their attributes.

Map
Provides a layout of assets and their health status to visualization and ease severity, also allows spatial selection.

3D Chart
Provides a visual representation of assets with sub-attributes and gives the ability to switch the derived signals.

Work Activities
Provides a list of current work activities with details.

Asset Explorer
Provides a list of assets, as well as their attributes, it also enables you to set filters.

Key Figures
Displays key figures of the asset.

Insight Providers

<table>
<thead>
<tr>
<th>Derived Signals (150)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
</tr>
<tr>
<td>----</td>
</tr>
<tr>
<td>DS-00357</td>
</tr>
<tr>
<td>DS-00354</td>
</tr>
</tbody>
</table>

Asset View | Asset Hierarchy | Insight Provider Catalog | Insight Providers
SAP Predictive Maintenance and Service
Asset Health Control Center

Insight Provider Catalog

Derived Signals
Provides a list of the current derived signals and their statuses to indicate service alerts and critical events for real-time visualization.

Components
Provides a hierarchical list of components of an asset, along with their attributes.

3D Chart
Provides sensor data visualization across assets and time, and the ability to explore derived signals.

2D Chart
Provides data visualization across one or more measurements.

Work Activities
Provides a list of current work activities with details.

Map
Provides a display of assets and their health status to visualization and issue severity, also allows spatial filtering.

Asset Explorer
Provides a list of assets, as well as their attributes. It also enables you to set filters.

Key Figures

Insight Providers

Asset View
Asset Hierarchy
Insight Provider Catalog
Insight Providers

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## SAP Predictive Maintenance and Service

### Asset Health Fact Sheet

#### Equipment View

**Serial #12345**

#### Asset Health Control Center

<table>
<thead>
<tr>
<th>Asset Name</th>
<th>Serial Number</th>
<th>Installation Year</th>
<th>Make/Model</th>
<th>Year</th>
<th>Flow</th>
<th>Spared</th>
<th>Health Score</th>
<th>Health Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump-00054</td>
<td>SN-053259</td>
<td>2010</td>
<td>Pump Ltd.</td>
<td>200 Series</td>
<td>500</td>
<td>No</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Pump-00303</td>
<td>SN-023847</td>
<td>2011</td>
<td>ACME Pump</td>
<td>Prime Model</td>
<td>400</td>
<td>Yes</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Pump-00224</td>
<td>SN-090637</td>
<td>2010</td>
<td>Rotator SE</td>
<td>Model 35</td>
<td>300</td>
<td>No</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>Pump-00347</td>
<td>SN-080553</td>
<td>2012</td>
<td>ACME Pump</td>
<td>HAT</td>
<td>800</td>
<td>Yes</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td>Pump-00618</td>
<td>SN-081416</td>
<td>2016</td>
<td>Pump Ltd.</td>
<td>700 Series</td>
<td>700</td>
<td>Yes</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Pump-00488</td>
<td>SN-088521</td>
<td>2014</td>
<td>ACME Pump</td>
<td>HAT</td>
<td>200</td>
<td>Yes</td>
<td>51</td>
<td></td>
</tr>
</tbody>
</table>

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SAP Predictive Maintenance and Service
Asset Health Fact Sheet

Equipment View

Asset Health Control Center

Insight Provider Catalog

Serial #12345
SAP Predictive Maintenance and Service
Asset Health Fact Sheet

Insight Provider Catalog

- **Derived Signals**
  - Provides a list of the current derived signals with various columns such as sensor data, events, and derived signals.

- **Components**
  - Provides a hierarchical list of components of an asset, along with their attributes.

- **2D Chart**
  - Provides data visualization across one or more measurements.

- **Map**
  - Provides a display of assets and their health status, along with their attributes. It also allows spatial filtering.

- **3D Chart**
  - Provides a three-dimensional data visualization across assets and time, and the ability to control derived signals.

- **Key Figures**
  - Key figures provide critical metrics.

- **Work Activities**
  - Provides a list of current work activities with details.

- **Asset Explorer**
  - Provides a list of assets, along with their attributes. It also enables you to set filters.
SAP Predictive Maintenance and Service
Asset Health Fact Sheet

Insight Provider Catalog

- Derived Signals
  Provides a list of the derived signals that are used to calculate the health score for an asset.

- Components
  Provides a hierarchical list of components of an asset, along with their attributes.

- Work Activities
  Provides a list of current work activities with details.

- 2D Chart
  Provides data visualization across one or more measurements.

- Map
  Provides a display of assets and their health status, including isolation and issue severity. Also allows quick selection.

- Asset Explorer
  Provides a list of assets, as well as their attributes. It also enables quick filtering.

- 3D Chart
  Provides a visual data visualization across assets and time, allowing the ability to control derived signals.

- Key Figures
  Key Figures

Insight Providers

<table>
<thead>
<tr>
<th>ID</th>
<th>Description</th>
<th>Health Score</th>
<th>Health Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump-00554</td>
<td>Centrifugal Pump</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Pump-00554-SP</td>
<td>Baseplate</td>
<td>91</td>
<td></td>
</tr>
<tr>
<td>Pump-00554-CS</td>
<td>Casing</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>Pump-00554-OT</td>
<td>Drivetrain Dry End</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Pump-00554-OT-BR</td>
<td>Bearings</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Pump-00554-OT-C</td>
<td>Coupling</td>
<td>94</td>
<td></td>
</tr>
<tr>
<td>Pump-00554-OT-CR</td>
<td>Controller</td>
<td>78</td>
<td></td>
</tr>
<tr>
<td>Pump-00554-OT-D</td>
<td>Driver</td>
<td>87</td>
<td></td>
</tr>
<tr>
<td>Pump-00554-OT-D6</td>
<td>Drive shaft</td>
<td>89</td>
<td></td>
</tr>
<tr>
<td>Pump-00554-OT-G8</td>
<td>Gearbox</td>
<td>88</td>
<td></td>
</tr>
<tr>
<td>Pump-00554-PND</td>
<td>Foundation</td>
<td>89</td>
<td></td>
</tr>
<tr>
<td>Pump-00554-HV</td>
<td>Hydraulics Wet End</td>
<td>45</td>
<td></td>
</tr>
</tbody>
</table>

Equipment View  Asset Health Control Center  Insight Provider Catalog  Insight Providers
SAP Predictive Maintenance and Service
Asset Health Fact Sheet

Insight Provider Catalog

- **Derived Signals**
  - Provides a list of the current derived signals grouped by signal type.

- **2D Chart**
  - Provides data visualization across one or more measurements.

- **Components**
  - Provides a hierarchical list of components of an asset, along with their attributes.

- **Map**
  - Provides a display of assets and their health status by geolocation and issue severity, also allows spatial filtering.

- **Asset Explorer**
  - Provides a list of assets, as well as their attributes, and allows you to set filters.

- **3D Chart**
  - Provides senior data visualization across assets and time, and the ability to control derived signals.

- **Key Figures**
  - Key Figures

Insight Providers

- **Equipment View**
- **Asset Health Control Center**
- **Insight Provider Catalog**
- **Insight Providers**

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SAP Predictive Maintenance and Service
Asset Health Fact Sheet

Insight Provider Catalog

- **Derived Signals**
  - Provides a list of the current derived signals from various sensors, along with their attributes.

- **2D Chart**
  - Provides data visualization across one or more measurements.

- **Work Activities**
  - Provides a list of current work activities with details.

- **Components**
  - Provides a hierarchical list of components of an asset, along with their attributes.

- **Map**
  - Provides a display of assets and their health status, generation and issue severity, and allows spatial selection.

- **Asset Explorer**
  - Provides a list of assets, as well as their attributes, and allows you to set filters.

- **3D Chart**
  - Provides advanced data visualization across time and space, and the ability to control derived signals.

- **Key Figures**
  - Key figures for the asset's performance.

---

Insight Providers

- **3D Chart**
  - Visualizes data across time and space.

- **Selected Assets**
  - Allows selection of specific assets for analysis.

- **Unit of Measure**
  - Selects the unit of measurement for the data.

- **Current Aggregation Level**
  - Sets the level of data aggregation.

- **Sensor ID**
  - Identifies the sensor or equipment being monitored.

---

Equipment View  Asset Health Control Center  Insight Provider Catalog  Insight Providers
SAP Predictive Maintenance and Service
Asset Health Fact Sheet

Insight Provider Catalog

- Derived Signals
  Provides a list of the current derived signals that are used to visualize the health status of an asset.

- 2D Chart
  Provides a display of assets and their health status in a two-dimensional view.

- Components
  Provides a hierarchical list of components of an asset, along with their attributes.

- Map
  Provides a display of assets and their health status in a two-dimensional view.

- Asset Explorer
  Provides a list of assets, as well as their attributes. It also enables you to set filters.

- 3D Chart
  Provides a three-dimensional visualization of assets' health status.

- Key Figures
  Displays key figures related to an asset's health status.

Insight Providers

<table>
<thead>
<tr>
<th>Work Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work Activity ID</td>
</tr>
<tr>
<td>WIA-00697</td>
</tr>
<tr>
<td>WIA-00729</td>
</tr>
<tr>
<td>WIA-00809</td>
</tr>
<tr>
<td>WIA-00941</td>
</tr>
</tbody>
</table>

Equipment View

Asset Health Control Center

Insight Provider Catalog

Insight Providers
Benefits Across the Maintenance Program

**SAP Predictive Maintenance and Service**

- Overview
- Asset Visualization
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  - Asset Health Fact Sheet
- Machine Learning Engine

Customers

Roadmap
SAP Predictive Maintenance and Service

Machine learning challenges

**High dimensional data**
- Feature construction/selection requires data scientists & domain user collaboration

**No labeled failure data**
- Anomaly detection and reinforcement through user feedback

**Rare failure events**
- Failure prediction using ensemble learning

**Outdated models, human scale**
- Model management, continuous learning and scoring

**Use case specific algorithms**
- Extensibility and integration of new algorithms
SAP Predictive Maintenance and Service
Machine Learning Engine

- Logistics & Maintenance Execution Systems
- Asset Health Control Center
- Asset Health Fact Sheet
- Insight Provider Catalog
- Machine Learning Engine
- SAP Leonardo Foundation
  - SAP Leonardo for Edge Computing

Machine Data
Business Data

SAP Predictive Maintenance and Service

Failure Prediction
Learning the correlations among features which lead to known failures

Reinforcement*

Anomaly Detection
Learning the “normal state” so we can watch for unanticipated failures

New Algorithms

Continuous improvement/learning

*PdMS roadmap Item
SAP Predictive Maintenance and Service
Machine Learning Engine

- Supervised learning enables failure predictions like Remaining Useful Life
- Finds contributing factors to failure events

- Expert feedback
- Models change as operational environment changes

- Unsupervised learning detects anomalies
- Enables health scores

- Extensibility for out-of-the-box algorithms
- Possibilities to deploy new R based algorithms

Failure Prediction
Learning the correlations among features which lead to known failures

Reinforcement*

Anomaly Detection
Learning the “normal state” so we can watch for unanticipated failures

New Algorithms

Continuous improvement/learning

**PdMS Roadmap Item
SAP Predictive Maintenance and Service
Machine Learning Engine - Model management

- Machine learning models are automatically applied to new incoming data
- Models are regularly re-trained using scheduling capabilities
- Model management capabilities allows us to maintain model versions
Benefits Across the Maintenance Program

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Customers

Roadmap
SAP Predictive Maintenance and Service
The synthesis of over 20 customer projects over 4 years
Customer example
Compressor manufacturer

Company
- Provider of compressed air systems and compressed air consulting services
- Changed their business model from selling compressors to selling compressed air… “Sigma Air Utility”
- Moved customers from CAPEX to OPEX

Solution
- Compressors equipped with sensors
- SAP Predictive Maintenance & Service On-Premise Edition
- SAP HANA
- SAP CRM Service

Process Innovation

Benefits
- IoT as an enabler for the new business model
- Improved availability of compressor stations
- Move from unplanned to planned maintenance
**Customer example**

**Industrial equipment manufacturer**

**Company**
- Leading manufacturer of separators and decanters for industrial usage
- New service offering which monitors equipment during the operation to ensure service contract compliance

**Solution**
- SAP HANA Cloud Platform
- SAP Predictive Maintenance & Service Cloud Edition
- SAP CRM Service

**Process Innovation**

**Benefits**
- Service execution based on real-time machine data
- Increased machine uptime
- Improved service contract compliance
- Higher service productivity and customer satisfaction

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# SAP Predictive Maintenance and Service

## Product roadmap – On-Premise Edition

<table>
<thead>
<tr>
<th>Release: PdMS 1.0</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PdMS, On-premise Edition</strong></td>
</tr>
<tr>
<td>• Monitor asset health</td>
</tr>
<tr>
<td>• Asset explorer, Geo-Spatial visualization, 2D &amp; 3D visualization, Key Figures, Work activity management, Derived signals management, Anomaly Detection, Distance-Based Failure Analysis, Remaining Useful Life Prediction</td>
</tr>
<tr>
<td>• Integration into SAP business processes via PM, S4/HANA Plant Maintenance and Multi-Resource Scheduling</td>
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<tr>
<td>• Advanced extensibility environment for customized and additional functionality, like new Insight Providers and Data Science algorithms</td>
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<tr>
<td>• Support for various connectivity scenarios, e.g. via PCo / MII, Telit, SAP HANA IoT Connector by OSIsoft</td>
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<tr>
<td>• Big Data Support for OT data with IT/OT integration</td>
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<tr>
<th>2017 – Planned innovations</th>
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<tbody>
<tr>
<td><strong>PdMS, On-premise Edition</strong></td>
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<tr>
<td>• Thing modeling tool to define assets and their component structure</td>
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<tr>
<td>• Self-service derived signal management with graphical tool support</td>
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<tr>
<td>• Machine Learning Engine supporting reinforcement and ensemble learning</td>
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<tr>
<td>• Integration with data visualization tools and algorithm editors</td>
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<tr>
<td>• Bad Actor Management based on health status and asset criticality</td>
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<tr>
<td>• Decision support through configurable Asset Health Factsheet with Health Score explanations and risk matrix</td>
</tr>
<tr>
<td>• Further Integrations into SAP’s Digital Core with S4/HANA, C4C, PM, AIN, APSM</td>
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<tr>
<td>• Industry-specific add-ons for Utilities and Oil &amp; Gas</td>
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<th>2018 – Product direction</th>
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<tr>
<td><strong>PdMS, On-premise Edition</strong></td>
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<tr>
<td>• Dynamic maintenance scheduling using constraint based optimization</td>
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<tr>
<td>• Fingerprint Similarity Analysis for Assets</td>
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<tr>
<td>• Library of ready-to-use machine learning content per asset type</td>
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<tr>
<td>• Automatic data pre-processing for machine learning</td>
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<tr>
<td>• Improved anomaly detection using Deep Learning techniques</td>
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<tr>
<td>• Support for Edge computing</td>
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<td>• Prescriptive maintenance</td>
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<th>2019 – Product vision</th>
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<tr>
<td><strong>PdMS, On-premise Edition</strong></td>
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<tr>
<td>• Coverage of complete asset lifecycle</td>
</tr>
<tr>
<td>• Asset Investment Optimization and Simulation</td>
</tr>
<tr>
<td>• Ubiquitous computing – decentralized thick clients on sensor devices to autonomously monitor, analyze, predict conditions and trigger actions – orchestrated by users from any place, by any device at any time.</td>
</tr>
</tbody>
</table>

**Emerging Issues Detection**

- Additional analytical and data science insight providers for warranty claim and root cause analysis
- Deeper integration with SAP ERP, S4HANA, CRM and C4C

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This is the current state of planning and may be changed by SAP at any time.
SAP Predictive Maintenance and Service
Product roadmap – Cloud Edition

Recent innovations

Predictive Maintenance and Service, cloud edition
- Monitor asset condition
- Asset explorer, Geo-Spatial visualization, 2D visualization, Key Figures, Work activities, Vibration analysis, Model and configure devices, Device onboarding, Email notifications, Rules framework
- Integration into SAP business processes via SAP HANA Cloud Platform, integration service, such as PM or C4C
- Big Data Support for OT data with IT/OT integration

Planned Q1/2017

Predictive Maintenance and Service, cloud edition
No feature delivery

Planned Q2/2017

Predictive Maintenance and Service, cloud edition
- Bad Actor Management for all monitored assets with drill down to component level
- Decision support through configurable Asset Health Factsheet with Health Score explanations
- Machine Learning Engine supporting reinforcement and ensemble learning
- Additional out-of-the-box machine learning algorithms for anomaly detection
- Extensibility of Machine Learning Engine through custom algorithms
- Flexible customization through configuration variants

Planned Q3/2017

Predictive Maintenance and Service, cloud edition
- Self-service derived signal management including KPIs, alerts and machine-learning health scores
- Configuration of scheduled derived signal computation per component
- Advanced extensibility environment for customized and additional functionality, like new Insight Providers
- Risk Matrix and asset criticality via integration with Asset Performance and Strategy Management

Emerging Issue Detection
- Management of Explorations
- History support

Delivery: PdMS FP06

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This is the current state of planning and may be changed by SAP at any time.
Thank you.

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SAP Predictive Maintenance and Service

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Operational Data Ingestion with SAP
Integration with SAP MII and PCo

- Safety Control
- DCS PLC/SCADA
- Devices
- Advance Control
- Plant Databases
- Manual Data
- Offline files

Data Historians

Real Time

e.g. OPC

SAP MII
SAP PCo

On-demand,
Near Realtime

SAP Data
Services

Batch

SAP Predictive
Maintenance and Service

MII = Manufacturing Intelligence and Integration
PCo = Plant Connectivity
SAP HANA IoT Connector by OSIsoft
Enable real time IT/OT convergence

Safety Control
DCS PLC/SCADA
Devices
Advance Control
Plant Databases
Manual Data

OSIsoft PI System

SAP HANA IoT Connector by OSIsoft

Real Time
On-Demand
Scheduled, near Real-Time

SAP Predictive Maintenance and Service
SAP Device Management for IoT by Telit
Flexible device integration

Device Integration

- MQTT/TR50 API
- Modules
- Asset Gateway
- Hosted Gateway
- LPWA Clouds

Management Platform

- 'Hosted' Asset Gateway (optional)

- Device Management
- Security
- Administration
- Data-at-Rest
- Data-in-Transit
- Flexible Data Model
- Multi Tenant
- Triggers
- Email/SMS Alerts

Predictive Maintenance and Service

- Enterprise Gateway
- SAP Predictive Maintenance and Service