SAP Industry 4.Now Technologies
Ansaldo Energia’s predictive maintenance - learn how the company implemented SAP IoT and Edge Services in their lighthouse plant for European Industry 4.0

Giorgio Murroni, Senior Product Manager SAP IoT and SAP Edge Services
October 29th, 2020
Agenda

- Enabling Industry4.Now
- SAP IoT and SAP Edge Services
- Customer Success: Ansaldo Energia
- Summary
- Appendix
Market Drivers and Dynamics
IoT technology as key enablers for Industry 4.0 business scenarios

Business Performance
- Increase Productivity
- New Revenue Streams
- Reduce Manual Tasks and Onsite Work

Customer Experience
- Individualized Products & Services
- Pro-active Decision Making
- Worker Safety

Efficiency
- Increase Productivity
- Real-time Transparency
- Remote Service

Technology Enablers
- Cloud Computing
- Internet of Things
- Edge computing
- Industrial Big Data Management
- 5G Cellular Networks
Business Architecture for Industry 4.0 - Enabling Technologies Overview
Connect your entire company
IoT technology as key enablers for SAP Industry 4.0

The Intelligent Enterprise

IoT enabling Intelligent Products for
- Product-as-a-service
- Remote monitoring and service
- Consumption insights and design optimization

IoT enabling Intelligent Factories for
- Intelligent data driven quality control
- IoT enabled Kanban
- Lot size of one

IoT enabling Intelligent Assets for
- Easy equipment onboarding incl. connectivity
- Remote monitoring and service
- Sensor driven replenishment of consumables
- Delivery insights for procurement and sales

IoT enabling Empowered People for
- Decision support to manage exceptions in near real-time
- Worker safety
### SAP IoT - Embedded Intelligence

Enable the **Transformation** of IoT Sensor Data into **Business Outcomes** in SAP Industry 4.0 Now Applications

<table>
<thead>
<tr>
<th>Example</th>
<th>Raw Sensor Data</th>
<th>Business Context</th>
<th>Transformation</th>
<th>Business Insight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replenishment Optimization</td>
<td>Silo/Container empty Space Distance</td>
<td>• Material ID</td>
<td>Calculate Material Volume over Time</td>
<td>Consumption Rate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Plant &amp; Storage Location</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Predictive Maintenance</td>
<td>Temperature, Pressure, Vibration, Current, etc.</td>
<td>• Asset Master Data</td>
<td><strong>Compute Health Score KPIs based on Predictive Models</strong></td>
<td>Maintenance Service</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Business Partner</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delivery Insights</td>
<td>Temperature, Humidity, Vibration, etc.</td>
<td>• Material Master Data</td>
<td>Minimum Temperature over tolerance time window</td>
<td>Damaged Delivery</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Handling Unit ID</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Sales Order</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Physical Asset**

- **Cloud & Device Connectivity**
- **Master Data Association**
- **Data Transformation**
- **Big Data Storage**
- **Data Analysis**

**SAP IoT data processing**
A smart factory is agile, adaptable, and efficient. Decisions can be taken real-time at the Edge.

### Example: Improved shop floor efficiency and transparency

<table>
<thead>
<tr>
<th>Raw Sensor Data</th>
<th>Business Context</th>
<th>Transformation</th>
<th>Business Insight</th>
</tr>
</thead>
</table>
| Mode of operations, output, energy consumption | • Production Order  
• Machine Master Data | Convert production input and output data into throughput, availability and quality | Calculation of Overall Equipment Efficiency |

### Example: Increased availability of shop floor

<table>
<thead>
<tr>
<th>Raw Sensor Data</th>
<th>Business Context</th>
<th>Transformation</th>
<th>Business Insight</th>
</tr>
</thead>
</table>
| Mode of operations, output, energy consumption | • System availability  
• Performance | Collect, analyse and action on data at the shop floor | Data integrity, reduced data gaps. |

### Example: Tailored stock levels

<table>
<thead>
<tr>
<th>Raw Sensor Data</th>
<th>Business Context</th>
<th>Transformation</th>
<th>Business Insight</th>
</tr>
</thead>
</table>
| Weight, fill level of raw material and semi-finished products – Kanban enablement | • Warehouse management  
• Material flow | Convert actual in stock quantities into stock requirements | Automatic trigger and calculation of tailored stock level |

### Example: Data driven quality control

<table>
<thead>
<tr>
<th>Raw Sensor Data</th>
<th>Business Context</th>
<th>Transformation</th>
<th>Business Insight</th>
</tr>
</thead>
</table>
| Quality measurement data | • Production order  
• Batch ID | Transform measurement data in quality results (accept / reject) | Non-conformance notification |
Agenda

• Enabling Industry4.Now

• SAP IoT and SAP Edge Services

• Customer Success: Ansaldo Energia

• Summary

• Appendix
SAP IoT – Main Services

SAP Business Apps extended with IoT

IoT embedded in SAP business applications

IoT enabled customer apps

<table>
<thead>
<tr>
<th>Event Services</th>
<th>Streaming Rules, Batch Rules</th>
<th>Actions, Integration</th>
<th>Decision Support Services</th>
<th>Analytics Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lifecycle Management</td>
<td>Time Series Management</td>
<td>Master Data &amp; Semantics</td>
<td>Derive &amp; Transform Data</td>
<td>Geo Services</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Digital Twin Foundation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data Ingestion &amp; Big Data Storage</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Onboarding &amp; Device Management</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SAP Edge Services
SAP Edge Services – Value Proposition

Bring the Intelligent Enterprise to the Edge with SAP Edge Services

<table>
<thead>
<tr>
<th>Challenges</th>
<th>SAP Edge Services</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of Business Context</td>
<td>Essential Business Functions</td>
<td>Business Integration</td>
</tr>
<tr>
<td>Latent Response</td>
<td>Configurable Edge Streaming</td>
<td>Real-time Decisions</td>
</tr>
<tr>
<td>Intermittent Connectivity</td>
<td>Automated Data Throttling</td>
<td>Increased Worker Productivity</td>
</tr>
<tr>
<td>Costly Communication</td>
<td>Local Persistency</td>
<td>Reduced Downtime</td>
</tr>
<tr>
<td>Lack of Local Intelligence</td>
<td>Cloud Managed Microservices</td>
<td>Cost Savings</td>
</tr>
<tr>
<td>Siloed IoT Endpoints</td>
<td></td>
<td>Efficient Mass Scale Management</td>
</tr>
</tbody>
</table>

75% of enterprise-generated data will be created and processed outside a traditional centralized data center or cloud by 2025¹

Source: Gartner 2018: What Edge Computing Means for Infrastructure and Operations Leaders

¹ Source: Gartner 2018: What Edge Computing Means for Infrastructure and Operations Leaders
SAP Edge Services
Brings together local compute, persistency, and business transactions at the edge

SAP Edge Services enables powerful microservices to be deployed at the edge but orchestrated from the cloud to extend the processing power of the cloud to the edge

- **Policy Service**
  Orchestration & lifecycle management of edge services from the cloud

- **Essential Business Functions Service**
  Provides business context (data and processes) at the edge

- **Streaming Service**
  Analyze IoT data streams in real-time based on business logic

- **Persistence Service**
  Locally store IoT data on IoT gateways

- **Custom Edge Services, e.g. Predictive Analytics**
  Deploy, execute, and integrate with business processes
Agenda

- Enabling Industry4.Now
- SAP IoT and SAP Edge Services
- Customer Success: Ansaldo Energia
- Summary
- Appendix
Ansaldo Energia S.p.A. - An International Utilities Company
SAP IoT and Edge Services support comprehensive Industry 4.0 strategy

First implemented in their lighthouse plant for European Industry 4.0, Ansaldo gathers and analyzes equipment data to provide the basis for Predictive Maintenance & Service (PdMS), and facilitate faster, more efficient processes.

- Interfacing and acquiring data from plant equipment such as milling machines, e.g. component rotation, axis rotation
- SAP Edge Services: analytical pre-processing for local alerts and throttling, e.g. sending only measurements out of predefined range
- SAP IoT: storage, normalization and validation of data not processed directly at the edge
- Utilize Edge to process locally and run in locations with intermittent connectivity
- Create situational awareness on health and performance of plant equipment and field assets
- Enable root cause analysis on operating processes at the edge
- Reduce downtimes of productive machines and systems
- Improved quality and customer service
- New revenue stream through predictive asset service

Company Profile:
Industry: Utilities
Headquarter: Italy
Size: Large Enterprise
Solutions:
SAP IoT
SAP Edge Services
SAP PdMS
SAP S/4HANA

+1.3M Expected in service revenue over the next years
5-8% Cost reduction in equipment maintenance processes
IoT Use Case: Predictive Maintenance

New asset onboarded and connectivity established to send sensor data

Automated enablement of the digital twin and asset onboarding

Create asset model in Asset Central and trigger asset onboarding

SAP Predictive Maintenance and Service

Sensors and Receptacles

Sensors attached to asset collect data, e.g. temperature, pressure, vibration, current etc.

Compute asset health status based on predictive models from data aggregates

Manage time series data from sensors in big data store and create data aggregates

Generate maintenance work order in S/4HANA for assets with health status indicating a maintenance need

SAP IoT

SAP Predictive Maintenance and Service

Predictive Maintenance and Service
Extension: Predictive Anomaly Detection and Improved equipment performance

Scores coming from the PdMS analysis are re-ingested into SAP IoT as measures and rules are applied for validation.

PdMS: Algorithms are applied to ingested IoT data to determine quality analysis and optimization of the production line.

SAP IoT operational dashboard visualizing data from multiple machines, plants and products.

Enterprise

SAP Edge Services Streaming Service to analyze, filter and aggregate ingested sensor data at the edge in real time eg. watchdog, median, avg, outliers.

Extract information such as spindle acceleration, machine state eg. is metal being consumed?

Remote Products eg. Connected turbines; send data to SAP IoT for remote monitoring.

Manufacturing equipment monitored during production process eg. Milling machines.

1

2
Machine Health Status prediction

1. Central management of edge instance with Policy Service, persist and process data at the edge for improved latency and reduced traffic to the Cloud.


- Cloud Application
  - PdMS Equipment model created and machines onboarded (IoT sync)
  - PdMS Indicators created and predictive models applied to obtain score
  - PdMS validated Indicators showing machine health status

- SAP Cloud Platform
  - Operation Dashboard
    - Calculation and Validation of predictive insights. Custom Dashboard Creation

- SAP IoT
  - Thing Instance Storage and Rules
    - Thing model created and maintained
    - Scheduled Rules used to trigger Service integration

- Edge Services
  - Plant
    - IoT Gateway X
    - Machine data persisted and processed (filtering and aggregation)
  - Routine jobs define which is actual divergence and if in/out of accepted threshold

© 2019 SAP SE or an SAP affiliate company. All rights reserved. | PUBLIC
SAP Predictive Maintenance and Service in Ansaldo

Core Capabilities:

- A 360 Degree View of Assets
- Advanced Analytics for Decision Support
- Intuitive and Scalable Machine Learning
- E2E Process Integration
Machine Health Status prediction

1. Central management of edge instance with Policy Service, persist and process data at the edge for improved latency and reduced traffic to the Cloud.


Cloud Application
- Cloud Application
  - PdMS Equipment model created and machines onboarded (IoT sync)

SAP Cloud Platform
- SAP Cloud Platform
  - Thing model created and maintained

SAP IoT
- SAP IoT
  - Thing model created and maintained
- Thing Instance Storage and Rules
- Scheduled Rules used to trigger Service integration
- Operational Dashboard

Edge Services
- Edge Services
  - Machine data persisted and processed (filtering and aggregation)
- Plant
- IoT Gateway X
- PdMS Indicators created and predictive models applied to obtain score
- PdMS validated Indicators showing machine health status
- Routine jobs define which is actual divergence and if in/out of accepted threshold
- PdMS validated Indicators showing machine health status
- Operational Dashboard
Operational Dashboard

As showcased at MECSPE 2019
## Benefits and Outcomes

### Business Social
- Production process optimization through MES & IoT data integration.
- Premium support & maintenance services offered to customers.
- Improved plant equipment performance.
- Early warnings, time-to-fault & health indicators integrated with external service order management in the ERP (SAP S/4HANA).

### IT
- Multiple ERPs combined into one.
- Completely scalable cloud architecture capable of handling future volume increases of existing services.
- Plant equipment telemetry and alarm data collection.

### Human Empowerment
- Business process reengineering activities resulted in improved visibility of related KPIs.
- Simplified process management.
- User-friendly onboarding procedure through the Unified Control Center UI without needing specific skills.
- Easier and more efficient interventions/repairs for field technicians.
Customer Success: The Benefits of Industrial IoT in challenging times

Additional value for similar customers in new business reality with Covid-19

Utilities > Manufacturer > Chemicals > Consumer Goods > Oil & Gas

Customer Example

Ansaldo Energia

Index Werke

Sika

Zentis

Large US based Oil & Gas company

Real-time inventory efficiency and visibility despite home office work

Reduction in physical onsite observations

Remote asset / product diagnostic & monitoring despite mobility restrictions

Improved worker safety with reduction of maintenance costs

Real-time procurement transparency despite mobility restrictions

Reduction in physical onsite observations

24/7 visibility in material "health status" despite home office work

Real-time procurement transparency despite mobility restrictions

Remote and safe monitoring of production despite mobility restrictions

Increased inventory visibility despite mobility restrictions

Improved worker safety by reporting safety related incidents in real-time

Improved worker safety by reducing physical contact frequency and duration
Agenda

- Enabling Industry4.Now
- SAP IoT and SAP Edge Services
- Customer Success: Ansaldo Energia
- Summary
- Appendix
**Summary**

IoT in the Cloud and at the Edge is a key enabler for Industry 4.0: Intelligent Product, Intelligent Factory, Intelligent Asset, and Empowered People

SAP IoT offers embedded intelligence as part of business applications.

SAP IoT and Edge services enable customers to extend Industry 4.0 applications both in the cloud and at the edge.

SAP Edge Services provides low latency execution of essential business functionality at any location – even when offline.

SAP Edge Services turns the edge intelligent and orchestrates edge topologies at scale from the cloud.
Agenda

- Enabling Industry4.Now
- SAP IoT and SAP Edge Services
- Customer Success: Ansaldo Energia
- Summary
- Appendix
Ansaldo Energia: Powering Factories with Intelligent Technology to Improve Product Performance

Power generation leader Ansaldo Energia S.p.A. manages complex projects around the world. But suboptimal, siloed processes were limiting operational visibility making project planning and delivery more difficult. To address these issues, the company is rolling out SAP S/4HANA®. At the same time, it is enabling predictive asset service with SAP’s Business Technology Platform resulting in a dual digital transformation that will help Ansaldo streamline manufacturing and improve its offering.

→ Click anywhere for BTS
Call to Action: Join our New Partner Training for SAP IoT and Edge

Coming Soon: Bootcamp for SAP IoT and Edge
Covers end-to-end real-life business scenario in “fast forward” mode

Date and Location
November 2020 (date of 1 day session will be announced shortly)
Classroom and Virtual Live Classroom | Recurring every two months

Agenda IoT
- Setup of device and thing model
- Onboard devices
- Create rules
- Set up actions
- Extend use case with sample UI5 application
- Create analytical model for consumption in SAP Analytics Cloud

Agenda Edge
- Overview of Edge Services
- Scenarios and building blocks
- Configure streaming rules, aggregations and business actions
- Configure synchronization with ERP
- Deploy configurations from cloud to edge
- Configure, deploy and run a machine learning model as user defined function at the edge

Audience
- Application Consultant
- Business Process Architect
- Developer
- Developer Consultant
- Enterprise Architect
- Program / Project Manager
- Solution Architect
- System Architect
- Technology Consultant

Course based on
- Shared tenant for hands-on dev

Link
- Available via the SAP IoT & Edge Learning Journey
IoT Enablement and Support Resources for Partners

IoT Product Enablement Resources

- SAP Partner Edge
  - SAP IoT
  - SAP Edge Services

- SAP Learning Hub
  - SAP IoT and Edge Learning Room
  - SAP IoT and Edge Learning Journey

- IoT Technical Resources
  - IoT Cloud and Edge Roadmap
  - Tutorials, Community, Videos
  - Sample Code for Leonardo IoT
  - Replenishment Sample Code
  - What is new – Release Notes (IoT | Edge)

SAP Industry 4.0 Strategy Whitepaper

- SAP Industry 4.0 Strategy

Partner Enablement Resources

- SAP PartnerEdge Build
- SAP Cloud Platform Learning Room
- Getting Started@help.sap.com

Marketplace & Discovery

- SAP App Center
- SAP Discovery Center
- SAP API Business Hub
- SAP Developer Center
- Use Cases for Internet of Things
- Live FAQ – IoT Community
Service Overview - SAP IoT & Edge Services

**Cloud Applications**
- SAP Digital Manufacturing Cloud
- SAP Predictive Asset Insights
- SAP S/4HANA
- SAP ECC
- ...

**On-Premise Applications**
- SAP S/4HANA
- SAP ECC
- ...

**Analytics Cloud**

**IoT & Edge Services**
- Device & Edge Orchestration
- Business Context Integration
- Time Series Services
- Rules & Action Services
- Geo Services
- Cloud Provider Integration

- IoT connectivity
- Bring your own model
- Time series data ingestion
- Rules on streaming data
- Geo location
- Storage integration

- IoT Device management
- Device model mapping
- Time series data management
- Rules on persisted data
- Geo matching
- Time series stream integration

- Policy service
- Master & Transactional data
- Transformation & Derivation
- Actions
- Geo fencing

- Business object synchronization
- Business partner
- Segment service
- Analytics integration

**Cloud Providers**
- AWS
- Microsoft Azure
- ...

Cloud Foundry
- Logging
- Authentication
- Authorization
- Destination
- ...

SAP HANA | Cassandra | Managed Object Store | Redis | Kafka | Spark | ...

SAP Cloud Platform Foundation

Edge
- SAP Digital Supply Chain applications
- SAP Edge Services
- SAP Plant Connectivity

Edge

1 SAP Edge Component Installed on Edge Appliance
2 Select warm and cold storage
Thank you.

Contact information:

Giorgio Murrone
Senior Product Manager SAP IoT and SAP Edge Services
Mob: +39 340 1007676