Holistic Development of Industrial Big-Data Applications and Services

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Agenda

Introduction - Digitalization and Analytics for the Industry
Holistic Development Approach for Data-Driven Services
Example - FEE Project
Conclusion
Digital Services Build on all Layers of Automation Systems

- Open access, intelligent cloud
- New end-to-end digital solutions
- Closing the loop with connected devices

50 cloud-based services and advanced analytics

>6,000 solutions installed

>70,000 systems installed

>70,000,000 digitally enabled devices connected

>55% of ABB’s sales from software and digitally enabled devices
Application example: Marine

Customer’s situation
In Zujar Canal region of western Spain, farmers grow sweet corn, tomato, olive, rice and other fruits and vegetables. Many farmers had to drive up to 40 kilometers to irrigate their land. Due to the, many farmers chose to irrigate their crops during the day and lose water to evaporation, instead of irrigating at night when conditions are ideal.

ABB solution
Provide complete, single-source irrigation control system with IoT features:
- 7,900 remote terminal units (RTUs) control 10,700 sets of water valves and counters
- Powered by small solar panels, RTUs communicate with ABB SCAD control center
- Using a private and secure wide area network (WAN) system built on the GPRS network
- Enabling 8,5000 users to program and monitor the solution using mobile phone or browser
- Energy cost cut by 30 percent, output risen b 25 percent
- Cut 47 cubic hectometers p.a. corresponding to minimum water needs of 2.3 Mio people¹
All Things Digital: From Maintenance to Control

From physical to digital differentiation
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Introduction – Digitalization and Analytics for the Industry

**Holistic Development Approach for Data-Driven Services**

Example – FEE Project

Conclusion
The Analytics process at ABB
From Value Proposition to Continuous Value Delivery

1. Work with Customer to Identify Value Proposition
   - What are Customer’s pains and gains?
   - Can analyzing data help?
   - Leverage domain knowledge
   - From Value Proposition to specific analytics questions

2. Analysts Investigate Available Data
   - Explore available data
   - Plan data collection
   - Collect sample data
   - Explore data and formulate hypothesis
   - Clean & prepare the data

3. Analyst Implement Data Analytics Techniques
   - Develop analytics
   - Design based on analytics question and available data
   - Variety of approaches available
   - No cookbook for selecting the best approach

4. Deploy results for continuous application
   - Validate results on actual fleet
   - Develop best visualization with end user (service staff, customer)
   - Deploy approach on the ABB analytics architecture

Develop the right thing
Use the right data
Understand the methods
Make it repeatable
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Introduction – Digitalization and Analytics for the Industry
Holistic Development Approach for Data-Driven Services

Example - FEE Project

Conclusion
Objective: Support Functionality for Plant Operators
- Early Warnings
- Ad-hoc Analysis
- Decision Support

Approach: Integrated Analysis for all data sources in the plant
- Measurements, engineering, alarms & events, electronic shift books
Development Approach

1. Scenario Identification
2. Paper Prototypes
3. Analytics Concept & Requirements Elicitation
4. PoC Data Analytics
5. Refined Wireframes & Prototypes
6. Integration and Deployment

Development Partners:

ABB
May 25, 2017
| Slide 11
### Project Example FEE - Big Data for Operator Support

Scenario Canvas for Application Partner Workshops

<table>
<thead>
<tr>
<th>Title:</th>
<th>Project Example FEE – Big Data for Operator Support</th>
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<tr>
<td>Date:</td>
<td>May 25, 2017</td>
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<td>Slide:</td>
<td>12</td>
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#### Development Partners:

Development Partners:

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<thead>
<tr>
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<tbody>
<tr>
<td>FEE</td>
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<tr>
<td>rapidminer</td>
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<tr>
<td>TECHNISCHE UNIVERSITAT DRESDEN</td>
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<td>UNIKASSEL VERSITAT</td>
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<td>ABB</td>
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**Scenario Canvas**

<table>
<thead>
<tr>
<th>Online-Data</th>
<th>Actions</th>
<th>Info. Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Predictors</strong></td>
<td><strong>Avoid Situation</strong></td>
<td><strong>Means of support</strong></td>
</tr>
<tr>
<td>Can it be predicted?</td>
<td>Does a prediction help?</td>
<td>Access to domain knowledge</td>
</tr>
<tr>
<td>Can it be detected?</td>
<td>How to find in historic data?</td>
<td><strong>Historical data</strong></td>
</tr>
<tr>
<td>Does detection help?</td>
<td>How early is it needed?</td>
<td>Is there sufficient data</td>
</tr>
</tbody>
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| Consequence | |
|-------------| |
| Is a project worthwhile? | |

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**Access to Domain Knowledge**

- What happens if the situation is not dealt?
- What happens if the situation is wrongly handled?
Description of Application scenarios

**Current State:**

**Who:**
- Operator in the control room (and process engineers)

**What:**
- Monitoring of the plant in 'calm' situations

**How:**
- Browsing operator screens and trend display for suspicious signals
- Is only done in 'calm' situation without stress

**Problems:**
1. Risk to simply overlook a suspicious signal
2. Monitoring without broad coverage in stressful situations
3. Difficult for unexperienced operators to judge the 'suspiciousness' of signals

**Desired State:**

**FEE Support:**
Identify suspicious signals and providing relevant data for diagnosis

**Desire:**
1. Fast visual impression on abnormalities in the process
2. Put into context to historical 'normal' and 'abnormal' signal paths
3. Providing extended context (relevant alarms, operator notes, documents)
Continuously operated plant

High Data Volume: ~1000 measuring points with sampling rate of 1 minute over two years

Heterogeneous: Pressure, flows, levels, analyzer, temperatures, varying compression over time and different from time-series to time-series

Nonstationary: Frequent load changes

Data Selection:
- Data selection without expert knowledge: Elimination of redundant and constant time-series to 104 signals
- Data selection by expert knowledge: 13 signals (shown)

Visualization of calculated anomaly scores in a heat map
Project Example FEE - Big Data for Operator Support

Big Data Architecture for Anomaly detection in chemical plants

New data (e.g. via OPC) 

Apache Kafka 

Apache Spark Streaming 

Apache Hadoop HDFS 

Apache Spark Core 

Apache HBase 

Query 

Application Server
Operator Interface - Suspicious Signals (1)

Heat map:

- Shows the signals with highest anomaly score
- Given an impression of the last couple hours
- Supports selecting single signals for detailed analysis
Operator Interface – Suspicious Signals (2)

Normal Situation
(Historical Situation with low Anomaly Score)

Current Situation
Operator Interface – Suspicious Signals (3)

Current Situation

Similar historical Situation

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Operator Interface - Suspicious Signals (4)
Operator Interface – Suspicious Signals (5)

Current Situation

Similar historic situation
Operator Interface – Suspicious Signals (6)

Relevant Search Terms: ca2_x7853, ha3_f2847_2, rk7_f8140, xia, lochblende, p325, u3206, teilstromfilter, qv3105, ea1_f1035

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Conclusion
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