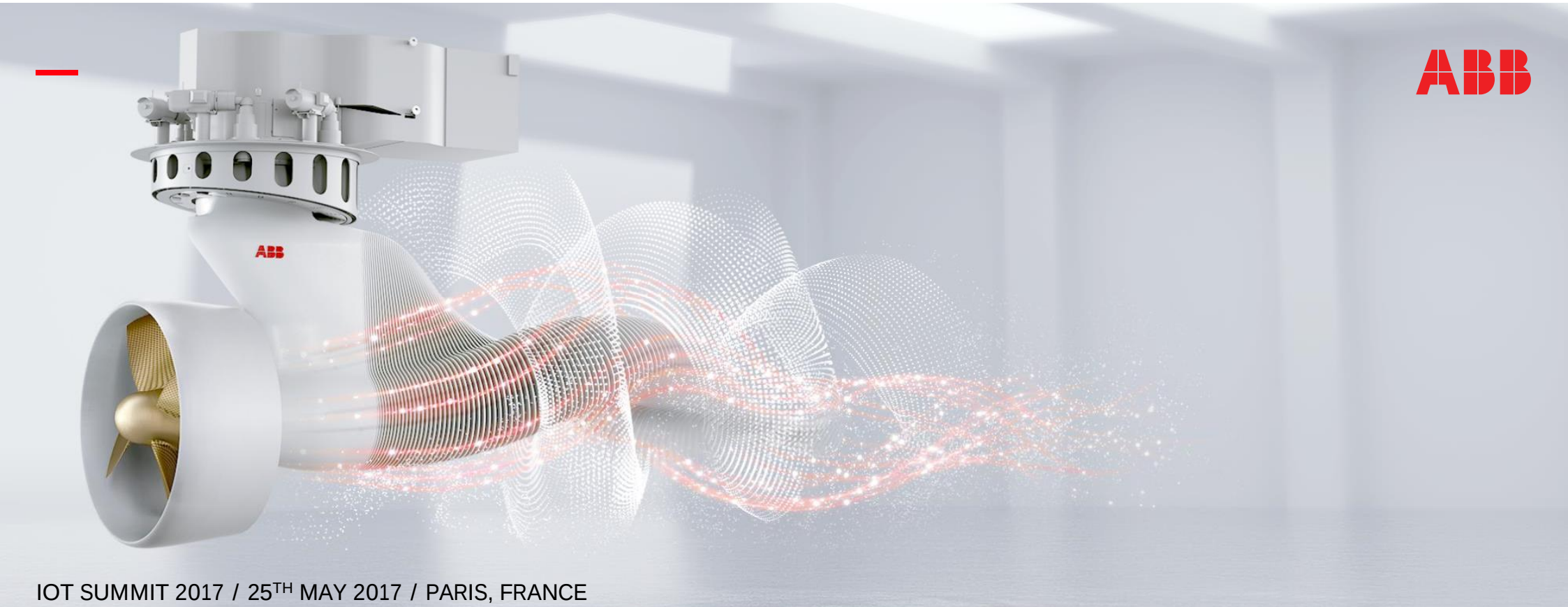


IOT SUMMIT 2017 / 25TH MAY 2017 / PARIS, FRANCE

Holistic Development of Industrial Big-Data Applications and Services

Dr. Benjamin Klöpper, Dr. Roland Weiss, ABB

Agenda

Introduction – Digitalization and Analytics for the Industry

Holistic Development Approach for Data-Driven Services

Example – FEE Project

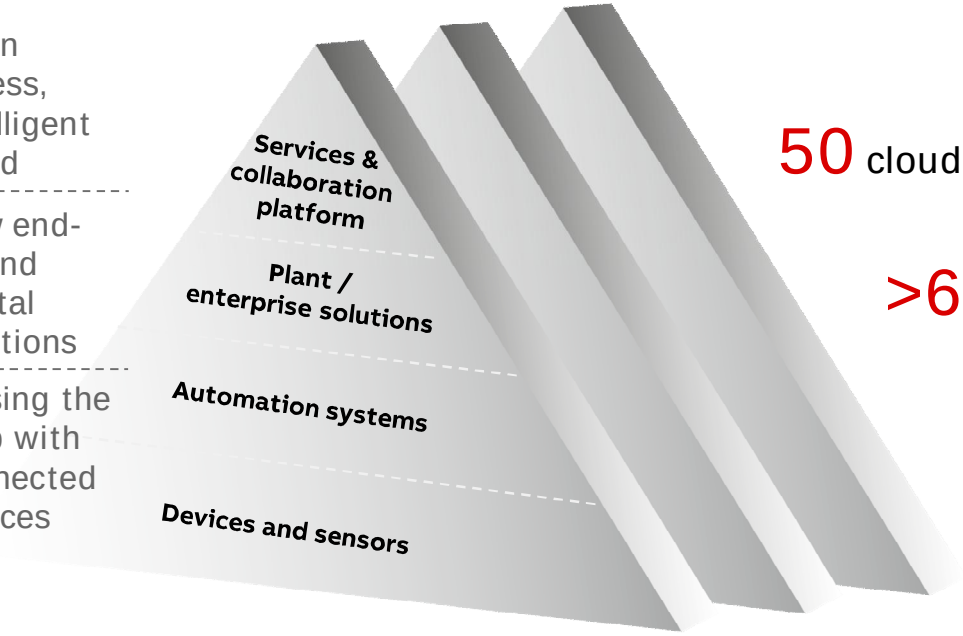
Conclusion

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.

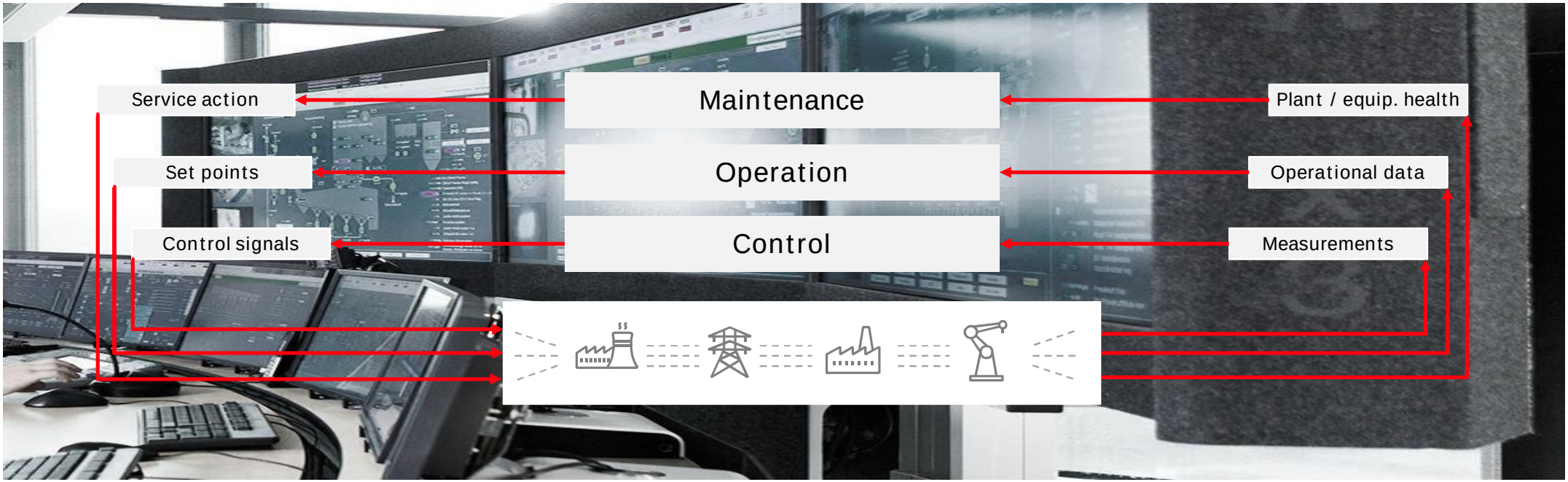
ABB solution

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 people[1]

[1] According to united nations statistics

All Things Digital: From Maintenance to Control



From physical to digital differentiation

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The Analytics process at ABB

From Value Proposition to Continuous Value Delivery

Work with Customer to Identify Value Proposition

1

What are Customer's pains and gains?

Can analyzing data help?

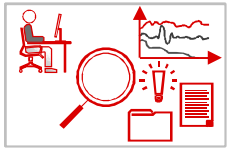
Leverage domain knowledge

From Value Proposition to specific analytics questions

Develop the right thing

Analysts Investigate Available Data

2



Explore available data

Plan data collection

Collect sample data

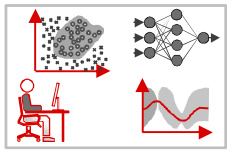
Explore data and formulate hypothesis

Clean & prepare the data

Use the right data

Analyst Implement Data Analytics Techniques

3



Develop analytics

Design based on analytics question and available data

Variety of approaches available

No cookbook for selecting the best approach

Understand the methods

Deploy results for continuous application

4

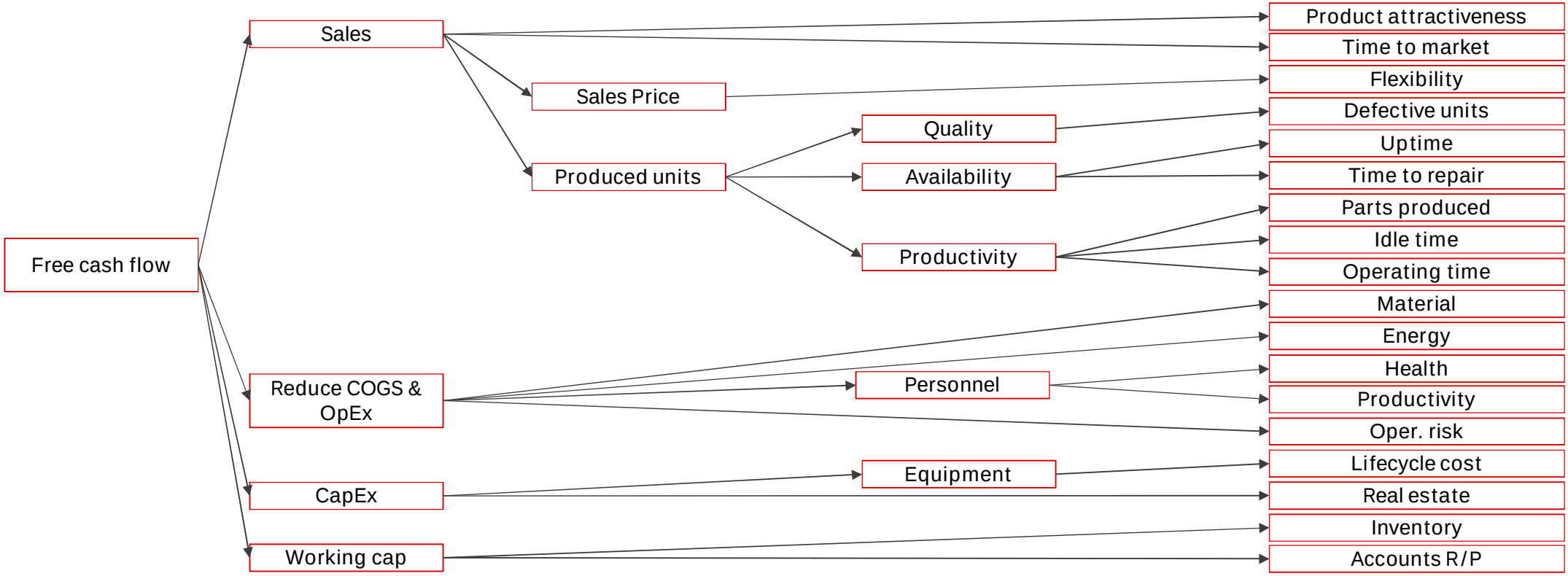
Validate results on actual fleet

Develop best visualization with end user (service staff, customer)

Deploy approach on the ABB analytics architecture

Make it repeatable

Value Driver Breakdown



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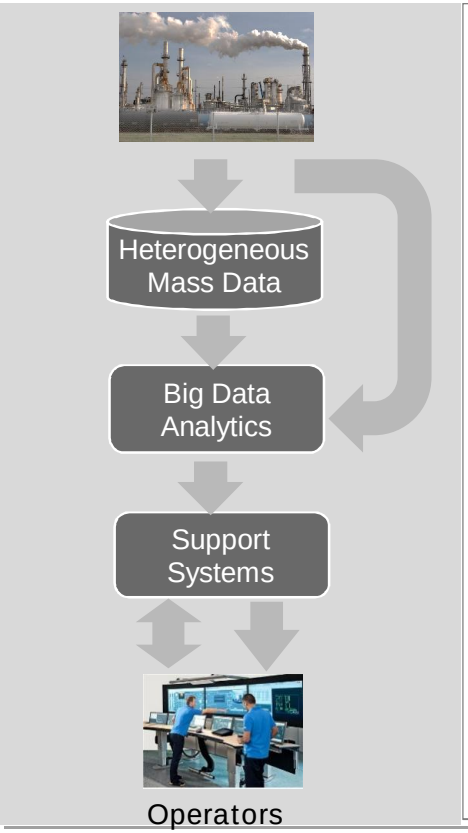
Project Example FEE – Big Data for Operator Support

Project Overview

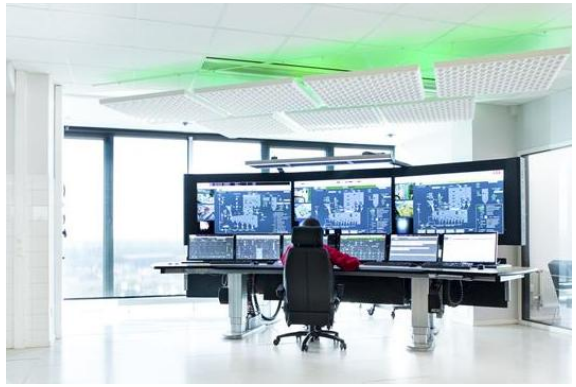


Objective: Support Functionality for Plant Operators

- Early Warnings
- Ad-hoc Analysis
- Decision Support

Approach: Integrated Analysis for all data sources in the plant

- Measurements, engineering, alarms & events, electronic shift books

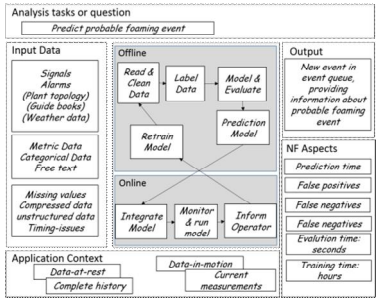


Project Example FEE – Big Data for Operator Support

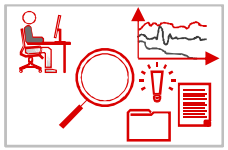
Development Approach

1. Scenario Identification

2. Paper Prototypes



3. Analytics Concept & Requirements Elicitation



4. PoC Data Analytics

5. Refined Wire frames & Prototypes

6. Integration und Deployment

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Project Example FEE – Big Data for Operator Support

Scenario Canvas for Application Partner Workshops

1

Title:
Plant:
Operation Mode (e.g. Start-up, Shut-down, Product Transition):

Situation

Role/ Actor:
Frequency:

Online-Data	*Actions*	*Info. Sources*
Predictors Can it be predicted?	**Avoid Situation** Does a prediction help? How early is it needed?	**Means of support** Access to domain knowledge
Indicators Can it be detected? How to find in historic data?	**Handle Situation** Does detection help?	**Historical data** Is there sufficient data Where is it recorded?

Consequ
Is a project worthwhile?
What happens, if the situation is not dealt?
What happens, if the situation is wrongly handled?

FEE Development Partners: rapidminer, Technische Universität Dresden, Universität Kassel, mrt, ABB

Project Example FEE – Big Data for Operator Support

Description of Application scenarios

1

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)

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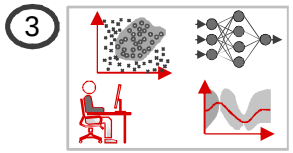
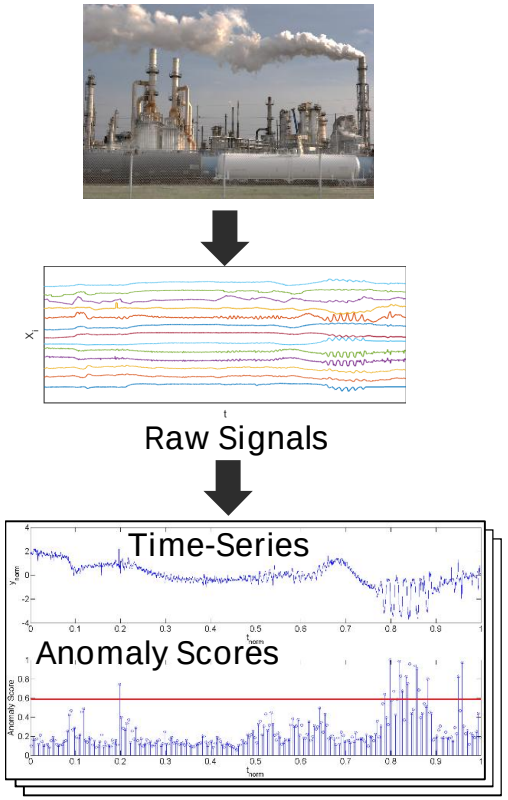
Project Example FEE – Big Data for Operator Support



- § Continuously operated plant
- § High Data Volume: ~1000 measuring points with sampling rate of 1 minutes 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)
- n Visualization of calculated anomaly scores in a heat map



User Heatmap

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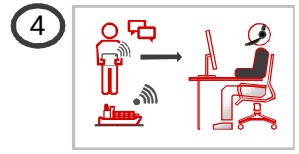
Project Example FEE – Big Data for Operator Support

Big Data Architecture for Anomaly detection in chemical plants

4



new data
(e.g. via OPC)

Apache Kafka

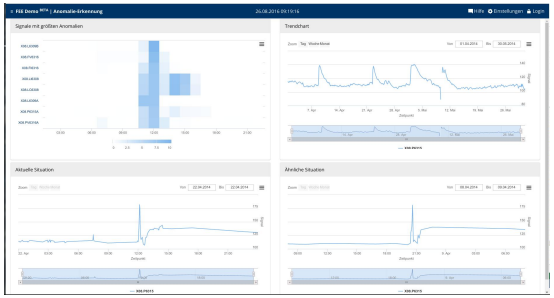
Apache Spark Streaming

Apache Hadoop HDFS

Apache Spark Core

Apache HBase

query



Application Server

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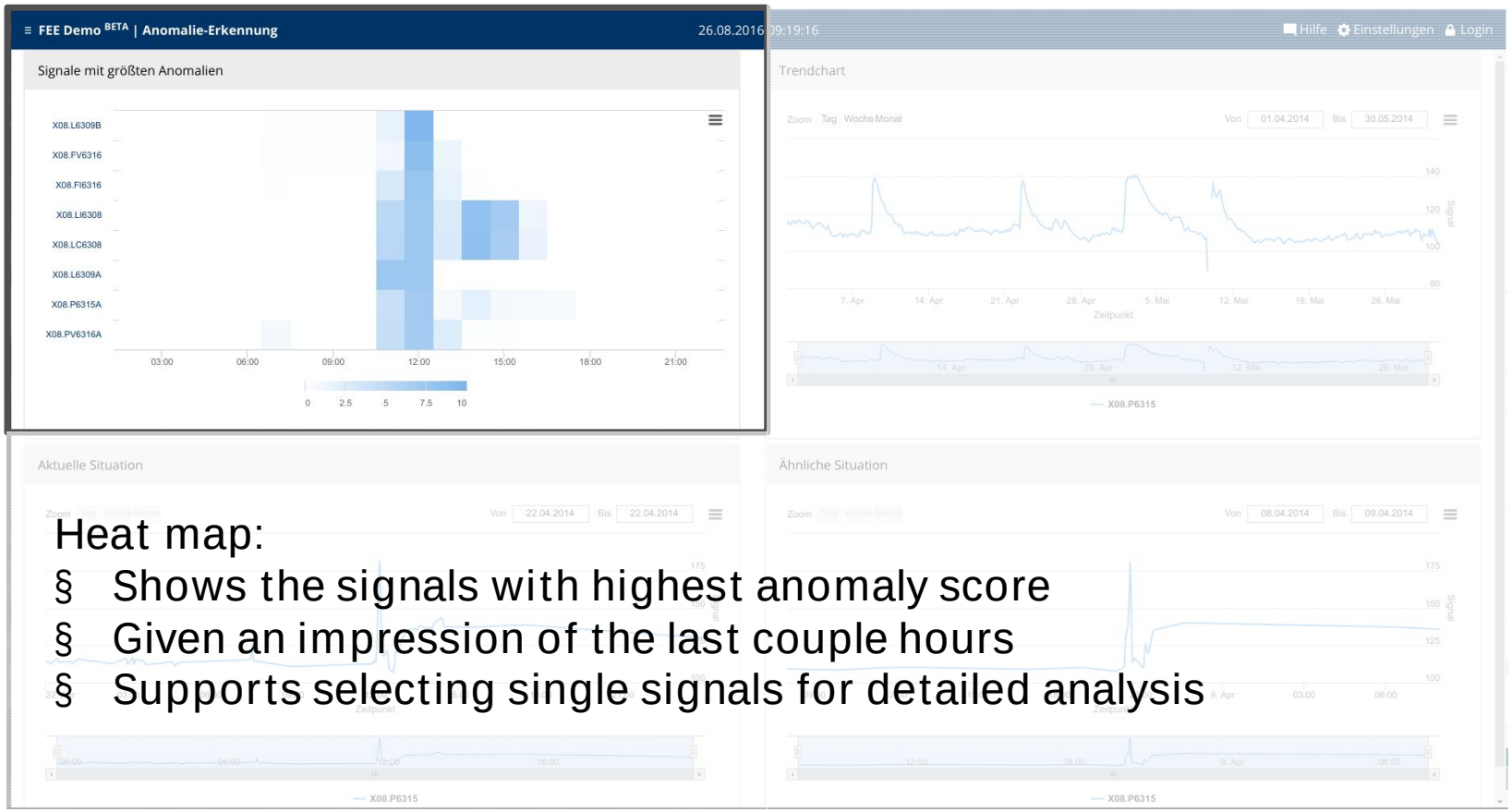
Operator Interface – Suspicous Signals (1)

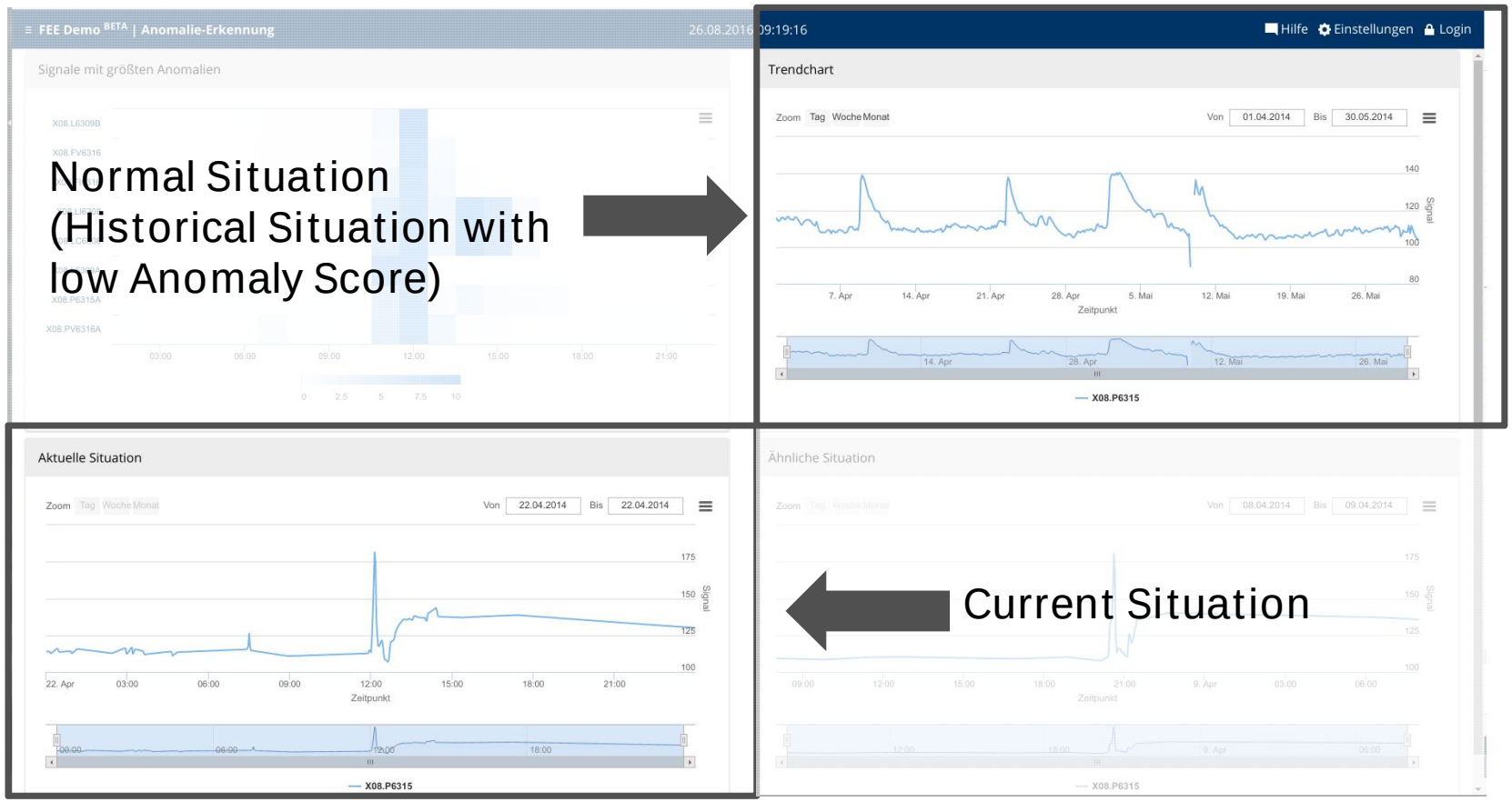


Heat map:

§ Shows the signals with highest anomaly score
§ Given an impression of the last couple hours
§ Supports selecting single signals for detailed analysis

Development Partners:

Operator Interface – Suspicous Signals (2)



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Operator Interface – Suspicous Signals (3)

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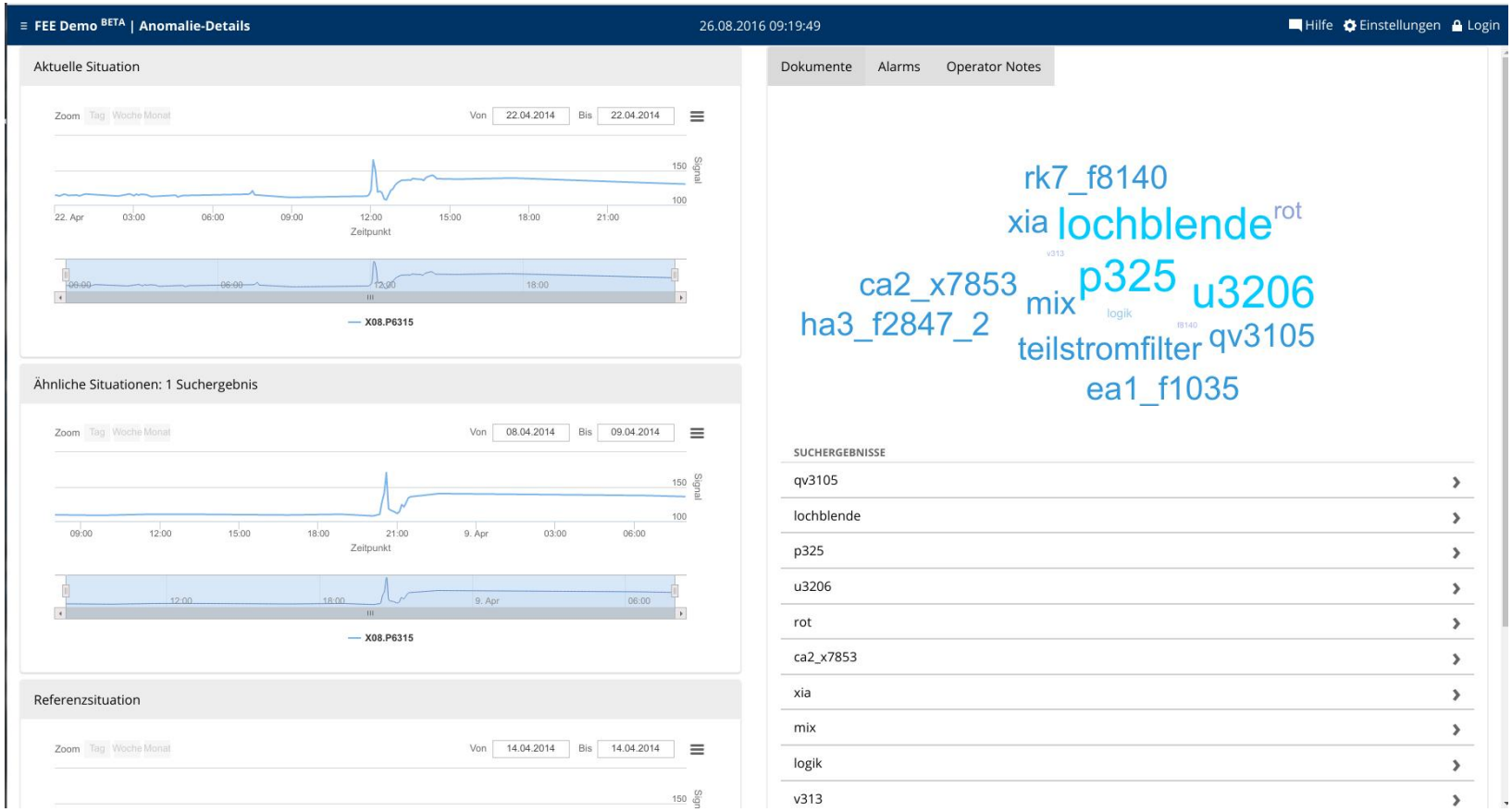
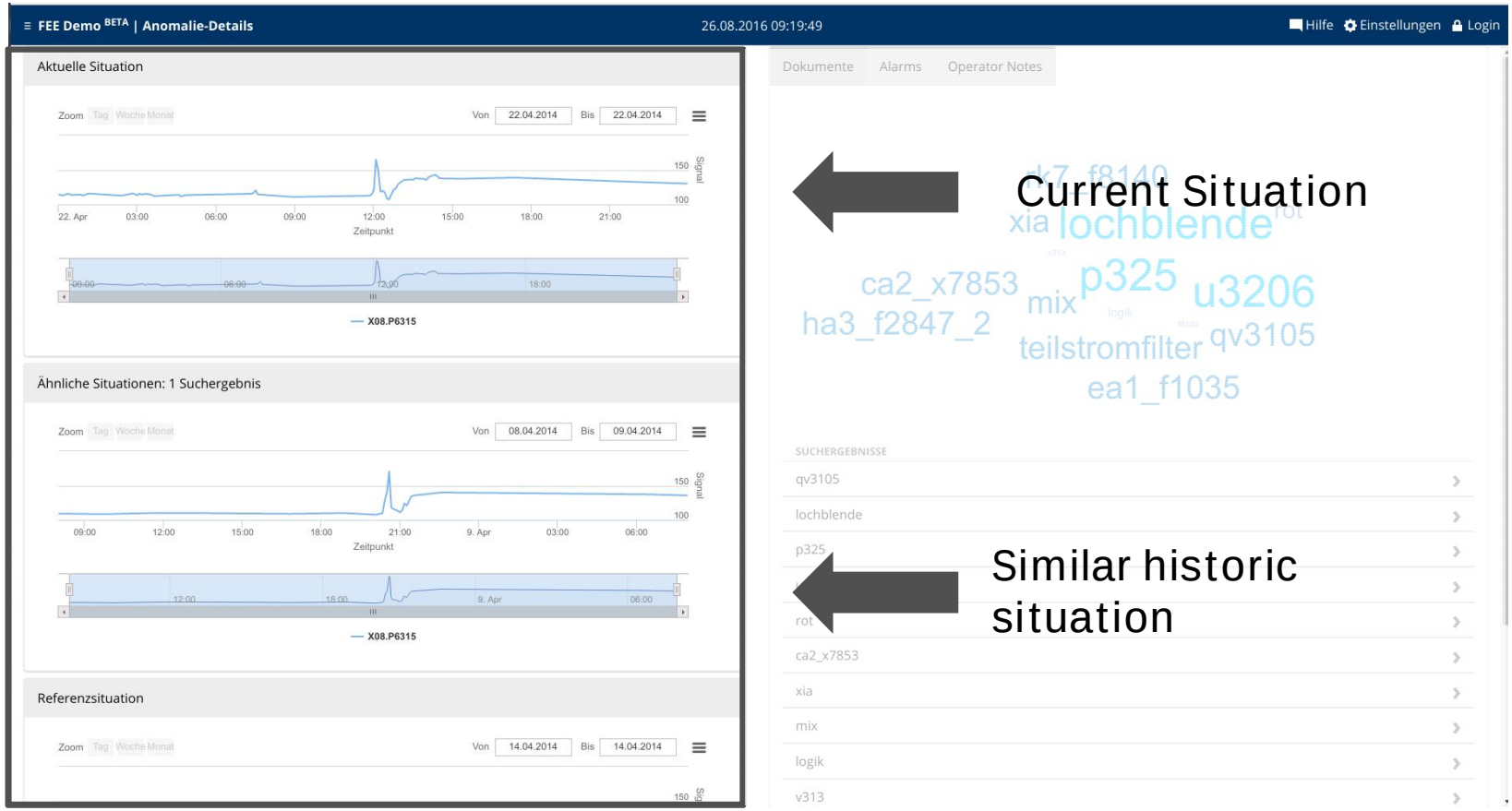
Operator Interface – Suspicous Signals (4)

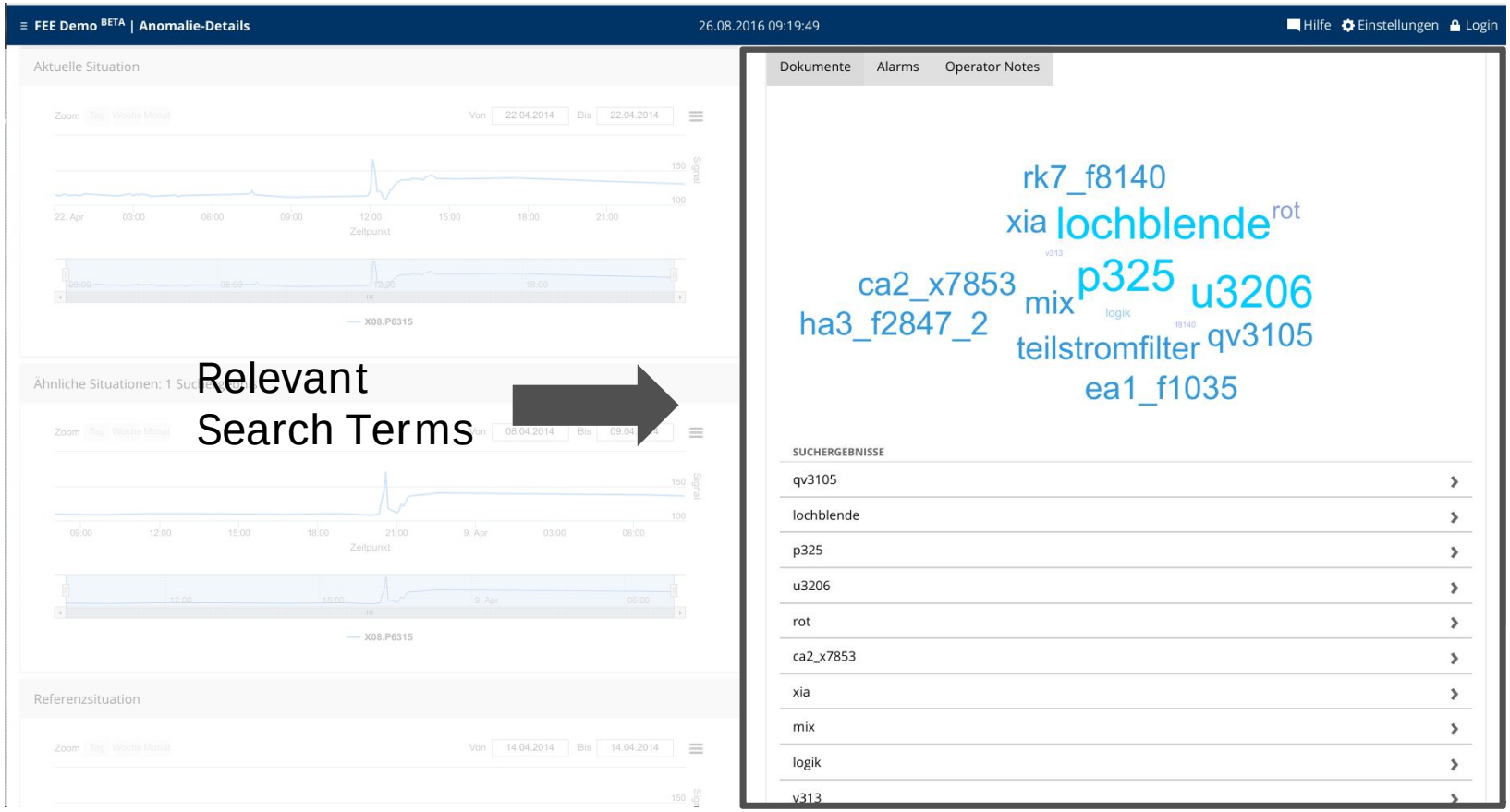


Operator Interface – Suspicous Signals (5)



Development Partners:

Operator Interface – Suspicous Signals (6)



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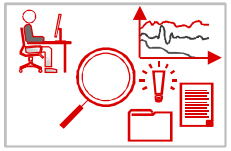
Conclusion

1

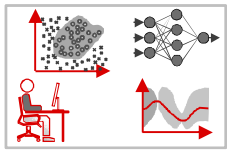
Develop the right thing

2



Use the right data

3



Understand the methods

4

Make it repeatable