Prediction of in-process quality

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Henkel

Agenda

Henkel at a glance 2017

Objective of Proof of Concept

Main tasks

Deliverables

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Henkel at a glance 2017

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Who we are
Henkel at a glance 2017

More than 53,000 employees worldwide from 120 nations

40% of our sales generated in emerging markets

More than €20 bn sales, +3.1% organic sales growth

188 manufacturing and 22 major R&D sites around the world

€3.5 bn adjusted[1] operating profit (EBIT)

More than 141 years of success

[1] Adjusted for one-time charges/gains and restructuring charges.

General information on Proof of Concept

Objective

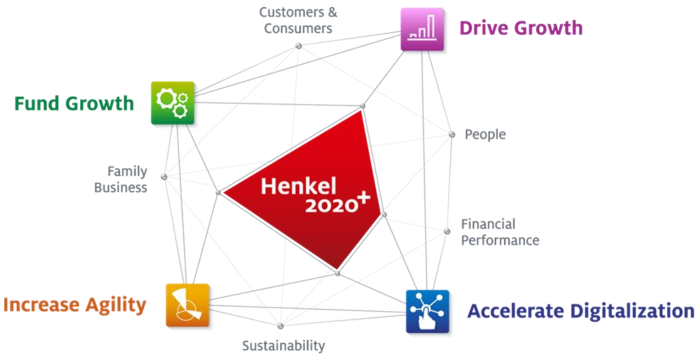
- Gain experience in connecting Automation layer to cloud (here OSIsoft PI)
- Gain experience in using machine learning methodologies (Big data, predictive analytics)
- Perform proof of concept on a real use case

Main Tasks

- Setup infrastructure and build architecture
- Investigate relevant data sources and validate data consistency
- Develop data model

Deliverables

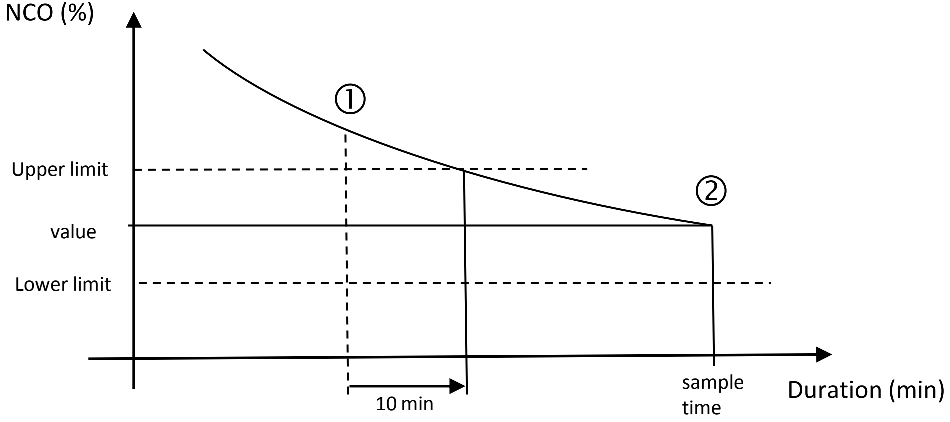
- Justification of PoC
- Outlook



➢ Red Carpet Incubation Program (RCIP) was the vehicle used for the PoC

Objective
Description & Targets

- The use case focus on one reaction phase (exothermic) within a multiphase production process
- In scope is one recipe
- The phase ends, when quality parameter (NCO) is in specification, measured by manual sampling



Target:

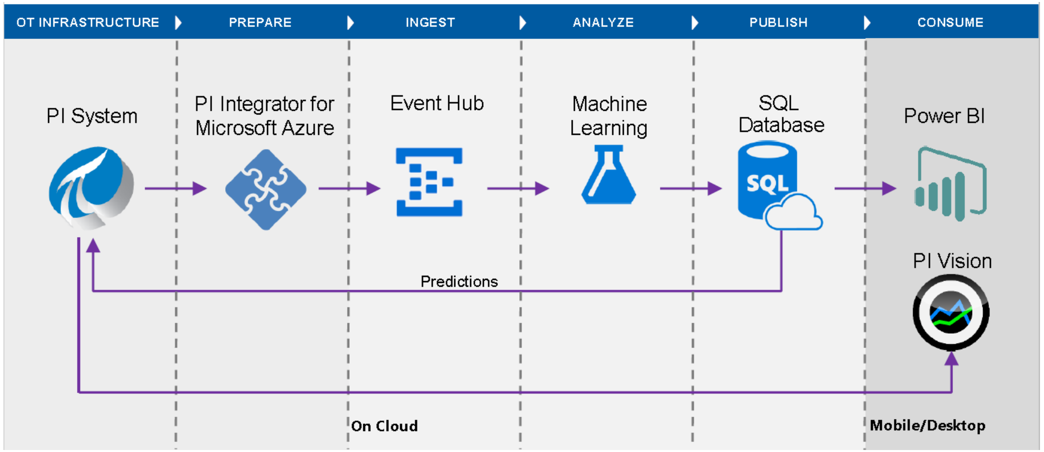
(1) Countdown to reach the upper limit of NCO

- Improved scheduling of sampling
- Efficiency improvement, due to sampling at earliest point

(2) Prediction of NCO content at sample result

- Real time development of NCO
- Detection of anomalies

Main Tasks
Infrastructure, Architecture



RCIP data science partner of OSIsoft

1. **PI Integrator** cleanses, contextualizes, and aligns data, and then publishes data to the **SQL Database** for training the model
2. **PI Integrator** streams the model's features to **Azure Event Hub** for live predictions
3. Store predictions into **PI System**
4. Visualize process overview with predictions and measurements in **PI Vision**

Main Tasks – Learnings (I)
Data sources & data model

- Detailed look in production process (here dosing & sampling) and human influence
  - Accuracy of time stamps and data entries
  - Impact on events (start or stop) or anomalies

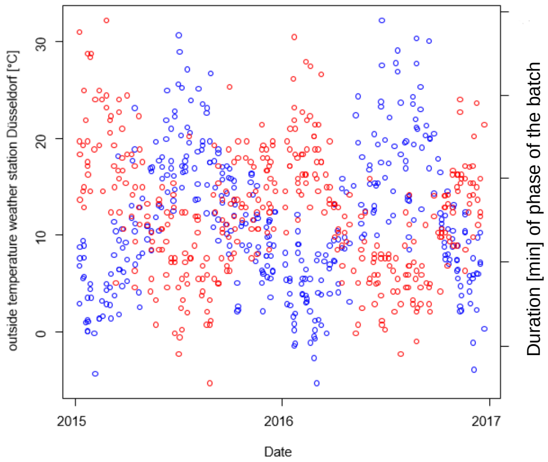
- Machine learning is able to investigate „features importance“
  - Make use of “all” available data
  - Development of “simple” chemical equations was not a purposeful approach

Main Tasks – Learnings (II)
Data sources & data model

- Consider seasonal impact on production process

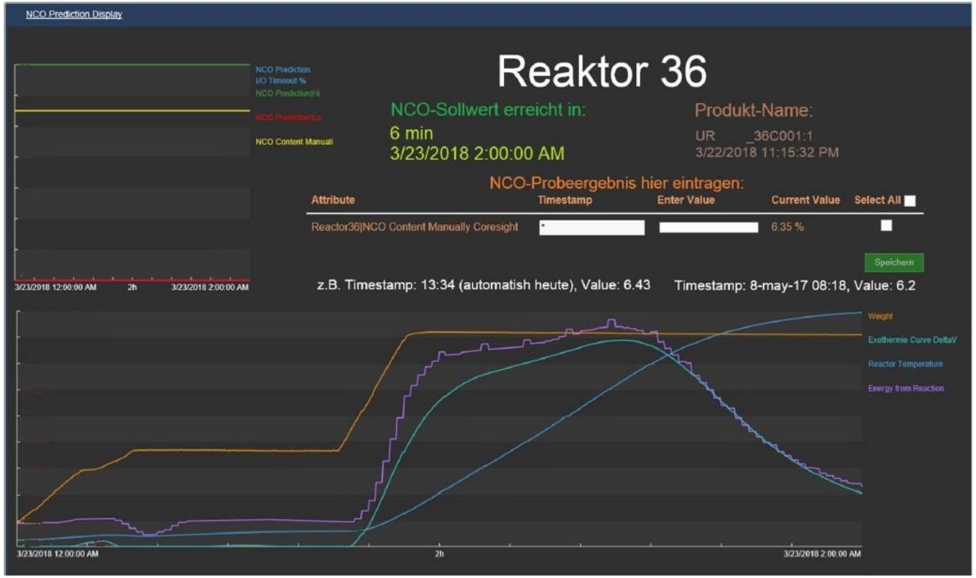
- Create awareness of unknown influences, not considered in the model
  - Slow development: transition coefficient due to fouling
  - Abrupt changes: change of raw material supplier

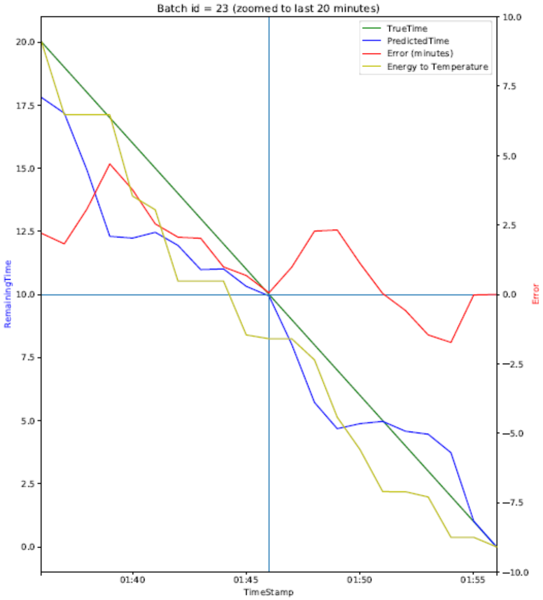
➢ After cleaning, 1/3 of data from the last 2 years has been used for modeling and training



Deliverables

Results, justification of PoC





1. 15 min in advance the prediction stabilizes
2. ≈ 5% time saving
3. ≈ -10% sampling possible (samples above upper limits)

Deliverables
Summary

- After cleansing, only 1/3 of data from the last 2 years could be used for modeling and training
- Reaction process can be computed in the Machine Learning model
- Continued training with new/more data did not improve the model's accuracy
- Model provides the operator with a standardized and readable format (minutes) indicating when the reaction's transition will occur
- Data accuracy needs to be improved
- ➢ Experts are needed to interpret results

Deliverables
Outlook, Next steps

- Use Case: Reactor
  - Make data acquisition more stable
  - Deploy to the whole process, all recipes and other reactors
  - ➢ Long term goal would be the replacement of manual sampling
  - ➢ Anomaly detection along the exothermic reaction process (alarm system)

- Machine Learning Methodology
  - Infrastructure design to "control" a production process needs to be validated
  - ➢ Possible alternative for sophisticated sensors
  - ➢ Look for further use cases in the area of "In-process quality control"

Questions?

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