The Next Step in Production: Using AI to Achieve Better Results

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Introduction

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Modular Factory

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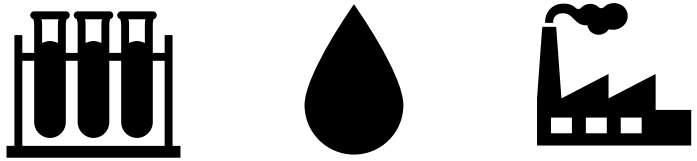
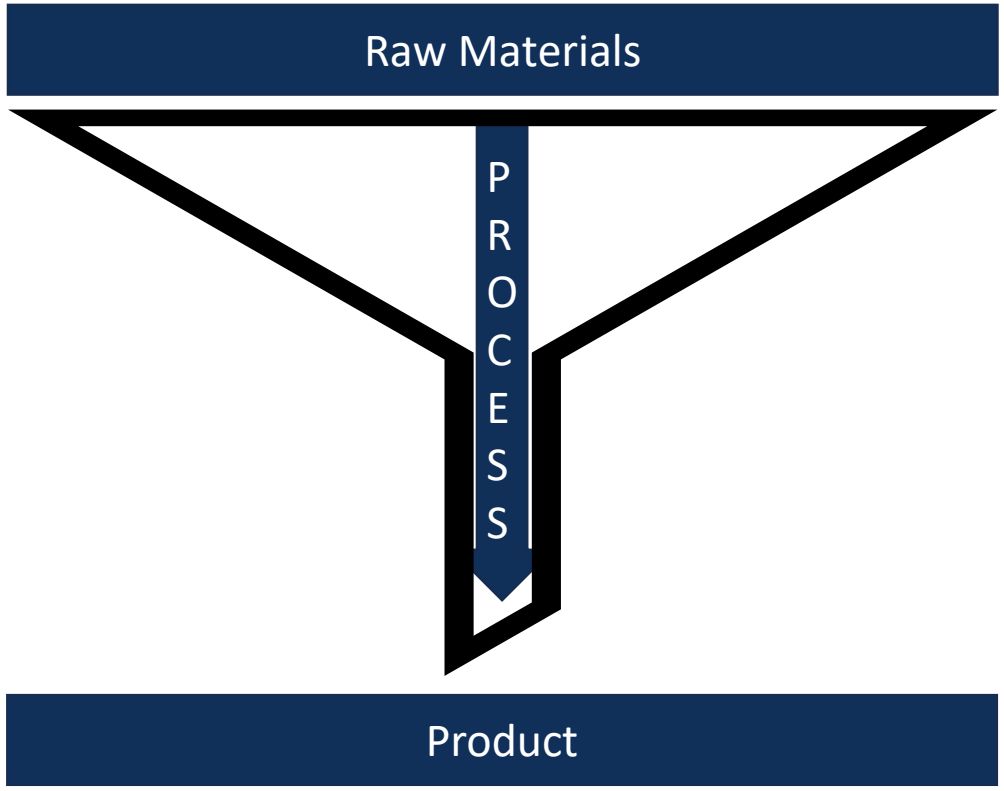
Sales and Business Development

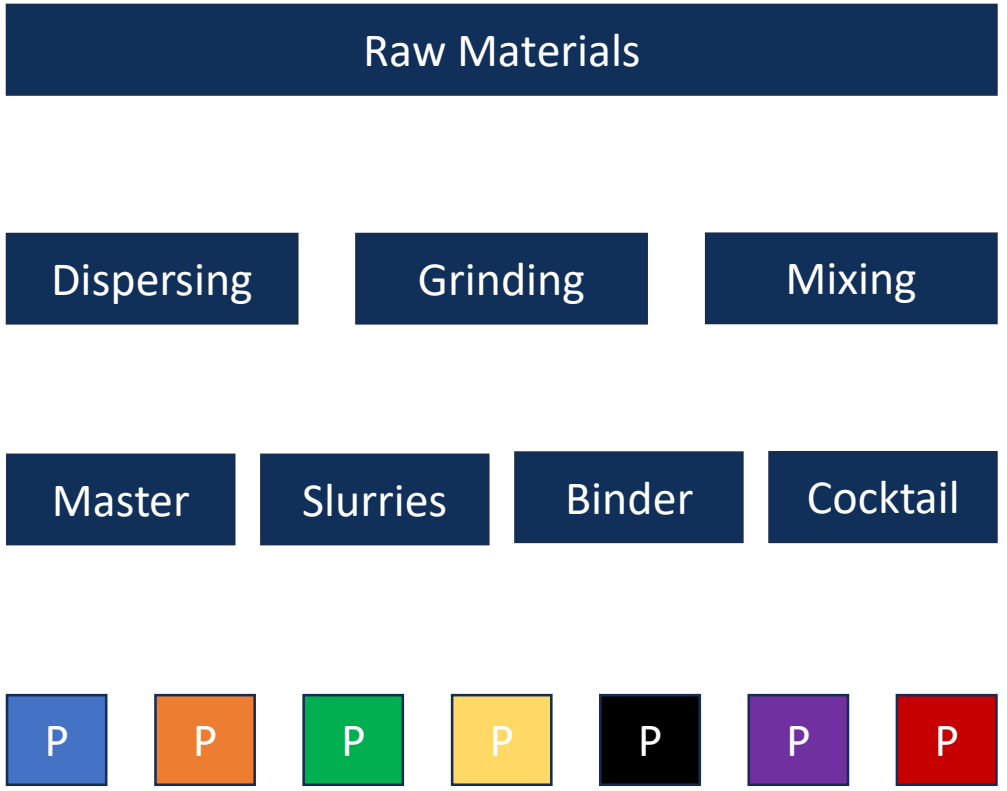


What is Modular Factory (MoFa)?

Traditional Manufacturing



Modular Manufacturing

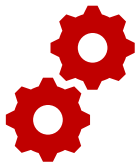


MoFa as a basis for production data

- Recipe Modularization
- Compact Setup
- Dispersion and Mixing
- PLC Controlled
- Sensors and interfaces
- AI Enabled

→ Benefits in production efficiency, stability and sustainability

Where are we and where do we want to go to?

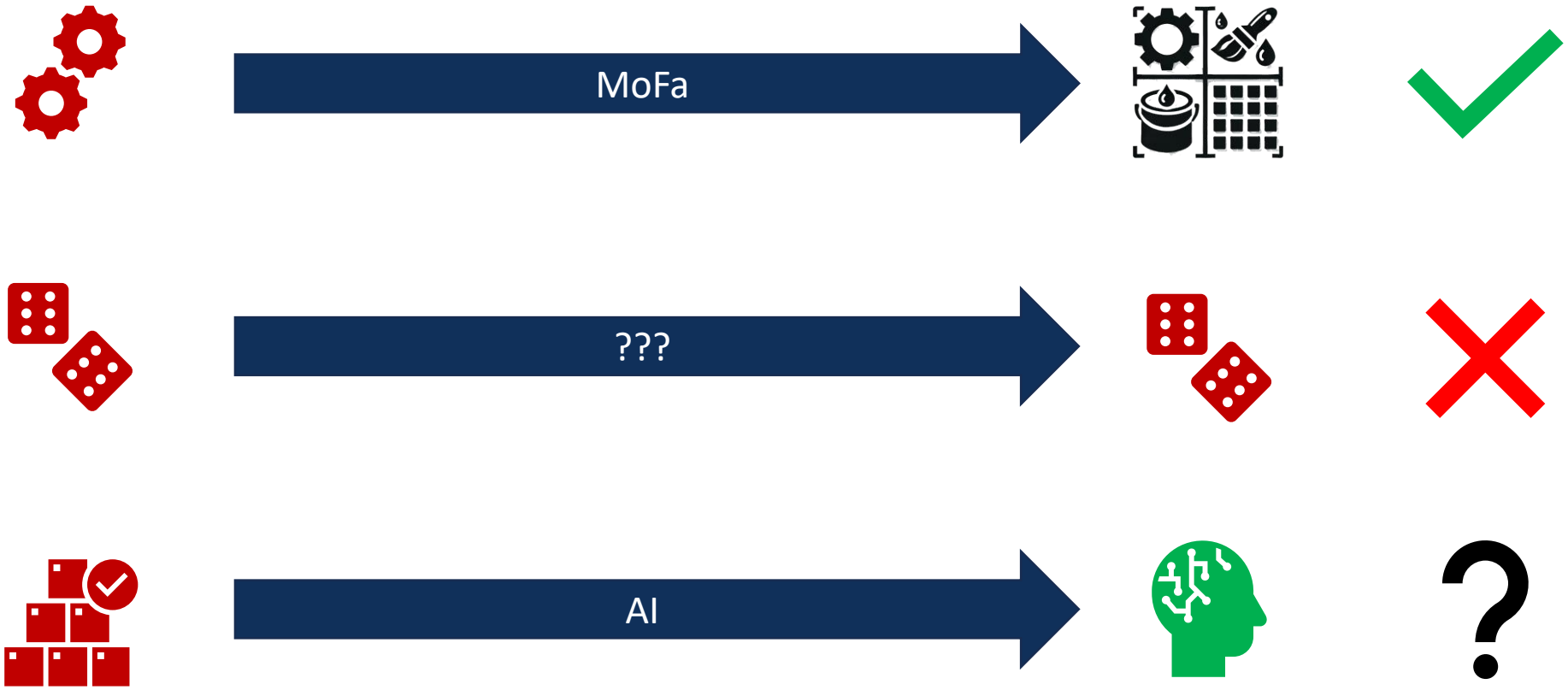


Instable processes complex formulations

Raw material variation → final product

Difficult prediction of product quality

Where are we and where do we want to go to?

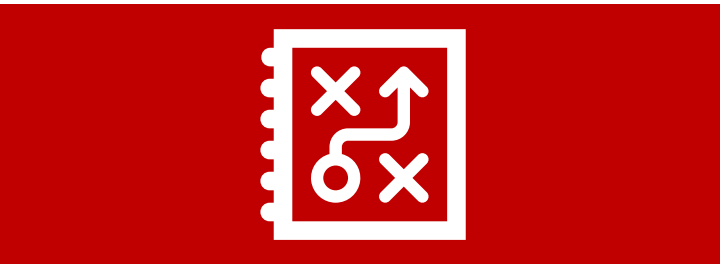


Case Study at a Paint Factory

Problem to solve:

- Heterogeneous recipe structures adapted to the customer
- Low production frequencies
- Difficult continuous data collection
- Raw material and recipe information is not sufficient as a basis for a quality prediction

→ Is an AI implementation possible at all?

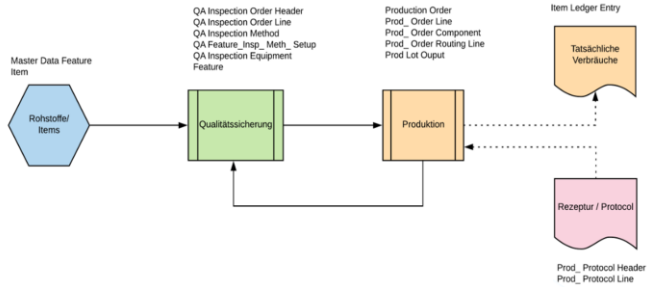


Phase 1:
Status Analysis

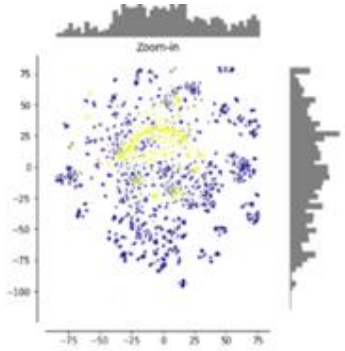
Internal Analysis: Screening Data

- Get to know the data
- Data collection
- Data Bundling

→ Creation of a database structure

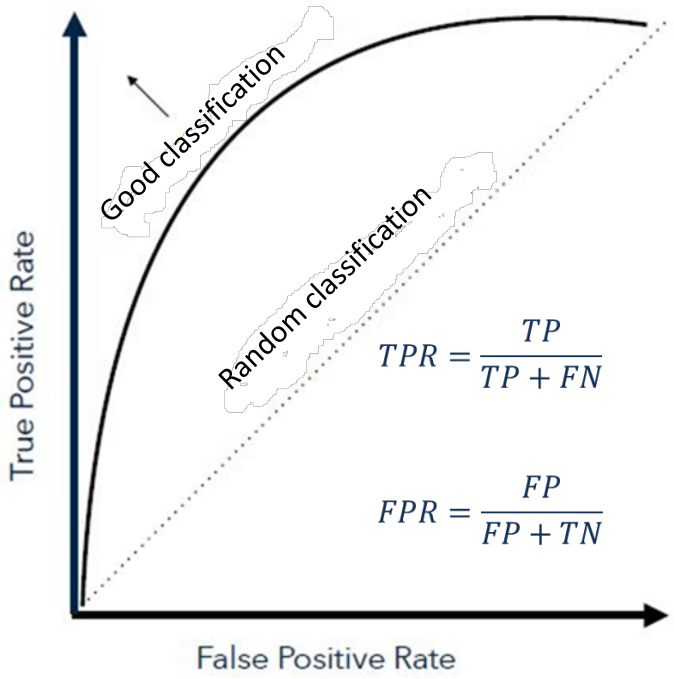


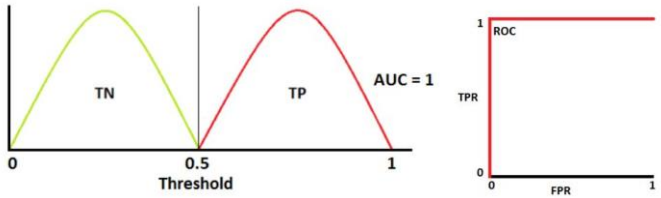
→ Based on this, further analysis
- → AI-based data analysis on a defined product group
- → Evaluation of correlations and patterns from the database
- → Mathematical modelling to validate solutions for O.K. and not O.K. products

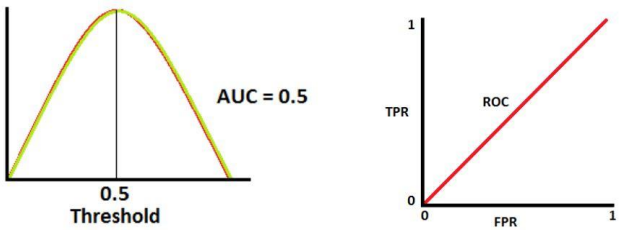


Internal Analysis: AUC Evaluation

Area under Curve (AUC)







Ideal classifier

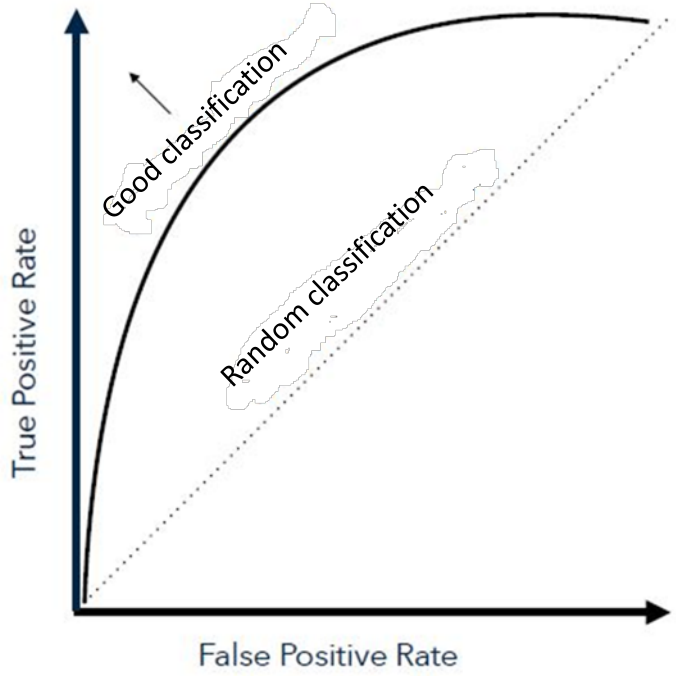
- 100% TPR and 0% FPR
- Prediction is consistent with the observed results
- Clear distinction between TN and TP

Random Classifier

- 50% TPR and 50% FPR
- It is not possible to distinguish between TN and TP
- Predictive model is inappropriate Insufficient data basis

Internal Analysis: Check Models

Area under Curve (AUC)



AUC Value	Quality
0.9 – 1.0	Excellent
0.8 – 0.9	Very Good
0.7 – 0.8	Good
0.6 – 0.7	Fair
0.5 – 0.6	Bad

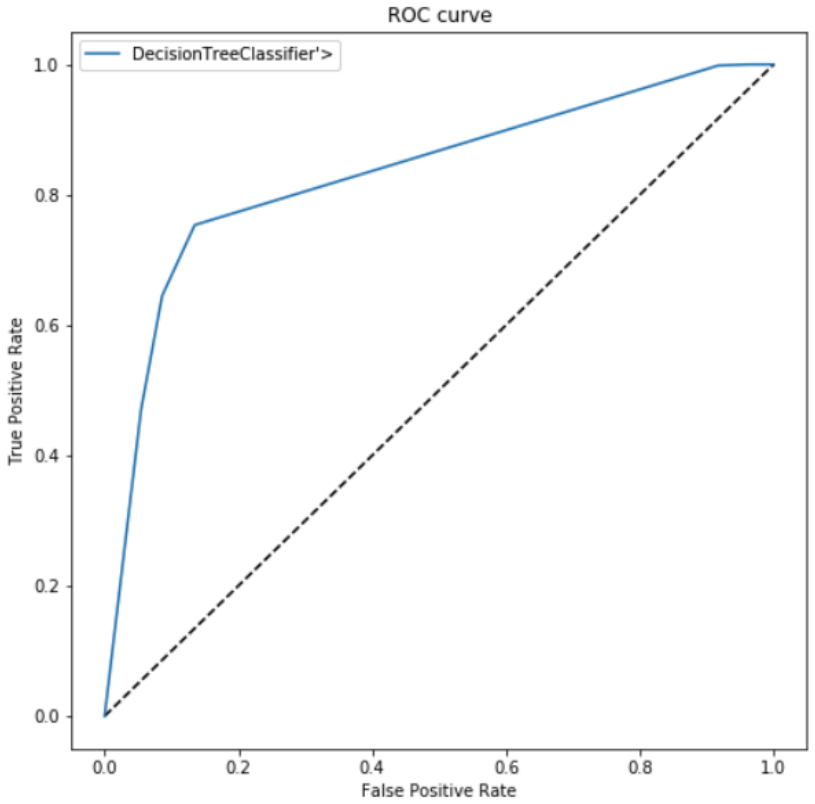
Integration of sensors to increase the data basis

AI possible, data basis O.K.

AI impossible, data basis not O.K.

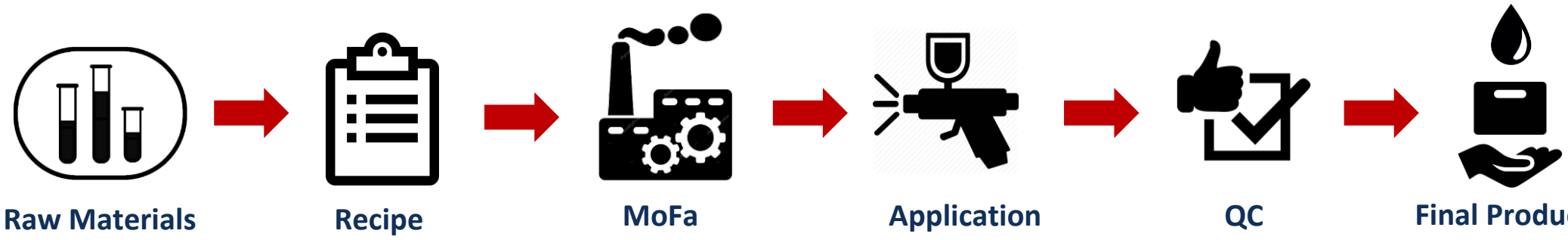
Internal Analysis: Result

- As-is analysis successfully completed → AUC ≥ 70%
- Problems can be solved by classification
- Clear significance for practical use
- Potential for data diversity and quality
- **Basis for the development of AI is in place**



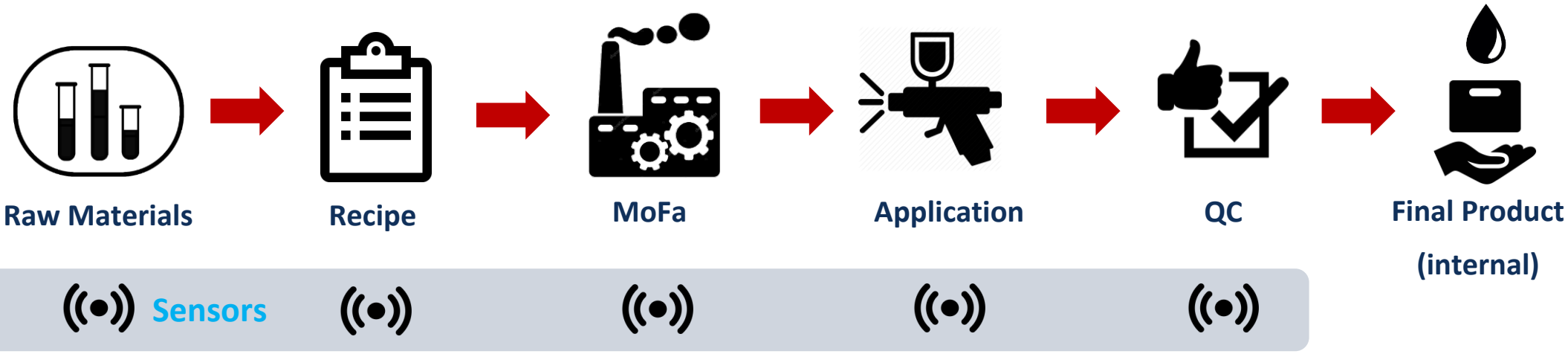
Phase 2:
AI Development

Process Analysis (Value Chain)



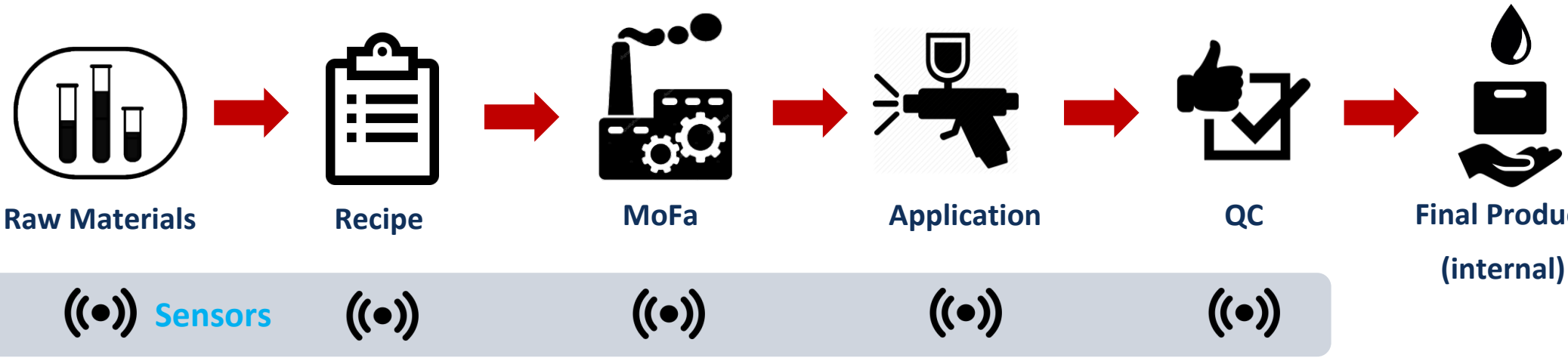
- Data chaos
- No connected value chain
- No prediction of product quality possible
- Rework, Returns and Disposal

Data Caption Analysis



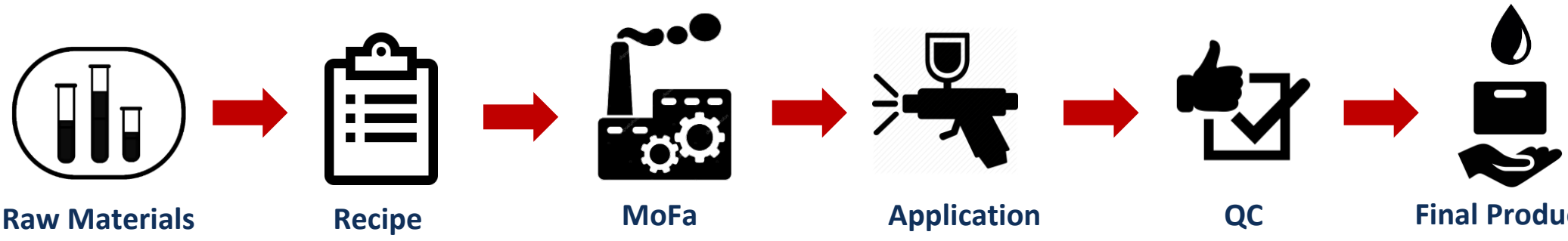
- What happens at which point?
- Where are sensors located?
- What data do the sensors provide?
- How are the sensors digitally stored and stored in the database?

Connect Data Caption and Process



- Integration of sensor technology and analytical measurement methods for the collection of raw data
- Networking of the entire process chain
- Building a Centralized Database Infrastructure

Data Caption System

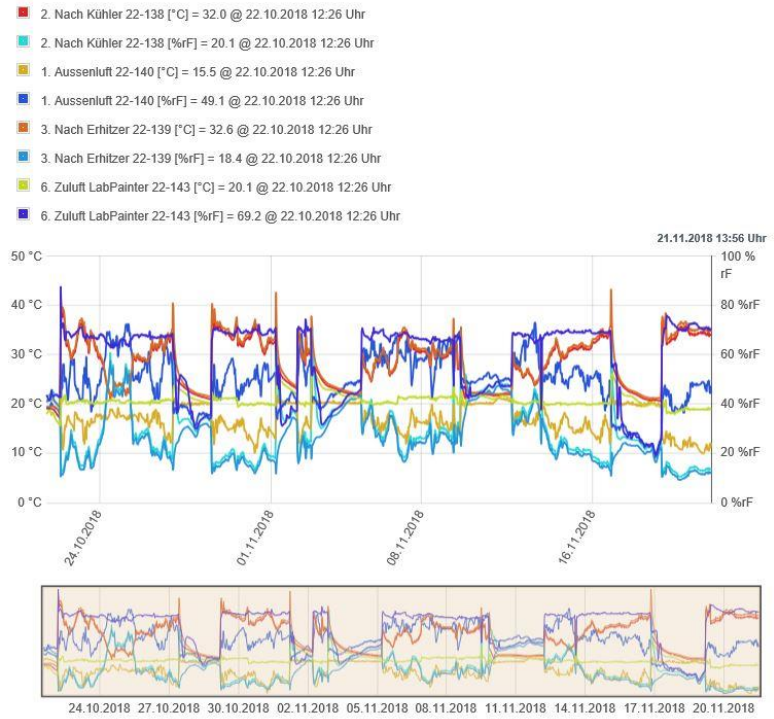


Sensors

Example: Lab Spray Application

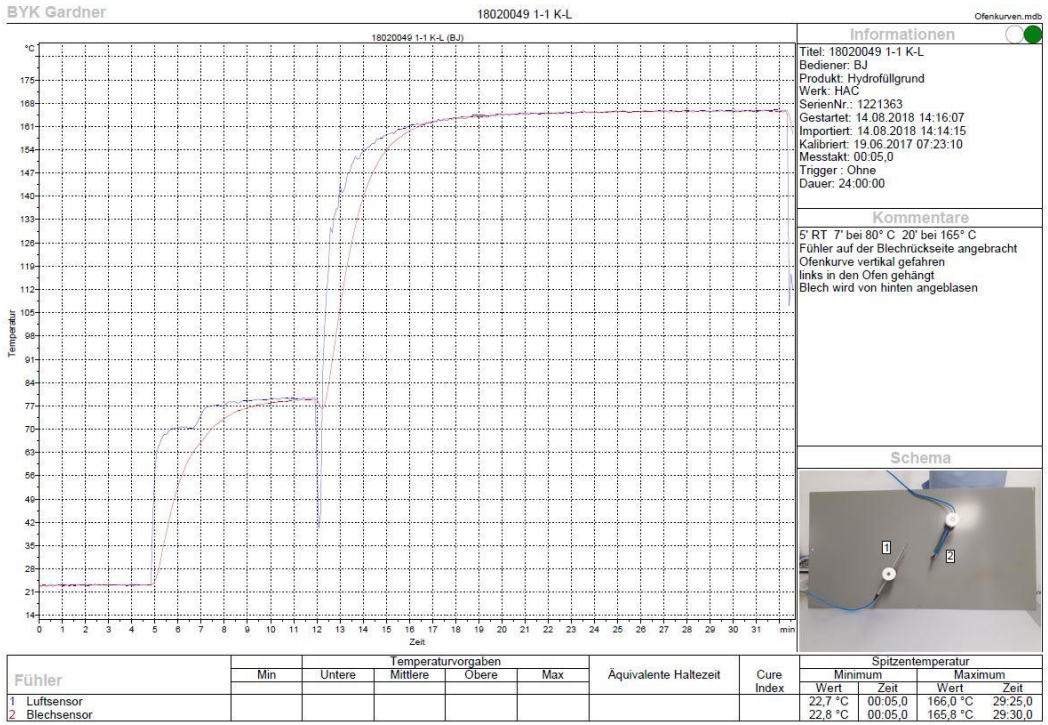
Air Data Paint Booth

Temperature / Humidity



Temperature Data Curing Oven

Control of Curing Process

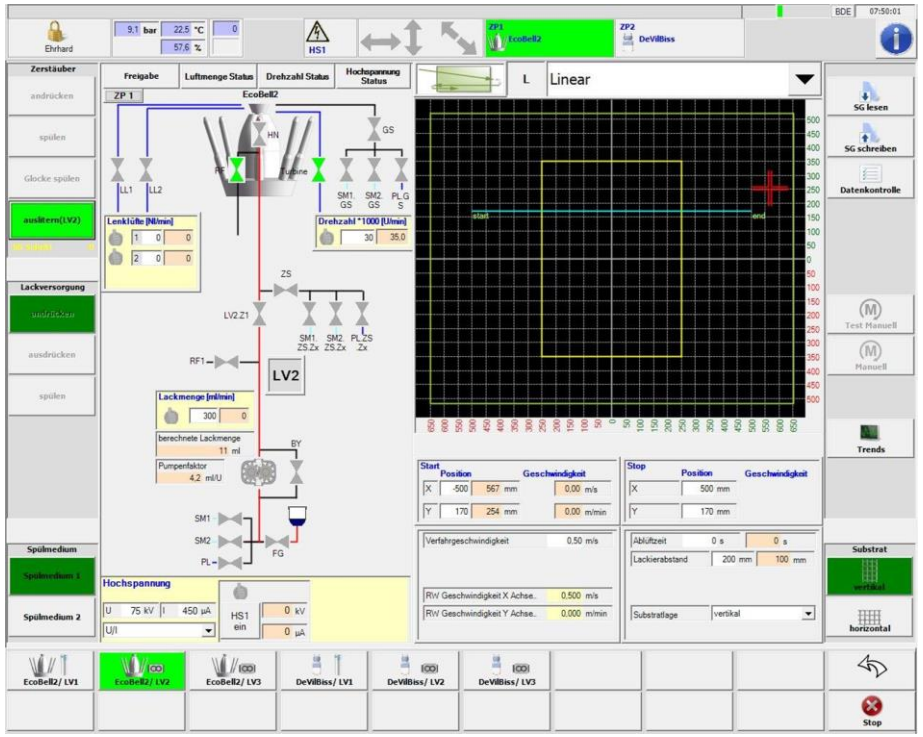


Fühler	Temperaturvorgaben Min	Untere	Mittlere	Obere	Max	Äquivalente Haltezeit	Cure Index	Spitzentemperatur Minimum Wert	Minimum Zeit	Maximum Wert	Maximum Zeit
1 Luftsensor								22,7 °C	00:05,0	166,0 °C	29:25,0
2 Blechsensor								22,8 °C	00:05,0	165,8 °C	29:30,0

Example: Lab Spray Application

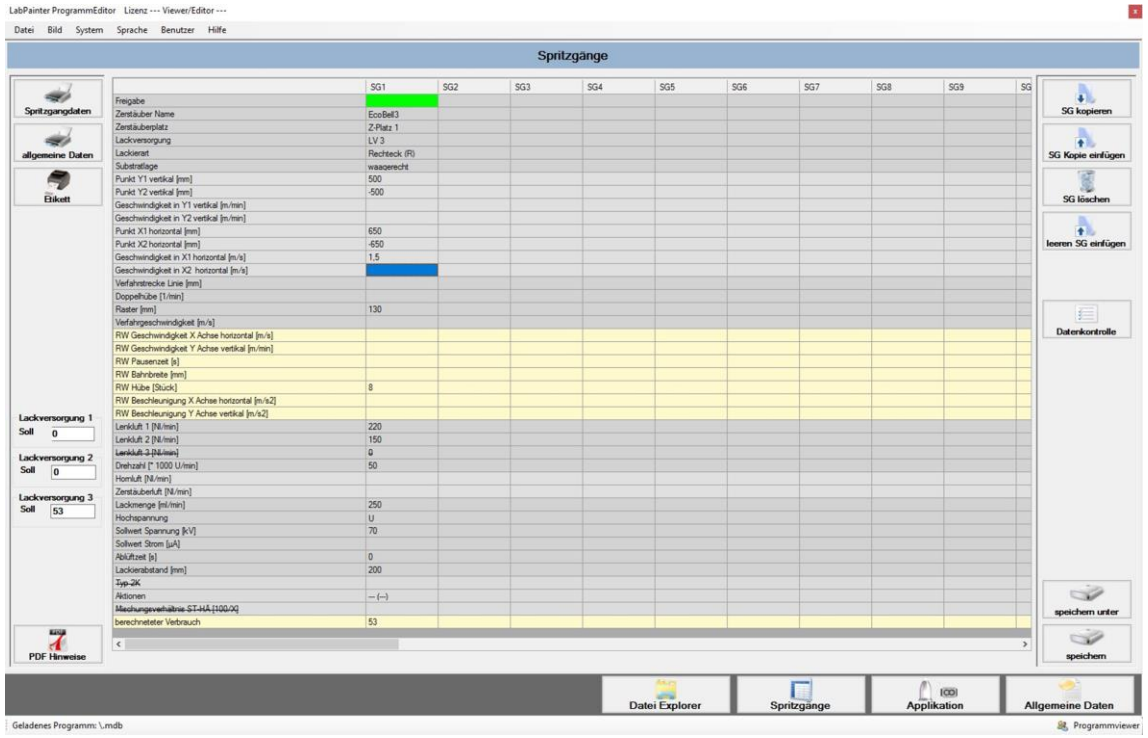
Lab Painter:

Application Setup

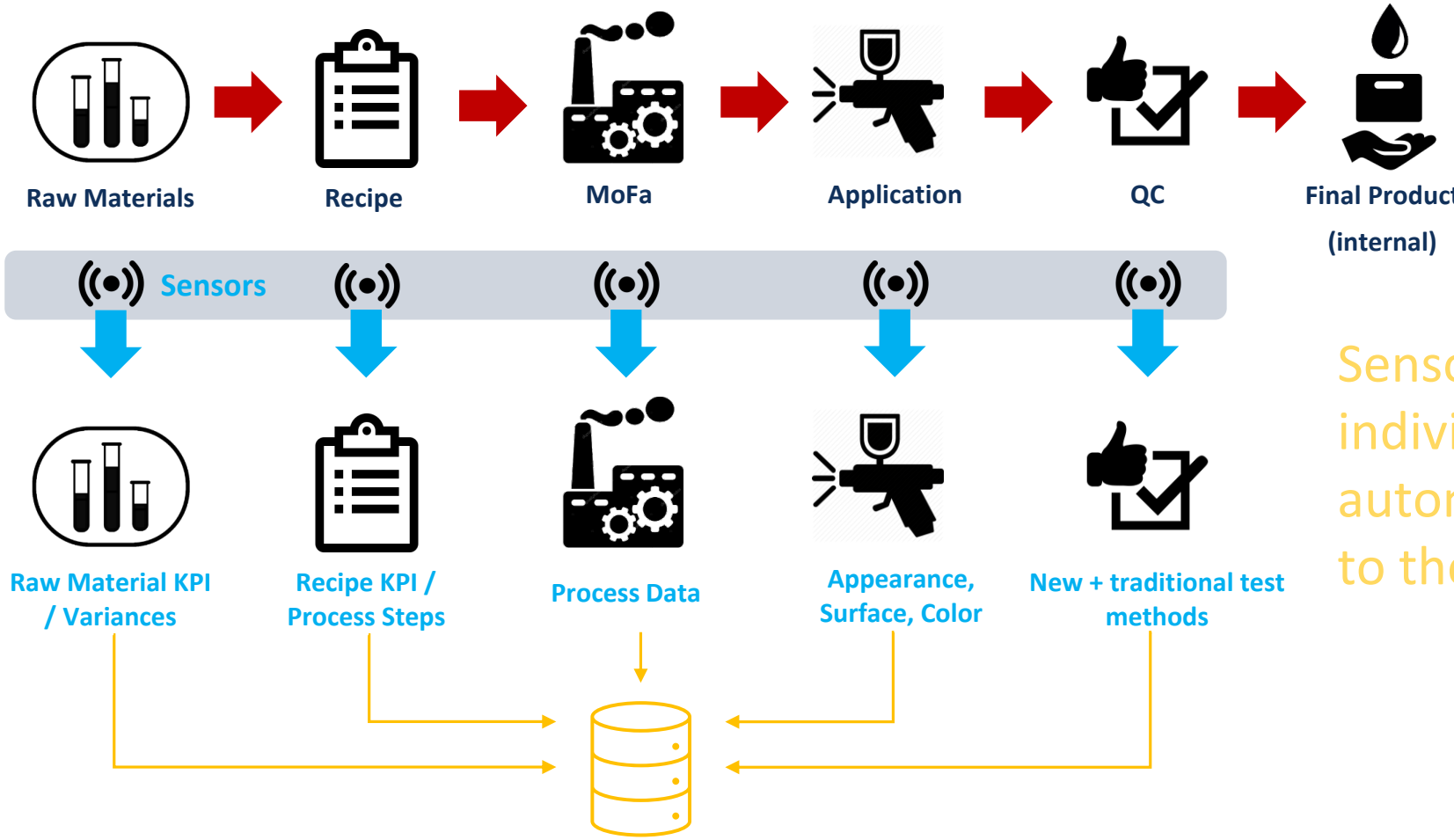


Automated Data Logging and Data

Export

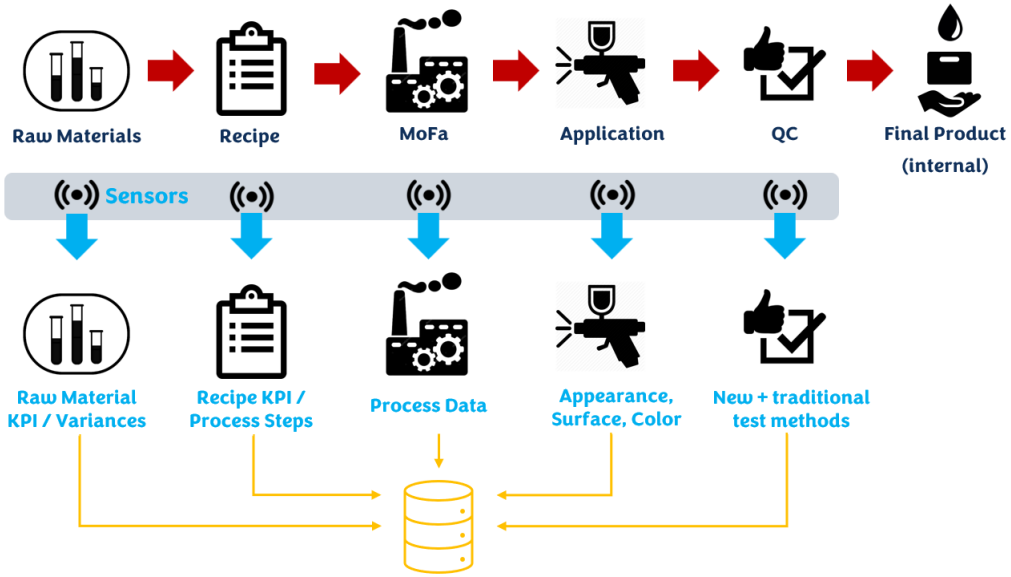


Organize Data Flow



Sensor data from the individual process steps is automatically transferred to the cloud database.

Database Structure

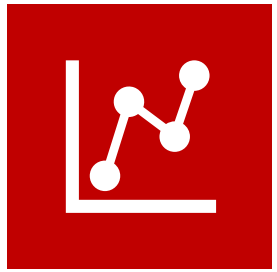


Data of the complete value chain is:

- Centralized
- Available
- Retrievable

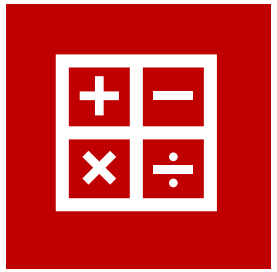
→ Basis for development of the Artificial Intelligence Application

Roadmap for AI Implementation

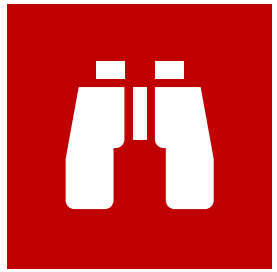


PROCESS ANALYSIS
TAKE II

FIX
WEAKNESSES

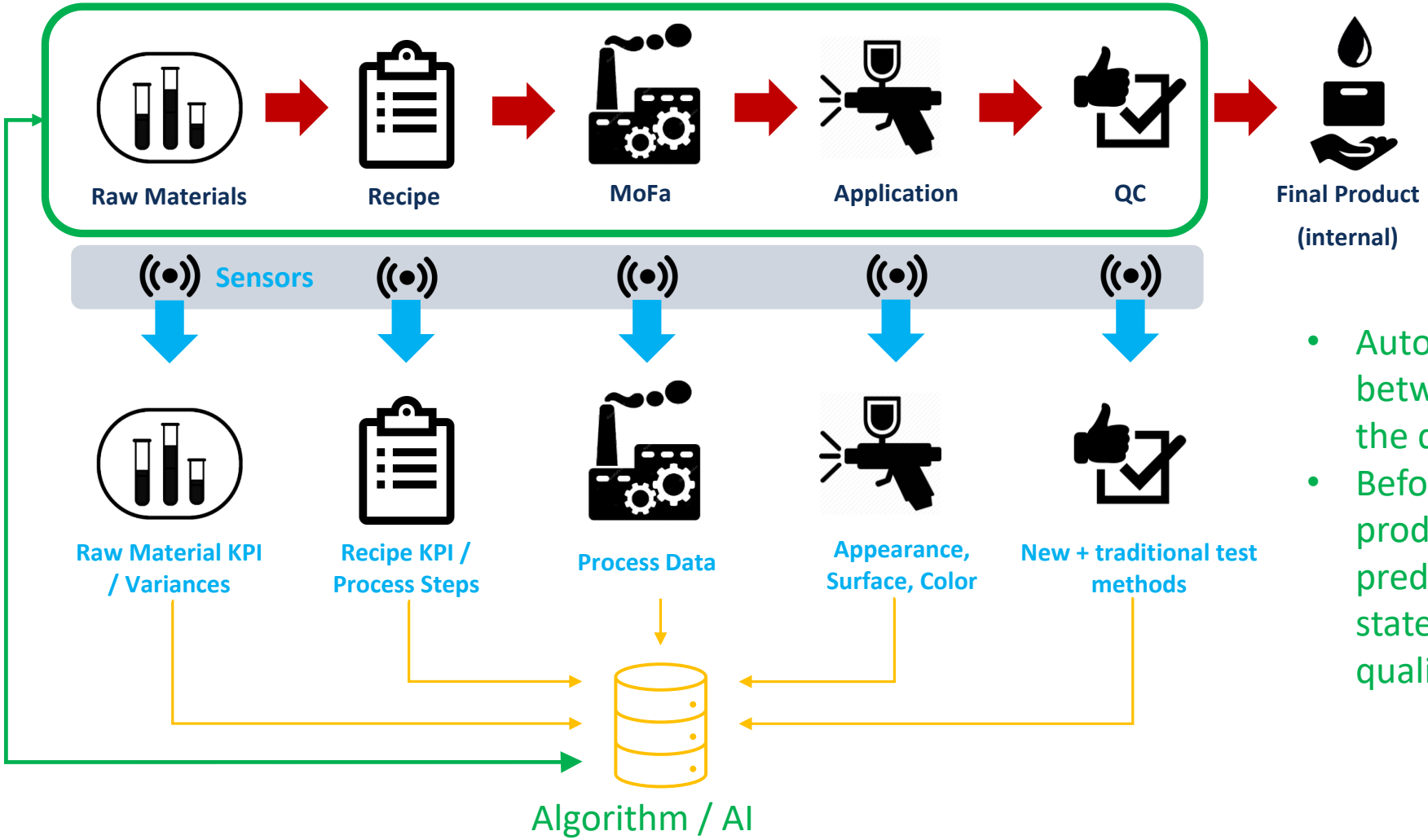


CHOSE ML
ALGORITHM



AI PREDICTION SYSTEM -
AUC **≥ 85%**

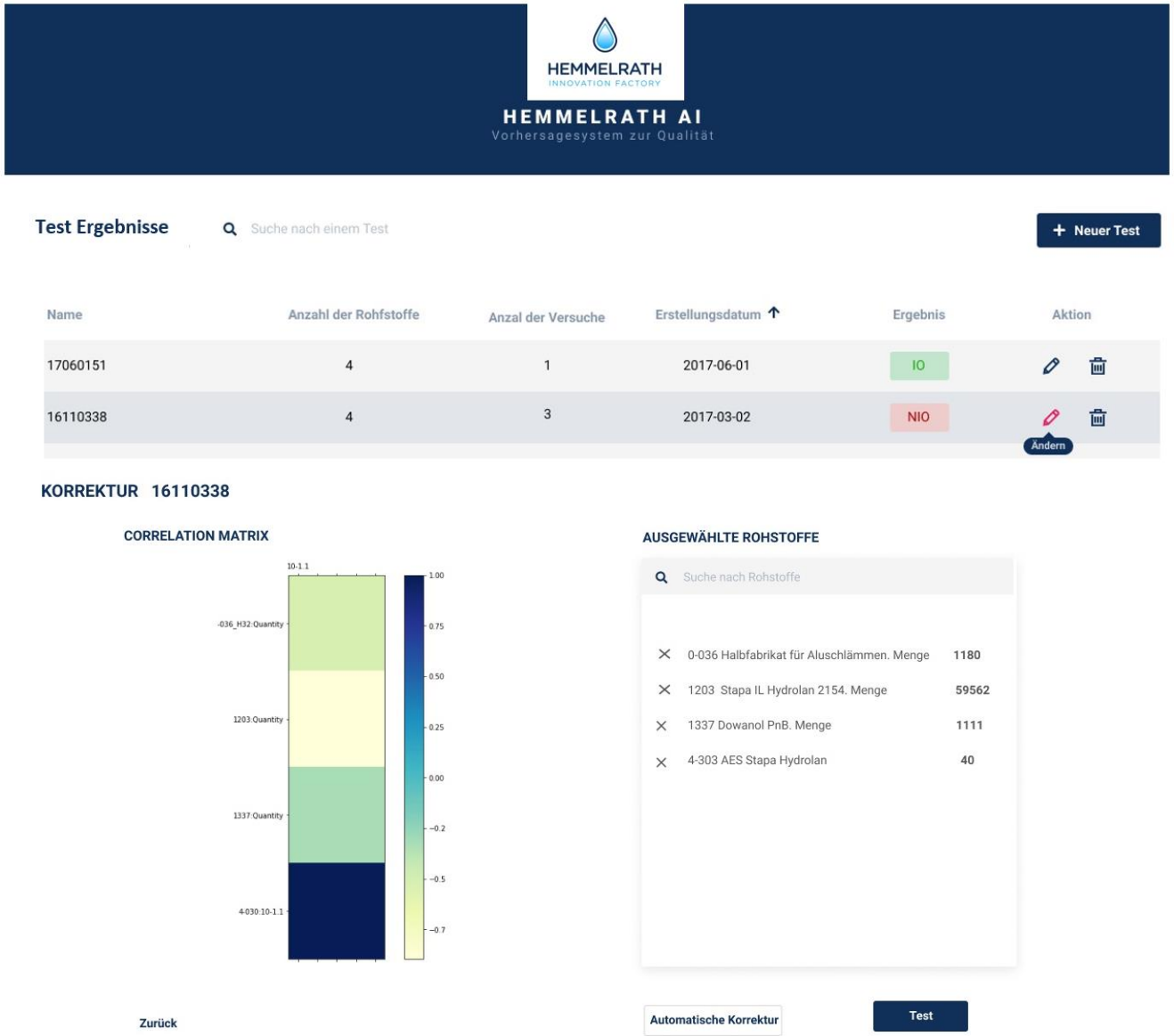
AI Optimization



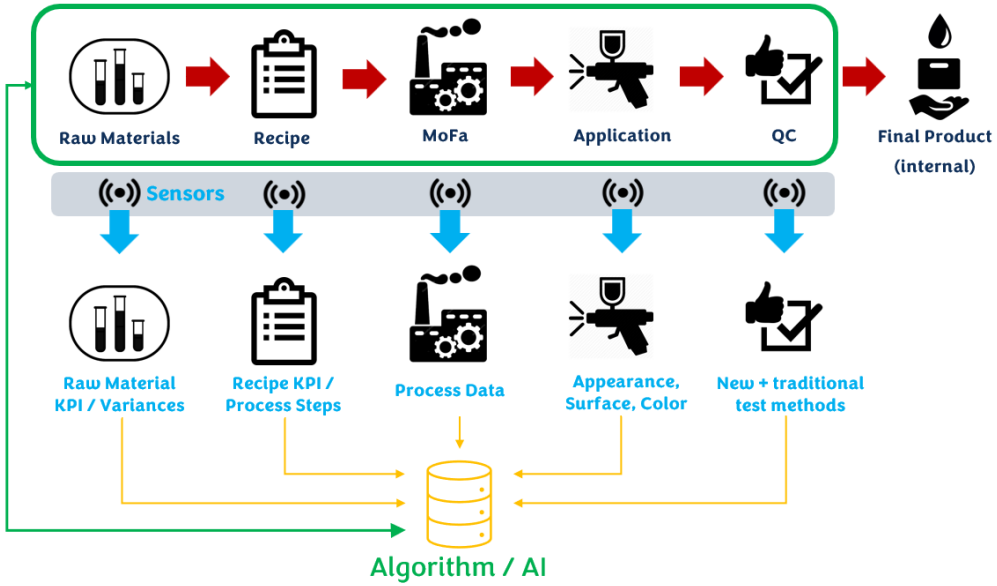
- Automatic communication between the AI and the data in the database
- Before starting a new production, the AI quality prediction system makes a statement about the product quality

Software

	Solids (Scale, Oven)
	Semi Finished Alu Slurry
	Stapa IL, Hydrolan 2154 Aluminum / SD / coated
	Hydrolan PnB
	AEP Stapa Hydrolan 2154, 50% SD



Results



- Development of an AI quality prediction and decision support system successfully completed.
- Predictability for O.K. / not O.K. products is **89%.**
- Raw material quality has a major influence on the quality of the product, with a stable production process (MoFa).

Thank You!

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