
High Tech in the Food Value Chain: Digitisation in industrial Food Processing and Packaging

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Digitisation: Motivation

(provocative) Examples / Claims from other Industries

- Automatic data acquisition, -processing und –interpretation...
- Machine learning algorithms, bringing the best system strategy to improve process efficiency
- System approach that fits to any kind of equipment of any kind of industry sector
- Combination of prediction and optimization
- Control of machinery or process installations with AI algorithms

Digitisation: Motivation

Examples from other Industries

Can the examples and success stories be transferred to food production?



Discrete processes

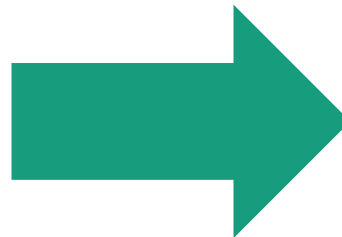
Products with constant and defined properties

Rather simple thermodynamic processes

Properties of food are often fluctuating: e.g.

- Summer / winter
- Different supplier / farms
- batchwise

Rather complex processes



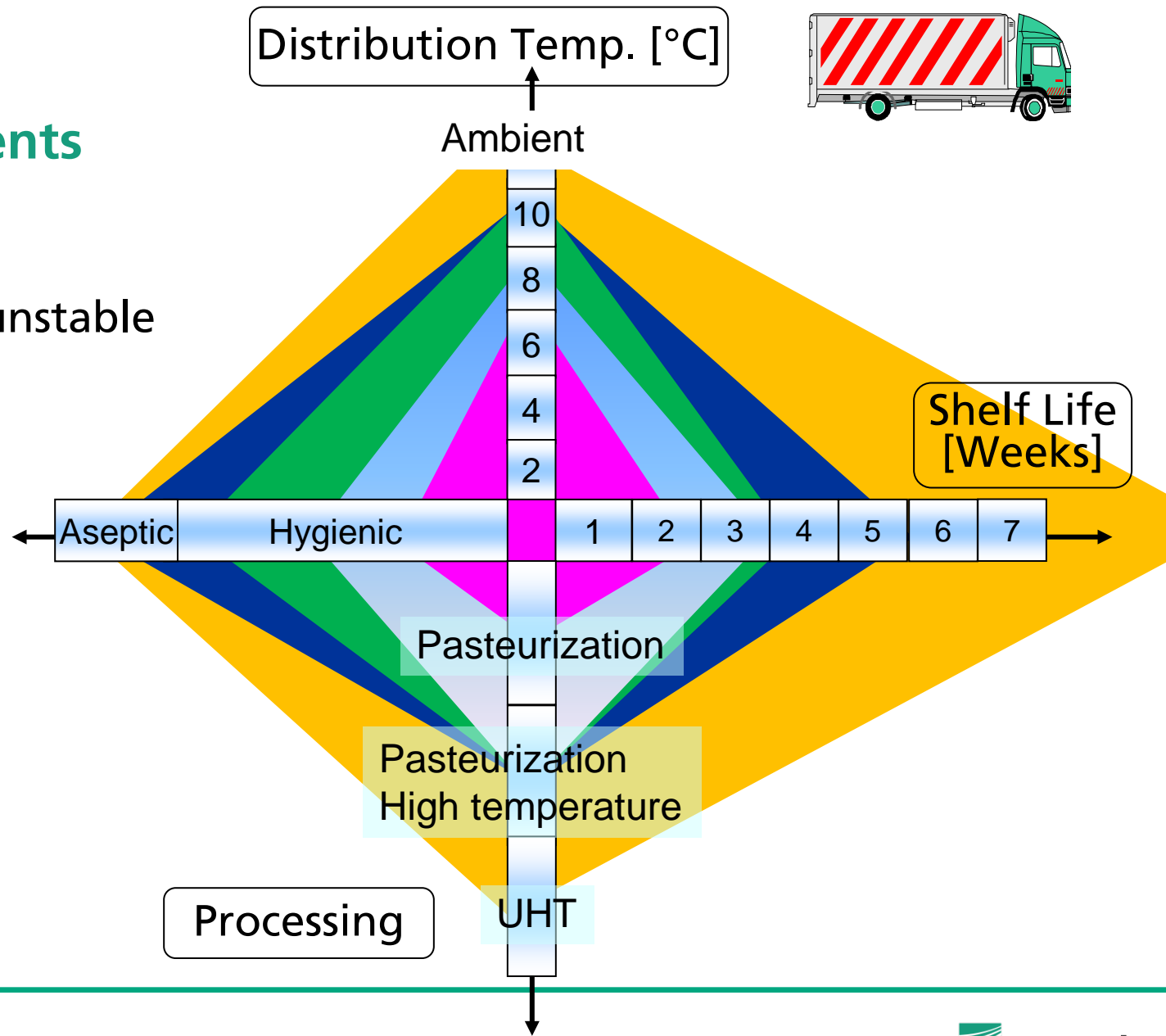
Quelle: Sig...



State of the Art: Complex Processes, high Quality Requirements

Example: Microbiologically unstable
Products

Packaging
Technology



Digitisation in Food Production

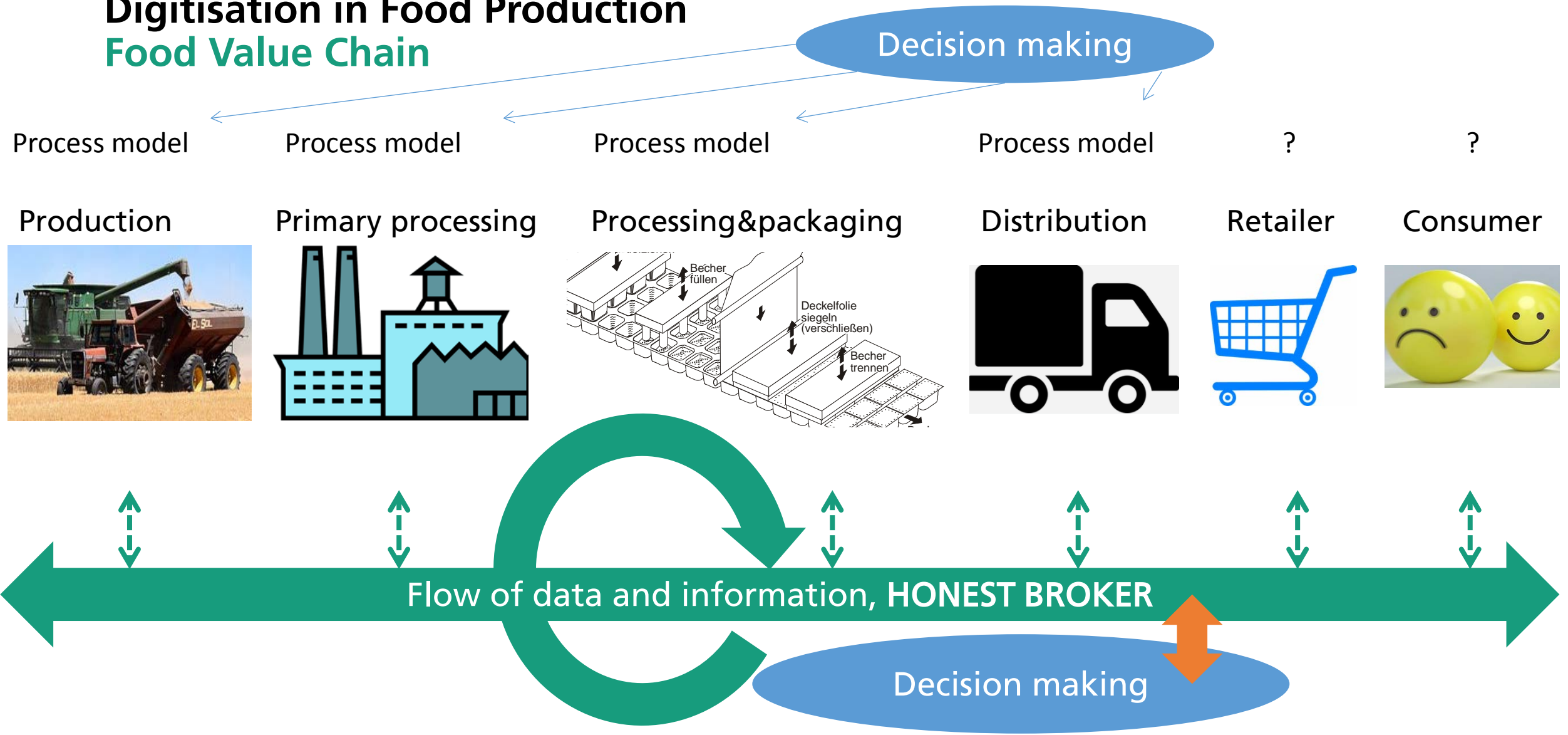
Opportunities and Objectives

- Improving food safety
 - Nestle's #1 Investment: Food Safety
- Increasing transparency
 - Consumer and B2B
 - Tracking & tracing
- Customisation
 - Well being, protein switch, personalised nutrition, packaging
- Improving production efficiency



Digitisation in Food Production

Food Value Chain



Opportunities of Digitisation

Machine Learning

- Core technology of artificial intelligence
- Automatic recognition of correlations in data records
 - E.g. artificial neural networks
 - must be trained for each case of application
 - Large amounts of data required

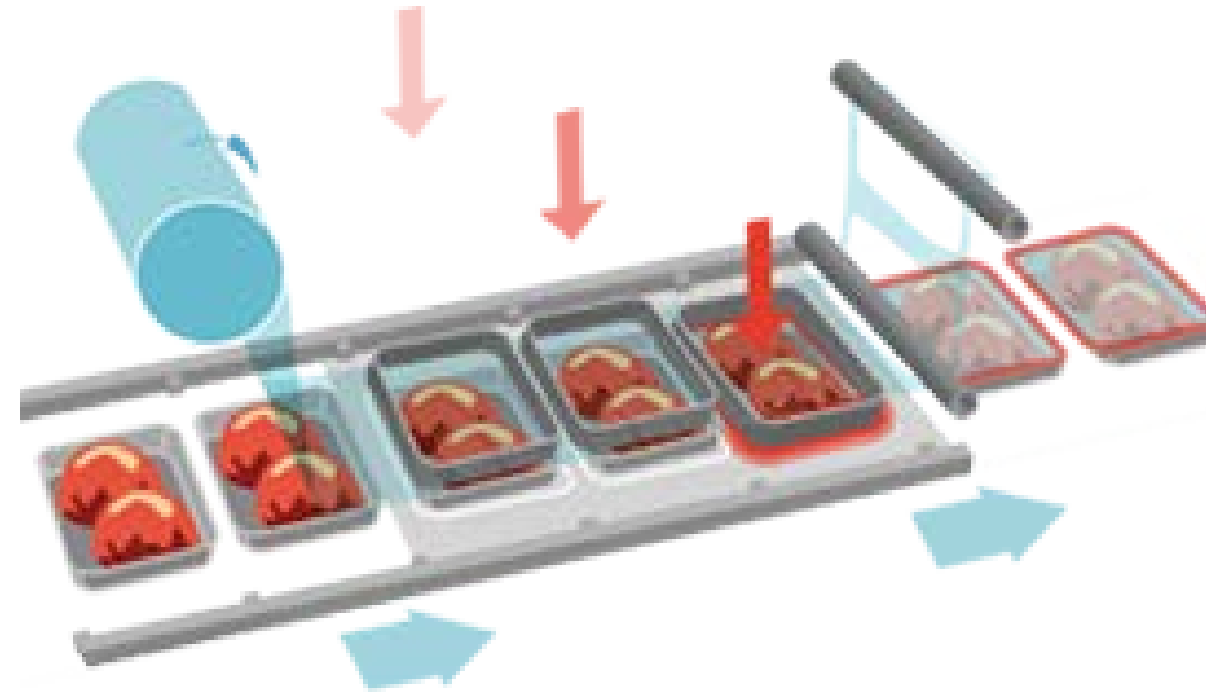
Opportunities of Digitisation

Machine Learning

Amount of data:
R&D data, food production

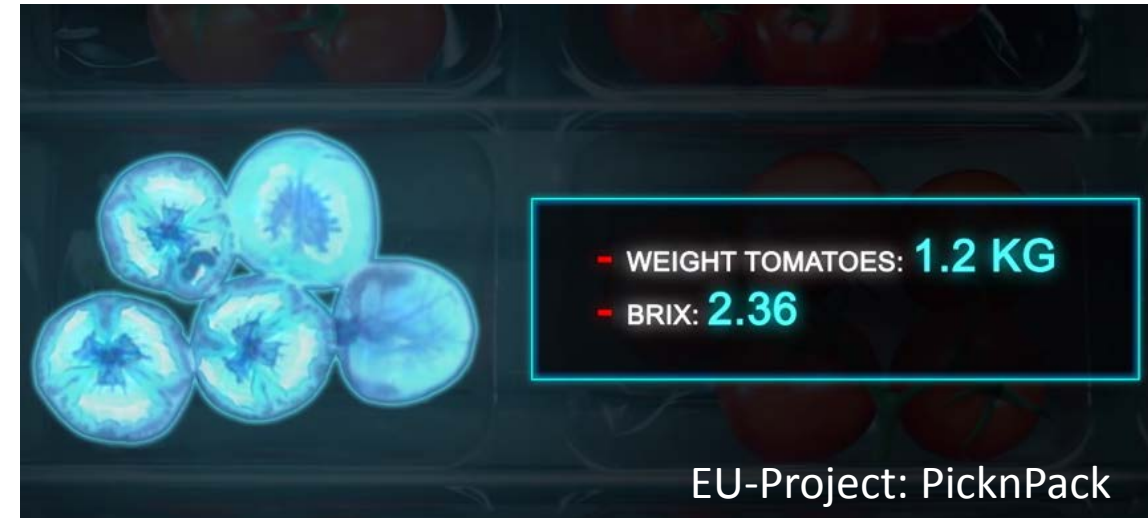
Amount of data:
Google, Amazon,
Facebook,

Food Packaging Process Description



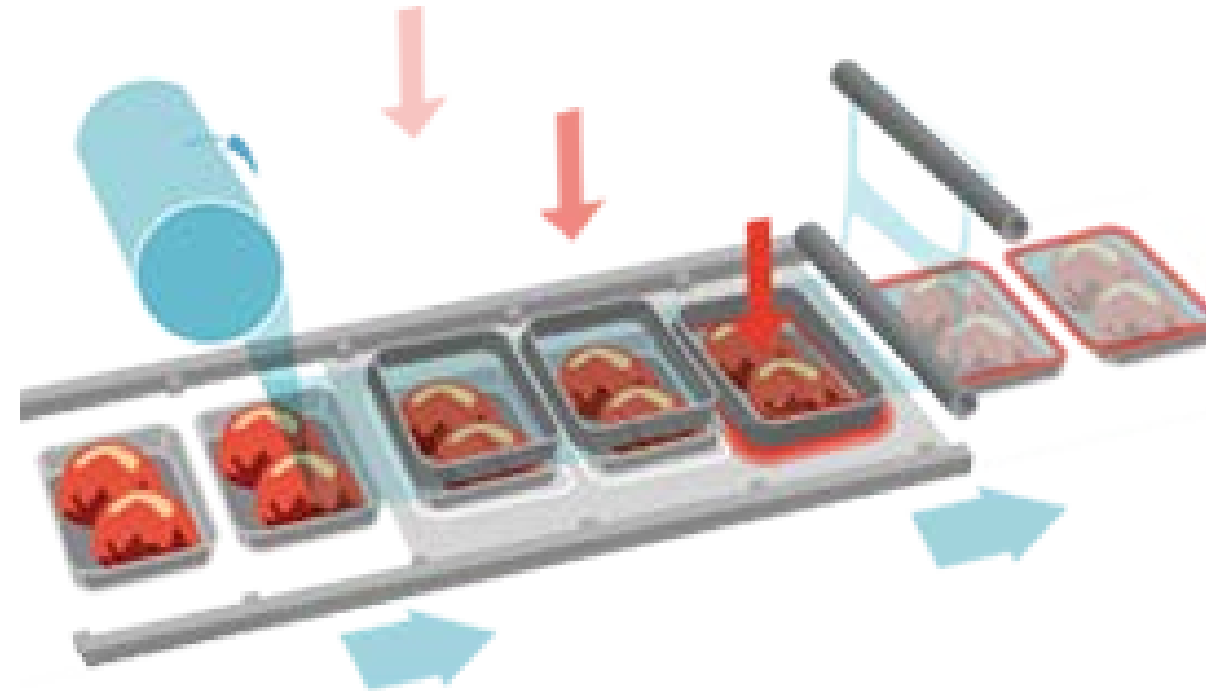
Example: Filling and closing machine

- Product related data
 - What is relevant?
 - Is it available inline or QM?



- Packaging related data
 - What is relevant?
 - Is it available?

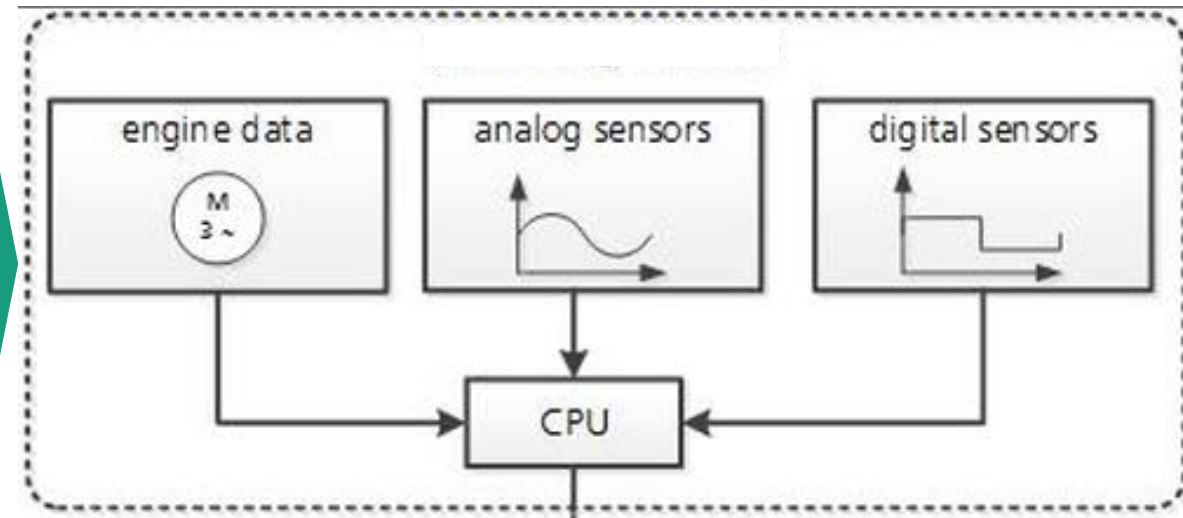
Food Packaging Process Description



Example: Filling and closing machine

- Recording of the changes of the sensor signals
- Recording over a few hours: > 100 million data points

- Machinery related data
 - What is relevant?
 - Is it available?



- Data from preliminary and subsequent processes (digitally interlinked)

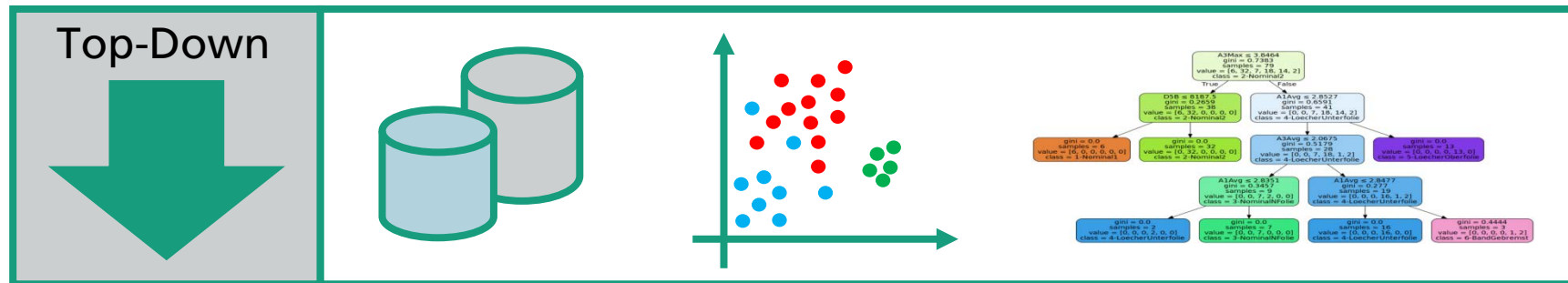
Food Packaging Process Description

- Data related to:
 - Malfunction
 - Safety issues

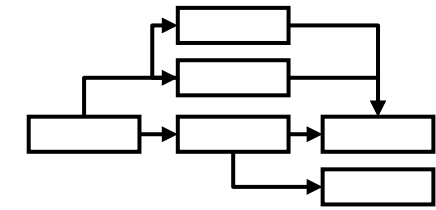


Food Packaging Process Description

- Example: malfunction diagnosis



Model for malfunction diagnosis

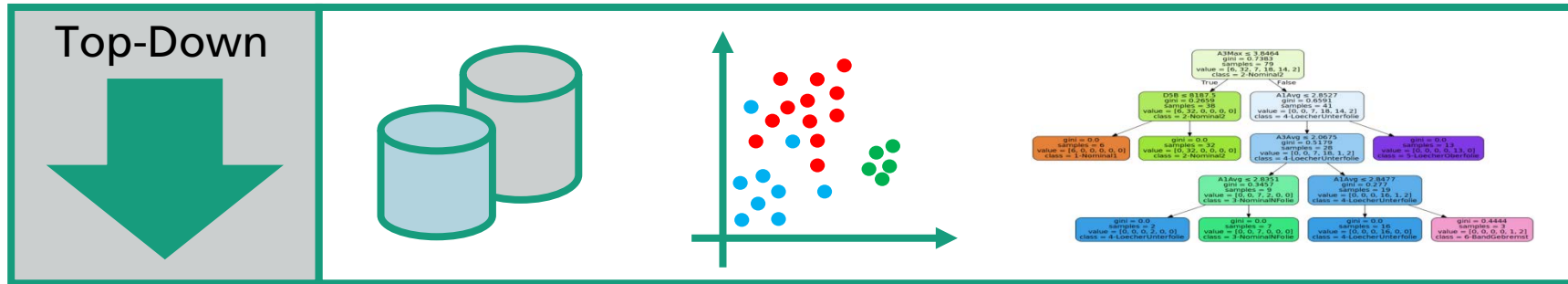


- The use of stochastic models (TOP-down, e.g. by machine learning) only requires large amounts of data
- The necessary number of repetition of individual malfunctions / safety issues should be as small as possible

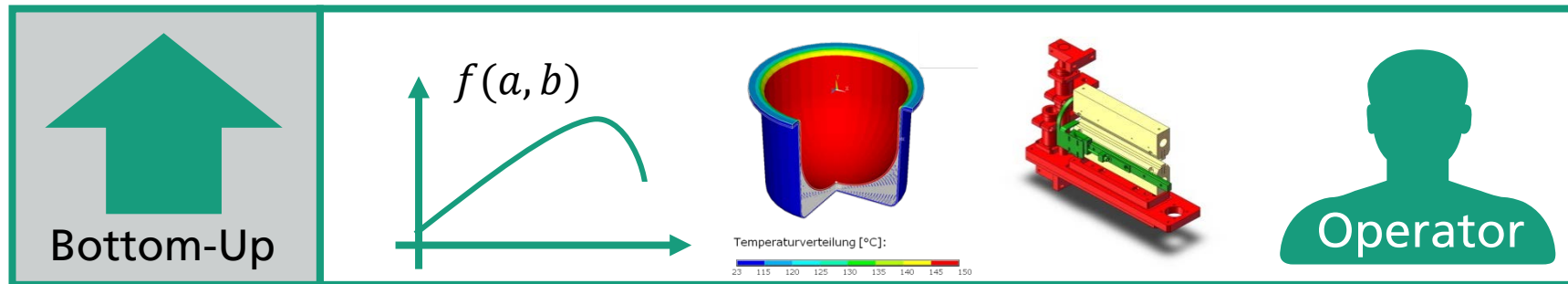
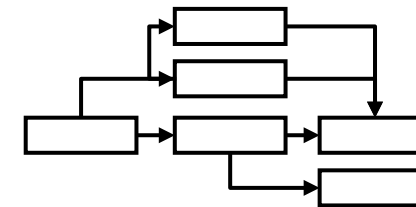
Food Packaging

Process Description: hybride Model

- Example: malfunction diagnosis



Model for malfunction diagnosis



Food Packaging

Top down Approach: Impact for R&D

Data  Value



Raw data Analysis Process model Recognition ... Interpretation

Feature extraction

ontologies

of patterns

Process knowledge

Semantic annotation of data

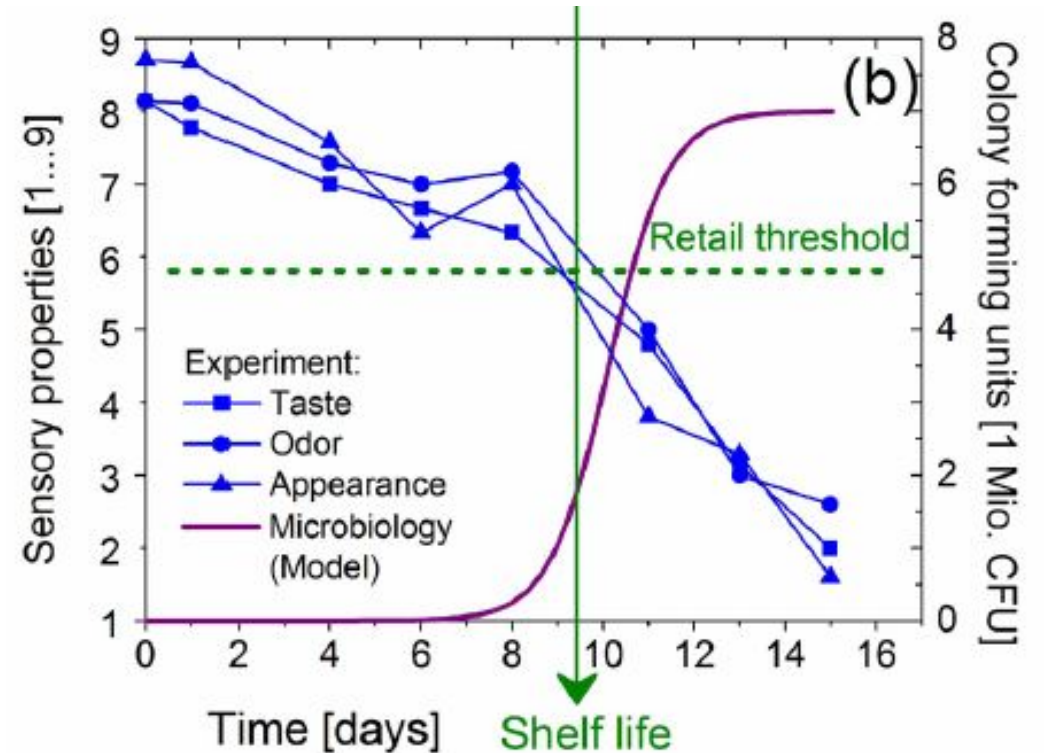
- Process knowledge is important!
- Finding sufficient algorithms

Food Packaging

Bottom up Approach: Impact for R&D

Numerical models: e.g.

- Thermoforming of packaging
- Sealing of packages
- Easy opening of packages
- Shelf life of packed food stuff
- Automatic cleaning of process machinery
-



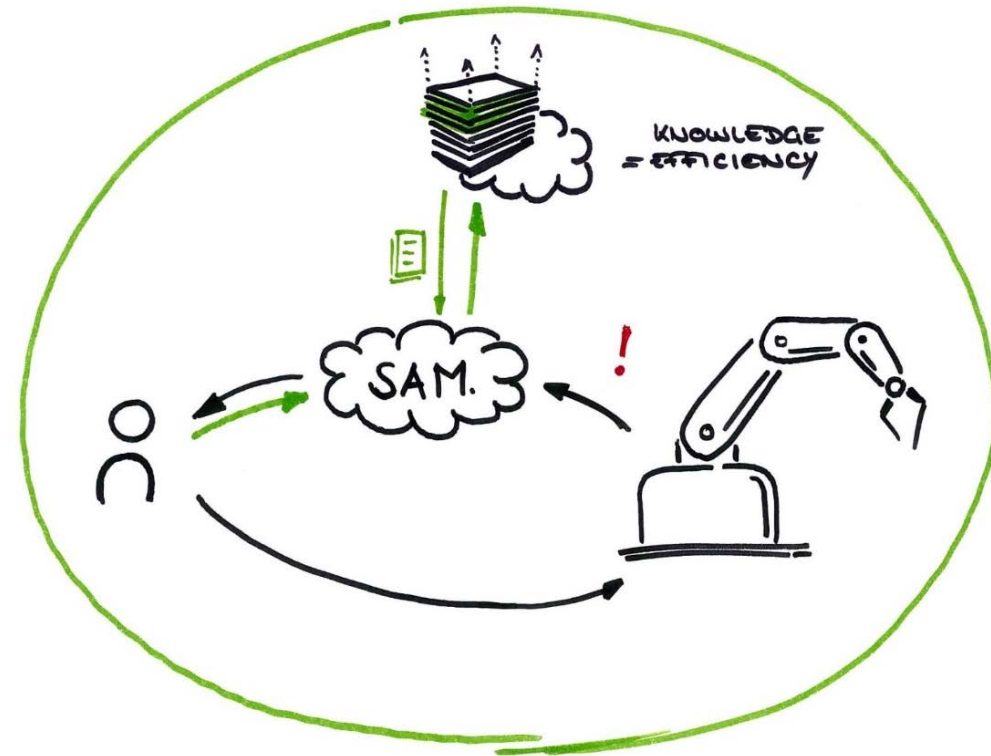
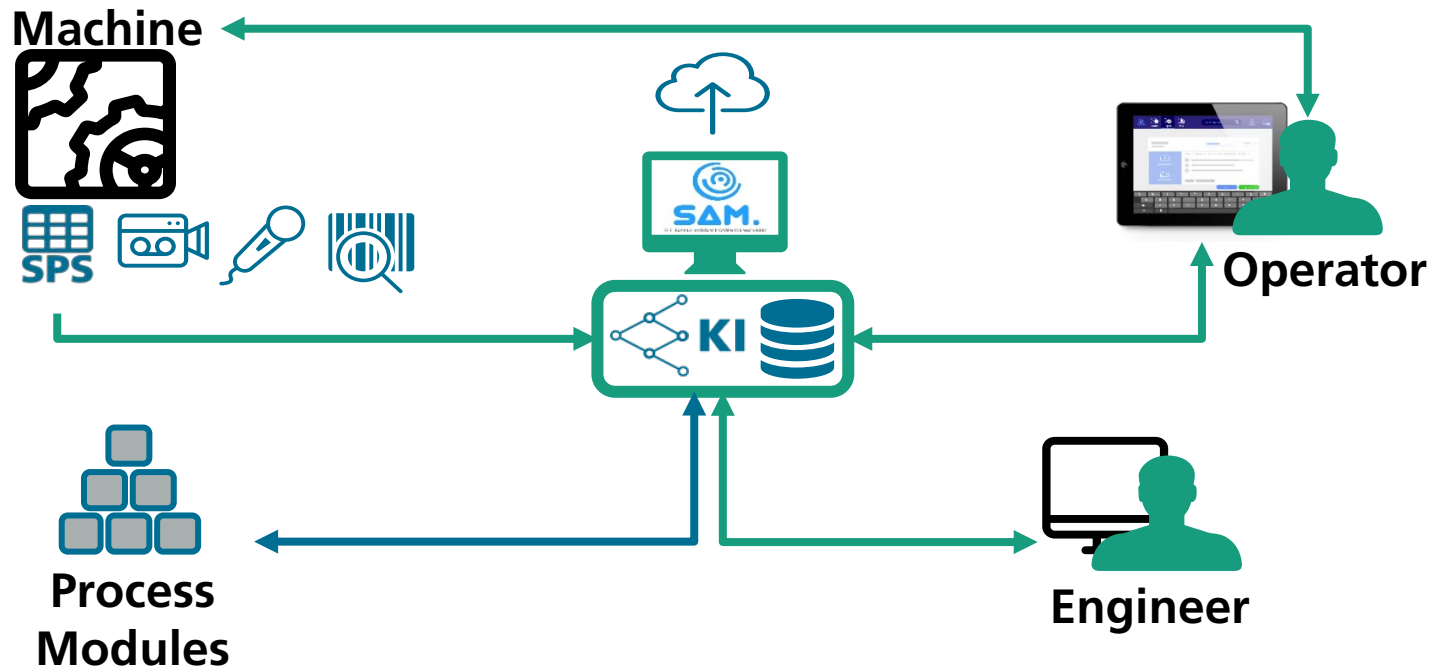
Source: Pant, A. and M. Reinelt (2015).
„Modellgestützte Verpackungsentwicklung.
Haltbarkeitsabschätzung am Beispiel verpackter
Erdbeeren.“ Verpackungs-Rundschau 66(10): 56-57

Food Packaging

Bottom up Approach: Impact for R&D



- Human experience and machine learning
- Self-learning Assistance system for Machines



Summary

- Digital interlinking of machine, product and quality control data may support food safety and process efficiency (Level: machine / process / company / food value chain)
- Faster and easier tracking & tracing
 - Continuous recording of production, processing and delivery conditions
 - High level of process automation is beneficial
- Objective for R&D: Real-time food safety and quality monitoring and control
- Hybrid models could bring additional information for process optimisation

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