# USE CASES OF DATA ANALYTICS IN THE PROCESS INDUSTRY

Nico Zobel, Andreas Backhaus, Andreas Herzog
Fraunhofer Institute for Factory Operation and Automation IFF

1. Introduction
2. Methods
3. Use Cases
4. Outlook




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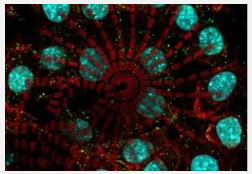
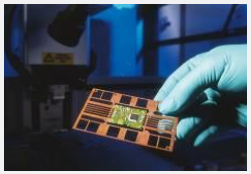
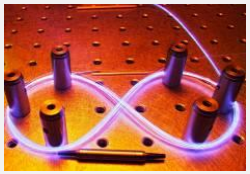
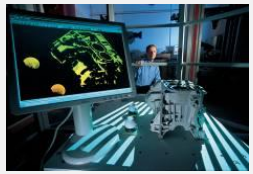
# Fraunhofer-Gesellschaft in Profile

- 66 institutes and research units
- About 24,000 employees
- Research budget of € 2 billion

Seven Fraunhofer Groups

- Information and Communication Technology
- Life Sciences
- Microelectronics
- Light & Surfaces
- Production
- Materials and Components
- Defense and Security

*As of March 2014*





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# Fraunhofer in Germany








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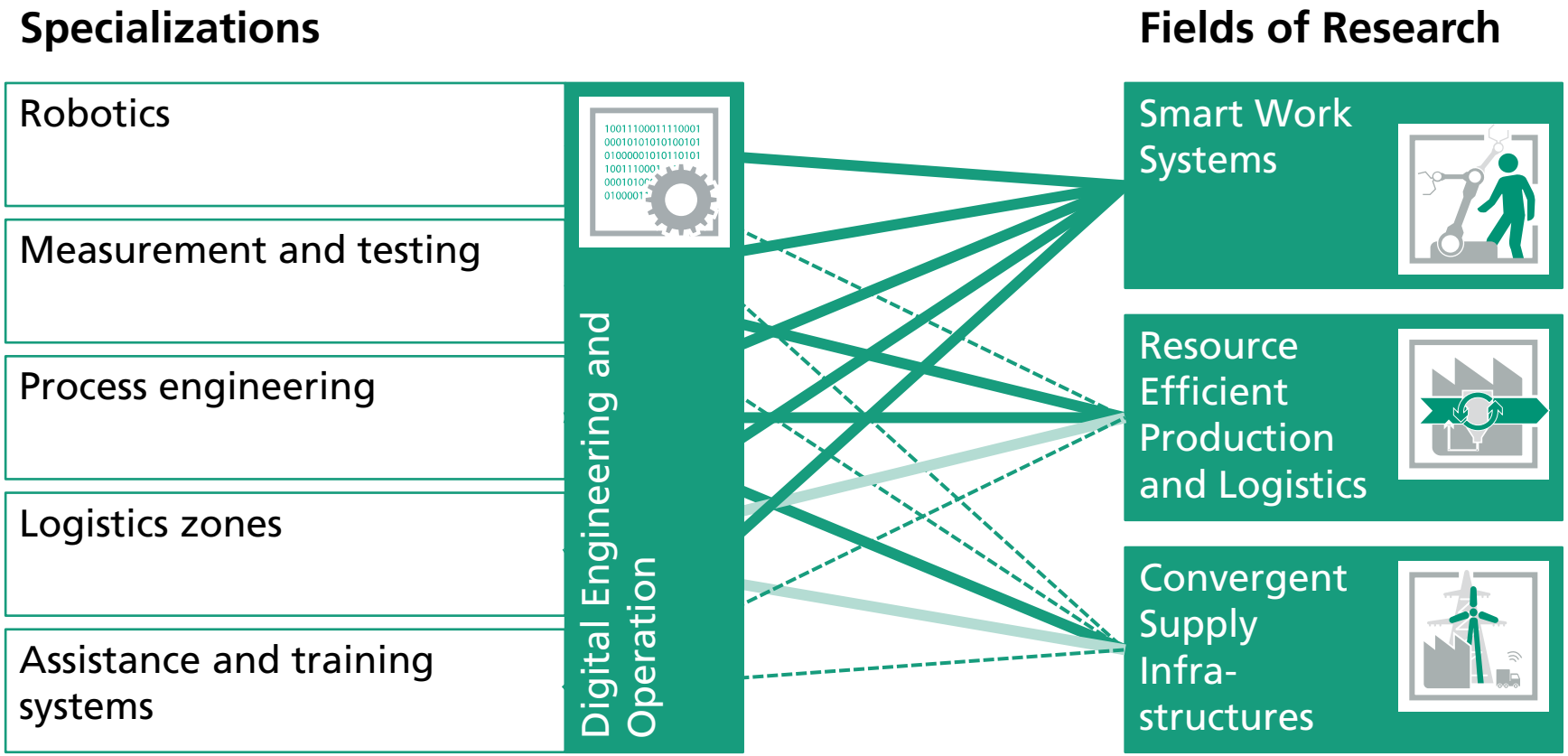
# Fraunhofer IFF as Technology Partner

## Interrelated Specializations for Fields of Research





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# Convergent Supply Infrastructures
## Process Engineering

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# Analytics at Fraunhofer IFF
## Digital Farming

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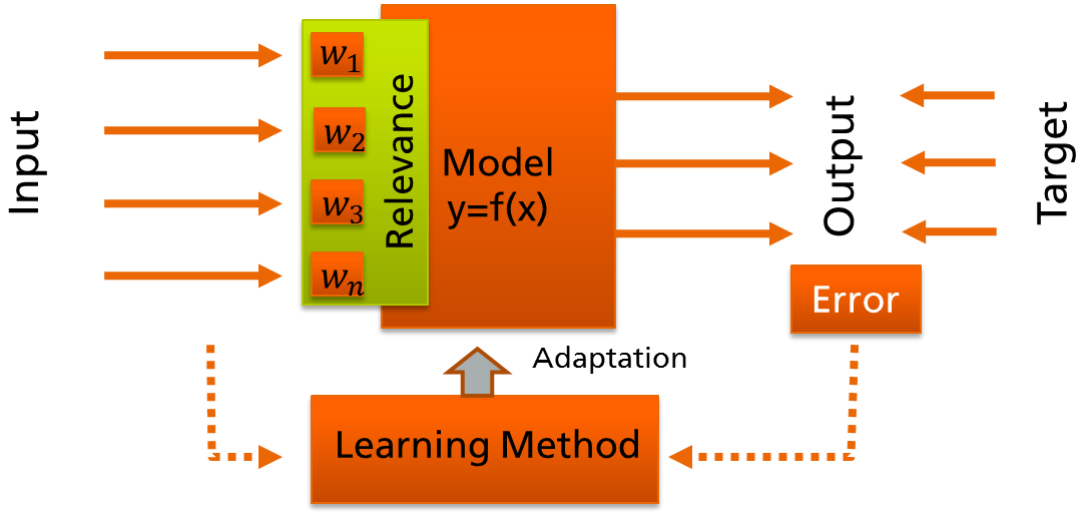
# Analytics
## Methods

- Learning Methods:
  - Gradient Descent
  - Genetic Algorithm
  - Simplex
- Training of up to ten methods in parallel





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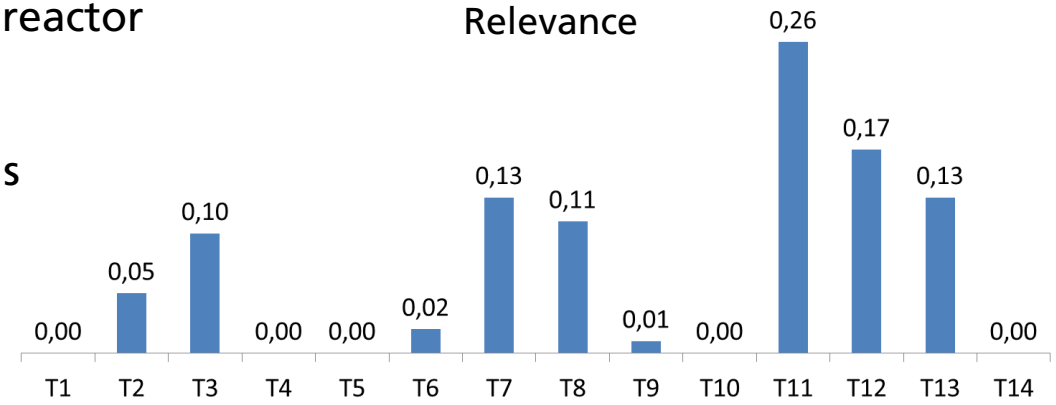
# Use Case #1
## bubbling fluidized-bed gasification of wood chips


**Objective:**
soft-sensor for CO in producer gas

**Data:**
- 15-Sec.-Values logged for 12 h (0,5 MB)
- Temperature distribution in the reactor

**Effort:**
1 day pre-processing, 3 days analysis (Desktop-PC)

**Result:**
average relative error 1,03 %
relevance distribution





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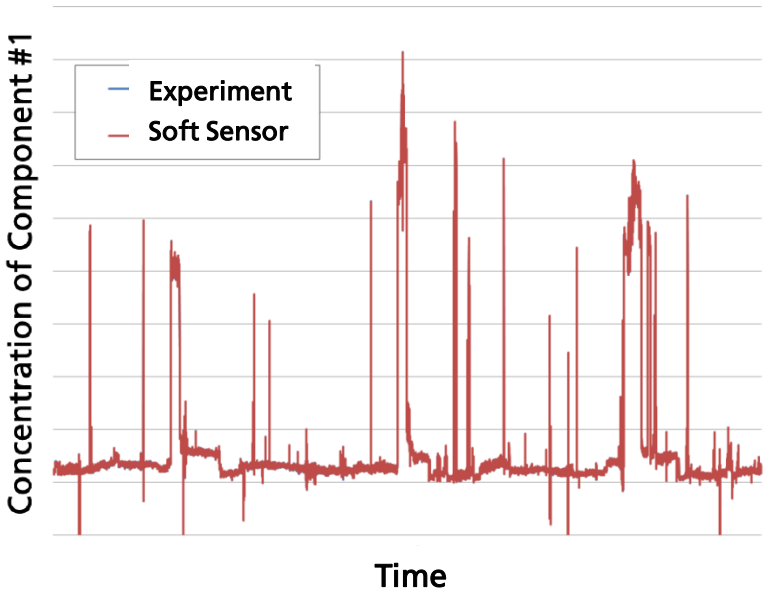
# Use Case #2
## Flue Gas Cleaning

**Objective:**
soft-sensor for flue-gas component #1

**Data:**
- half-hour values logged over 3,5 years (58.000 rows, < 1 MB)
- temperature, volume flow, concentrations of components #2 to #6

**Effort:**
1 day pre-processing, 3 days analysis (Desktop-PC)

**Result:**
average relative error 0,25 %



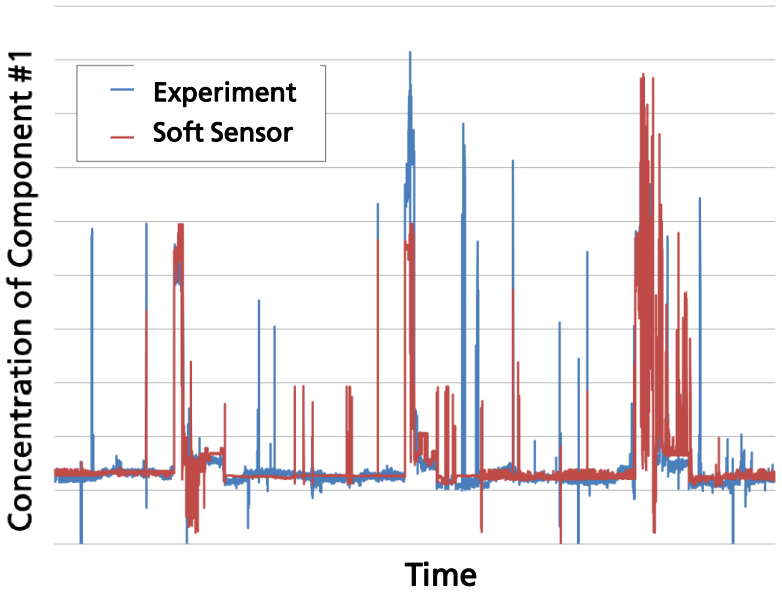
# Use Case #2
## Flue Gas Cleaning

**Objective:**
soft-sensor for flue-gas component #1

**Data:**
- half-hour values logged over 3,5 years (58.000 rows, < 1 MB)
- temperature, volume flow,

**Effort:**
1 day pre-processing, 3 days analysis (Desktop-PC)

**Ergebnis:**
average relative error 3,67%





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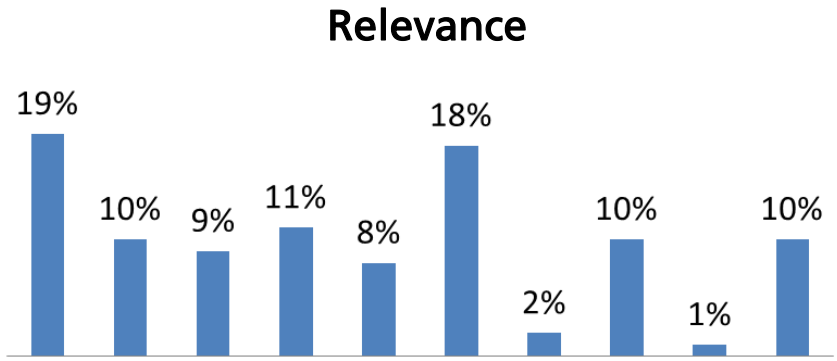
# Use Case #3
## $CO_2$-Separation

**Objective:**
analysis of production costs

**Data:**
1-sec.-values logged over 5 months (140 MB)

**Effort:**
1 day pre-processing, 3 days analysis (Desktop-PC)

**Result:**
relevance distribution





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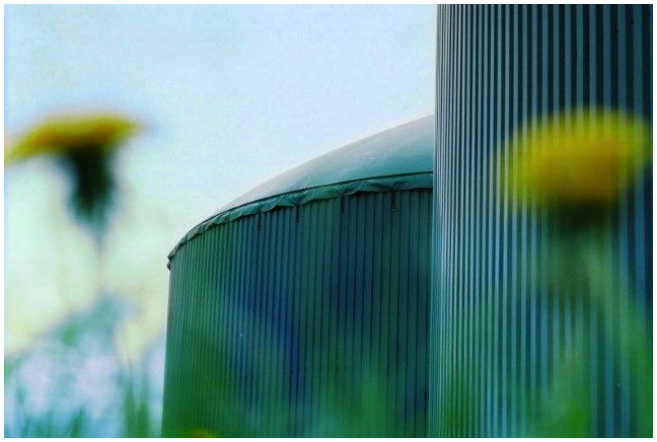
# Use Case #4
## Digestion



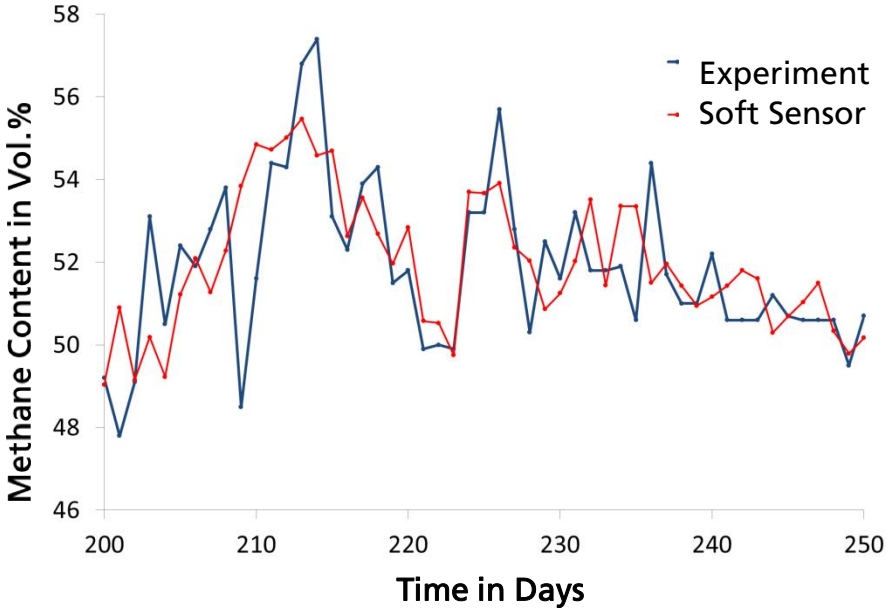
Quelle: ABOwind

**Objective:**
soft-sensor for methane content in biogas

**Data:**
- 1-day-values logged for one year (350 rows, 100 kB)
- Temperatures, feed composition, stirring power, ...

**Effort:**
1 day pre-processing, 3 days analysis (Desktop-PC)

**Ergebnis:**
average relative error 1,74%





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# Use Case #5
## Drying / Granulation

**Objective:**
Prediction of blocking of liquid injection nozzle

**Data:**
approx. 20 blocking instances

**Effort:**
ongoing






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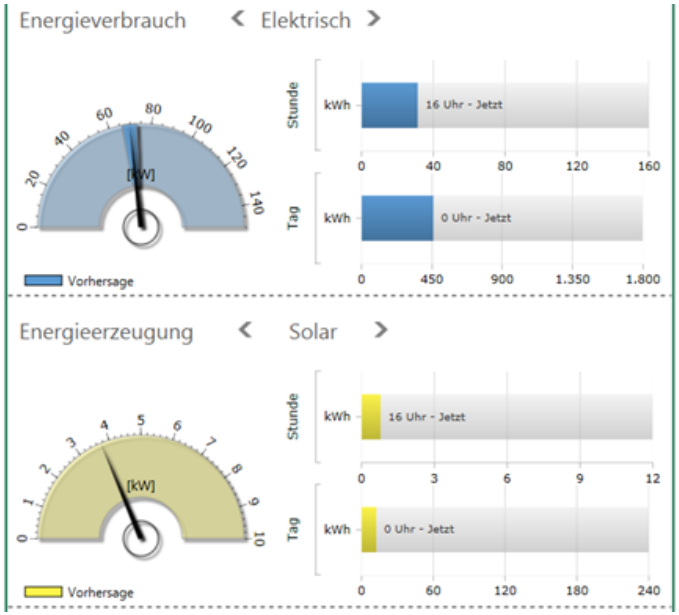
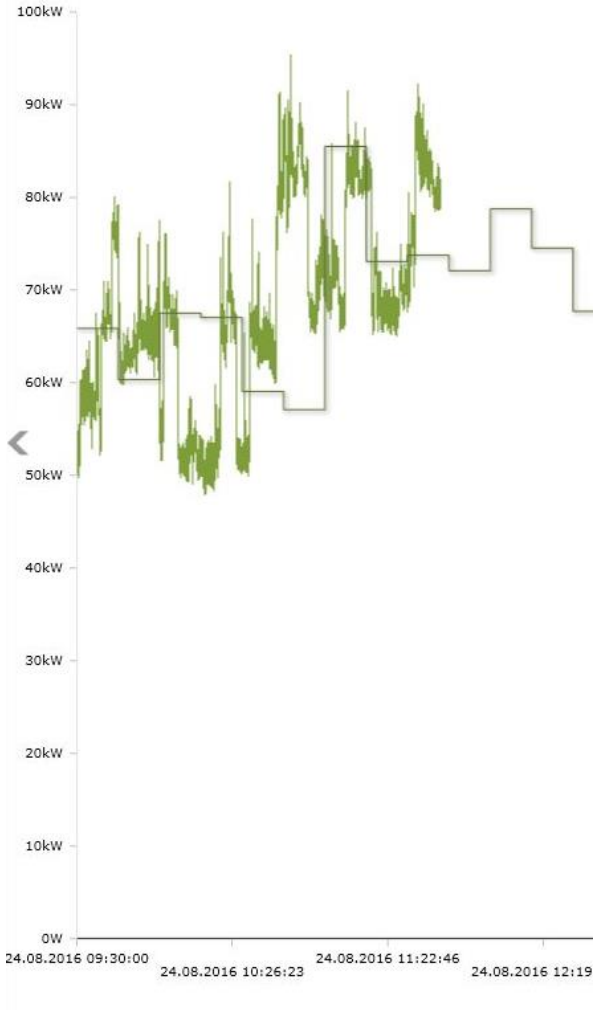
# Use Case #6
## Forecast of Electrical Power Consumption





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# Outlook

- Product quality of distillation column
- Flame monitoring
- Predicitive maintenance of pumps and compressors by application of operator experience (fuzzy logic) and analytics (ANN)
- Combined analysis of heterogeneous data:
  - Engineering
  - Operation
  - Maintenance
  - Inspection
- „Soft Sensor as a Service“ via Virtual Fort Knox

# Your Technology Partner for Applied Research



**Fraunhofer Institute for Factory Operation and Automation IFF**

Dr.-Ing. Nico Zobel

Sandtorstrasse 22
39106 Magdeburg

Phone: +49 391 4090-363

nico.zobel@iff.fraunhofer.de
www.iff.fraunhofer.de





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