



# European Sensor Systems Cluster – ESSC

**“Renaissance of chemical and biological sensors”**

## Industrial Process Monitoring

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# General Requirements – Sensors for process monitoring

- Long term stability - harsh conditions
- Robustness
- Low maintenance
- Stability towards cleaning/sterilization
- Self-calibration or minimum calibration
- Miniaturization
- Non-invasive
- Online and Inline
- Multiple parameters
- Connectivity and low power

**Improvements necessary!!!**

# Examples of chemical sensors for inline process monitoring

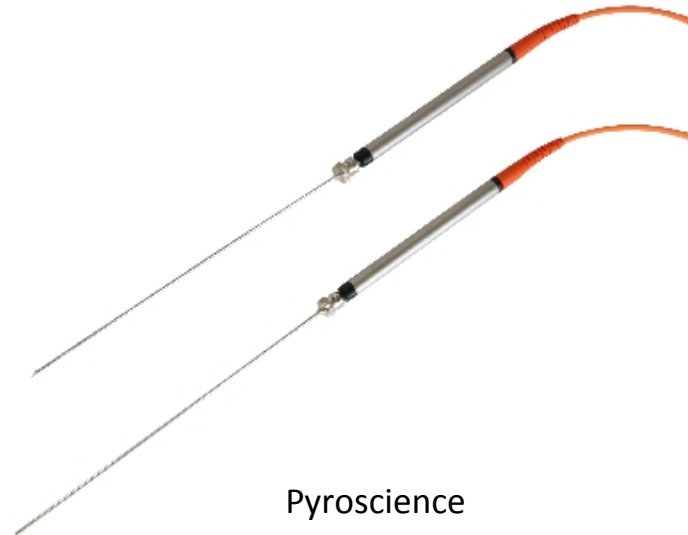
Optical oxygen sensor



Mettler-Toledo

Resistance to steam  
Sterilization/CIP

Solvent resistant  
oxygen sensor



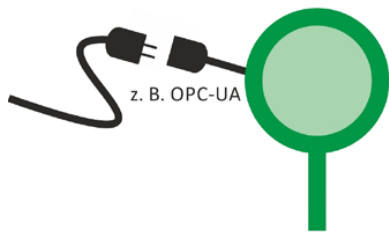
Pyroscience

Short-term exposure

# Smart Sensor

## Properties

connectivity and communication



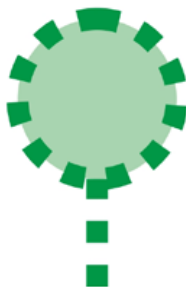
Maintenance and Operational function



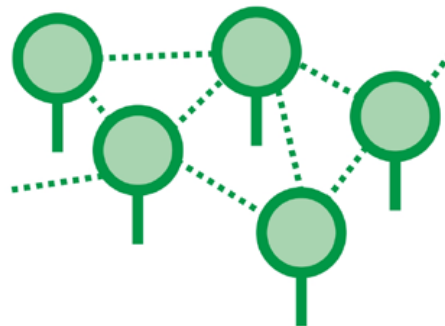
Trace-ability and Compliance



Virtuelle discription



Interactivitiy



NAMUR Roadmap  
„Prozesssensoren 4.0“

# Benefits of Smart Sensors

## **Continuous processes**

- Higher measurement frequency → More stable and controlled processes
- Possible elimination of downstream processing
- Increased yield and better constant quality

## **Batch process**

- Increase of the plant capacity – shorter waiting time for off-line analytics
- Reduced batch times
- Less side-products via better reaction control

## **Bioprocesses / Fermentation**

- Real-time information about the process conditions
- More robust and scale-able processes
- Better Process optimization
- Monitoring of metabolites of the product
- Recognition of process endpoints.

# Examples – Industrie 4.0 in industrial processes

## **Continuous processes**

- Integration of external databases (weather forecasts, prices of resources, currencies, etc. )
- Last minute decision based on demand

## **Batch processes**

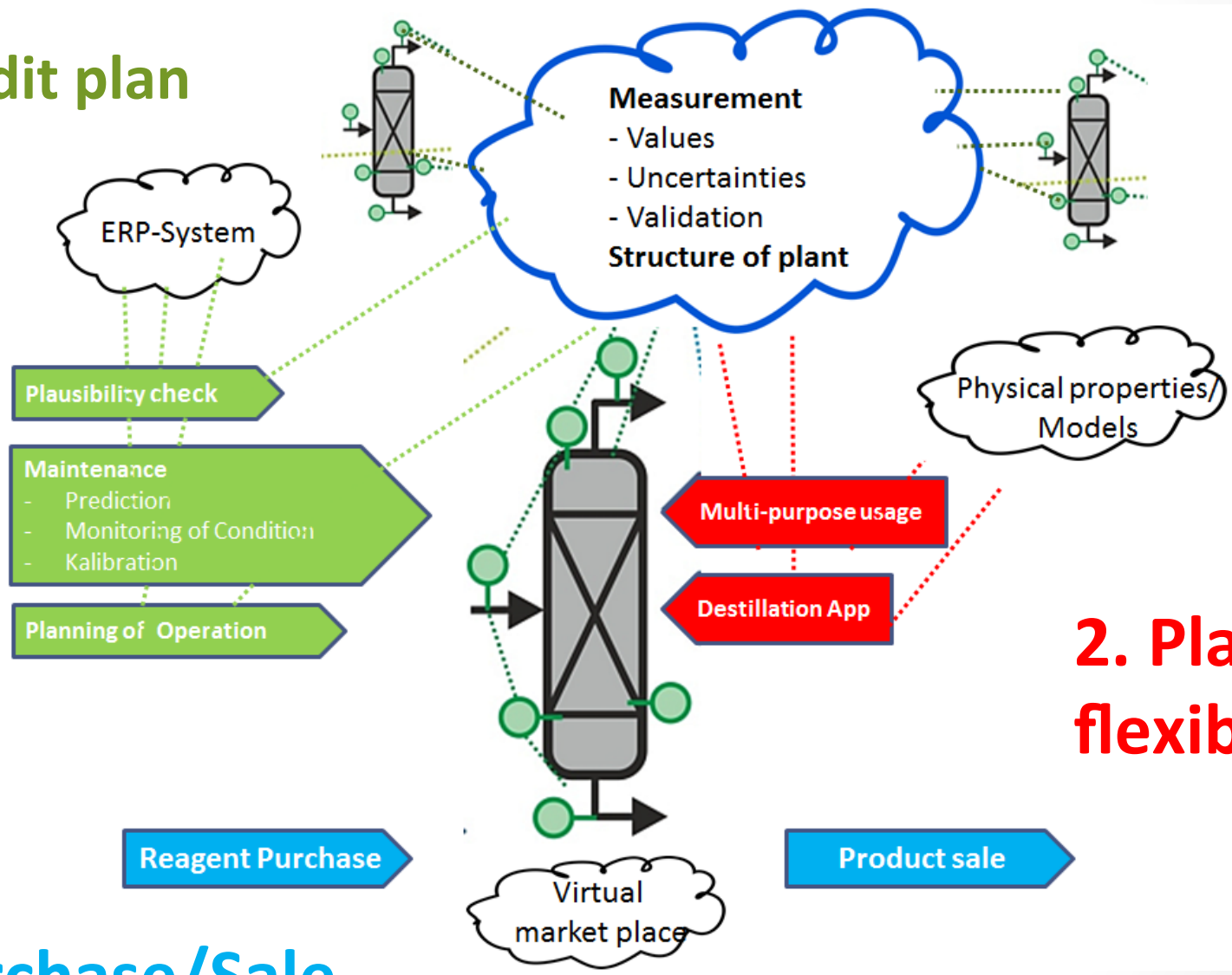
- Accelerated change of products – predictive adjustments
- Automated change of products depending on market trends

## **Bioprocesses**

Model from the cloud for control of advanced processes

# Example scenarios of Sensors 4.0 in Processing

## 1. Audit plan



## 2. Plant-flexibility

## 3. Purchase/Sale

# Topic: **Sensor platform for multi-parametric process control**

Call timing: 2020-2021

Instrument: RIA

**Challenge description: Multi-parameter sensors require heterogenic integration of complementary sensor technologies** (e.g. electrochemical and optical sensors).

Sensors requirements: GMP and PAT regulations, withstanding cleaning in place and sterilisation procedures, self-maintenance, on-site calibration, communication features, interaction in a network.

**Possible solutions:** Research on the development of generic techniques for heterogenic integration of different sensor technologies. This includes methods for the **realization of different sensor types on common substrates, using similar materials, packaging and fabrication techniques, as well as electronic readout systems and data treatment.**

**EU positioning:** Europe has a strong commercial position in sensor systems for process analytical technology because many large companies are established in Europe. Process instrumentation and services are strongly covered by European manufacturers

**Companies interested:** Endress + Hauser, Bayer, BASF, Evonik, Krohne Messtechnik GmbH, Aliseca GmbH, ABB AG, Siemens AG, Bilfinger Maintenance GmbH, Evonik Industries AG, Hamilton, Mettler-Toledo, Metroglass,



# Topic: Smart and intelligent process control systems for smart manufacturing and process-intensification

Call timing: 2020-2021

Instrument: RIA

**Challenge description:** Miniaturized and cheap smart sensor systems based on chemical sensors for **widespread deployment in industrial** processes for small and large volume reactors are needed in the future. These systems enable **multipoint** measurements to **achieve a better view on the actual concentration distributions** in a reactor. **The optimisation of processes can be shifted from an empirical to a systemic approach.** The obtained data and knowledge would lead to models that enable a **predicable process**. Furthermore, upscaling and downscaling of processes can be facilitated and accelerated by using sensor data. Sensors requirements: GMP and PAT regulations, withstanding cleaning in place and sterilisation procedures, self-maintenance, on-site calibration, communication features, interaction in a network.

# Topic: **Smart and intelligent process control systems for smart manufacturing and process-intensification**

Call timing: 2020-2021

Instrument: RIA

**Possible solutions:** Miniaturized sensor devices with **electrochemical or optical transducing elements. Advanced sensor materials based on materials research.** Sensor modules needs communication interfaces to achieve sensor networks connected to cloud services. **Data model and Data Analysis** . This is enabling the “internet of things” for process analytics or the Industrie 4.0 concept for chemical production.

**EU positioning:** Europe has a strong commercial position in sensor systems for process analytical technology because many large companies are established in Europe using these instruments. Process instrumentation and services are strongly covered by European manufacturers

**Companies interested:** Endress + Hauser, Bayer, BASF, Evonik, Krohne Messtechnik GmbH, Aliseca GmbH, ABB AG, Siemens AG, Bilfinger Maintenance GmbH, Evonik Industries AG, Hamilton, Mettler-Toledo, Metroglass,

# Topic: Sensor for single use reactors

Call timing: 2018-2019

Instrument: RIA



<http://www.genengnews.com>

**Challenge description:** Single use reactors are more and more in use biotechnology and pharmaceutical industry to eliminate cumbersome and expensive cleaning and sterilization procedures. **Although sensor technology exists, there is a lack in the number of parameters, sensor stability, cost-efficiency, resistance toward sterilisation and ease-of-use.**

**Possible solutions:** Electrochemical, optical chemical sensor and spectrometric approaches are feasible. The **active-sensor element** can be integrated into the single use reactors and the read-out electronics can be separated. **Advances in sensor materials** will lead to higher stability, better calibration and ease-of-use.

**EU positioning:** Europe has a several companies which are active in the market of disposables reactor technology for biotechnology. According to the German NAMUR roadmap “Prozess-Sensoren 4.0” the market for disposables an increase of 15-20% is expected.

**Companies interested:** GE Healthcare Life Sciences, Merck Millipore, CerCell, Sartorius, Blue-Sense, Applicon, m2p-labs,