



MEMBER OF THE NYNOMIC GROUP

# Process Analytical Technologies - Functional and Non-Functional Requirements in AgriFood

EPIC Technology Meeting on Photonics for AgriFood Industry

Enlightening the Future at DigiFoods

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# Introduction tec5 AG, Germany

## Spectrometer Systems for the Agri and Food Industry

- We are a manufacturer of high-performance spectrometer technology
- With our wide portfolio, tec5 provides standardized spectrometer components, system components and fully integrated systems
- tec5 is based in Steinbach, Germany, close to Frankfurt Main
- tec5 is member of the Nynomic group

*„Integrating precise and robust measurements, even under tough environmental conditions, is key to an optimized production process.“*



# Introduction tec5 AG, Germany

## Spectrometer Systems for the Agri and Food Industry

### Solutions for

- 100% inspection of all goods
- Real time control and monitoring
- Inline, online, at-line, handheld
- In the process, on the field and integrated into the production machine
- UV, VIS, NIR and Raman technology

*„To solve the various challenges of non-functional requirements is key to successfully implement optical technologies in production and field environment.“*



# Solving functional and non-functional requirements

## Definition:

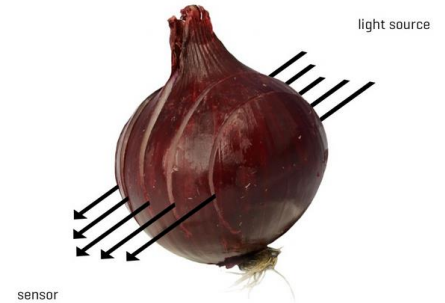
*“Functional requirements define what a system is supposed to do,  
and non-functional requirements define how a system is supposed to be.”*



# What are functional and non-functional requirements?

## Functional Requirements

- Wavelength range and resolution
- Detector type
- Measurement geometry and light source design
- Multichannel setup
- Data pre-treatment and processing
- Process control integration
- Transferability of calibrations
- Measurement speed



# What are functional and non-functional requirements?

## Non-Functional Requirements

- IP Ingree Protection
- Installation dimensions
- Hygienic design (material, surface finish, design...)
- Environmental temperature
- Vibration robustness
- Ex class (e.g., powder-Ex)
- Legal requirements (CE / EMC / UL etc.)
- Maintainability und usability



# Range of Products

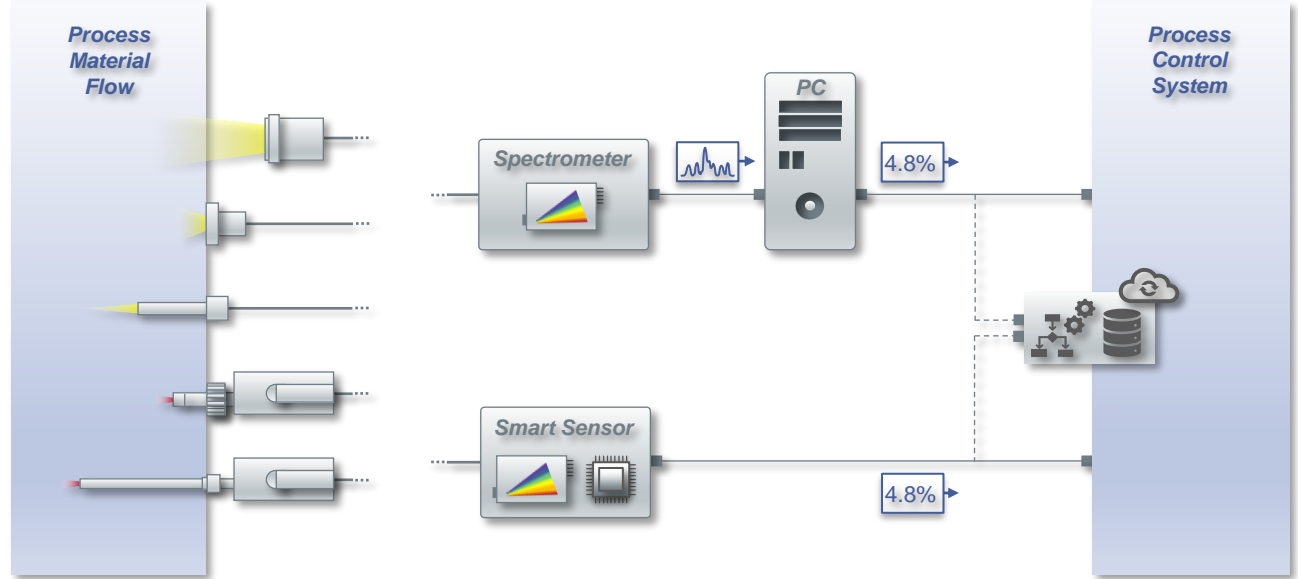
Comprehensive solutions from sample presentation to PLC interfaces with both the



- PC Line

and \_\_\_\_\_

- Embedded Line





# Example of inline color measurement on cocoa mass

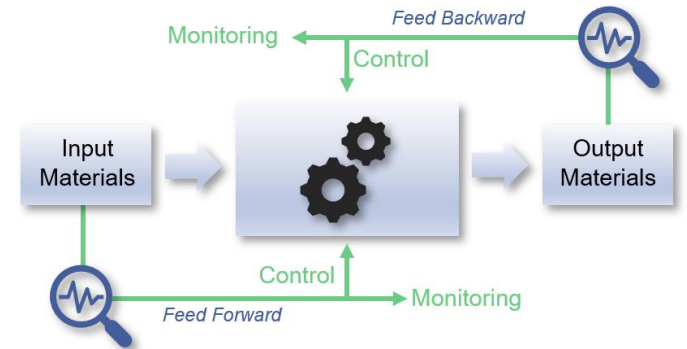
## Project Scope

- Digitalization of the process using data of a color and NIR sensor, other production data and AI-based modelling of the control parameters
- Different cacao masses are produced with different color specs
- Variation of raw beans caused by origin and season
- Adjusting process steps alkalization and roasting in real time to reach the right colour spec



## Project goal

*„Improve process control as a function of raw material variations and, as a result, optimize end-product consistency“*





# Example of inline color measurement on cocoa mass

## Specifications of the Installation Requirements at Customer Site:

- Installation in process stream - 24/7/365
- Temperature in and around pipe: range 110 +/- 10°C
- Food requirements
- Output color values (LCH values)
- Process Interface OPC-UA



# Example of inline color measurement on cocoa mass

## Technical Challenges and Solution

- 24/7/365 – with direct integration in the process stream
  - ➡ Measuring head with integrated reference
  - ➡ Offers cyclically referencing to ensure long-term stability
- Measuring head needs to withstand 110°C at the sensor installation point
  - ➡ High-temperature materials and components
- Measuring head needs to be food compliant
  - ➡ Sapphire window is secured against falling out by design
  - ➡ Food compliant material used



# Conclusion

- Various non-functional requirements have to be taken into account when bringing optical technology in production and field environment
- To meet those requirements is essential for a successful implementation in the long run
- A standard toolbox is available to cover those requirements
- And if necessary, the toolbox can be customized according application specific requirements



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## **Thank you for your attention**

## **Questions?**

**Steffen Piecha**

**Head of Sales**

**[s.piecha@tec5.com](mailto:s.piecha@tec5.com)**

