

# Production optimisation by use of in-line sensors in Arla Foods

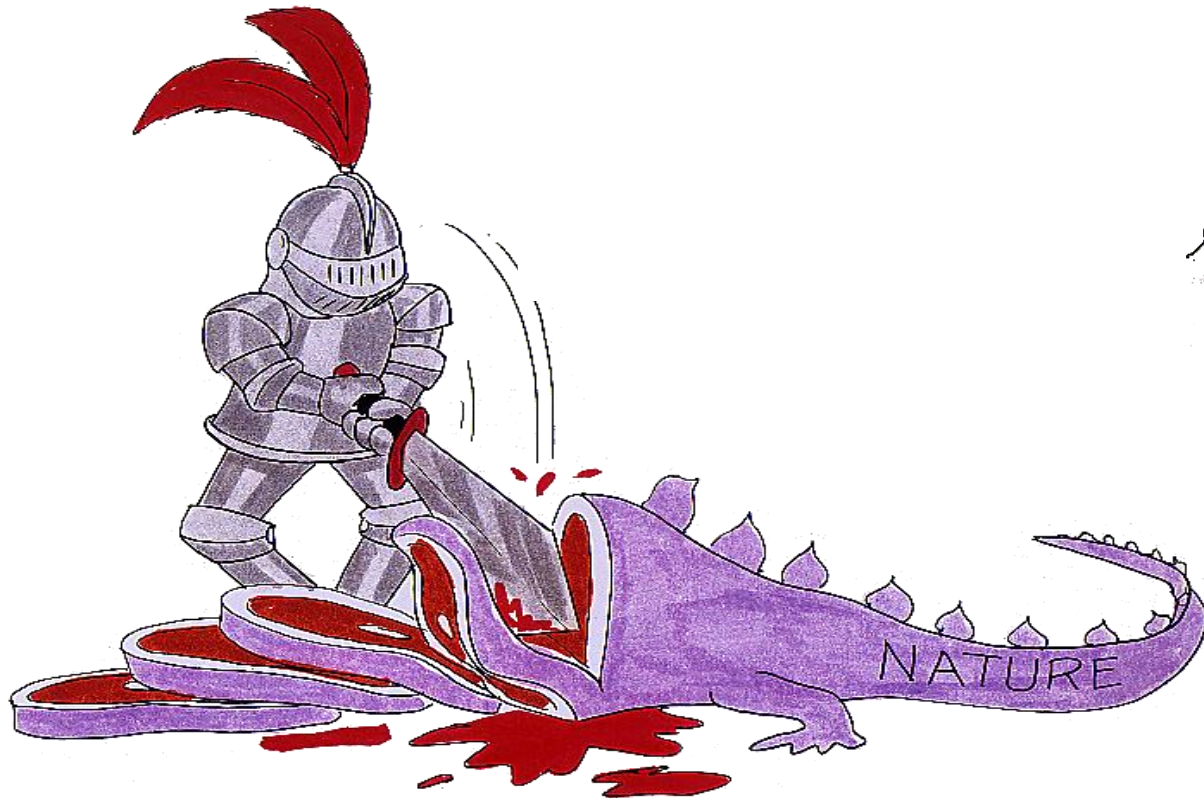
Christian B. Zachariassen  
Excellence Manager, Manufacturing Intelligence  
Corporate Supply Chain

Simon Mortensen  
Project Manager, Butter  
Holstebro Dairy



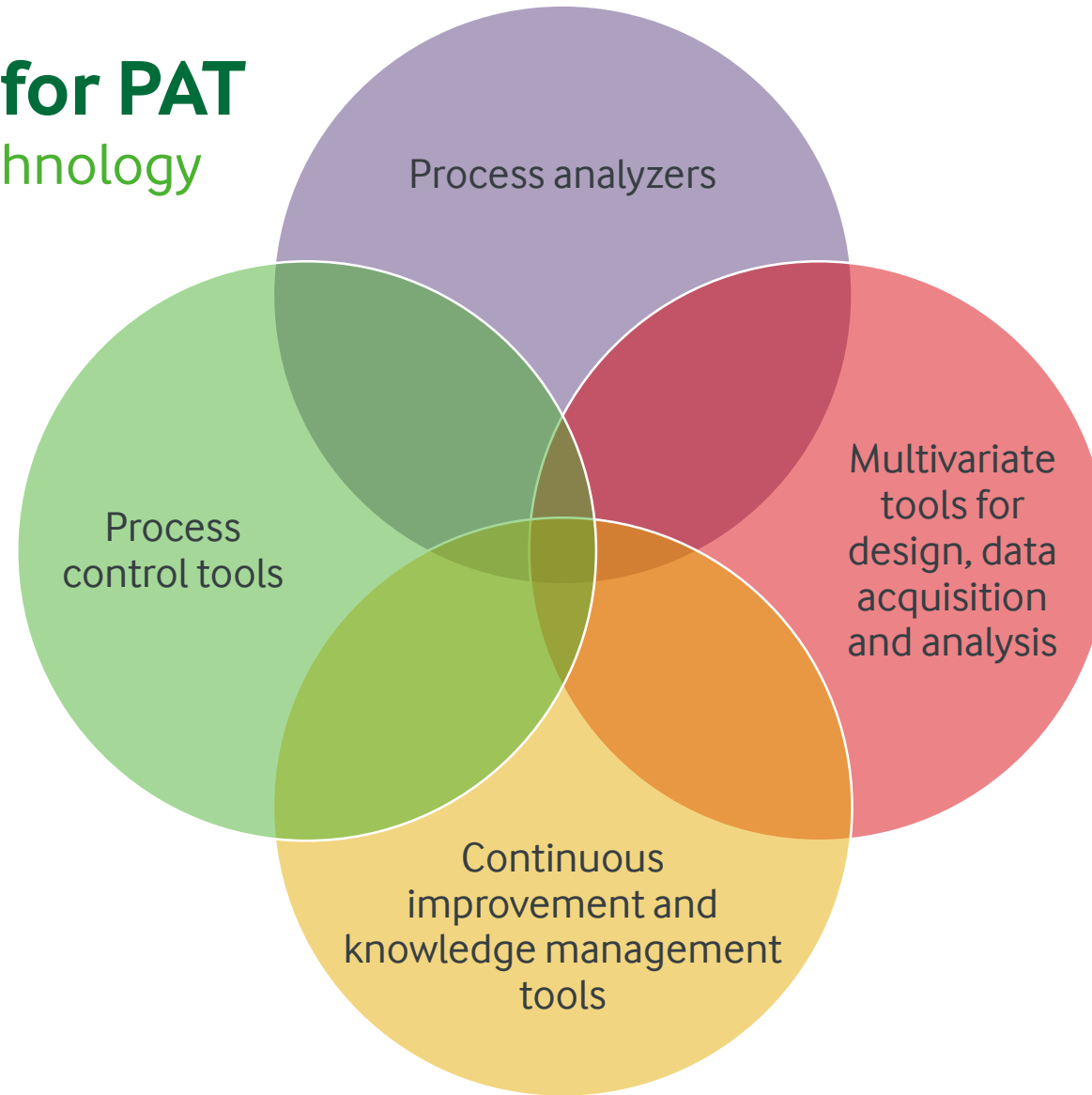


# Why sensors?



# Essential tools for PAT

## Process Analytical Technology



# Sensor development

1975, 0.01MP bw



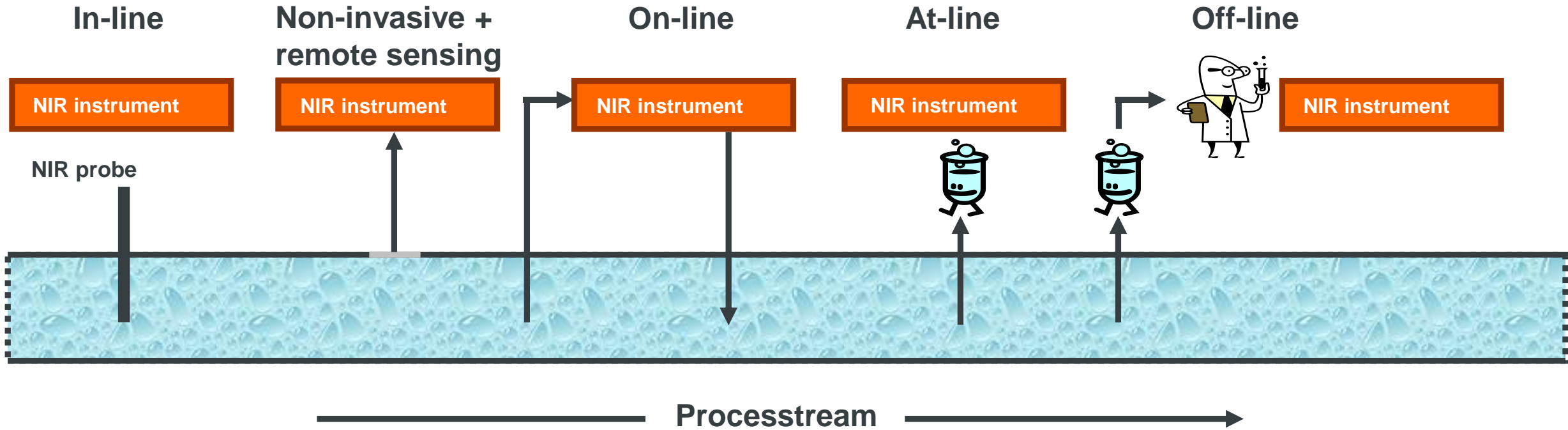
1997, 0.3MP



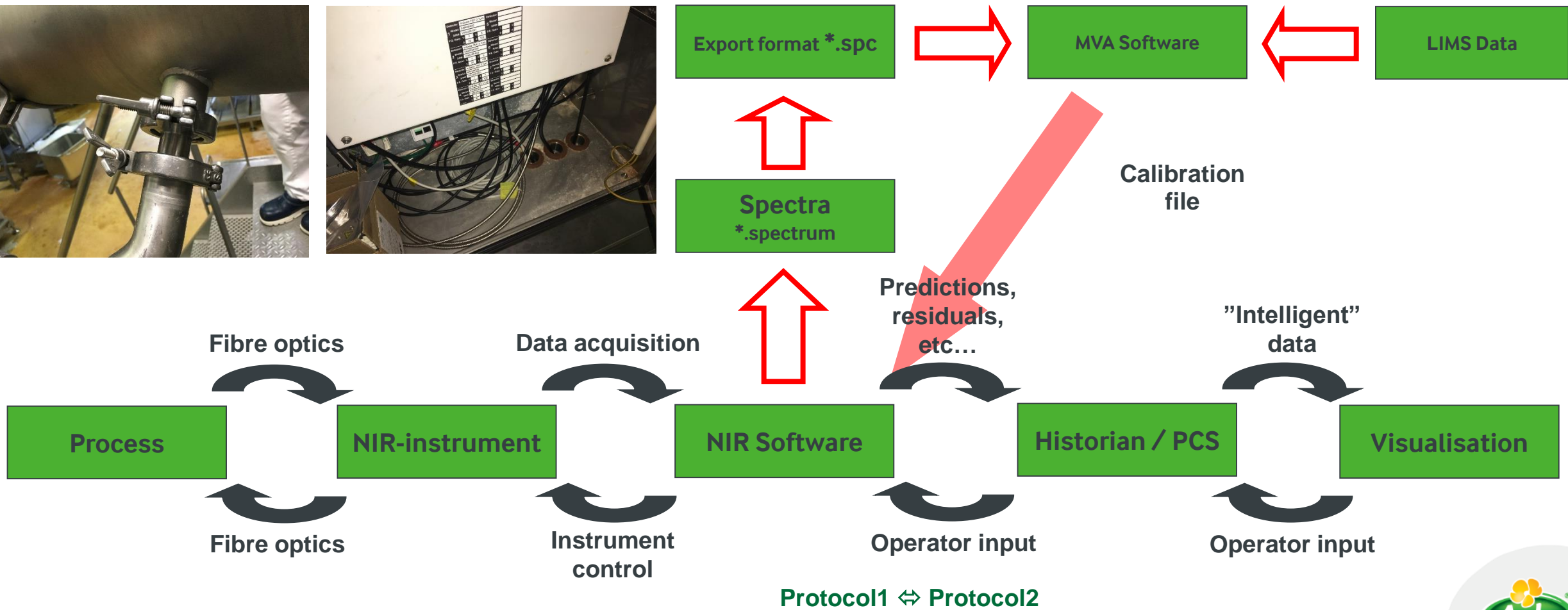
2007, 2MP



# Sensor interfacing to the process

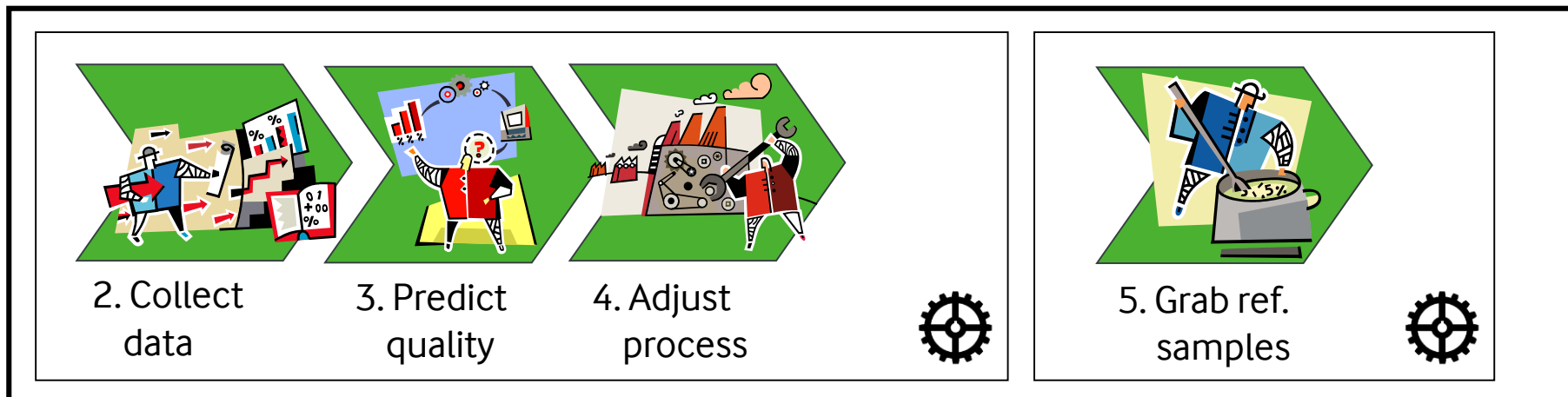


# Calibration interfaces

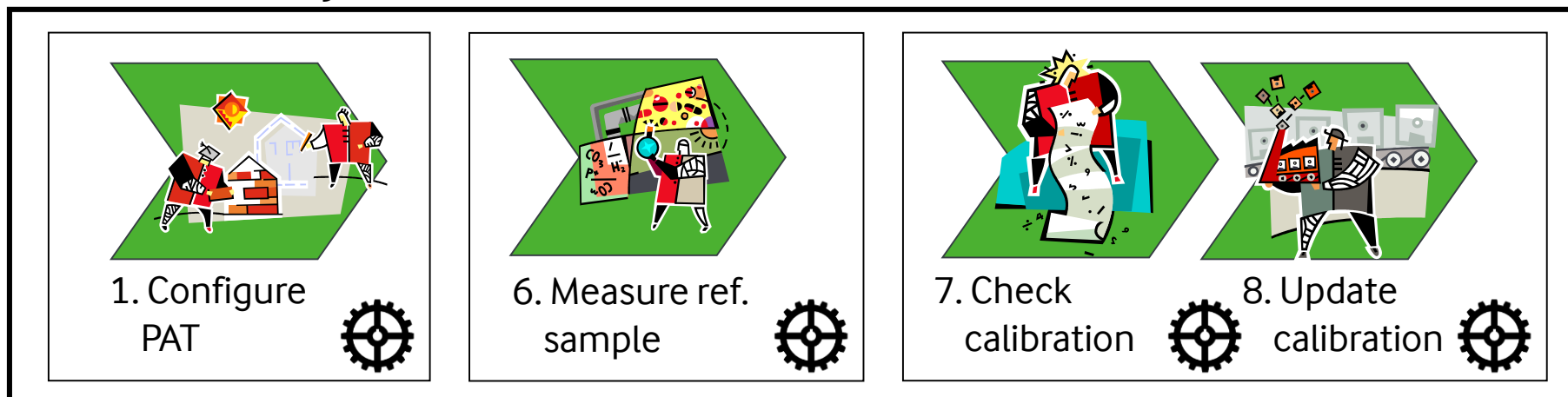


# Calibration workflows

## Production line

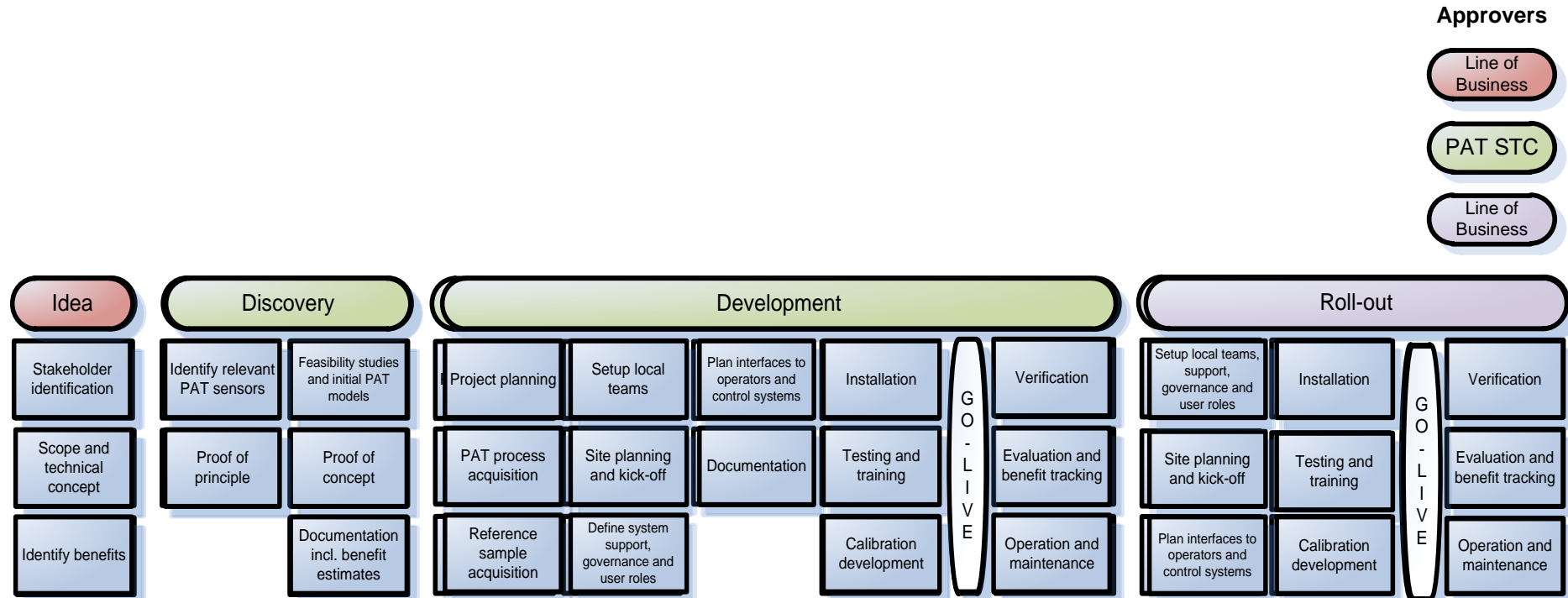


## PAT/Laboratory





# Sensor implementation - Way of working



# Optimization with in-line NIR at Holstebro Dairy



# Optimization with in-line NIR at Holstebro Dairy

- **What do we produce?**
  - Butter and spreadable (butter mixed with vegetable oil)
- **What do we measure?**
  - Water and salt in end products
- **How do we measure?**
  - In-line, At-line, laboratory
- **Why in-line???**



# Implementing a new instrument

- What do you get?
- It is a long proces, break it down into steps.
- Prioritize what is important to get out of the instrument. Where are you today?



# Sampling and understanding your process

- Secure that your sampling is correct, or at least the best you can get.
- Know your proces and your products.
- The need of actually getting product on the line and have the variation in the sampling data.
- What is the variation in the proces. Make small tests and secure to take samples when the process is stable.

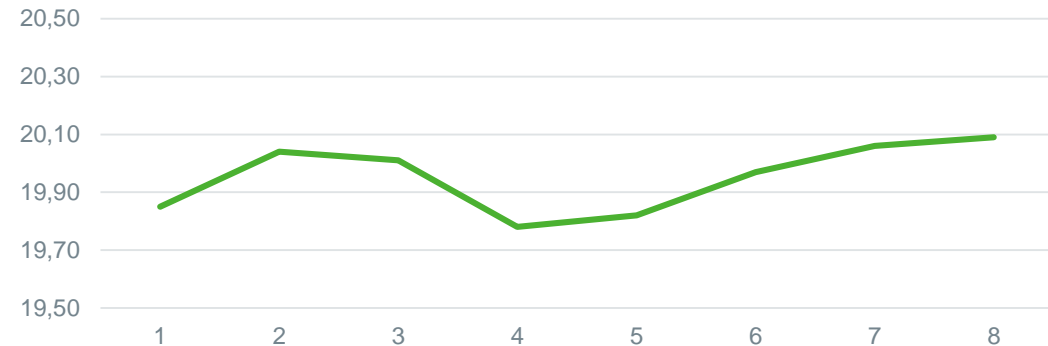


# How to use the output

What do you want to show your operators?

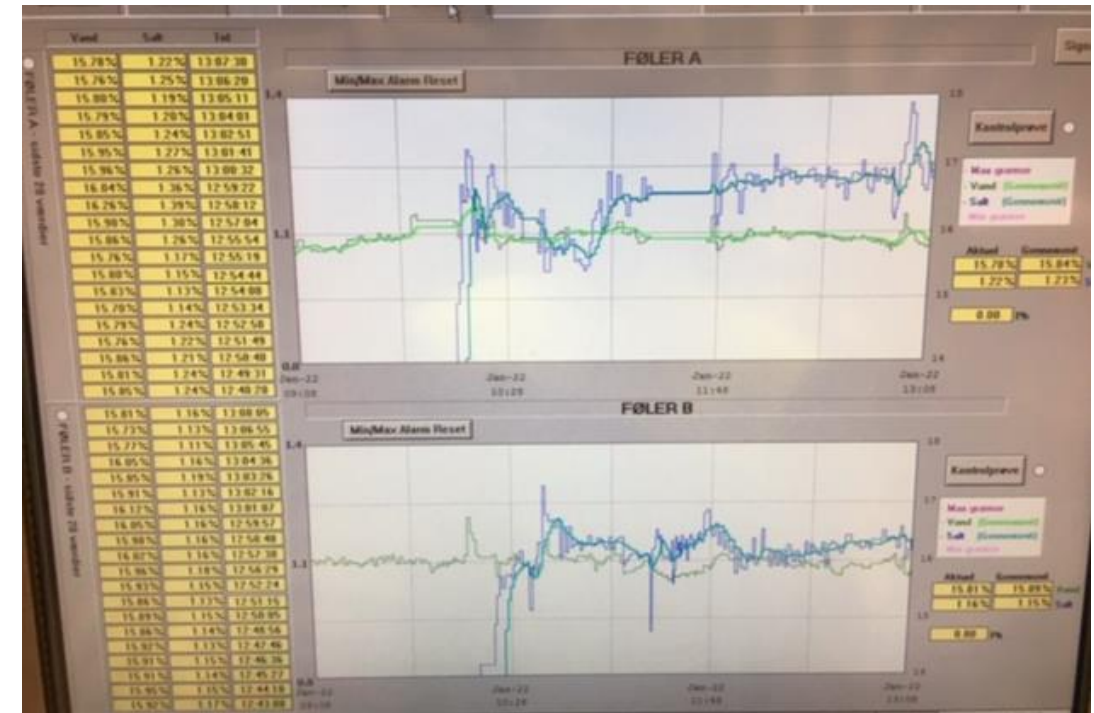
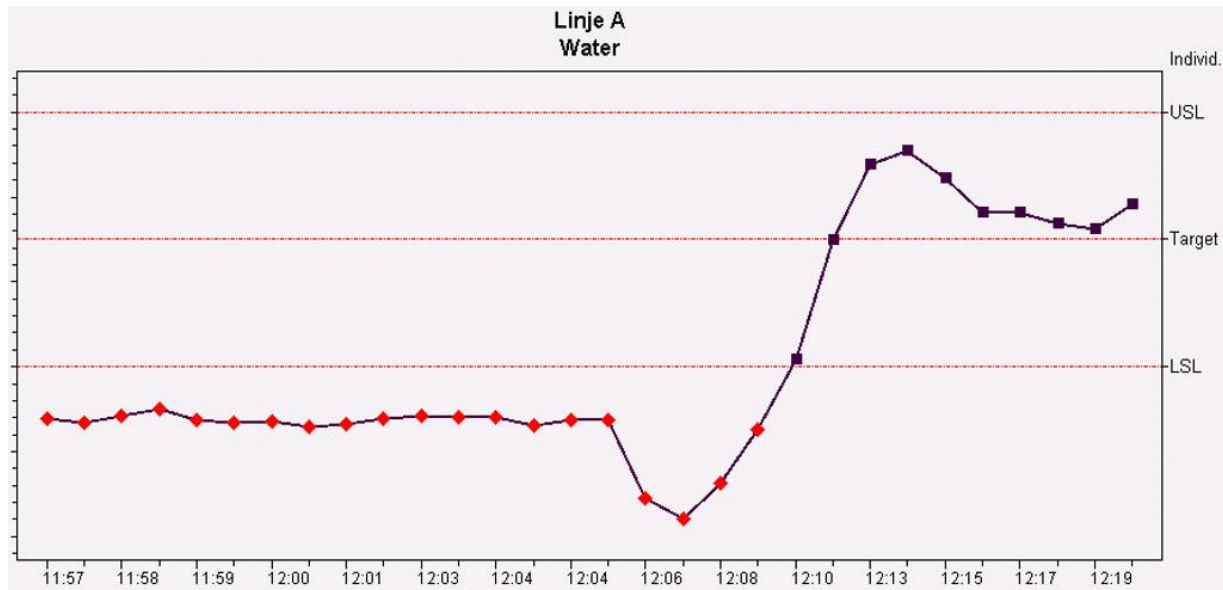
**19,85**

<b>19,85</b>
<b>20,04</b>
<b>20,01</b>
<b>19,78</b>
<b>19,82</b>
<b>19,97</b>
<b>20,06</b>
<b>20,09</b>



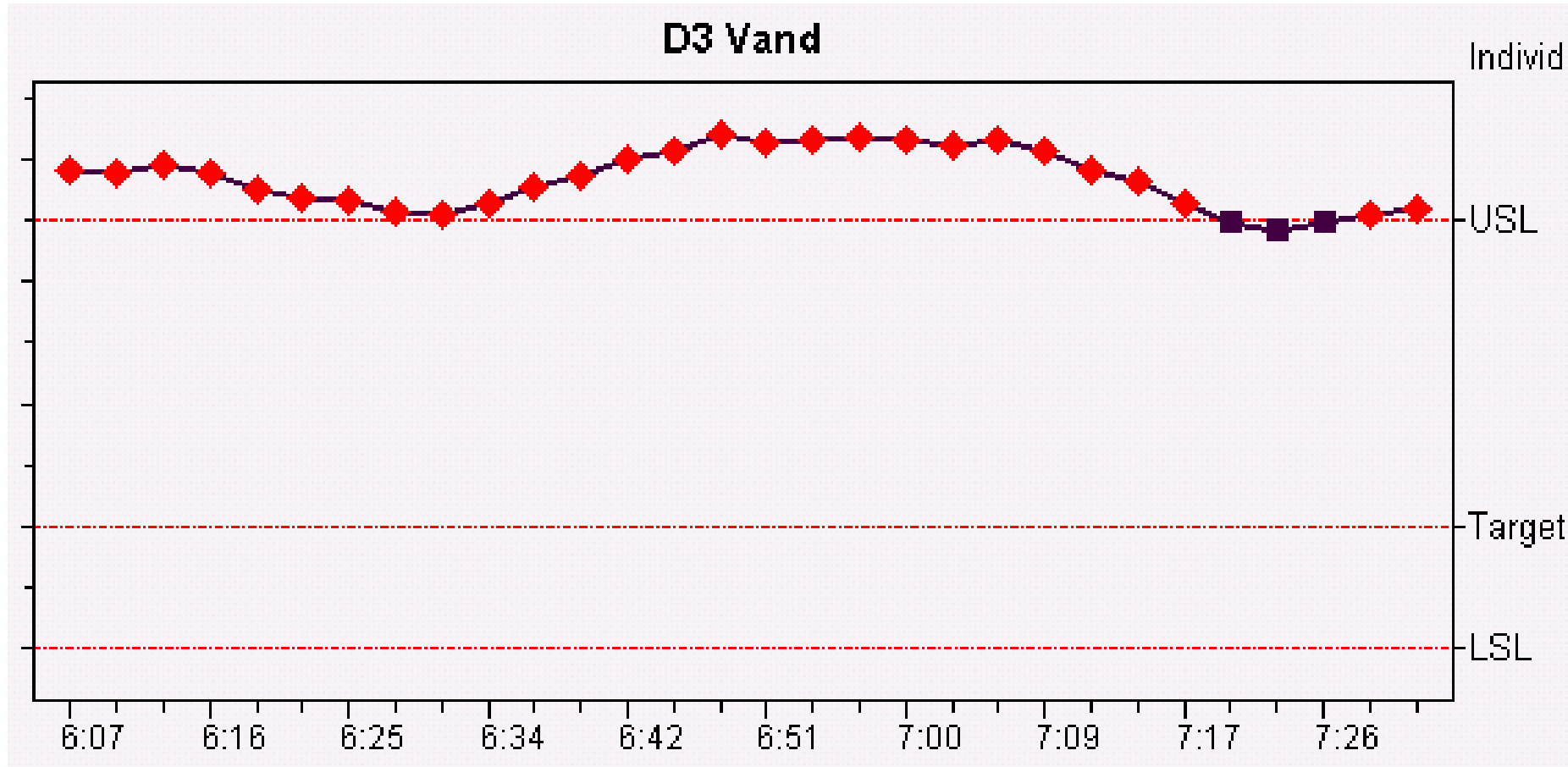
# What should the operators do?

- Setting up control limits
- Measurement frequency
- Moving average



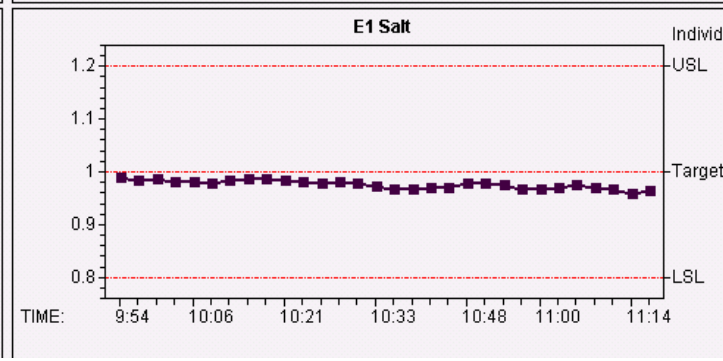
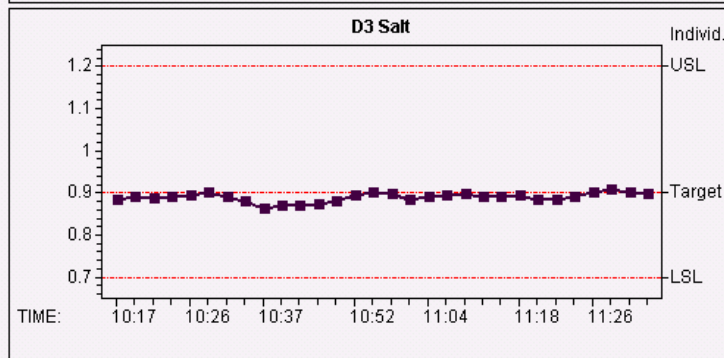
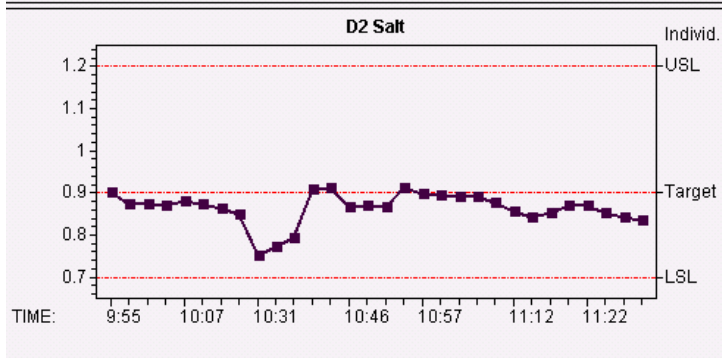
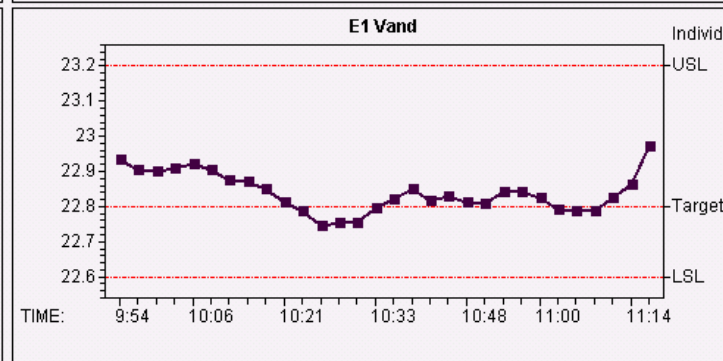
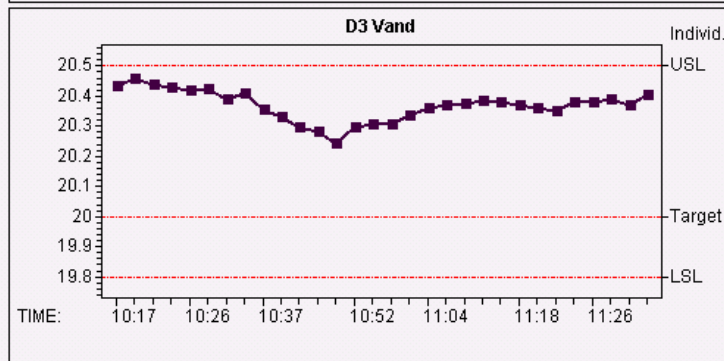
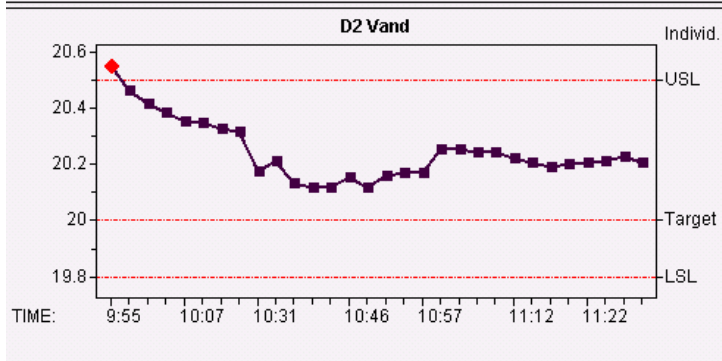
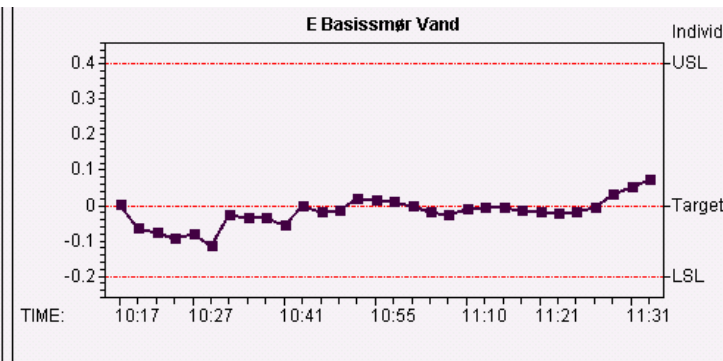
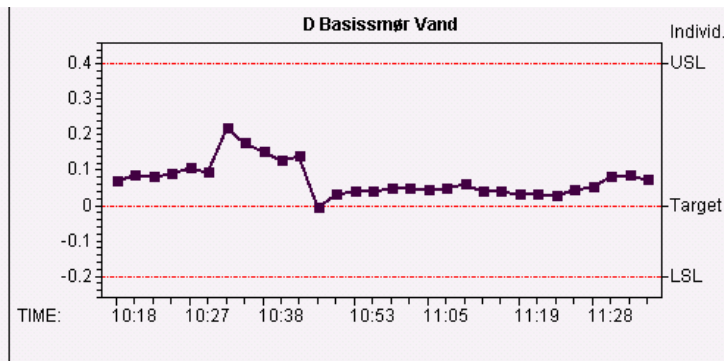
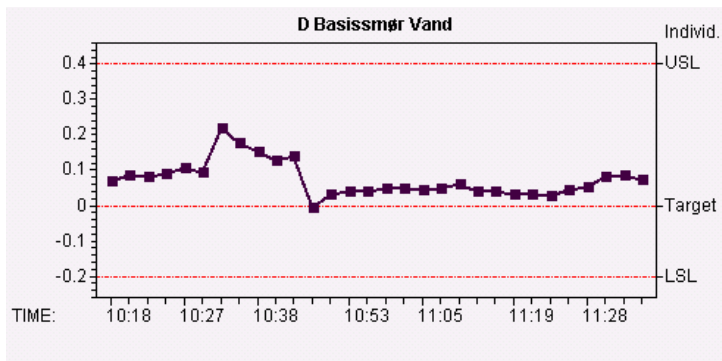
# Wrong results might be better than none?

Can still give valuable information

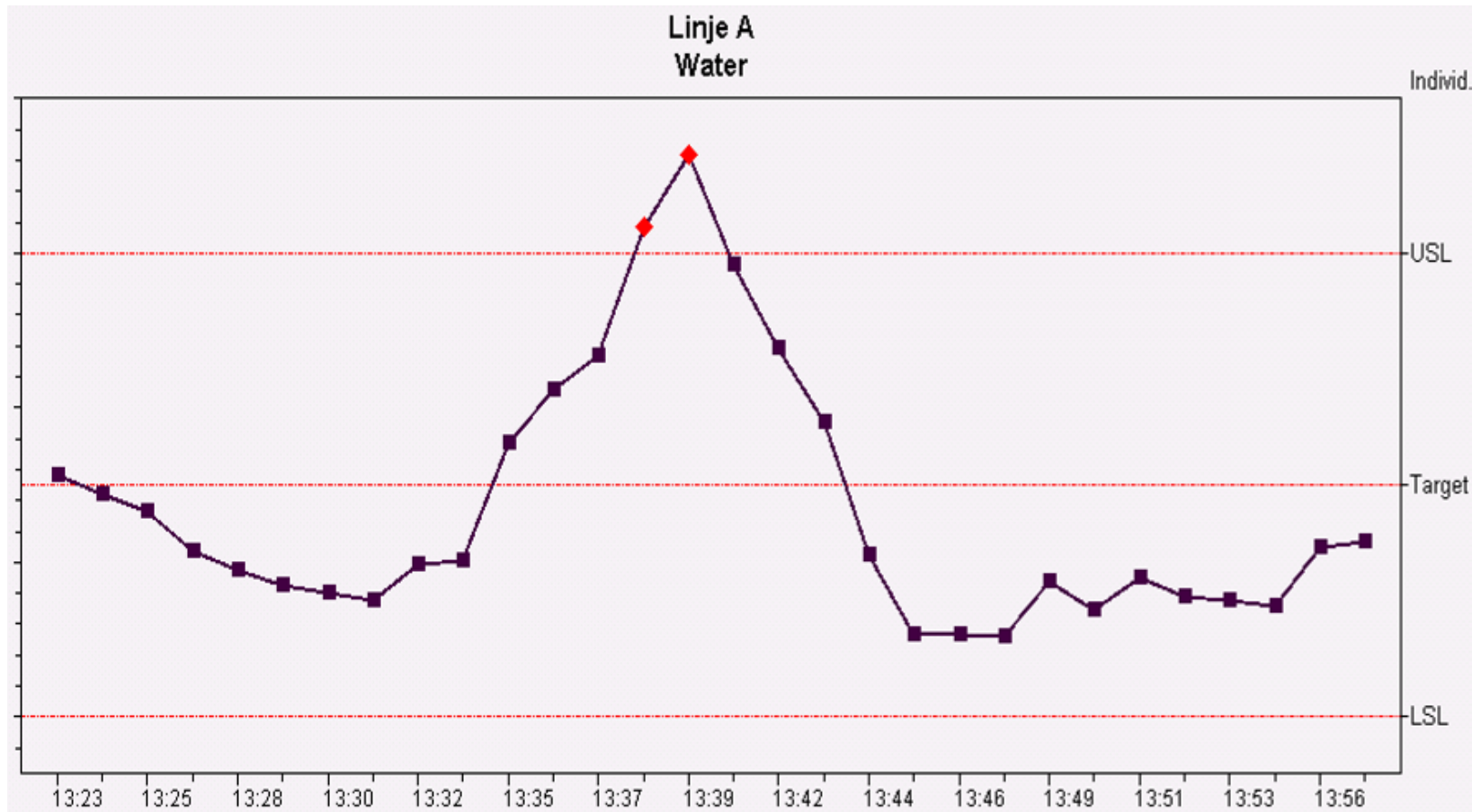




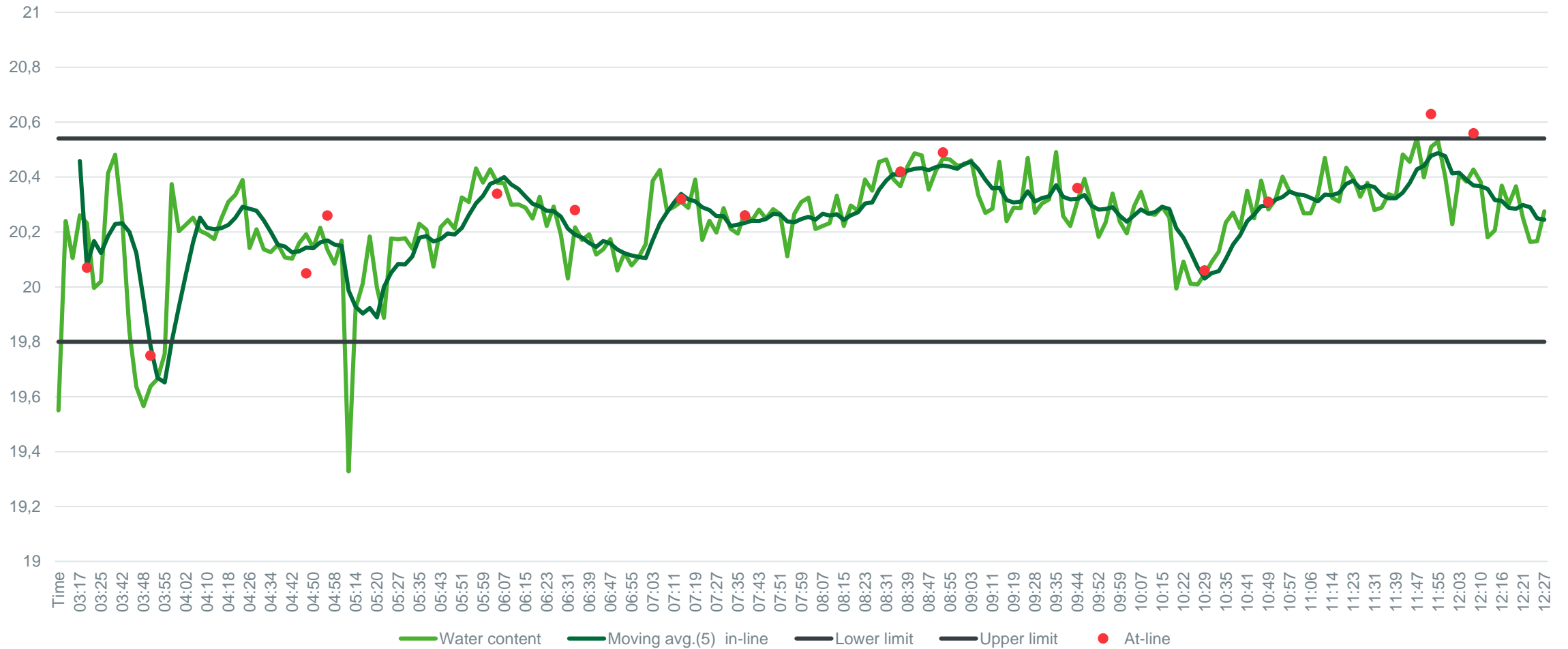
# Complete view



# How does it work?

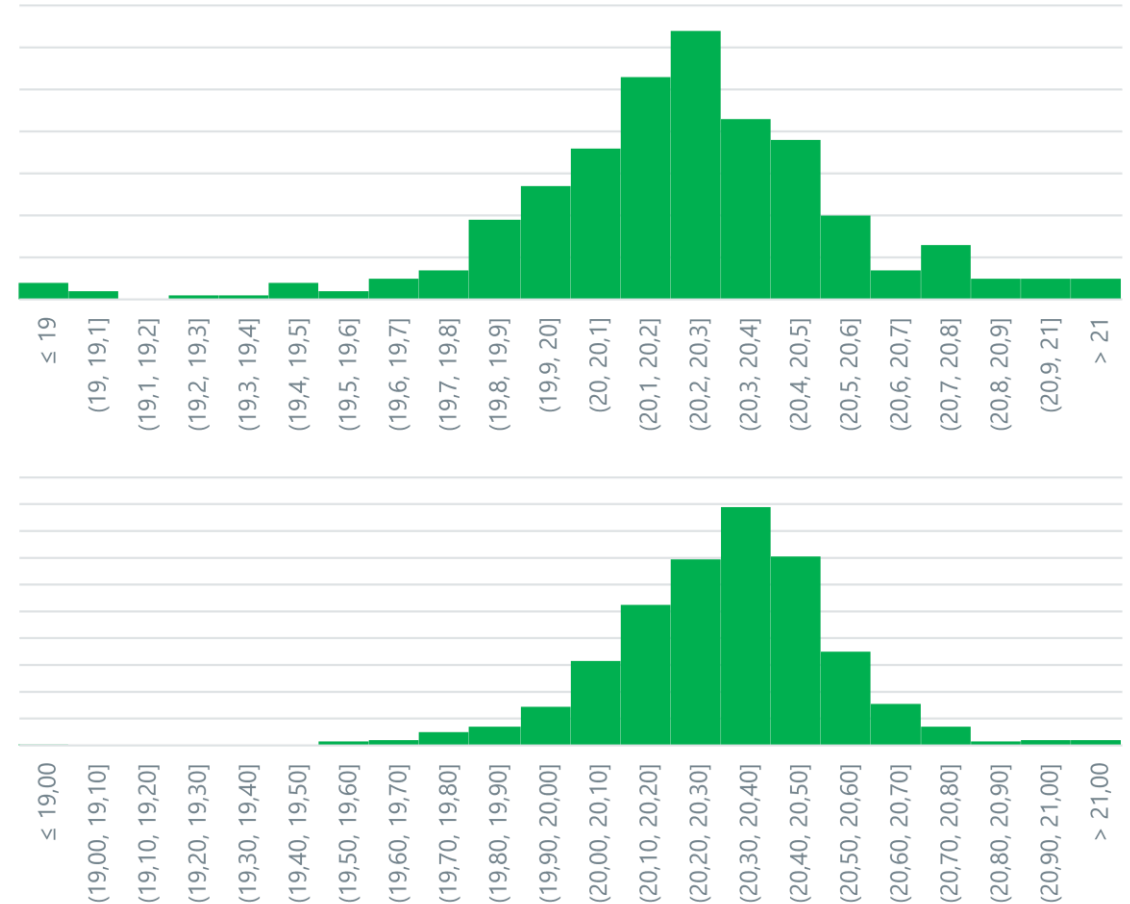


# Live production and how it works



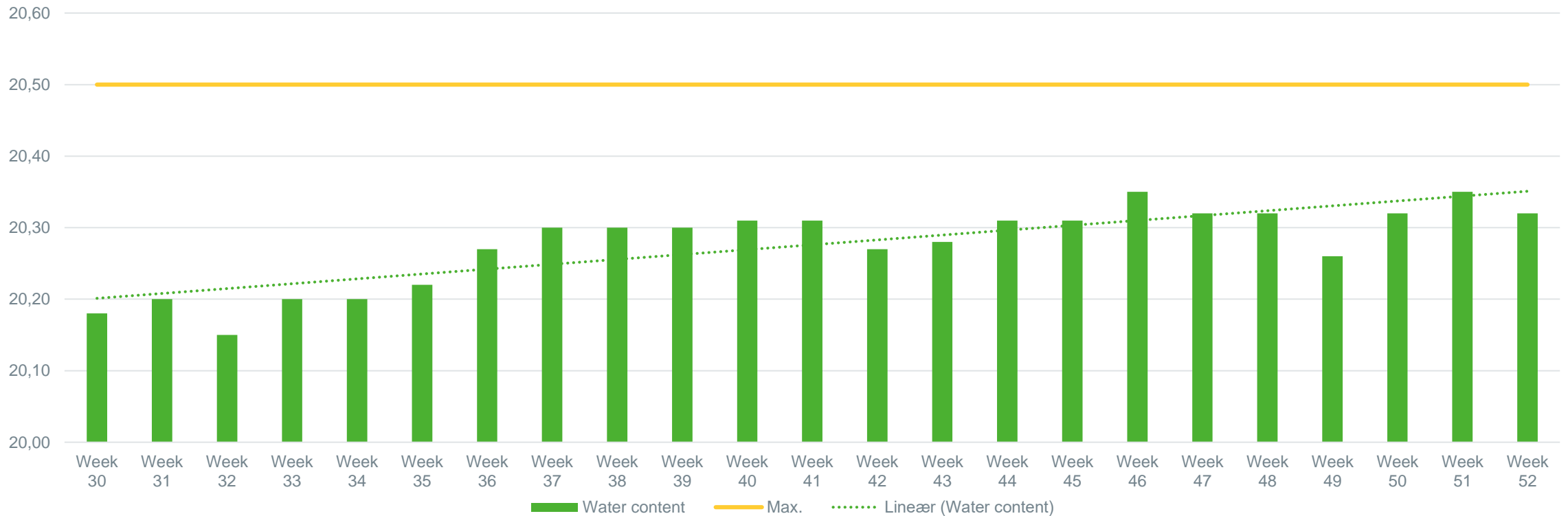
# Benefits from in-line sensors

- High frequency of measurements
- Reduce process variation
- Increasing average
- Securing quality, high percentage measured by the in-line sensor
- Valuable knowledge of the process



# Getting closer to targets

Performance



# Keeping focus

- Maintenance of calibrations, what and when is it enough?
- Keep validating results (products, concentration, etc.)
- Prepare for new products and changes in production.

