

Welcome to the Webinar



“New Solutions for Smart Weighing”

All attendees microphones are muted for the entire webinar session. Be sure your speaker is active and join the audio conference.

If you have a question, please send it to the host using the “Q&A” function. Questions will be answered at the end of the presentation.



Presenter - Michael Guckes

- Product Manager Industrial Electronics and Smart Measurement Solutions
- Product manager for industrial amplifiers and software
- Graduate engineer
- 20 years of experience in factory automation
- E-Mail: michael.guckes@hbkworld.com



Michael Guckes

Agenda

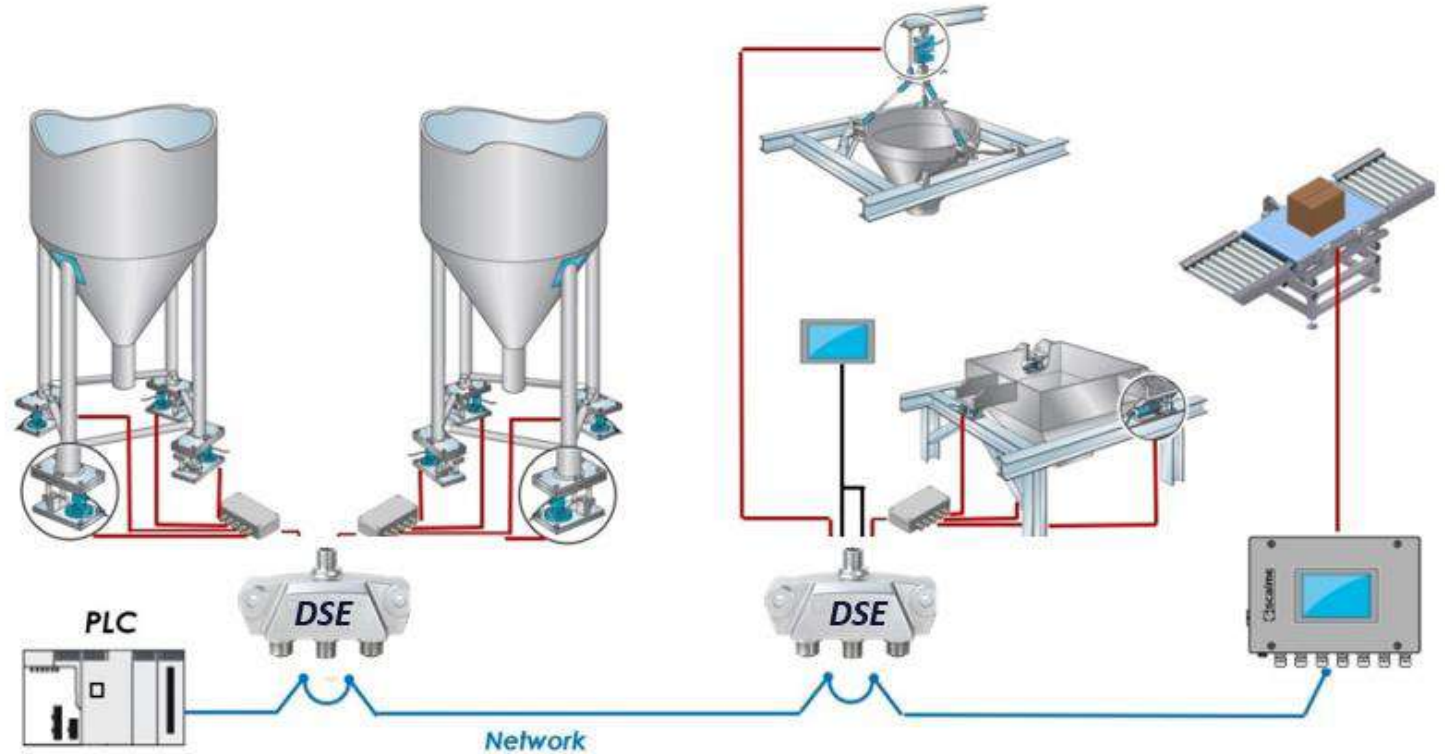
- What are new trends in weighing ?
- What benefits does high-quality measurement technology bring ?
- How do “Smart Functions” support efficient weighing ?
- Modern automation concepts and efficient processes - applications
- A look how we can proceed in an economic way - LIVE demo
- “Smart Weighing” – What do we win with “Machine Learning” ?

Weighing technology

LoadCells with integrated electronics



LoadCell measuring chains



Application examples

- Check Weighing for foods and drinks
- Multi-Head and Silo-weighing for filling and dosing

Trends of modern production technology

Industrial environments include three factors: quality, time and cost

What users need:

- Precise and electrical robust operation
- Simple integration into the system components
- Easy handling
- Comprehensive, preventive diagnostics, easy maintenance
- High system availability

Megatrends:

- Shorter and shorter product life cycles
- Increasing IT networking
- Demographic change



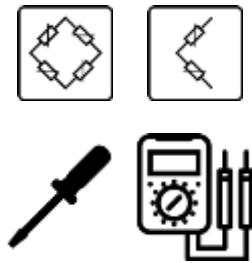
Digital revolution: Communication 4.0

2021



Digital revolution: Measurement & controls 4.0

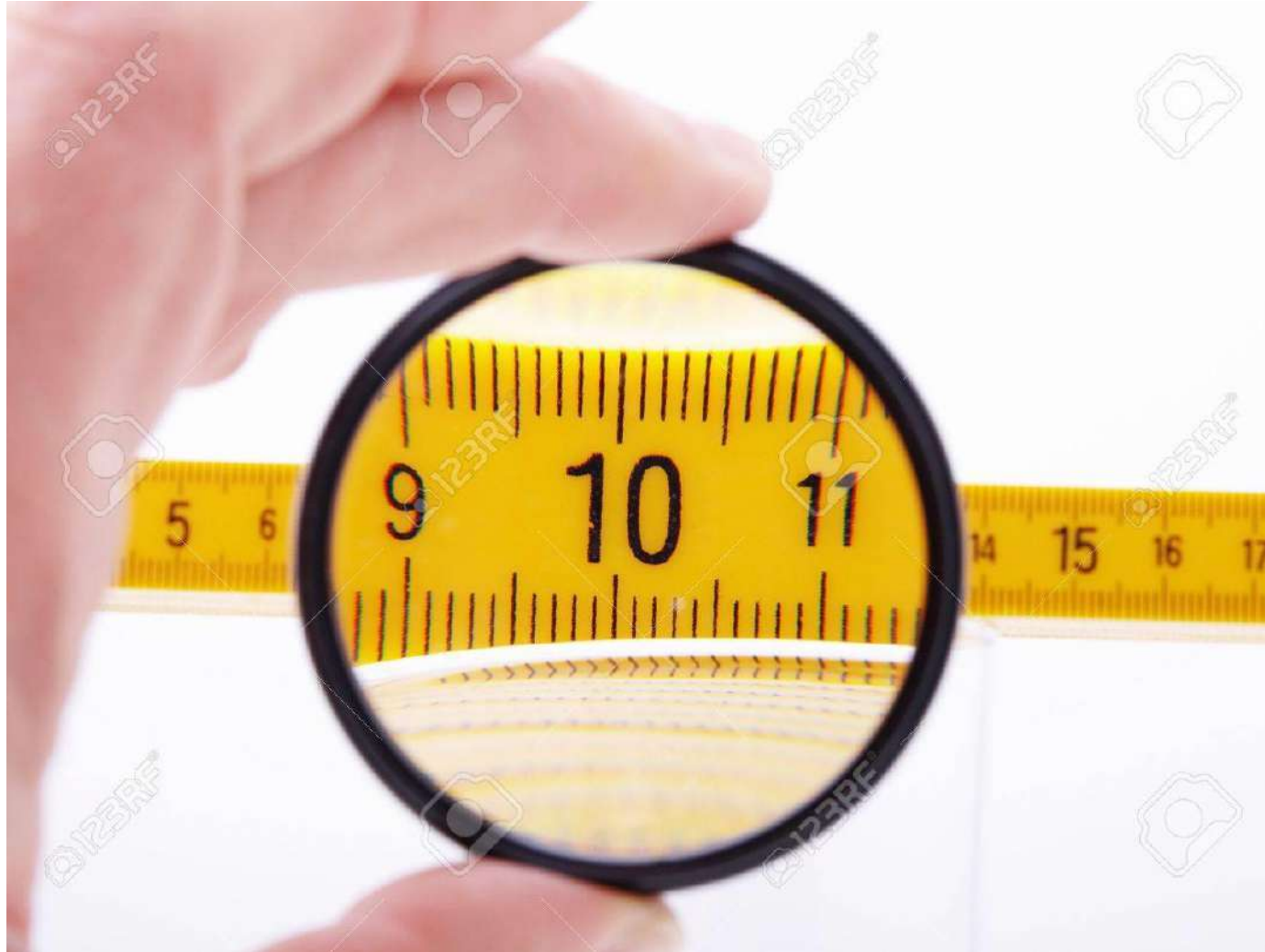
1998



Today's Smart Electronics



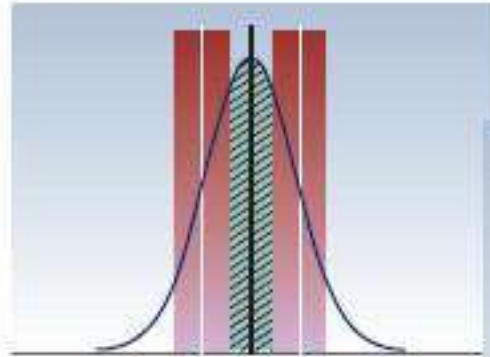
What benefits does high-quality measurement technology bring



Performance, Accuracy, Measurement Uncertainty – Why

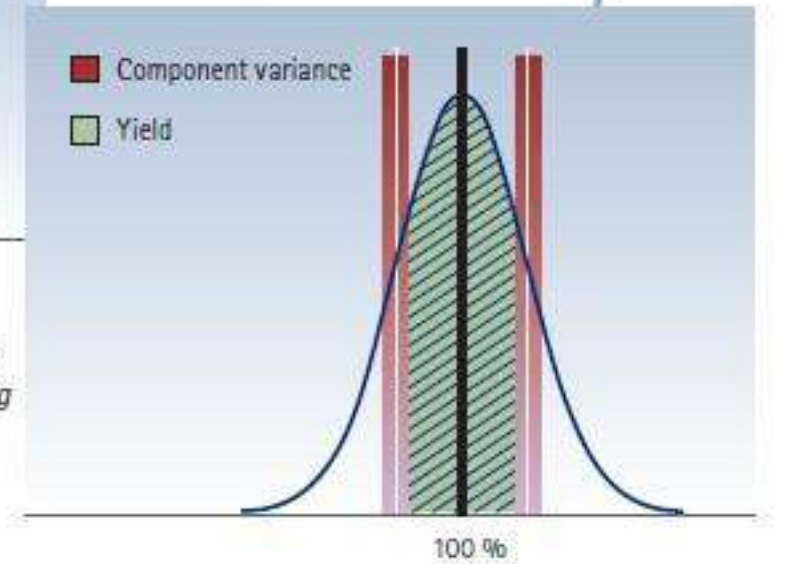
- Greater accuracy makes it possible to record manufacturing tolerances more precisely.
- Components are precisely tested and manufactured with the necessary tolerance.
- Reduces rejects and conserves resources while maximizing output.

...without



Process monitoring with conventional measuring amplifiers, high rejection rate due to measuring inaccuracies

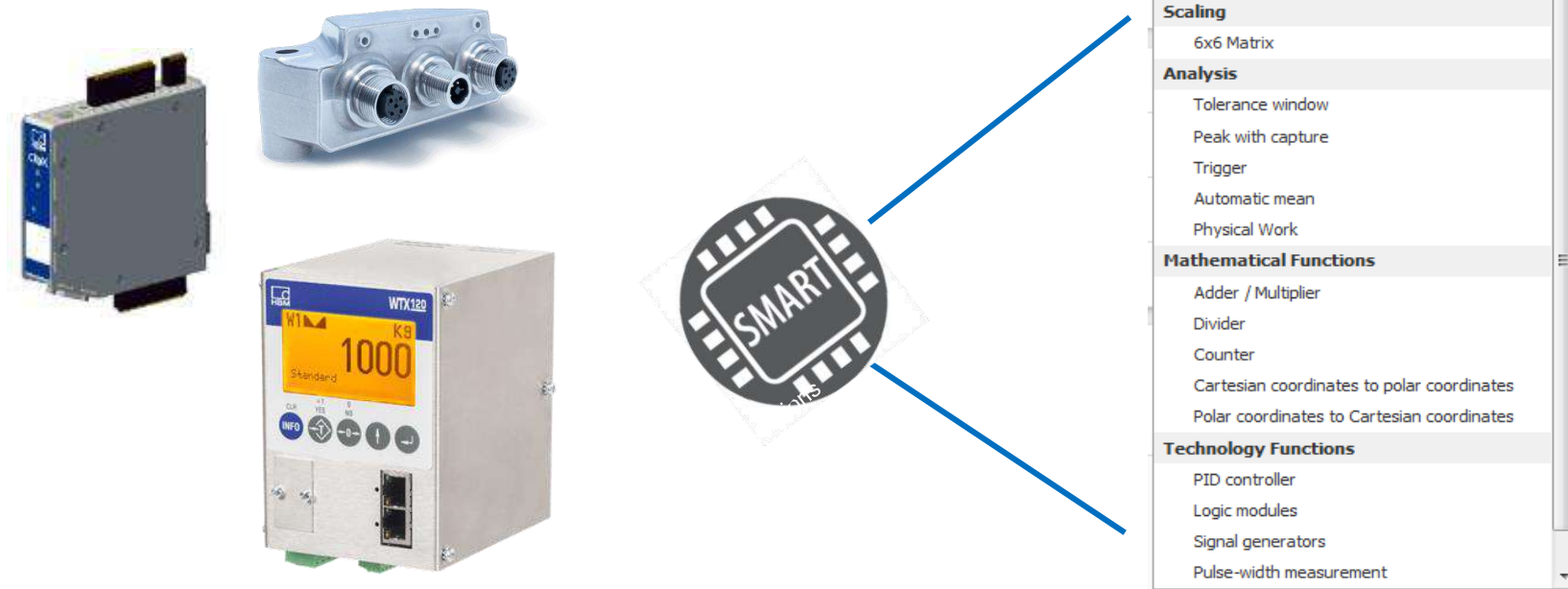
... with



Increased efficiency optimum yield with precise measurement results

How do “Smart Functions” support efficient weighing

Automation with Calculated channels



- A lot of **applications require additional signals/ information and calculations** to be derived from the measured signal .e.g.: Peak, Mean, math. logic functions, timer, counter, PID regulator,..
- Combinations are possible, Calculation speed is **1ms** for each channel, easy setup via Web-GUI

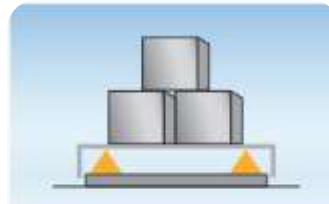
Intelligent hardware – Edge computing

1. Summing & Center of gravity

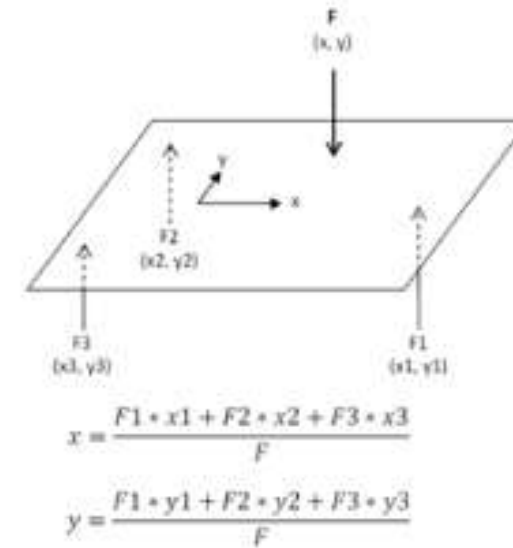
- a) IPC: press-force control
- b) WT: Silko-/ Container weighing



Serve-press
with several force sensors



Platform scales
with several load cells



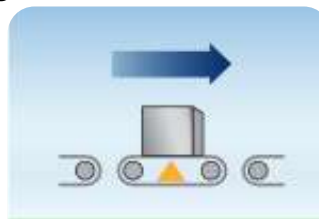
Calc.channel: Mathematical functions

2. Speed & Automatic averaging

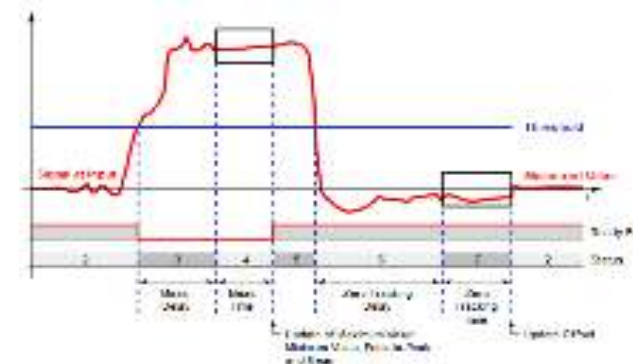
- a) IPC: Motion-control for robots (collision detection)
- b) WT: Check Weighing



Serve-press
with several force sensors



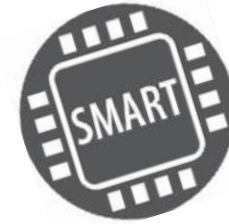
Dynamic weighers



Calc.channel: Automatic Mean

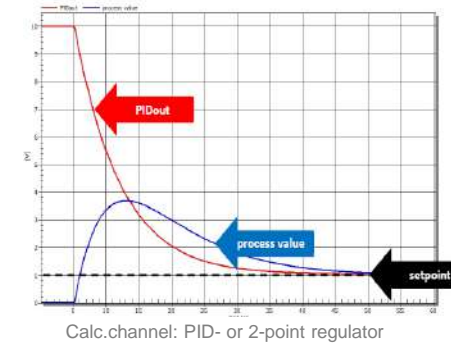
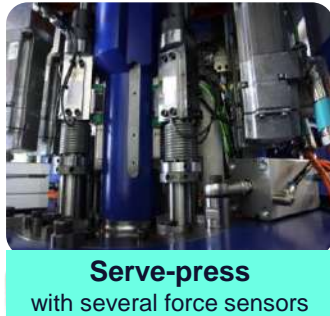
Intelligent hardware – Edge computing

Real-time calculated channels



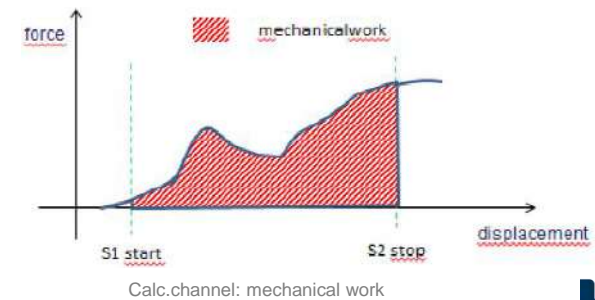
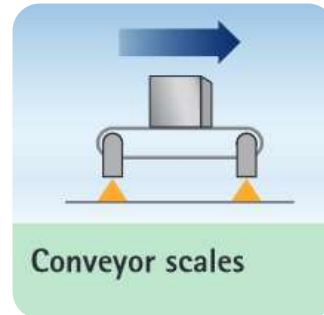
3. Process-time optimization

- a) IPC: press-speed control
- b) WT: Container filling



4. Continuous processing

- a) IPC: Energie & work control
- b) WT: Conveyor scales



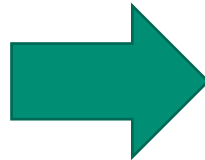
Intelligent hardware – Edge computing

- Intelligence in the measurement components
- Change from programming to parameterization

Pre-implemented logic: PID - controller

```
0001 IF switch = TRUE THEN
0002   devSpeed:=T#10ms;
0003 ELSE
0004   devSpeed:=T#25ms;
0005 END_IF
0006
0007 IF devTimer.Q THEN
0008   devTimer (IN := FALSE, PT := devSpeed);
0009   engine := NOT engine;
0010   IF engine = FALSE THEN
0011     steps := steps + 1;
0012   END_IF
0013 ELSE
0014   devTimer (IN := TRUE, PT := devSpeed);
0015 END_IF
```

Software program code



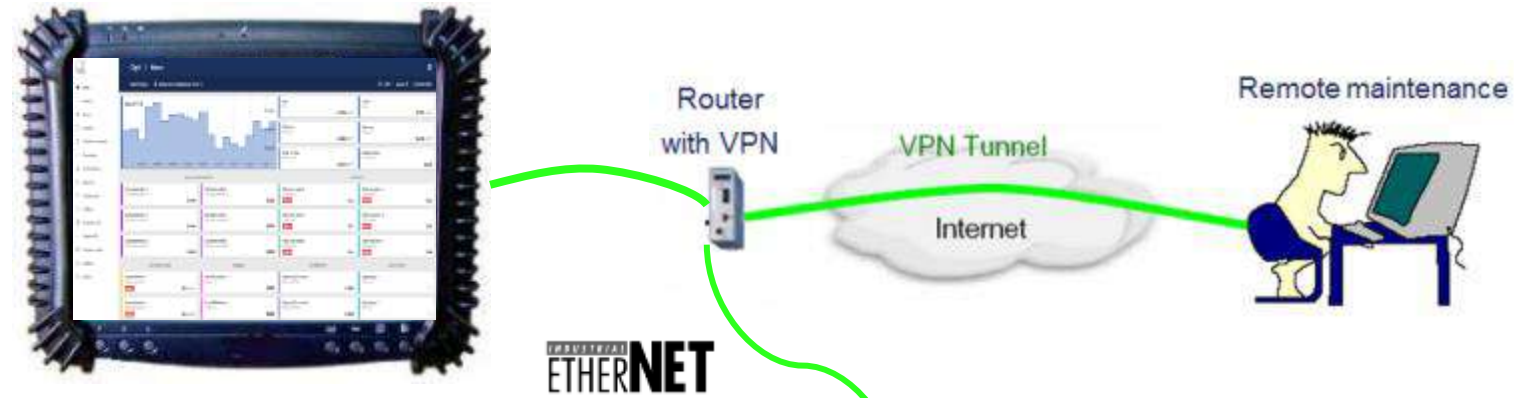
#2 PID controller 1 0.161 ^

Sources		Function Parameters		Outputs	
Setpoint	0 (setpoint) v	Y _{max}	20	V Regulating Varia...	Calculated Chanf v
Process Value	U9C Force (Gross) v	Y _{min}	0	Min/Max Flag	- v
K _p	5 (kp) v				
T _i	6.1 (ti) v				
T _d	3.2 (td) v				
Y _{default}	0 v				
Start/Stop with	1 v				
Enable by	1 v				

↑ UP ↓ DOWN DELETE

Pre-implemented calculated channel in the edge controller

Operation and visualization – 100% Control



Connection for remote maintenance via Internet

Every ClipX has its own web interface with responsive design:

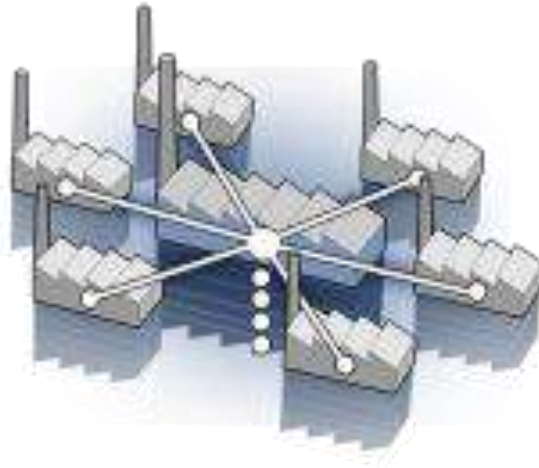
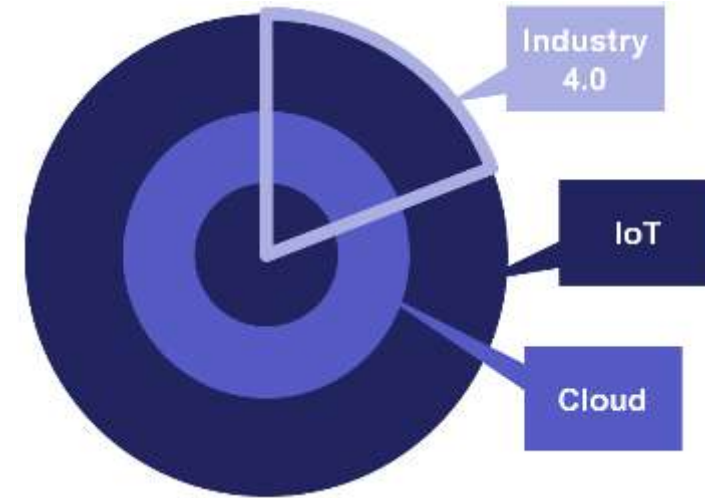


Modern automation concepts and efficient processes

Industry 4.0 is only a part of cloud and IoT

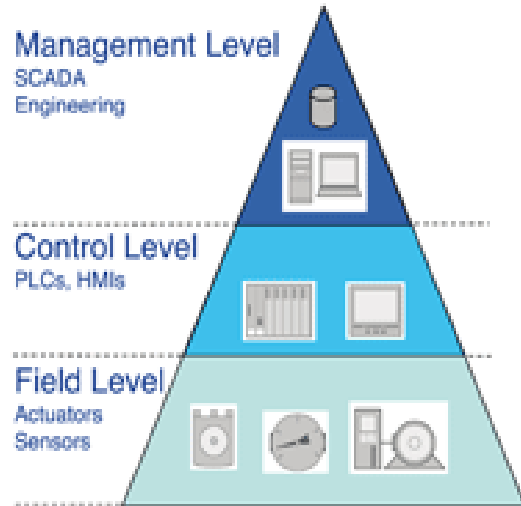
Brings benefits:

- Asset services
- Predictive maintenance
- Device management

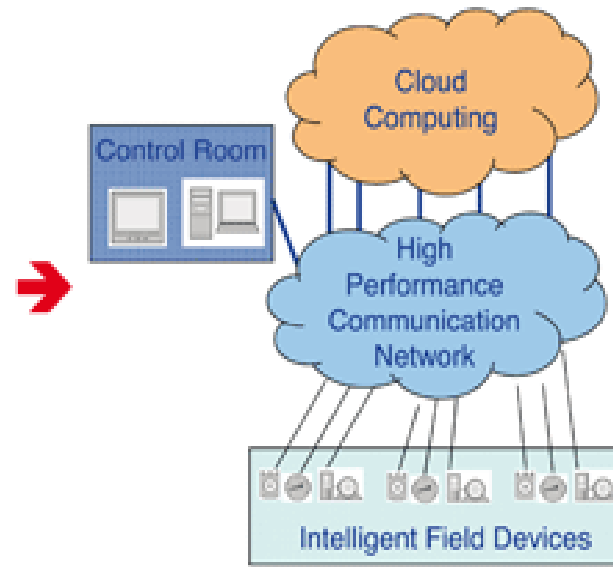


Communication technology for Weighing 4.0

Today



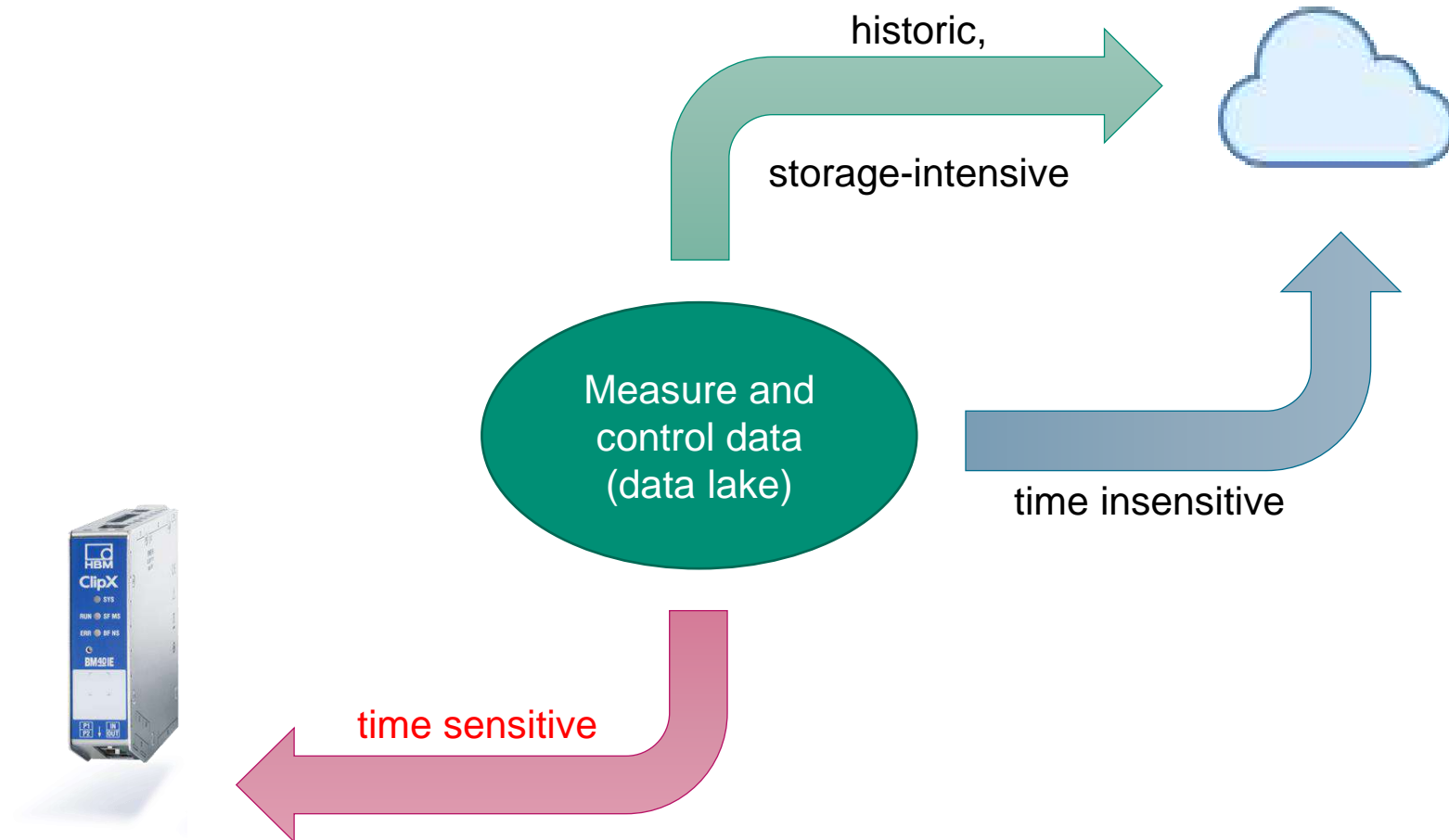
Future



- Ethernet technology will replace the Fieldbus in the long term
- TSN standard for real-time capable networks
- Communication protocols and the LAN and WLAN interfaces integrated on one system on chip
- High integration on one component lower the costs for an efficient communication connection
- Google Cloud joins the OPC Foundation

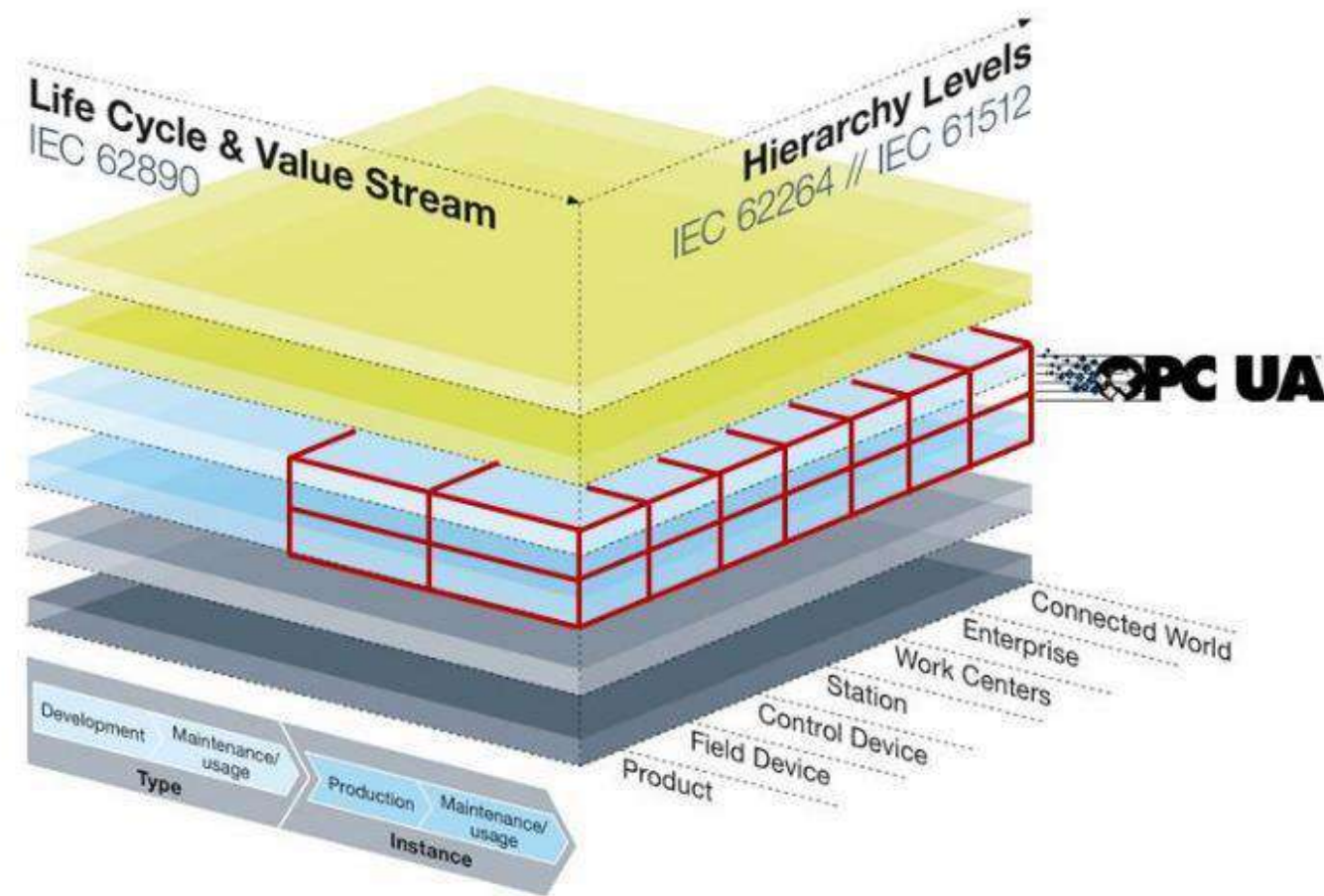
Intelligent hardware – data processing

- Despite cloud uptake – edge computing is essential
- ‘Process data where it is most useful’



Properties of OPC UA

- OPC UA covers a large area of the Industry 4.0 Reference Architecture Model (RAMI 4.0)



Flexibility for Production Systems with Open Automation



Ready-to-use multifunctional PC software

for production and weighing applications. Can be used for servicing and parameterization or for continuous plant operation.

Powerful plant operating and servicing tools



Web-based visualizations

for terminals, tablets, and smart devices in the form of an integrated web-server, a PWA or mobile apps. Modern ergonomic user interfaces with intuitive operation

Operates on all browser-based devices, whether stationary or mobile



APIs and drivers

as a pre-made programming kit with templates for the creation of individual GUIs perfectly adapted to the application at hand.

Multifunctional human machine communication for high security of know-how and investment



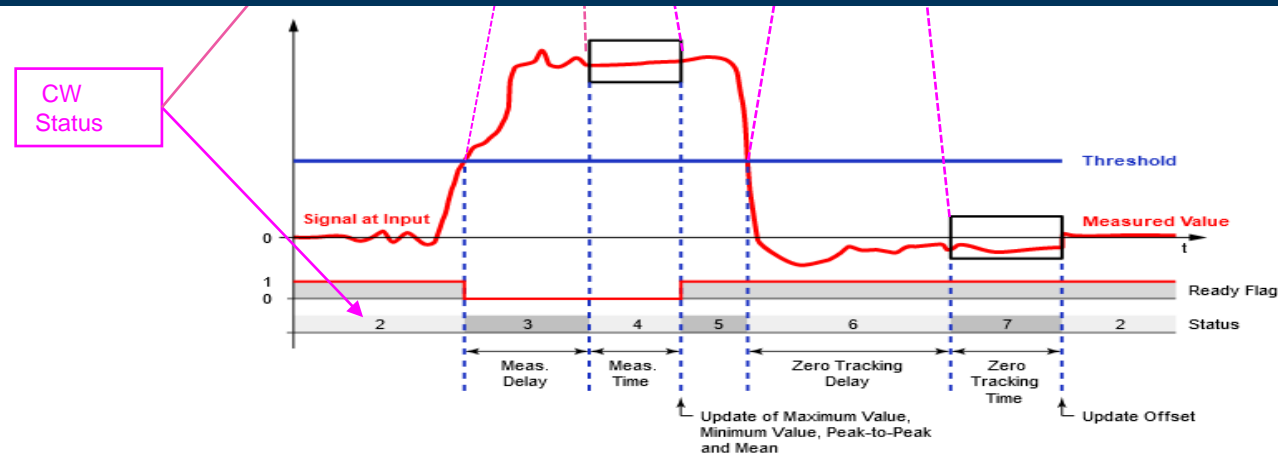
Remote operation, maintenance and diagnostics

Live demo accessible world wide (max. 2 connections)



ClipX live via internet: <http://clipxdemo.hbm.com>

ClipX Check Weighing (CW) – Pre-Trigger, add. Zero-tracking



ClipX with Check Weighing (CW) – up to 1200 part per minute

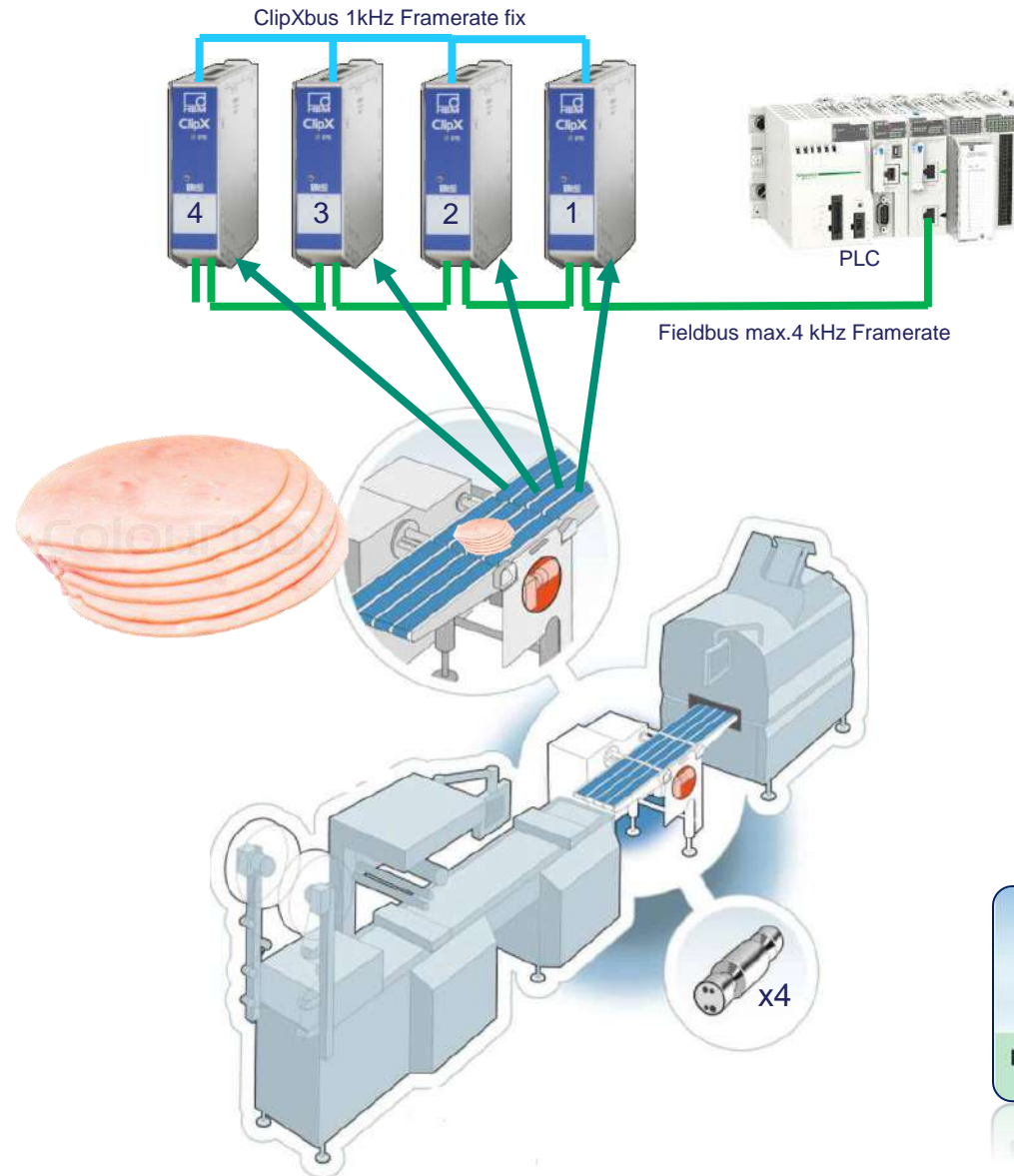
The image displays the ClipX software interface, divided into two main sections: configuration and data visualization.

Configuration Section (Top): The 'Calculated Channels' window is open for a 'Checkweigher' device. The 'Sources' table is configured as follows:

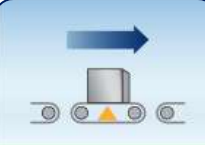
Source	Function Parameters	Output
Input: 5 CW in	Measurement Delay: 300 ms	Measured Value: --
Threshold: 5 (trigger)	Measurement Time: 100 ms	Maximum Value: --
Enable by: 1	Start on: High level	Minimum Value: --
Start Measure with: 0	Zero Tracking Delay: 300 ms	Peak-to-Peak: --
START MEASURE	Zero Tracking Time: 100 ms	Mean: Calculated Channel 3
Start Zeroing with: 0		Offset: Calculated Channel 5
START ZEROING		Ready Flag: Calculated Channel Flag 1
		Status: --

Data Viewer Section (Bottom): The 'DataViewer' window shows a real-time graph of the sensor signal. The y-axis ranges from 0 to 10. The x-axis shows time from 08:48:56.000 to 08:49:02.000. Three signals are overlaid: a cyan line for the 'Sensor signal', a red line for the 'CW signal' (Check Weighing), and a magenta line for 'zero tracking'. Annotations include a blue arrow pointing to the sensor signal, a red arrow pointing up to the CW signal, and a magenta arrow pointing down to the zero tracking signal. A 'Settings' panel on the right shows various measurement and visualization options.

ClipX – multichannel application



- Solution of the measurement and automation task with standard components and without programming effort
- The weights of all 4 tracks are recorded even with different loads by adding up the individual tracks and evaluating (CW) the total signal
- Simple connection of the HBM measurement chains to the existing PLC via EtherCAT - PLC controls and loads all parameters (parameter set) into the individual ClipX (Plug & Measure)
- Web server intervention is no longer necessary during operation and service
- The ClipX-WebServer and the free PC software ClipX-Data-Viewer are available for setup and comprehensive service
- ClipX transmit detailed diagnostics of the measurement chain to the PLC, which can also be used remotely
- Parallel operation of PLC web server and PC software possible, e.g. service and setup
- Free ePlan macros (ClipX) and step files (ClipX and sensors) for convenient circuit diagram and machine design



Dynamic weighers

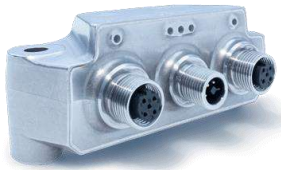
ClipX 1:

1. SumValue = 1+2+3+4
2. Filter SumValue
3. Find Triggerresult (CW)
4. Send Triggerresult to PLC
5. Goto 1.

DSE – Check-Weigher implementation (webserver)



- Home
- Device
- Amplifier
- Autozero
- Filter
- Application mode
- Checkweigher
- Fieldbus
- Parameter Sets
- Storage



DSE-HIE (dse-gu) | cw-1

Checkweigher

Trigger

Trigger mode: Pre trigger

Trigger source: Level

Level in kg: 0,5

Result window

Setting time in ms: 244

Measurement time in ms: 193

Correction factor: 1

APPLY CHANGES

RESET

Device setting

Checkweigher: Device setting | Filter: Device setting

Mean value	Standard deviation
0.578 kg	0.000 kg

Simulation

Checkweigher: Device setting | Filter: Device setting

Mean value	Standard deviation
0.578 kg	0.000 kg

#	Time	Result
01	2.538 s	0.578 kg

Result/Statistic

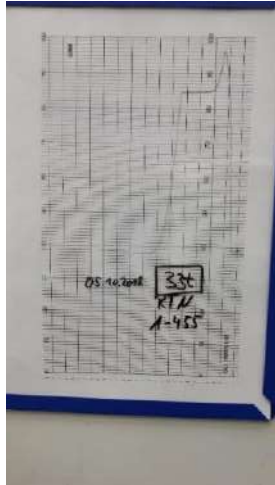
Trigger result	Mean value	Standard deviation
0.578 kg	0.506 kg	0.072 kg
Minimum value	Maximum value	Total count
0.434 kg	0.578 kg	2

OPC-UA / REST application with ClipX (HBM Smart Factory)

Where we all come from



Manually control



Manufacturing of ring torsion load cells

Monitoring of temperature in the ovens

SMART Solution



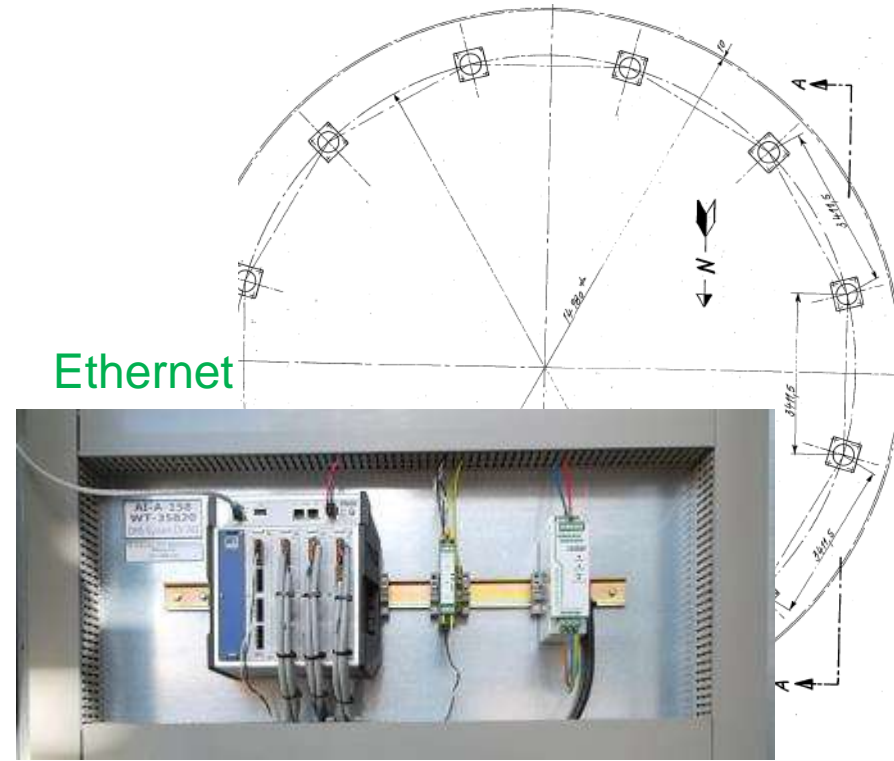
Automatic acquisition and check by ClipX smart device



PMX Application in tank - silo weighing (NLFT)



Ethernet



PMX used for Tank level measurement

- 1000 t chlorine-gas tank on 12 supports with HBM Strain gauges
- Mathematical functions for Level calculation
- Analog signals for control to plc (safety regulation)
- Local PMX in cabinet with data-monitoring(Catman) in DIN-rail PC
- HBM delivered SG, Service, Control and Long-term fatigue analysis

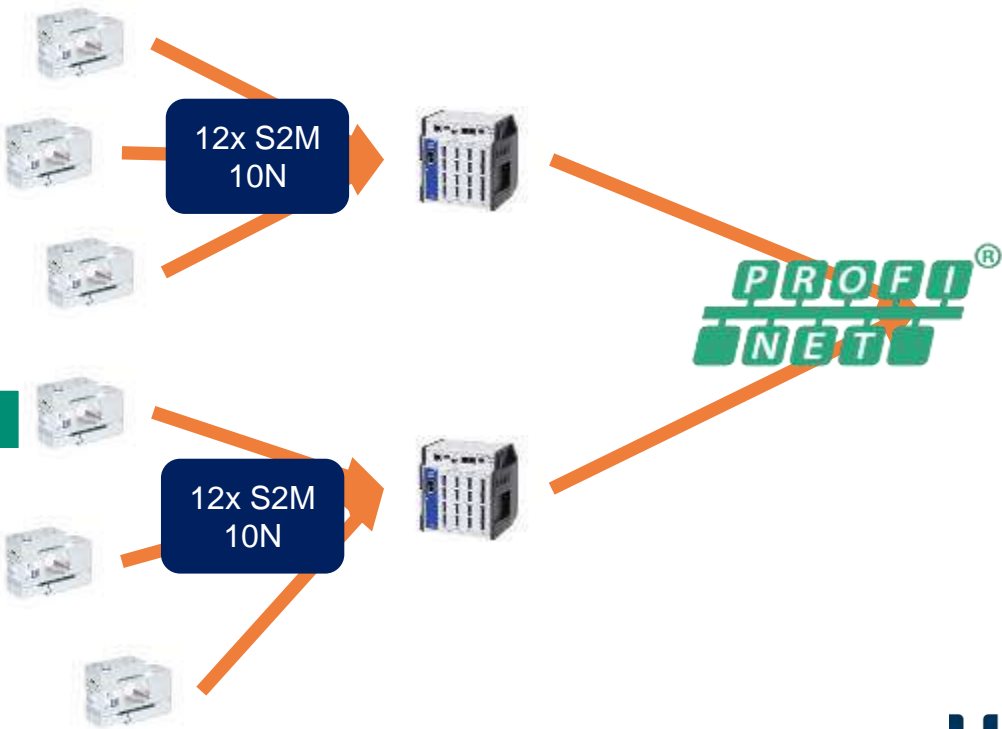
PMX in WT application – filling and dosing

Architecture with PMX, benefit from Multi-channel, High Accuracy and Smart functions



Best repeatability 0,01g

Normal repeatability with industrial environment 0,03g



Operation and visualization – 100% Control

100% Quality - 40,000 corks per hour..



Quality inspection:

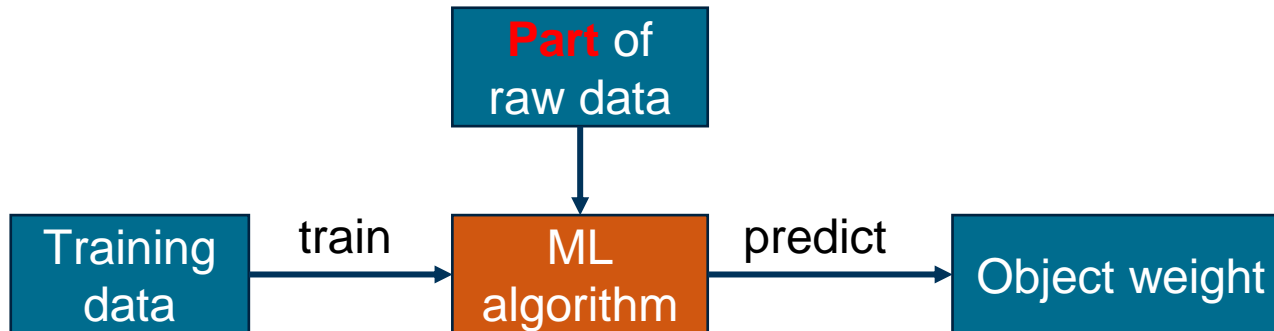
- HBM load-cell measuring weight / density of each cork
- PMX with stabil, robust and accurate multi-channel CF-amplifier (PX455) 12 channels
- Evaluation with limit-switches check-weighing algorithm
- Visualisation and operation with dot-NET-API application

“Smart Weighing” – What do we win with “Machine Learning”

- Original approach



- Proposed approach

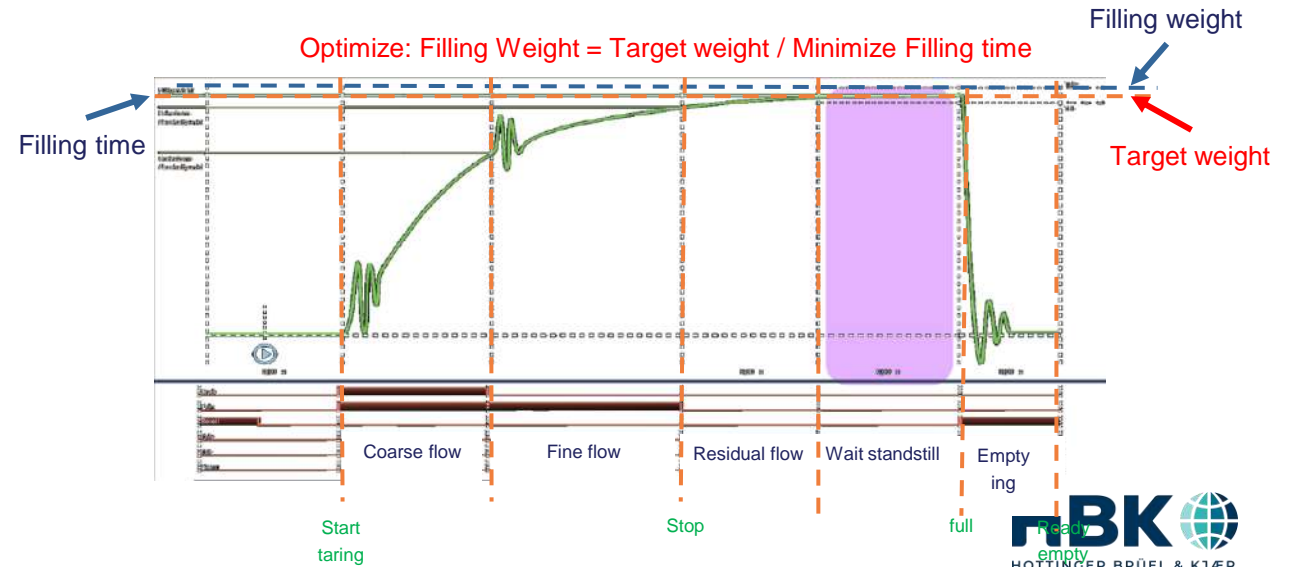
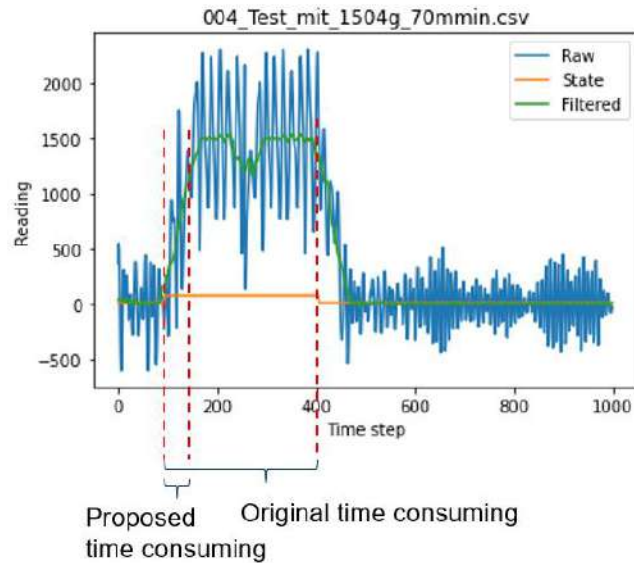
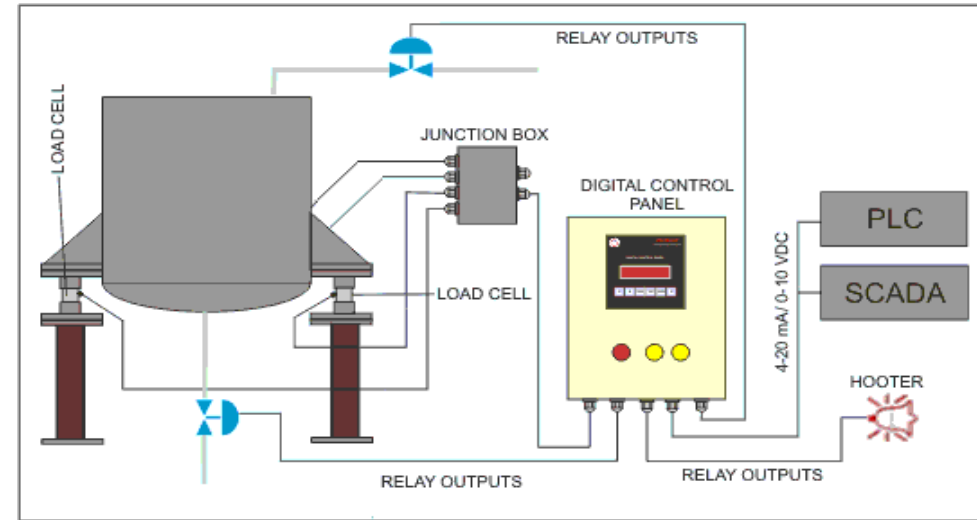


SMART Sensors - Object Detection Using Machine Learning

#1: Check Weighing



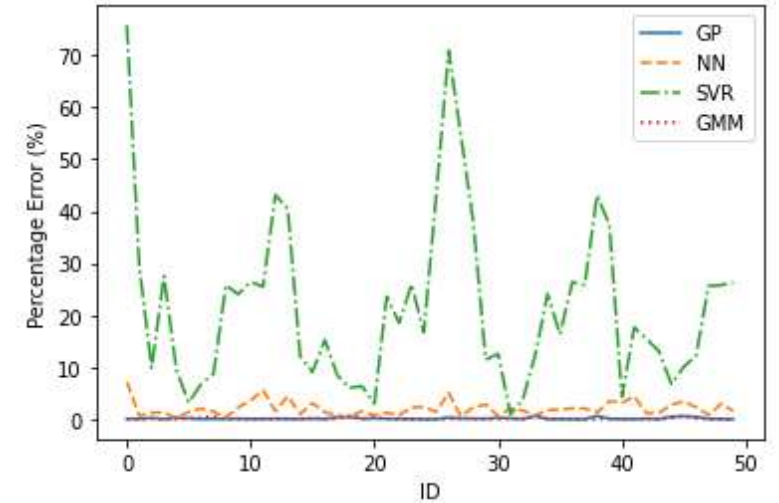
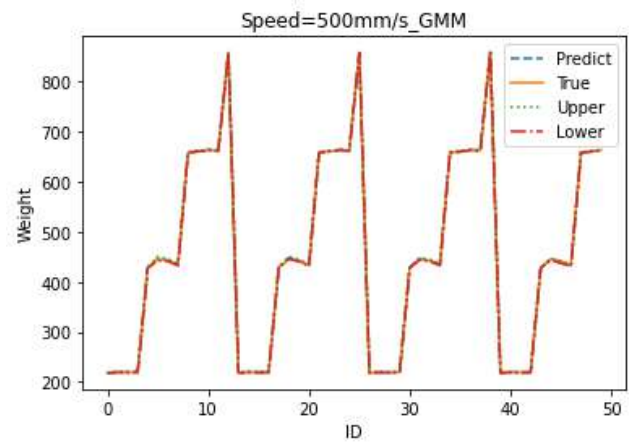
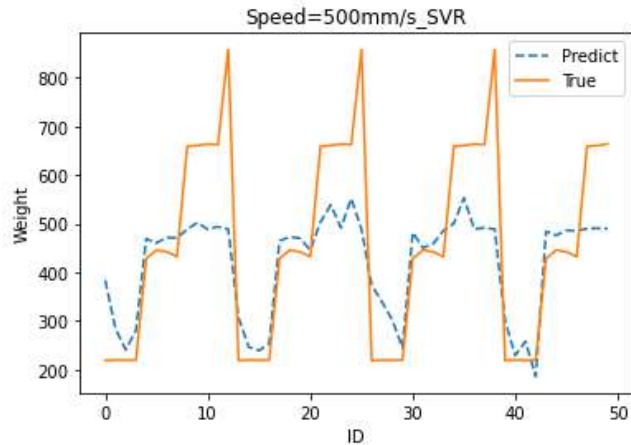
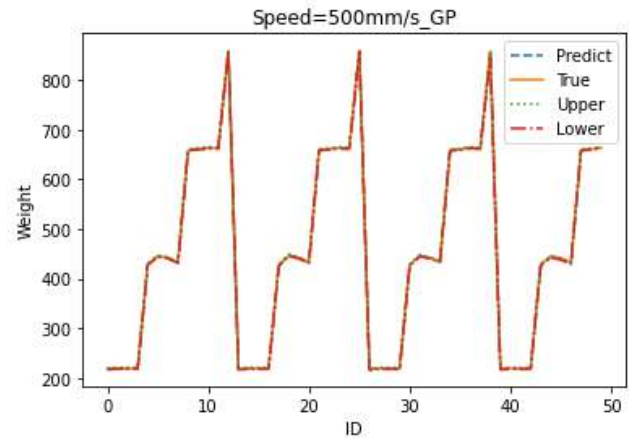
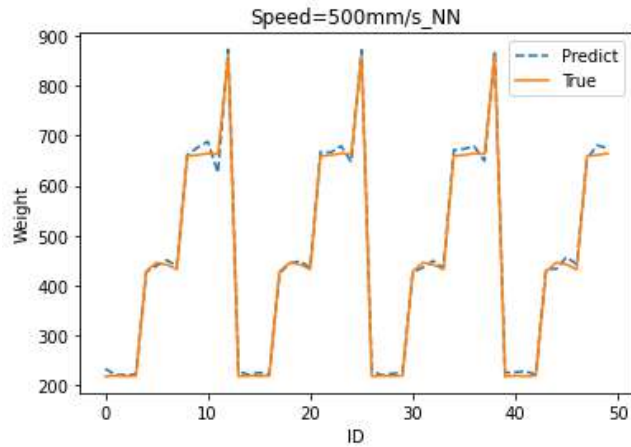
#2: Filling Dosing



ML – Data – Check Weighing

Methods comparison

- Speed: 500mm/s
- Training data: Old Data (26)+ New Data (450)



Approach	R ²	Error (%)
GPR	0.9998	0.27
NN	0.9937	2.49
SVR	0.3760	31.31
GMM	0.9999	0.20

Gaussian Mixture Model (GMM)

SMART digital measurement chains in weighing automation

Act as...

- Solution provider for precise weighing measurements
- Innovative integration via bus-systems into machine control systems
- Flexible for monitoring and automation tasks in various weighing applications



Users benefit...

- Save time and money
- Use modern and future-proof weighing technologies
- Get “full service” with HBM (field-service, calibration, custom-sensors, application-support, software-development)

Thank You

Dipl.Ing. Michael Guckes

Mail: michael.guckes@hbk-world.com