Acquisition of high-resolution raw data as the key to meet all stakeholders‘ requirements for process analysis

Dr. Andreas Quick | iba AG

Aluminium 2022 | 28-Sep-2022

iba AG: Measurement Systems for Industry and Energy

More than
2,000 customers

More than
25,000
installations worldwide

For almost
40 years

20
Regional offices

More than **170**
employees worldwide

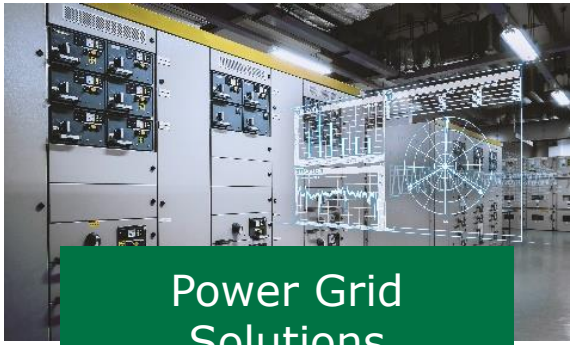
70%
Technicians &
Engineers

Use Cases of the iba System

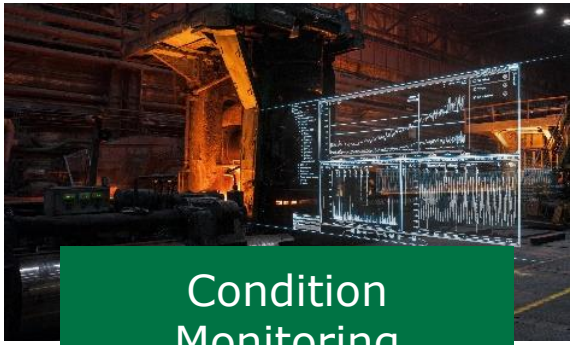
Troubleshooting

Process Analysis
Process Monitioring

Quality
Documentation



Power Grid
Solutions



Condition
Monitoring

Digital
Transformation

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Requirements

Stakeholders

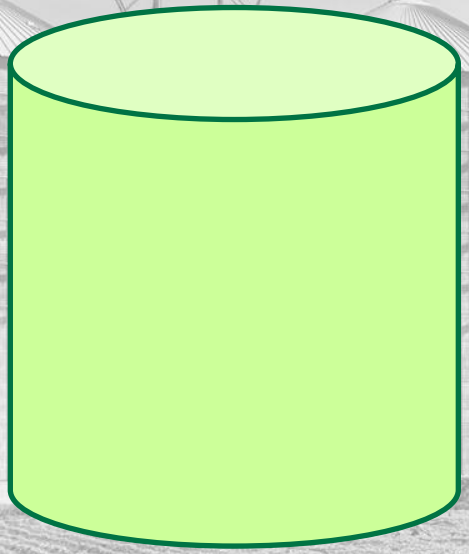
- Maintenance
- Production
- Quality
- Process Technology
- R&D / Engineering
- Data Scientists

Requirements

- Troubleshooting
- Less failures
- Fast fault location
- Root-cause analysis
- Quality documentation
- Reduce rejects
- Process analysis
- Process optimization
- Increase productivity
- Increase reliability
- Anomaly detection
- Less unplanned downtimes
- Improve quality
- Reduce operation costs
- Minimize repair costs
- CO2 reduction
- Reduce energy and resource consumption
- Better insights to make better decisions
- Condition-based maintenance
- Benchmarking

Data Silos – Everyone has his own data

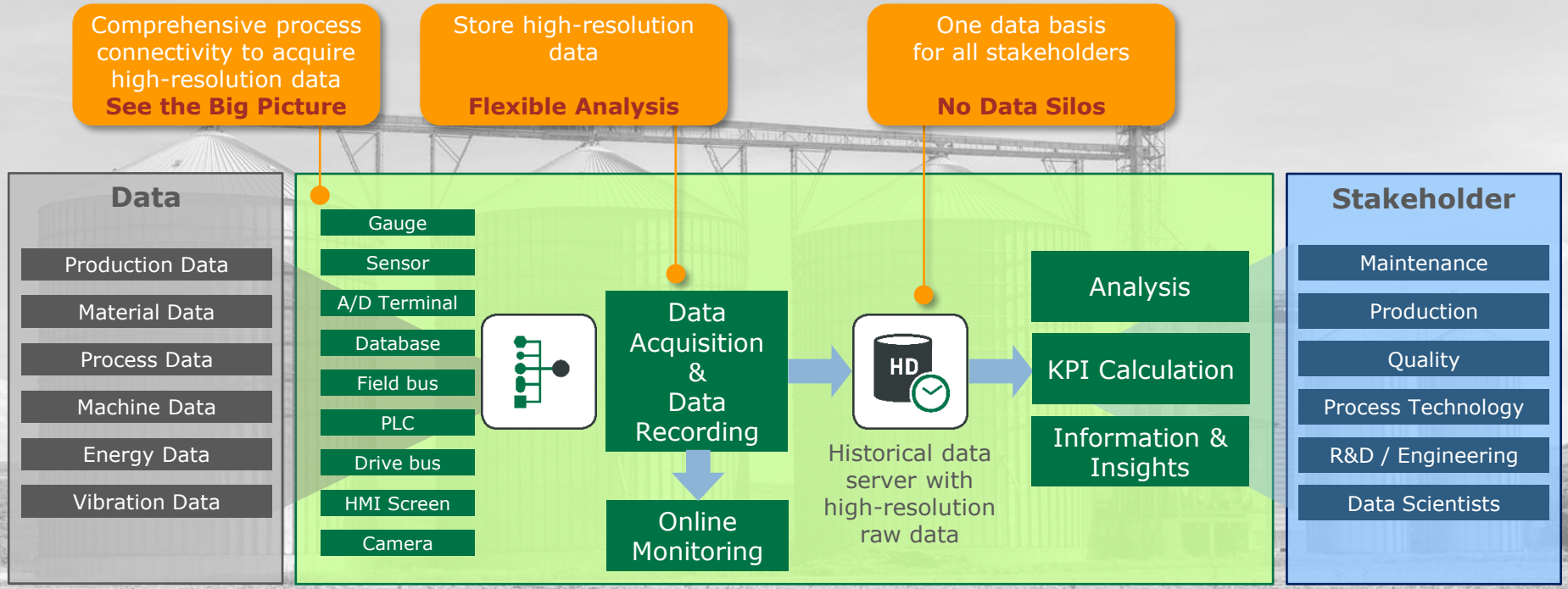
Target: One Data Basis



Benefits

- Better collaboration
- Communication between stakeholders is based on the (same) data
- Consistent results
- Digital transformation as common task of all stakeholders
- Same tool environment

Architecture & Design Principles of a Measurement System

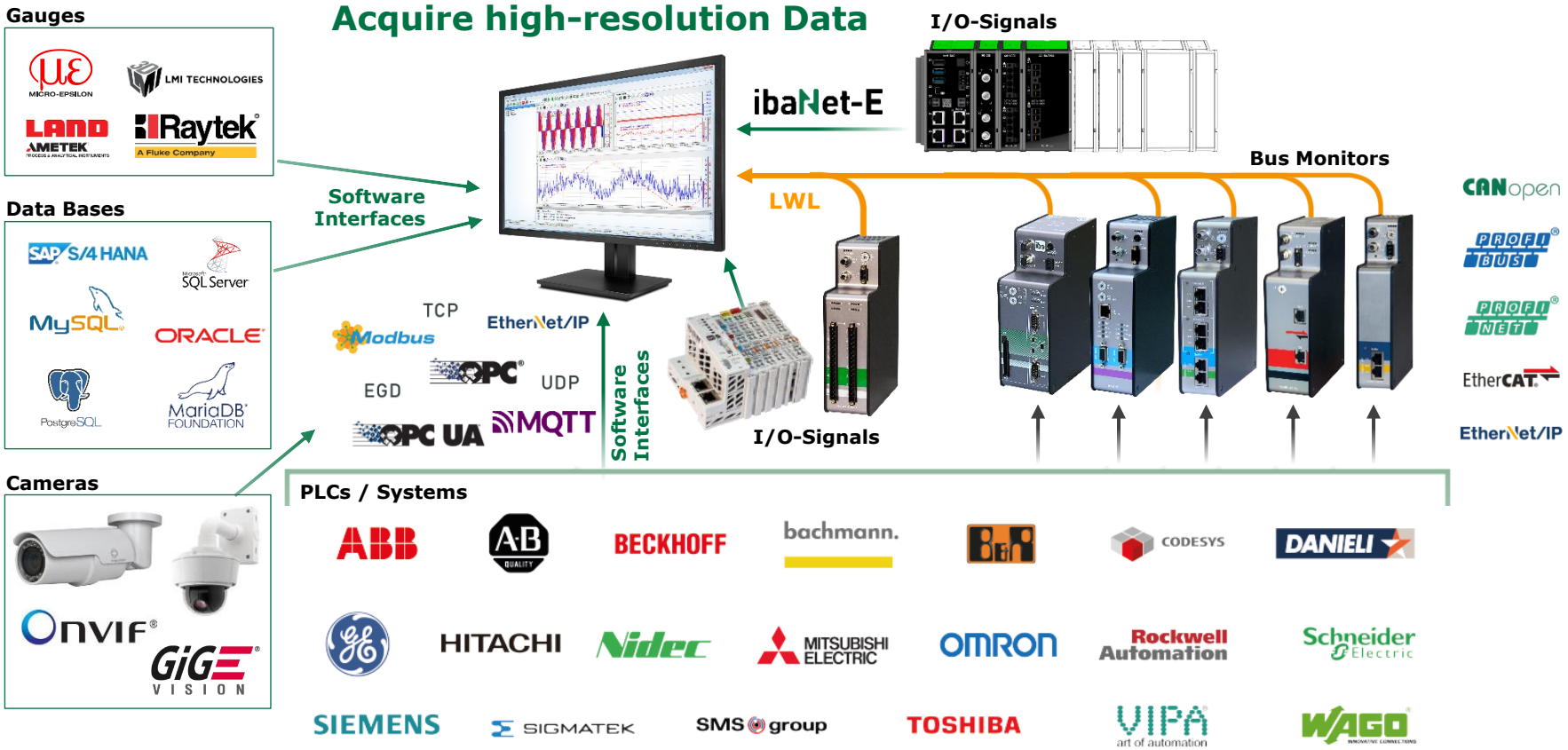


1

Measurement System

Design Principles

Comprehensive Process Connectivity – See the Big Picture



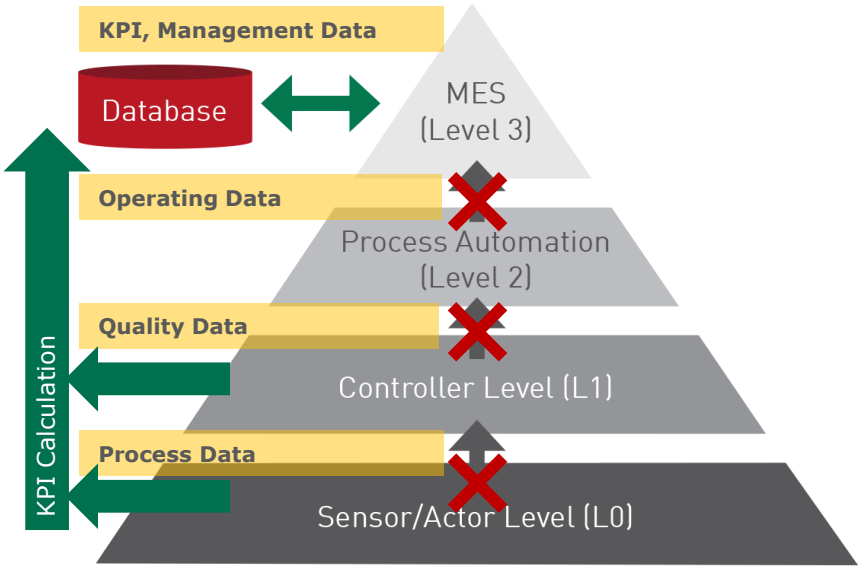
Store high-resolution Data – Flexible Analysis

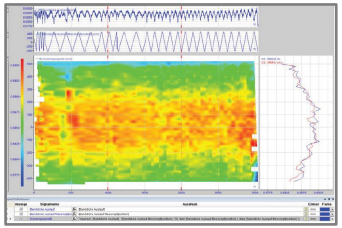
Flexible approach to calculate KPIs

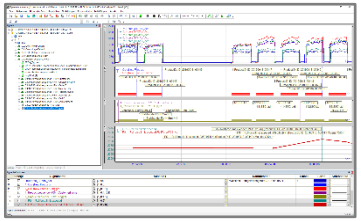
- Calculation of KPIs is based on raw data
  (no stepwise aggregation at different levels)

Benefits

- Source of data and calculation methods for KPIs are known and comprehensible
- Signals can be combined with each other; calculation of process-specific KPIs
- Flexible – no need for interface adaptations in Level 1/2/3 in case more or different data should be extracted into the database
- Drill-Down possible;
  otherwise: information retrieval = information loss!







Example – Calculation of KPIs based on Raw Data

Application: Aluminium rolling mill

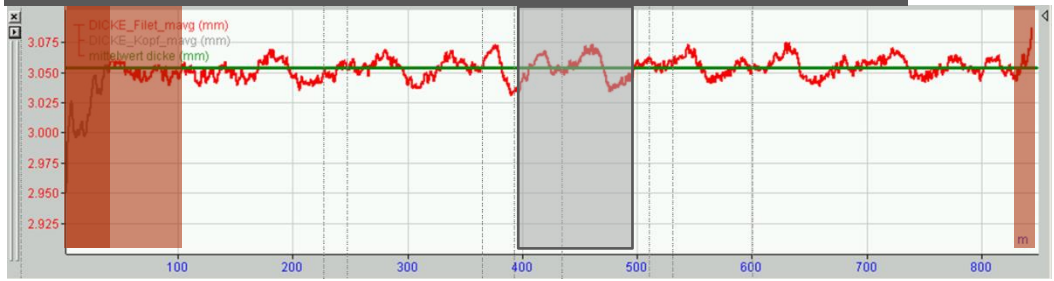
Physical Signal; time-based

KPI_Avg = 2,970 mm

Calculation in ibaAnalyzer

```
TimeToLength (…)
XCutValid (…)
XMarkRange (…)
Avg (ValidThickness)
```

Length-based values; Head/Tail discarded



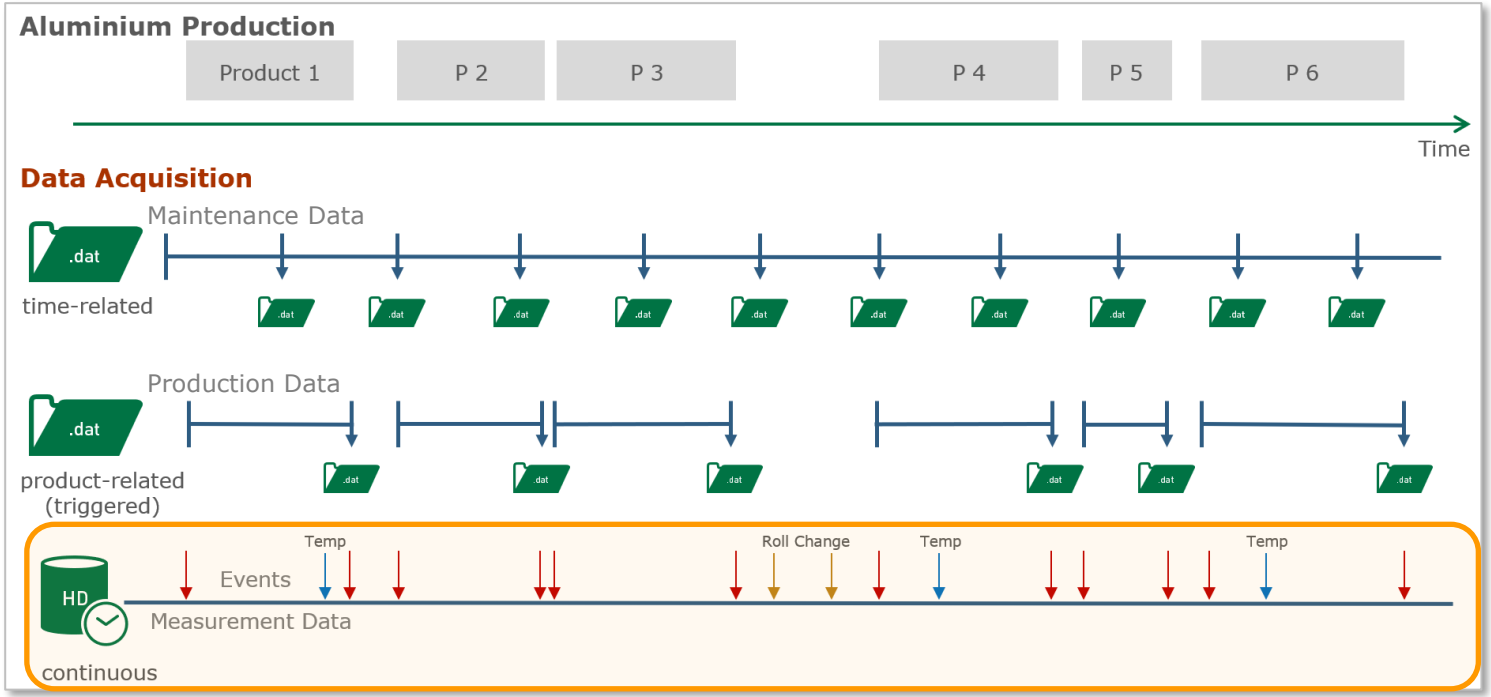
KPI_Avg = 3,052 mm

KPI_Avg_head2 = 3,065 mm

KPI_middle = 3,015 mm

One Data Basis for all Stakeholders – No Data Silos

Raw Data & Events



Data can be evaluated under various aspects by different stakeholders

Online (automatically)

Offline (interactively) (human in the loop)

2

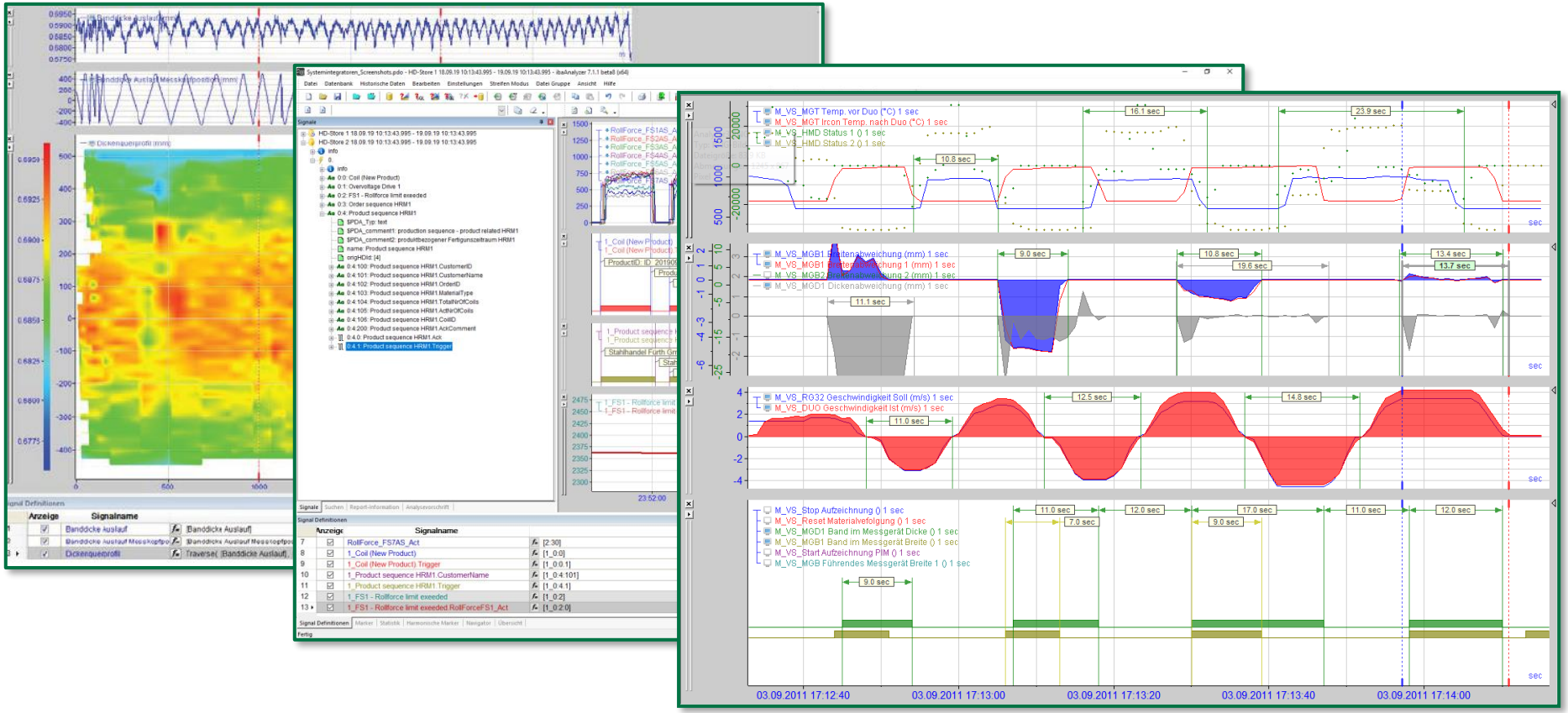
Usage of Measurement Data

Interactive Offline Analysis

Raw Data Analysis

- Signal-oriented analysis
- Troubleshooting
- Fault location
- Understand your process and reduce complexity
- Interactive calculation of KPIs

Raw Data Analysis



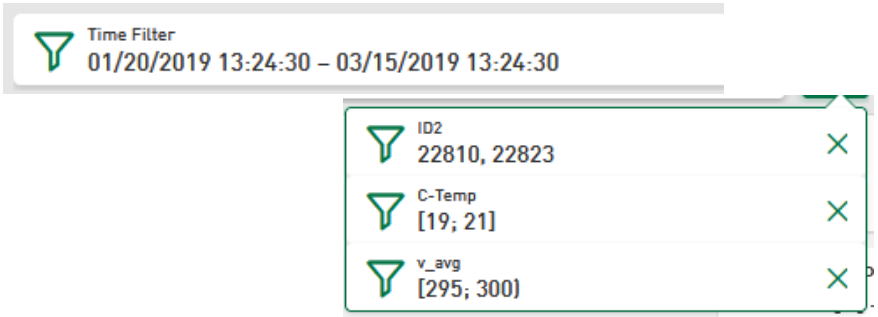
KPI-based Analysis

- Dashbord-based visualization and analysis
- Stakeholder-specific dashboards
- Visualization and analysis of KPIs
- Drill-down to raw data for root-cause analysis

Dashboard-based interactive Analysis of KPIs (1)

Interactive Filtering

- Filter are applied to the entire dashboards
- Intuitive design – no database knowledge needed
- Easy analysis by stepwise refinement
- Undo function for filter



Dashboard-based Interactive Analysis of KPIs (1)

Typical Analysis Scenario

- KPIs abstract the process and production to relevant numbers
  → benchmarking, reporting, overview
- But for root-cause analysis, raw data is needed
- Interactive drill-down to raw data
- 3 modes for visualization of raw data

Visualization of KPIs and raw data in ONE tool on ONE dashboard

3

Usage of Measurement Data

Online Monitoring

Proven Architecture of a Monitoring System

Transfer of key performance indicators (KPIs) to higher systems

Interactive long-term analysis with drill-down to raw data

Long-term monitoring of KPIs with alarming

IT-Network

OT-Network (shop floor)

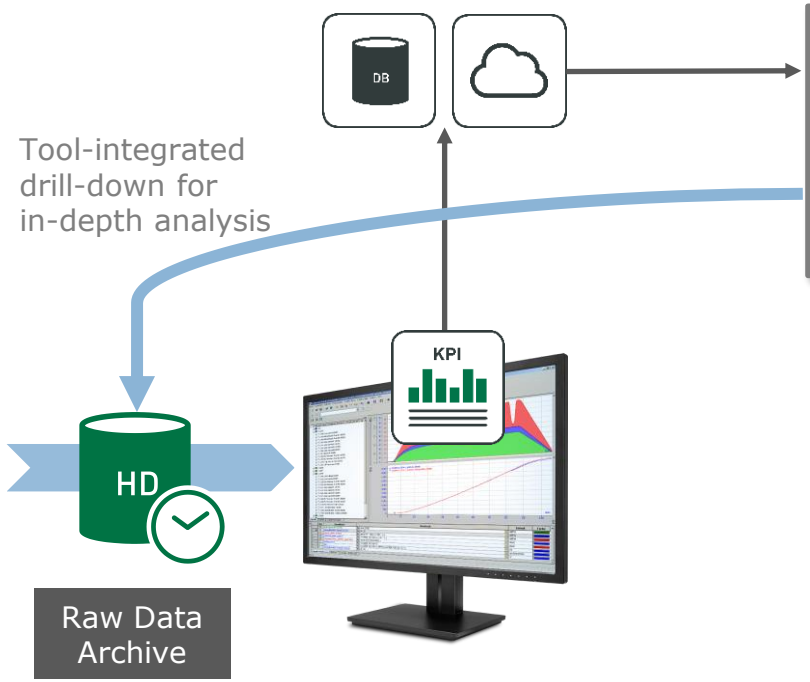
Edge Analytics
Evaluate data at their origin

Online alarming on the shop floor

Process control

Process

(1) Online Monitoring based on KPIs



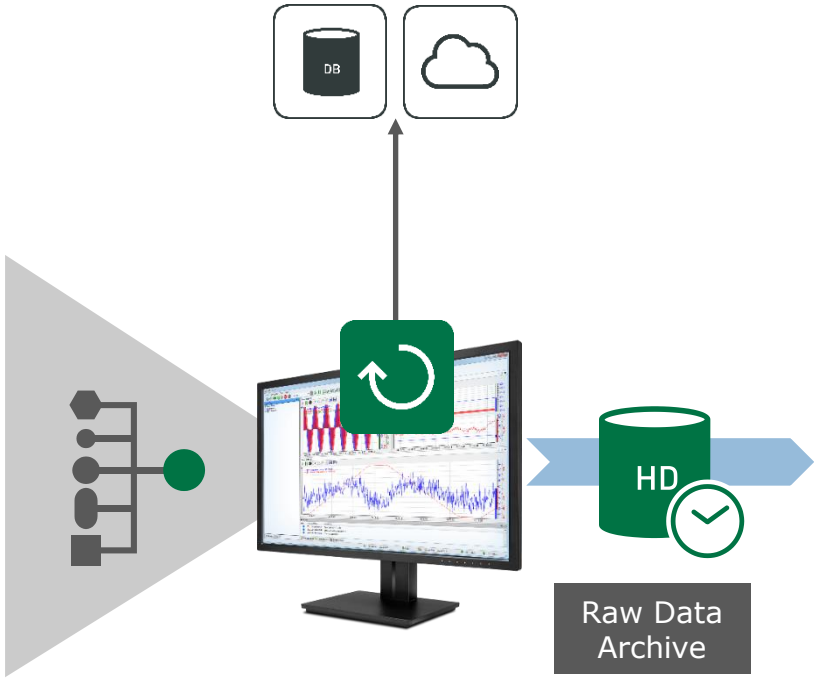
Online Process Monitoring

- Automated product (coil) release

Offline Process Analysis

- Benchmarking
- Process optimization
- Product analysis
- Find potential for energy and resource savings as well as CO2 reduction
- Root-cause analysis

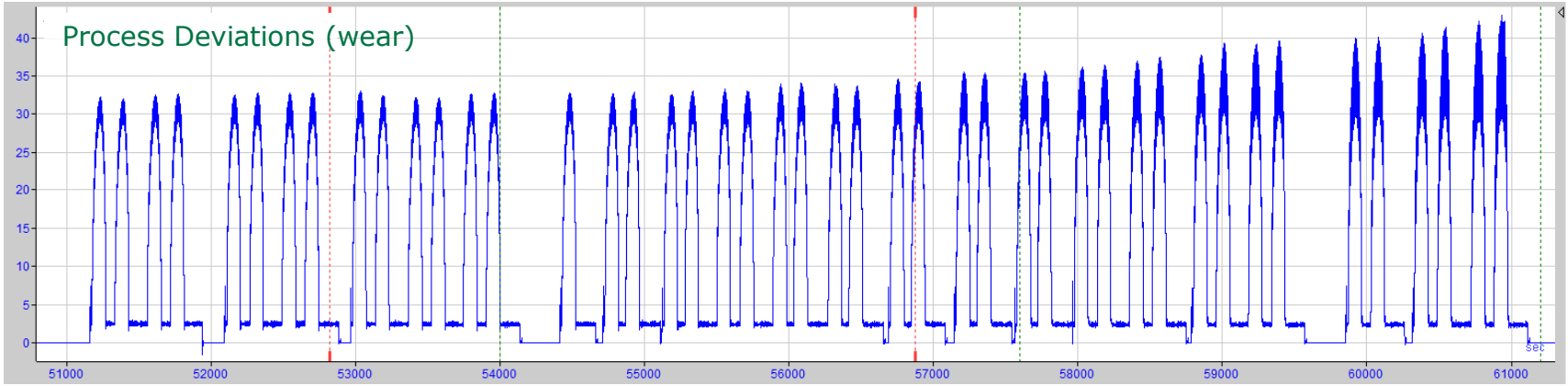
(2) Process Monitoring in the Time Domain



- Real-time monitoring in the data acquisition system
- Monitoring is based on existing signals;
  no further sensors required
- Process analysis in time-domain
- Time normalization using Time Synchronous Averaging (TSA)
  → establish comparability of similar processes
- Automatic learning of limits for different process conditions

Target: Detection of Process Deviations & Anomalies

A



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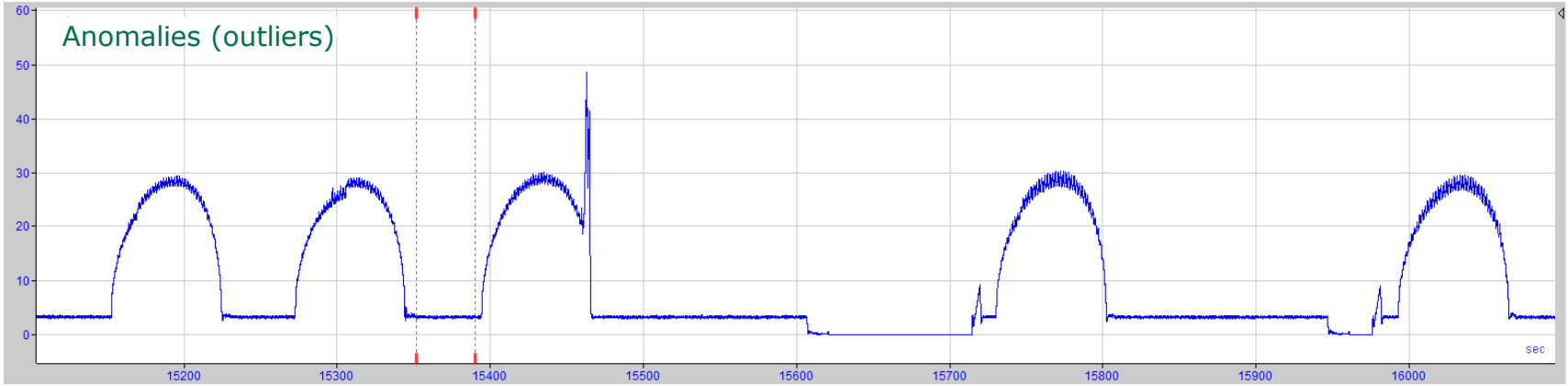
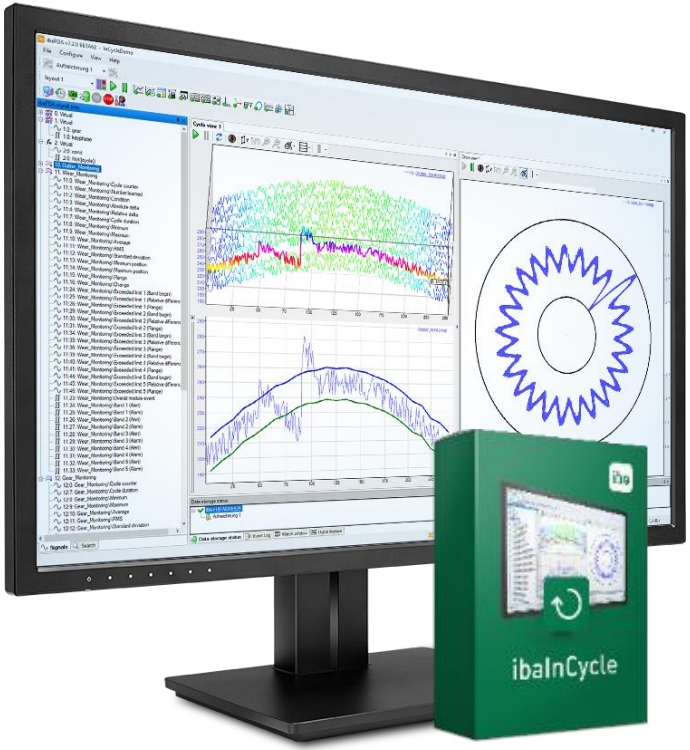


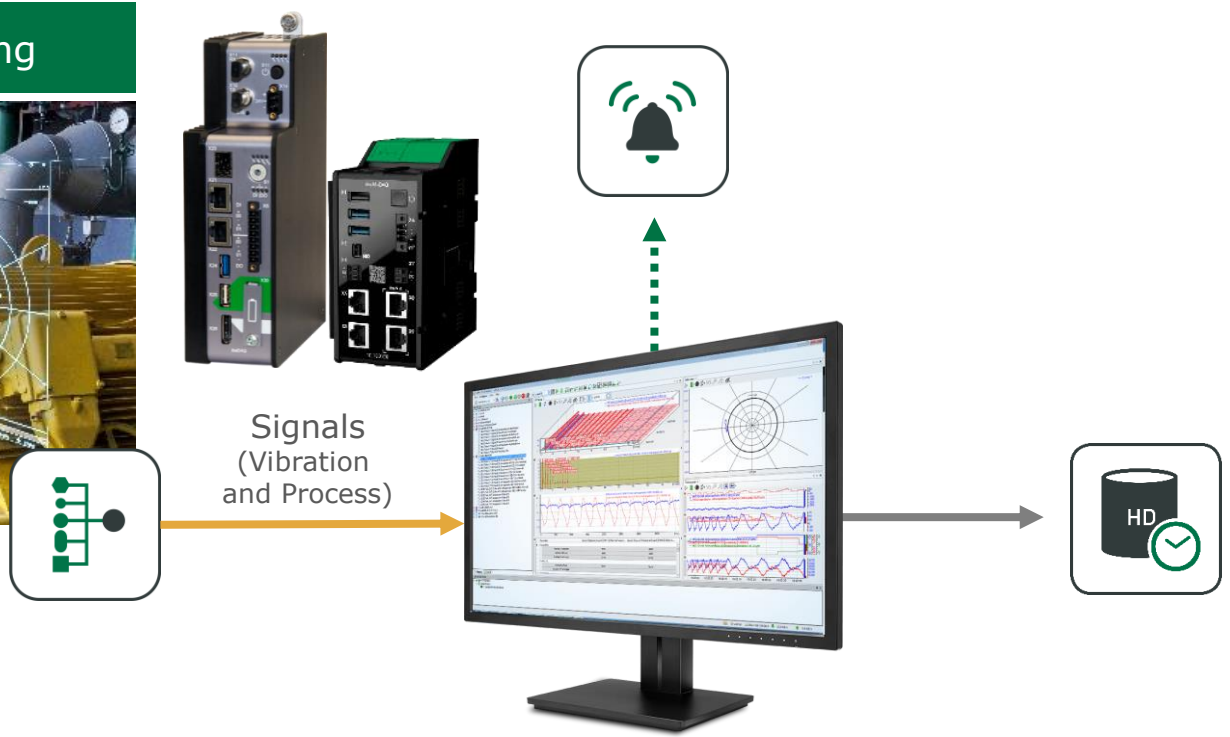
Typical Applications



- Monitoring of cyclical and rotating processes
  - Motor- and gear monitoring
  - Machine monitoring (e.g. wear of saw blades)
- Monitoring of single, semi cyclical process steps
  - Presses (forge, displacement and pressure curves)
  - Crane monitoring
  - Sequential processes in machines and plants
  - Monitoring of step responses and rolling stand characteristics
  - Monitoring of robot systems, especially monitoring of movements

(3) Process Monitoring in the Frequency Domain

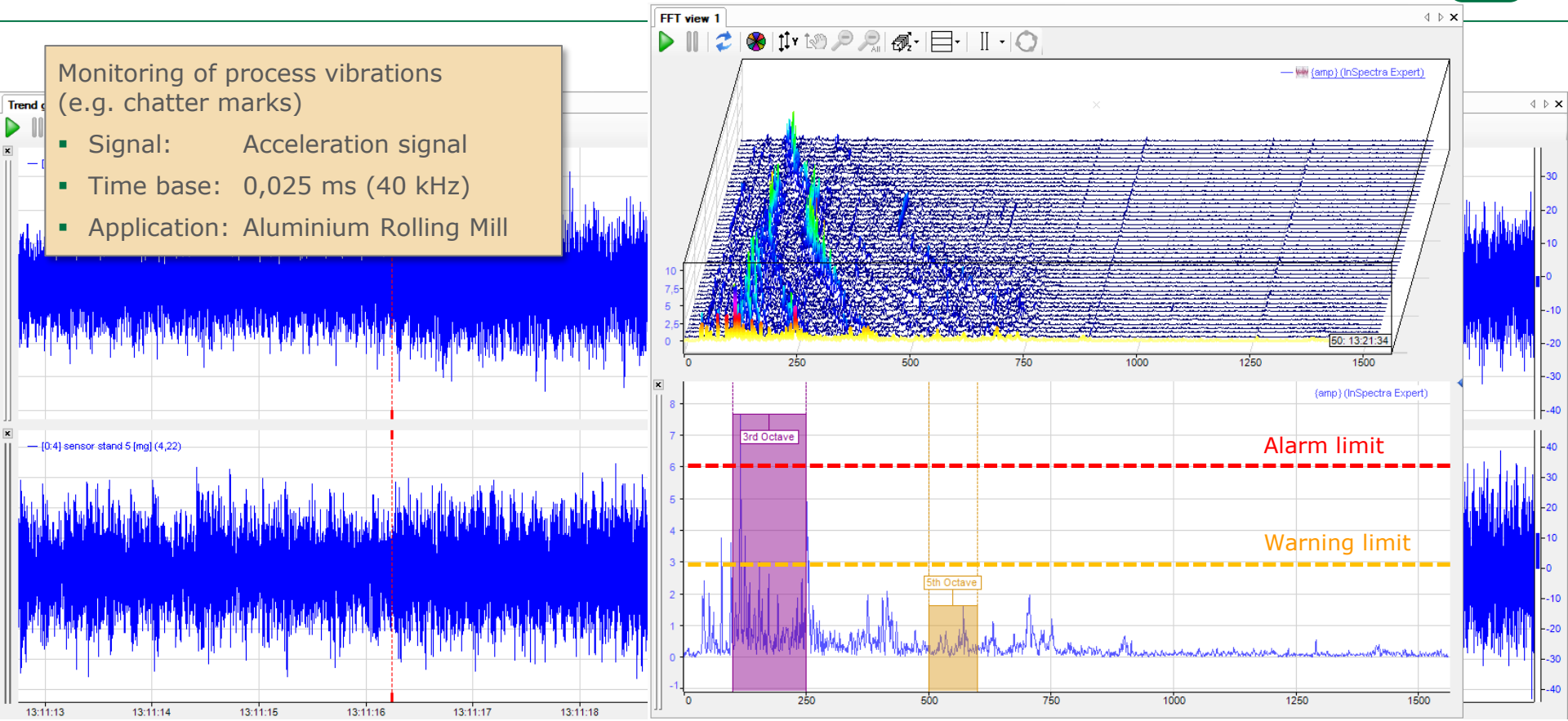
Online Vibration Monitoring



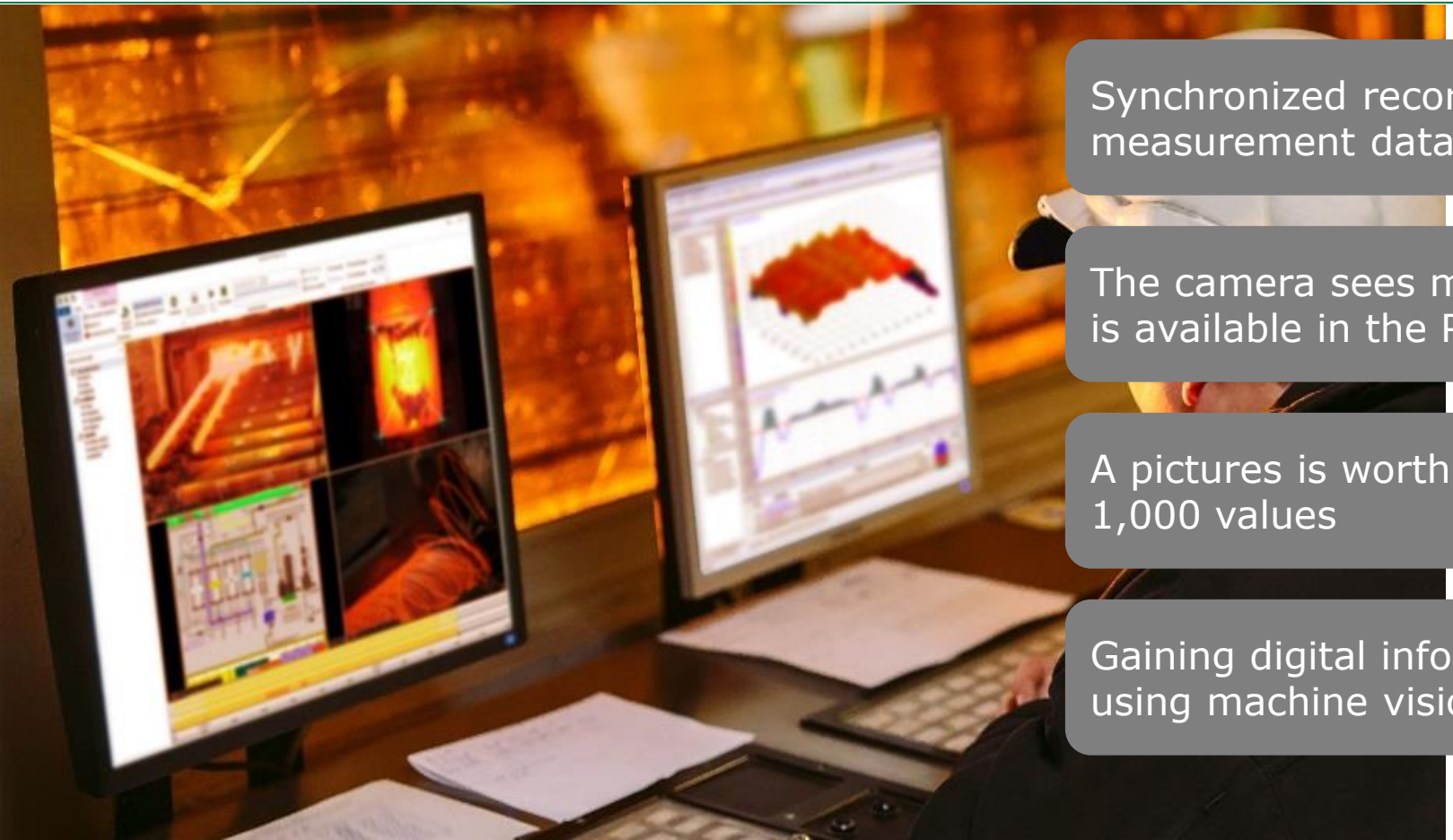
(3) Online Vibration Monitoring using FFT

Monitoring of process vibrations
(e.g. chatter marks)

- Signal: Acceleration signal
- Time base: 0,025 ms (40 kHz)
- Application: Aluminium Rolling Mill



(4) Process Monitoring with Machine Vision



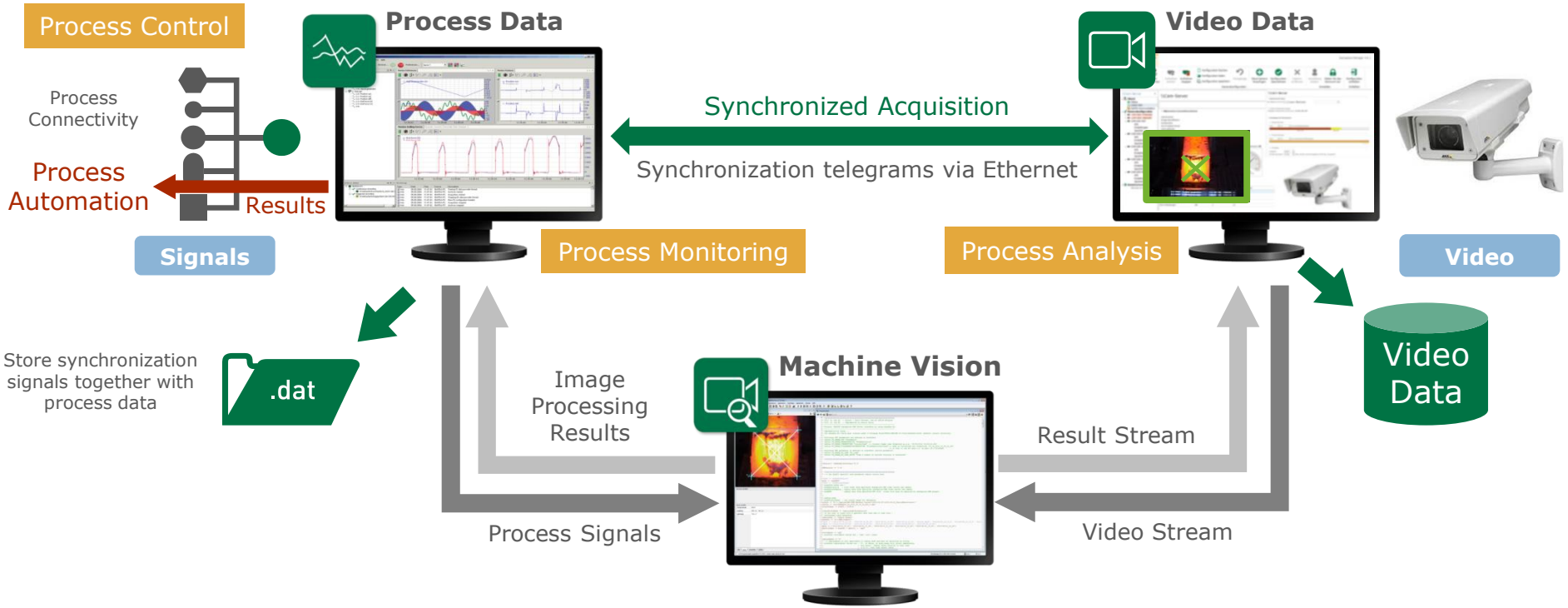
Synchronized recording of measurement data and video

The camera sees more than is available in the PLC

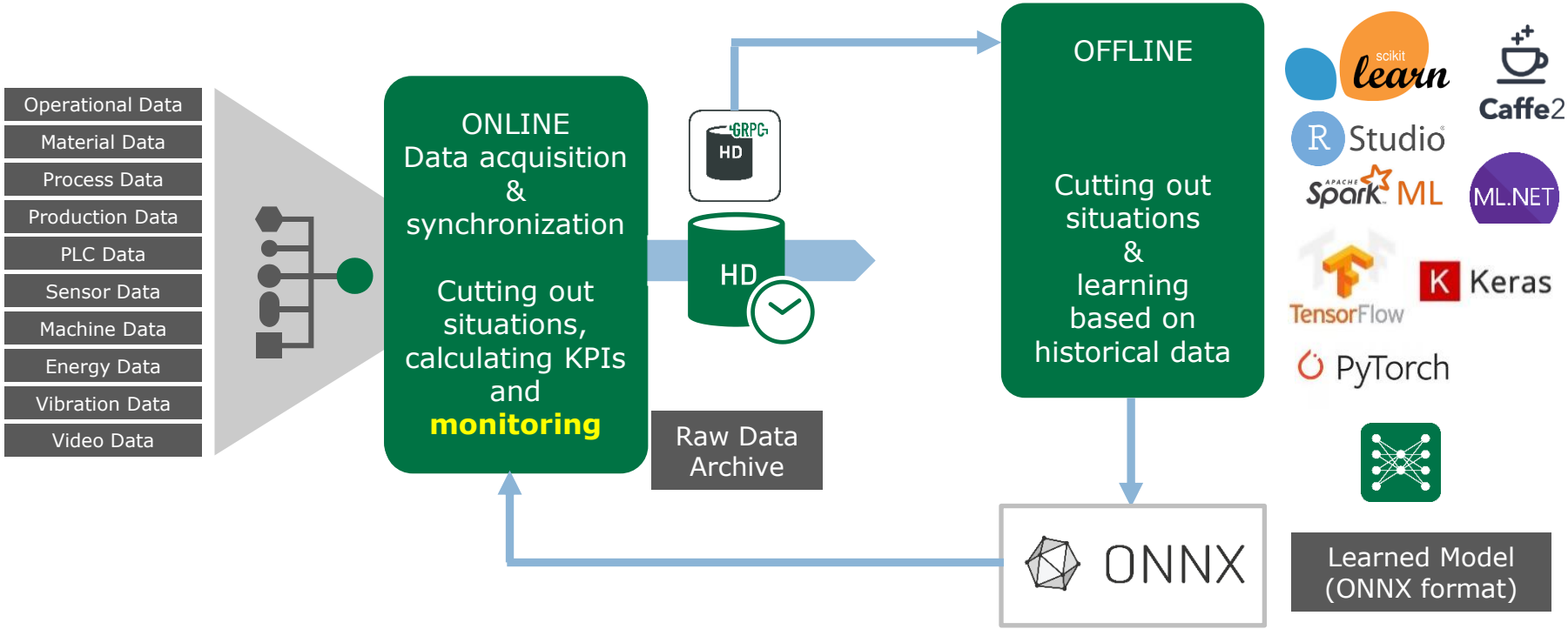
A pictures is worth more than 1,000 values

Gaining digital information using machine vision

Process Analysis, Monitoring & Control based on Video Data



(5) Online Process Monitoring using Machine Learning (AI)

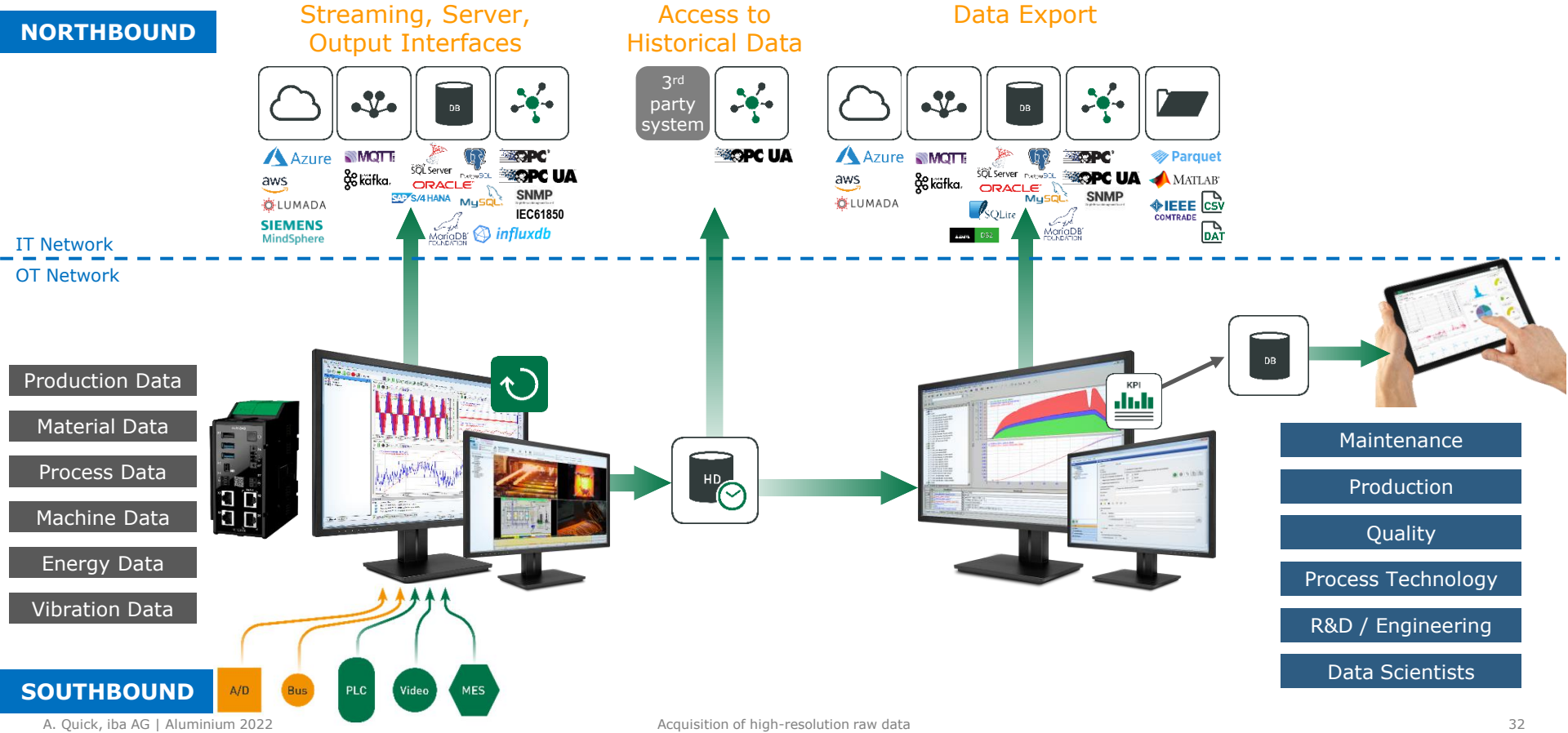


4

Open Ecosystem

Transfer Data to external Systems

The iba System – An Open Ecosystem



Key Takeaways

Acquire high-resolution raw data
Meet all stakeholders' requirements

Comprehensive process connectivity
Gain a holistic view of the process

No data silos
Data is the basis for collaboration

Let's talk about data
Digital transformation is a common effort

Tool environment for analysis
Make big data manageable

Thank you!

Please see us in Hall 5
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