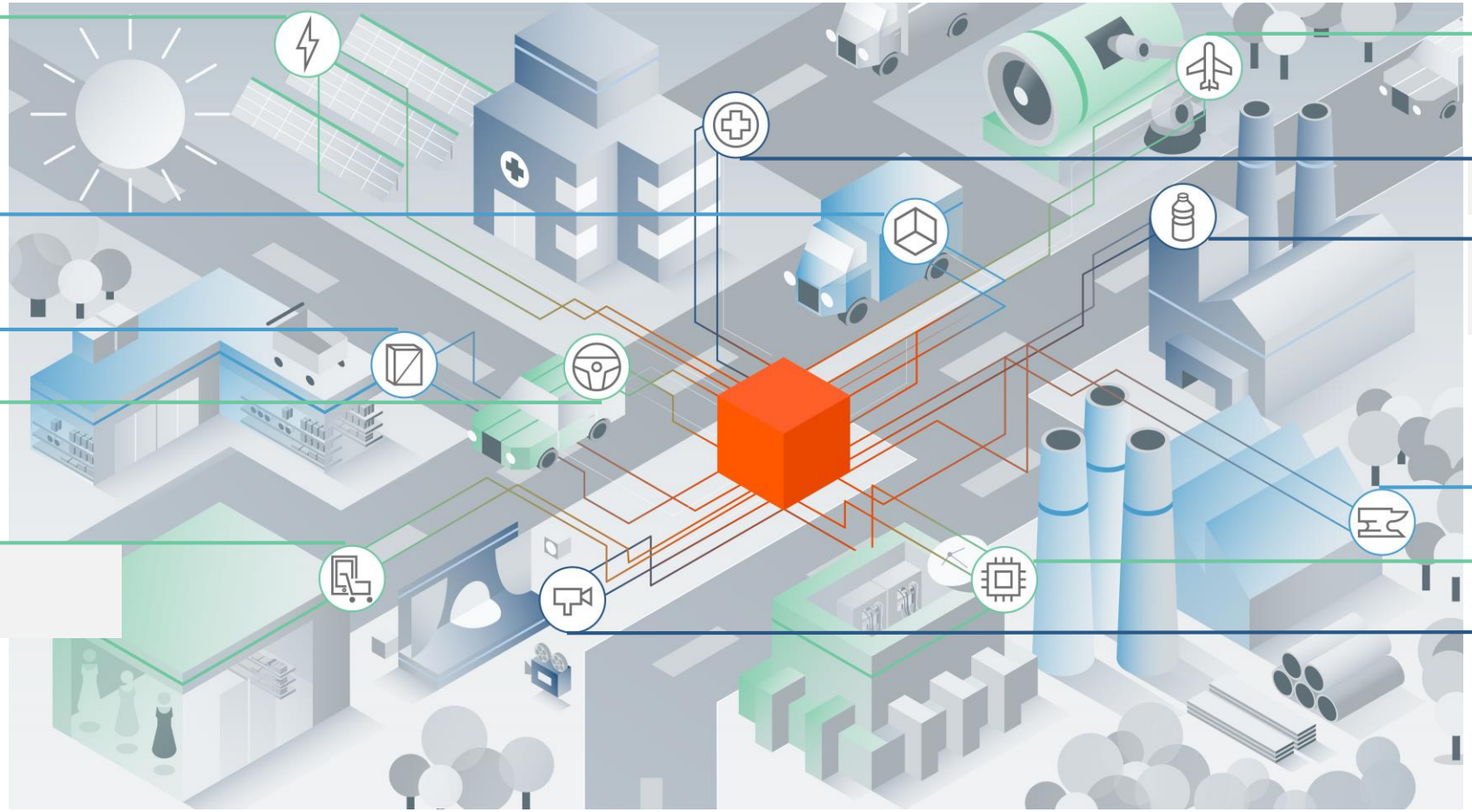
Putting IIoT into practice: visions, barriers & practical implementation from a robot- and plant engineers point of view

International Automotive Conference 2019
Joining Smart Technologies
8/9 May 2019

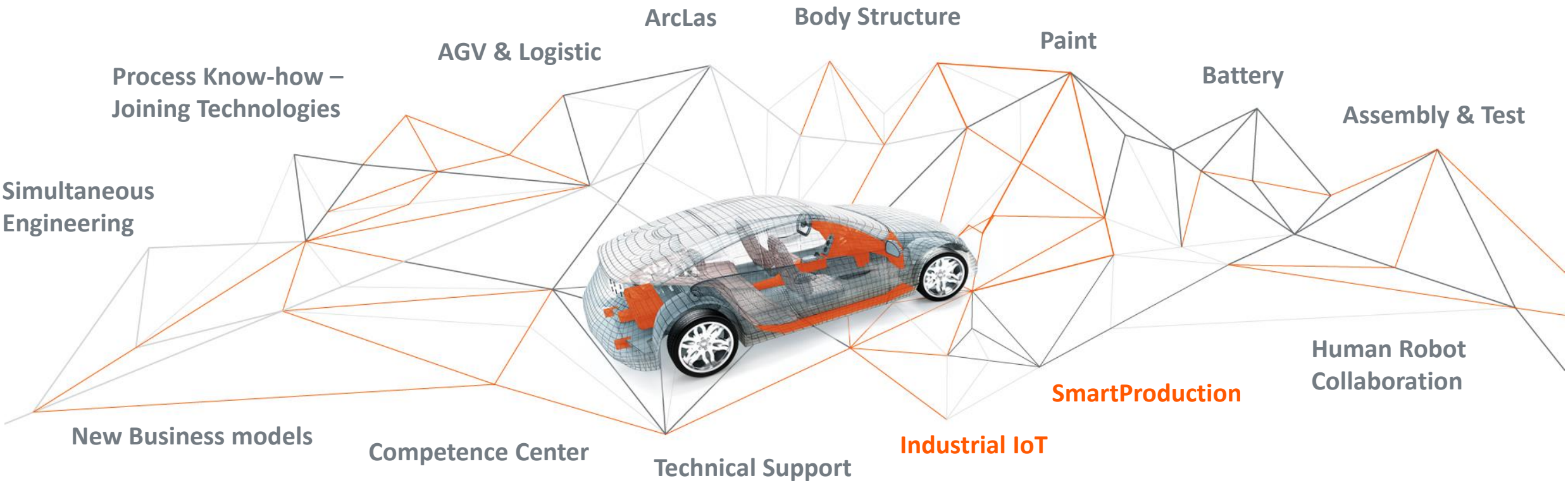
Robert Kamischke
KUKA Systems - VP BU Digital Solutions

Company segments

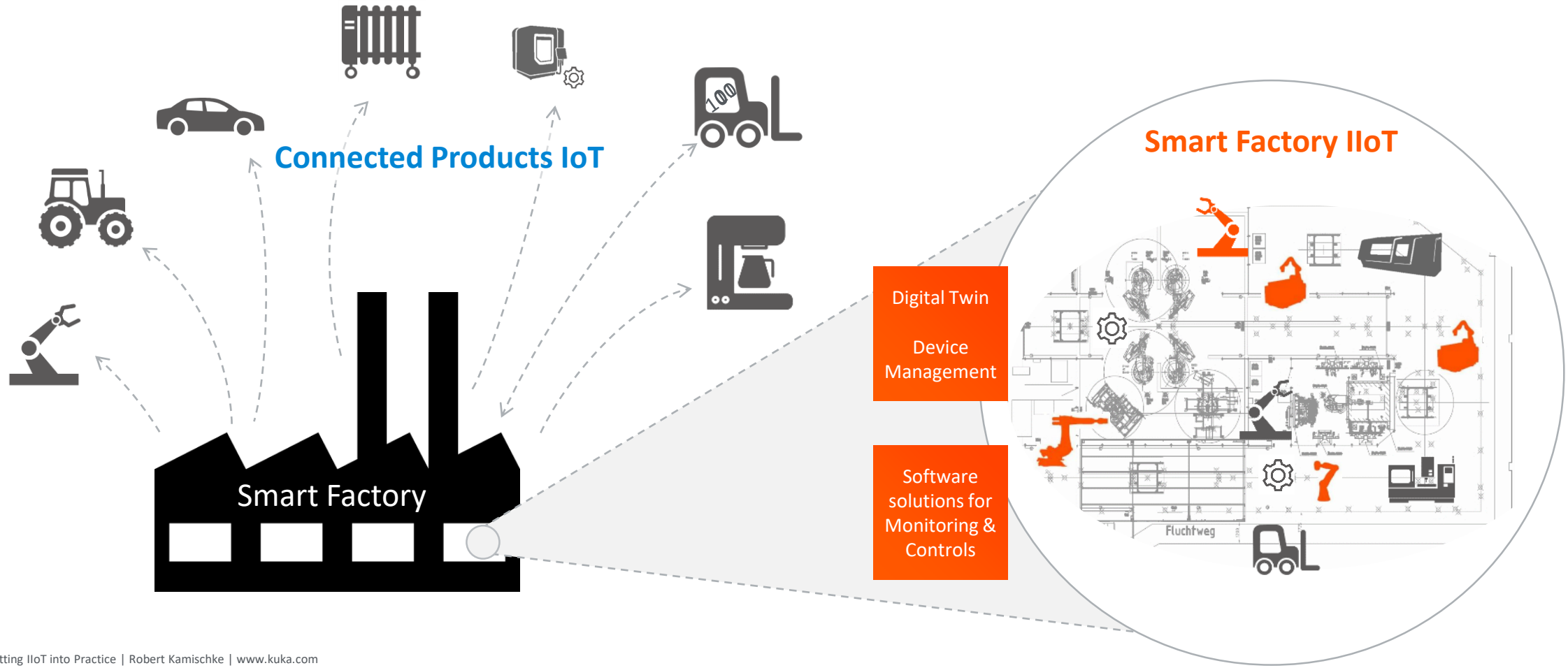
The industries we address



Benefit from our comprehensive expertise in Automotive



The interaction of IoT and IIoT in the context of Industry 4.0 is a 360° view



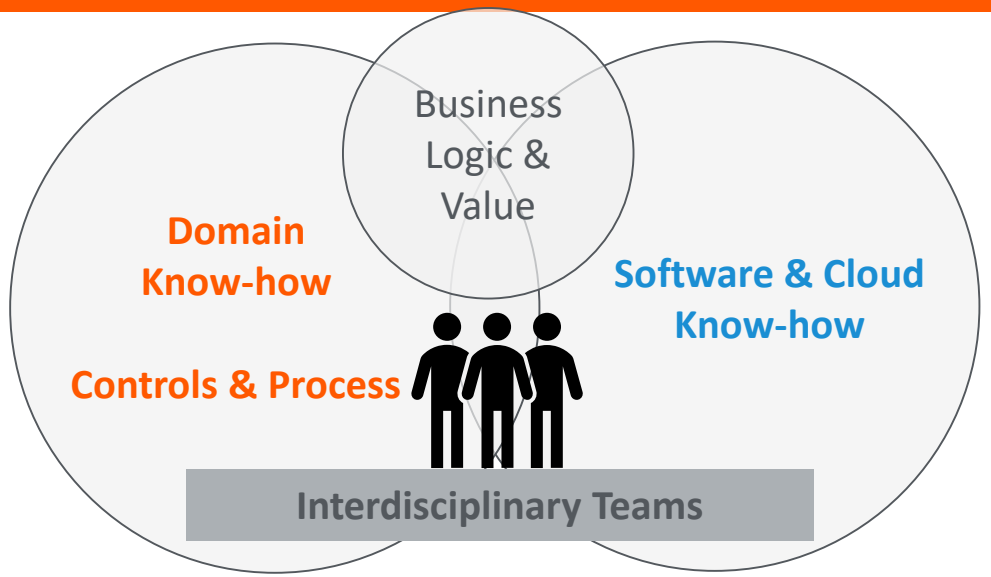
Core Competencies of Digital Transformation

Digitalization @ KUKA - Challenges and Solutions

Embedded Software Know-how, High Availability, Classic Product Development Processes

Agile Development of Micro Services, High Level Languages, Managed Service

IIoT needs …



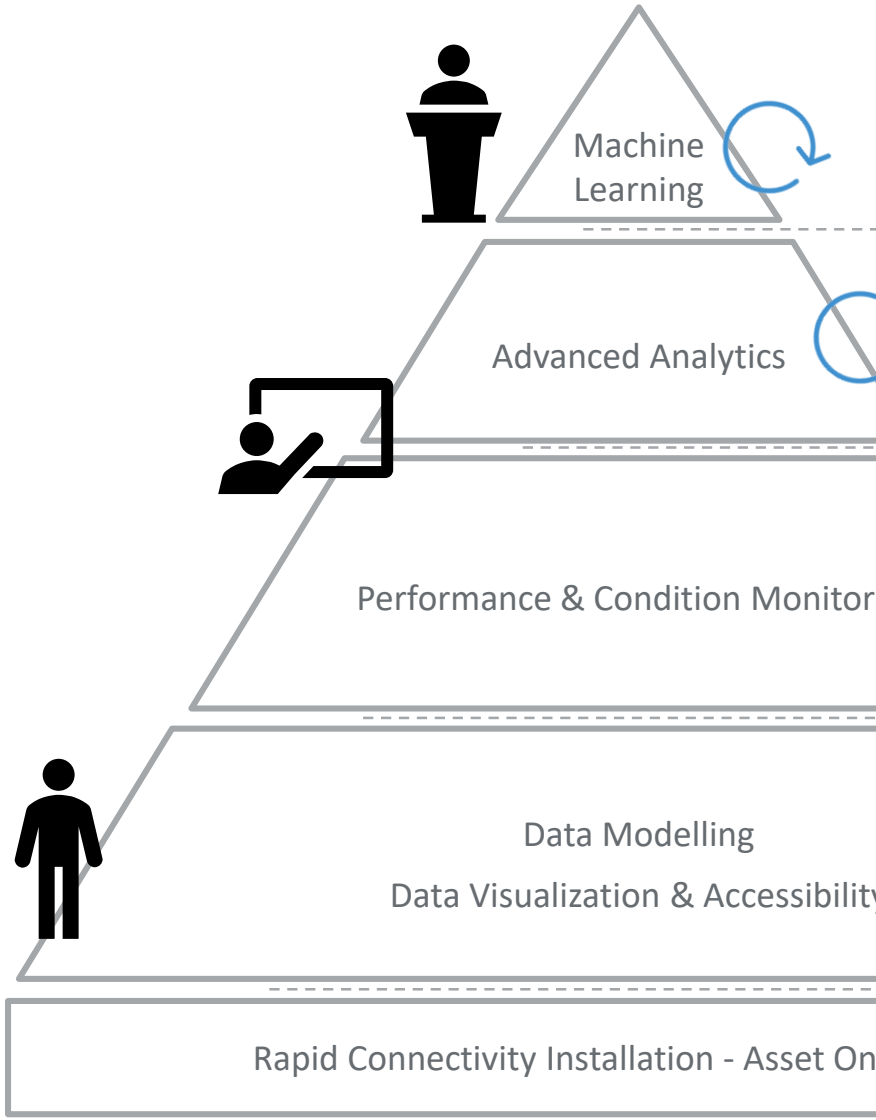
…. Standards & Cloud Infrastructure

KUKA

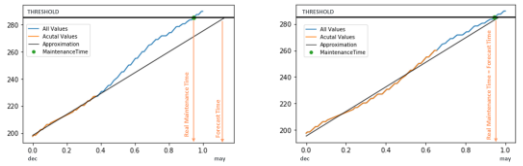
DEVICE INSIGHT

Since 2016 development of connectivity & cloud solutions for KUKA	Development to Trusted Advisor	Strategic Investment in Device Insight 2017	CENTERSIGHT as platform for KUKA IIoT

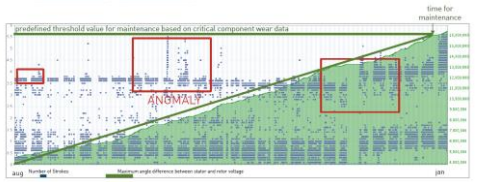
Our experience: Project approach must be interdisciplinary



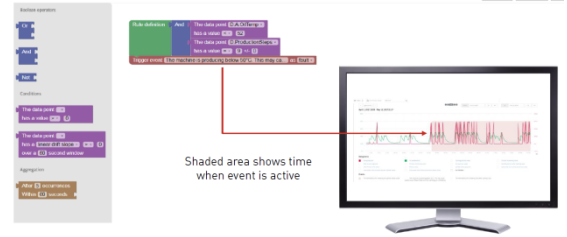
Machine learning algorithms to predict maintenance times



Statistical methods for the automatic detection of anomalies



Rule Engine - integrated in IIoT platform - enables alerting and notification



Visualizations tailored to the addressees make status and need for action immediately visible

Connect machines to the Edge - via OPC UA

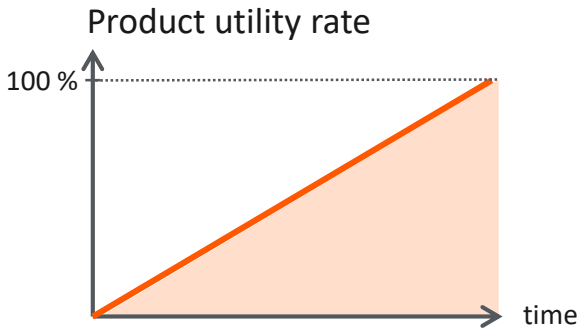
For a successful transformation the **MVP Approach** can be helpful

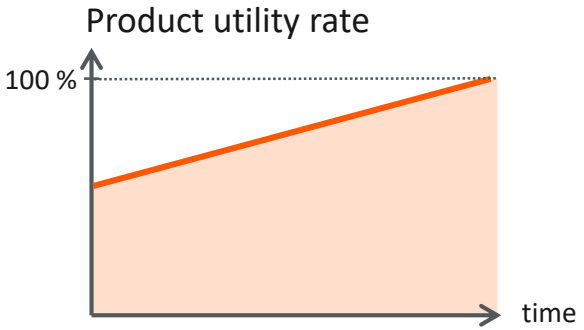
How to build a **minimal viable product**

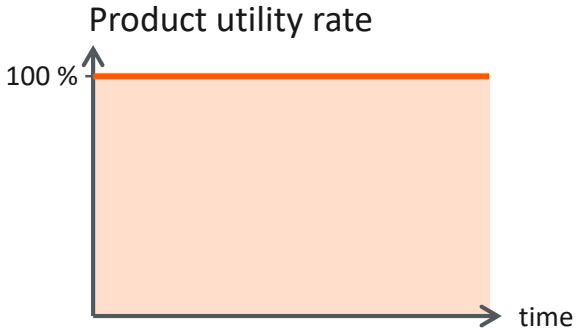
Not like this …

Also not like this …

Like this …



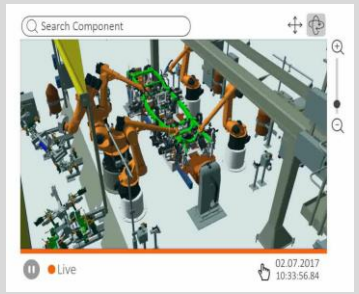


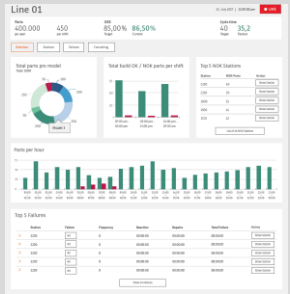


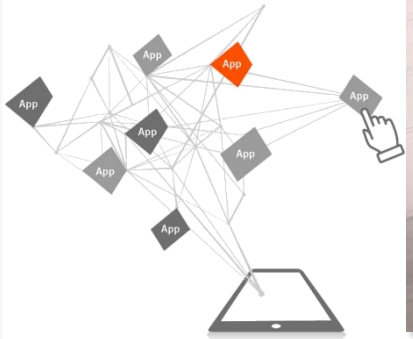
IIoT is the key for new Digital Services with different Business Modells

KUKA Solutions

- **IIoT-Consulting and Ramp-up support**
- **SmartFactory as a Service**
- **Digital interfaces** (e.g.: KUKA robot connection)
- **Digitization process** (e.g.: digitization spot welding process)
- **SmartProduction_monitoring - VCS**
  Web-based system for analysis of process data from PLC and robot for overall process optimization
- **SmartProduction_management - Virtual Shadow**
  Digital twin of the existing plant by means of a kinematized virtual model







SmartFactory as a Service – „Werksviertel“ Munich

New ecosystems emerge on the basis of IIoT capabilities and standards

SmartProduction_monitoring - VCS

We have understood the challenges of our customers ...

"The **current production output** does not match the specifications."

"If I want to check the current **system status**, I need to go into the **production hall**."

"Only **detailed raw data** is available at the plant without reconditioning."

„The **amount of try-out parts** is much too high.“

"I need a **general, continuous visualization of the collected data**."

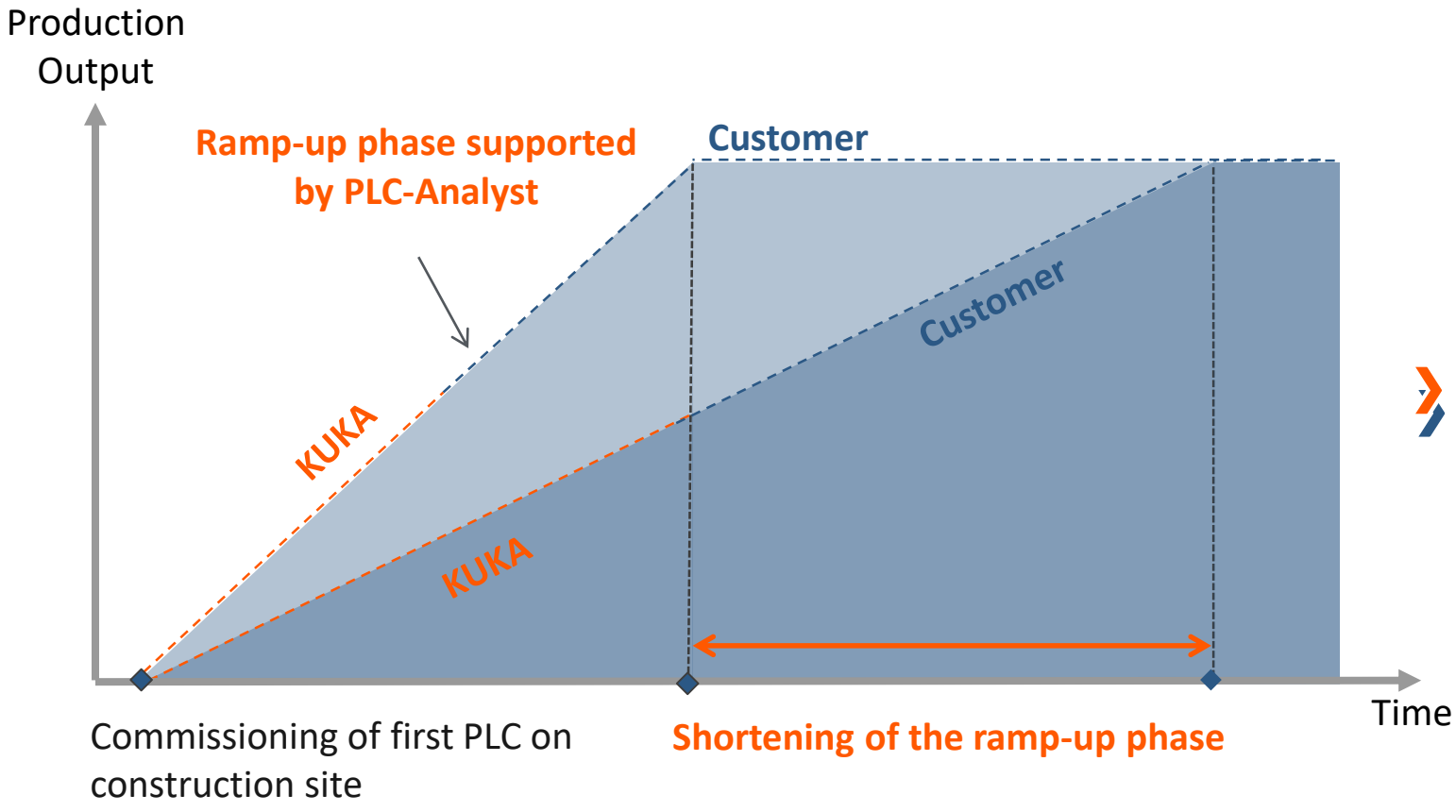
... and have developed a solution

SmartProduction_monitoring

- Web-based system
- Process data acquisition from PLC/robot
- Analysis of long-term trends
- User-specific displays for different user levels

SmartProduction_monitoring - PLC-Analyst

Tool to support and quicken the Ramp-up phase of Automotive Manufacturers



How to create a Win-Win situation?

Implementation of PLC-Analyst on first PLC on construction site KUKA uses PLC-Analyst during its own commissioning phase Achieving KPI's faster; Leave construction site earlier	KUKA
Continue using PLC-Analyst after take over by customer Identifying bottleneck's and crucial errors quicker Achieving an earlier start of high volume production	Customer

SmartProduction_monitoring – PLC-Analyst (VCS 2.0)

Web-based system that collects process data from PLC/robot to analyze errors, performance, technical availability, cycle time, etc.

Range of functions

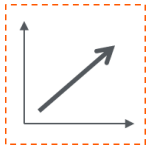
- Long-term trend analysis, error detection and preventive maintenance
- Visualization & Validation of processes in cycle time diagram
- Status report and optimization of production by bottleneck detection
- Fast and focused decision-making based on automated reporting
- From pull to push reporting with modular setup

Customer value

Ramp-up phase

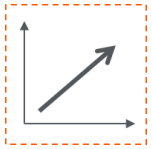
…through faster identification and elimination of errors

Output



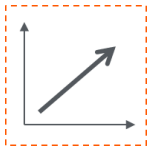
…through faster evaluation and elimination of interruptions

Transparency

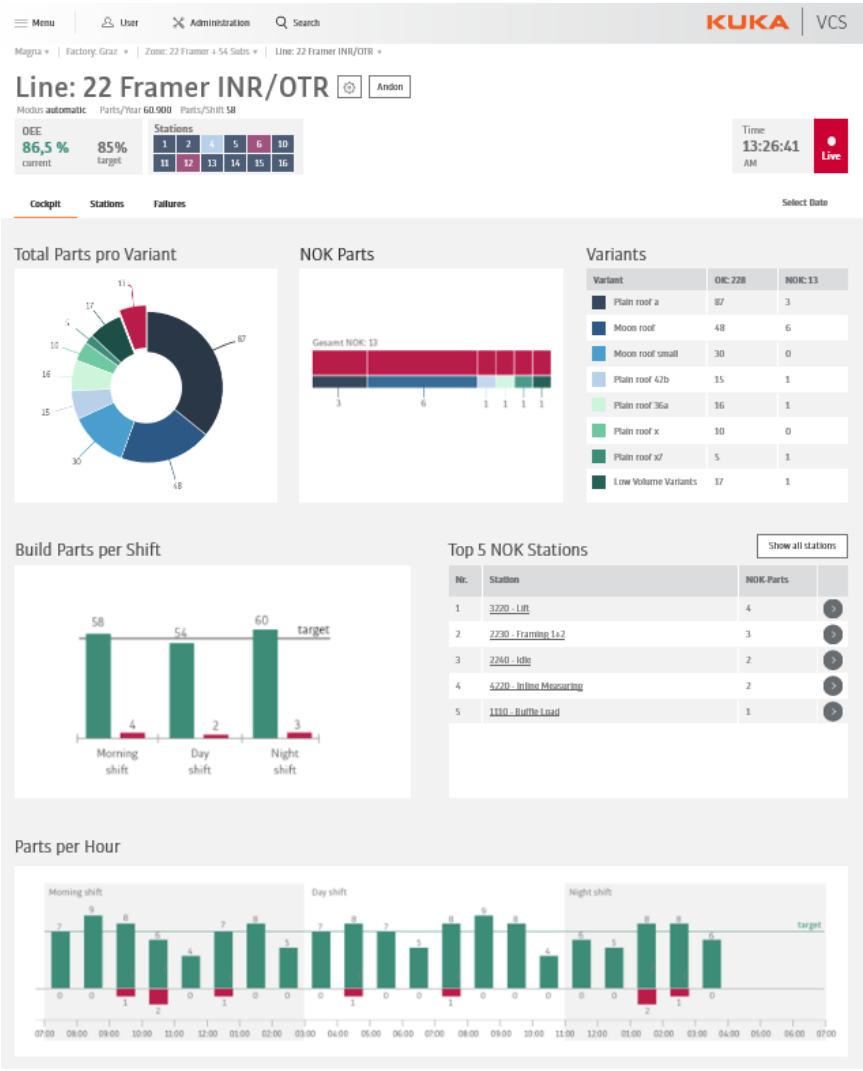


…through “live” Cycle Diagram with validation of process

Availability

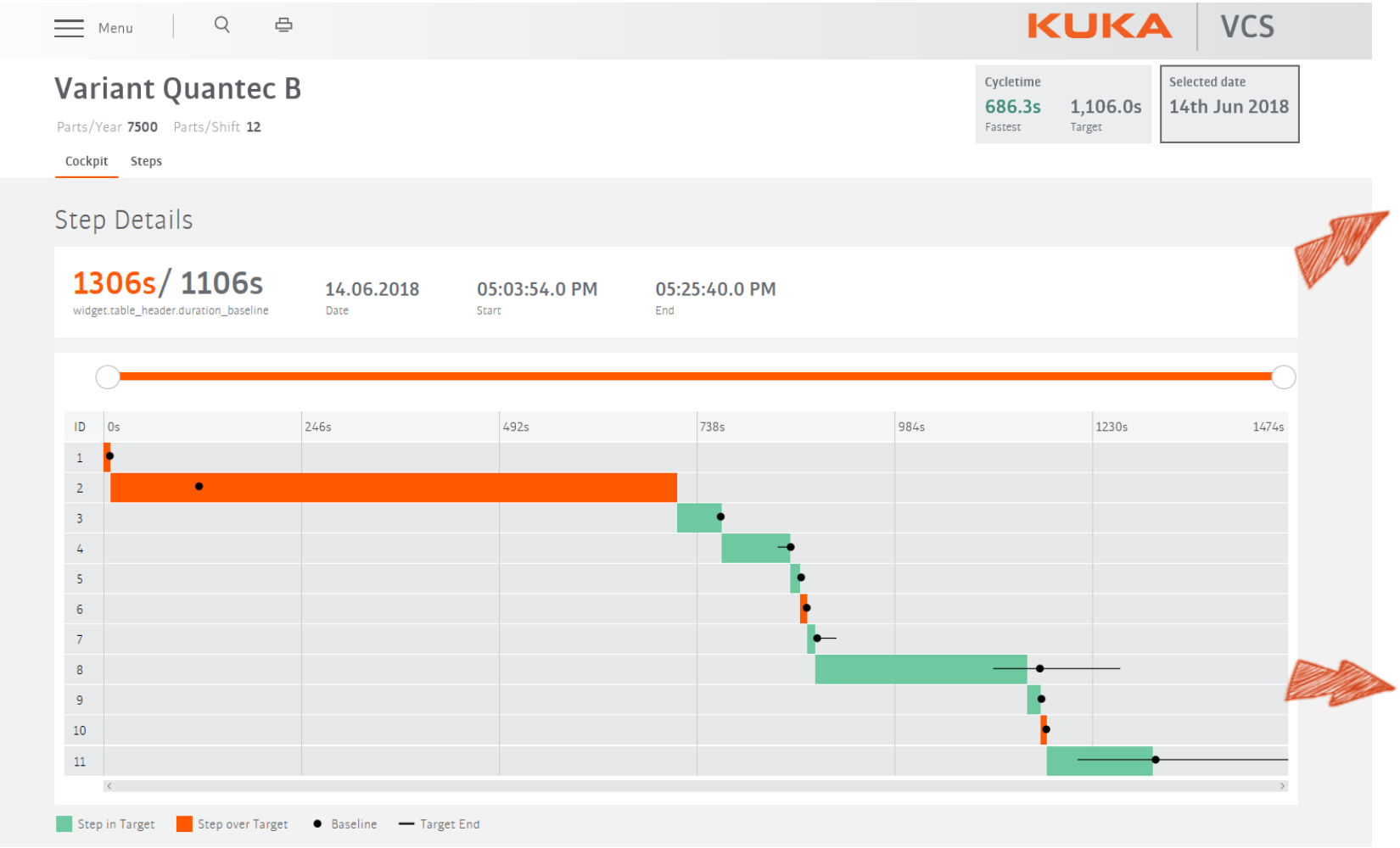


…through visualizing and validating adjustments



SmartProduction_monitoring – PLC-Analyst

Detailed view of production steps



Production steps

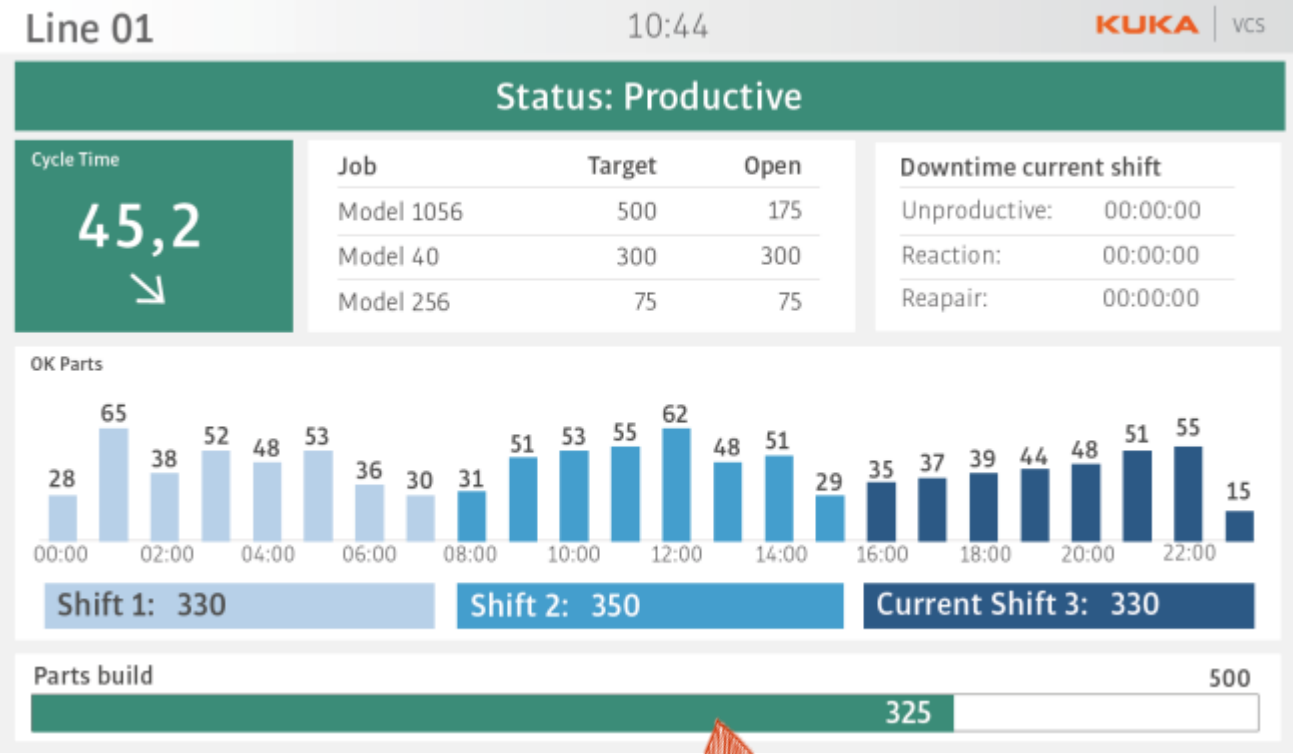
Detailed visualization of the single steps within a production cycle. Helping to understand the behavior of the machines.

Pre-defined tolerance ranges

Chance to identify the degradation of components through the precise monitoring at the process step level.

SmartProduction_monitoring – PLC-Analyst

Live view of Andon board

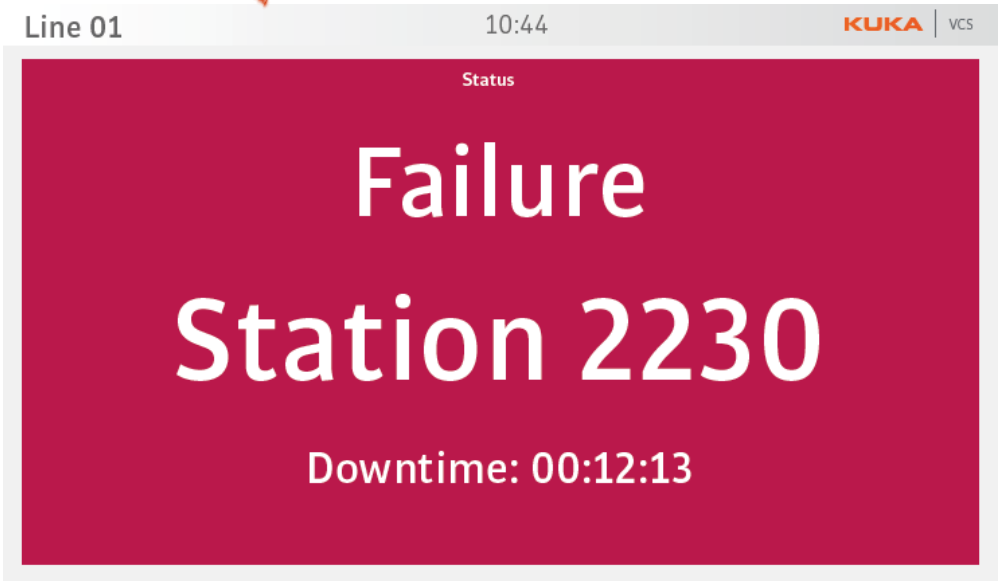


Andon board – Productive

Live overview of the line. Enables real-time feedback and establishes the link between action and results.

Andon board – Unproductive

Display of problems and alarms in real time, on site. Helps find the location of the problem and provides lead time for the next level of support.



SmartProduction_management – Virtual Shadow (Module of PLC-Analyst)

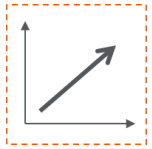
Virtual translation of existing plant for further integration steps, efficient maintenance and fast root causing

Range of functions

- Virtual model of the production plant
- Deep dive failure analysis and remote support
- “Crime scene” - traceability of any manipulation
- Reuse of existing virtual model from commissioning phase
- Better understanding of production and production benchmarking

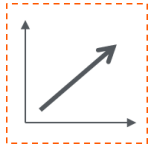
Customer Value

Flexibility



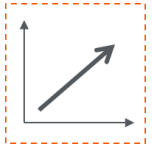
…through no need of physical presence

Output



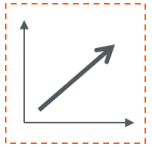
…through early identification and elimination of interruptions

Transparency

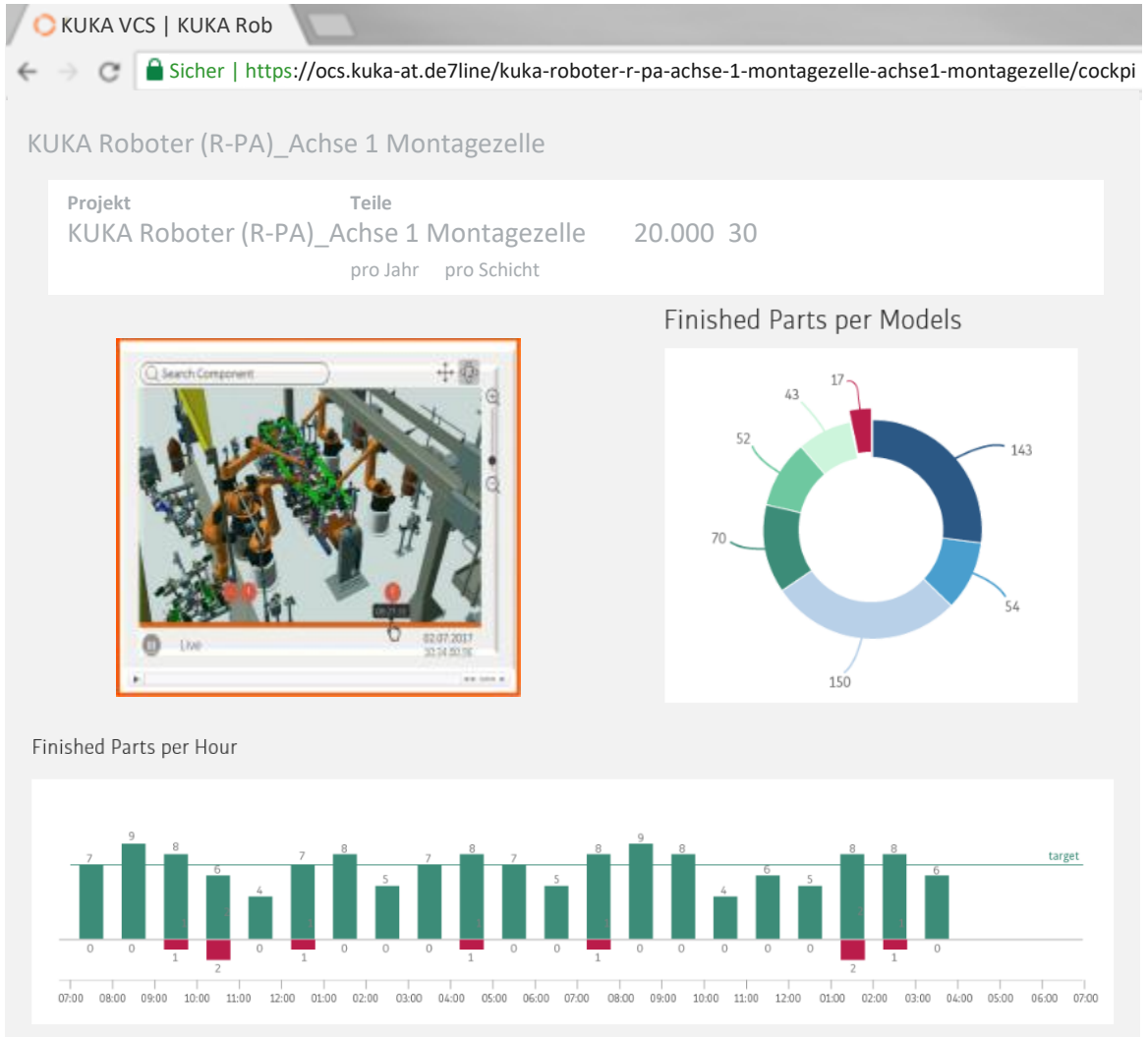


…through constant monitoring and visualization

Availability



…through visualizing and validating adjustments

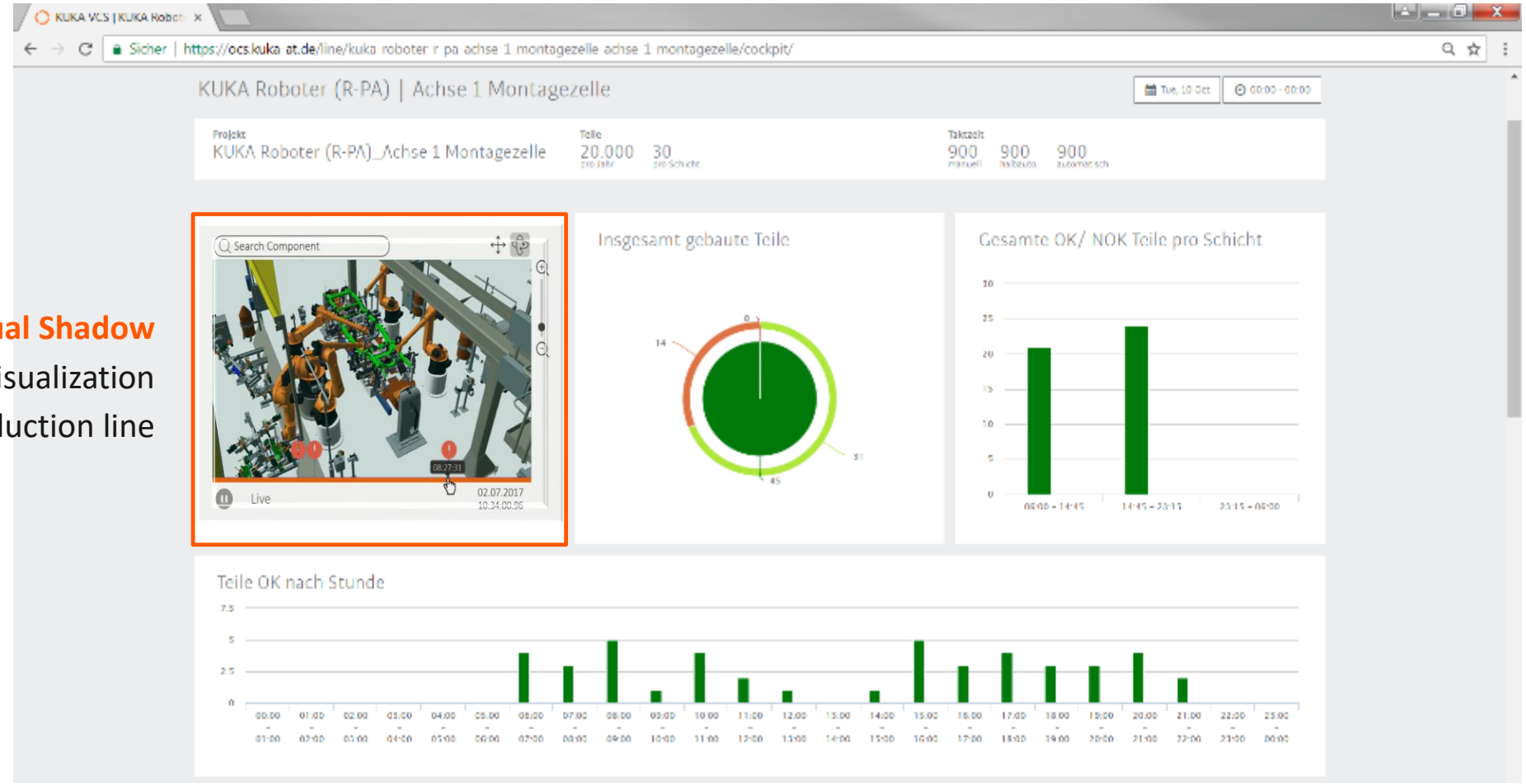


The integration of the **Virtual Shadow** in the VCS tool allows you to jump back in time and take a **look at the actual cause of damage.**

Virtual Shadow

3D live visualization

of your production line



KUKA

Our Approach

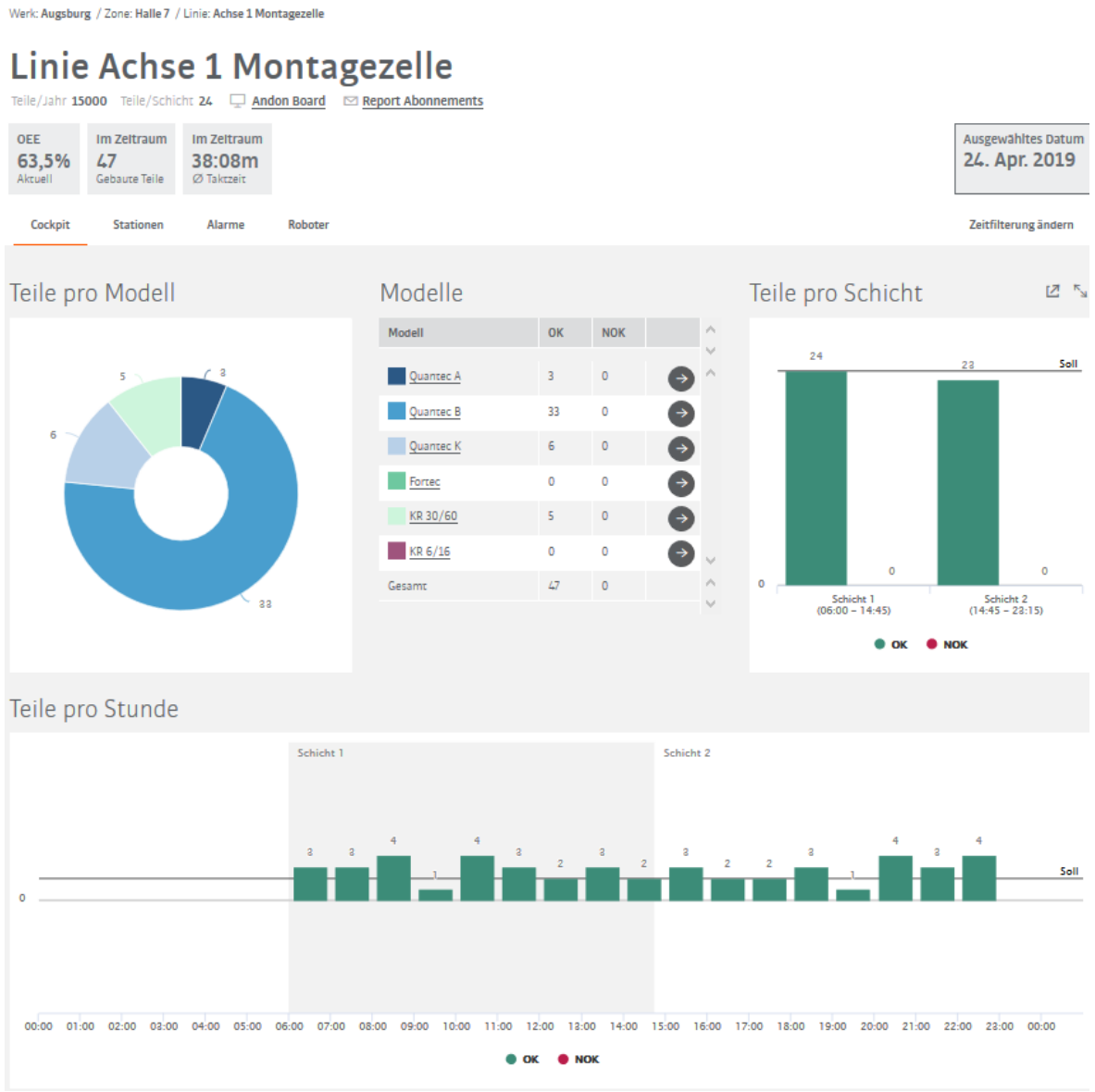
Using our own production to leverage our IIoT Products & Solutions - a fascinating journey

Three examples/use cases:

- Robot Final Assembly, Production Hall 7, Augsburg
- Milling Machine Center, Production Hall 10, Augsburg
- KTPO Plant Body Shop, Toledo (US)

SmartProduction_monitoring - VCS

Robot Assembly Line 1, Augsburg



- Tracking cycle time per robot modell
- Long-term trend analytics
- Maintenance improvement
- Overall OEE measurements
- Andon board
- Data for SW development

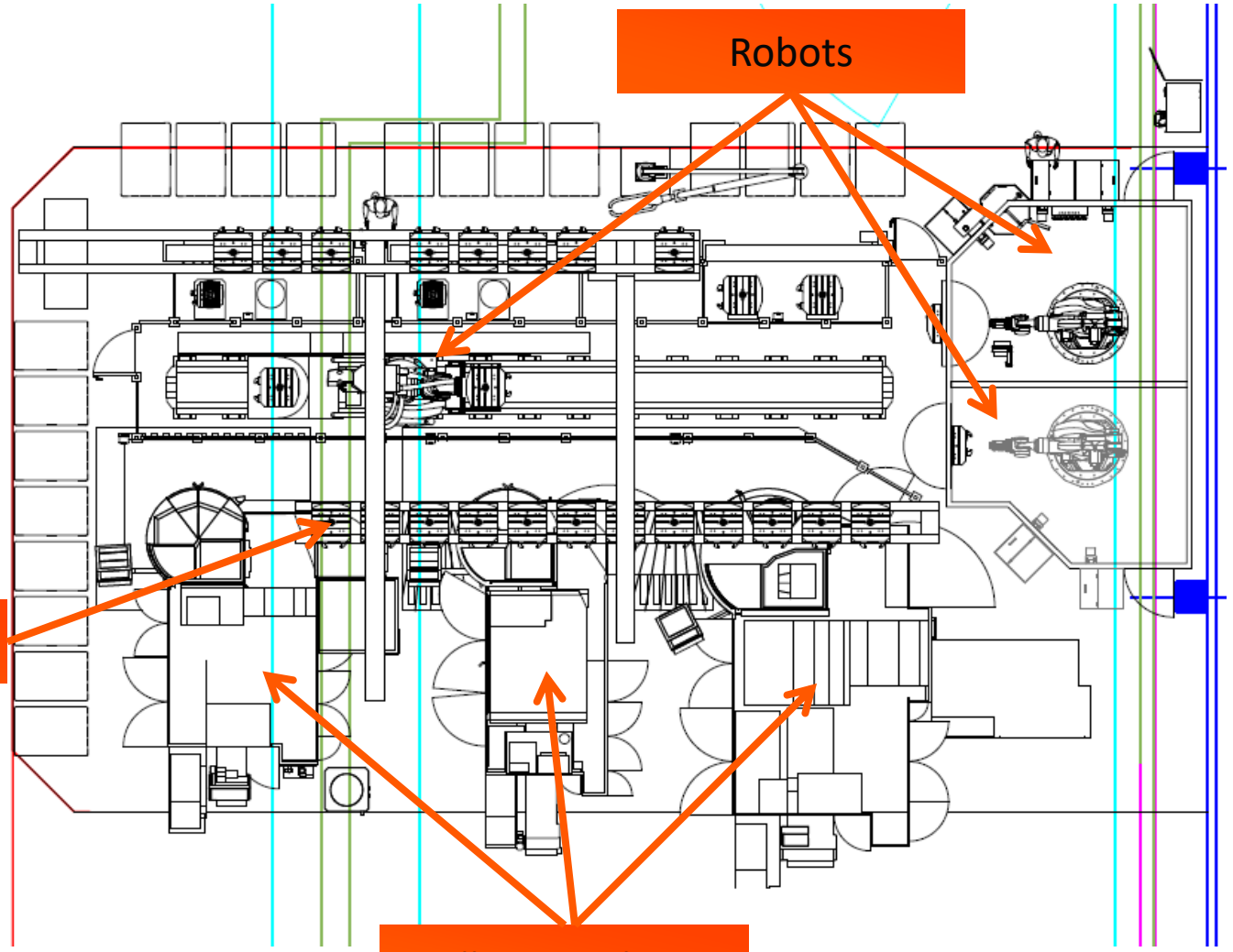
SmartProduction_monitoring – VCS & VIS

Milling Machine Center, Production Hall 10

New center consisting of:

- 3 milling machines and 3 robots
  - 1 robot on 7 axis for transport
  - 2 robots for flash removal
- High complexity for manual optimization
- Ramp-up of line with digital tools
- SOP May 2019

- Optimized production Ramp-up
- Minimized down time
- Transparency
- Fast failure analytic
- One common system architecture for further developments



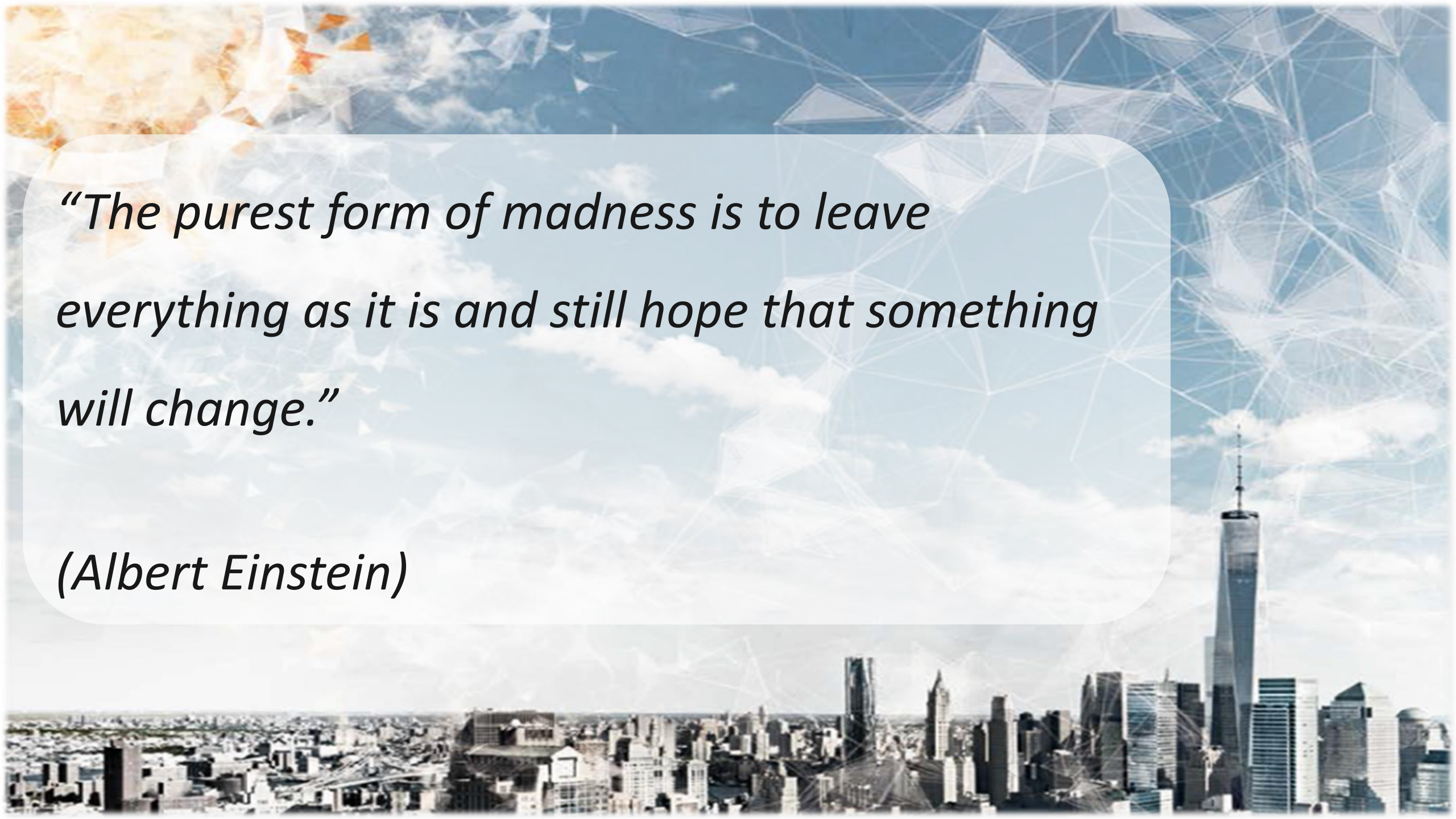
SmartProduction_monitoring

VCS „KTPO“ KUKA Toledo (US)
Production Operation

- Integration of Ramp tool during new product launch
- SW development by experience of own BiW production
- Next step - Joining Process Optimization

“The purest form of madness is to leave everything as it is and still hope that something will change.”

(Albert Einstein)



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