Conference Theme and Keywords

Digital Transformation to Reduce Testing Efforts in Battery Cell Production

Presented by
Christoph Lienemann

Agenda

1. Introduction PEM at RWTH Aachen University
2. Digitalization in Battery Production
3. Use-Cases in details

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1. **Introduction PEM at RWTH Aachen University**
2. **Digitalization in Battery Production**
3. **Use-Cases in details**

Our origin

- Founded in 1870
- One of only 11 Elite Universities
- Highest third-party funds in GER

- 40.000 students
- 10.000 students in Mech. Eng.
- 62 institutes in Mech. Eng.

- Founded in 1906
- 580 employees*
- 10.000m² office and production

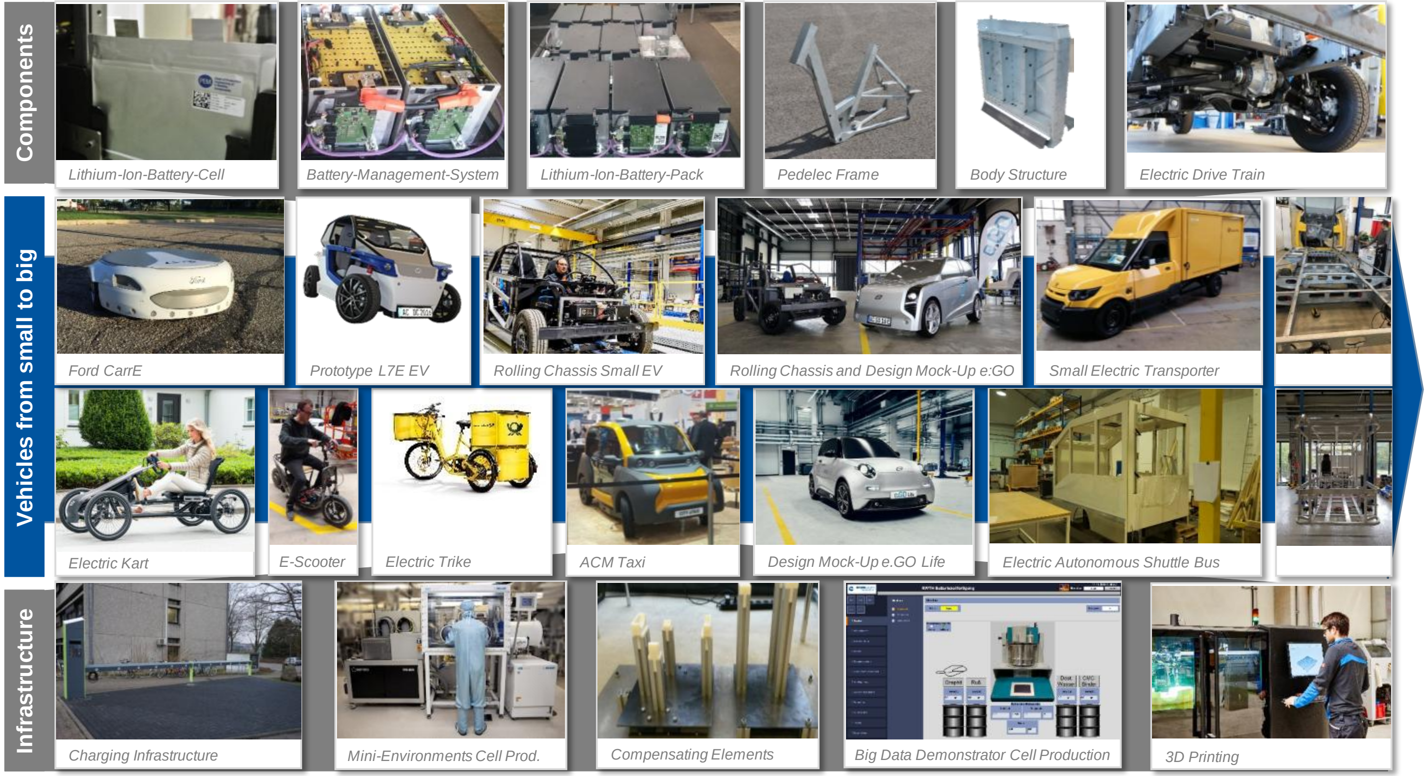
- Factory Planning
- Assembly Planning
- Excellence Cluster

- Founded in 2014
- More than 50 permanent employees*
- 4.000m² office and production

- PEM institute conducts technology-driven research in all fields of the E-Mobility value chain.

**last updated: June 2017*

We can build various types of electric vehicles, components and infrastructure prototypes in our facilities in Aachen

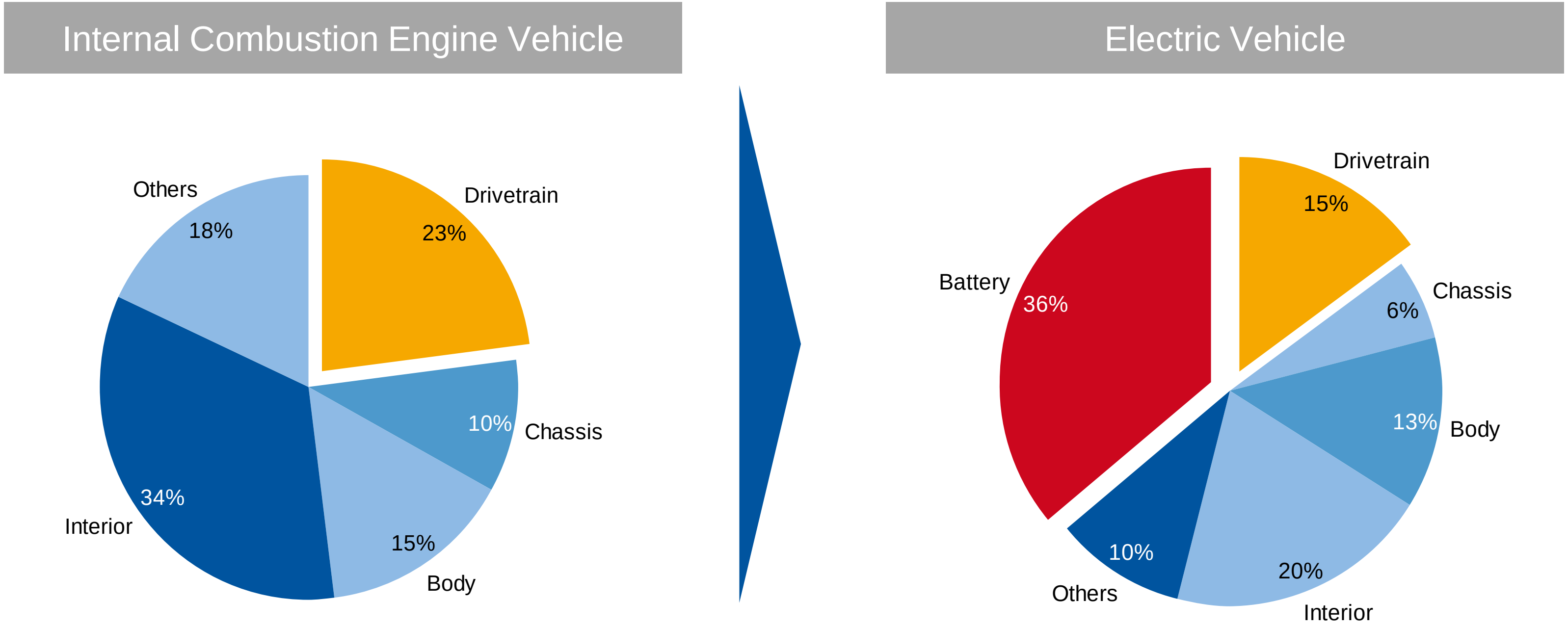


One of our industry partners: e.GO Mobile AG

Source: e.GO Mobile AG Homepage

Elementary are the changes in the area of the drive and energy storage

Example costs of the components in the production of an electric car



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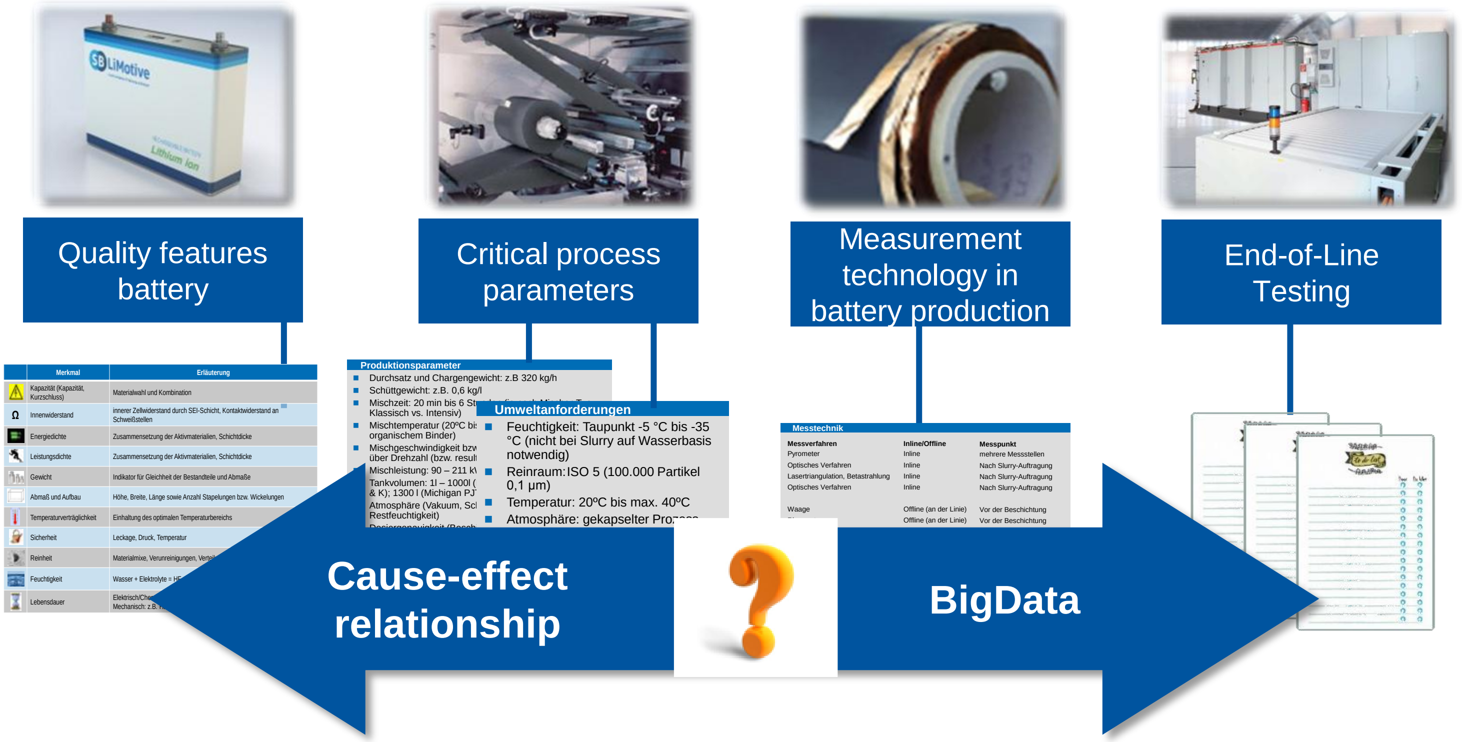
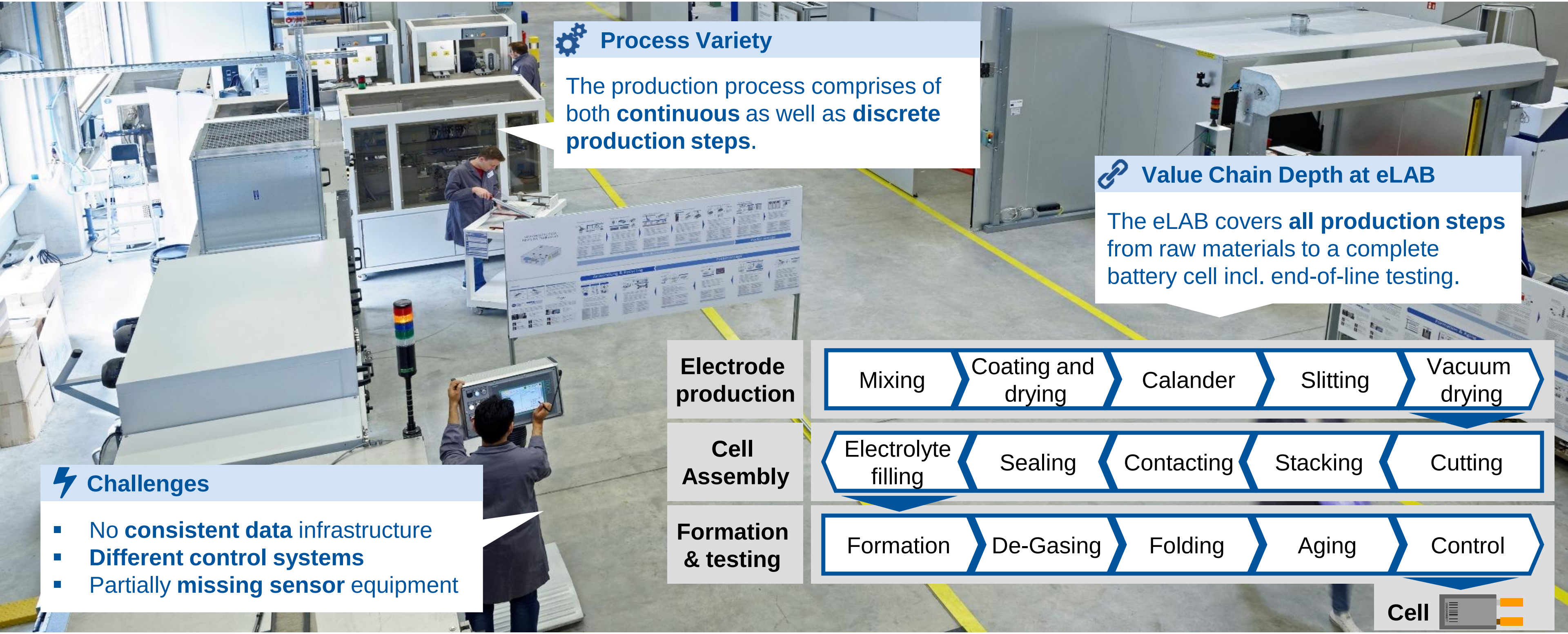
Focus on quality assurance in battery cell production



Source: Sources for pictures: m+w zander, Karo Electronics, Kroenert, IBG, SB Limotive, ThyssenKrupp Homepage

We cover the entire production equipment, that is necessary for the production of Batteries from cells to packs



Process Variety

The production process comprises of both **continuous** as well as **discrete production steps**.

Value Chain Depth at eLAB

The eLAB covers **all production steps** from raw materials to a complete battery cell incl. end-of-line testing.

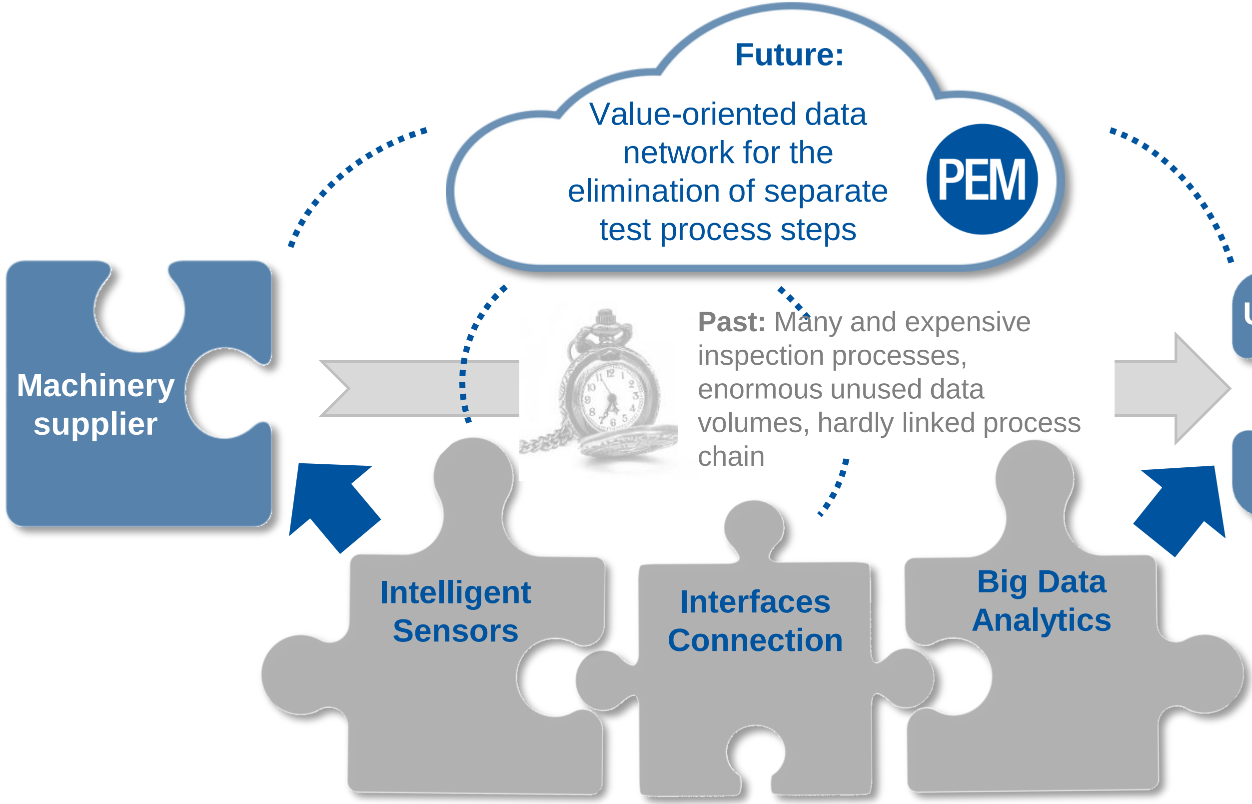
Electrode production	Mixing	Coating and drying	Calander	Slitting	Vacuum drying
Cell Assembly	Electrolyte filling	Sealing	Contacting	Stacking	Cutting
Formation & testing	Formation	De-Gasing	Folding	Aging	Control

Cell

Challenges

- No **consistent data** infrastructure
- **Different control systems**
- Partially **missing sensor** equipment

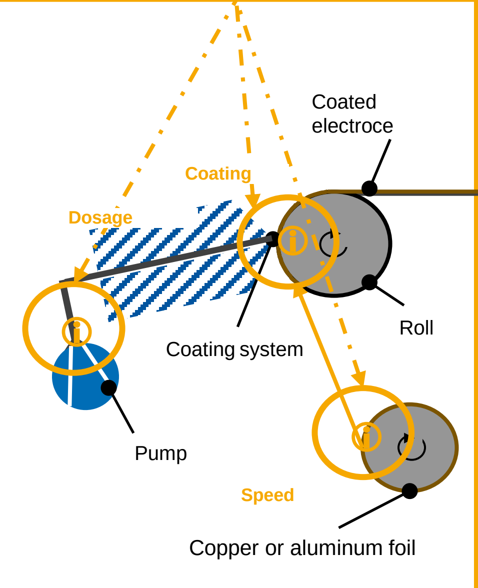
Vision: Digitalized production line to reduce testing costs and improve process quality



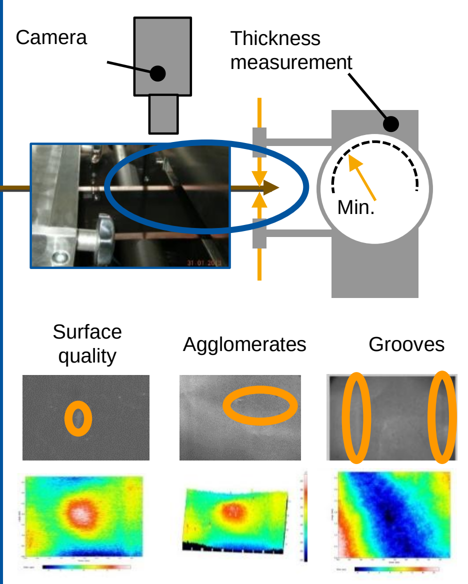
Use case with interrelations: Process-interrelated data management for process control & error removal

Example: Wet thickness measurement and visual inspection after electrode coating

Feedback of measured thickness to process control

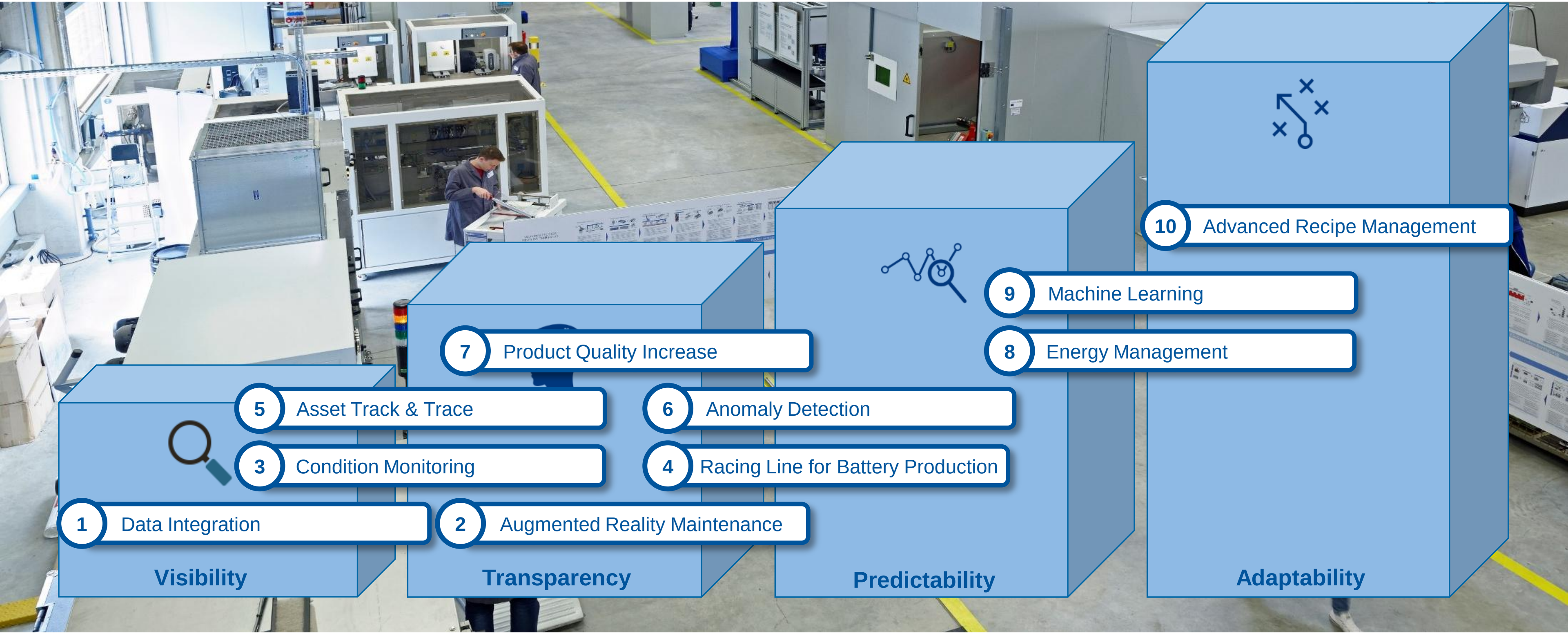


Thickness measurement and material testing



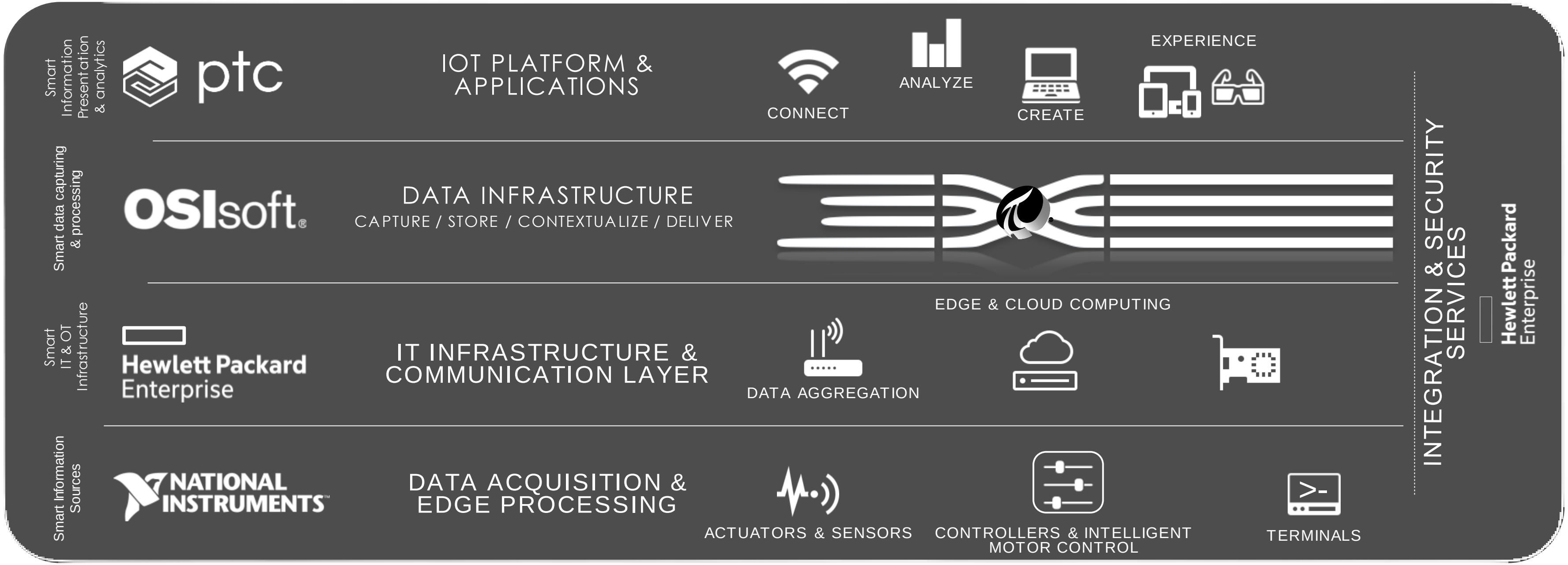
Marking of faulty electrode areas

Several use cases were identified and aligned with I40 Maturity Index to demonstrate the various business potentials



A Collaborative Approach to Digitalization

„… if you want to go fast, go alone;
if you want to go far, go together“



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Agenda

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The use cases span the roadmap to digitization in the battery production both in the two dimensions

		Mixing		Coating	Drying		Calander	Slitting	Vacuum drying	Cutting	Stacking	Contacting	Sealing	Electrolyte filling	Formation	De-Gasing	Folding	Aging	Control
	(m=manual; a= automatic; s= machine support)	Manual Mixing	Extruder	Coating equipment	Furnace	Laser													
	Type of process	m	a	a	a	a	m	m	m	m	m	m	m	m	a	a	a	a	a
Computerisation	System control																		
Connectivity	I40-solution stack (HPE, PTC, OSI, NI)																		
Visibility	Data integration																		
	Product Quality Increase																		
	Asset Track & Trace																		
	Energy Management																		
Transparency	Augmented Reality																		
	Asset Track & Trace																		
	Product Quality Increase																		
	Condition Monitoring																		
	Anomaly detection																		
	Racing Line for Battery Production																		
Predictive Capacity	Anomaly detection																		
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	Machine Learning																		
	Energy Management																		
Adaptibility	Advanced Recipe Management																		

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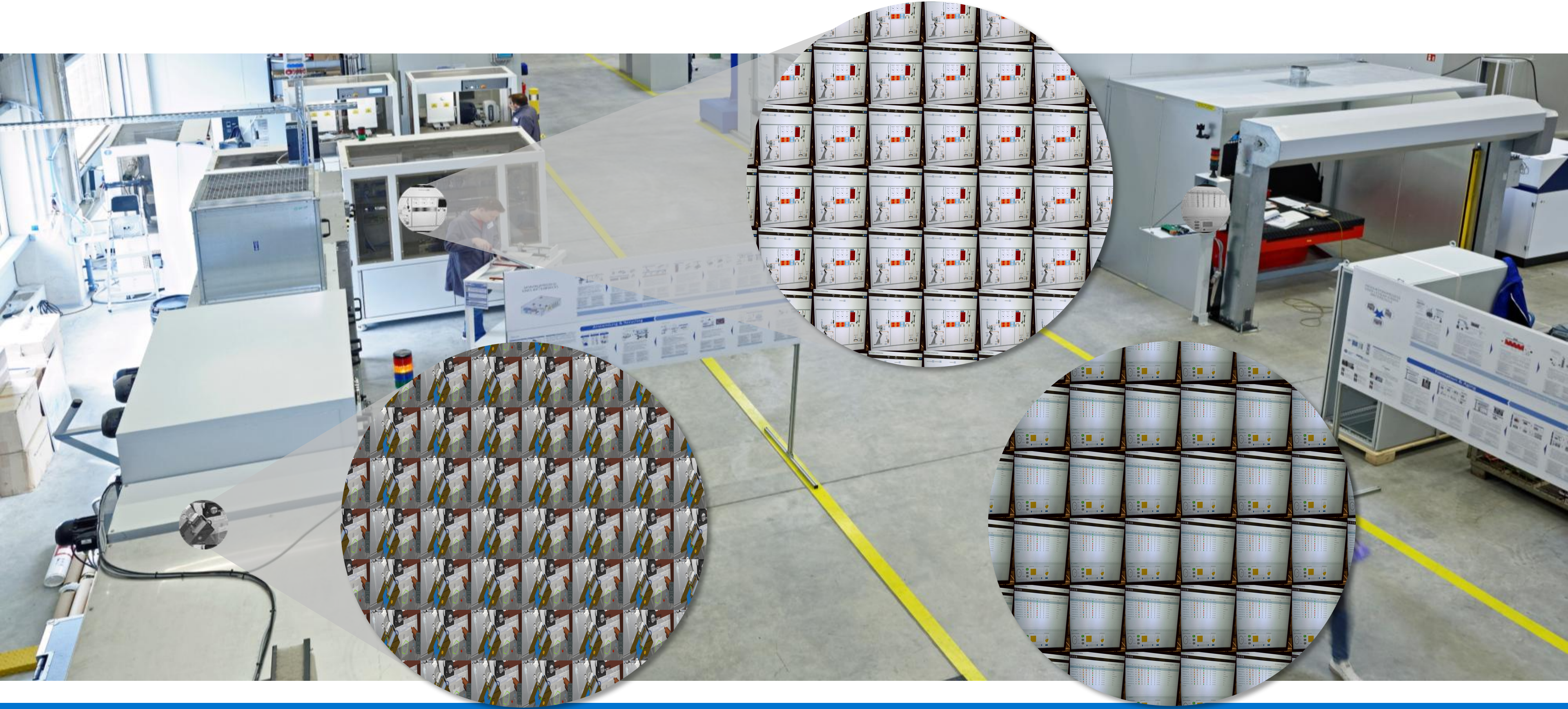
Adaptibility	Advanced Recipe Management																		

Scope End of 2017

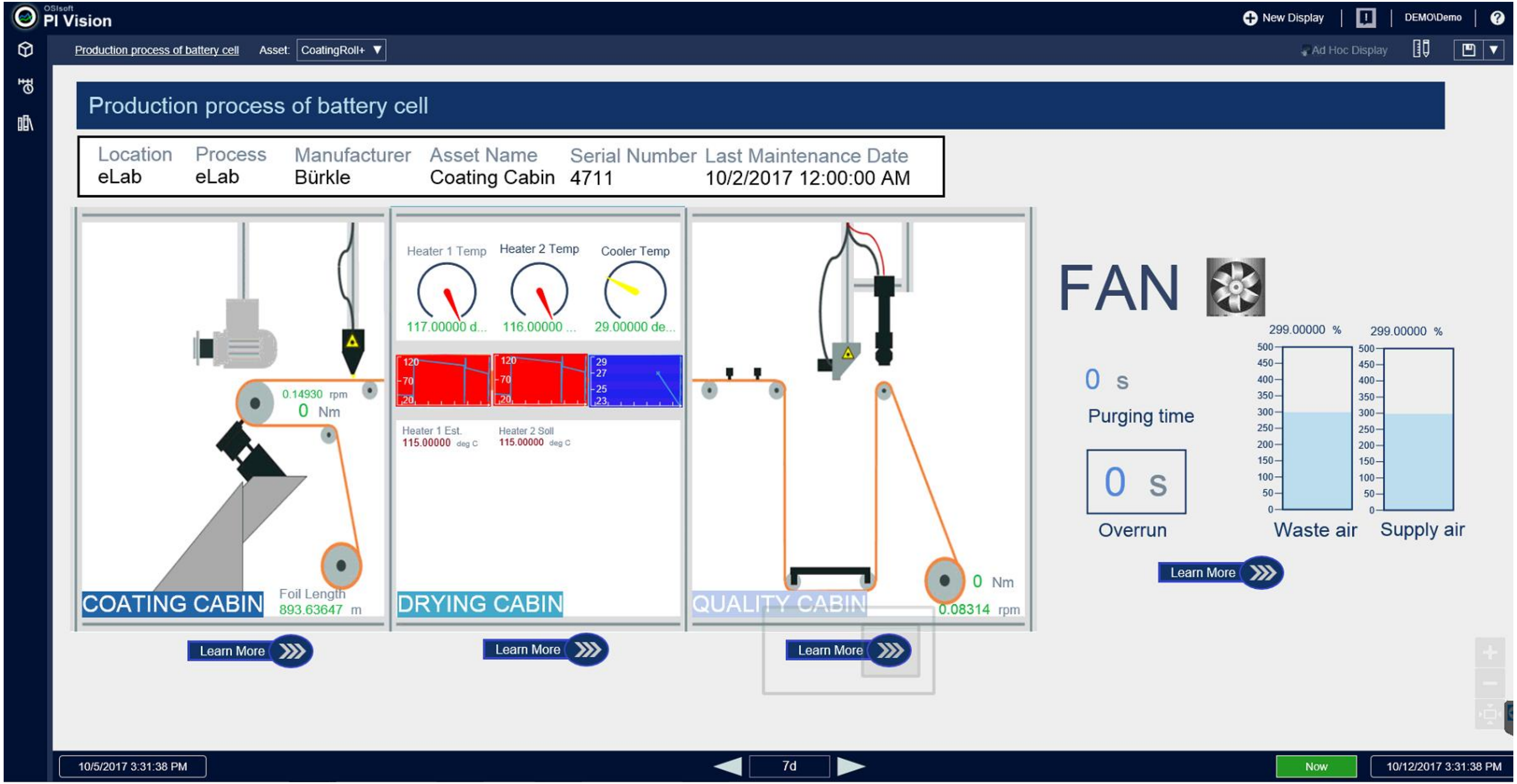
Scope Mid September

Scope End of 2018

First impressions of implemented use-cases

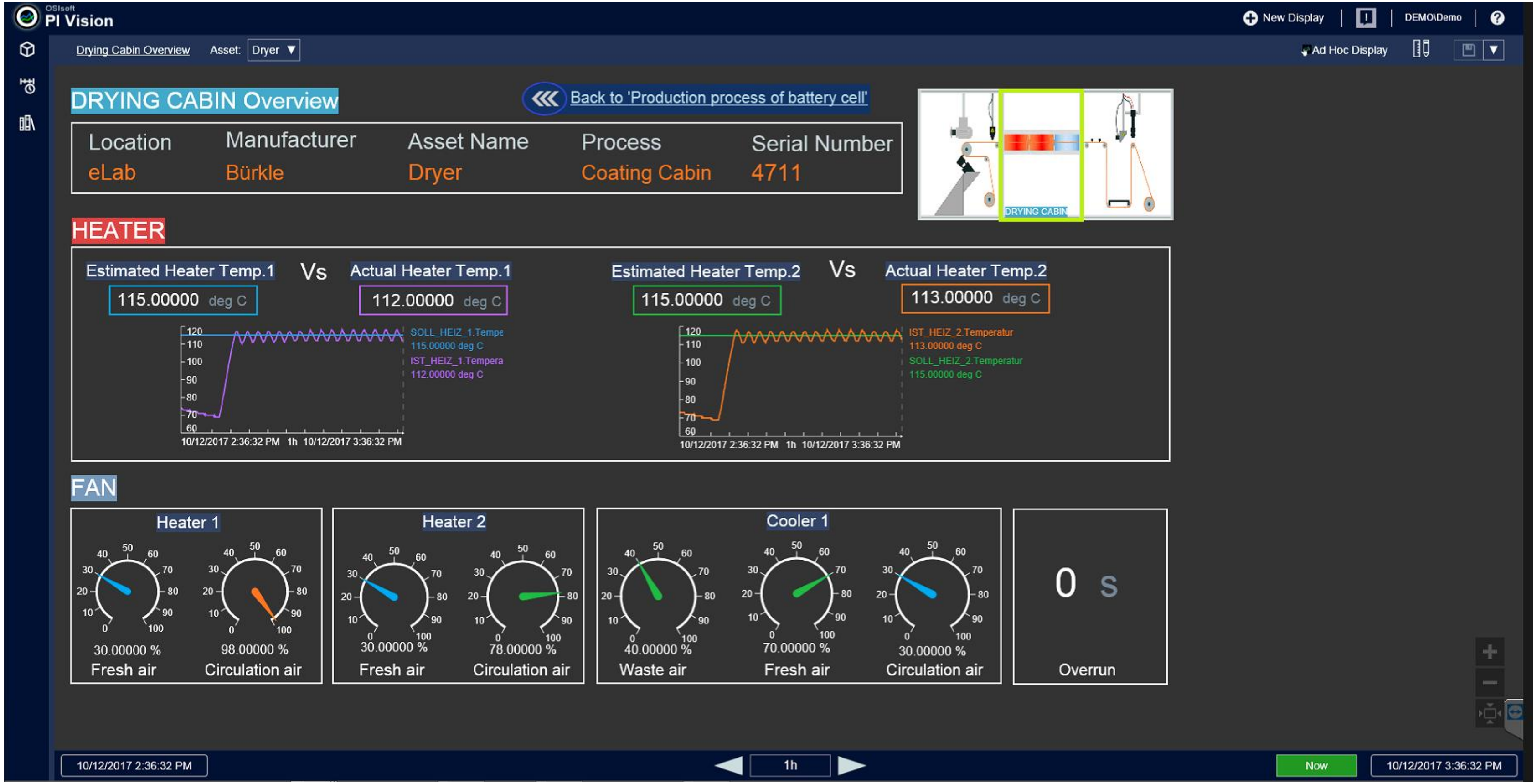


Coating

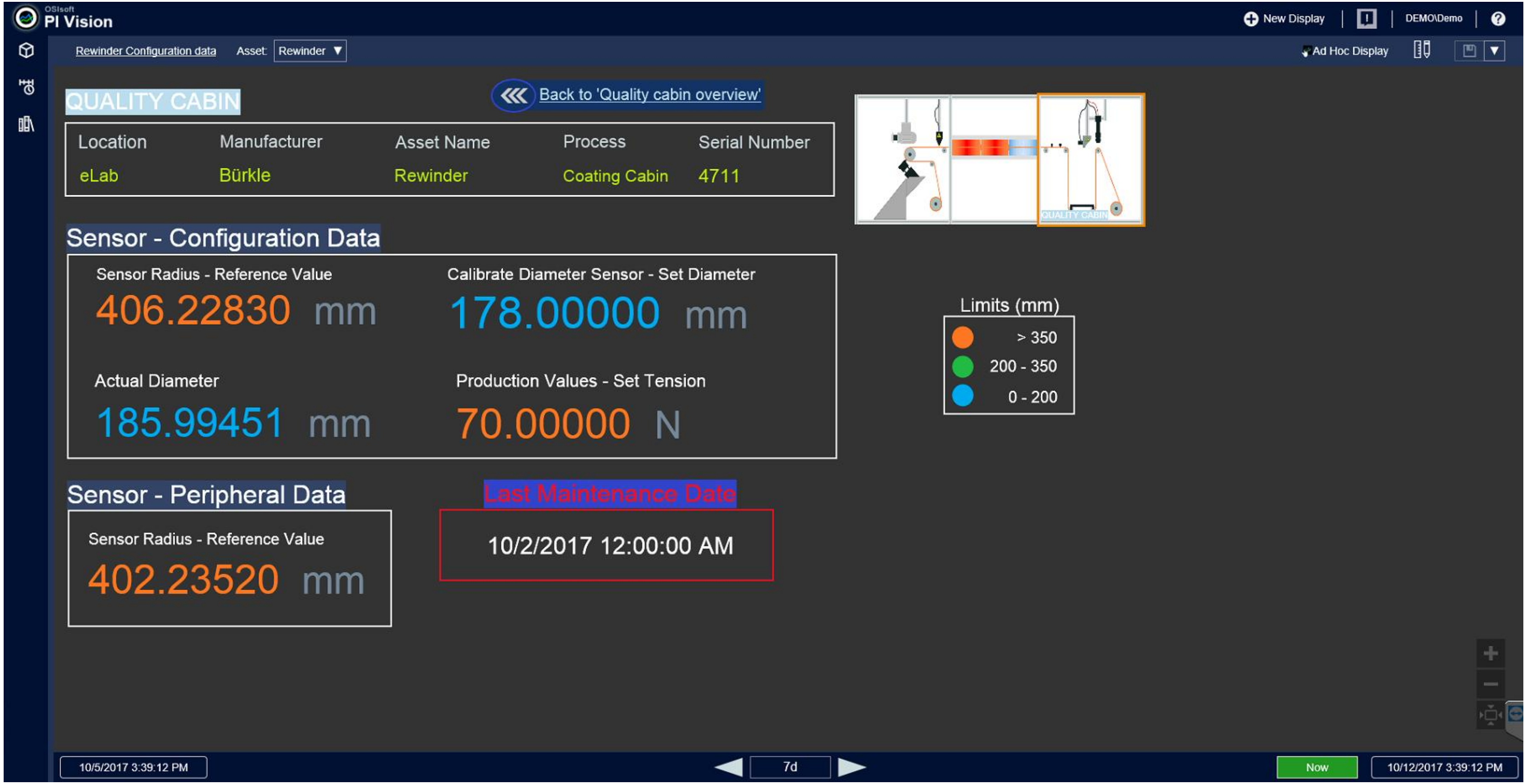


PI Vision
New Display
DEMO\Demo
Production process of battery cell
Asset: CoatingRoll+
Ad Hoc Display
Production process of battery cell
Location eLab
Process eLab
Manufacturer Bürkle
Asset Name Coating Cabin
Serial Number 4711
Last Maintenance Date 10/2/2017 12:00:00 AM
0.14930 rpm
0 Nm
COATING CABIN
Foil Length 893.63647 m
Heater 1 Temp
Heater 2 Temp
Cooler Temp
117.00000 d...
116.00000 ...
29.00000 de...
Heater 1 Est. 115.00000 deg C
Heater 2 Soll 115.00000 deg C
DRYING CABIN
QUALITY CABIN
0 Nm
0.08314 rpm
FAN
0 s
Purging time
0 s
Overrun
299.00000 %
299.00000 %
Waste air
Supply air
Learn More
10/5/2017 3:31:38 PM
7d
Now
10/12/2017 3:31:38 PM

Drying Process Overview



Quality check



Summary Slide

Future:

Value-oriented data network for the elimination of separate test process steps

COMPANY and GOAL

PEM of RWTH Aachen University focus on production technology for e-mobility components. For the battery cell production in Aachen the goal is to link and analyze the cause-effect relationships with big data to reduce testing efforts.

CHALLENGE

Linking and analysis of the cause-effect relationships with big data to reduce testing efforts. High scrap rates in production. High testing efforts.

- Different machinery
- Various process types
- No data availability
- Limited budget
- Missing sensors

SOLUTION

With a strong solution stack of our partners and a structured procedure and methodology first results could be achieved. We just started a big change process.

- Connecting the industry partners and their expertise
- Using OSIsoft system for data structure
- Bringing in process know-how

RESULTS

Three implemented and validated use-cases in 6 weeks to increase process quality. Next steps will fully integrate all use-cases.

- Integrated selected cause-effect relationship in the control centre
- Software and hardware infrastructure ready for full integration
- Expecting costs saving on testing (~around 20% of production costs)
- Expecting to reduce scrap rate to <2%

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We would like to invite you to Aachen!

Questions

Please wait for the **microphone** before asking your questions

State your **name & company**

Please remember to…

Complete the Online Survey for this session

감사합니다

Danke

谢谢

Merci

Gracias

Thank You

ありがとう

Спасибо

Obrigado

Backup: New Agenda