KNORR-BREMSE

From Digitalization to Industry 4.0
IoT Apps in production

„Internet of Things – Möglichkeiten und Chancen zur Zusammenarbeit zwischen Russland und Deutschland“

June 23rd, 2021

David Siep

AGENDA

- **Introduction – Overview Knorr-Bremse**
- Motivation – Main drivers for I4.0 @ Knorr-Bremse
- Case Example:
  - IoT Platform @ Knorr-Bremse

Knorr-Bremse makes mobility safe. By rail and road. Every day. Across the globe.

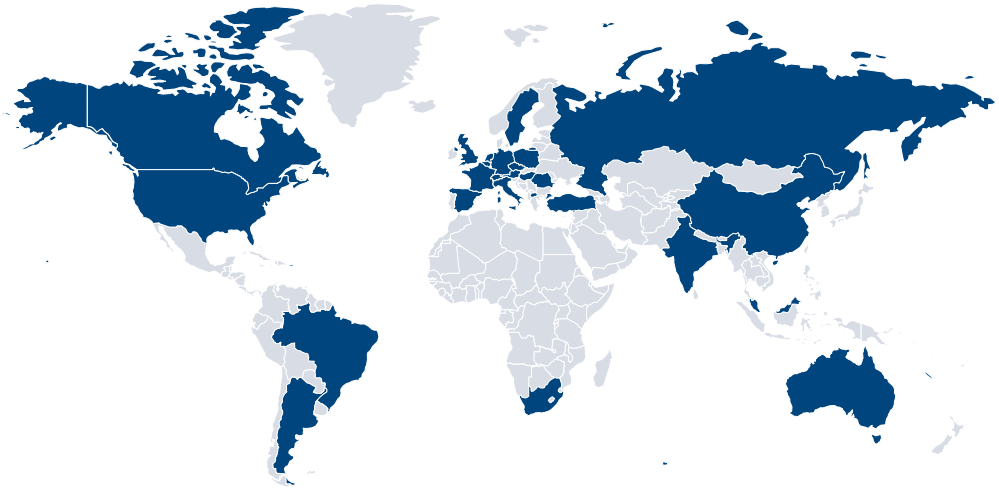
Rail Vehicle Systems

- High-speed trains
- Regional & commuter trains
- Metros
- LRVs
- Monorails
- Locomotives
- Passenger cars
- Freight cars
- Off-train

Commercial Vehicle Systems

- Trucks
- Trailers
- Buses
- Engines
- Special vehicles

Knorr-Bremse is based in 30 countries/regions around the world at more than 100 locations, some 80 of which are manufacturing facilities



The Americas

- Argentina
- Brazil
- Canada
- Mexico
- USA

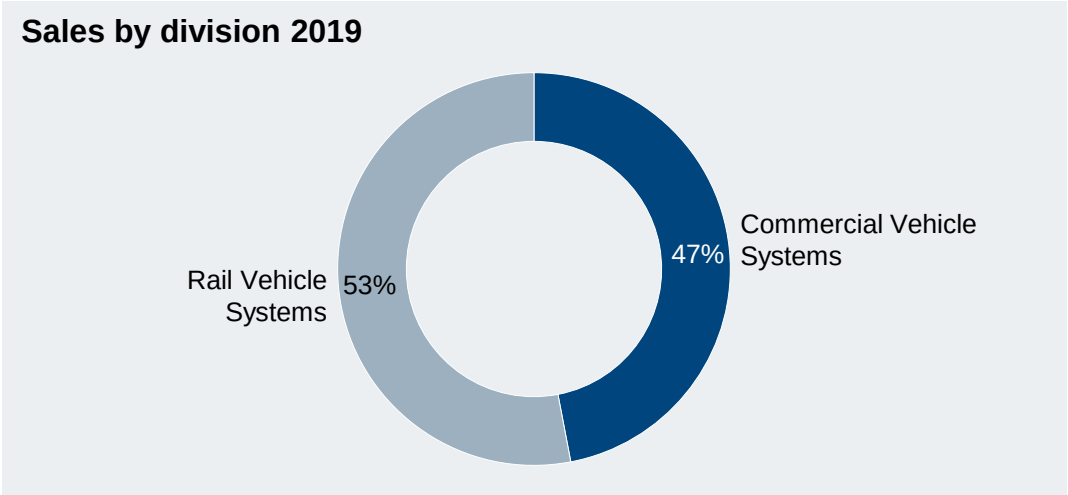
Europe / Africa / Middle East

- Austria
- Belgium
- Czech Republic
- Germany
- France
- Hungary
- Italy
- Macedonia
- Netherlands
- Poland
- Romania
- Russia
- Spain
- Sweden
- Switzerland
- South Africa
- Turkey
- United Kingdom

Aisa / Pacific

- Australia
- China
- India
- Japan
- Kazakhstan
- Singapore
- South Korea

Sales by division



	2018	2019	Δ
Knorr-Bremse Group	**6,616 Mio. €**	**6,937 Mio. €**	**+4.8%**
Rail Vehicles Systems	3,462 Mio. €	3,656 Mio. €	+5.6%
Commercial Vehicle Systems	3,160 Mio. €	3,280 Mio. €	+3.8%

The product portfolio includes braking systems, on-train and off-train products as well as service solutions over the entire life cycle of a vehicle

KNORR-BREMSE

Braking Systems
Windscreen Wiper and Wash Systems
Sanitary systems
Couplers
Test Benches

IFE Innovationen Für Einstiegssysteme

Entrance Systems

MERAK

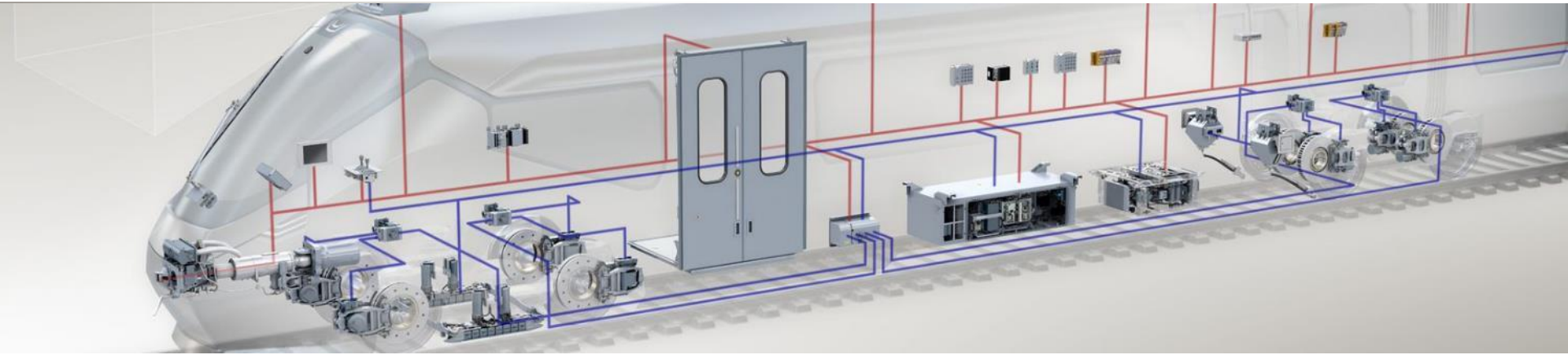
Climate Control Systems

Selectron

Train Control and Management System (TCMS)

KIEPE ELECTRIC

Electrical Systems
Traction
Auxiliary Power Supply
System Integration



Microelettrica Scientifica

Power Electrics

RAILSERVICES always on track

After-Sales-Service

NEW YORK AIR BRAKE

Brake Control Systems

Off train

ZELISKO

Signalling Systems

WESTINGHOUSE *platform screen doors*

Platform Screen Doors
Platform Edge Doors
Safety Gates

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Digitalization in Manufacturing enables four main levers to overcome current challenges in production.

1. **New/advanced Technologies: Robotics, Cobotics, 3D-Printing, etc.**

Increase flexibility and productivity:
- (Low-cost) automation and robotization of processes
- Additive manufacturing for low-volume or complex parts

2. **Asset performance enhancement through data analytics**

Enhance performance:
- Optimizing throughput
- Asset reliability
- Resource efficiency

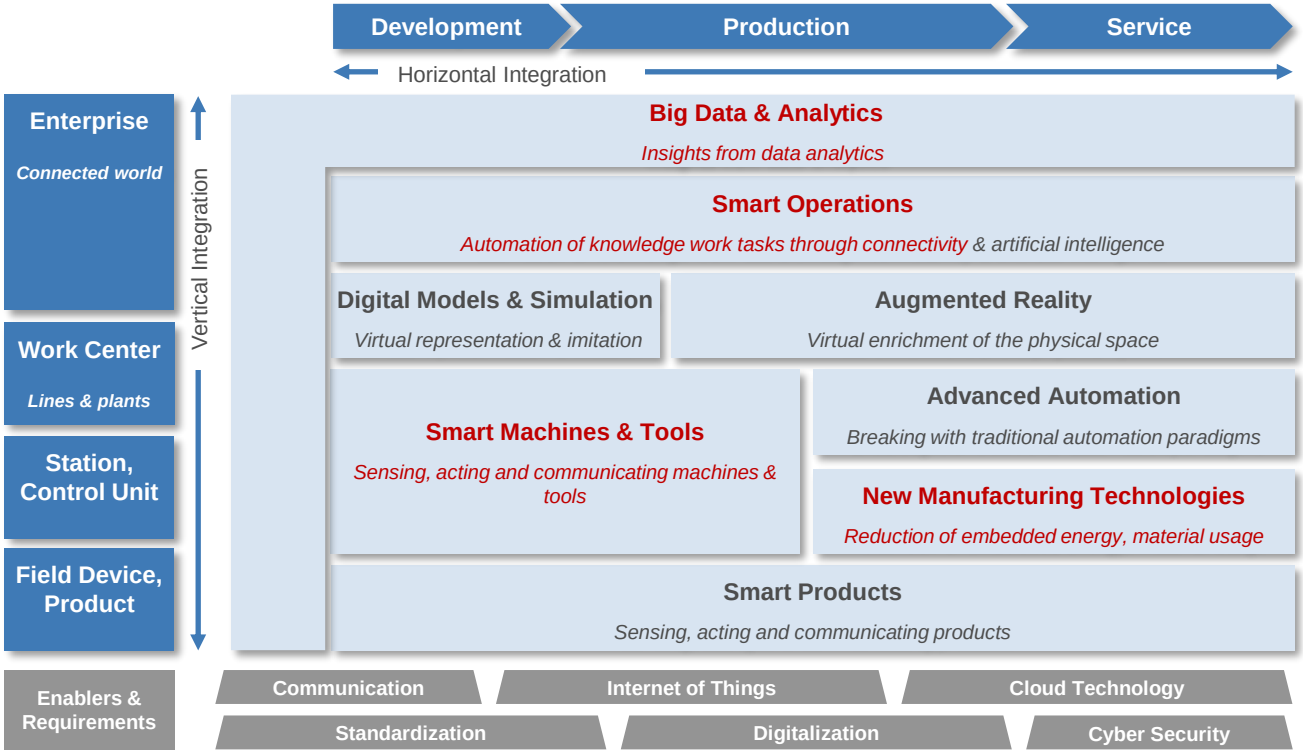
3. **Asset-network value optimization**

Optimize asset value by:
- Improving scheduling and planning in production
- Integrating end-to-end activities

4. **Digital Workforce**

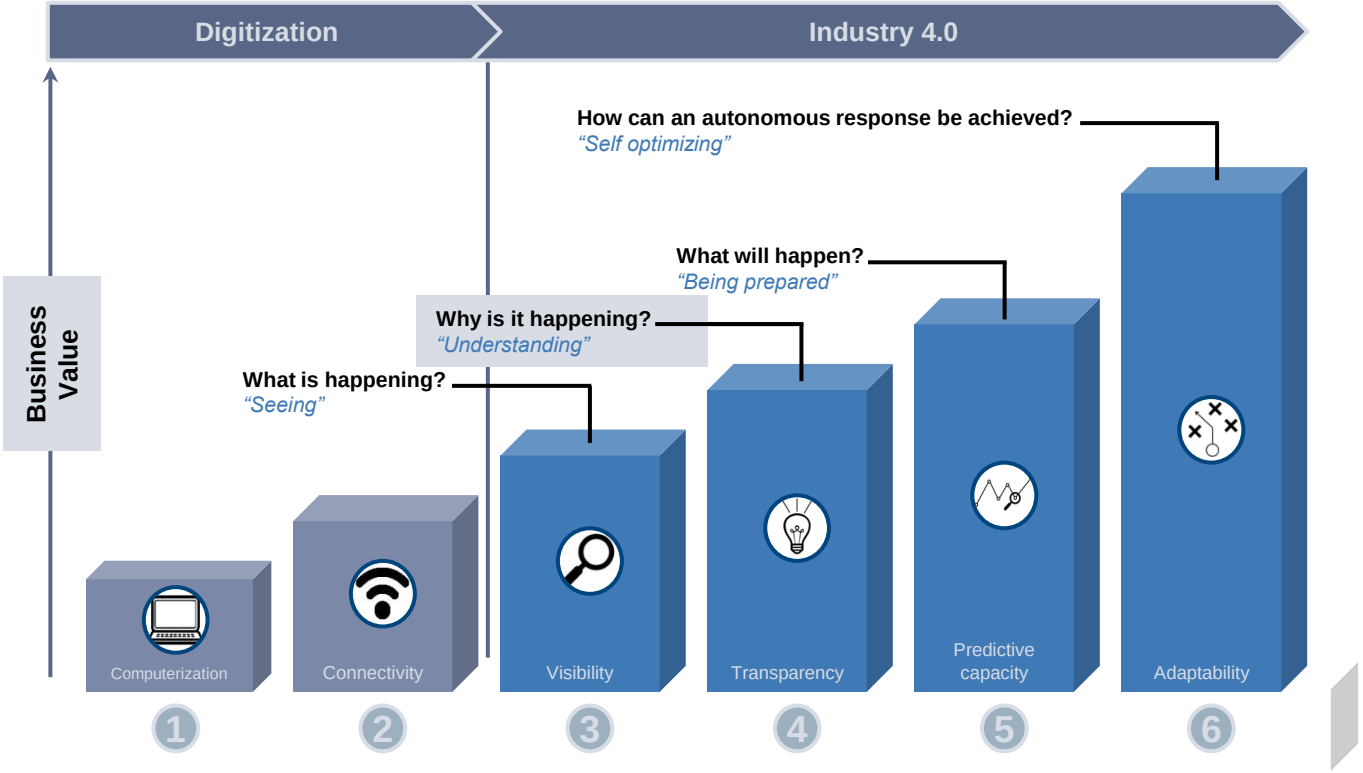
Human-Machine and Human–Human Interface technology:
- Digital tools to streamline processes
- Real-time access to information

Within the overall framework, four main technology fields are currently in focus from a production perspective



Focus areas

The overall scope of Digital Manufacturing is to achieve self optimizing systems. To realize the full potential, six generic steps have to be taken.



Key drivers

- High effort to ensure flexibility to customer demands and handle complexity
- Cost-efficiency

Key enablers

- Decreasing costs and effort for new/advanced technologies
- Advanced solutions to achieve end-to-end-connectivity

Source: PTC / RWTH Aachen; KB visualization

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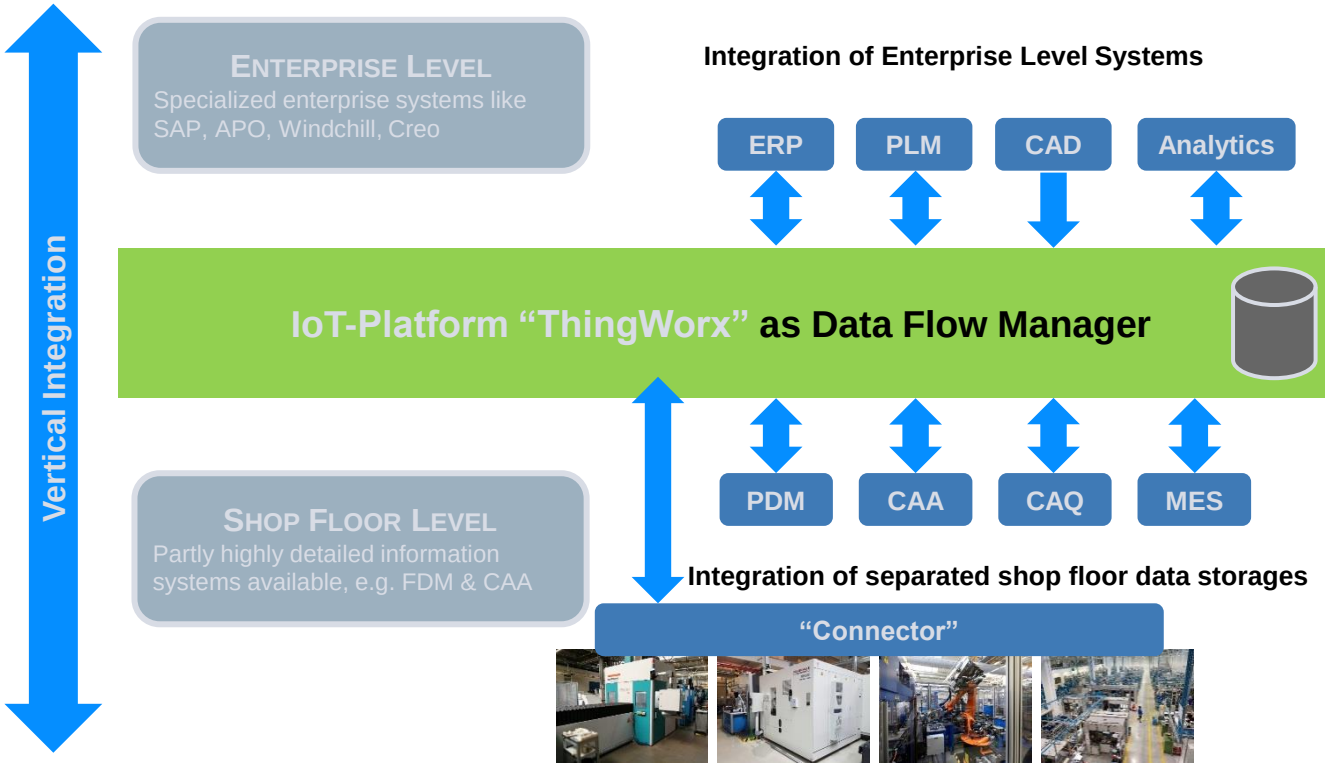
- **Case Examples:**
  - **IoT Platform @ Knorr-Bremse**

EXAMPLE 1

Both KB divisions are currently rolling out the IoT-Platform ThingWorx to establish connectivity across all production assets.

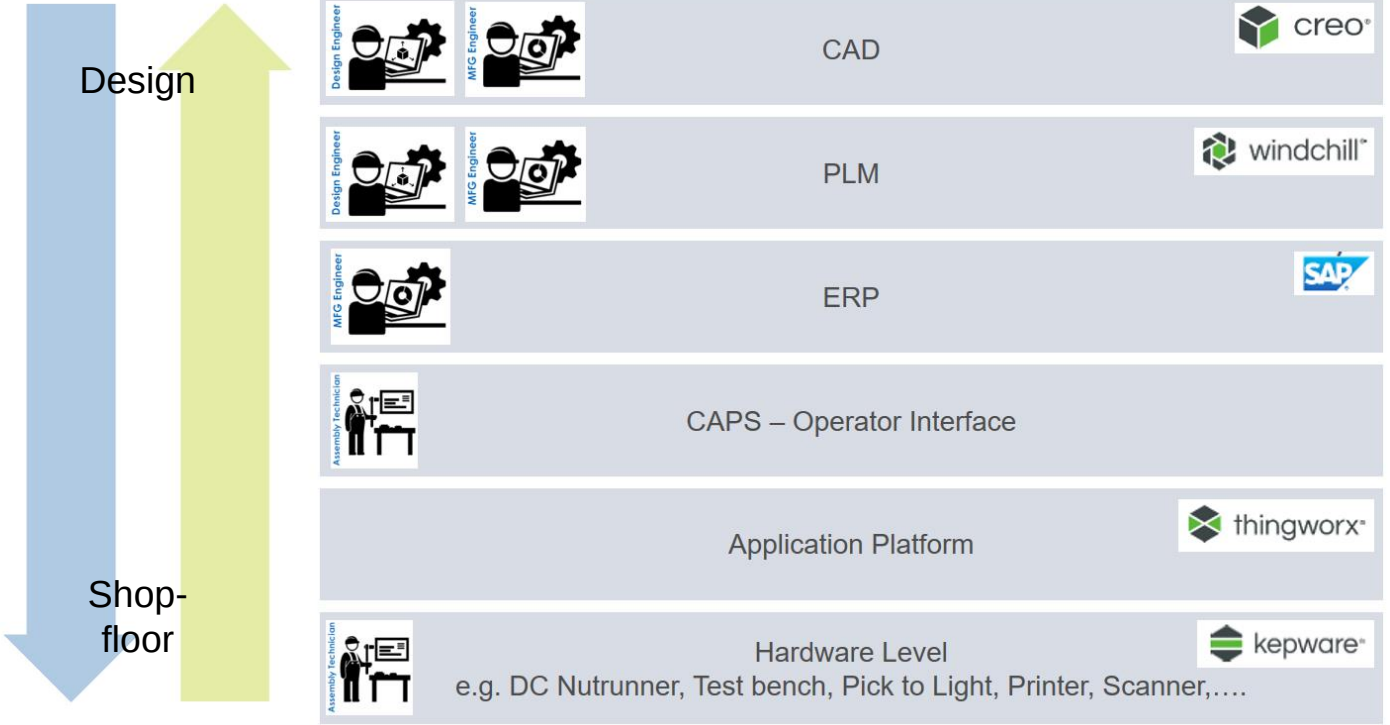


Applications @ Knorr-Bremse

- IoT-Platform rollout in both divisions
- Focus on CNC-machines and assembly lines
- Process integration and application development as a second focus area
- Goal is an increased level of transparency and reduction of effort for data collection

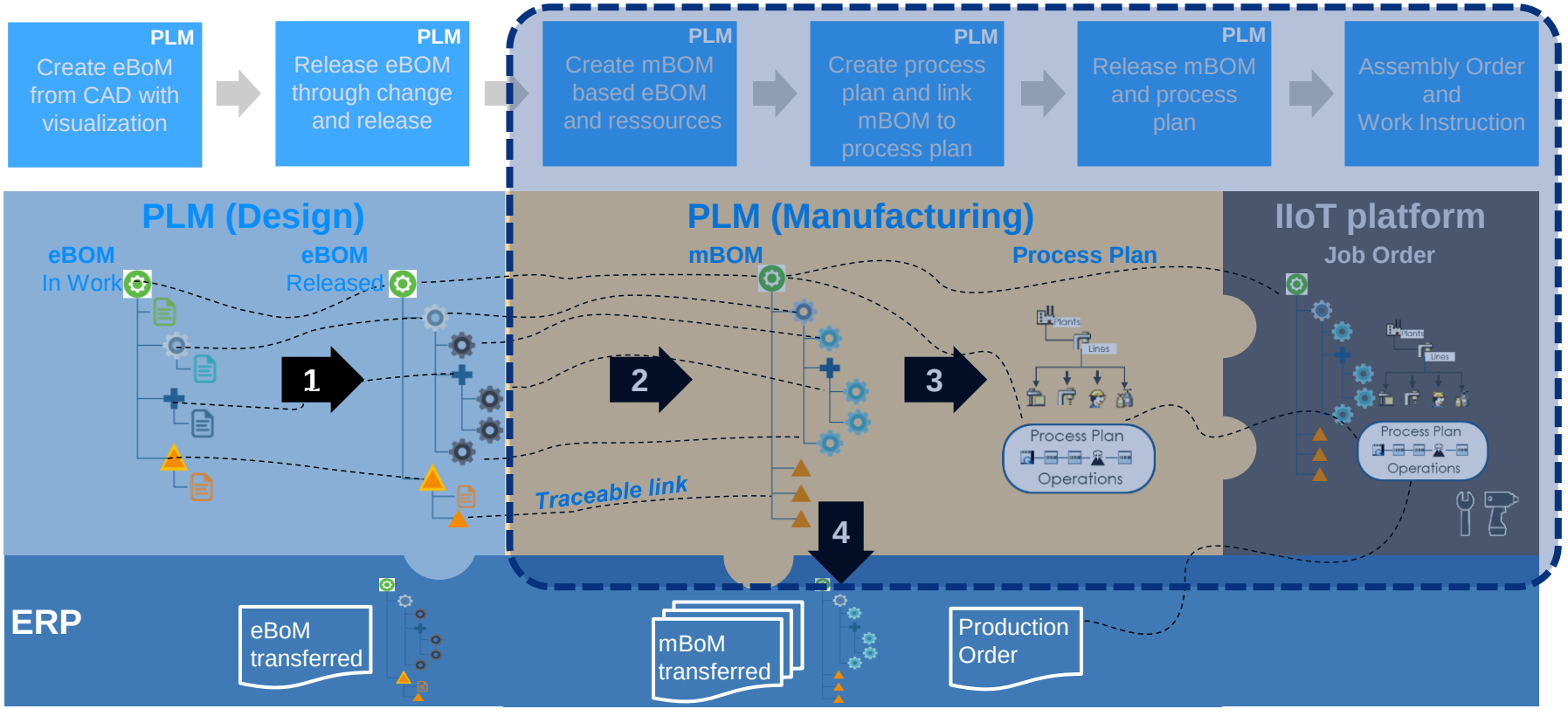
EXAMPLE 1

Worker guidance @KB: A harmonized IoT platform is a key enabler for vertical integration - from design to the shop floor



EXAMPLE 1

Worker guidance @KB: CAPS as an integral part of vertical integration

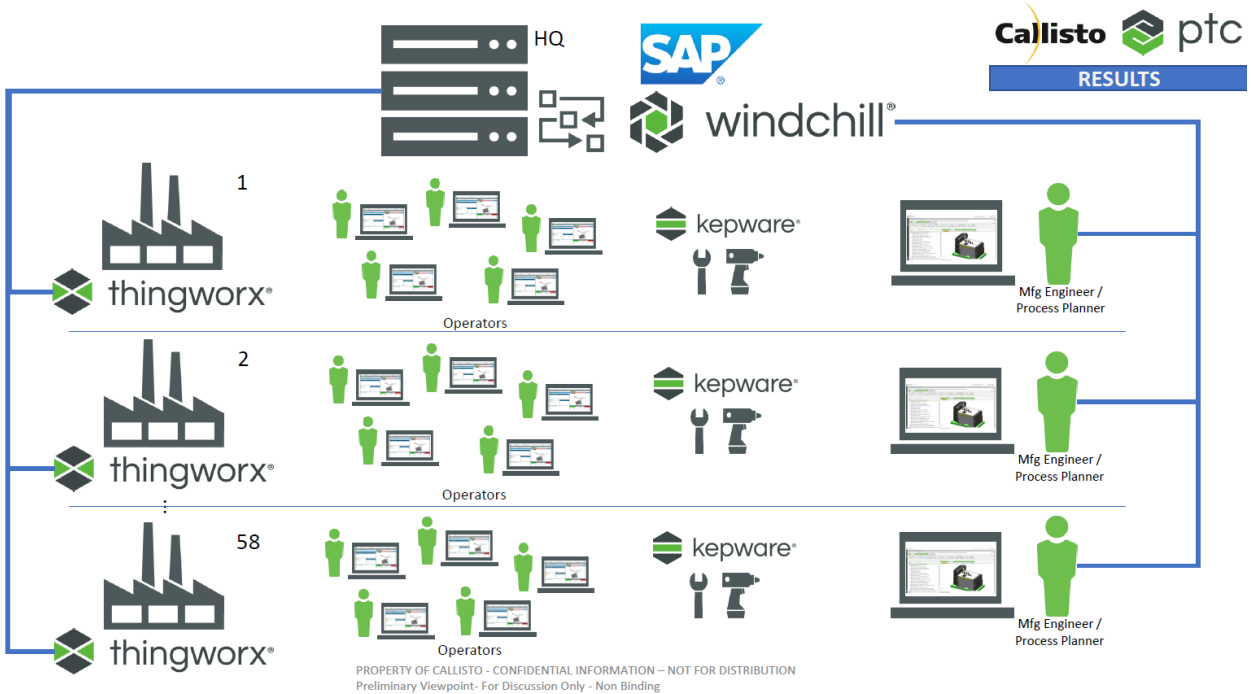


eBOM = engineering bill of materials (design view)

mBOM = manufacturing bill of materials (production view)

EXAMPLE 1

Worker guidance @KB: Global system architecture



- Full consistency of data
- Real time processing of changes
- One standard for the group
- Ensures quick global roll-out*
- ….

IoT platform Already standard @KB	HMI – KB specific development	PLM platform Already standard @KB
~ 60 sites	**~ 6.000 operators**	**~ 300 process planners**

*started in 2020

Thank you very much for your attention!

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