

# „Industrie 4.0“: how digitalization revolutionizes the production chain

Prof. Dr. Dieter Wegener

Head of External Cooperation, Siemens Corporate Technology

Speaker “ZVEI Management Team Industrie 4.0”

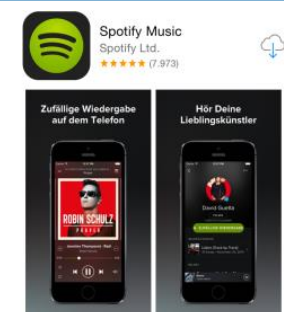
**Public Conference on Industrie 4.0, Silicon Valley, November 08<sup>th</sup>, 2018**

# The world is going digital in B2C – new innovative business models are bringing about a change in user behavior

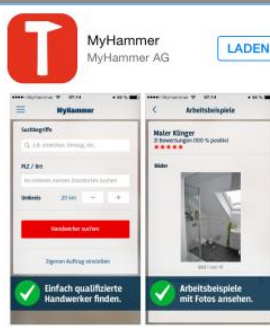
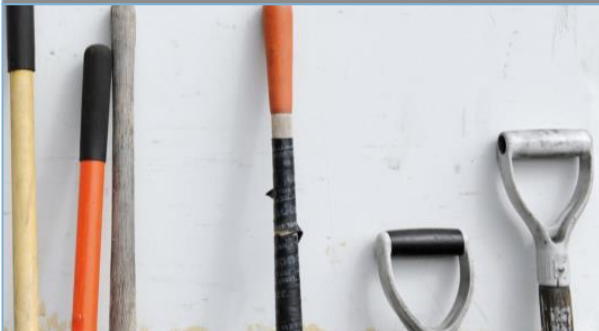
## Vom Buchladen zum eBook



## Vom Plattenladen zum Streaming



## Von den Gelben Seiten zum Marketplace



## Vom Taxi zum Ride Sharing



Quelle: Siemens

# The new business model has been also launched in B2B

## Example: Proactive maintenance at Rolls Royce aircraft engines



© Mark Hillary | Flickr

Condition monitoring, proactive maintenance, "power-by-the-hour",  
as-a-service business model – payment model based on flight hours

**New business model with Data  
Integration & Big Data Analytics**

Quelle: [www.springboeck.ch/SR\\_Technics.htm](http://www.springboeck.ch/SR_Technics.htm)

1

**Digitalization of Economy**

2

**Initiative „Industrie 4.0“**

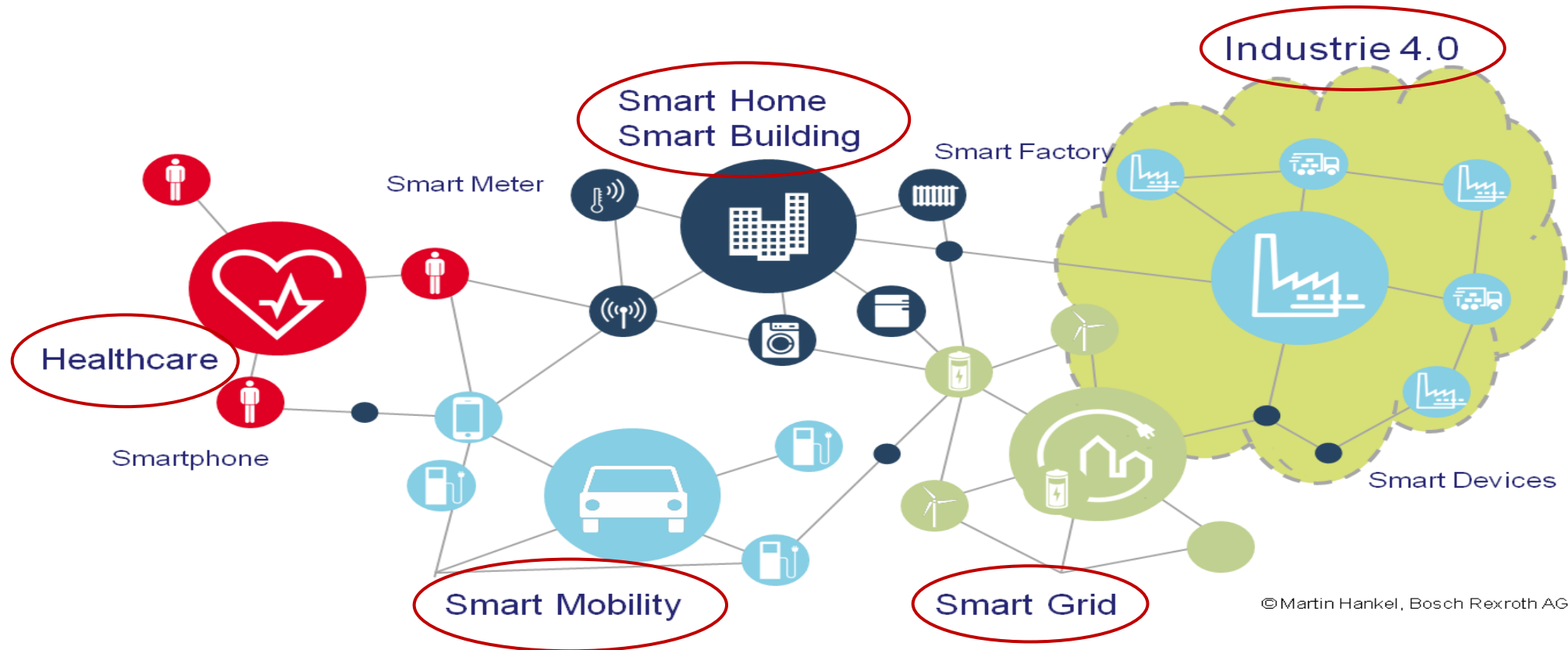
3

**„Industrie 4.0“ operates in 3 dimensions**

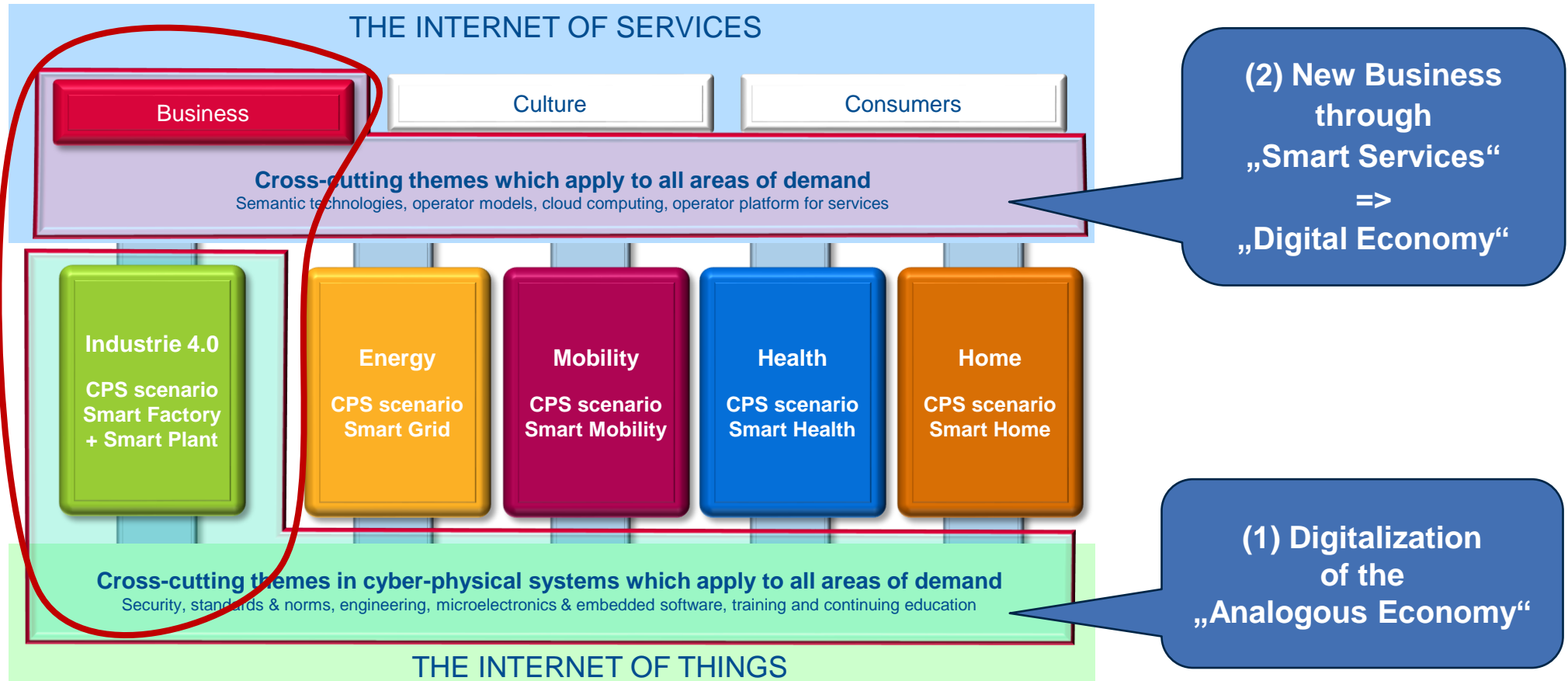
4

**Example „Smart Services“ in „Smart Factory“**

# „Digitalization of Economy“ is leading to a „Connected World“



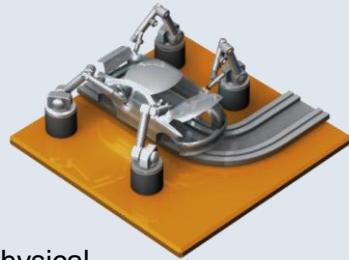
# Two aspects at „Digitalization of Economy“ - „Industrie 4.0“ is one Application Scenario



Quelle: Acatech / ZVEI

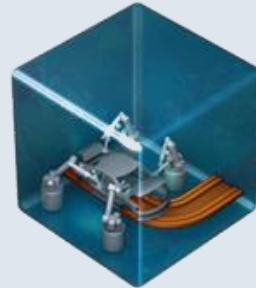
# A Cyber-physical system (CPS) corresponds to a “Digital Twin”

Cyber-physical system (CPS)



Physical production facility

+

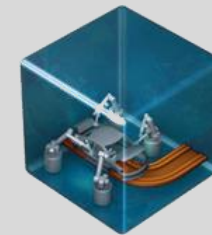
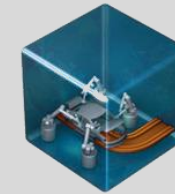
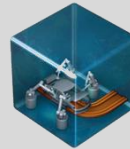
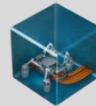


Digital model

Contains all the information about...

- software / IT
- mechanics
- electrics, electronics
- automation, HMI
- safety, security
- maintenance
- location, identity
- status
- SW version
- interfaces
- ...

**The digital model is always up-to-date and is expanded over the course of the entire lifecycle**



Product design

Production planning

Production engineering

Production execution

Services

Source: Siemens AG

1

**Digitalization of Economy**

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**Initiative „Industrie 4.0“**

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**„Industrie 4.0“ operates in 3 dimensions**

4

**Example „Smart Services“ in „Smart Factory“**



# ZVEI-Industrie 4.0 Management Team is the key stakeholder for Industrie 4.0 in Germany

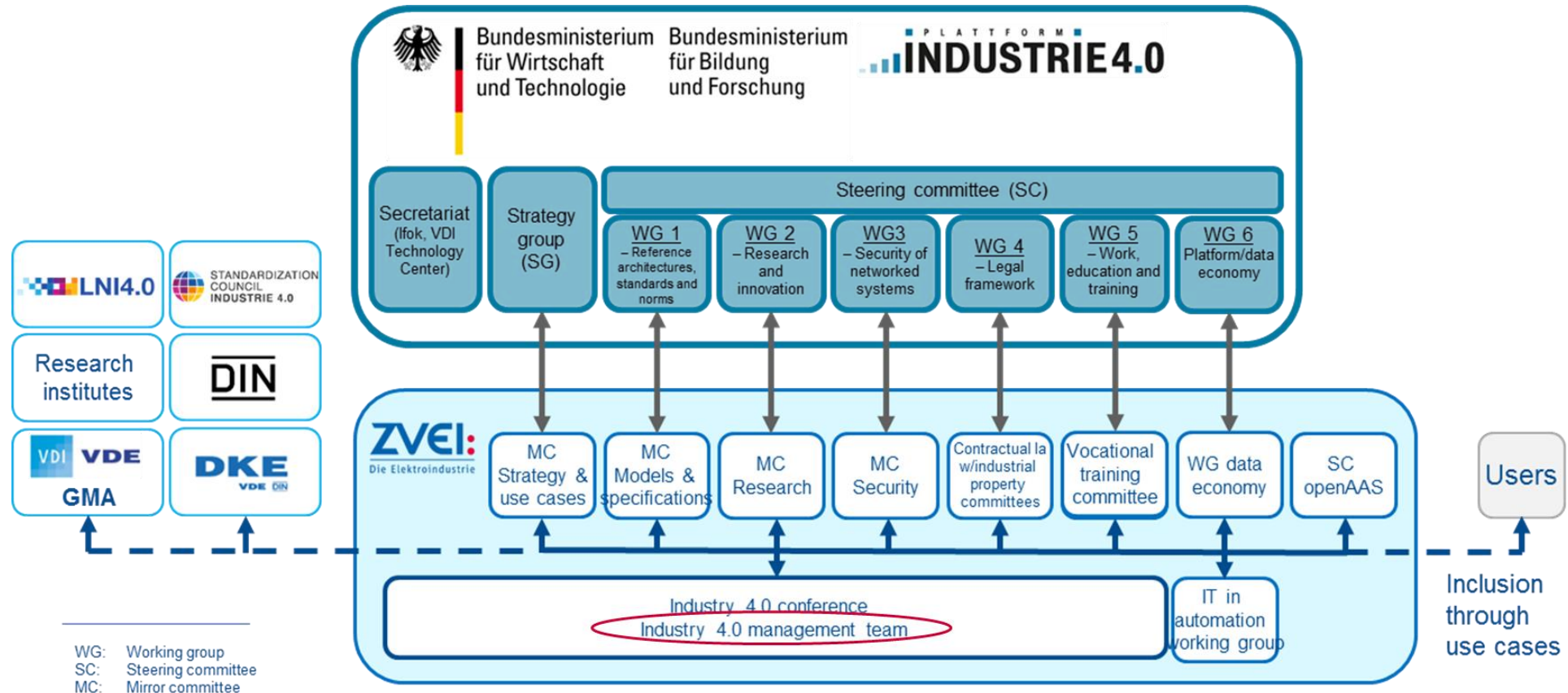


**145**  
Mitglieder  
aus  
**90**  
Unternehmen  
& Institute

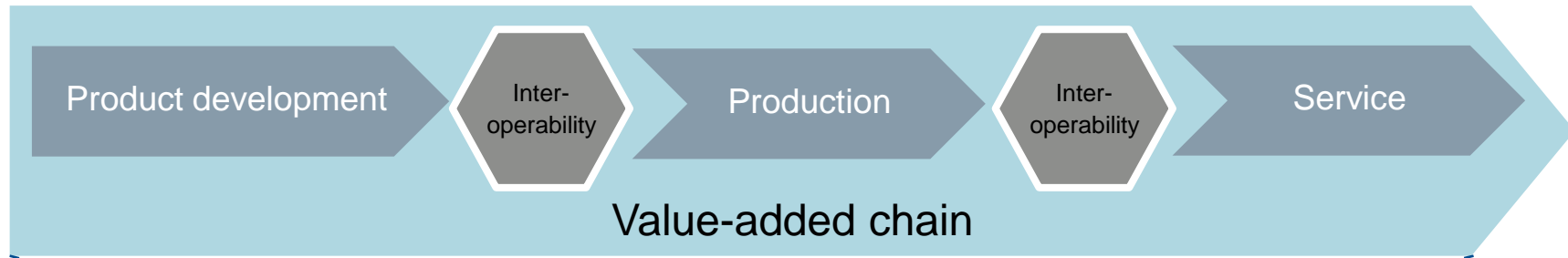
Dieter Wegener | Führungskreis Industrie 4.0

# ZVEI-management-team "Industrie 4.0"

## Exchange with the political "Industrie 4.0 platform"



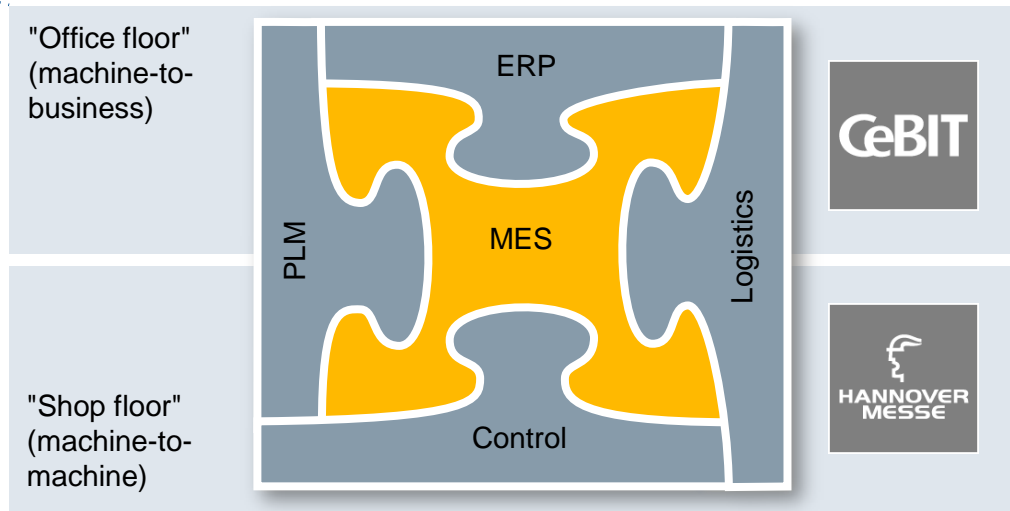
# ZVEI-management-team defines areas of activity for “Industrie 4.0”, viewed from the technical perspective



bitkom

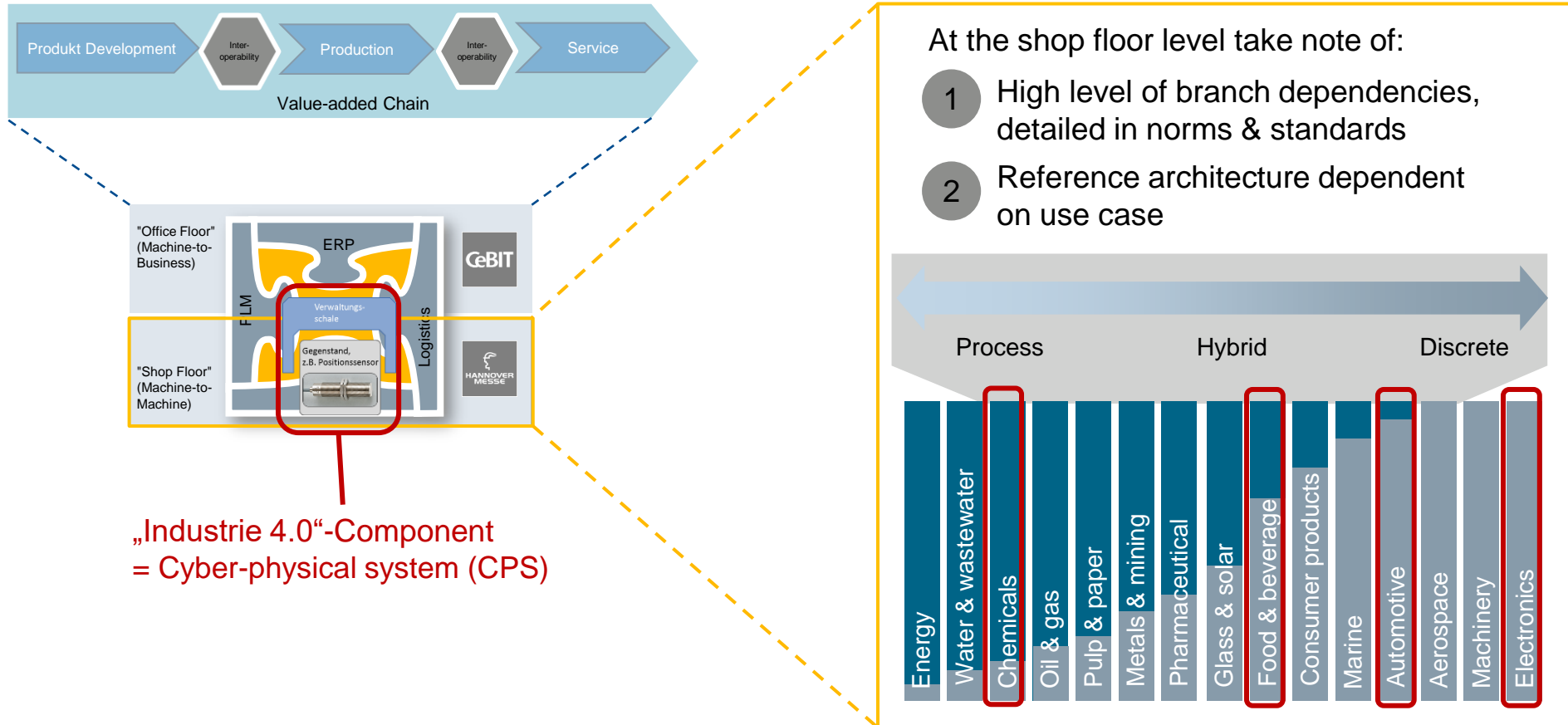
VDMA

**ZVEI:**  
Die Elektroindustrie



Source: Siemens AG

# ZVEI-management-team defines „Industrie 4.0“-Component for different branches



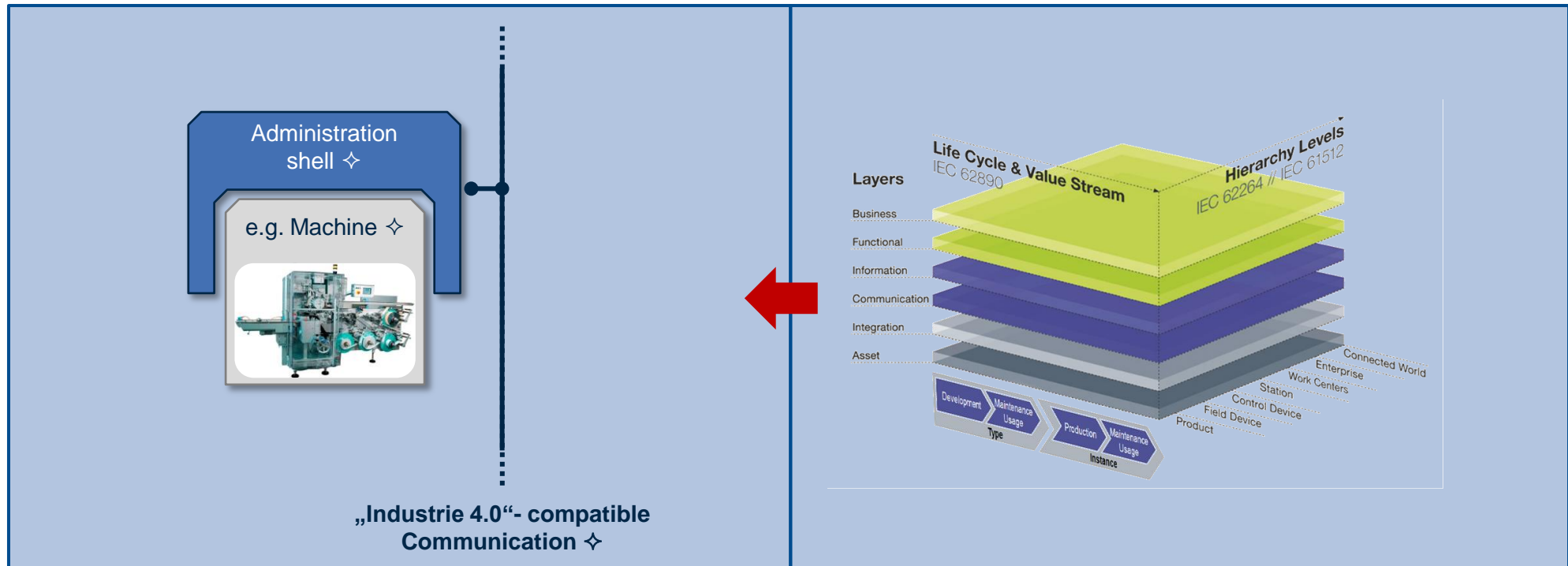
Different Use Cases

Source: Siemens AG

# Every „Industrie 4.0“-Component will be developed based on the Reference-Architecture-Model “RAMI 4.0“

## „Industrie 4.0“-Component

## RAMI 4.0 Reference-Architecture-Model „Industrie 4.0“



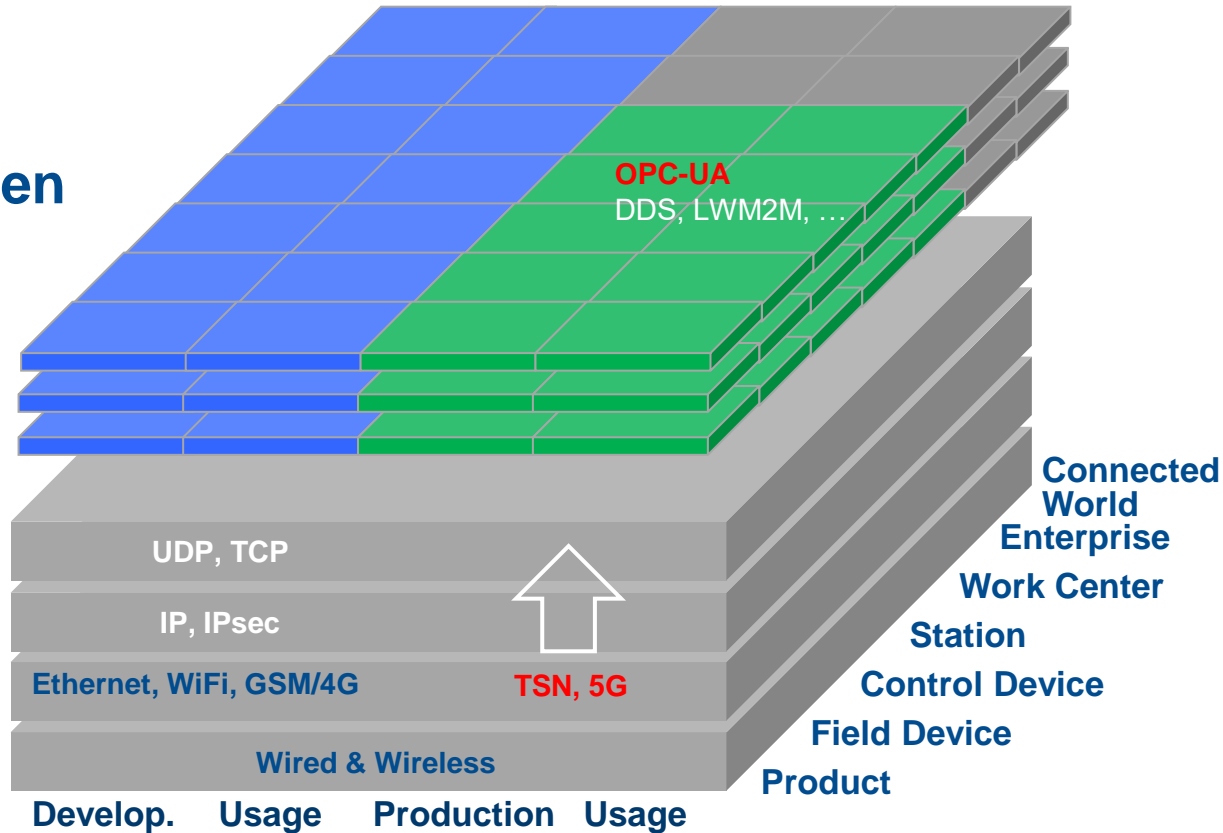
# Communication Layer

## Possible Standards



### OSI Schichten

- 7 Application
- 6 Presentation
- 5 Session
- 4 Transport
- 3 Network
- 2 Data Link
- 1 Physical



1

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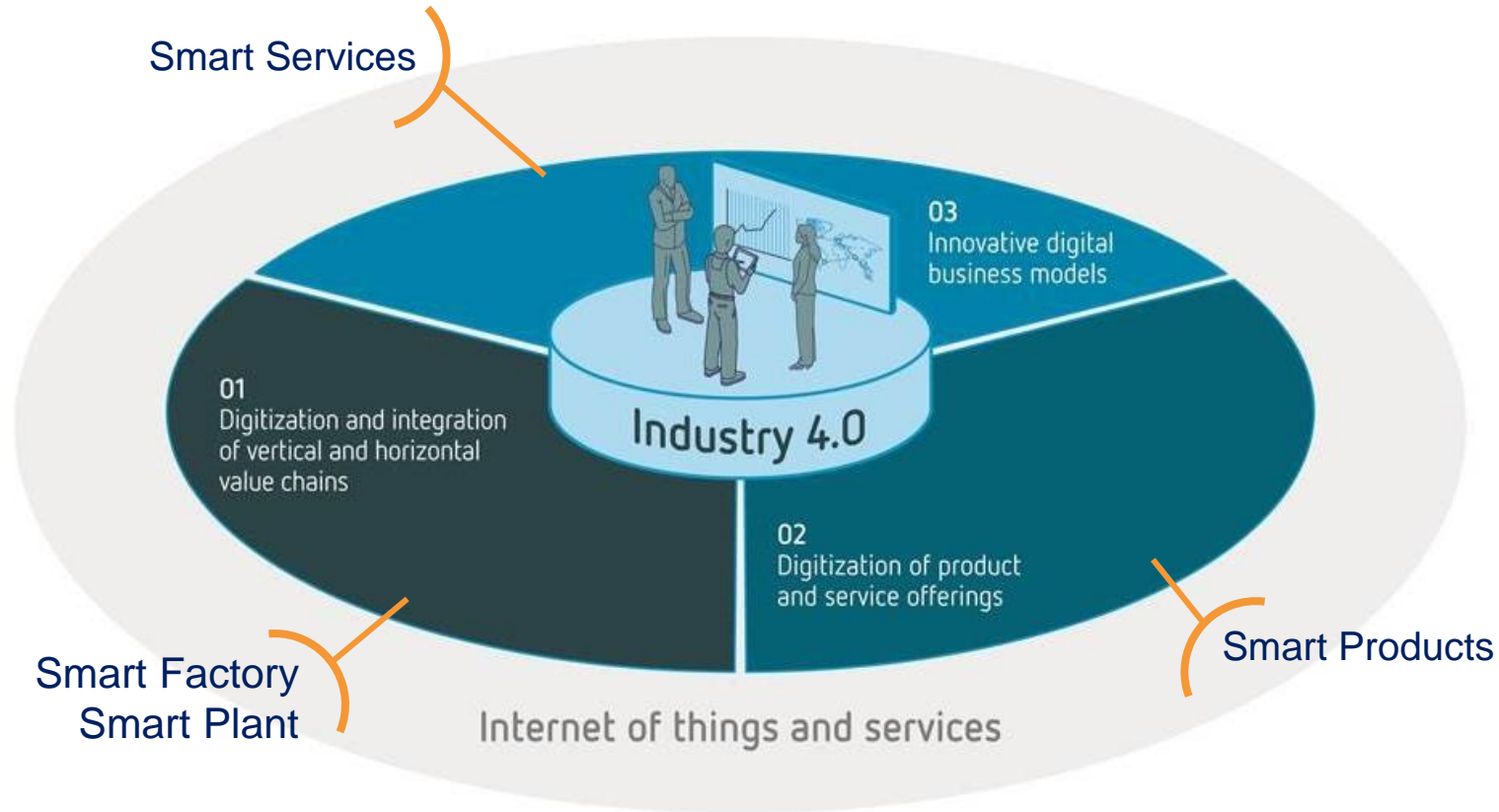
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**„Industrie 4.0“ operates in 3 dimensions**

4

**Example „Smart Services“ in „Smart Factory“**

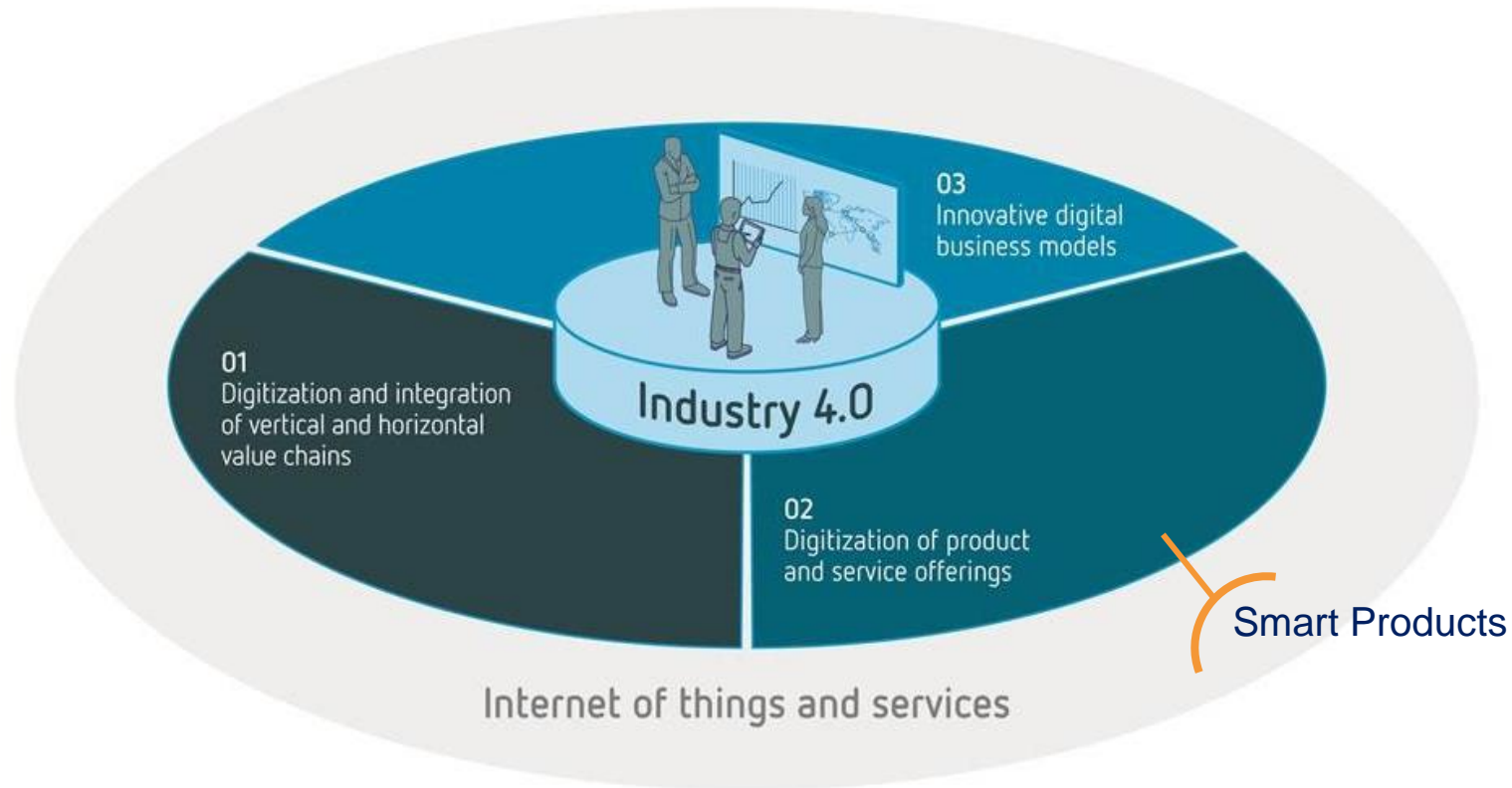
# „Industrie 4.0“ impacts on every company in 3 dimensions



Quelle: ZVEI nach PwC



# Siemens approach for „Smart Products“ is the „Digital Twin“

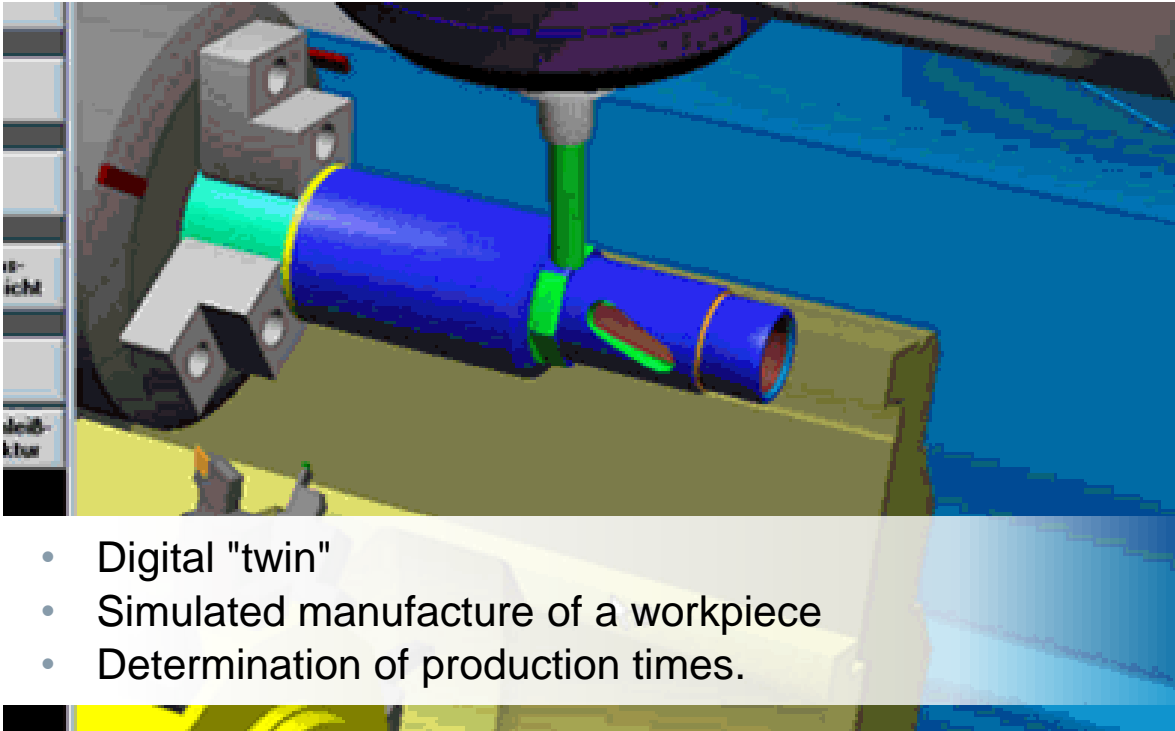


Quelle: ZVEI nach PwC

## "Virtual machine" –

Increase in productivity through simulation of the production process

SIEMENS

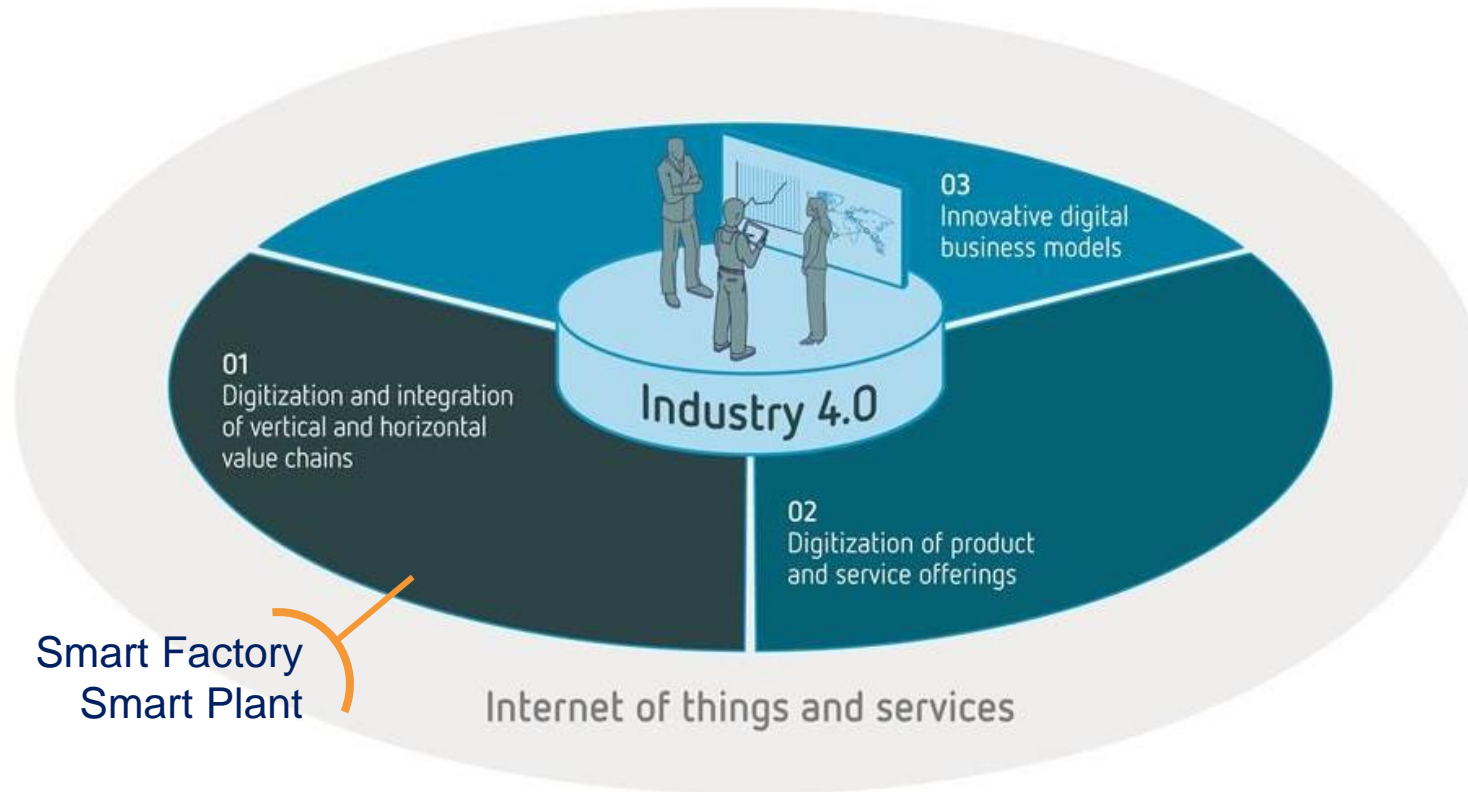


- Digital "twin"
- Simulated manufacture of a workpiece
- Determination of production times.



**10% increase in productivity in day-to-day operations and time savings of up to 80% during setup/configuration of the real machine.**

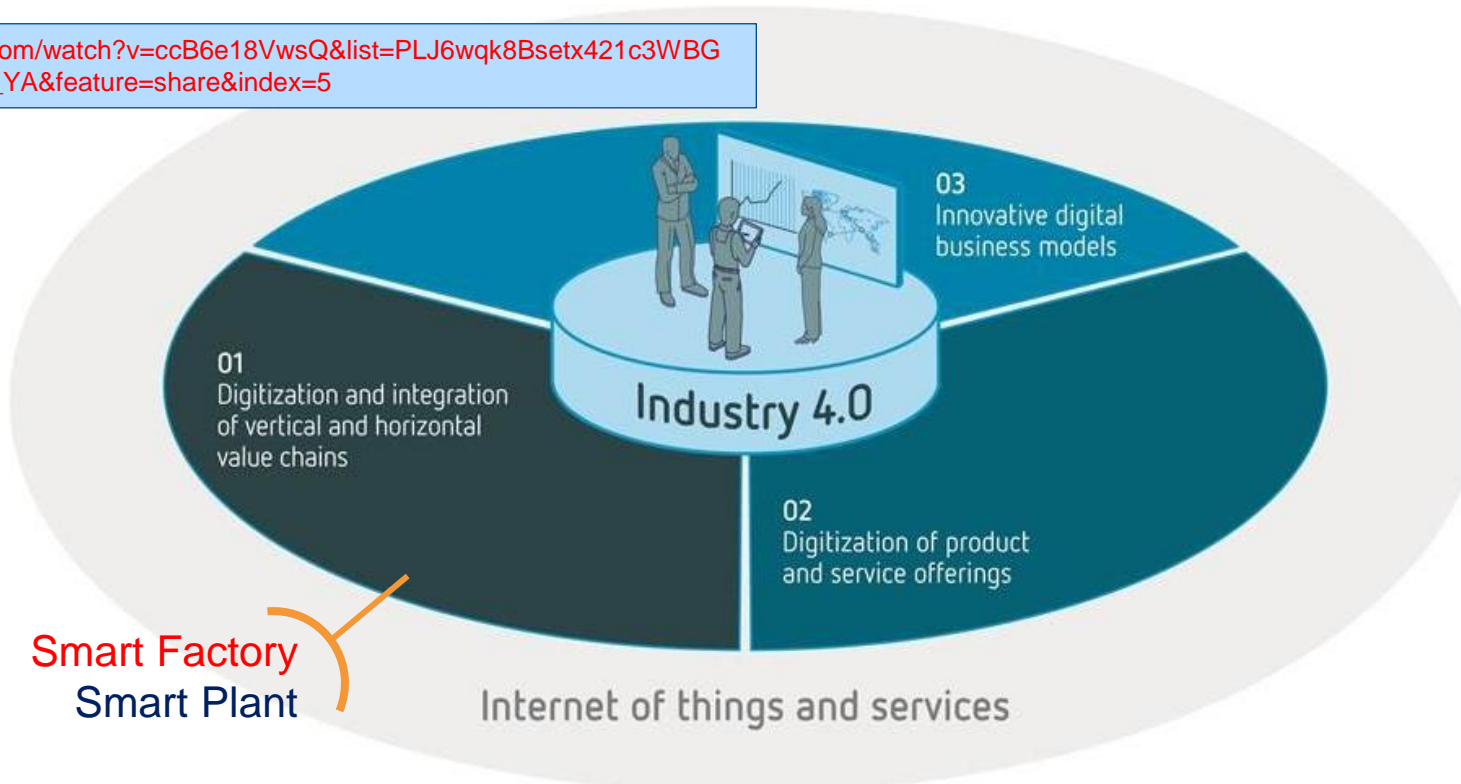
# Siemens approach for „Smart Factory / Smart Plant“ is the „Digital Enterprise“



Quelle: ZVEI nach PwC

# Example for a „Smart Factory“: „Digital Factory“ of SIEMENS in Amberg, Germany

[www.youtube.com/watch?v=ccB6e18VwsQ&list=PLJ6wqk8Bsetx421c3WBGXhnERtyMGm\\_YA&feature=share&index=5](https://www.youtube.com/watch?v=ccB6e18VwsQ&list=PLJ6wqk8Bsetx421c3WBGXhnERtyMGm_YA&feature=share&index=5)



Quelle: ZVEI nach PwC

# The digital twin is the “heart” of the smart factory – Plant simulation adds value – Volvo as an example

## Benefits

- Virtual model
- Personnel deployment planning
- Definition of multidisciplinary work packages
- Visualization of construction status
- Planning of mechanical finishing
- Definition of work packages for finishing/commissioning
- Library of industry-specific checklists



Movie: Volvo Cars Group

# From our leading position in automation, we're driving digitalization of our business and the entire industry

... for the process and discrete industries

Totally Integrated Automation (TIA)/  
**No. 1** in automation

1996



PLM Software



3D simulation  
e.g. reinforcement simulation



CAE software  
e.g. flow dynamics



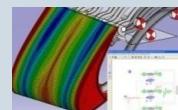
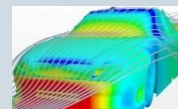
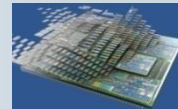
EDA Software



Cooperation with Bentley Systems

2017

Comprehensive portfolio  
for Industrie 4.0  
**Digital Enterprise**



## Digital Enterprise

Industrie 4.0 from Siemens

Industrial software  
and automation



Industrial communication



Industrial security



Industrial services

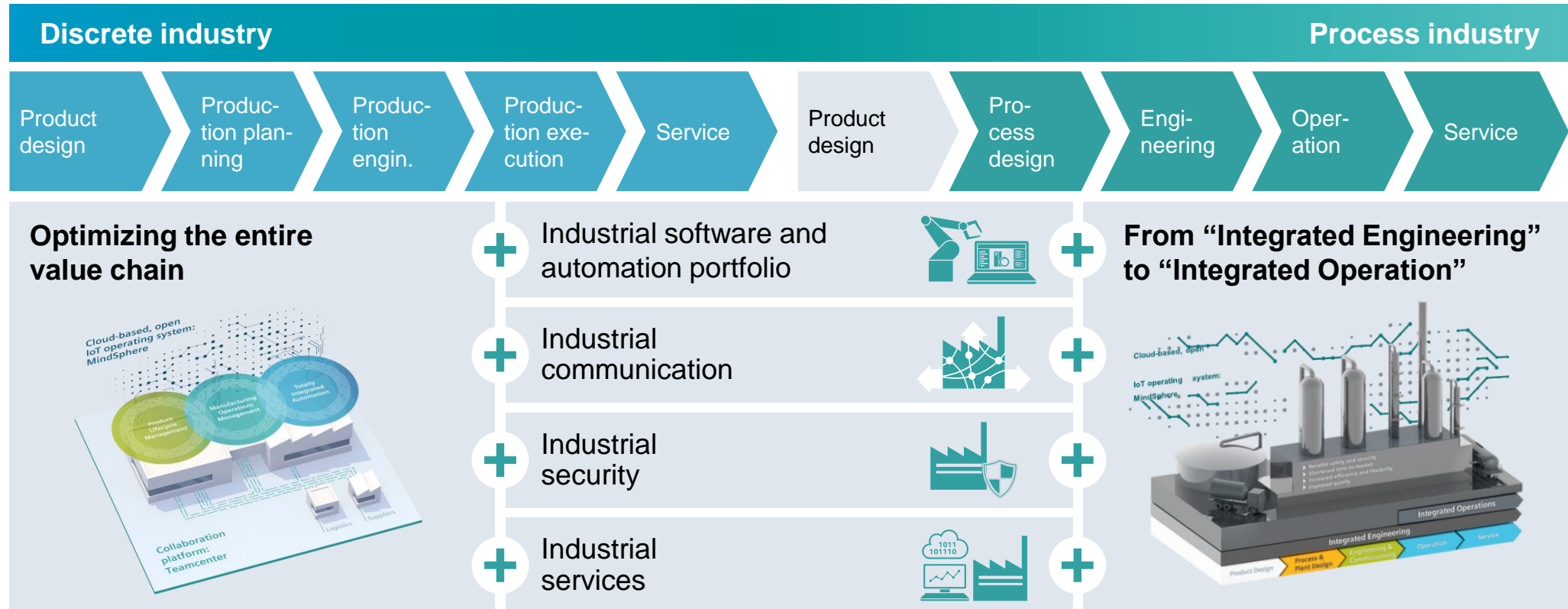


MindSphere –  
the cloud-based,  
open operating system  
for the Internet of Things



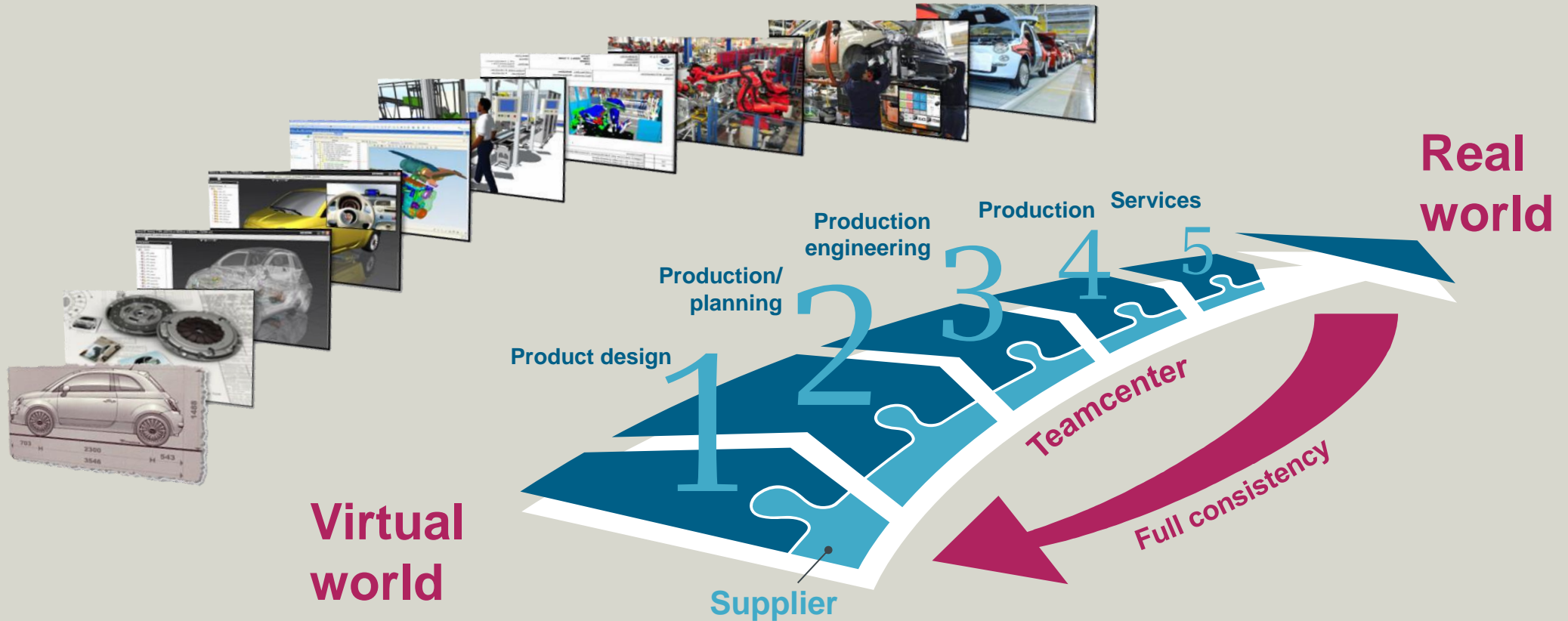
# The Digital Enterprise for the discrete and process industries brings the virtual and real worlds together

## Digital Enterprise



# Full consistency between virtual and real production world – from digital model to real production

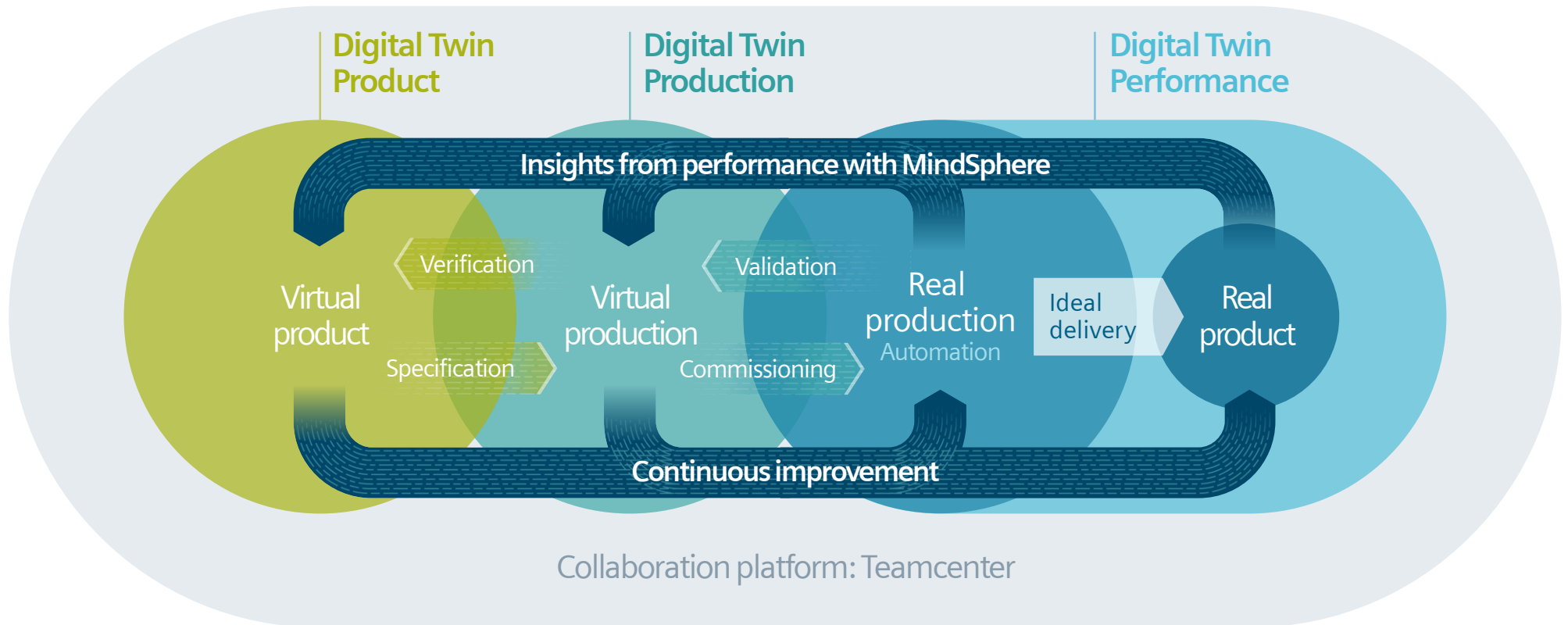
SIEMENS





# Simulation and the Digital Twin

## Basis for continuous improvement



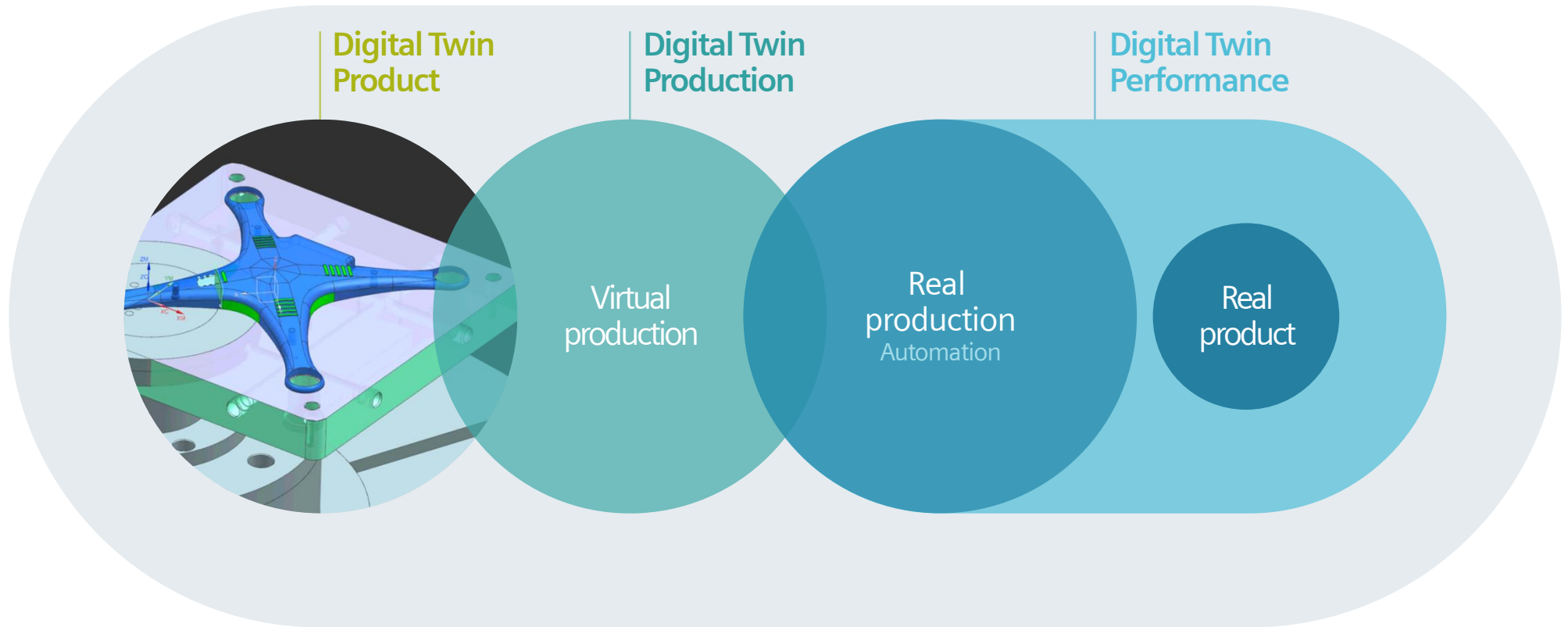
# Digital Twin meets Additive Manufacturing – and example

**SIEMENS**  
*Ingenuity for life*

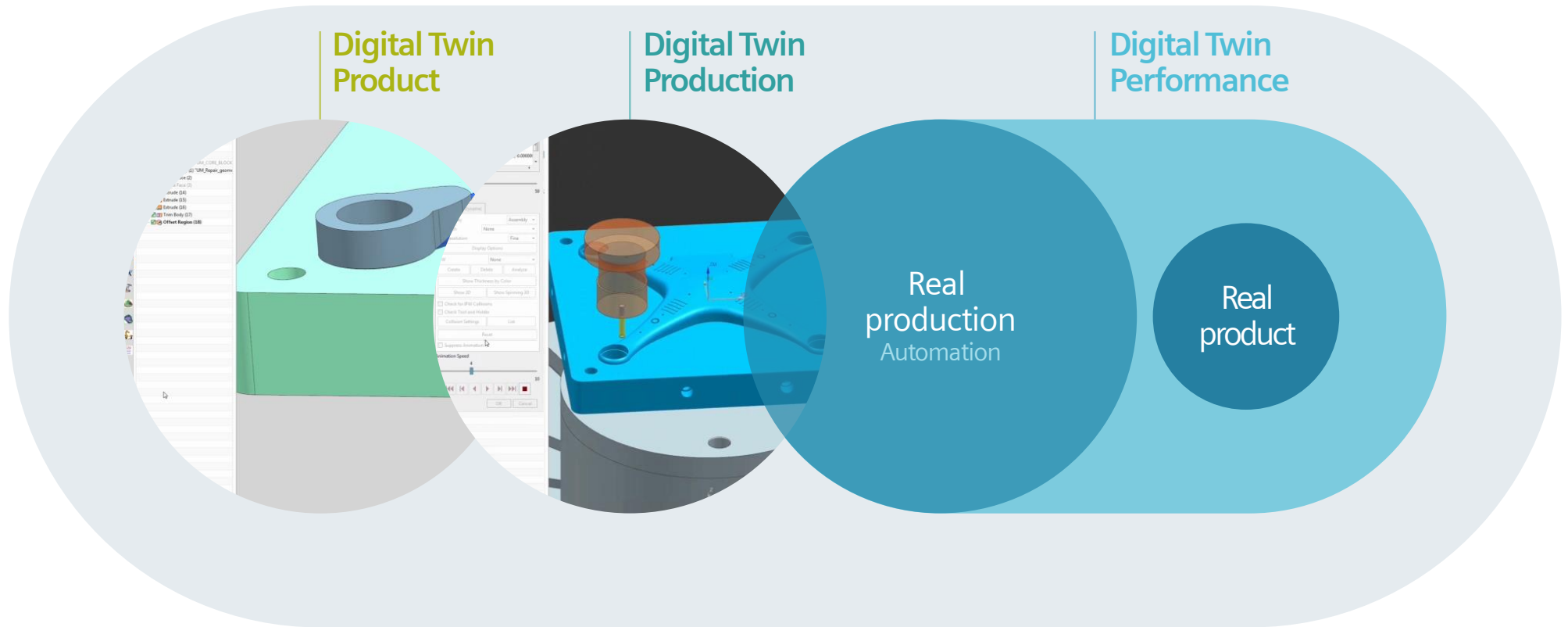


Unrestricted © Siemens AG 2018

# Digital Twin meets Additive Manufacturing – and example



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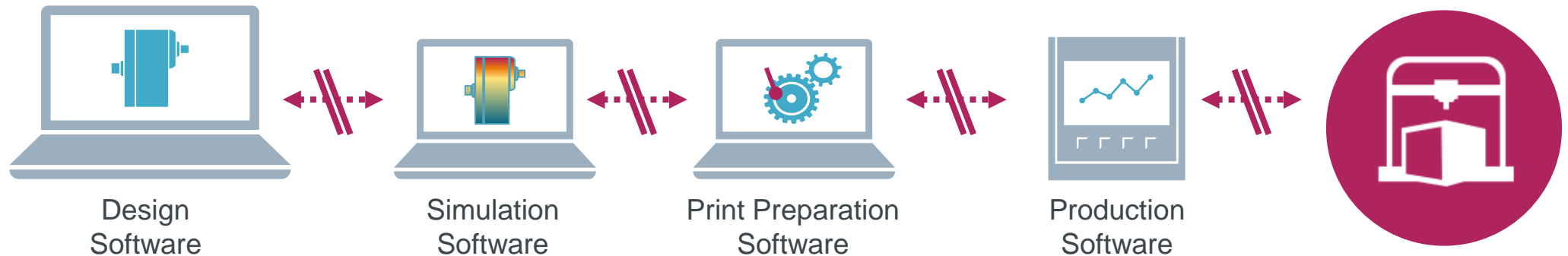




# Additive Manufacturing

Towards an integrated design and production

50% of initial designs are unprintable, 30% need complete rework



Disconnected software

Multiple file conversions

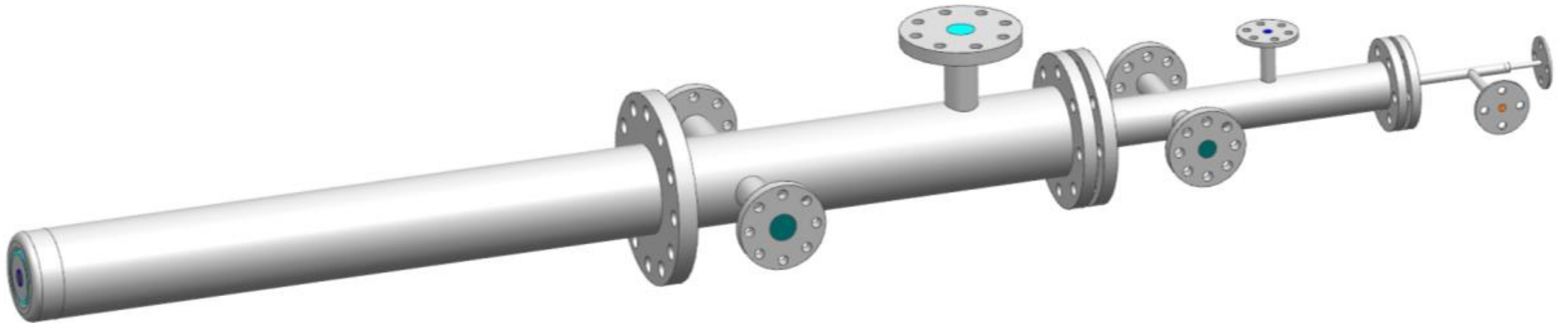
Out of control workflow

Conventional thinking

# Generative Design

## Example: High-temperature burner system

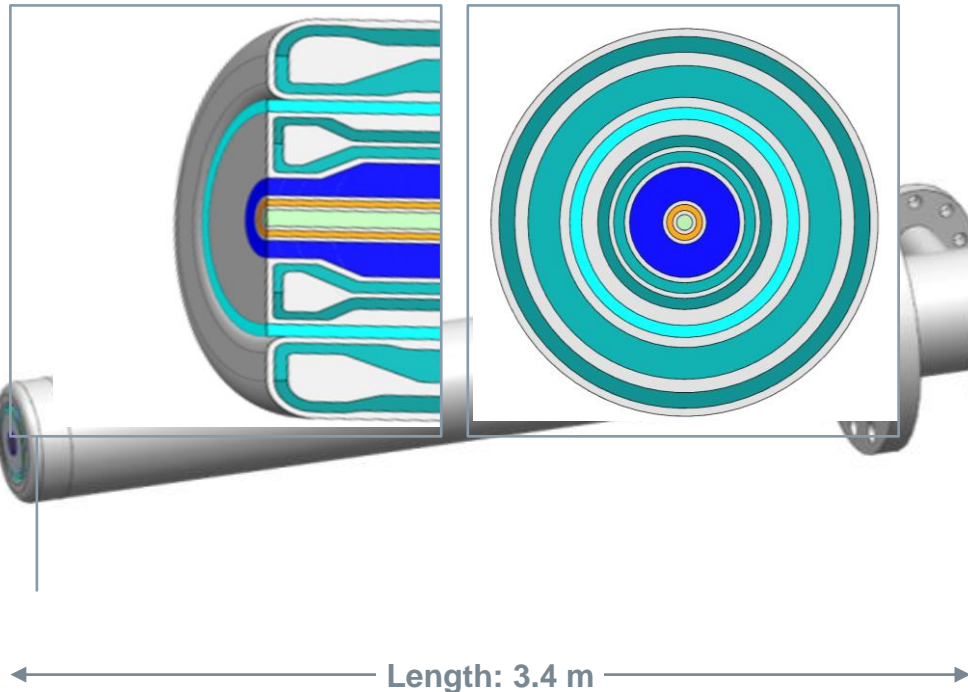
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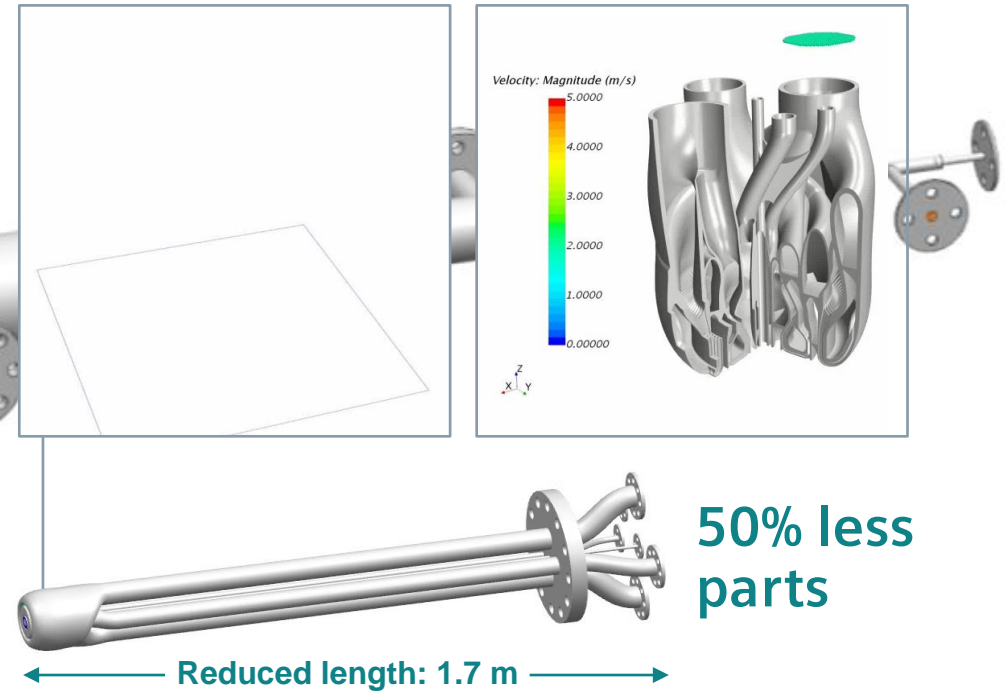
# Generative Design

Example: High-temperature burner system

## Conventional design

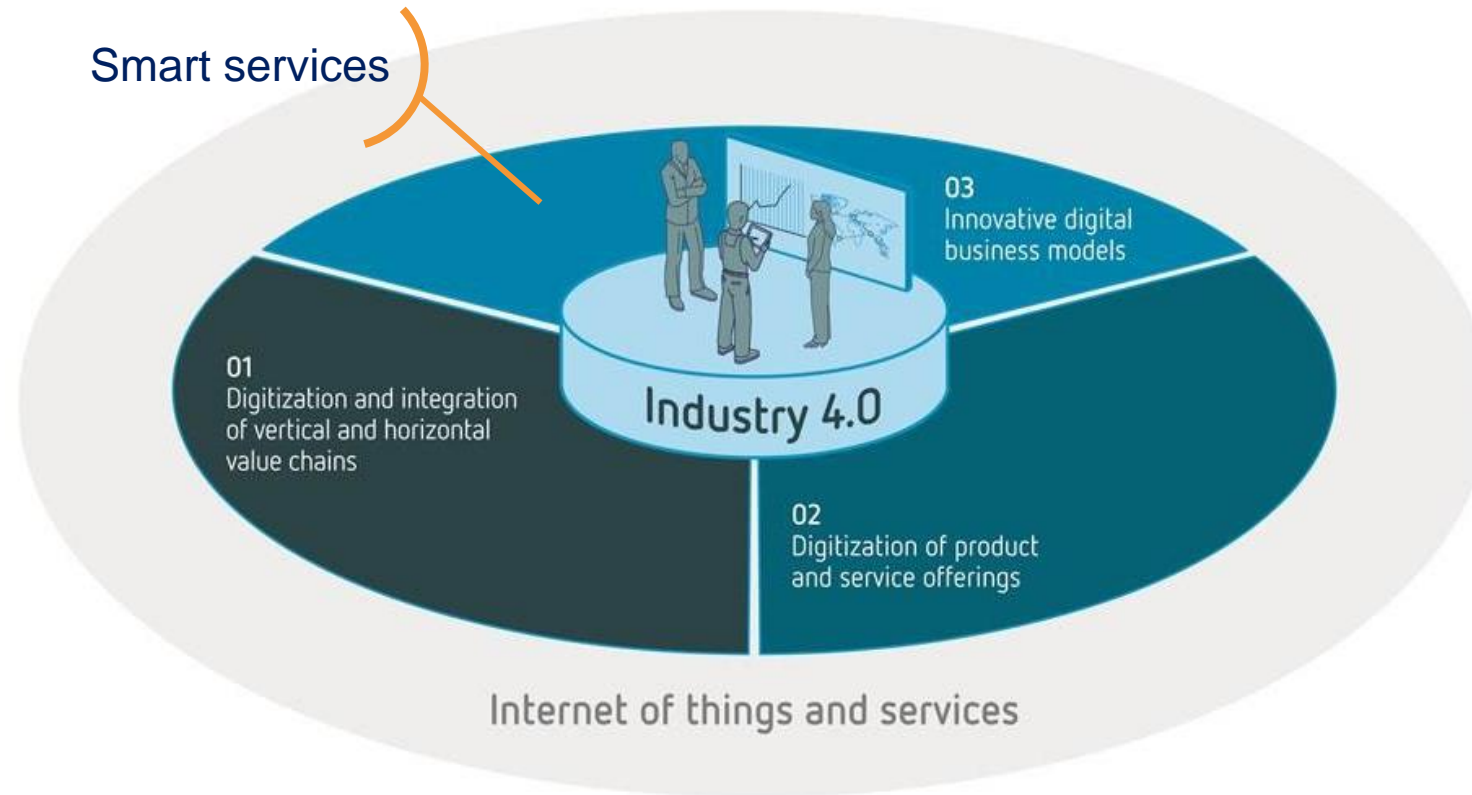


## Generative design

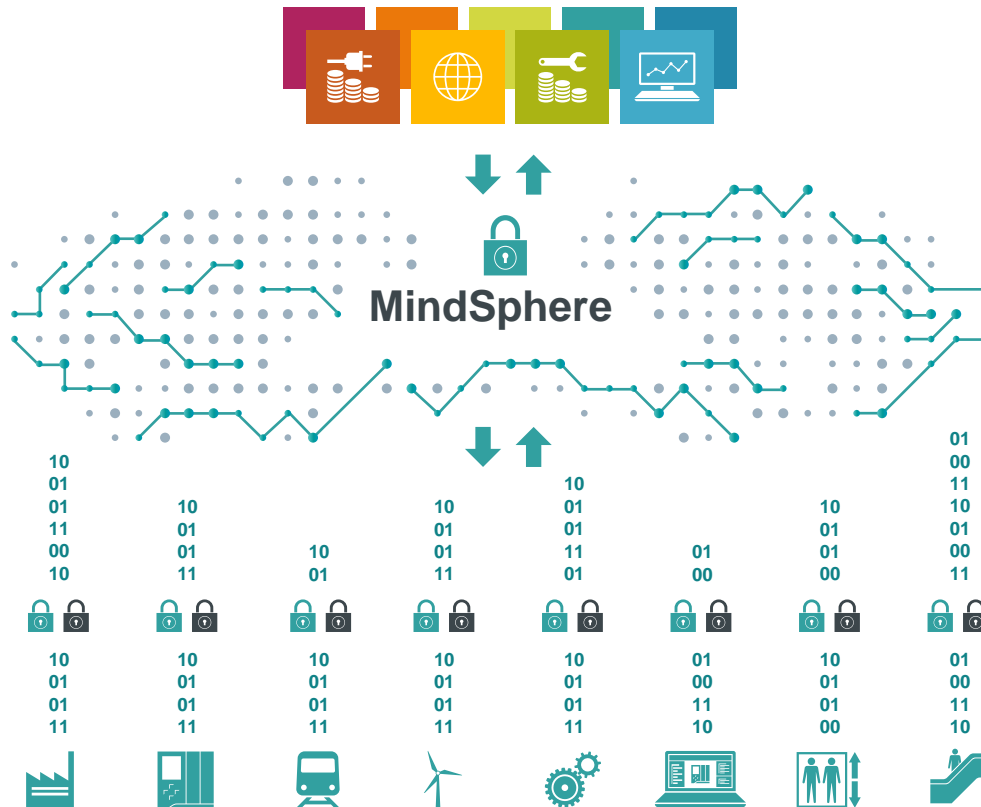




# Siemens approach for „Smart Services“ based on „Mindsphere“



# MindSphere – The cloud-based, open operating system for the Internet of Things – from Siemens



## MindApps

- Apps from OEMs, from end customers, from partners and from Siemens
- Transparency in plants and analytical insight (e.g. fleet management)

## MindSphere

- Open interface for developing customer-specific apps
- Different cloud infrastructures: SAP, AtoS, Microsoft Azure as public or private clouds or on the premises (planned)

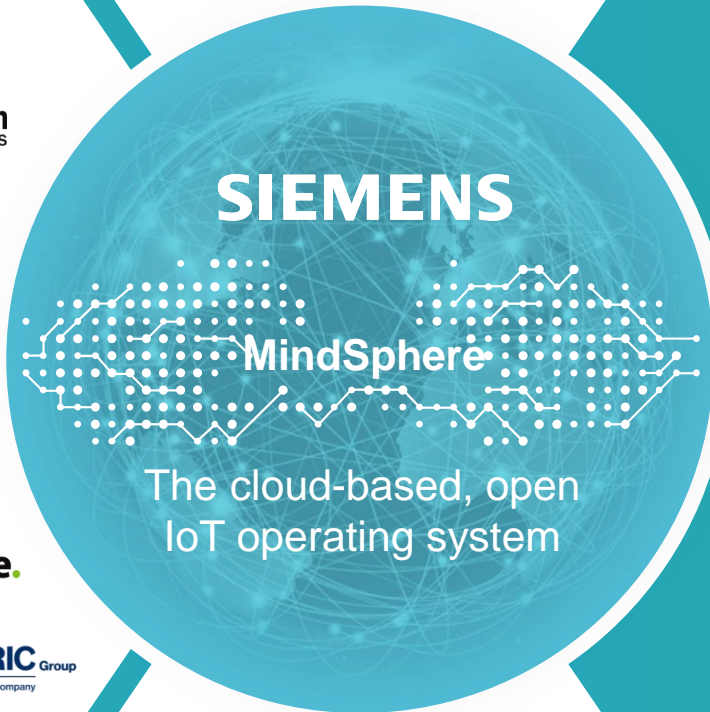
## MindConnect

- Open standards for connectivity, e.g. OPC UA
- Plug & play connection of Siemens and third-party products
- Secure and encrypted data communication

# MindSphere applications – A comprehensive ecosystem with strong partners

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## Our partners



- Consulting/strategic partners
- Connectivity partners
- Application developers
- Technology providers
- System integrators
- IaaS providers

# Condition monitoring of machine tools with MindSphere – Gebr. Heller Maschinenfabrik GmbH

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*Ingenuity for life*

## Gebr. Heller Maschinenfabrik GmbH

- Leading supplier of CNC machining centers and flexible production systems

## Siemens Solutions

- Complete automation and drive technology
- MindSphere platform

## Benefits

- Global access to data (connectivity over the cloud)
- Increased productivity, quality and availability for the end customer
- New business model for collaboration with the end customer

Heller offers its own condition monitoring app: “Heller Services Interface”



Photo: Gebr. Heller Maschinenfabrik GmbH

# Cloud connectivity at the customer's request – Calvatis GmbH uses new business models with MindSphere

**SIEMENS**  
*Ingenuity for life*



Photos: Calvatis GmbH

## Calvatis GmbH

- Manufacturer of industrial cleaning machines and cleaning agents for the F&B industry

## Siemens Solutions MindSphere

- Connects the cleaning machines to the cloud via MindConnect Nano
- Visualizes the data
- Facilitates performance management and predictive maintenance

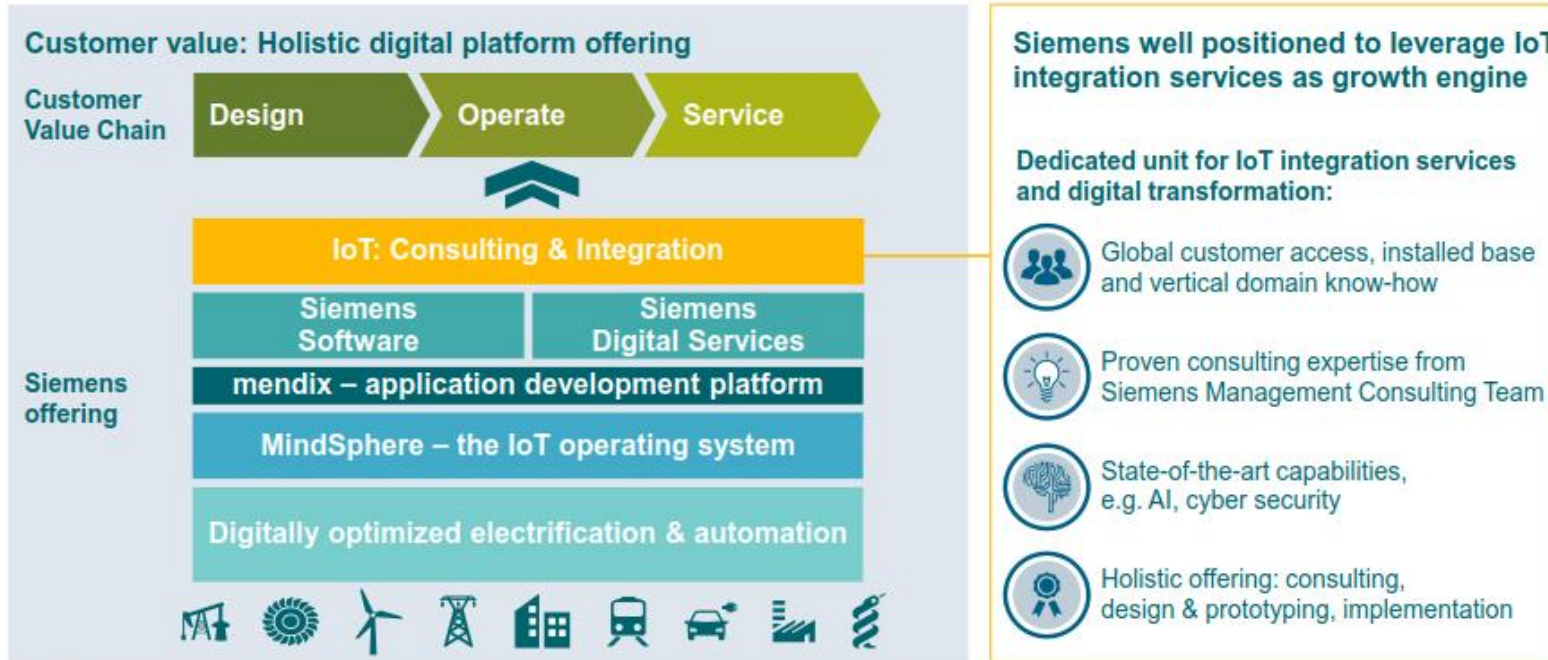
## Benefits

- Meets explicit end customer demand
- Permits new digital services and business models
- Vision: Pay-per-use business models

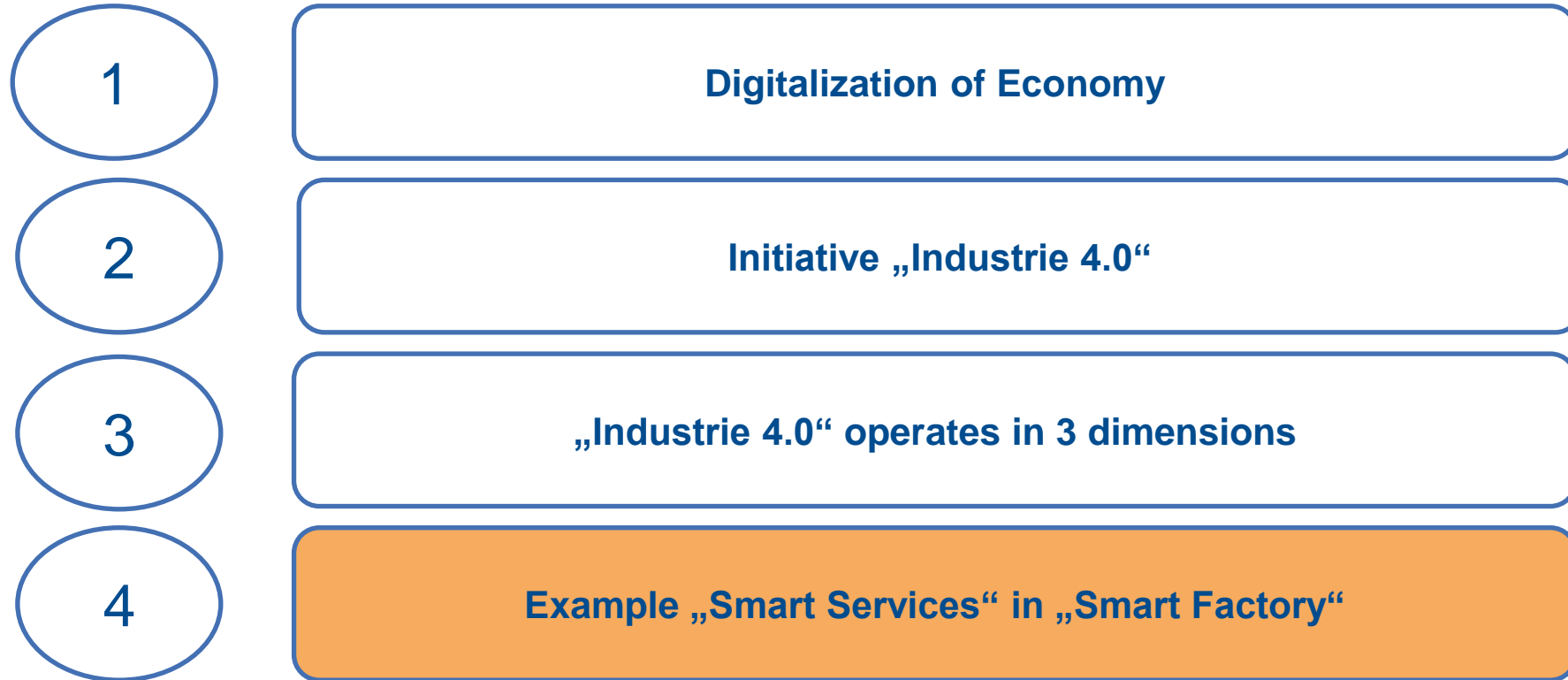
# M&A of „mendix“ : It will be become much easier for our customers and for ourselves to write „Mindapps“



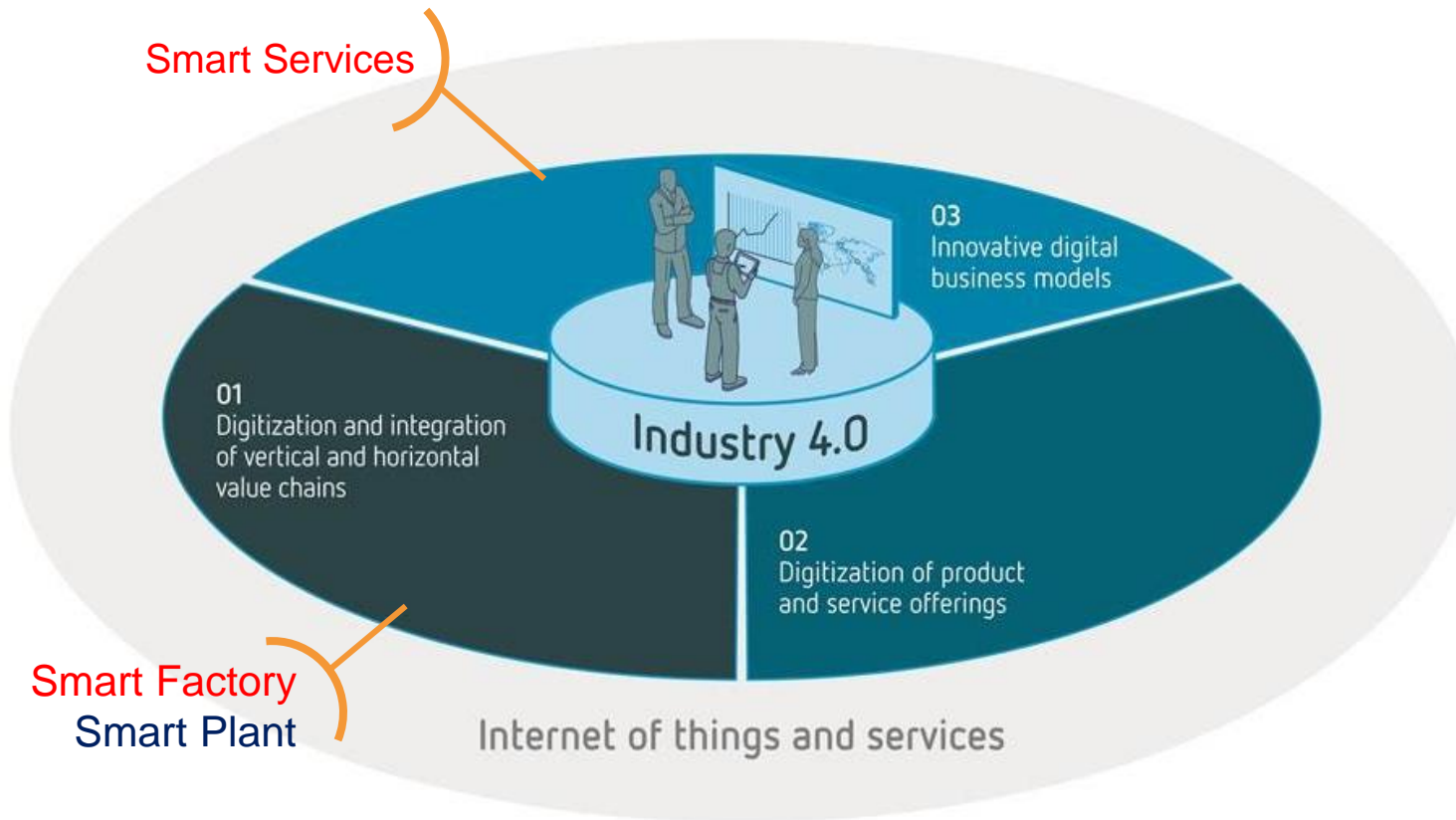
Siemens is expanding its IoT platform offering: Integration Services **SIEMENS** to support the digital transformation of our customers *Ingenuity for life*



# Overview



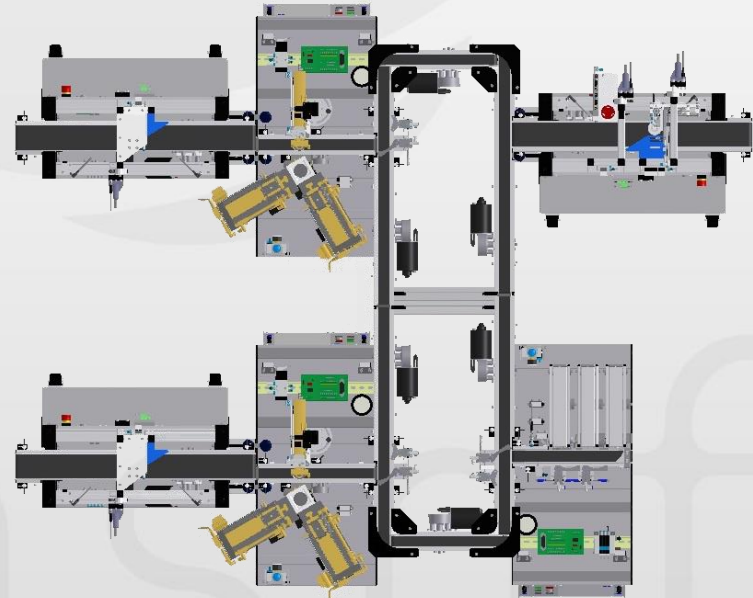
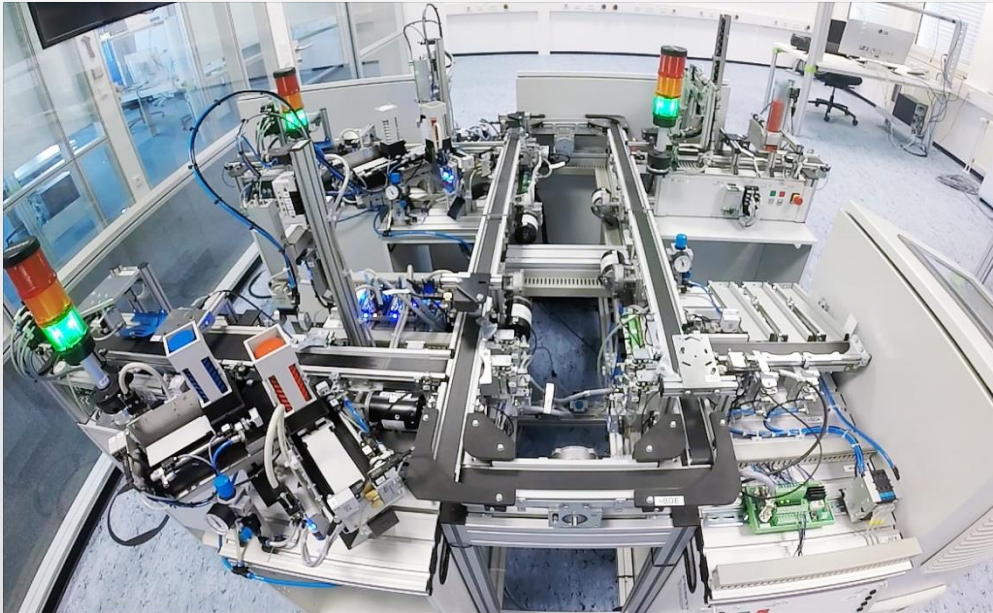
# Example „Smart Services“ in „Smart Factory“



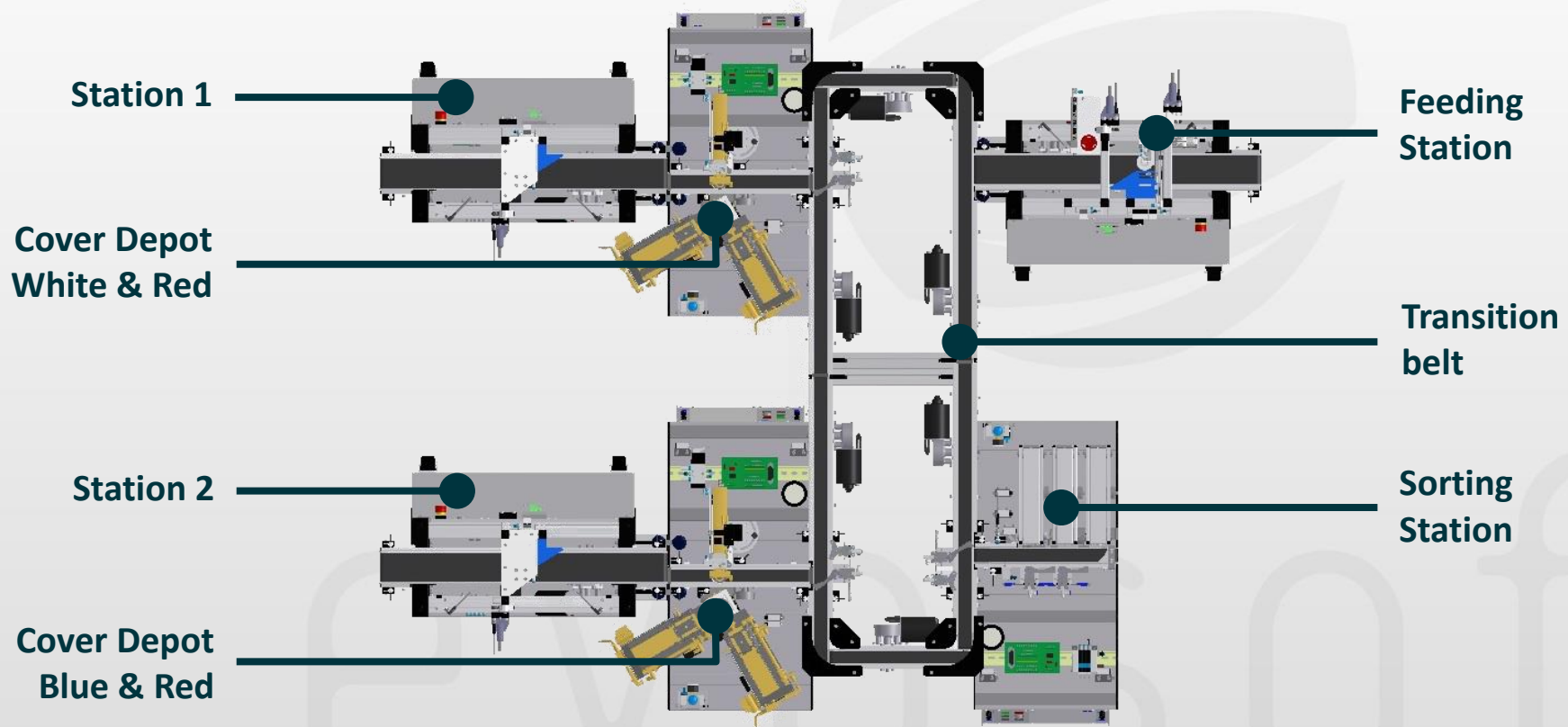
Quelle: ZVEI nach PwC



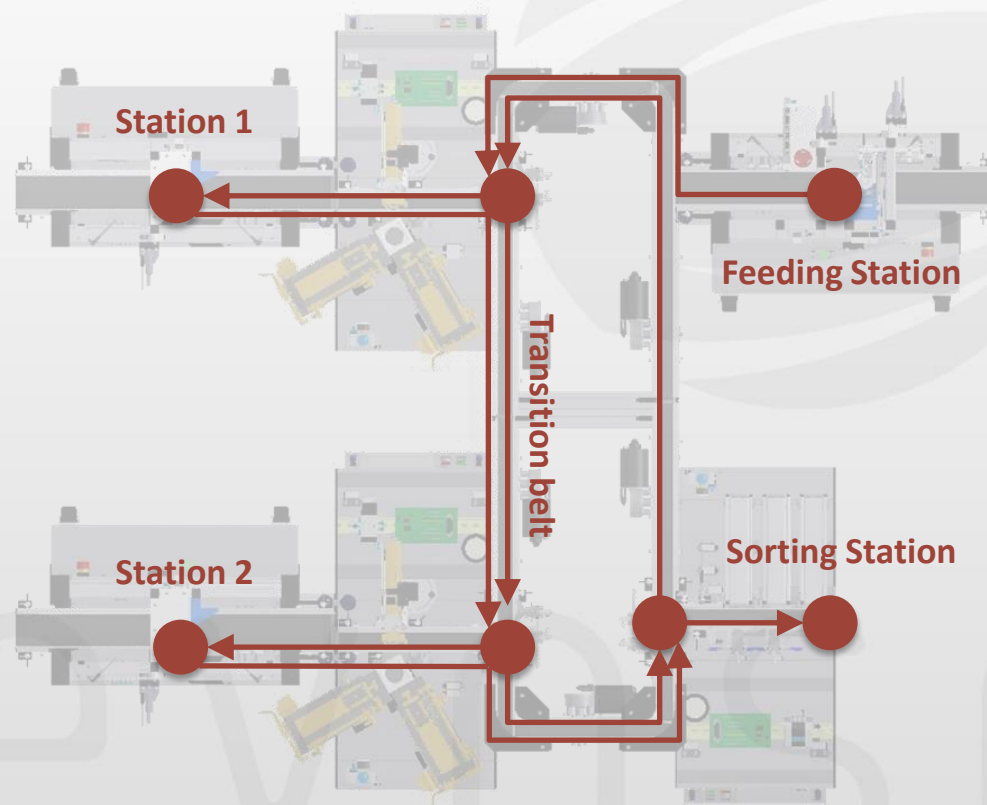
# Structure of a „Smart Factory“



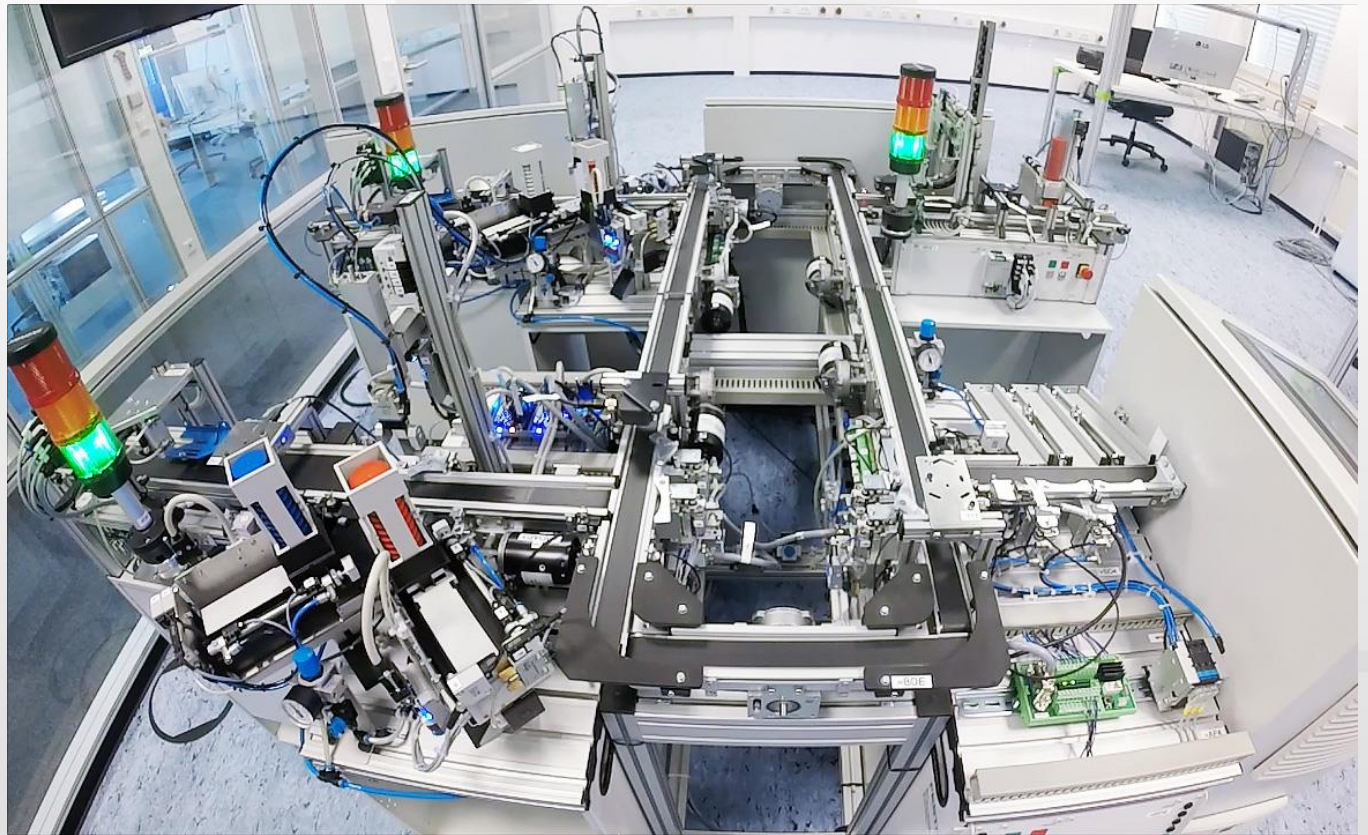
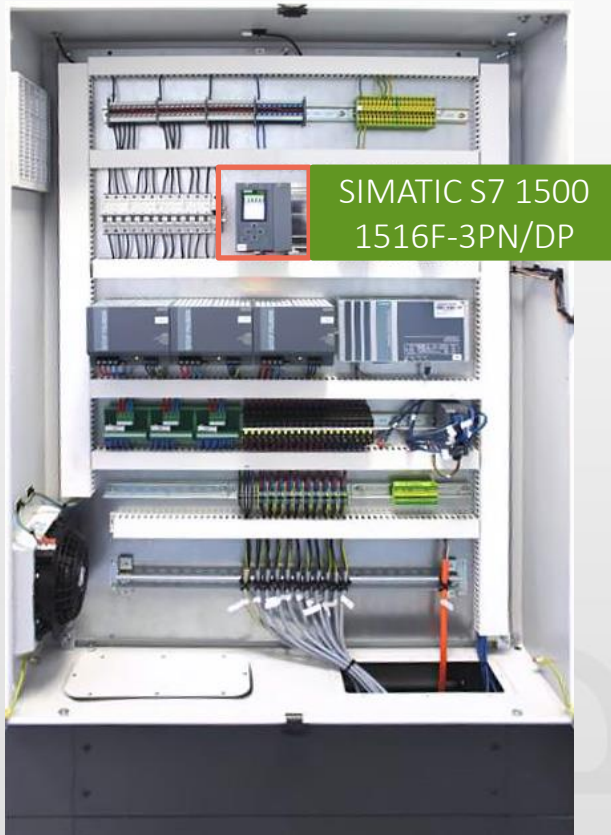
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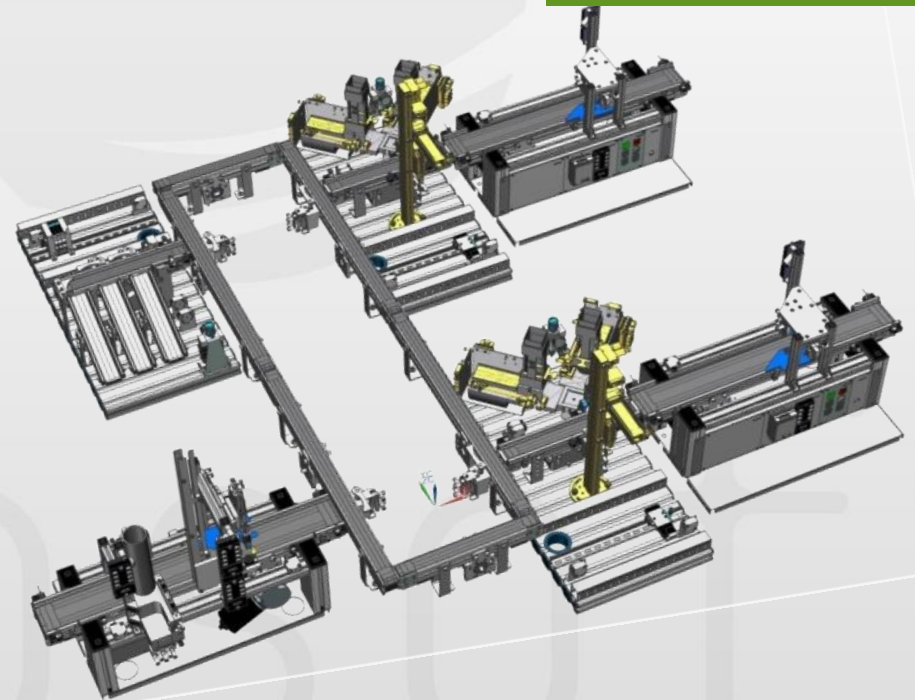
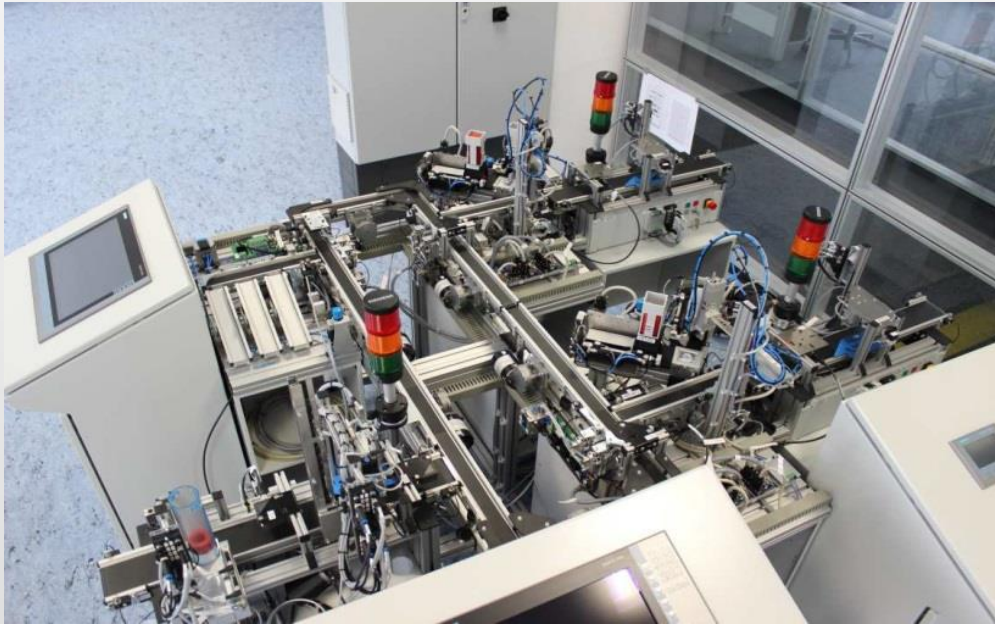
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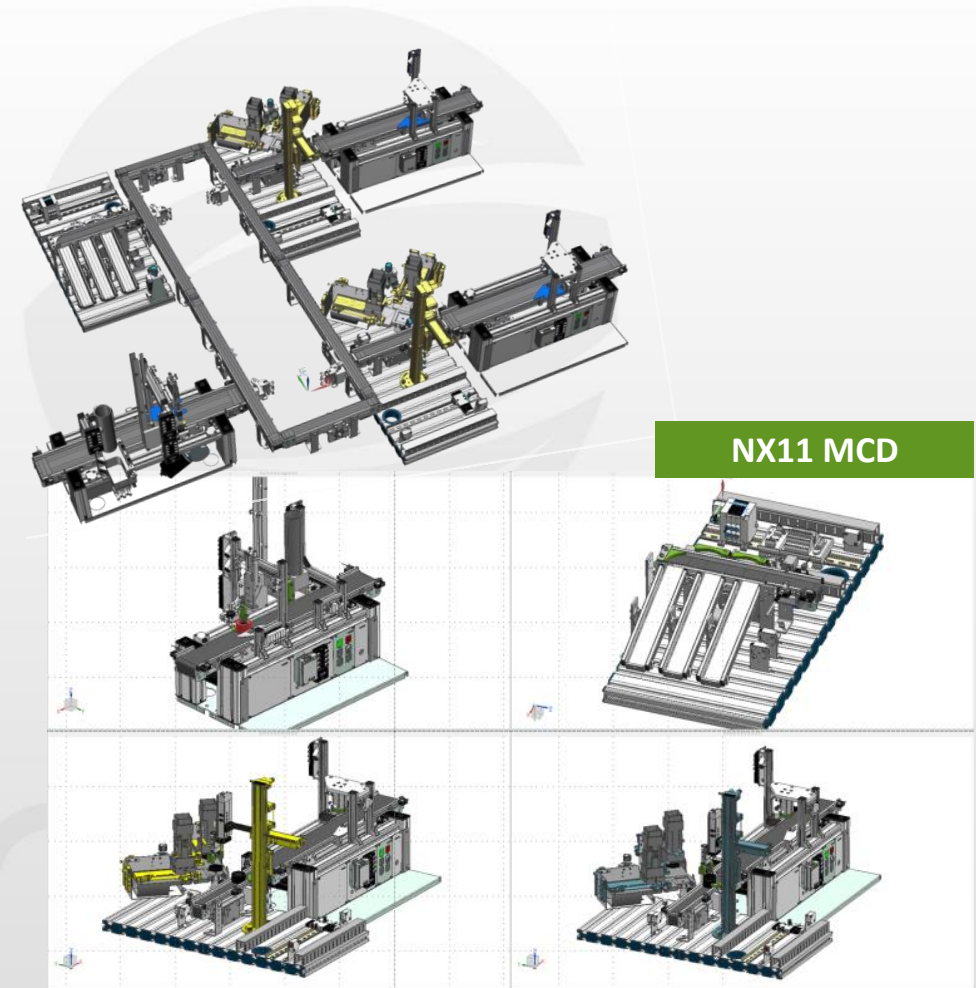
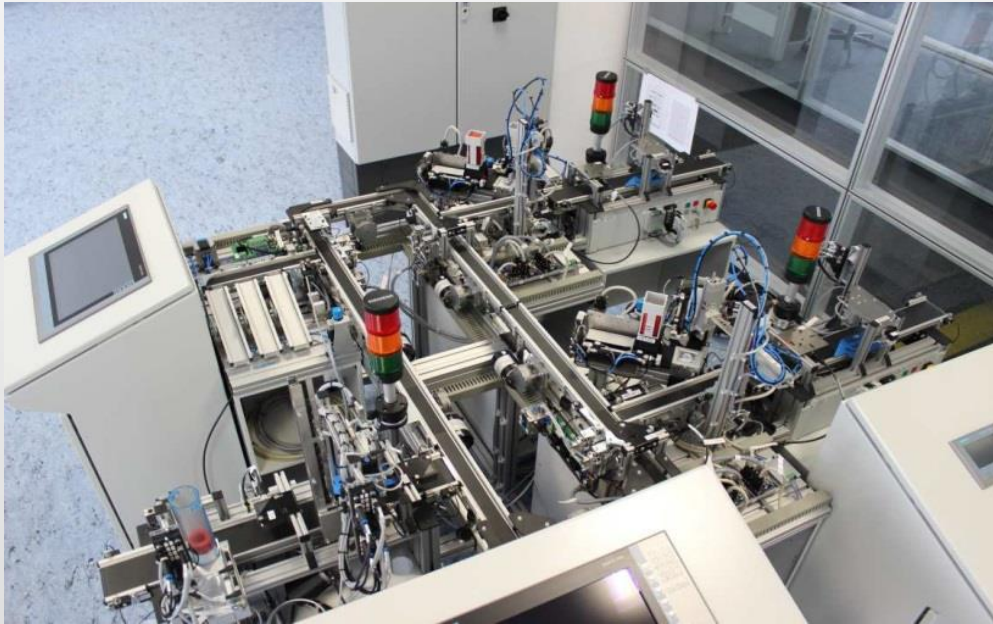
# Structure of a „Smart Factory“



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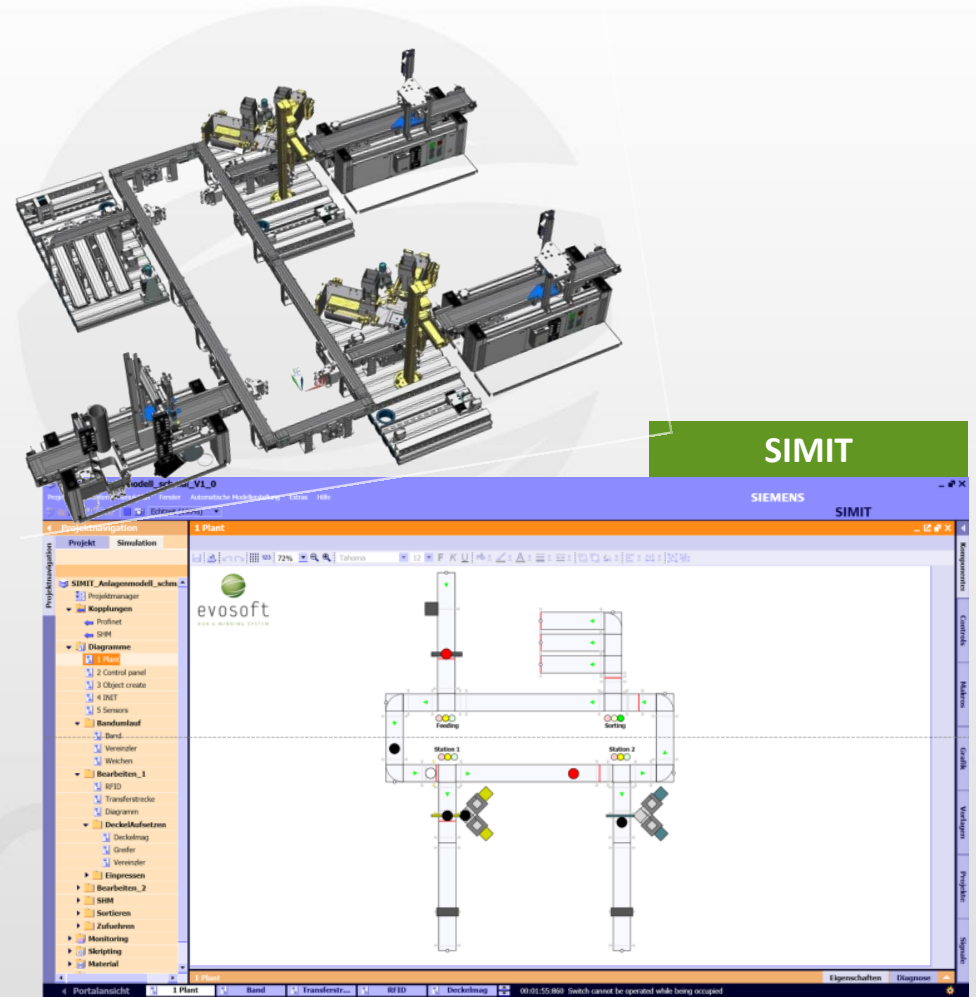
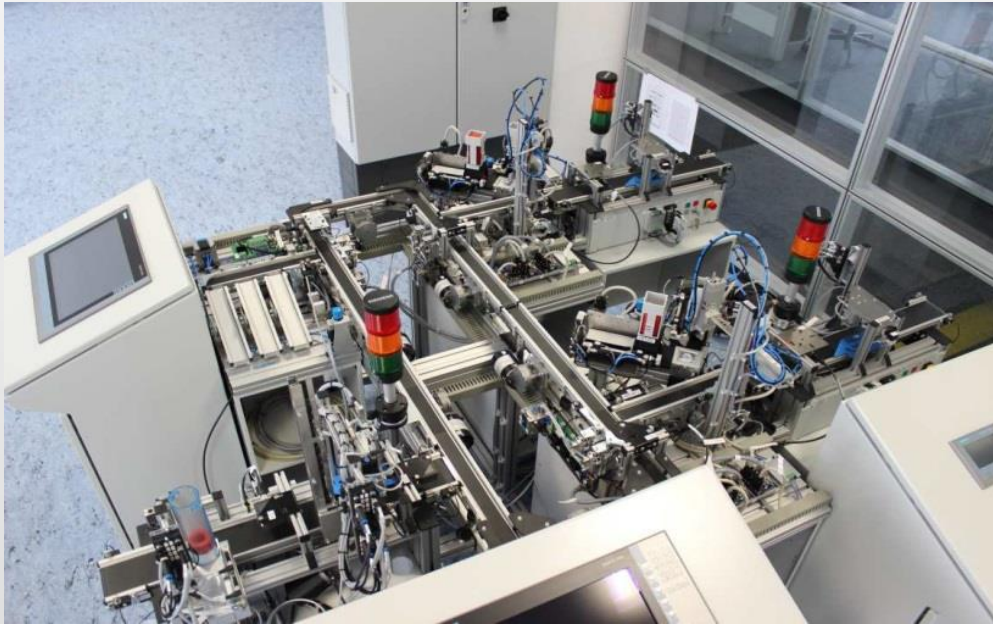
# Structure of a „Smart Factory“



NX MCD (Mechatronics Concept Designer):

Digitaler Zwilling für Mechatronisches Engineering und Virtuelle Inbetriebnahme im Maschinenbau

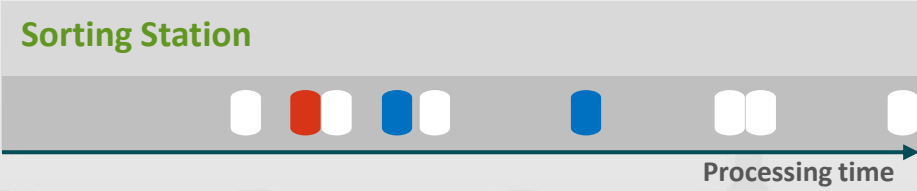
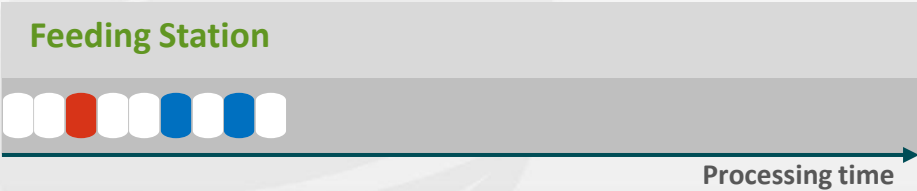
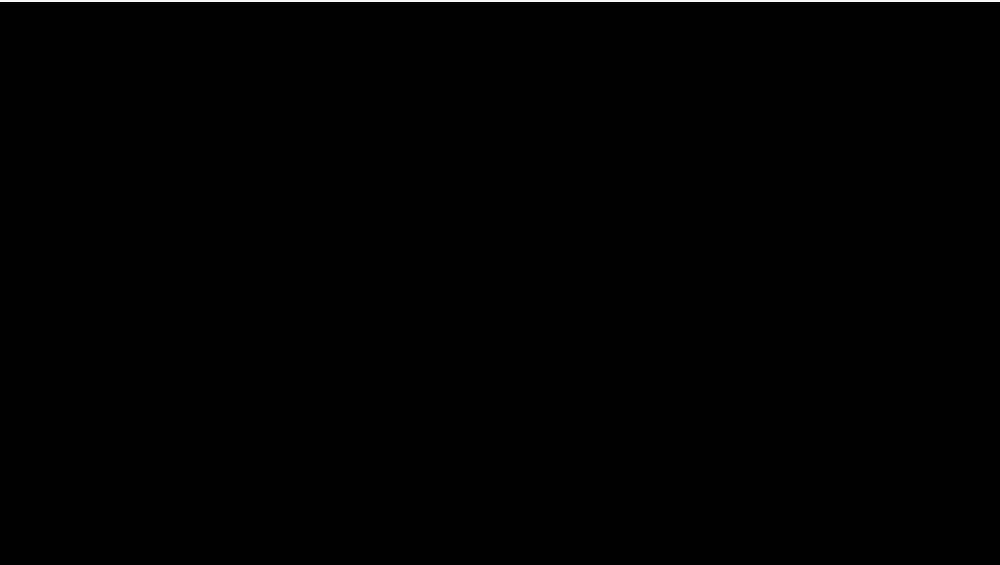
# Structure of a „Smart Factory“



## Simulation SIMIT:

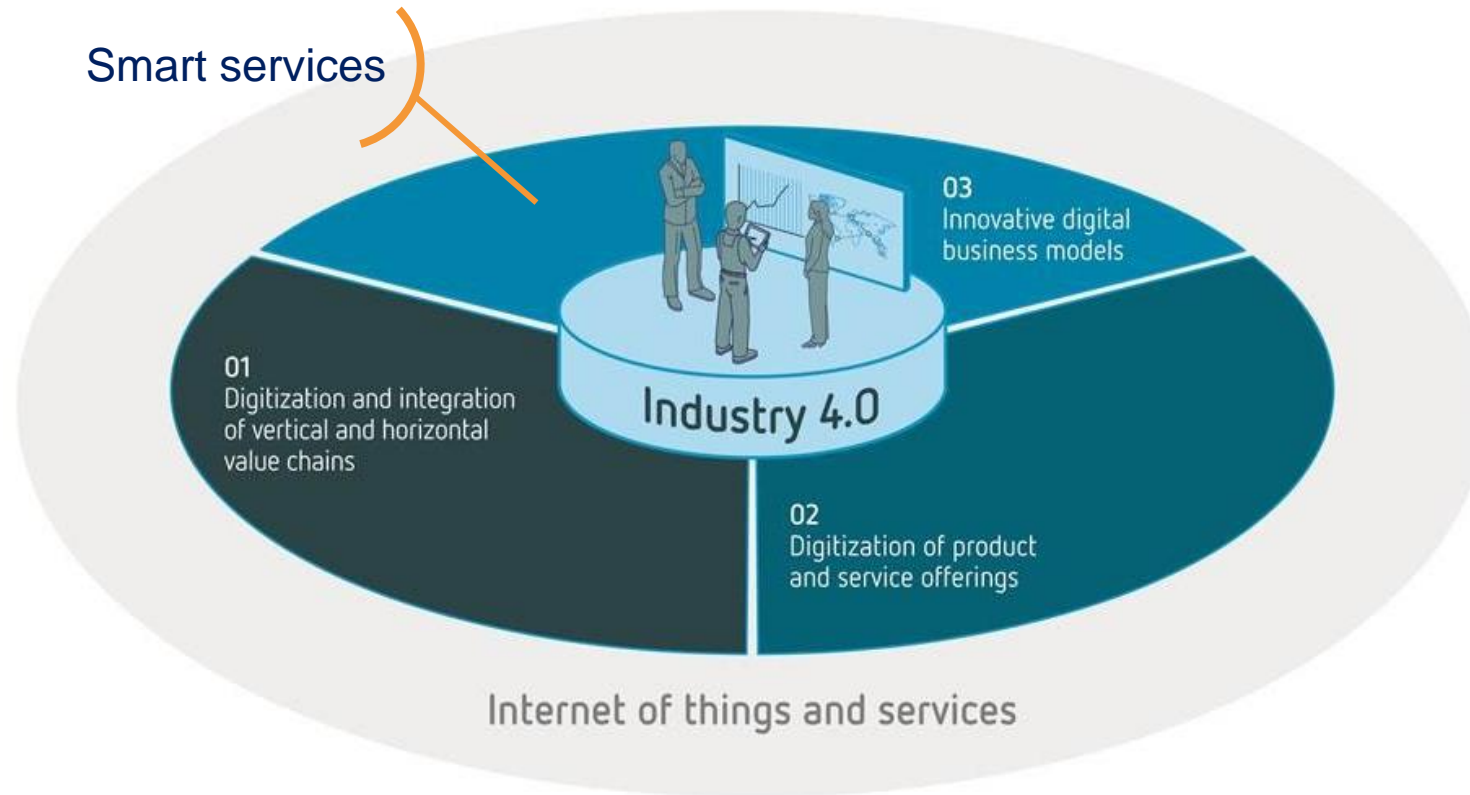
Simulationssoftware von SIEMENS Automatisierungssystemen

# Original Behaviour



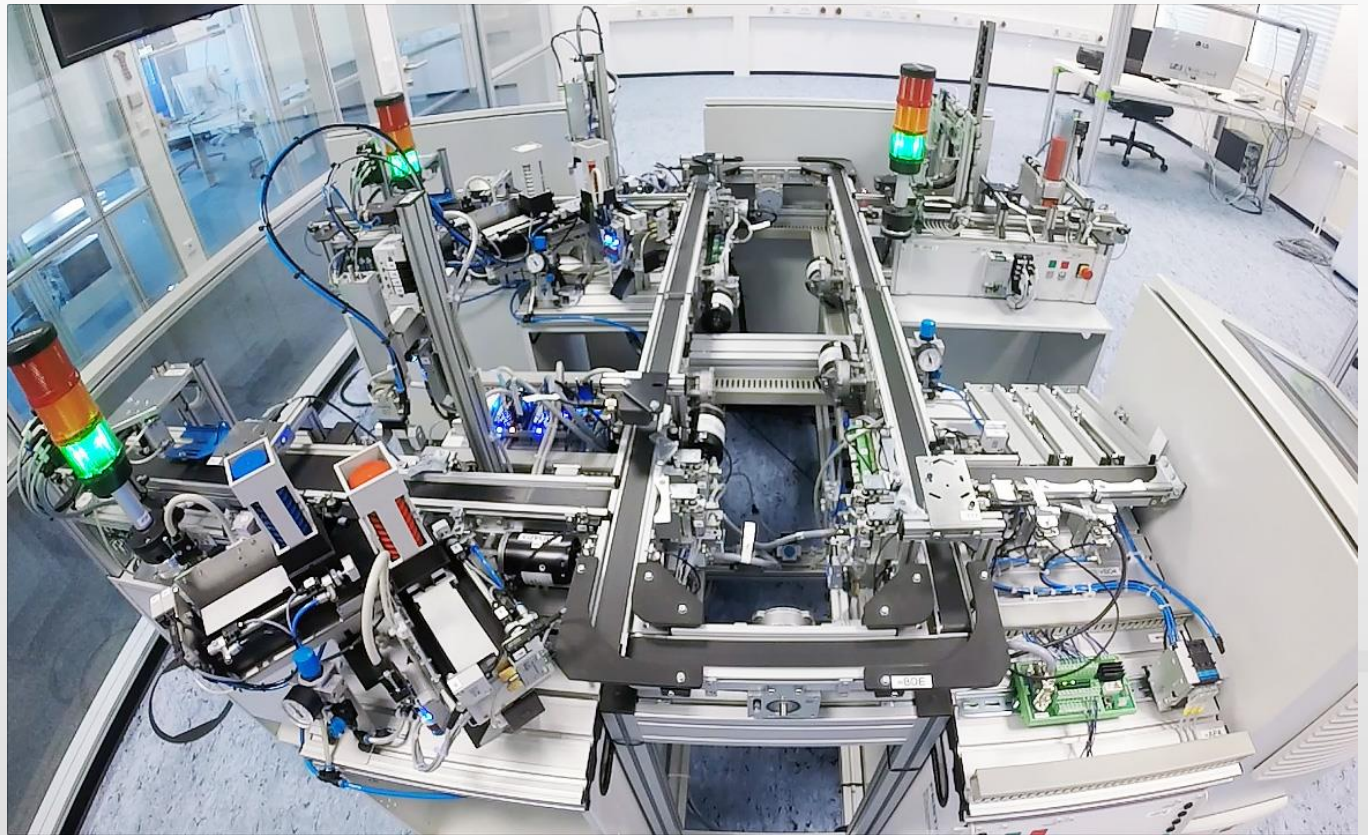
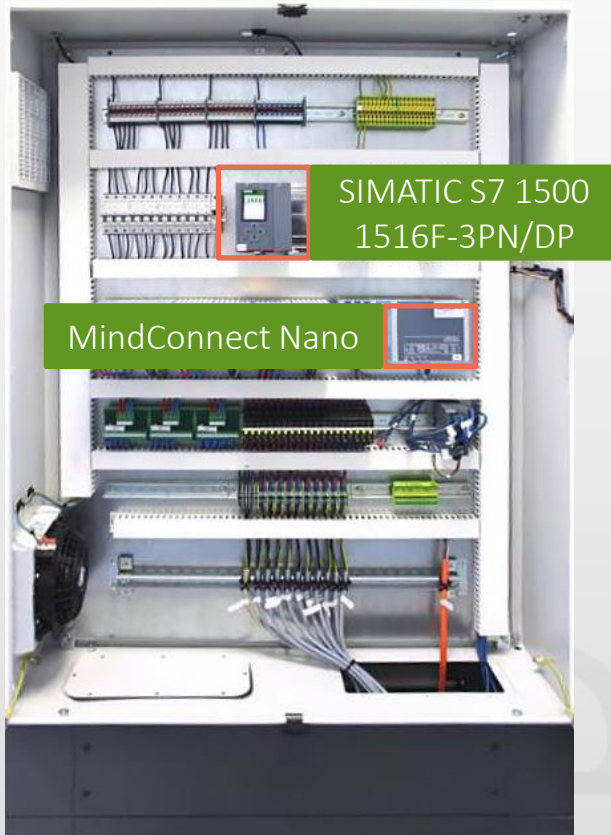


# Siemens approach for „Smart Services“ based on „Mindsphere“

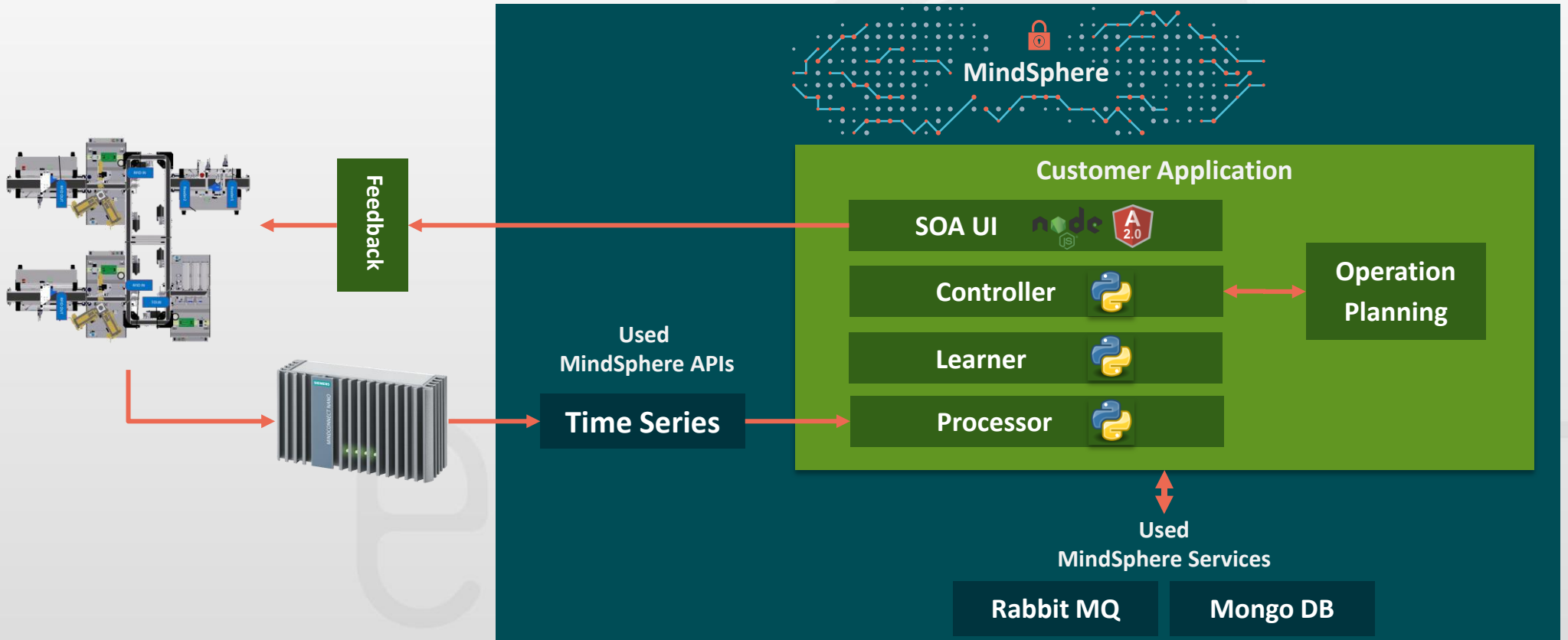


Quelle: ZVEI nach PwC

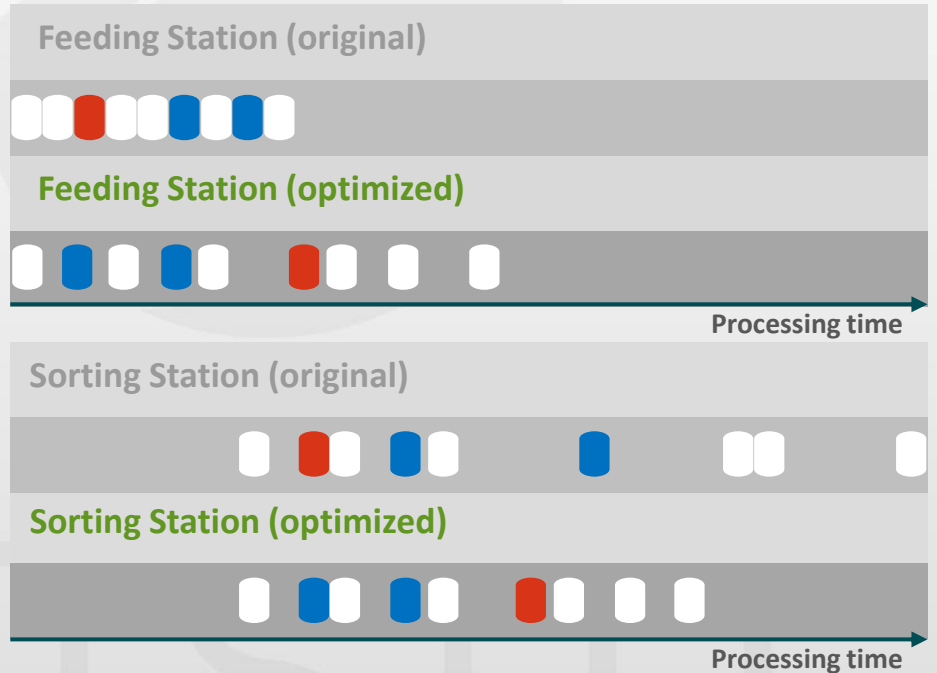
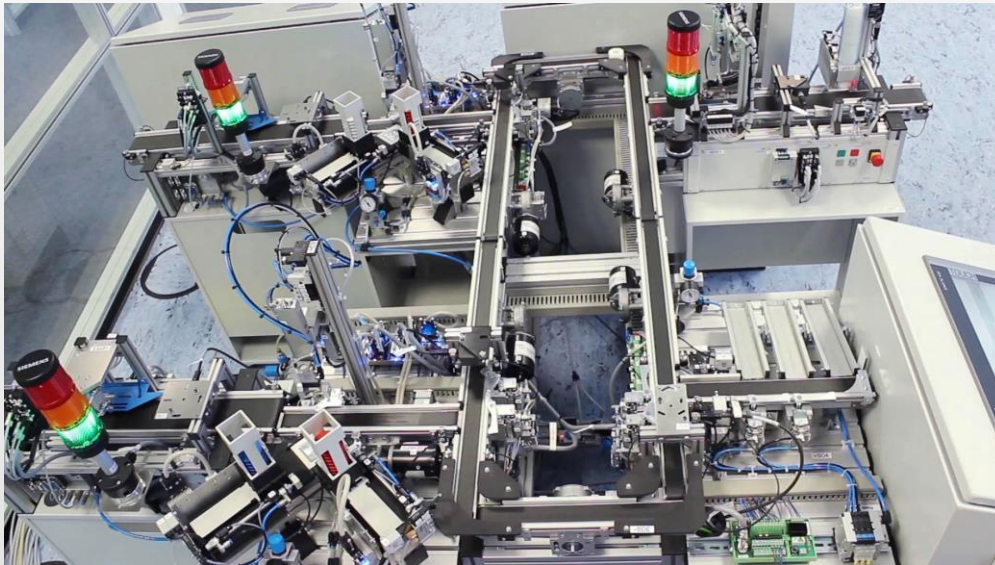
# Expansion of a „Smart Factory“ with „Smart Services“



# Expansion of a „Smart Factory“ with „Smart Services“



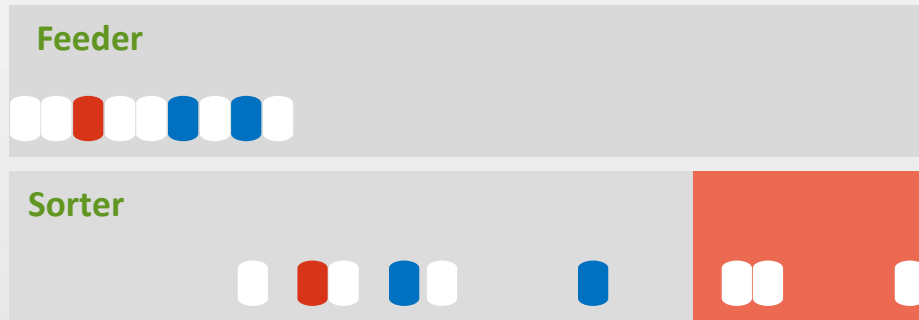
# Optimized Behaviour with „Smart Services“



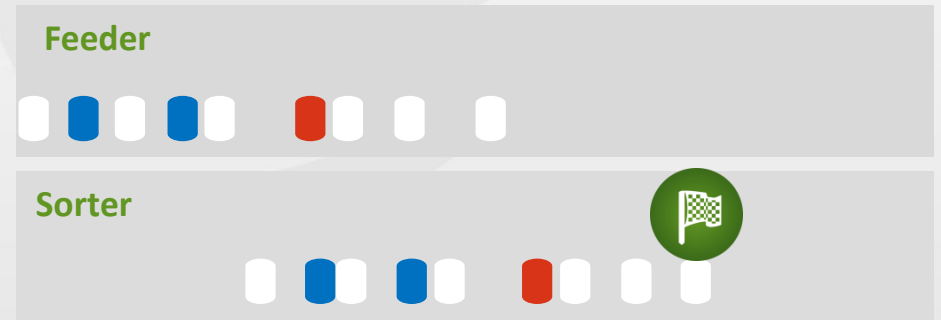


# Summary

Original



Optimized



Efficiency Increase  
**31,4%**

# Summary Investments

Original



Optimized



## Hardware

- Mindconnect Nano

## Software

- Cloud Integration
- Simulation License
- App Development

**break-even within first year**

**Thank you for your  
attention!**

**Any questions?**