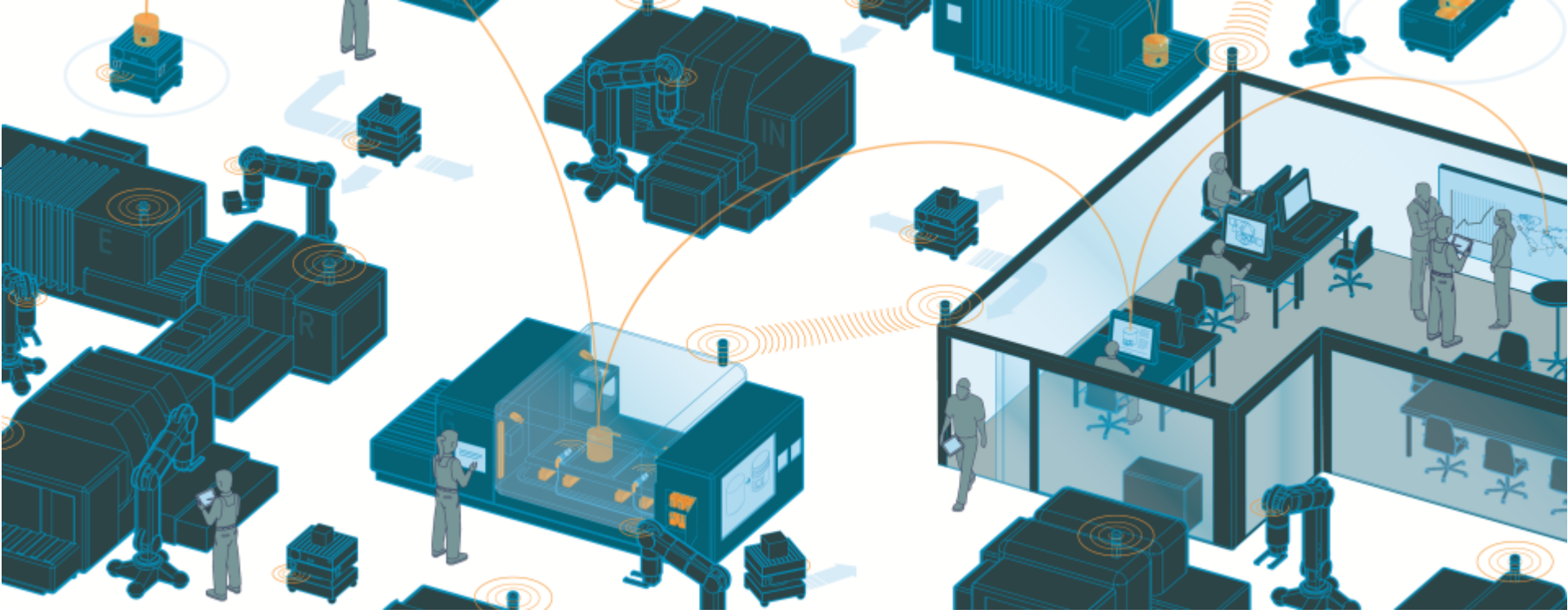
PCIC EUROPE
PETROLEUM & CHEMICAL INDUSTRY COMMITTEE

VIENNA 2017 – TUTORIAL EUR17_65

INDUSTRIE 4.0 ARCHITECTURE UPDATE IN RESPECT WITH INTERNATIONAL STANDARDS

Prof. Dr. Dieter Wegener
Sprecher ZVEI-Führungskreis Industrie 4.0

Jean-Charles Guilhem
Chairman of the GA Board PCIC Europe



ZVEI – German Electrical and Electronic Manufacturers' Association

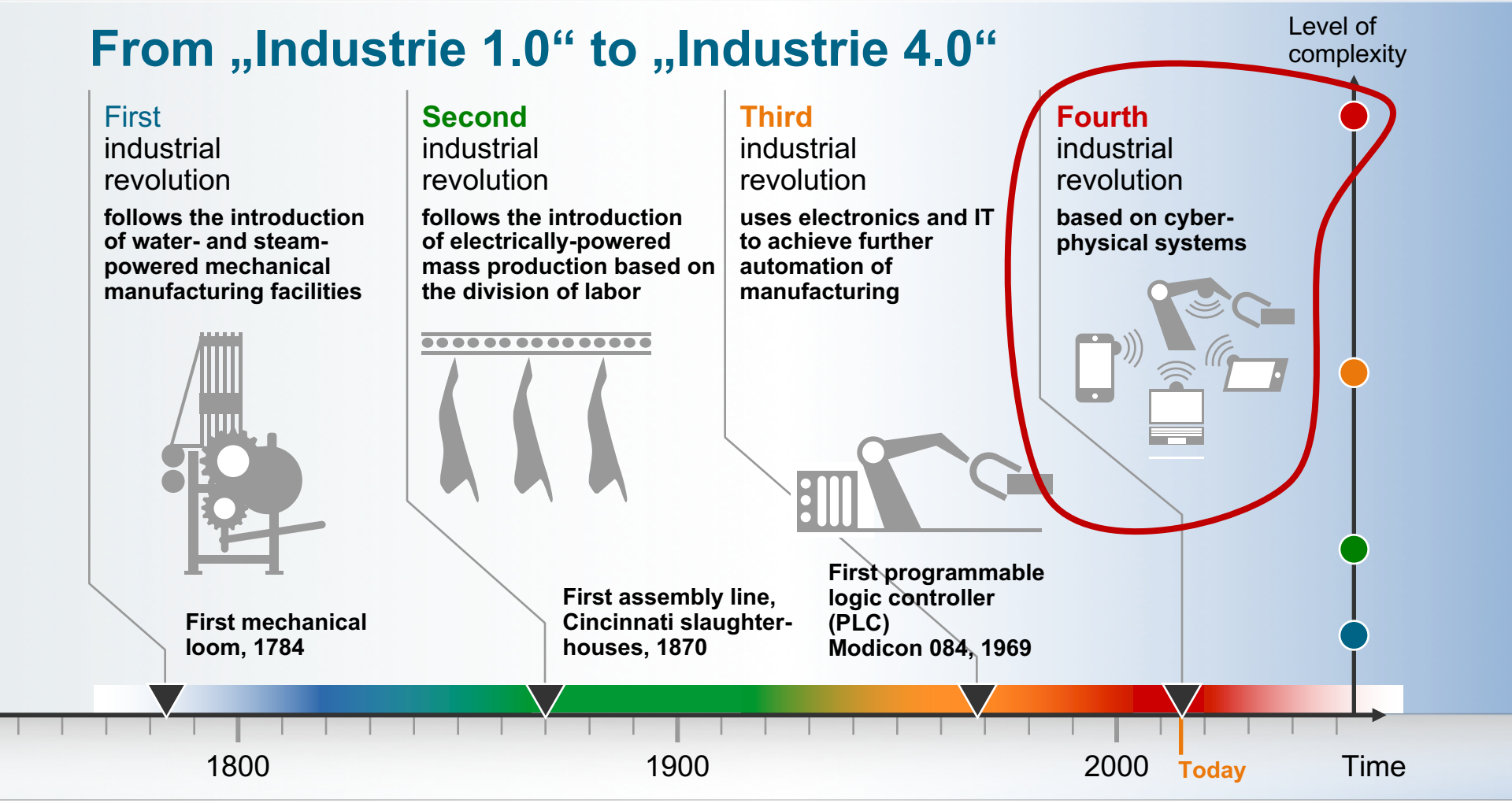
PCIC Europe – 14th Annual European Conference - Vienna, 16th May 2017

Overview

1. „Industrie 4.0“ vision
2. „Industrie 4.0“ initiative
3. Standardisation 4.0
4. „Industrie 4.0“ operates in 3 dimensions
5. What you should do

The evolution of „Industrie 4.0“ in manufacturing

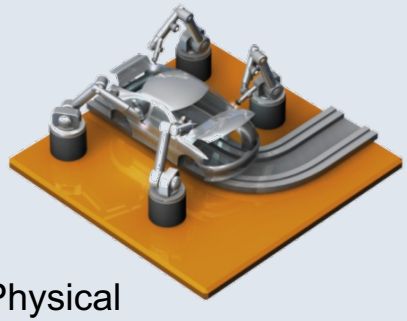
From „Industrie 1.0“ to „Industrie 4.0“



Source: DFKI (2011), Siemens AG

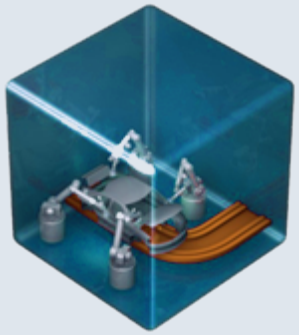
Cyber-physical system (CPS)

Cyber-physical system (CPS)



Physical production facility

+

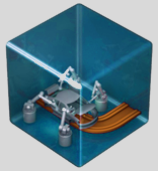


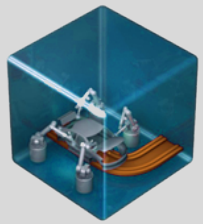
Digital model

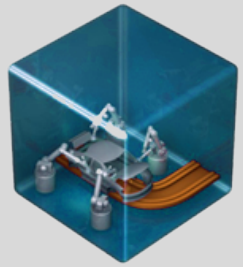
Contains all the information about…

- 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**

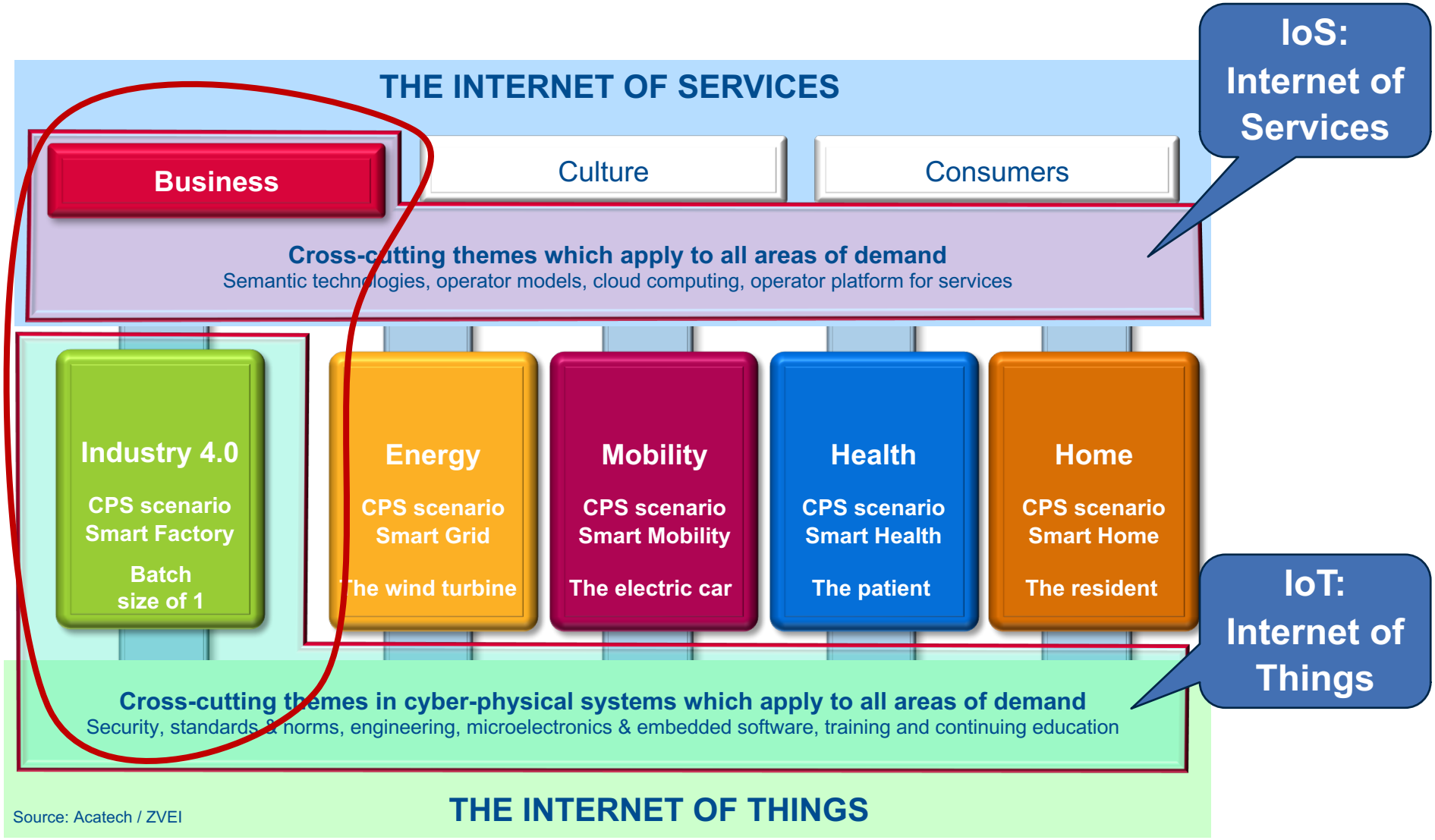
Source: Siemens AG

Overview

1. „Industrie 4.0“ vision
2. **„Industrie 4.0“ initiative**
3. Standardisation 4.0
4. „Industrie 4.0“ operates in 3 dimensions
5. What you should do

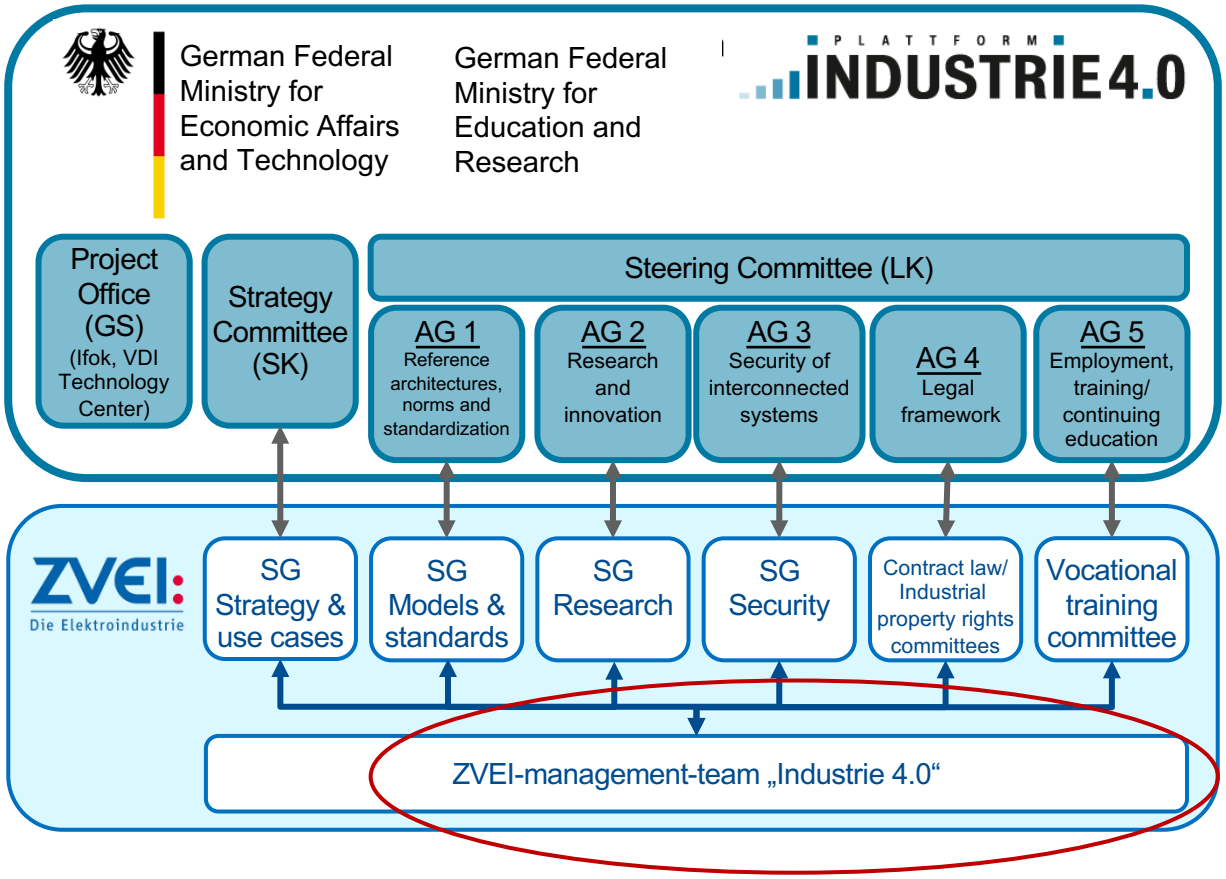
Digitization of the economy: the physical world and the cyber world fuse

ZVEI: Die Elektroindustrie



Source: Acatech / ZVEI

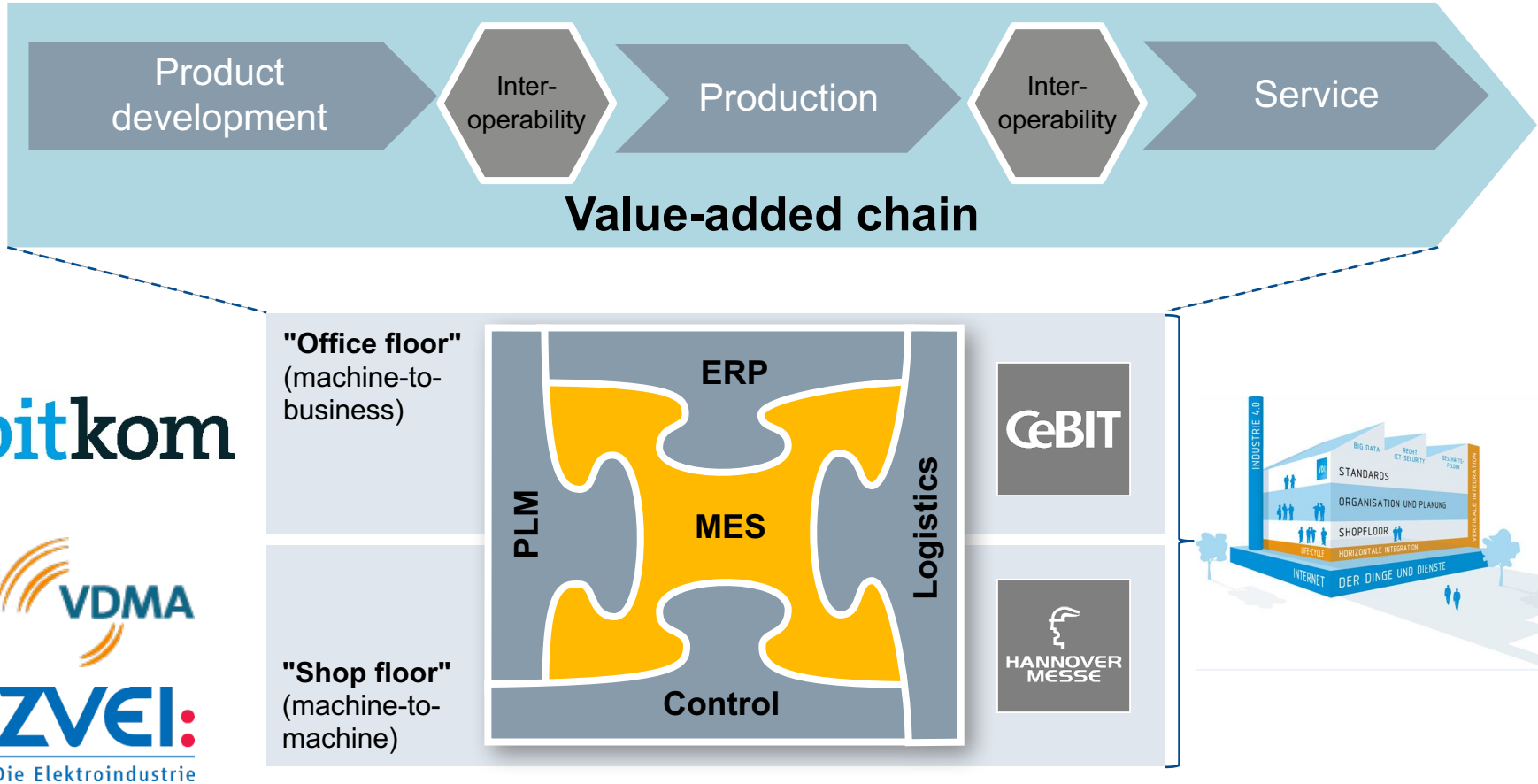
ZVEI-management-team ”Industrie 4.0”
Exchange with the political ”Industrie 4.0 platform”



AG: Arbeitsgruppe – Working Group
SG: Spiegelgremium – Mirror Group

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

ZVEI: Die Elektroindustrie



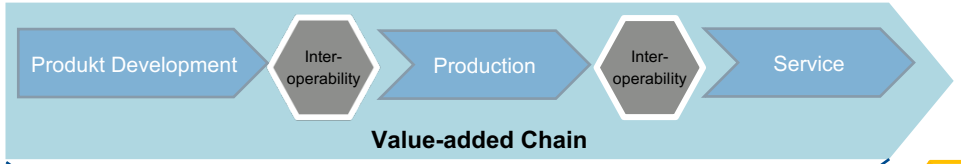
bitkom

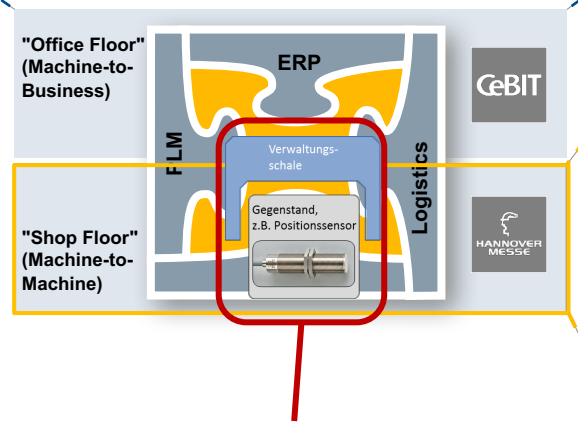
VDMA

ZVEI: Die Elektroindustrie

Source: Siemens AG

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



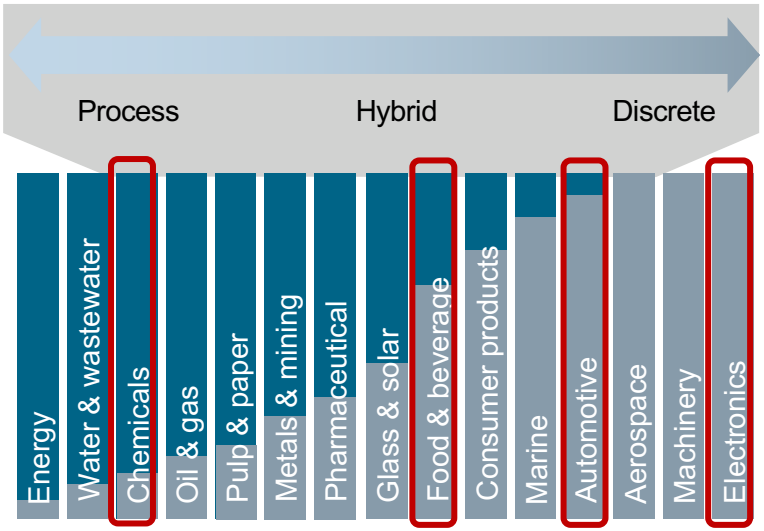


„Industrie 4.0“-Component

= Cyber-physical system (CPS)

At the shop floor level take note of:

1. High level of branch dependencies, detailed in norms & standards
2. Reference architecture dependent on use case

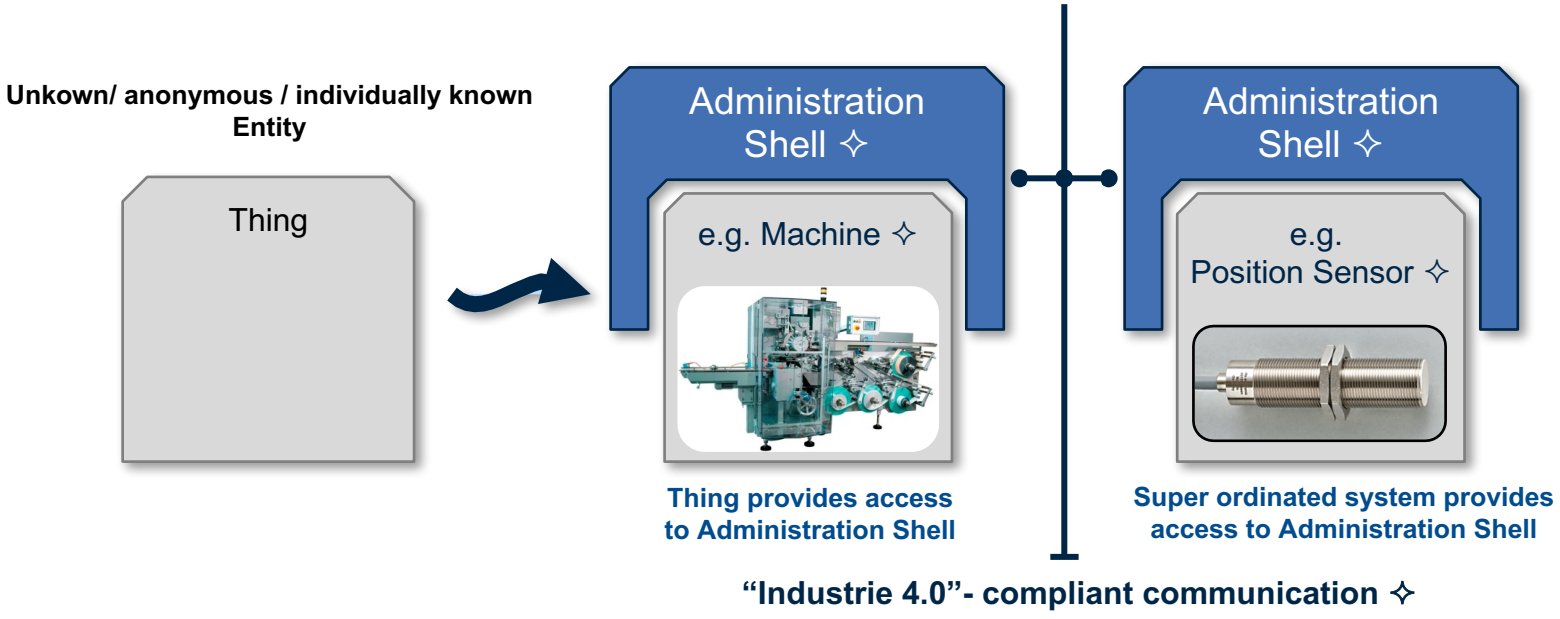


Different Use Cases

Source: Siemens AG

The concept of the “Industrie 4.0”-Component verified in real use cases

Important machine parts become “Industrie 4.0”- Components



✧ = Interfaces/ data formats I4.0-compliant designed

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

„Industrie 4.0“-Component

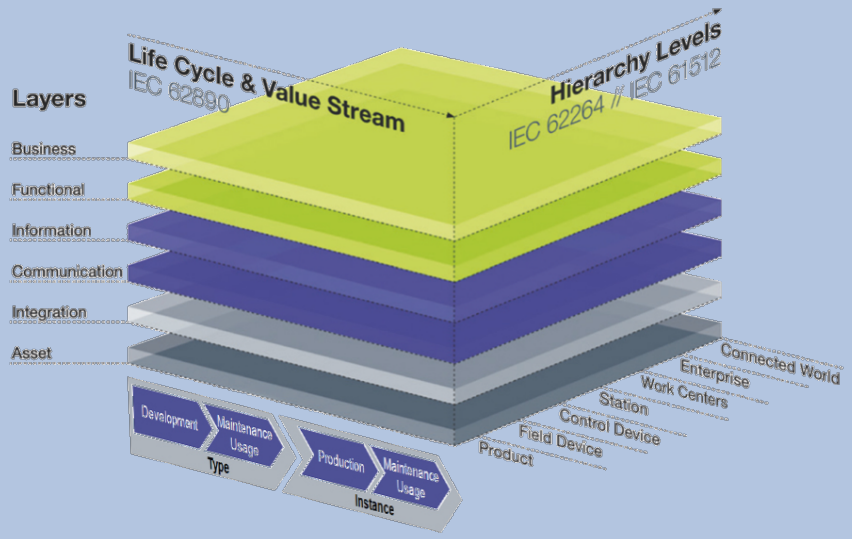
Verwaltungs-
schale ✧

z.B. Maschine ✧

„Industrie 4.0“- compatible
Communication ✧

RAMI 4.0

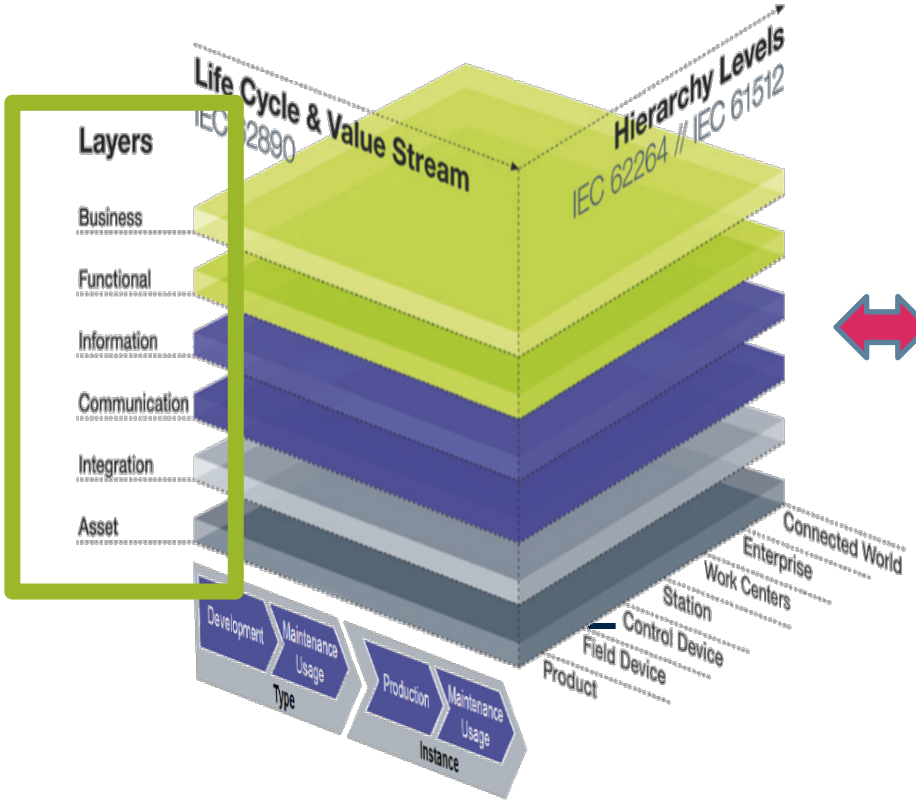
Reference-Architecture-Model „Industrie 4.0“



Industrie 4.0 Technological Concepts

Reference Architecture Model Industrie 4.0 (RAMI 4.0)

Industrie 4.0 Component ex: Sensors



Industrie 4.0 Component ex: System

RAMI 4.0 to enable connectivity between Industrie 4.0 Components

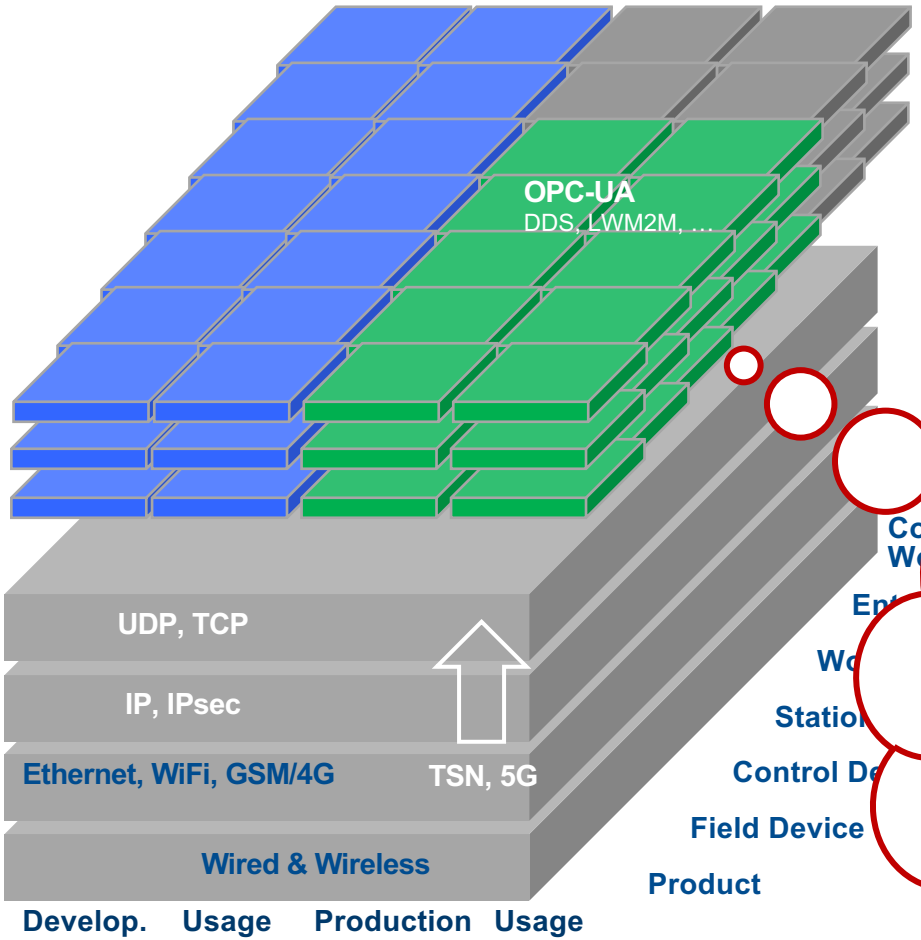
Communication Layer
Possible standards

ZVEI: Die Elektroindustrie

OSI Layers

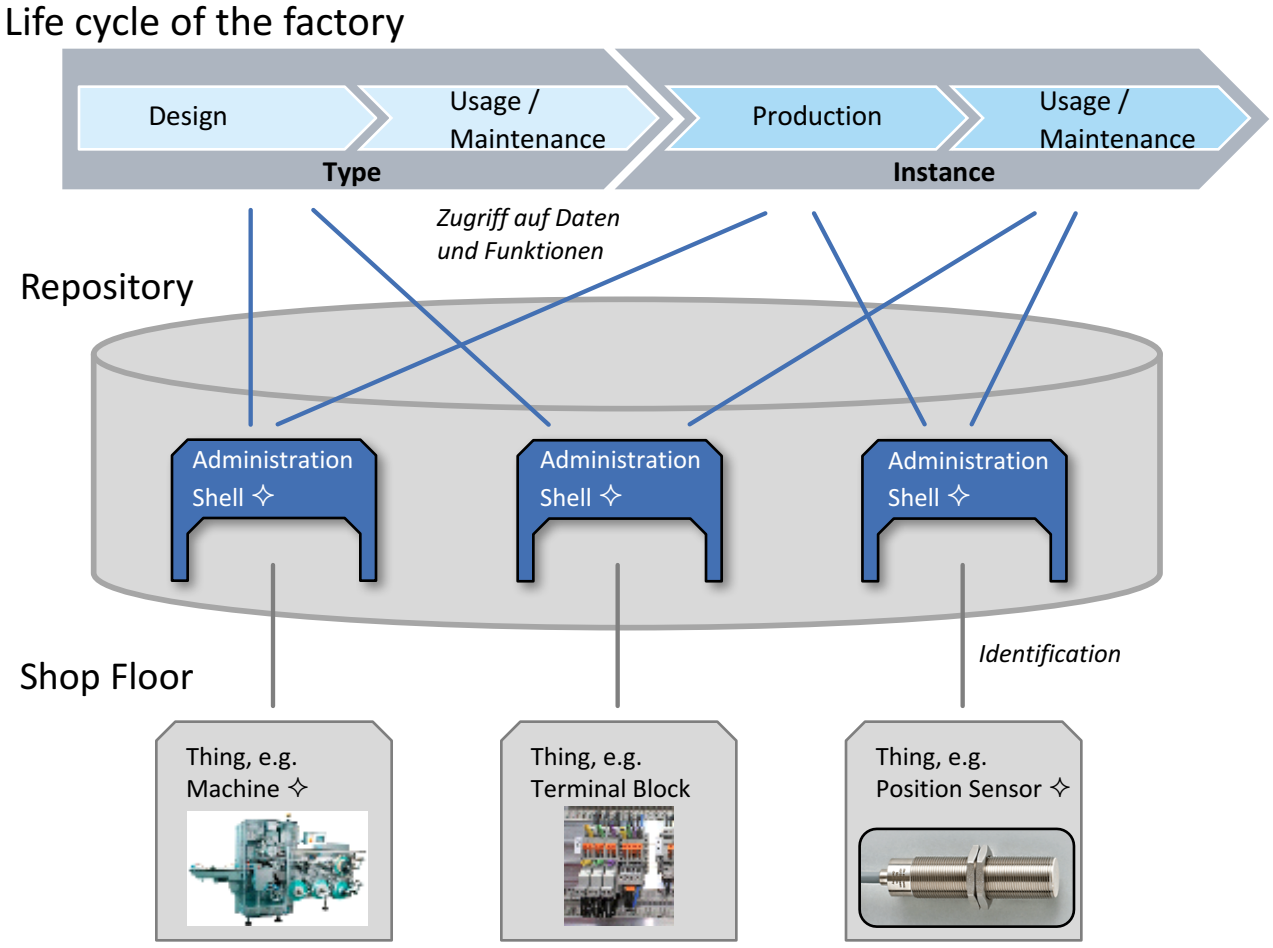
7 Application
6 Presentation
5 Session

4 Transport
3 Network
2 Data Link
1 Physical



openAAS project: Implementation of the administration shell using OPC UA

Distribution along the life cycle: Administration Shells (data + functions) can be hosted centralized



Tool support during life cycle

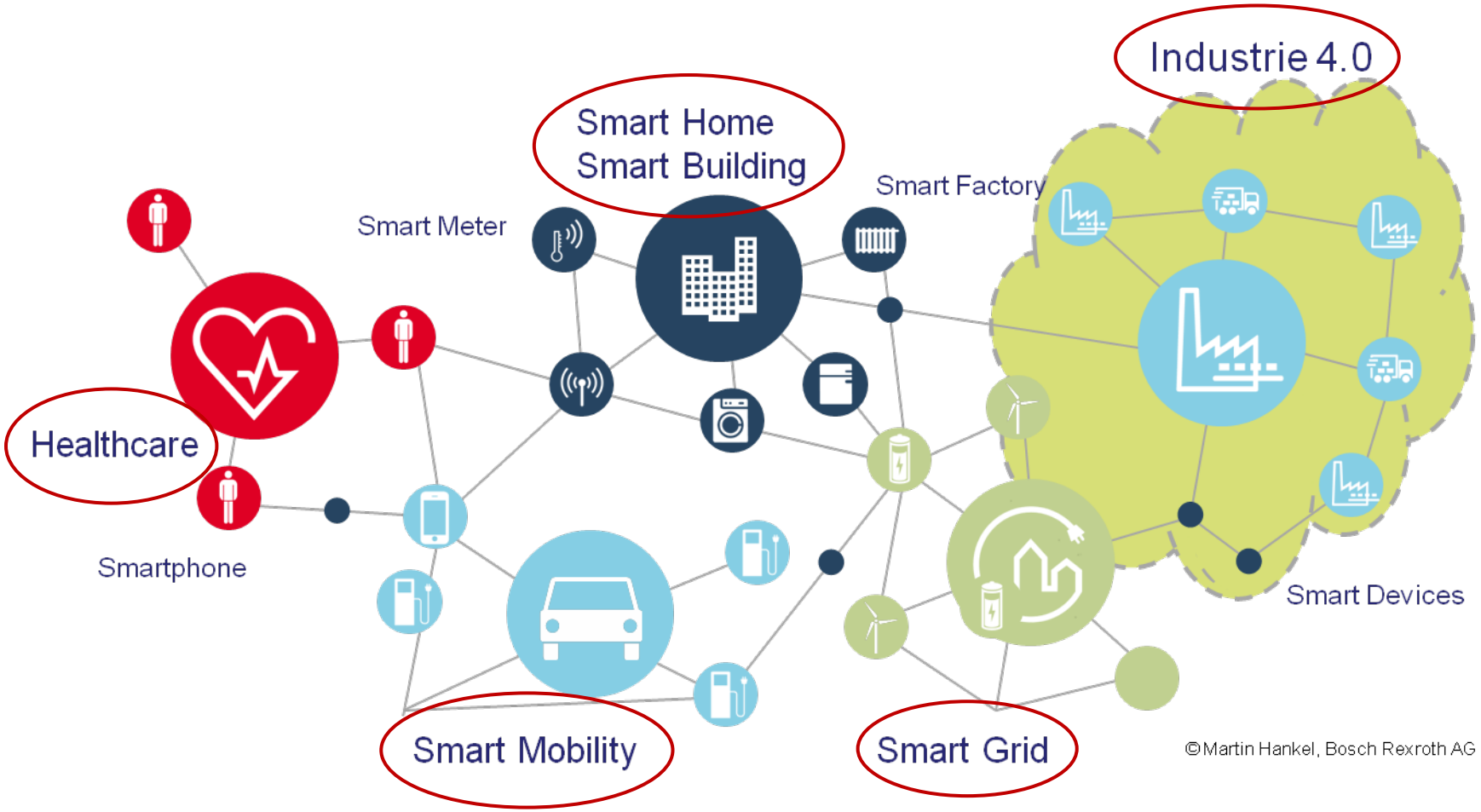
IT-server landscape

Components from various sources

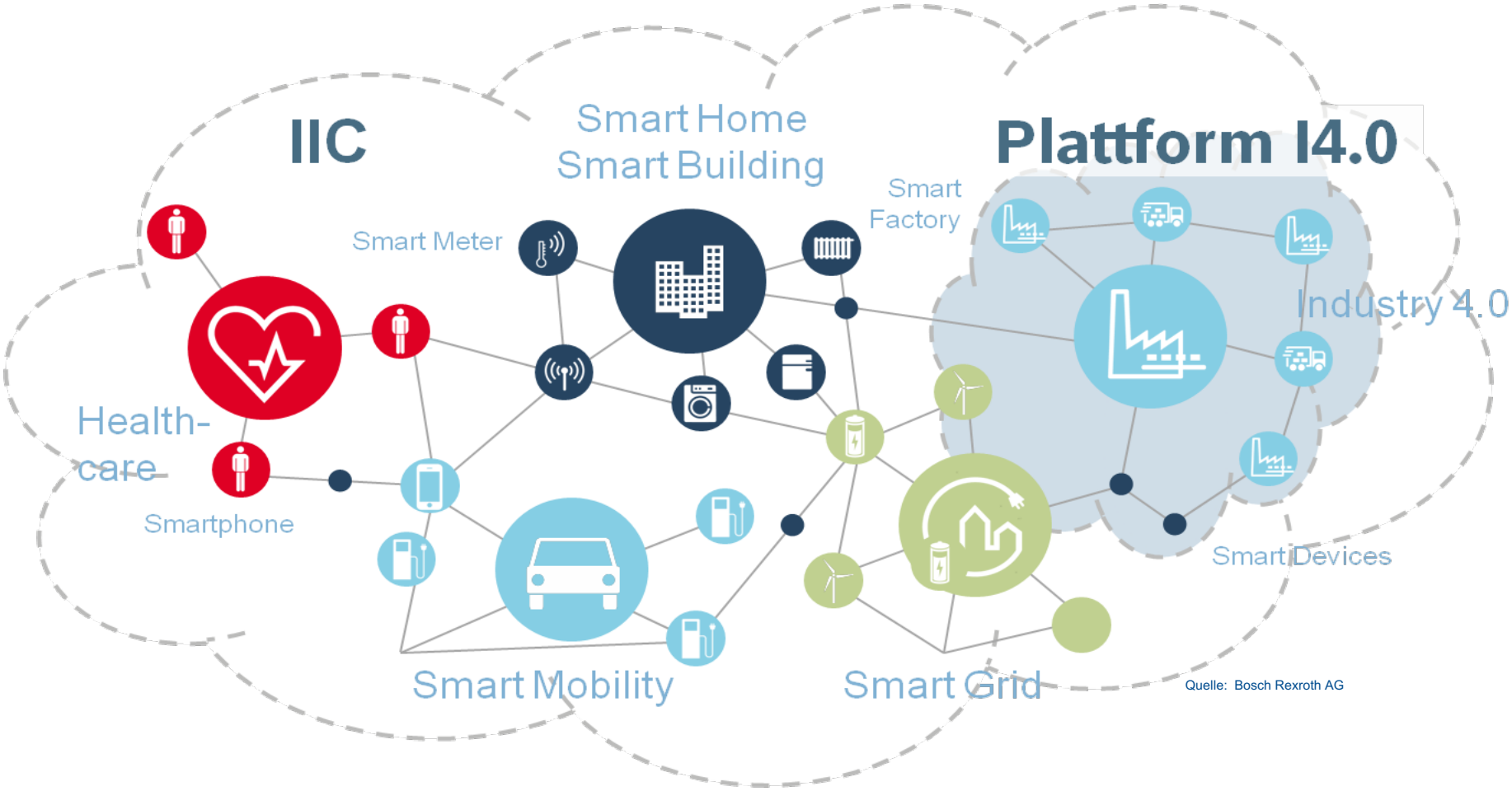
Overview

1. „Industrie 4.0“ vision
2. „Industrie 4.0“ initiative
3. **Standardisation 4.0**
4. „Industrie 4.0“ operates in 3 dimensions
5. What you should do

"Industrie 4.0" must fit in with the other application scenarios in the "Internet of Things and Services"

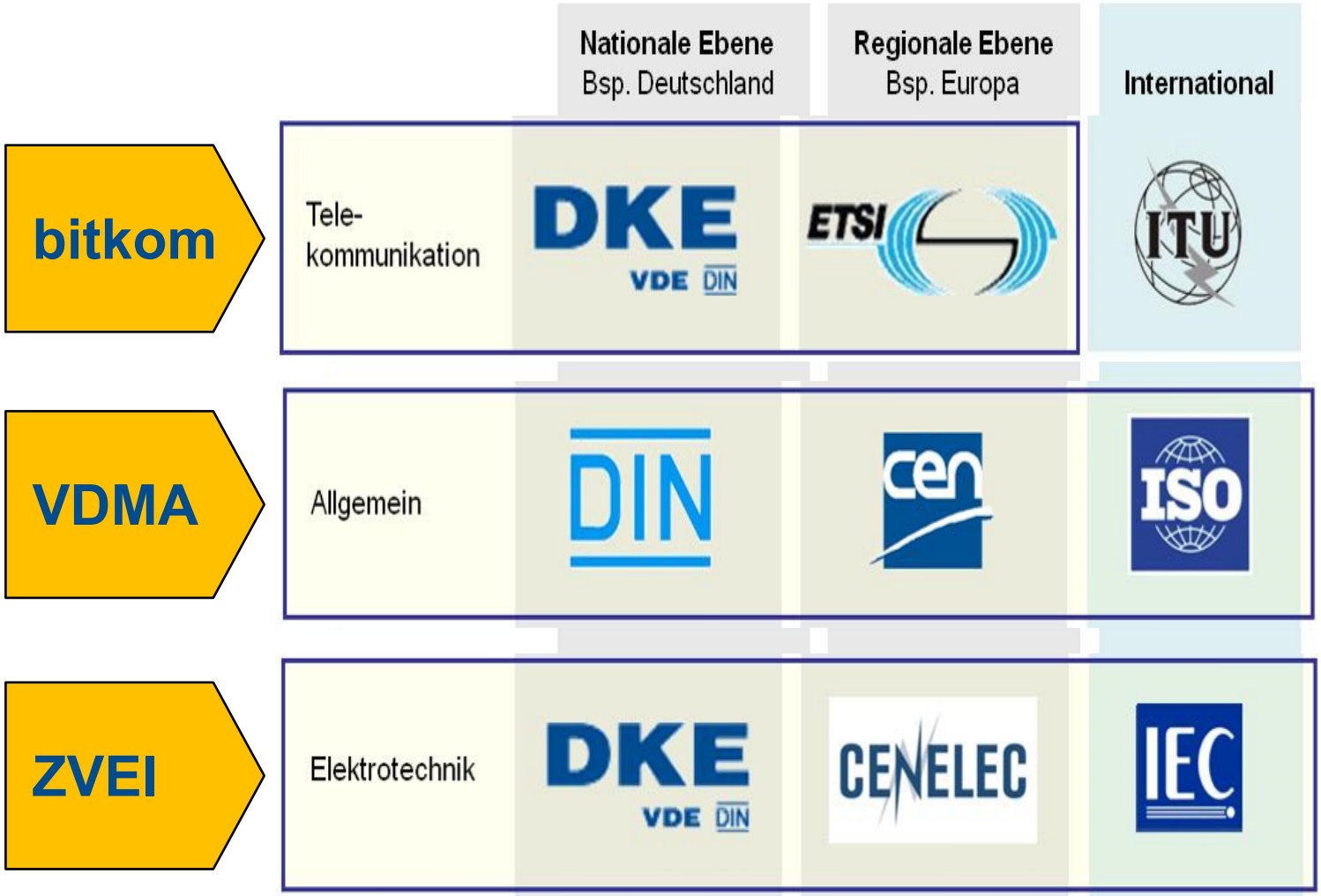


Close Cooperation between „Plattform I4.0“ and „Industrial Internet Consortium (IIC)“ has been started



Quelle: Bosch Rexroth AG

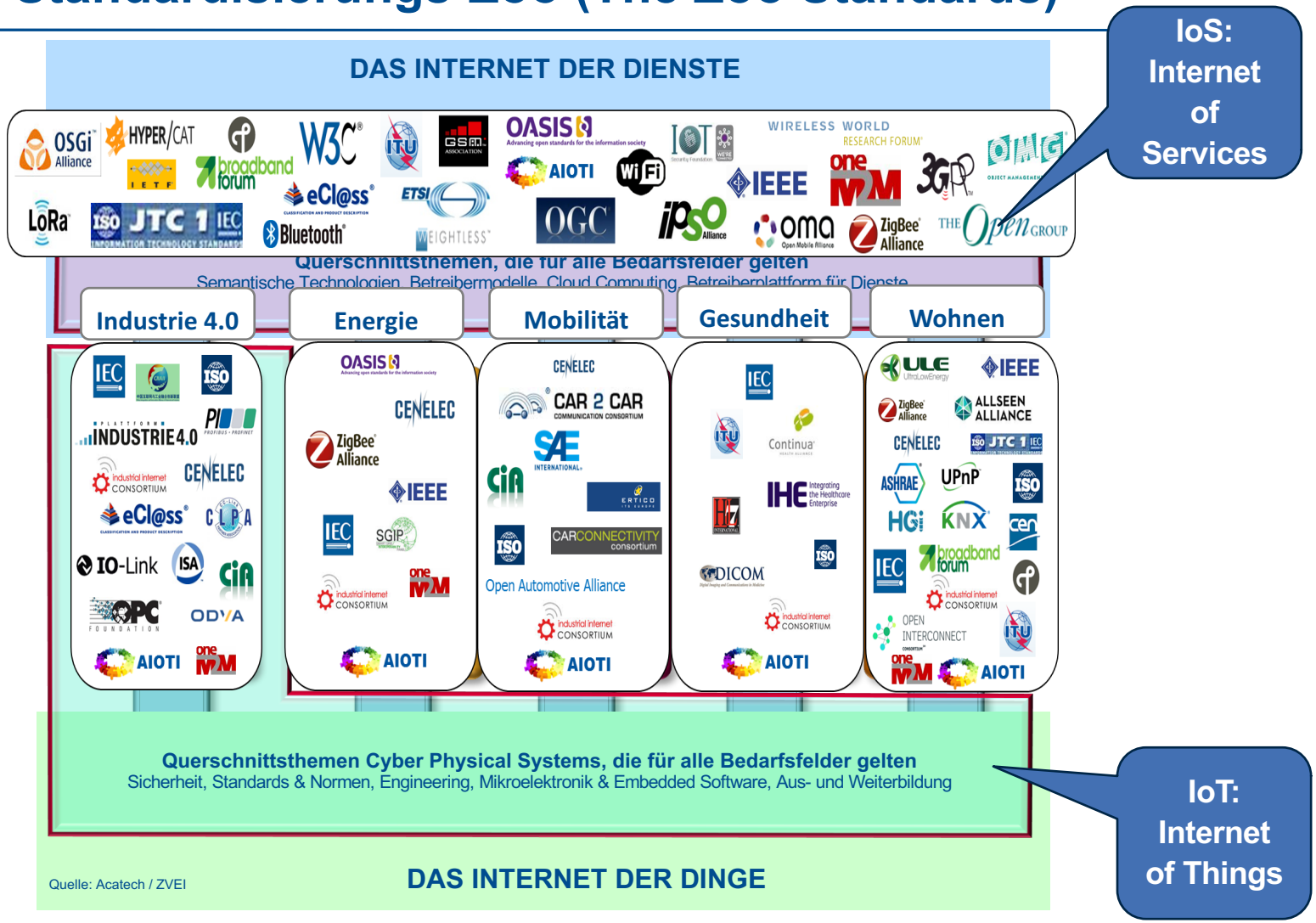
Normungslandschaft (Standardization Bodies)



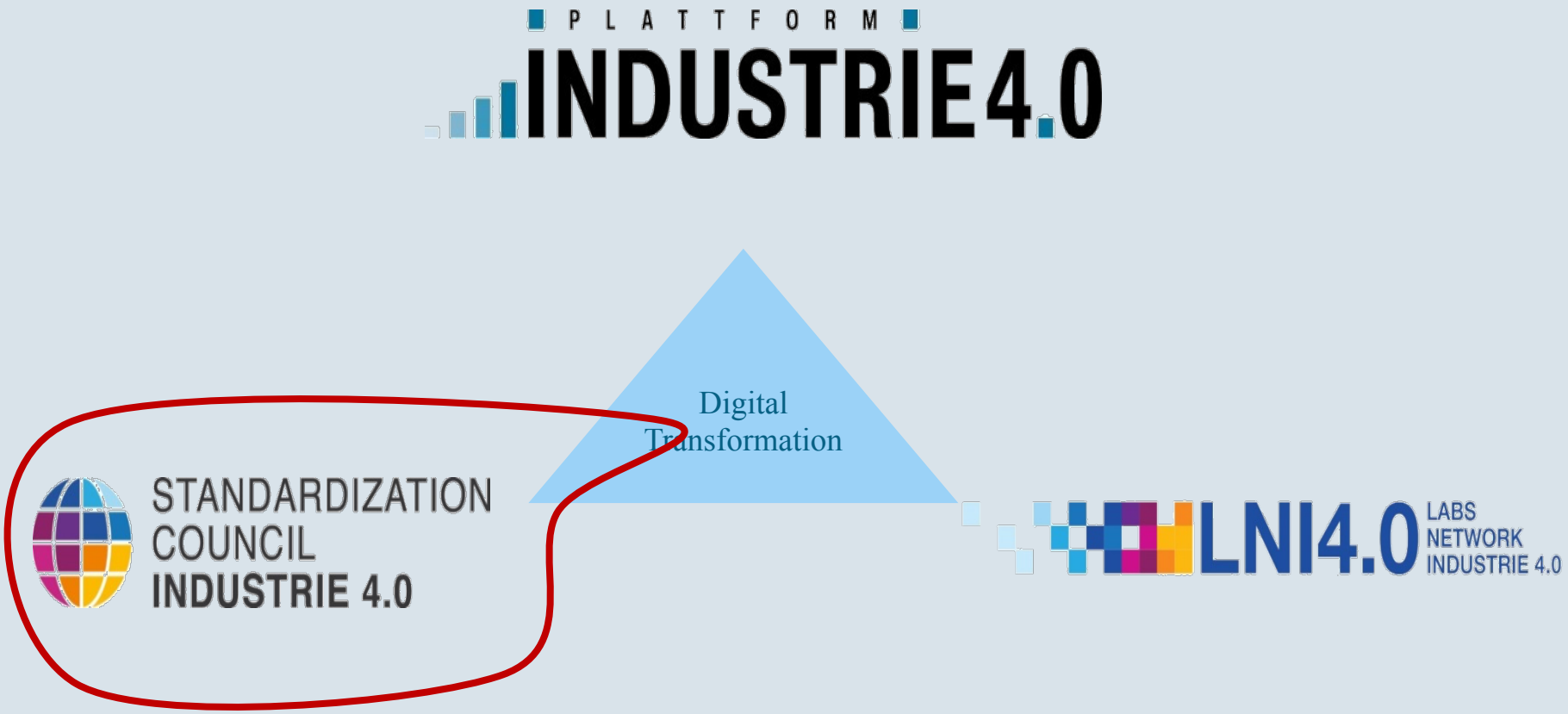
Quelle: DIN und eigene Grafik

Digitalisierung der Wirtschaft (Digitalization of the Economy): Der Standardisierungs-Zoo (The Zoo Standards)

ZVEI: Die Elektroindustrie



Plattform I4.0 is extended by SCI4.0 and LNI4.0



Strong partners form a broad basis.

”SCI4.0” - the initiators

STANDARDIZATION COUNCIL INDUSTRIE 4.0

bitkom

ZVEI: Die Elektroindustrie

VDMA

DKE VDE DIN

DIN

PLATTFORM INDUSTRIE4.0

Standardization Strategy

PLATTFORM INDUSTRIE 4.0 AG1

Standardization Process-Support

Coordination Recommendations Support

STANDARDIZATION COUNCIL INDUSTRIE 4.0

Office DKE

Advisory Board

Steering Committee

Expert Panel

Roadmap

Use Cases

Test

Validation

LNI4.0

Standardization Implementation

Proposals for international Standards

DIN, DKE

CEN/CENELEC, ETSI

IEC, ISO

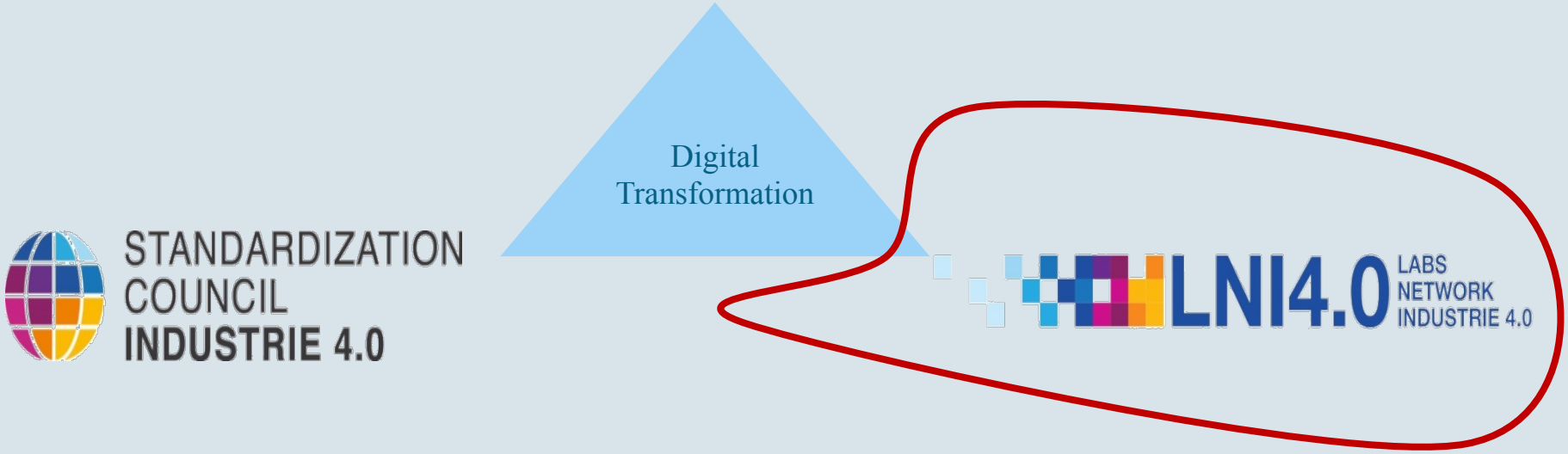
Int. standardization organizations (with mandate)

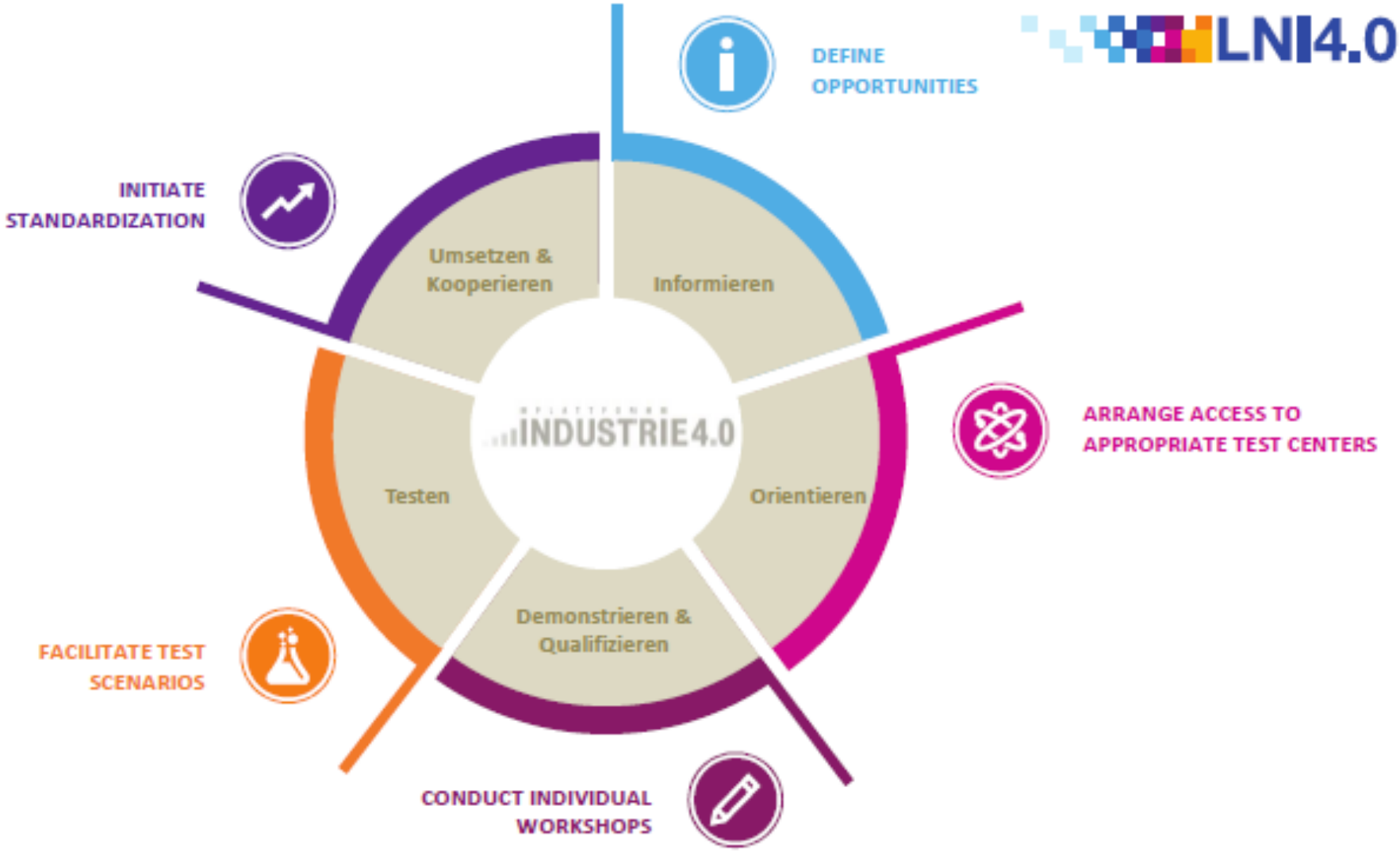
de facto standard , open source (consortial-consensus)

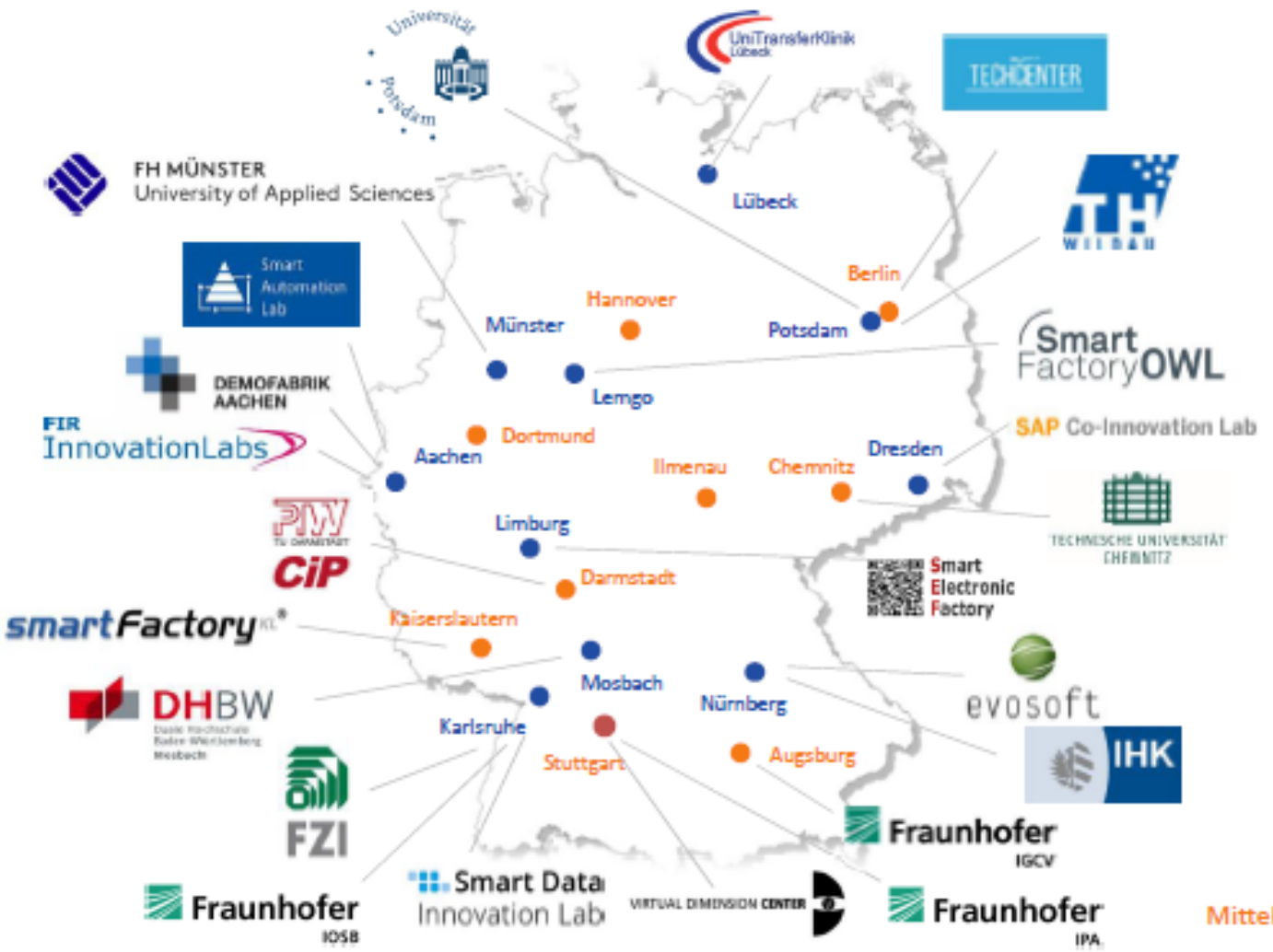
International standard (full consensus)

Plattform I4.0 is extended by SCI4.0 and LNI4.0

PLATTFORM INDUSTRIE 4.0




LNI4.0
DEFINE
OPPORTUNITIES
INITIATE
STANDARDIZATION
ARRANGE ACCESS TO
APPROPRIATE TEST CENTERS
FACILITATE TEST
SCENARIOS
CONDUCT INDIVIDUAL
WORKSHOPS
Umsetzen &
Kooperieren
Informieren
Testen
Orientieren
Demonstrieren &
Qualifizieren
PLATTFORM
INDUSTRIE4.0



- Cooperating with 26 test labs
- High availability through increasing numbers
- Regional distribution in Germany
- Local contacts
- Broad technology mix

Mittelstand-Digital

Mittelstand 4.0 – Kompetenzzentren

„top down“ identification

Consolidation

PLATTFORM INDUSTRIE4.0

Strategic coordination

STANDARDIZATION COUNCIL INDUSTRIE 4.0

Standardization bodies

Industrie 4.0 Standards

LNI4.0

Validation of test results

SME companies and test centers

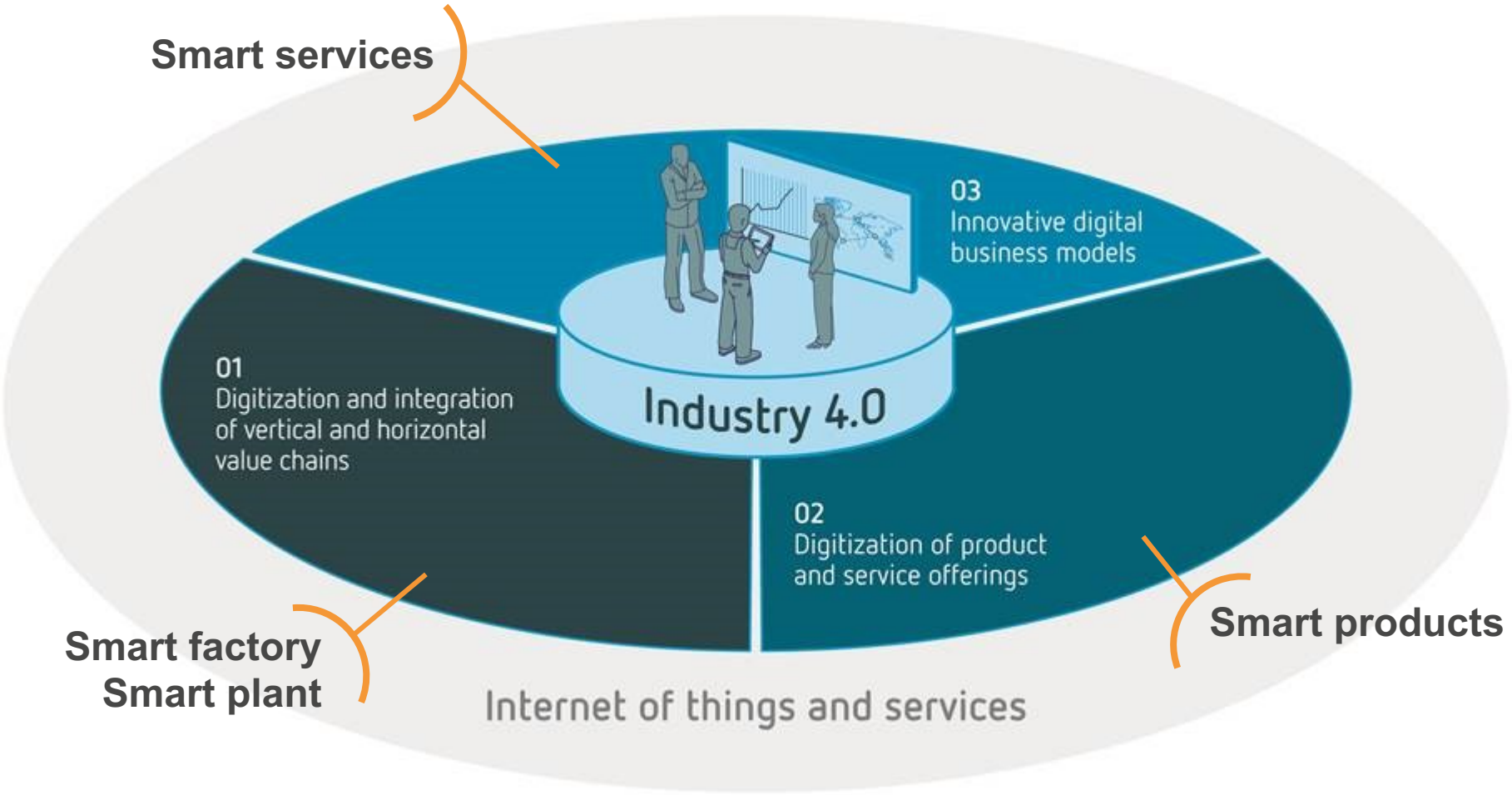
„bottom up“ requests

Standardization requirements and coordination

Overview

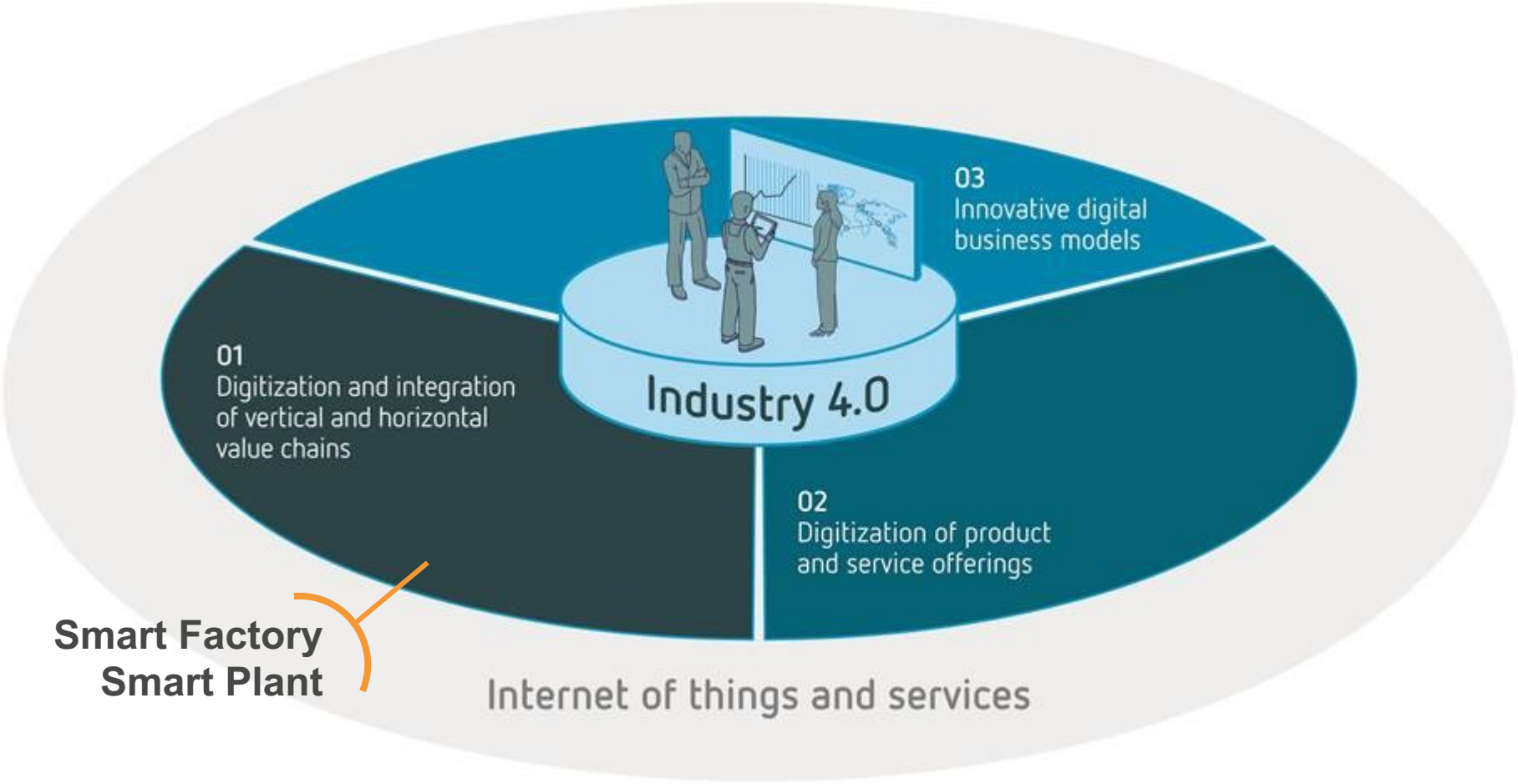
1. „Industrie 4.0“ vision
2. „Industrie 4.0“ initiative
3. Standardisation 4.0
4. **„Industrie 4.0“ operates in 3 dimensions**
5. What you should do

„Industrie 4.0“ impacts on every company in 3 dimensions



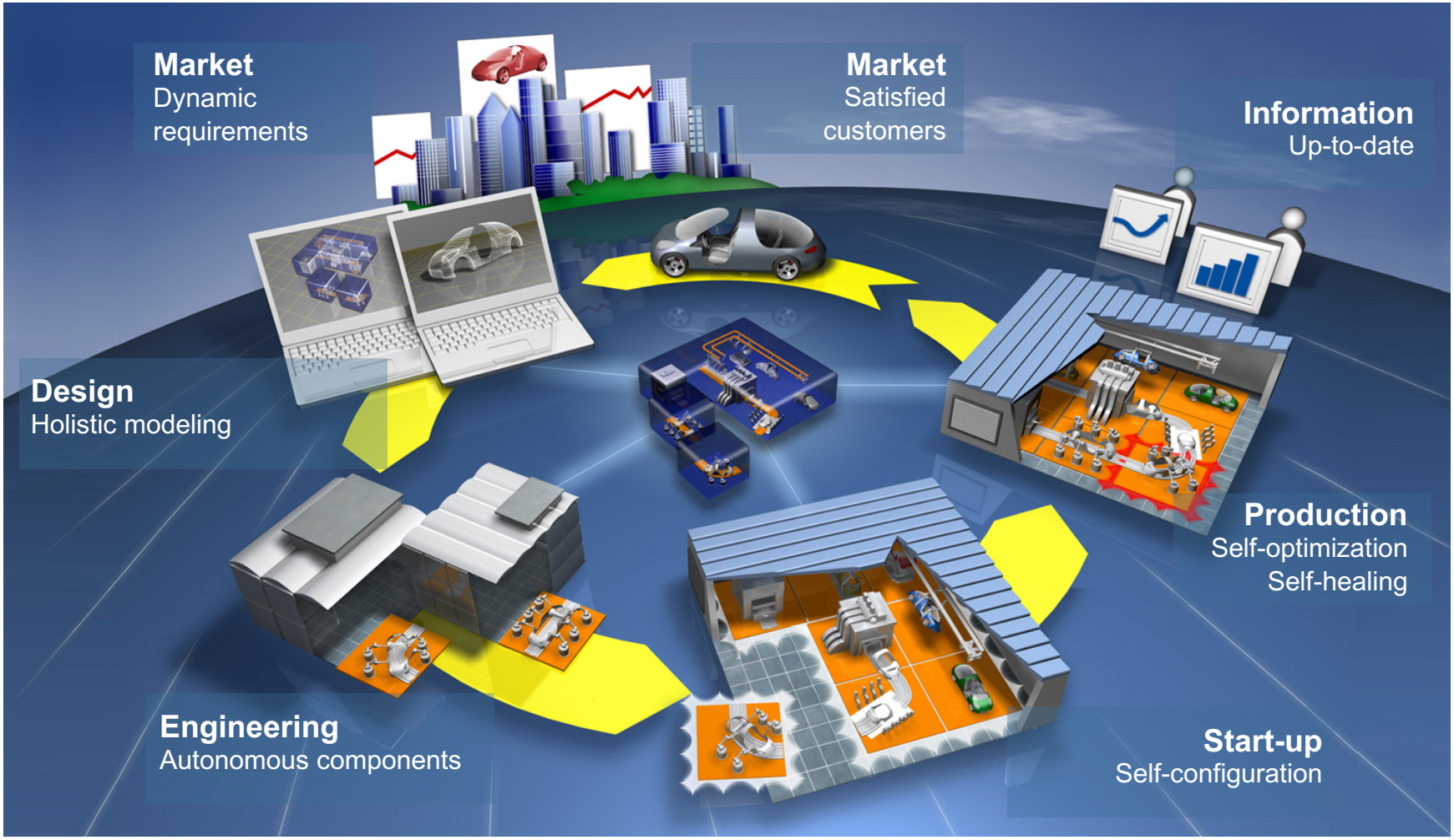
Source: ZVEI following PwC

„Industrie 4.0“ vision of „Smart Factory“ or „Smart Plant“



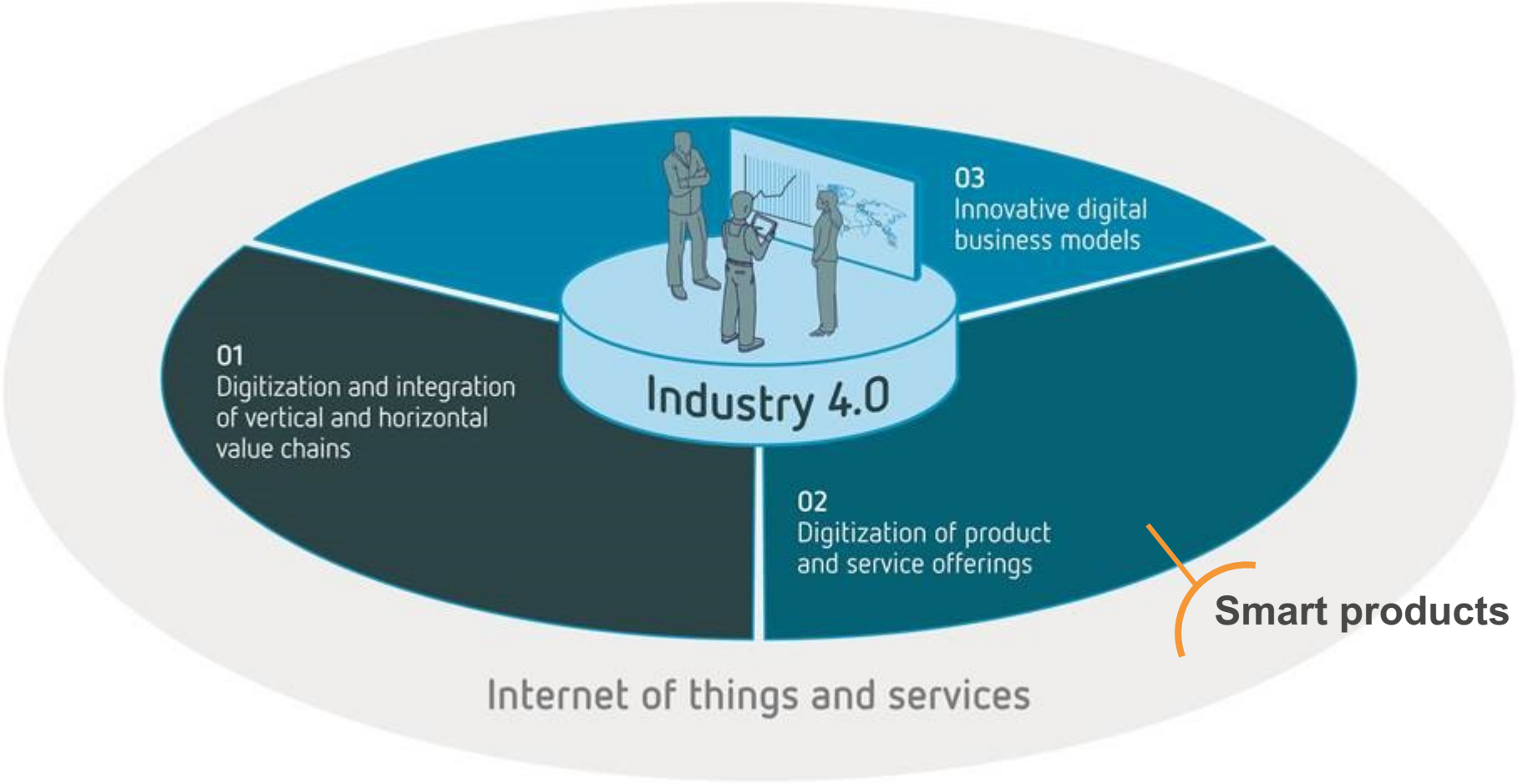
Source: ZVEI following PwC

„Industrie 4.0“ vision of a „Smart Factory“



Source: Siemens AG

„Industrie 4.0“ impacts on every company in 3 dimensions

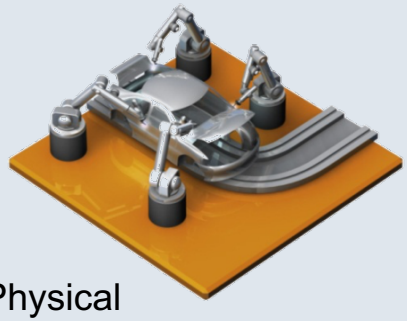


Source: ZVEI following PwC

A Cyber-physical system (CPS) is a „Digital Twin“ and is the conceptual base to develop „Smart Products“

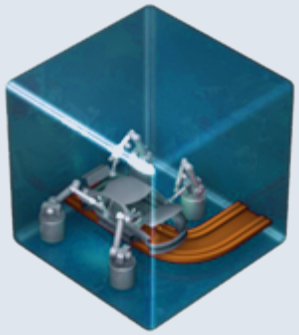
ZVEI: Die Elektroindustrie

Cyber-physical system (CPS)



Physical production facility

+

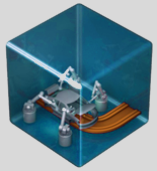


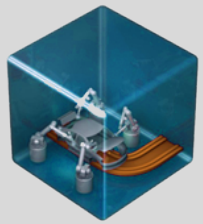
Digital model

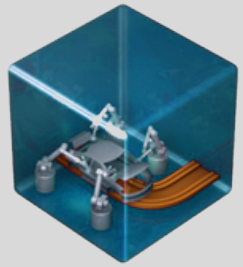
Contains all the information about…

- 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



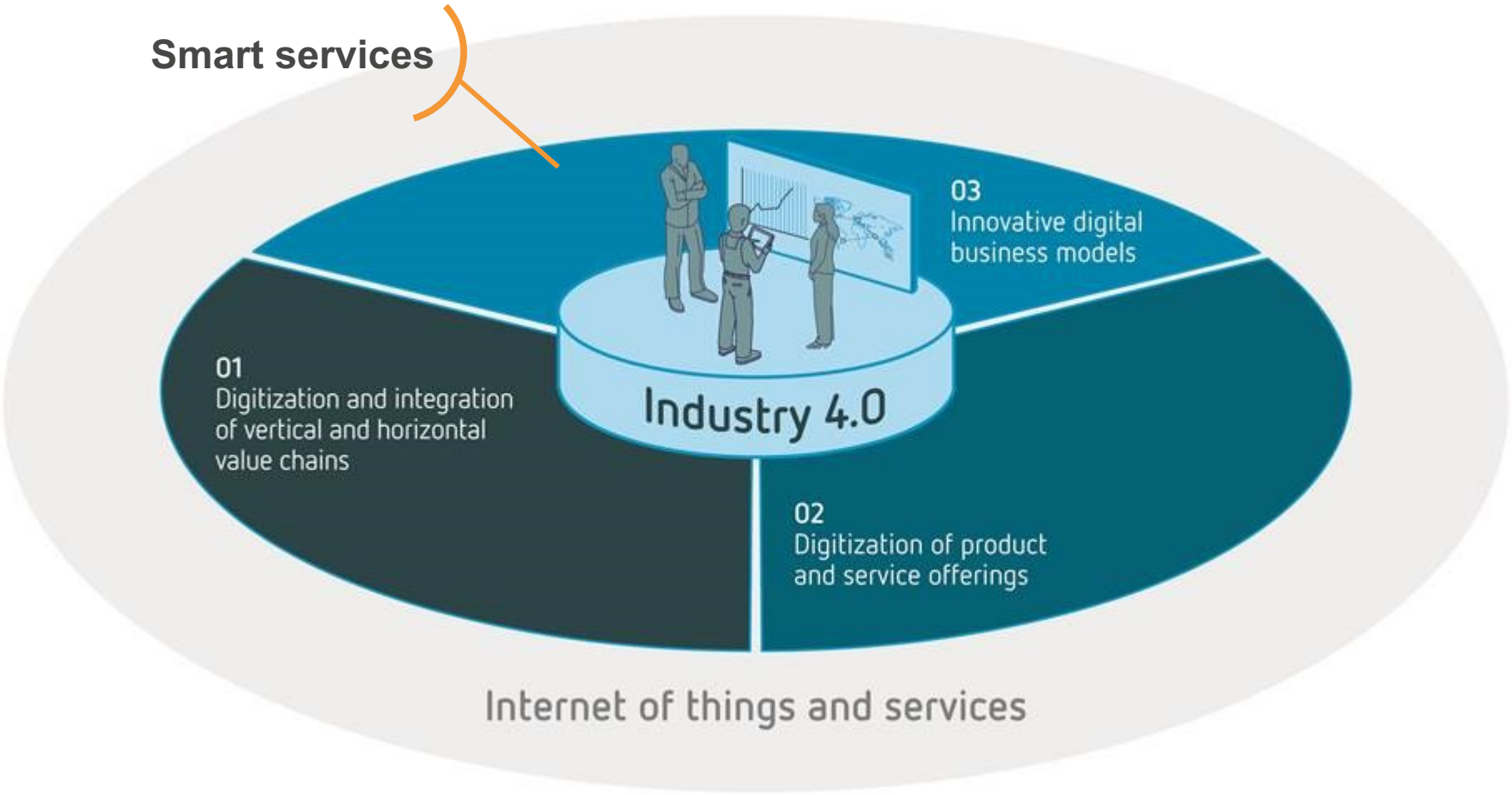




Product design → **Production planning** → **Production engineering** → **Production execution** → **Services**

Source: Siemens AG

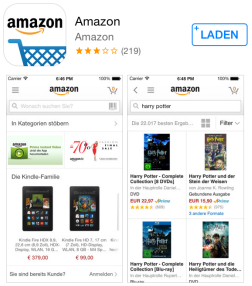
„Industrie 4.0“ impacts on every company in 3 dimensions



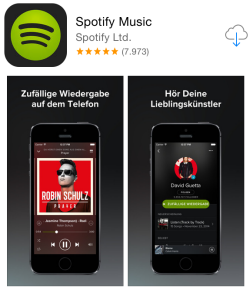
Source: ZVEI following PwC

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

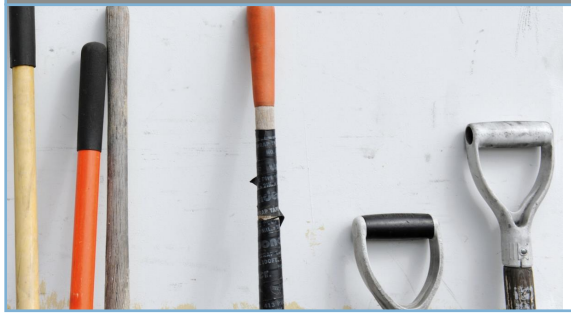
From bookstores to eBooks

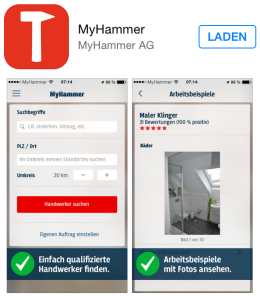


From record stores to streaming

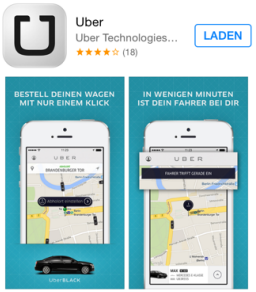


From Yellow Pages to marketplaces



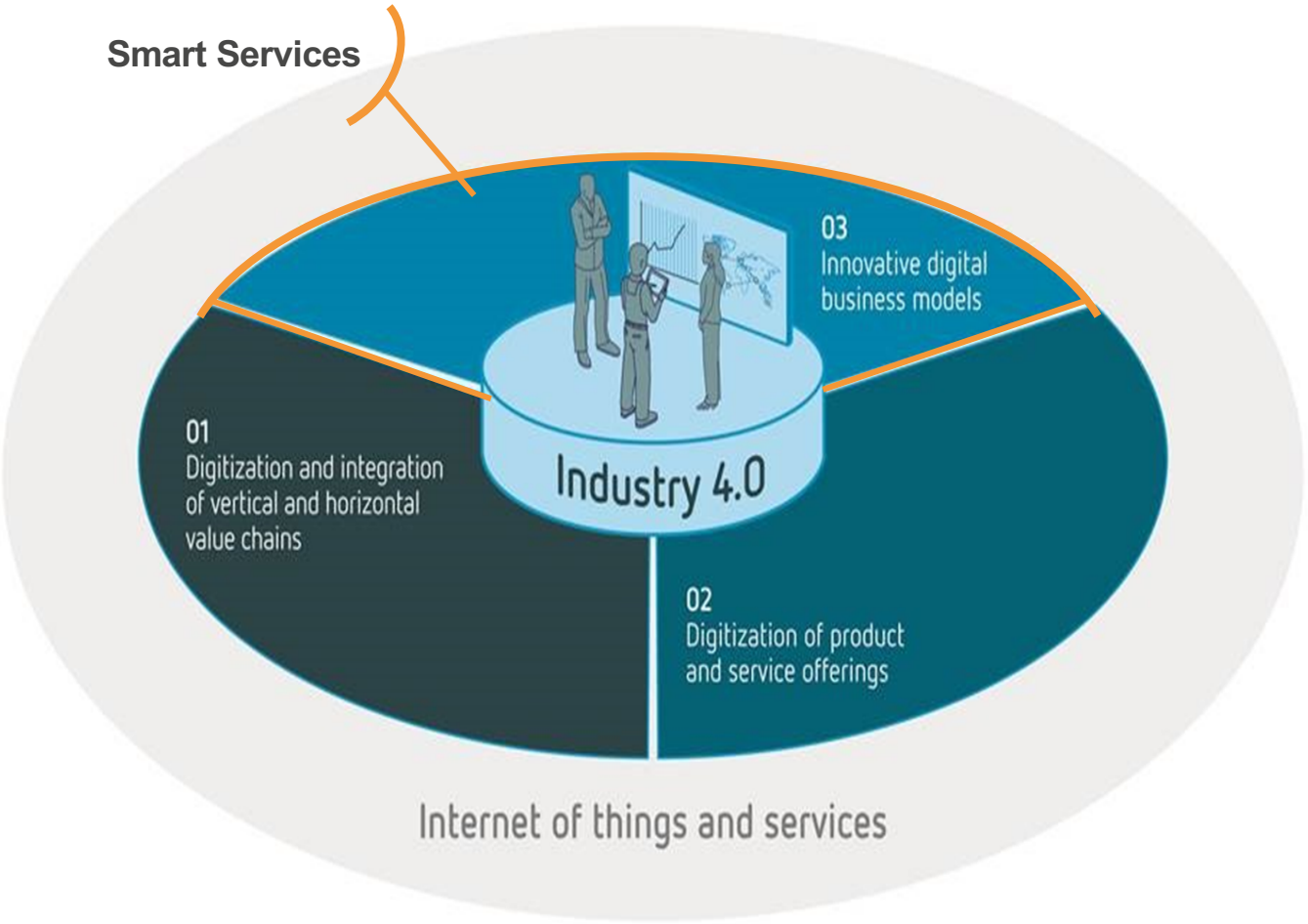


From taxis to ride-sharing



Source: Siemens

Smart services: New business models are enabled by standardized Administration Shells



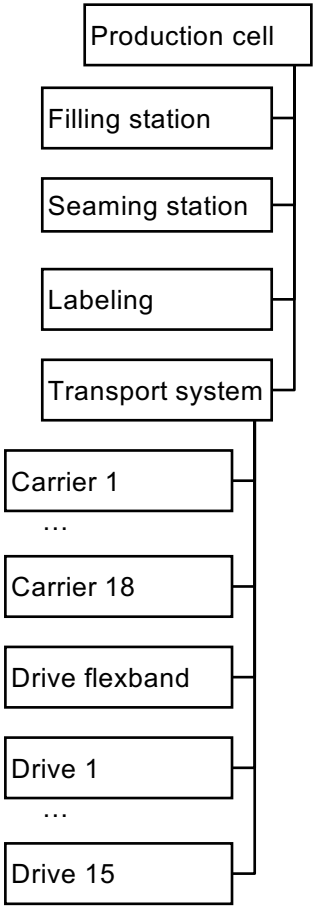
Quelle: ZVEI nach PwC

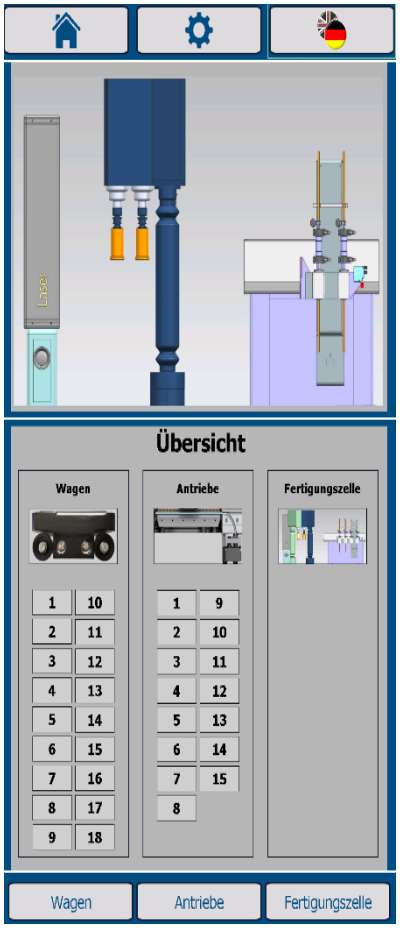
Industrie 4.0-demonstrator: Production cell with transportation system

ZVEI: Die Elektroindustrie

Real production cell and its components

Structure of the production cell in the digital world

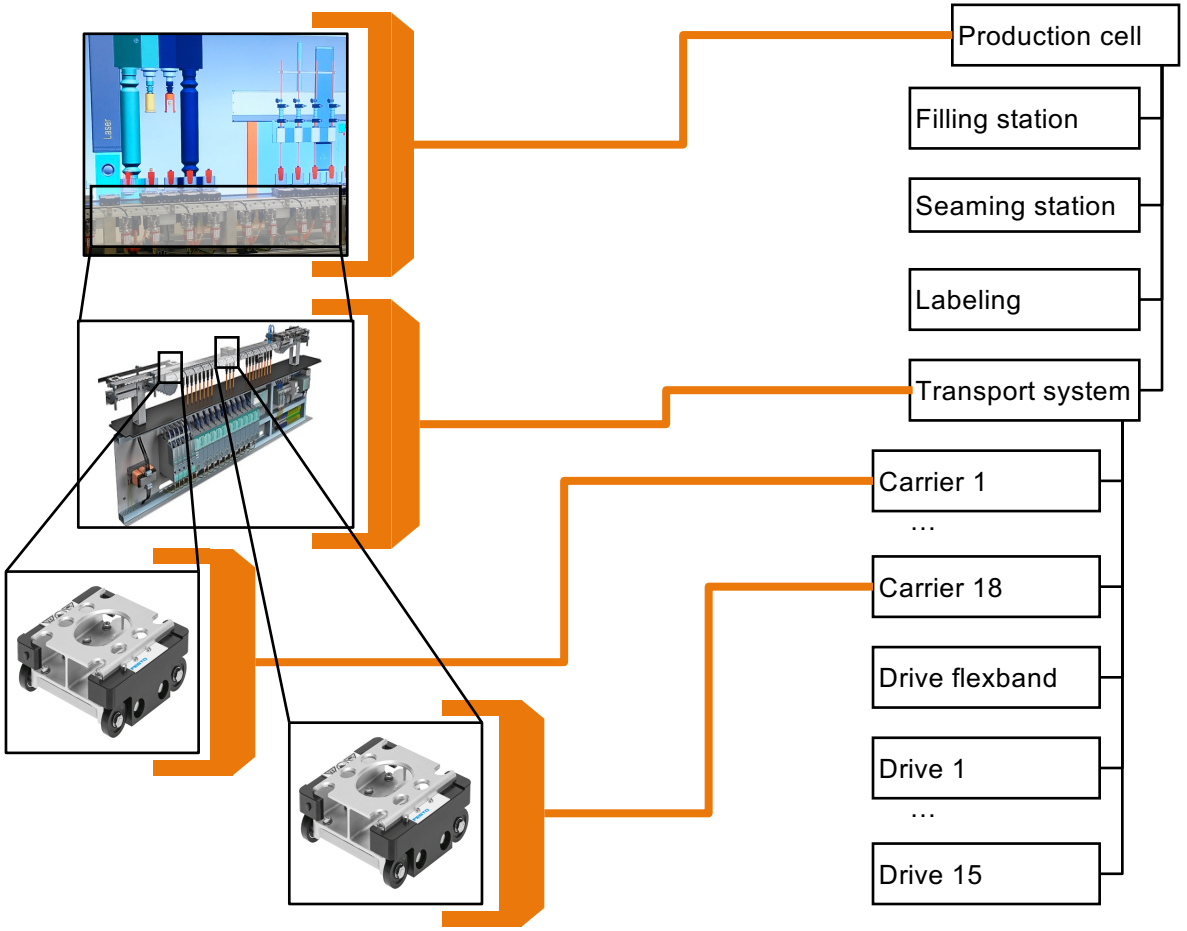




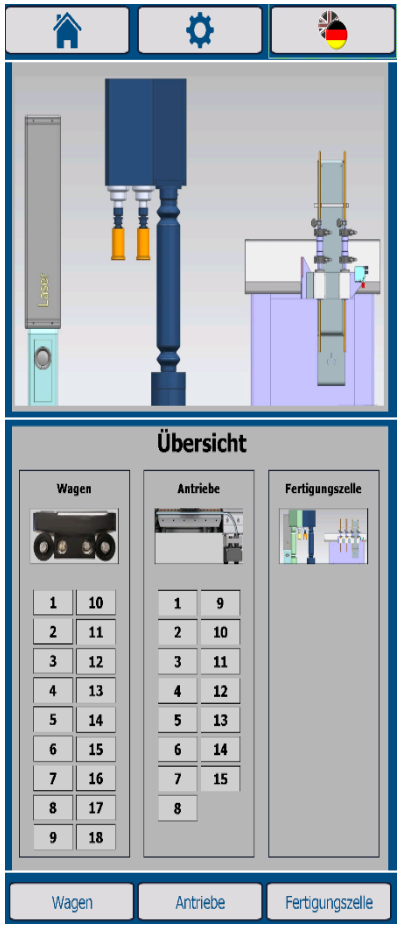
Industrie 4.0-demonstrator: Several I4.0-components are connected via Administration Shells

ZVEI: Die Elektroindustrie

Real production cell and its components



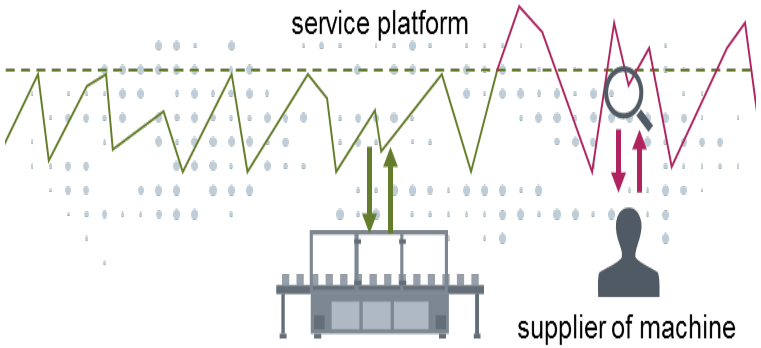
Structure of the production cell in the digital world



Smart services using the example of a transportation system…from the operators‘ view

Operator of transportation system

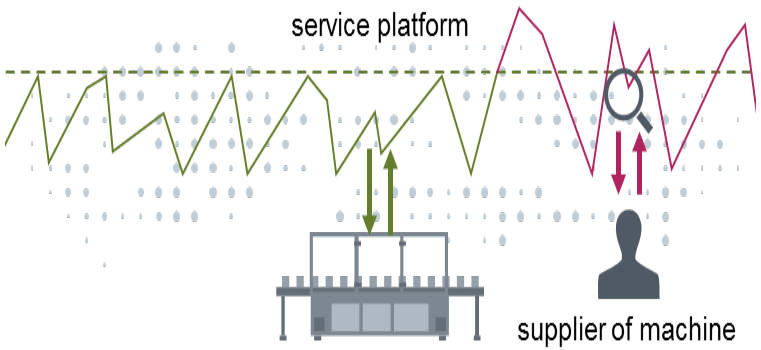
- Increase of efficiency, e.g. by early fault detection, longer warranty periods, etc.



Smart services using the example of a transportation system…from the suppliers‘ view

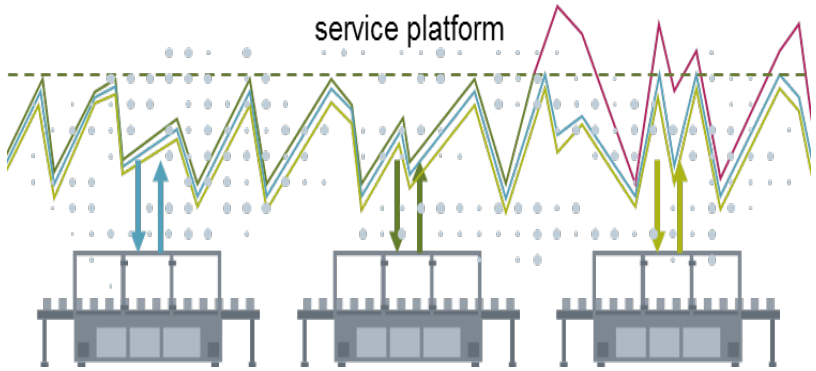
Operator of transportation system

- Increase of efficiency, e.g. by early fault detection, longer warranty periods, etc.



Supplier of transportation system and provider of data-driven services

- New offerings, e.g. condition monitoring services, benchmarking of machines, etc.



Administration Shells of the transportation system

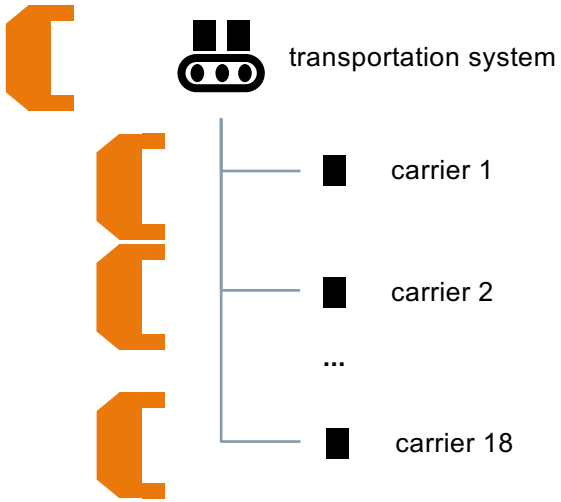
Assets

complex object: asset composed of other assets with own asset administration shells

carrier

Asset Administration Shells

operator of transportation system



Administration Shells of the transportation system are supplemented by the Adminstration Shells of the plug/socket and the sensor

Assets

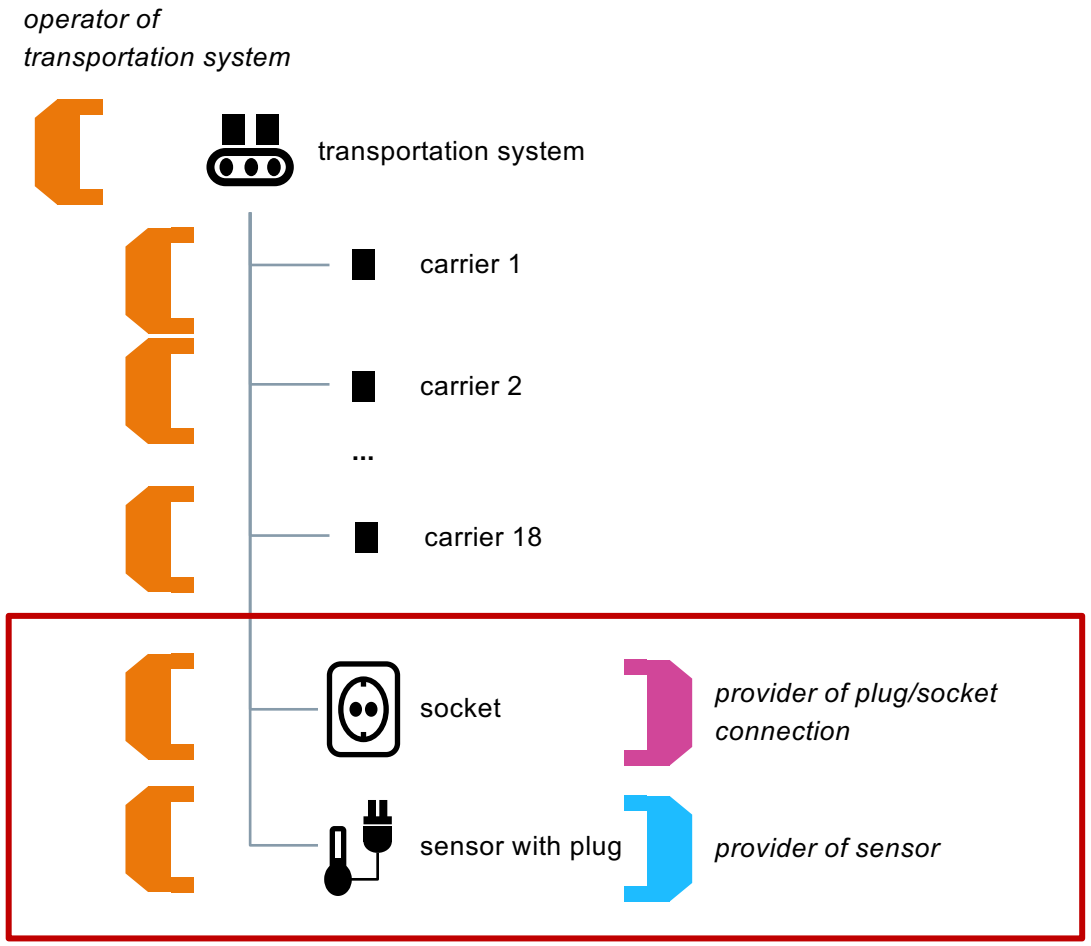
complex object: asset composed of other assets with own asset administration shells

carrier

intelligent object: asset administration shell deployed on asset

passive objects: asset administration shell not deployed on asset

Asset Administration Shells



Additional Administration Shells by the provider of „smart services“ as an „add-on“

Additional smart service offerings für the supplier of components, here plugs/sockets and sensors.

Assets

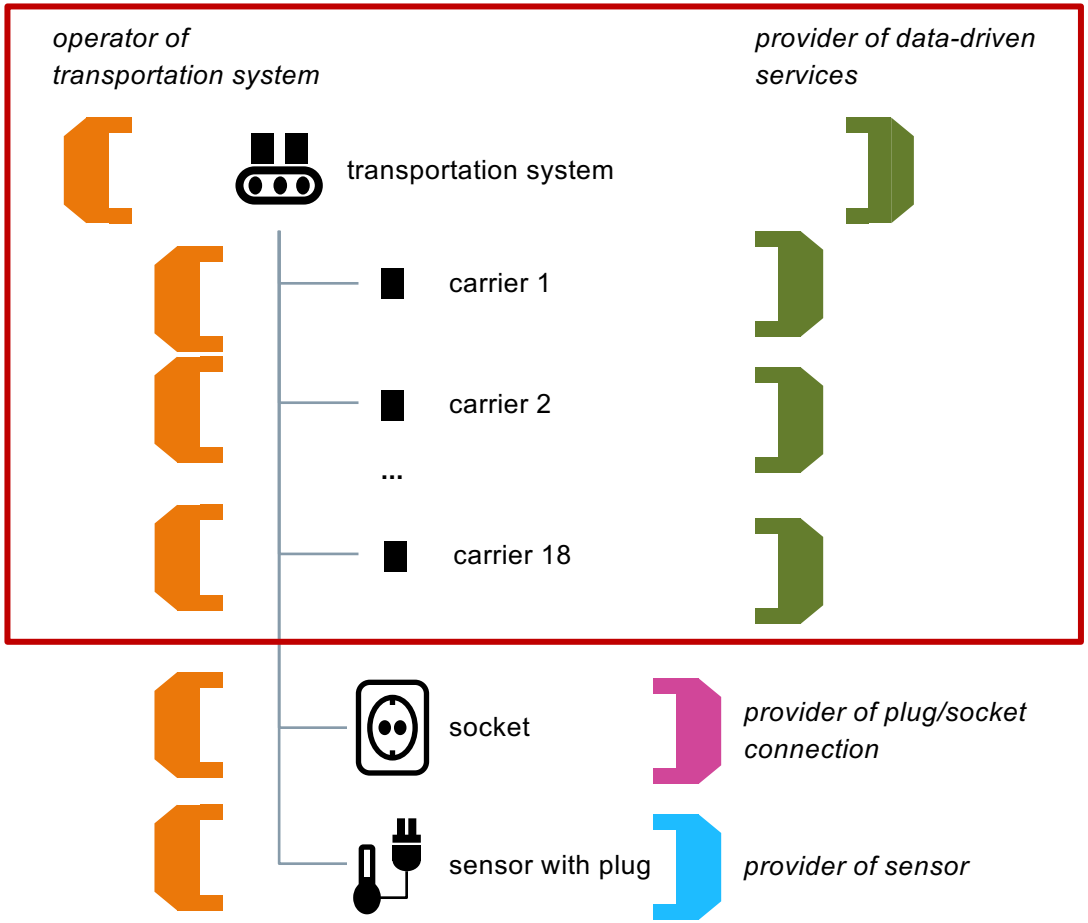
complex object: asset composed of other assets with own asset administration shells

carrier

intelligent object: asset administration shell deployed on asset

passive objects: asset administration shell not deployed on asset

Asset Administration Shells



Industrie 4.0-demonstrator as a proof of concept for the Administration Shell

OpenAAS project

- Open source software
- Asset Administration Shell

Contents

- Exemplary implementation of the Administration Shell using OPC UA
- Open Administration Shell as a starting point for future standardization activities for all parties

Overview

1. „Industrie 4.0“ vision
2. „Industrie 4.0“ initiative
3. Standardisation 4.0
4. „Industrie 4.0“ operates in 3 dimensions
5. **Digitalization around the World and Conclusion**

Digitalization Programs around the World

ZVEI: Die Elektroindustrie

- China: “Smart Automation 2.0” ➔ Industrie 4.0
  - In 2016 “World factory” acquires German Kuka robots to take a leap into Industrie 4.0
- India: “Make it in India”
  - The “software office” to deploy internet corridors across the country
- Japan “IVI” ➔ Industrie 4.0
  - Develop the Industry Value Chain Initiative (IVI) aligned with German Industrie 4.0 architecture
- South Korea : “Creative Economy”
  - To finance start up ecosystem to develop the future South Korean “Engine”
- USA : “Industry Renaissance” ➔ Internet of Things (IoT)
  - Shale gas to change game from well to wheel across process and manufacturing industries
- UK: “Future of Manufacturing“ ➔ ??
  - To re-balance economy between financial economy and real economy
- Germany (2010): “Industry 4.0”
  - To keep world leadership in manufacturing and exporting funded by €20 billion from public
- France (2014): “Usine du Futur” ➔ “Industrie du Futur” (Industrie 3.0) ➔…. Industrie 4.0
  - Robotization program presented in September 2013 moving toward digitalization, thus Industrie 4.0
- Europe Community (2014 – 2017): “Horizon 2020” ➔ “Horizon 2030”
  - To secure Europe global competitiveness with €80 funding. New call for Industrial Dynamics

Bilateral work with other countries

STANDARDIZATION COUNCIL INDUSTRIE 4.0

Source: DKE

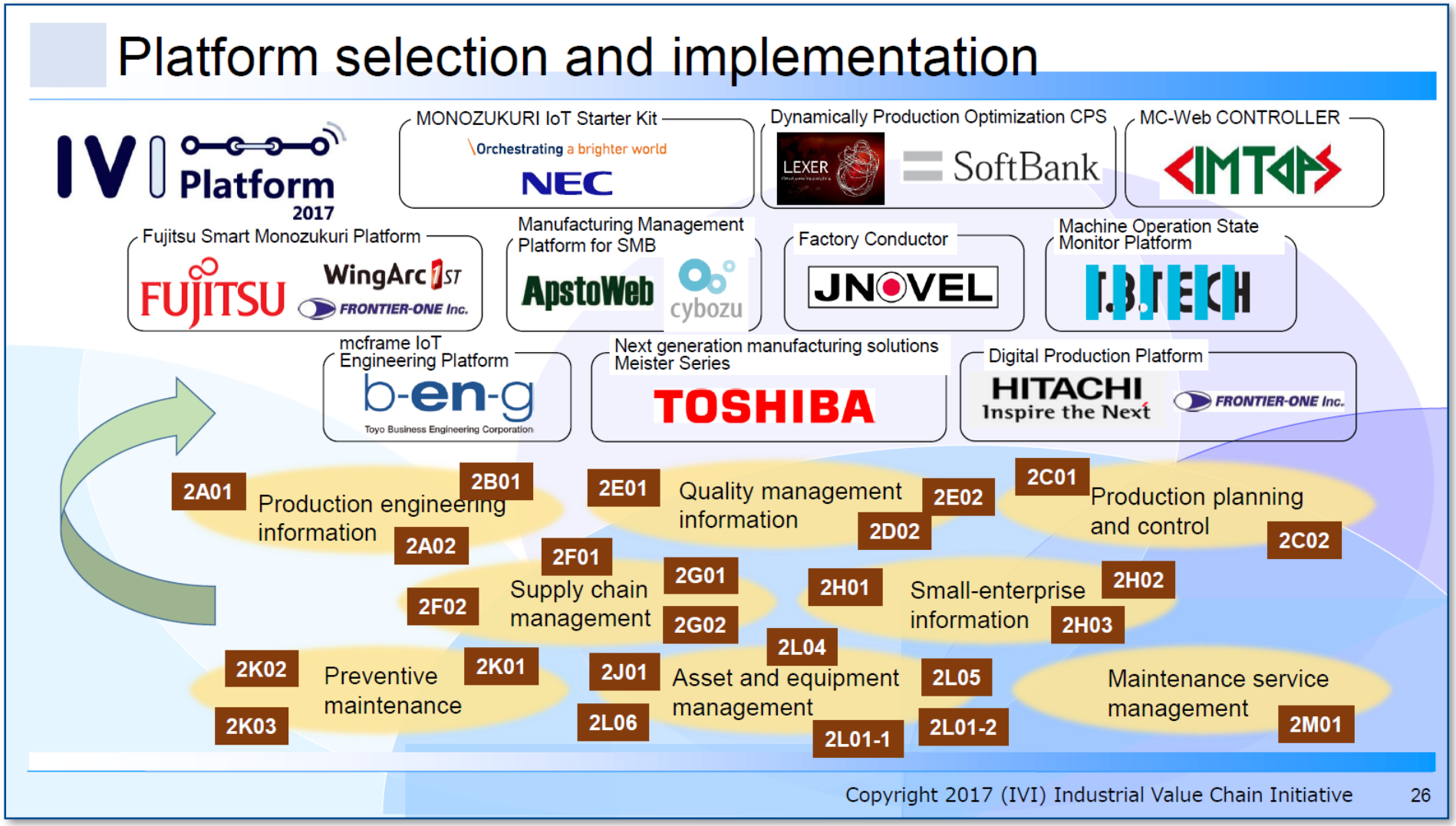
Source: AIF&PI4.0

- Connecting of the industry community
- Defining joint working items
- Setting up co-partnerships
- Setting up working groups
- Closer international cooperation

…for Standardization

Japan Digitalization Program
Industrial Value Chain Initiative (IVI)

ZVEI: Die Elektroindustrie

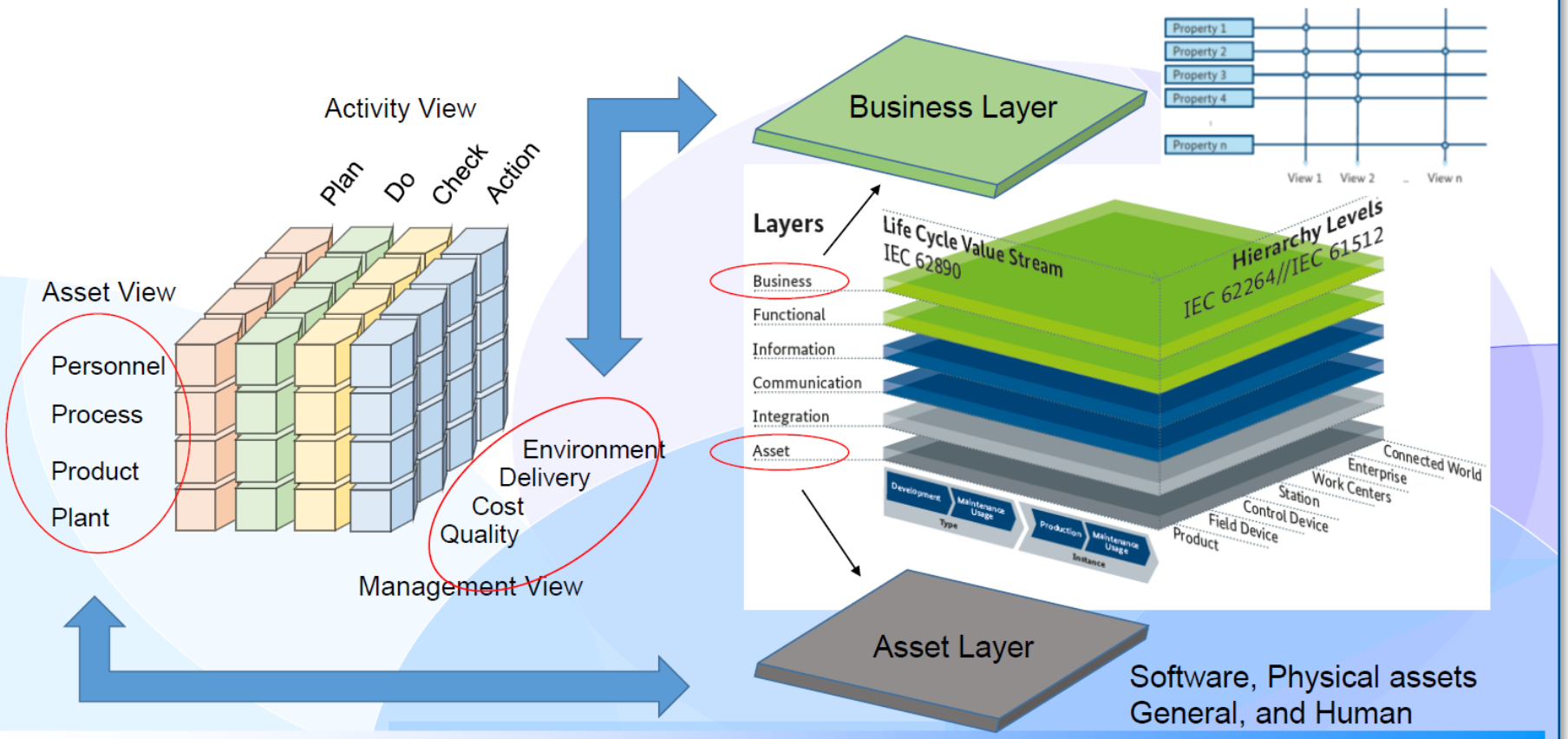


with Courtesy of Yasuyuki Nishioka, Prof. Dr. Hosei University

Digitalization around the World
Japan Model (IVRA) vs German Model (RAMI 4.0)

ZVEI: Die Elektroindustrie

Mapping from IVRA to RAMI 4.0



with Courtesy of Yasuyuki Nishioka, Prof. Dr. Hosei University

Digitalization Guidances at European Level

- **June 2016 – Intellectual Property (IP)**
  - Directive (EU) 2016/943 of the European Parliament and of the Council of 8 June 2016 on the protection of undisclosed know-how and business information (trade secrets) against their unlawful acquisition, use and disclosure.
  - The Directive harmonizes the definition of trade secrets in accordance with existing internationally binding standards. It also defines the relevant forms of misappropriation and clarifies that reverse engineering and parallel innovation must be guaranteed

- **September 2016 – Creating a Digital Single Market by 2025**
  - Publication of the EU Guidelines for Creating a Digital Single Market
    The European Commission proposes to create a gigabit society by 2025.
  - We (read EU) encourage investment in high capacity networks with a new regulatory framework, the European Electronic Communications Code, and a 5G Action Plan.

Digitalization Initiative at Global Level

G20 Initiative

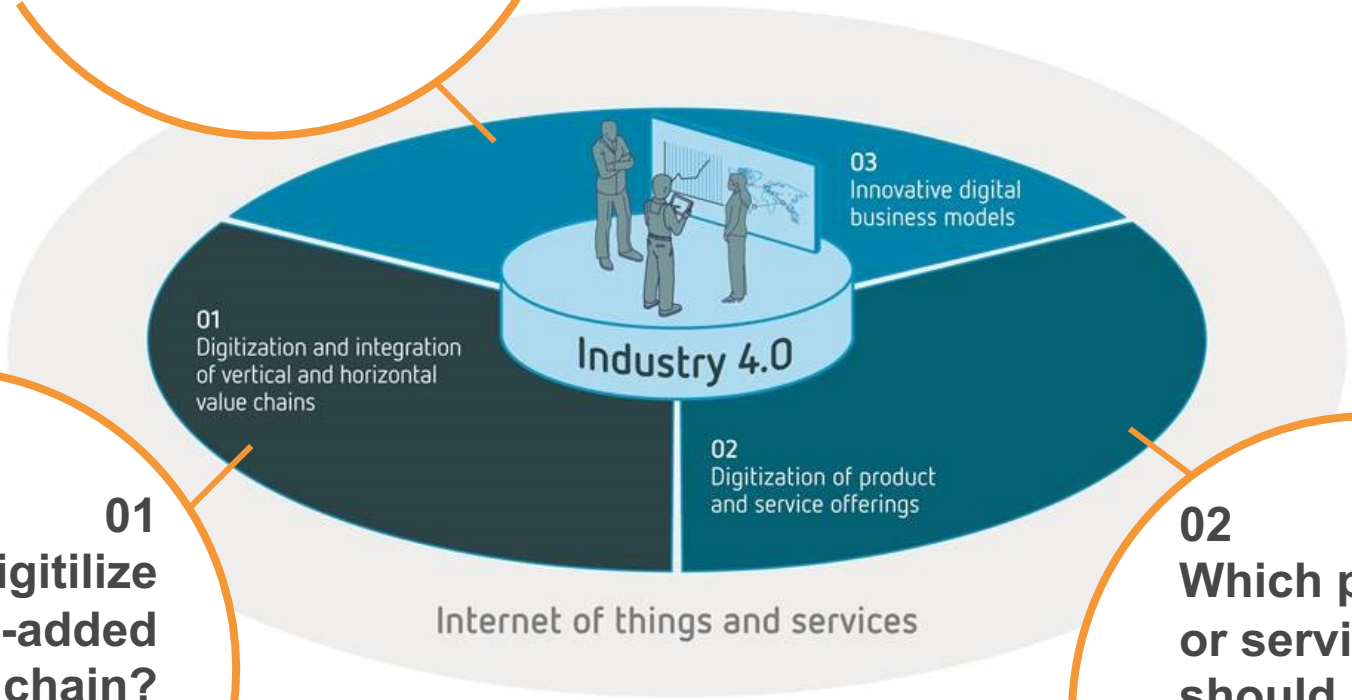
- **April 2017 – Digital Ministers Meeting – Düsseldorf – Germany**
  - **The G20 Digital Ministers' meeting in Düsseldorf agreed on a roadmap for joint policies for a digital future.**
  - **Preparatory meeting to Hamburg G20 Summit**

- **July 2017 – G20 Summit – Hamburg – Germany**
  - **High-speed Internet access for all by 2025**
  - **Digitalization requires international standards**

”Industrie 4.0” affects the entire economy: 3 questions every company has to ask itself

ZVEI: Die Elektroindustrie

03
What are the new business models that I can offer my customers?



01
How can I digitilize my value-added chain?

02
Which products or services should be digitized?

Source: ZVEI following PwC

Thank you very much for your attention!

Any questions?


PCIC
EUROPE
PETROLEUM & CHEMICAL INDUSTRY COMMITTEE