STANDARDIZATION COUNCIL INDUSTRIE 4.0

THE REFERENCE ARCHITECTURAL MODEL RAMI 4.0 AND THE STANDARDIZATION COUNCIL AS AN ELEMENT OF SUCCESS FOR INDUSTRY 4.0

WASHINGTON D.C., 2018-04-10

A joint project by

bitkom VDMA DKE VDE DIN DIN ZVEI: Die Elektroindustrie PLATTFORM INDUSTRIE4.0

Overview

STANDARDIZATION COUNCIL INDUSTRIE 4.0

- What is Industrie 4.0
- Why Standardization Council Industrie 4.0
- How to realize Industrie 4.0
- Summary

STANDARDIZATION COUNCIL INDUSTRIE 4.0

WHAT IS

INDUSTRIE 4.0?

Industrial Revolution
Transforming industries and innovation

STANDARDIZATION COUNCIL INDUSTRIE 4.0

1st industrial revolution

Triggered by mechanical production facilities. Driven by water- and stream-power.

1784
1st mechanical loom

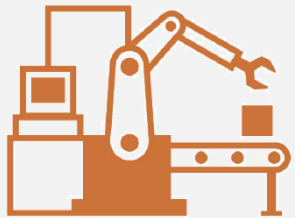
2nd industrial revolution

Implementation of large-scale production. Based on the division of labor driven by electric energy.

1870
1st band-conveyor, slaughterhouse of Cincinnati

3rd industrial revolution

Automation of the production with electronics and IT.



1969
1st programmable logic controller (PLC), Modicom 084

4th industrial revolution

Based on Cyber-Physical Systems.

Today

The potential of digital transformation
The main tracks of Industrie 4.0 (I4.0)

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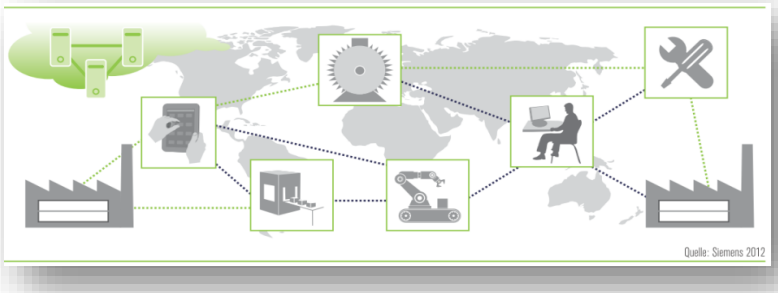
Horizontal Integration

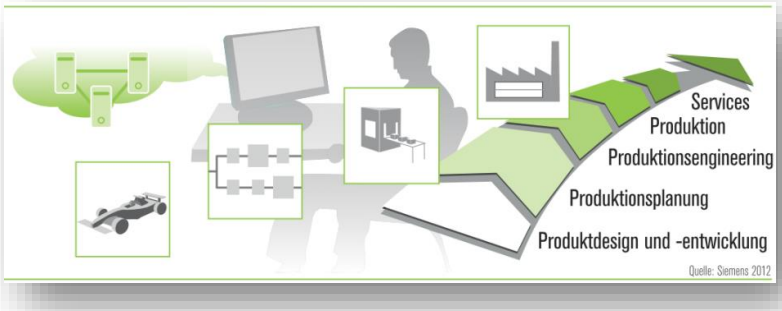


Life Cycle Costs • Value Chains • Tailored Products

Vertical Integration

Reconfigurability • Batch Size 1 • Apps • Steady Change

Continuously Engineering



Systems Engineering • Through Supply Chain • Digital Factory

Human as conductor of added value creation

Quelle: Festo & Siemens

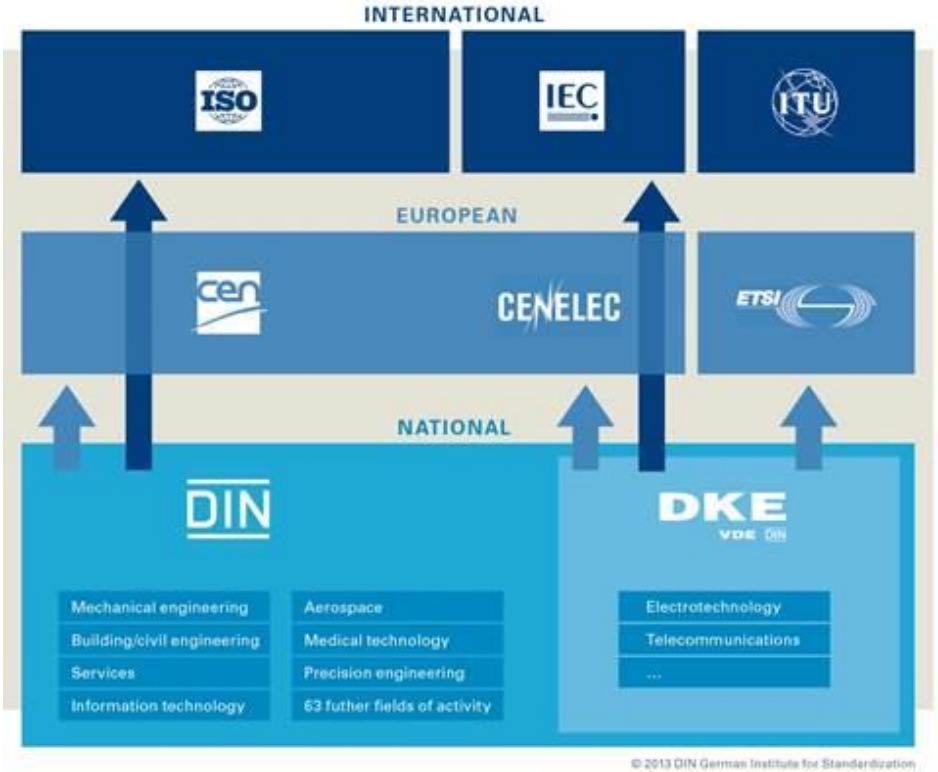
Orchestration • Skill-Sets • Knowledge Based Work • Training

STANDARDIZATION COUNCIL INDUSTRIE 4.0

WHY

STANDARDIZATION COUNCIL I4.0

The world of harmonized Standardization Today
From German Point of View



ISO: International Organization for Standardization

IEC: International Electrotechnical Commission

ITU: International Telecommunication Union

CEN: European Committee for Standardization

CENELEC: European Committee for Electrotechnical Standardization

ETSI: European Telecommunications Standards Institute

DIN: German Institute for Standardization

DKE: German Commission for Electrical, Electronic & Information Technologies of DIN and VDE

DIN and DKE represent German interests in European and international standardization.

Standardizing Industrie 4.0
Core Tasks

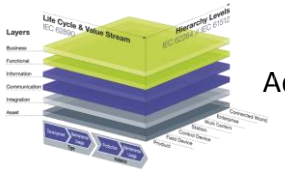
STANDARDIZATION COUNCIL INDUSTRIE 4.0

Collaboration
Industrie 4.0 requires cross-connected standards over domains.
The SCI4.0 connects all relevant organizations within the Industrie 4.0 Network

Agile Standardization
Close relationsip between the SCI4.0 and LNI4.0, to enable Standardization through trial and write

Internationalization
The concepts from Germany are being discussed in an early stage with our international partners for consolidation

Orchestration
How to realize Industrie 4.0?



Source: ZVEI

Administration Shell | Semantics | Communi-cation | 5G-Technology

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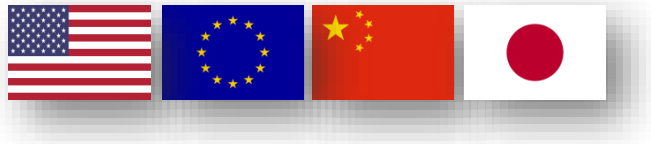

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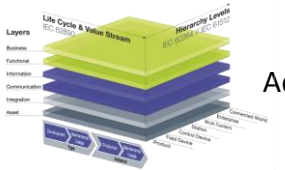

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Standardizing Industrie 4.0
Collaboration

STANDARDIZATION COUNCIL INDUSTRIE 4.0

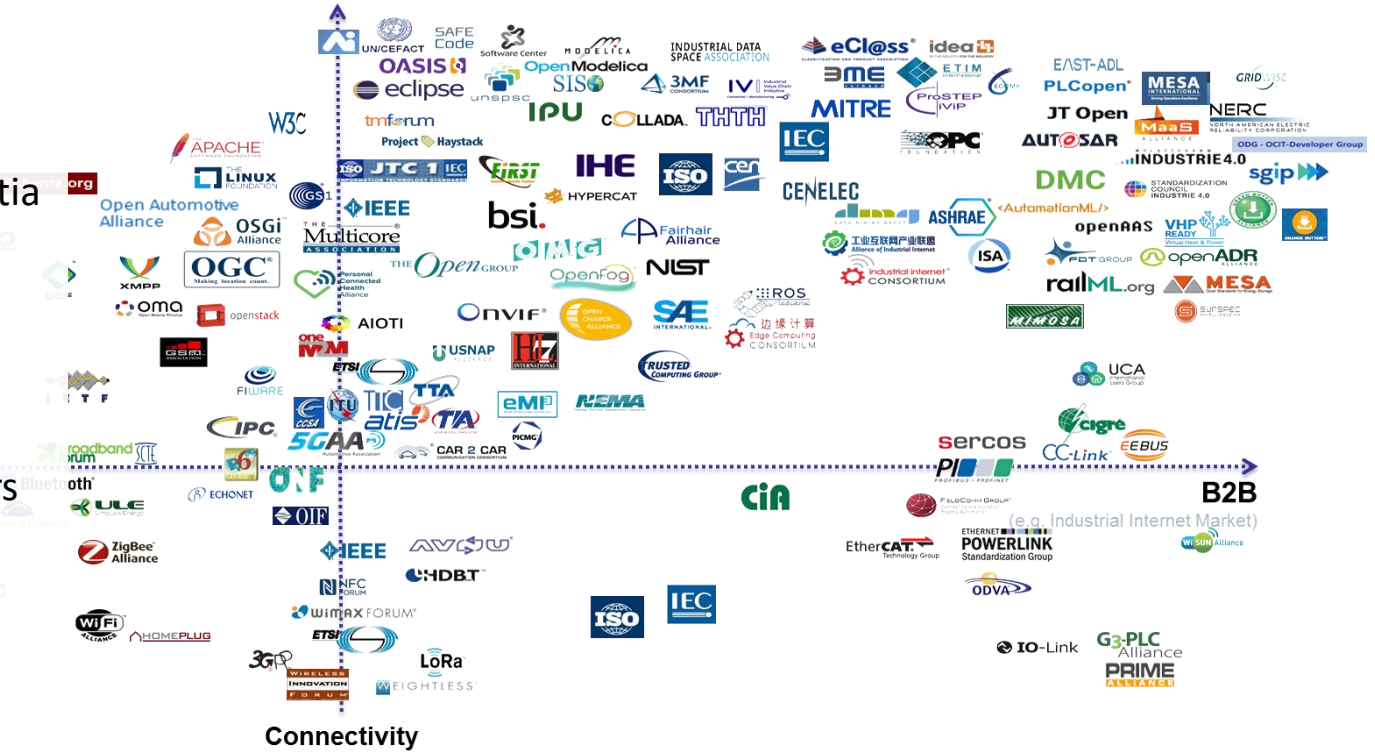
Several standards development organizations need to be considered

Challenges:

- Increased complexity
- High amount on consortia standards
- Parallel solutions are increasing

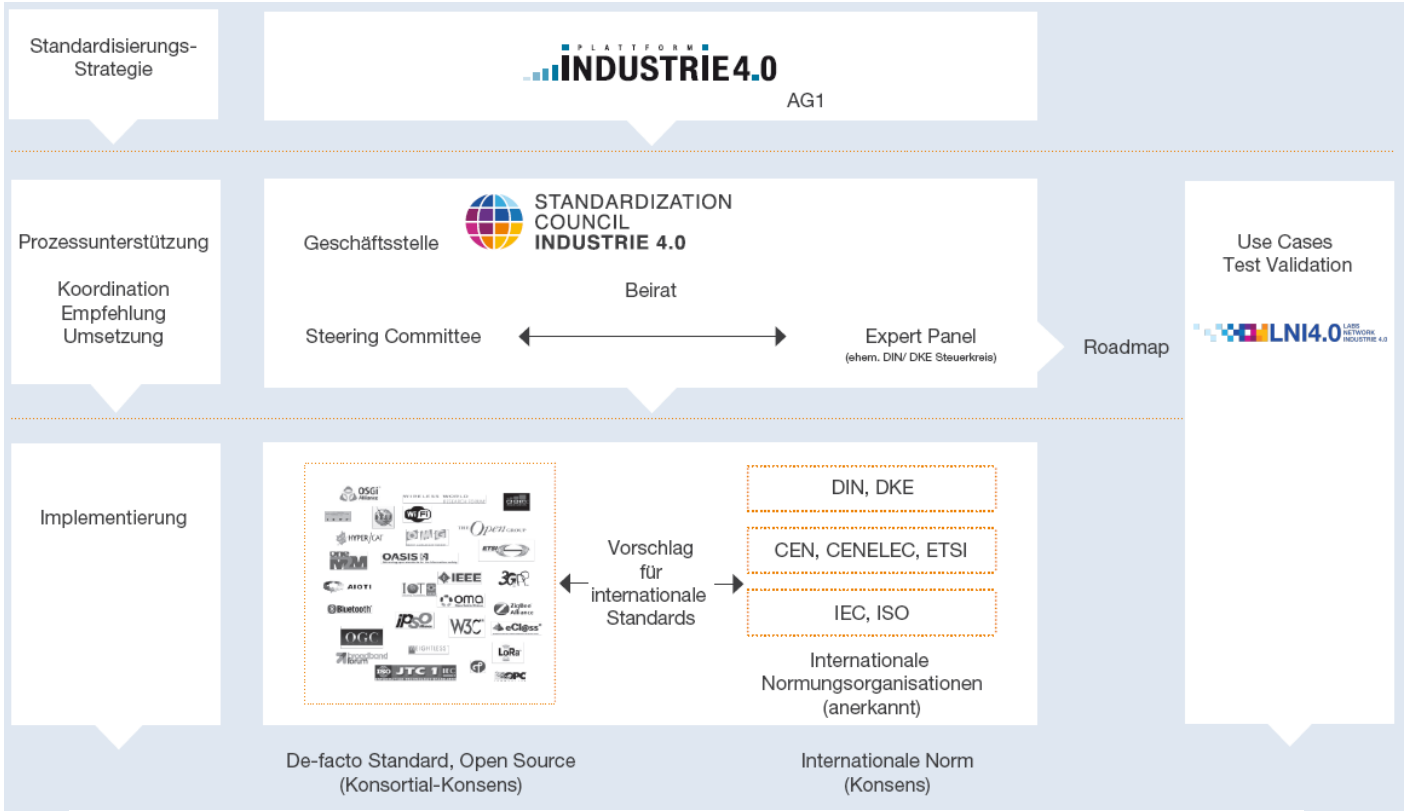
Resulting:

- Coordination of partners needed



Standardizing Industrie 4.0
How SCI 4.0 is embedded

STANDARDIZATION COUNCIL INDUSTRIE 4.0



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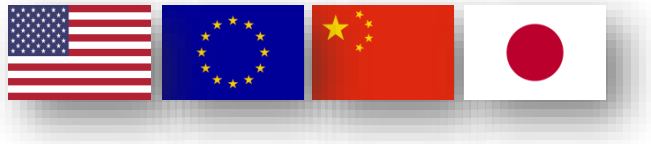

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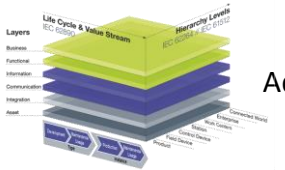

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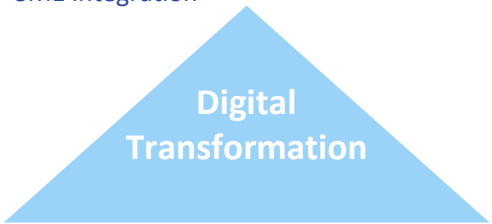
Standardizing Industrie 4.0

Triangle of Digital Transformation

PLATTFORM INDUSTRIE 4.0

- Strategic planning / Recommendations
- International Cooperation
- SME integration



STANDARDIZATION COUNCIL INDUSTRIE 4.0

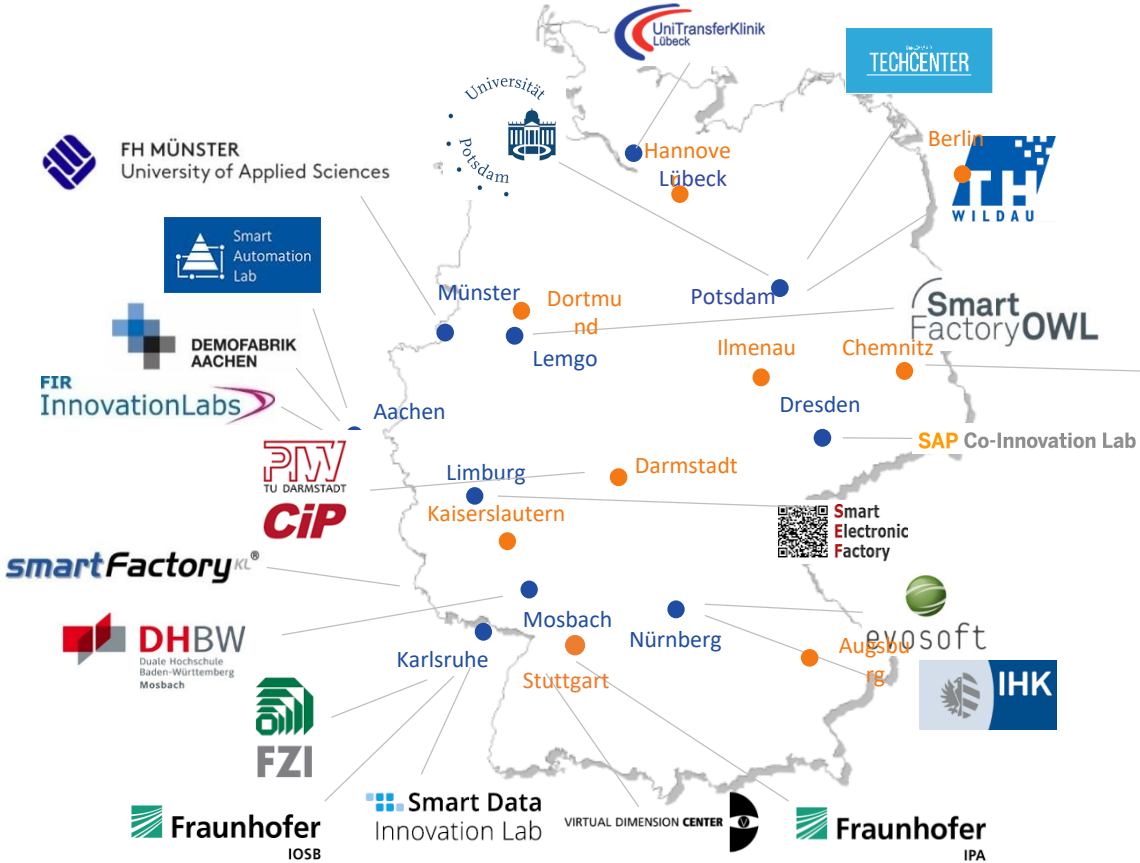
- Initiation of cross sectoral Standards
- Coordination of national and international Standards
- Cooperation with international fora & consortia

LNI4.0 LABS NETWORK INDUSTRIE 4.0

- Network of Testbeds / Labs
- Practical testing and validation of concepts
- Validated return of results into standardization

Standardizing Industrie 4.0
LNI 4.0 – Landscape of test centres

STANDARDIZATION COUNCIL INDUSTRIE 4.0



- ~30 test labs
- High availability through increasing numbers
- Regional distribution in Germany
- Local contacts
- Brought technology mix

SMEs 4.0 – Competence Centers
Mittelstand-digital.de)

Process to orchestrate „Industrie 4.0“ standardization

STANDARDIZATION COUNCIL INDUSTRIE 4.0

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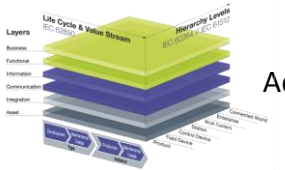

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Administration Shell | Semantics | Communi-cation | 5G-Technology

Standardizing Industrie 4.0
Internationalization

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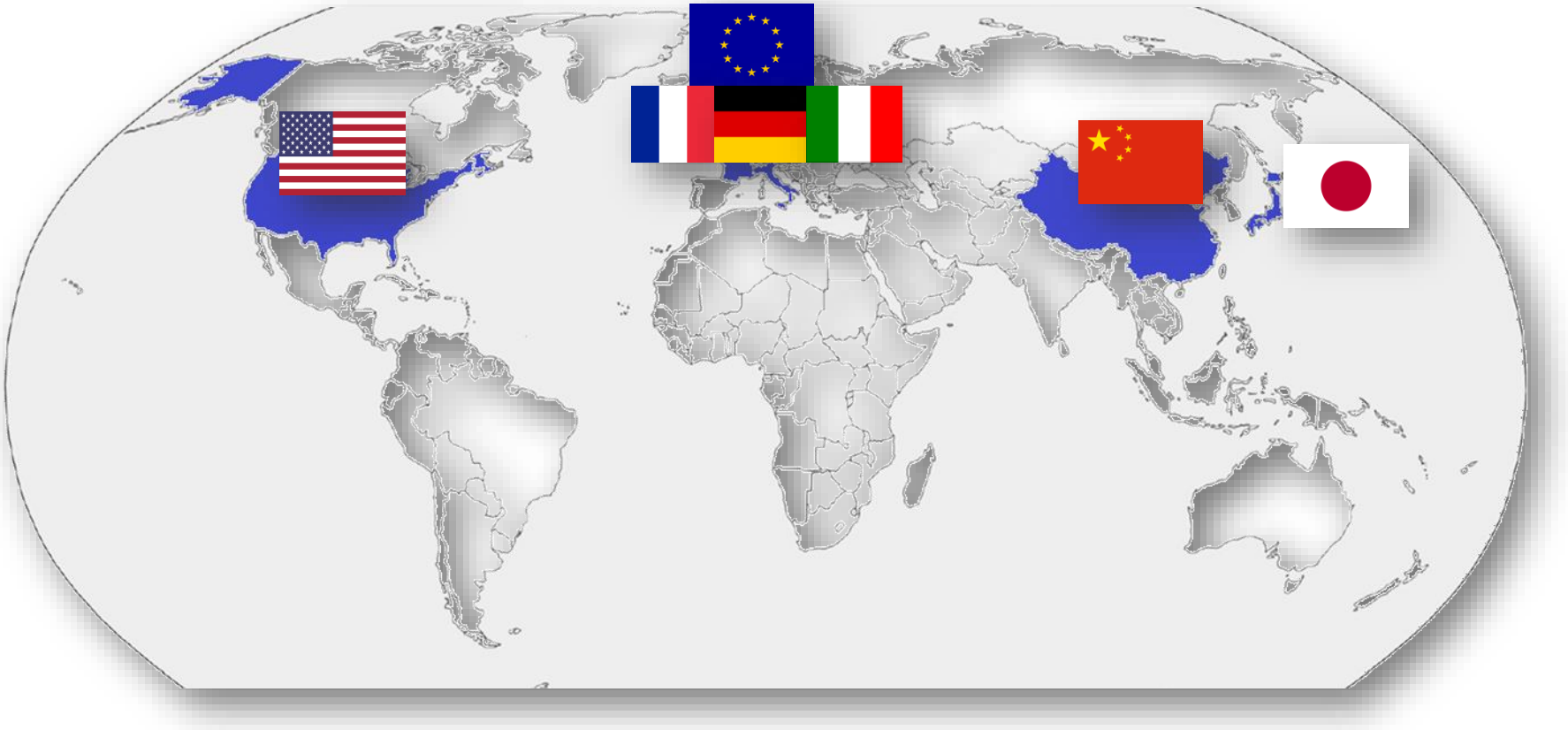

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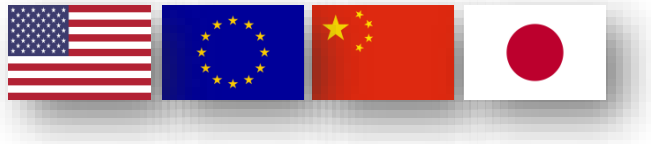

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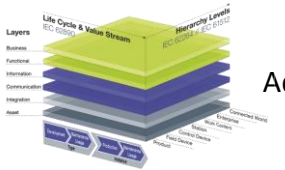

Administration Shell | Semantics | Communi-cation | 5G-Technology

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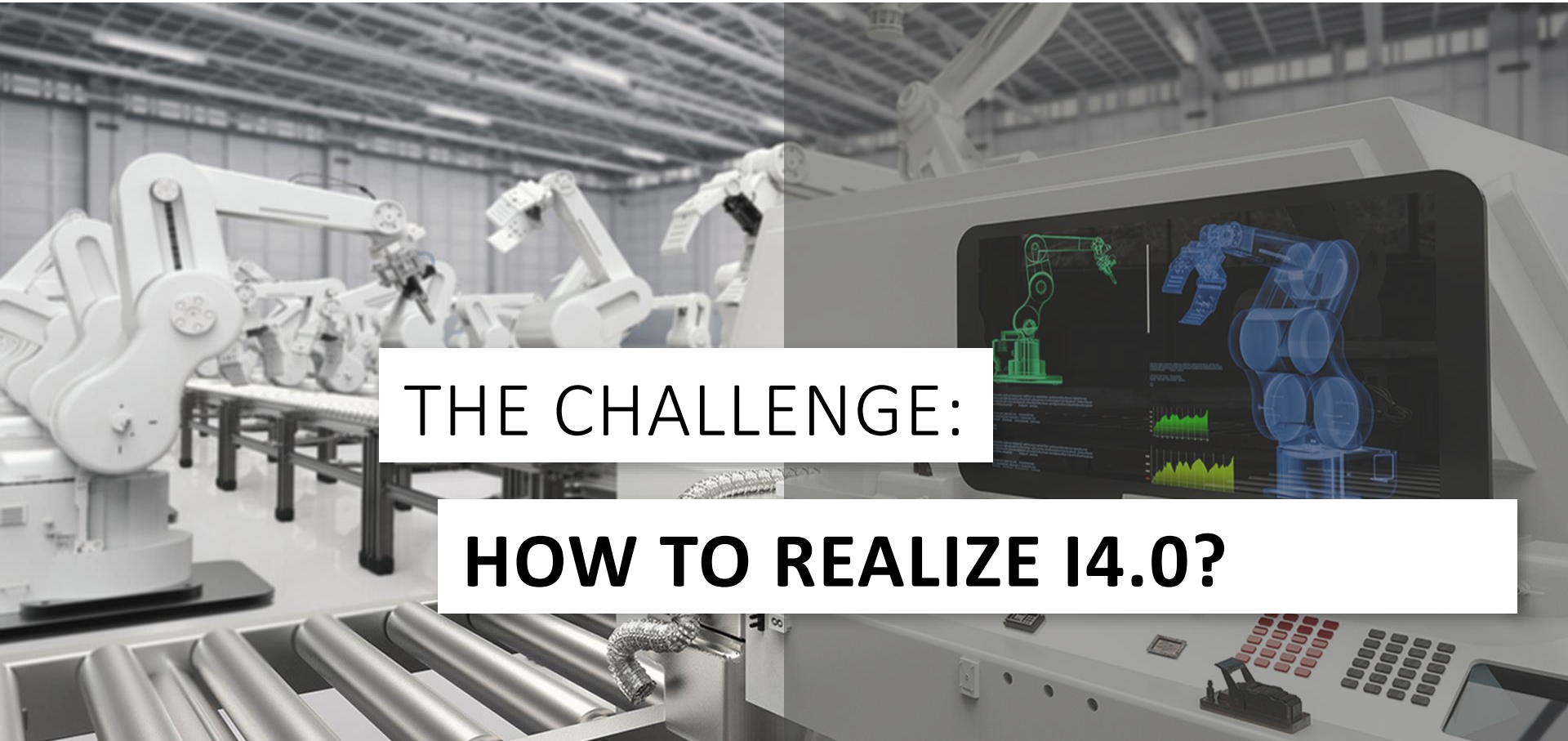
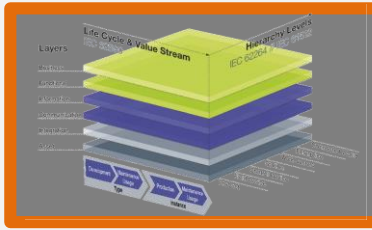


THE CHALLENGE:

HOW TO REALIZE I4.0?

Standardizing Industrie 4.0
Progress of Standardization

STANDARDIZATION COUNCIL INDUSTRIE 4.0



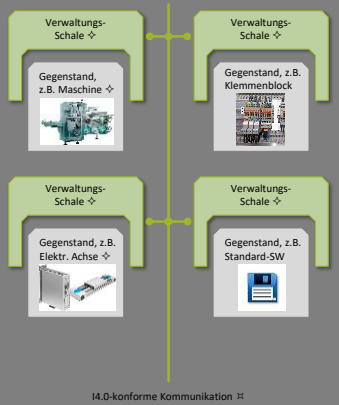
Architecture of Industrie 4.0

Semantic – Identification – Functions – Communication – Standards – Internationalization & Partnering

Concepts of the I4.0-Component

Sub Models

Language of Industrie 4.0



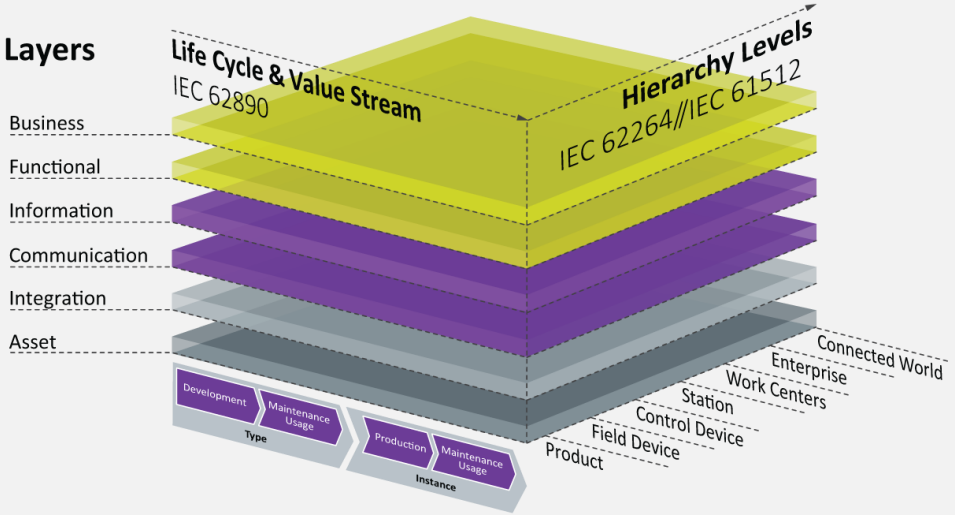
Implementation Guidelines

Reference Architectural Model Industrie 4.0 (RAMI 4.0)

The Reference Architectural Model

RAMI 4.0 is a three-dimensional structured layer model providing a **uniform structure and uniform wording**, presenting the **entire scope of I4.0**.

- RAMI allows the relevant **aspect of a particular asset** to be shown at every point in time along its **life cycle**
- Complex inter-relationships can be broken down into smaller, clearer sections
- Service-Orientated-Architecture



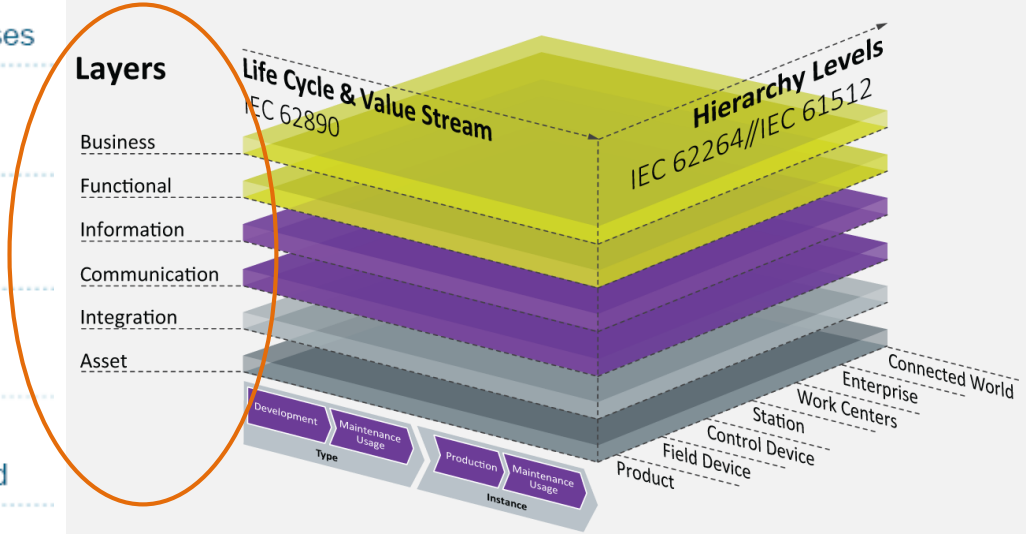
Source: ZVEI

Reference Architectural Model Industrie 4.0 (RAMI 4.0)

STANDARDIZATION COUNCIL INDUSTRIE 4.0

Axis I Architecture

- **Business** — Organisation and Business Processes
- **Functional** — Functions of the Asset
- **Information** — Necessary Data
- **Communication** — Access to Information
- **Integration** — Transition from Real to Digital World
- **Asset** — Physical Things in the Real World

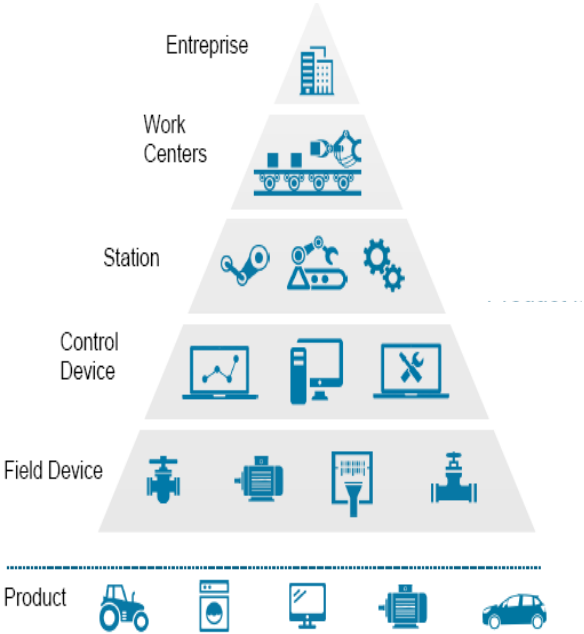


Source: ZVEI

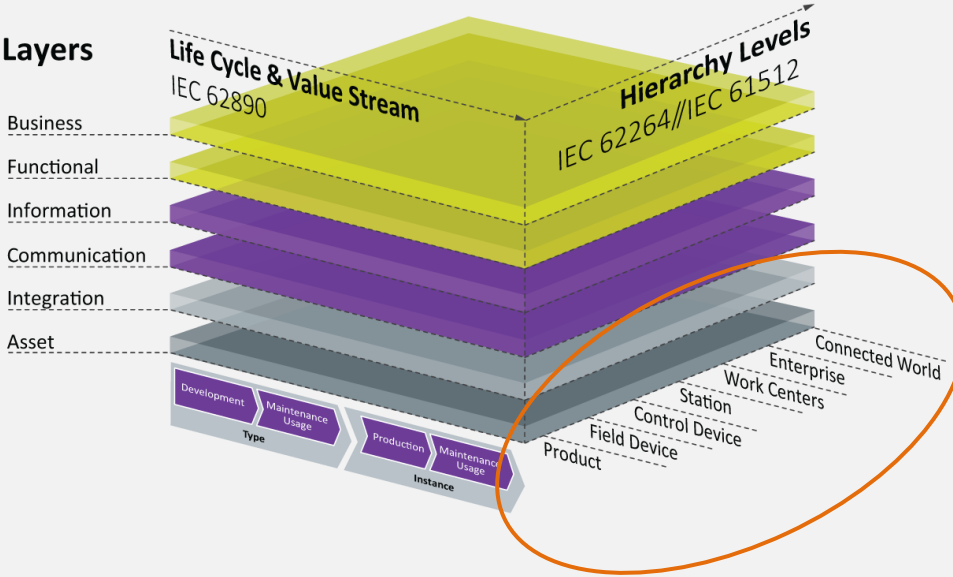
Reference Architectural Model Industrie 4.0 (RAMI 4.0)

STANDARDIZATION COUNCIL INDUSTRIE 4.0

Axis II Hierachy – the Factory



new world



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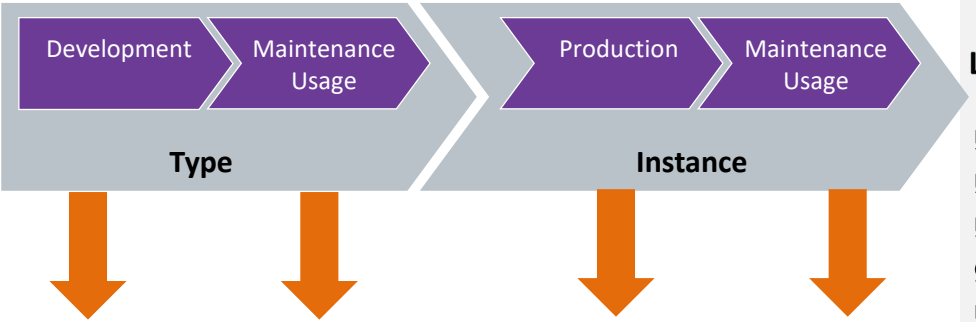
STANDARDIZATION COUNCIL INDUSTRIE 4.0

Axis III Product Life Cycle

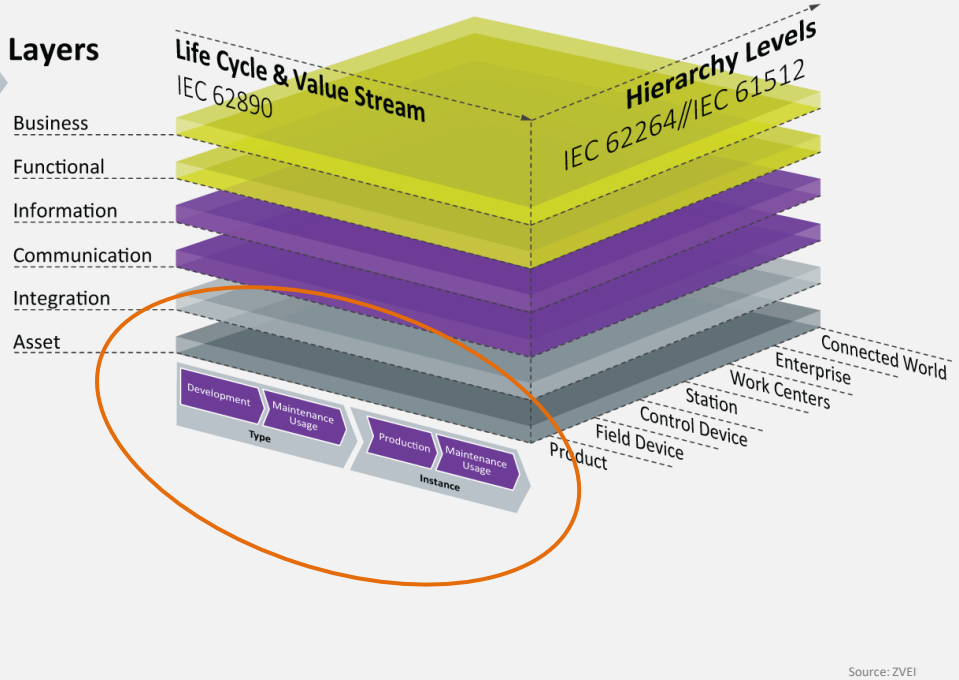


Construction Plan
-Development
-Construction
-Computer simulation
-Prototpe

Construction Plan
-Software Updates
-Instruction Manual
-Maintenance Cycles

Production
-Product
-Data
-Serial Number

Facility Management
-Usage
-Service
-Maintenance
-Recycling
-Scrapping



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Standardizing Industrie 4.0
Progress of Standardization

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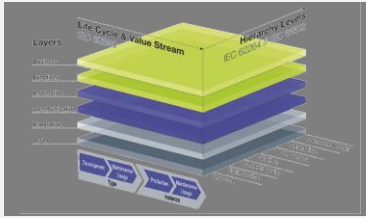


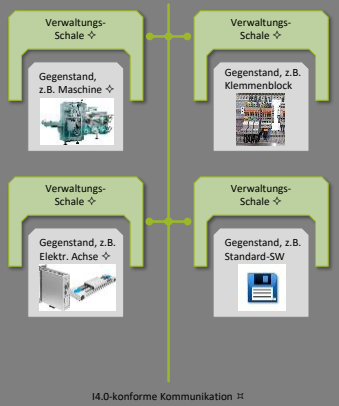
Architecture of Industrie 4.0

Semantic – Identification – Functions – Communication – Standards – Internationalization & Partnering

Concepts of the I4.0-Component

Sub Models

Language of Industrie 4.0

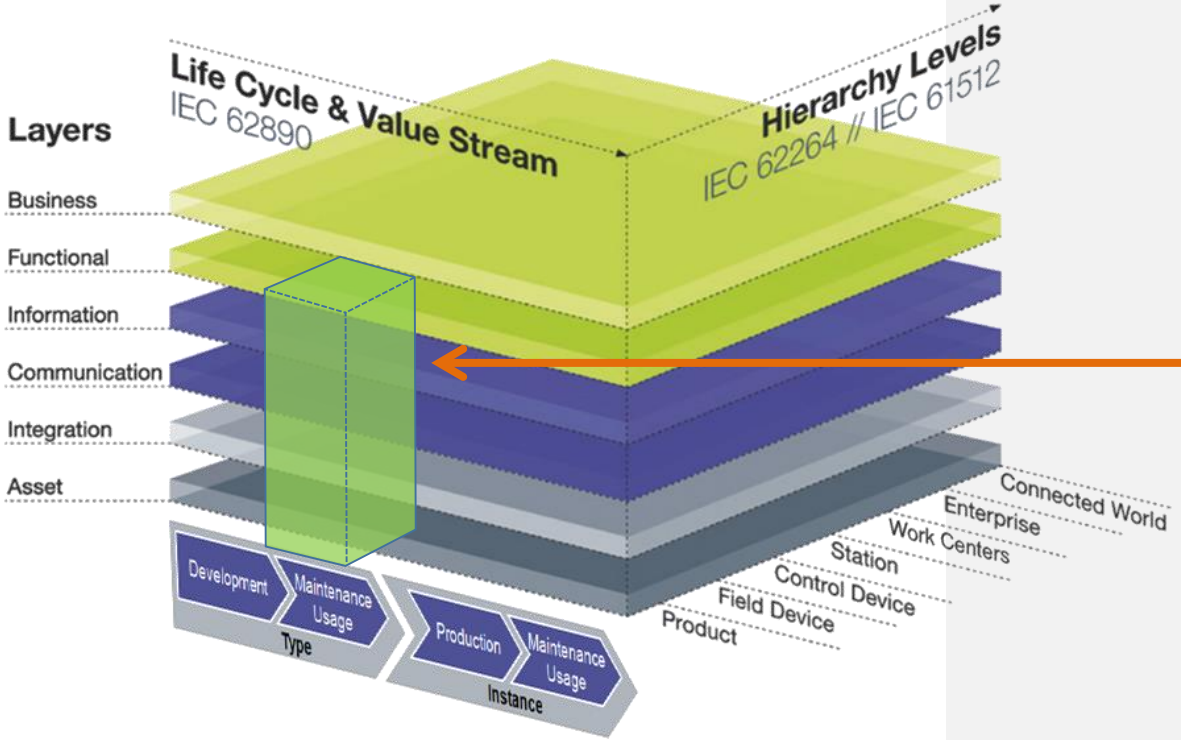


Implementation Guidelines

Standardizing Industrie 4.0
The I4.0 Component

STANDARDIZATION COUNCIL INDUSTRIE 4.0

RAMI4.0



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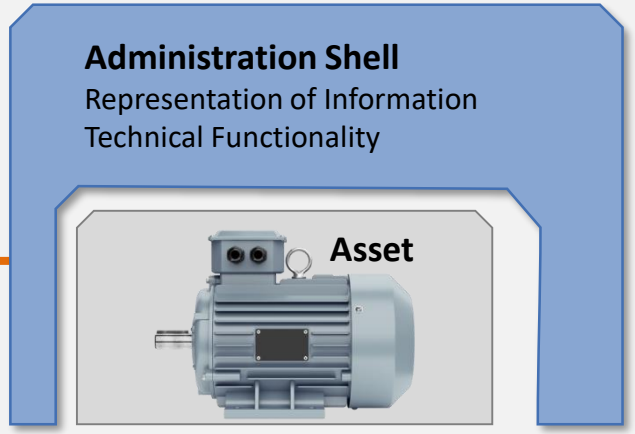
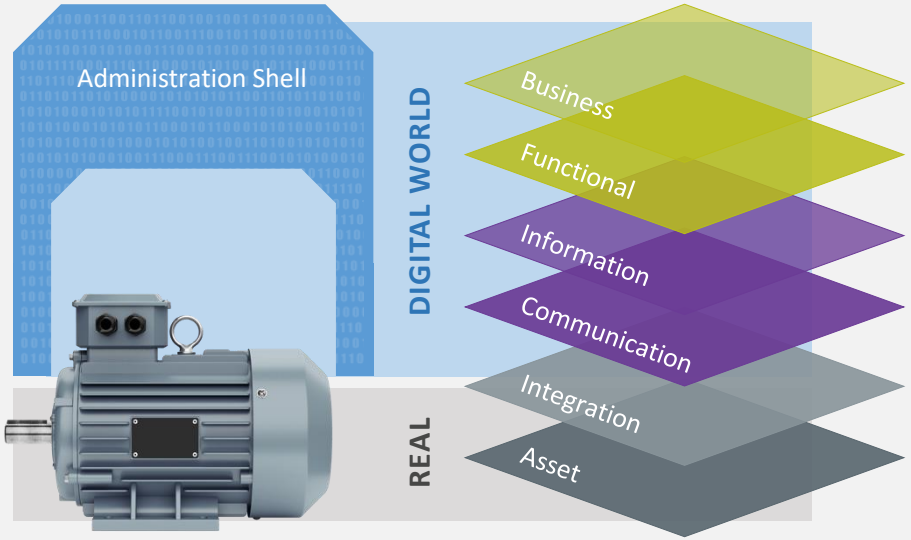


Unique description of the asset containing /linked to all relevant data

STANDARDIZATION COUNCIL INDUSTRIE 4.0

By defining an "Administration shell" that reflects the virtual image of an object, we build…

- …a place to determine its **Function** in the whole business process
- …the **Information** database of the product…
- …the standardized **communications** interface in the network
- …the **Integration** between the digital world and the physical asset



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Progress of Standardization

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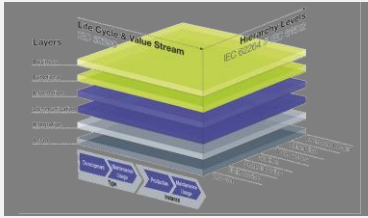

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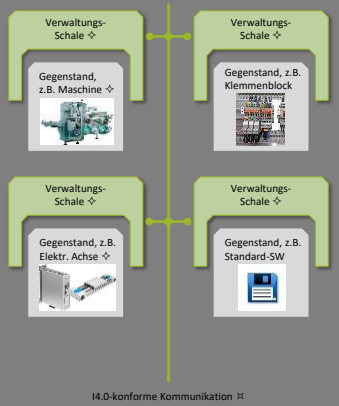

Implementation Guidelines

Sub Models enable to handle the complexity

The **5 main requirements** for properties of sub-models:

- Properties must be **suitable for types and instances**
- There must be a **capability of hierarchical and countable structuring** of the properties
- Properties must **be able to reference other properties**, also in other Administration Shells
- Properties must be **able to reference information and functions** of the Administration Shell
- Properties must take into account **aspects of information security** by means of graduated guarantees of availability, integrity, confidentiality, visibility and authenticity

Standardizing Industrie 4.0
General structure of the Administration Shell with Sub Models

STANDARDIZATION COUNCIL INDUSTRIE 4.0

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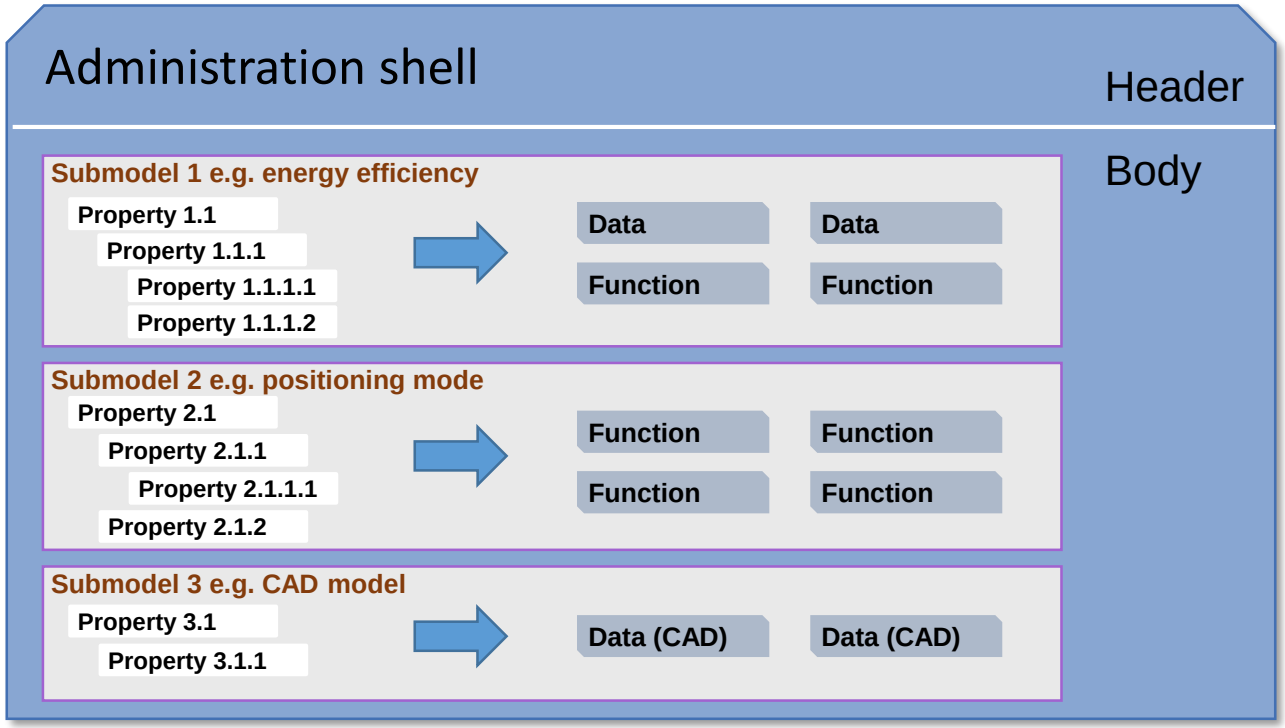

Source: ZVEI SG Modelle & Standards

Standardizing Industrie 4.0
Progress of Standardization

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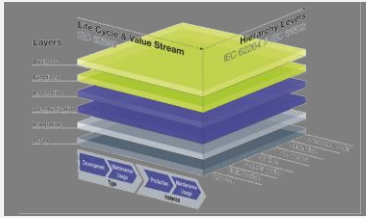

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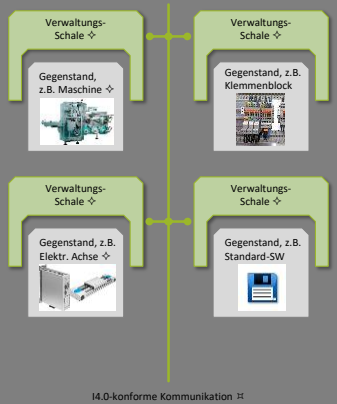

Implementation Guidelines

Standardizing Industrie 4.0
Language of Industrie 4.0

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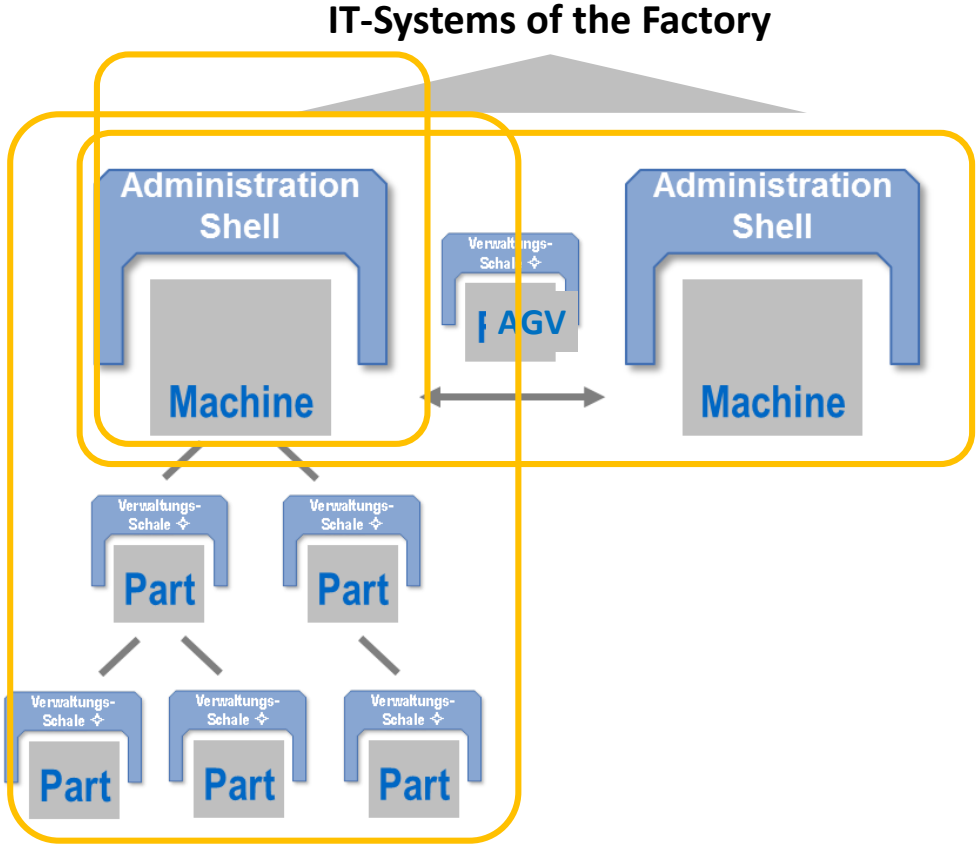


The communication (language) of I4.0 supports several modes

- Activation of assets in a station/plant
- Dynamic cooperation and reconfiguration
- Asset oriented hierarchies
- Decentralized Functionalities

The Knowledge is encoded in a common exchangeable **semantic** for e.g.

- Knowledge about the I4.0 component
- Knowledge about relations
- Properties
- Relations of Data and Informations

Summary

STANDARDIZATION COUNCIL INDUSTRIE 4.0

We need a **"universal language"** for all players and devices that is…

I. … STANDARDIZED

- secure interoperability
- across branches
- across companies
- across devices
- globally accepted, no proprietary solution
- open standard instead of closed system

II. … SAFE & SECURE

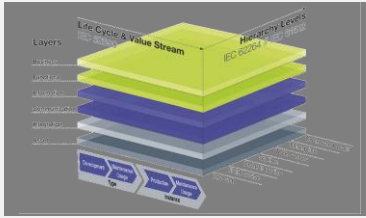
- right data
- right receiver
- no delay (real-time transmission)
- no external intervention
- security standards / security by design

III. … TESTED & TRAINED

- established testing processes
- test environments
- test centres
- exchange of best practices
- training & qualification programs for developers and users

Standardizing Industrie 4.0
Progress of Standardization

STANDARDIZATION COUNCIL INDUSTRIE 4.0



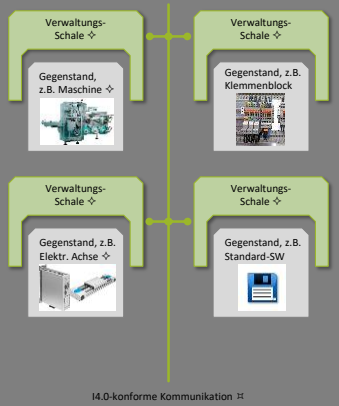
Architecture of Industrie 4.0

Semantic – Identification – Functions – Communication – Standards – Internationalization & Partnering

Concepts of the I4.0-Component

Sub Models

Language of Industrie 4.0



Implementation Guidelines

Roadmap Industrie 4.0
Version 3: 2018-04-24 Hannover Fair

STANDARDIZATION COUNCIL INDUSTRIE 4.0

- Additions in the standardization environment
- Recommendations for action in the environment of Industrie 4.0
  - ⇨ Reference architecture model
  - ⇨ Industrie 4.0 component
  - ⇨ Semantics
  - ⇨ Administration shell
  - ⇨ Use cases
  - ⇨ I 4.0 relevant standards and specifications

Roadmap | RAMI4.0
Standards are under development

STANDARDIZATION COUNCIL INDUSTRIE 4.0

- **New Standards for Industrie 4.0 (Examples)**

under preparation:

DIN SPEC 27070 ⎫ RA eines Security Gateways zum Austausch von Industriedaten und Dienste
DIN SPEC 16593 ⎭ Referenzmodell für Industrie 4.0-Servicearchitekturen [SOA]
IEC 62832 Part2 | Model elements
IEC 62832 Part3 | Application of Digital Factory for Life cycle management of production systems
IEC 62657 Part1 | Industrial communication networks - Wireless communication networks
- Wireless communication requirements and spectrum considerations-
IEC 62657 Part2 | Industrial communication networks - Wireless communication networks
- Coexistence management-
IEC 62657 Part3 | Definition of system elements, properties, interfaces and relationships
IEC 62657 Part4 | Coexistence management with central coordination of wireless applications
3GPP TR 22.xxx | Communication for Automation in Vertical Domains (5G)
VDI/VDE GMA IEEE TSN …u.v.m.

Puplished:

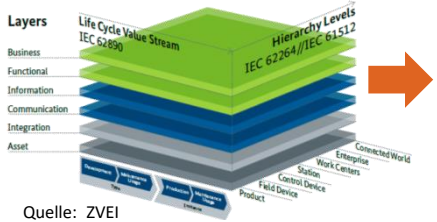
DIN SPEC 91345 | Referenzarchitekturmodell Industrie 4.0 (RAMI4.0)
DIN SPEC 16592 | Universelle Schnittstellen für die Automatisierung (OPC-UA und AutomationML)
DIN SPEC 91349 | Taxonomie zu Regelwerken bei Smart Data
IEC 62832 Part 1 | Industrial-process measurement, control and automation Digital Factory framework
IEC-PAS-63088 | Smart Manufacturing – Reference Architecture Model Industry 4.0 (RAMI4.0)

- **Identified Standards for Industrie 4.0 (in progress)**

Standardlist for Smart Manufacturing/Industrie 4.0:
around 550 Stds are identified by international experts (IEC/ISO) as main standards for Industrie 4.0. Classified (Facets for Smart Manufacturing) and needs to be proofed for update s

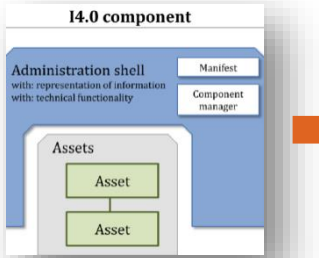
Core Standards for Industrie 4.0:
around 130 Standards were identified from experts (ZVEI SG Modelle & Standards) as core standards for Industrie 4. and has to be checked and e.g. modified case by case

DIN SPEC 91345 ➡ IEC-PAS-63088



Quelle: ZVEI

➡ **ISO/IEC JWG 21**



Quelle: ZVEI

➡ **Joint work with France and Italy**

Save the Dates

STANDARDIZATION COUNCIL INDUSTRIE 4.0

23rd – 27th April: Hannover Fair 2018

HANNOVER MESSE USA

10th – 14th September: Hannover Fair USA 2018, Chicago

- Industrie 4.0 meets the Industrial Internet of Things – Solutions Theater
- US-German Standards Panel on Smart Manufacturing

THANK YOU!

STANDARDIZATION COUNCIL INDUSTRIE 4.0

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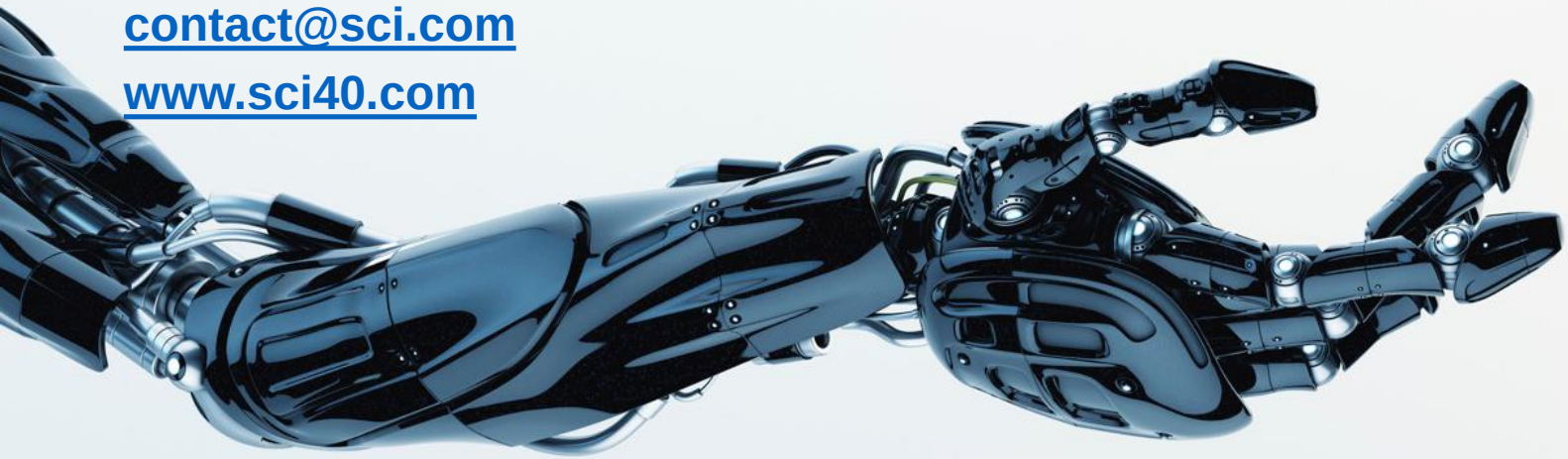
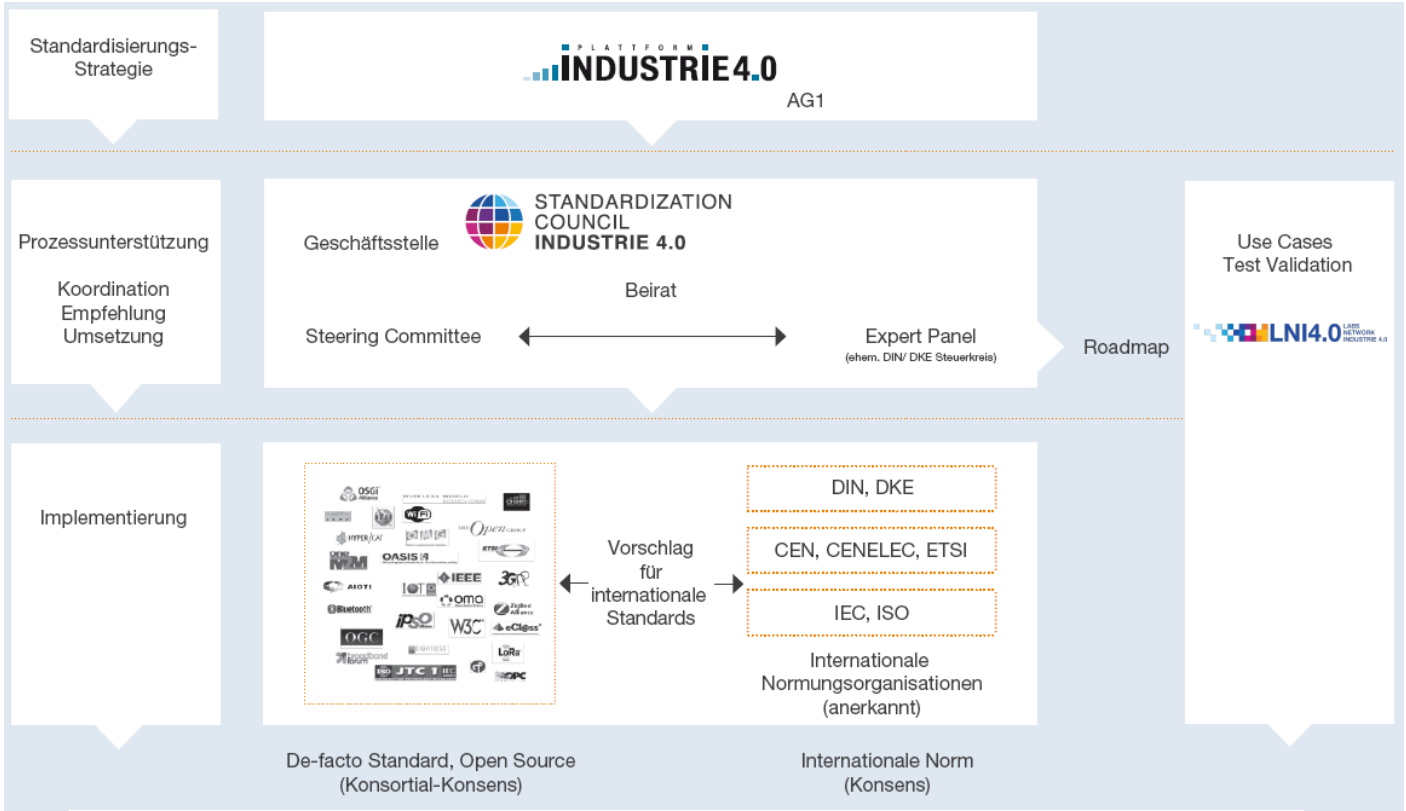
www.sci40.com



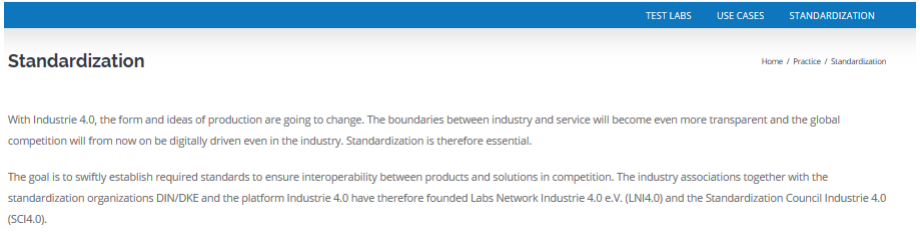
Standardizing Industrie 4.0
How SCI 4.0 is embedded

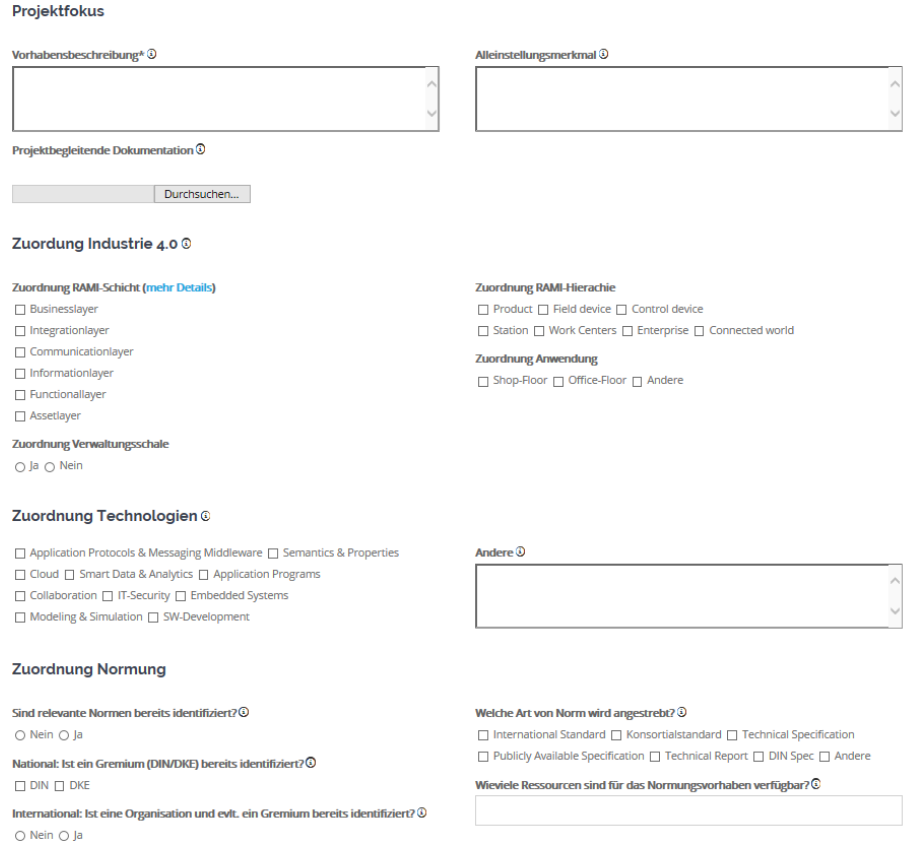
STANDARDIZATION COUNCIL INDUSTRIE 4.0



Standardizing Industrie 4.0
Web-based process for Standardization

STANDARDIZATION COUNCIL INDUSTRIE 4.0



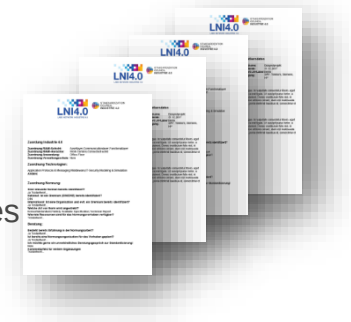


Just fill out -> send -> Standardization starts
www.lni40.de

automatic generated email
as pdf@ SCI4.0 office

Next steps

- Consolidation with the Platform I4.0/AG1 and the working groups
- Clarification of ressources and start of standardization



Standardizing Industrie 4.0
Internationalization - Japan

STANDARDIZATION COUNCIL INDUSTRIE 4.0

[PROGRESS REPORT]

Joint Use Case Development – Value Based Services

Progress report on the analysis and development of common Use Cases Value Based Services as a business application scenario

A joint project of

Robot Revolution Initiative RRI – Standardization Council Industrie 4.0 – Labs Network Industrie 4.0

Joint Use Cases Development – Value Based Services

Next steps until 2018

#1 Completion of the description of the Usage Viewpoint for a concrete business setup within the group “modelling examples”

#2 Completion of the description of the Functional Viewpoint aspects

#3 Detailing the “Use Cases” within TC65 Smart Manufacturing, Germany-Japan cooperation

#4 Achieve overall goal and create descriptions that match each other at the interface between Usage Viewpoint and Functional Viewpoint

Standardizing Industrie 4.0
Internationalization - China

STANDARDIZATION COUNCIL INDUSTRIE 4.0

中德智能制造/工业 4.0 标准化工作组
系统架构互认研究报告¶
Report on Sino-German Intelligent Manufacturing/ Industrie 4.0 System Architecture Alignment¶

¶

中德智能制造/工业 4.0 标准化工作组↵
Sino-German Intelligent Manufacturing/Industrie 4.0 Standardization Sub-Working Group¶

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A joint project of¶

National Intelligent Manufacturing Standardisation Administration Group (IMSG) – Standardization Council Industrie 4.0 (SCI4.0)¶

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Alignment Report
RAMI 4.0 / IMSA
Ab März
www.sci40.com

中德智能制造/工业 4.0 预测性维护标准化¶
路线图¶
The Standardization Roadmap of Predictive Maintenance for Sino-German Intelligent Manufacturing/Industrie 4.0¶

¶

中德智能制造/工业 4.0 标准化工作组↵
Sino-German Intelligent Manufacturing/Industrie 4.0 Standardization Sub-Working Group¶

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Standardization Roadmap of Predictive Maintenance
ab März
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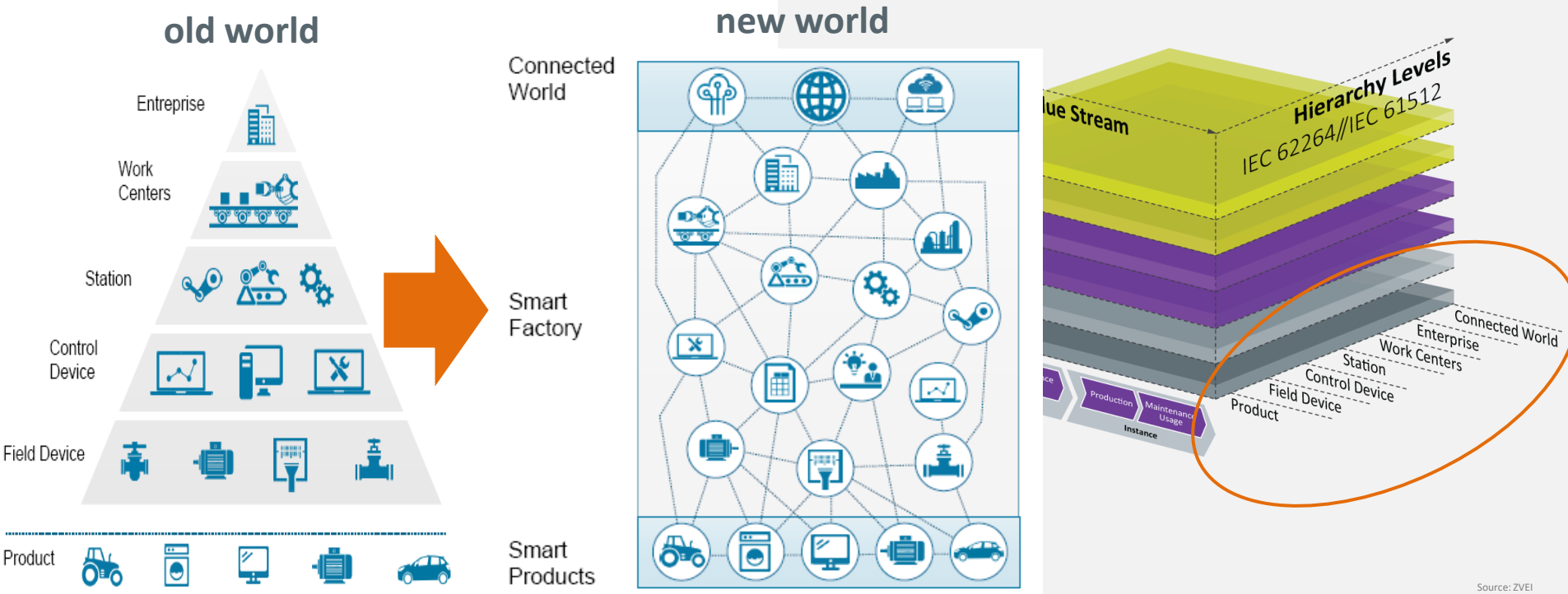
Reference Architectural Model Industrie 4.0 (RAMI 4.0)

STANDARDIZATION COUNCIL INDUSTRIE 4.0

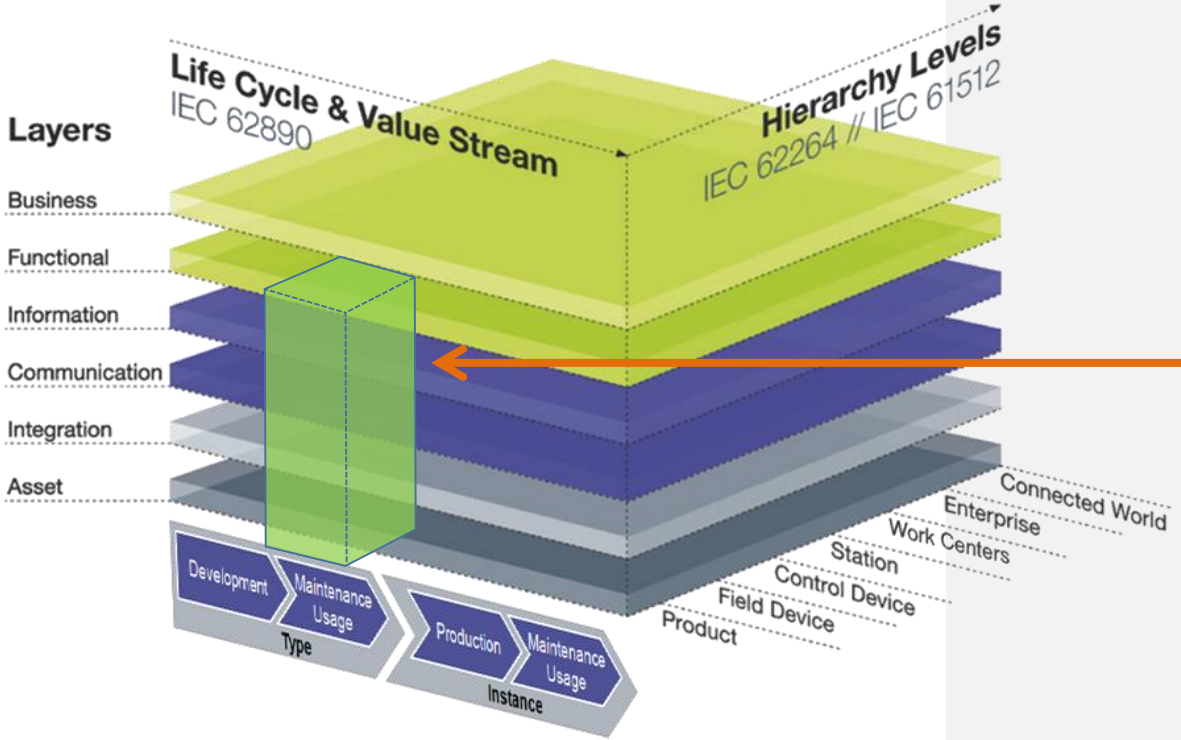
Axis II Hierachy – the Factory



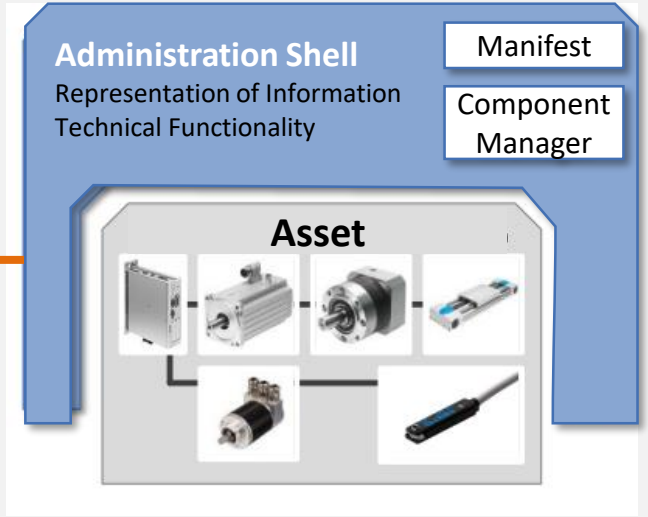
Standardizing Industrie 4.0
I4.0 Component: translate real product objects into virtual images

STANDARDIZATION COUNCIL INDUSTRIE 4.0

RAMI4.0



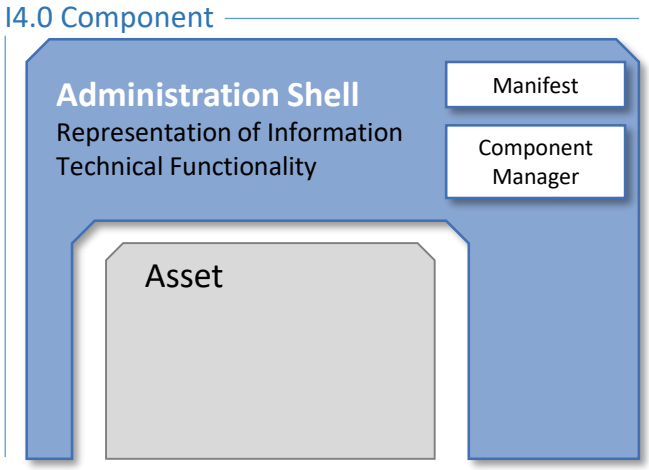
I4.0 Component

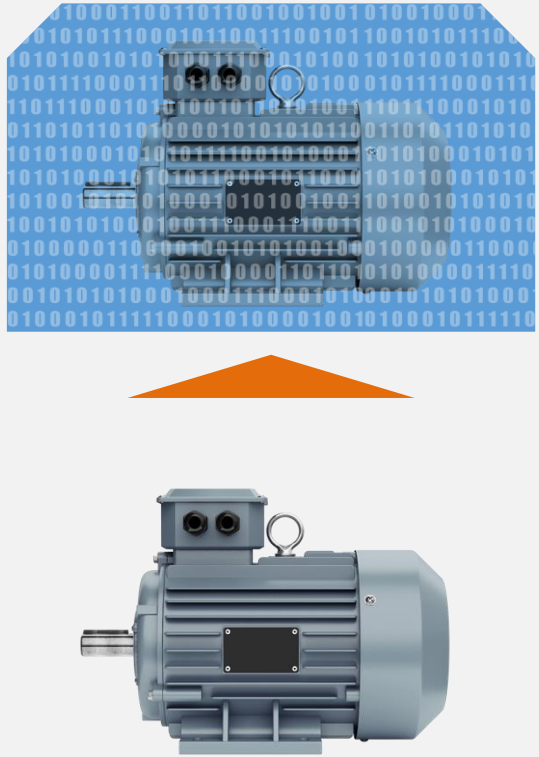


Unique description of the asset containing /linked to all relevant data

STANDARDIZATION COUNCIL INDUSTRIE 4.0

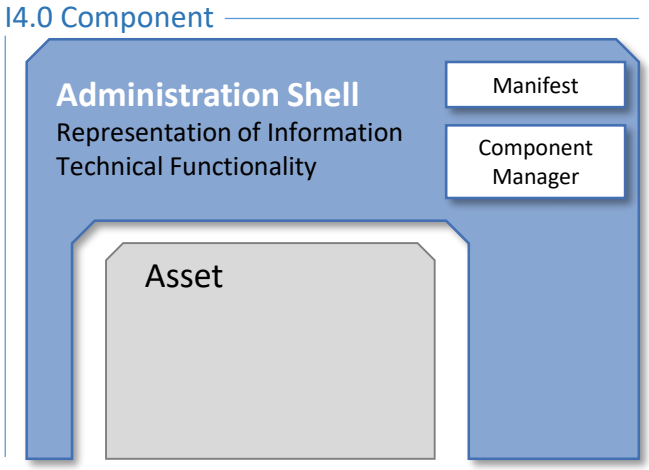
We have to translate real product objects into virtual images

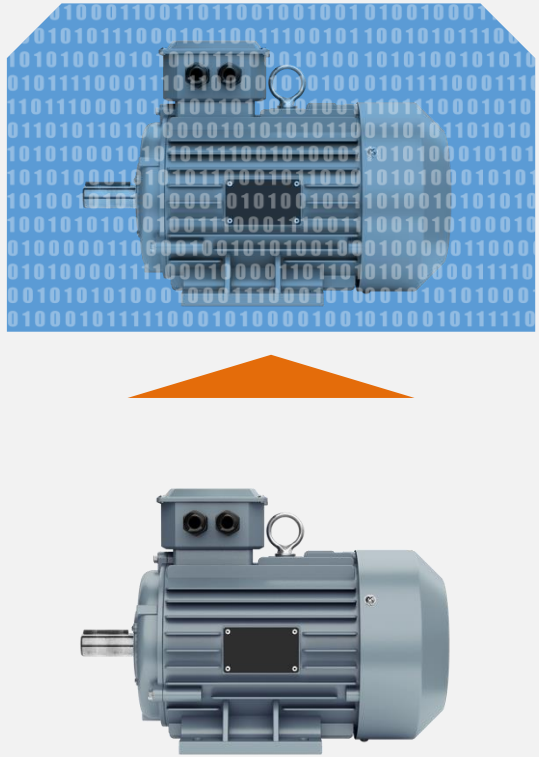




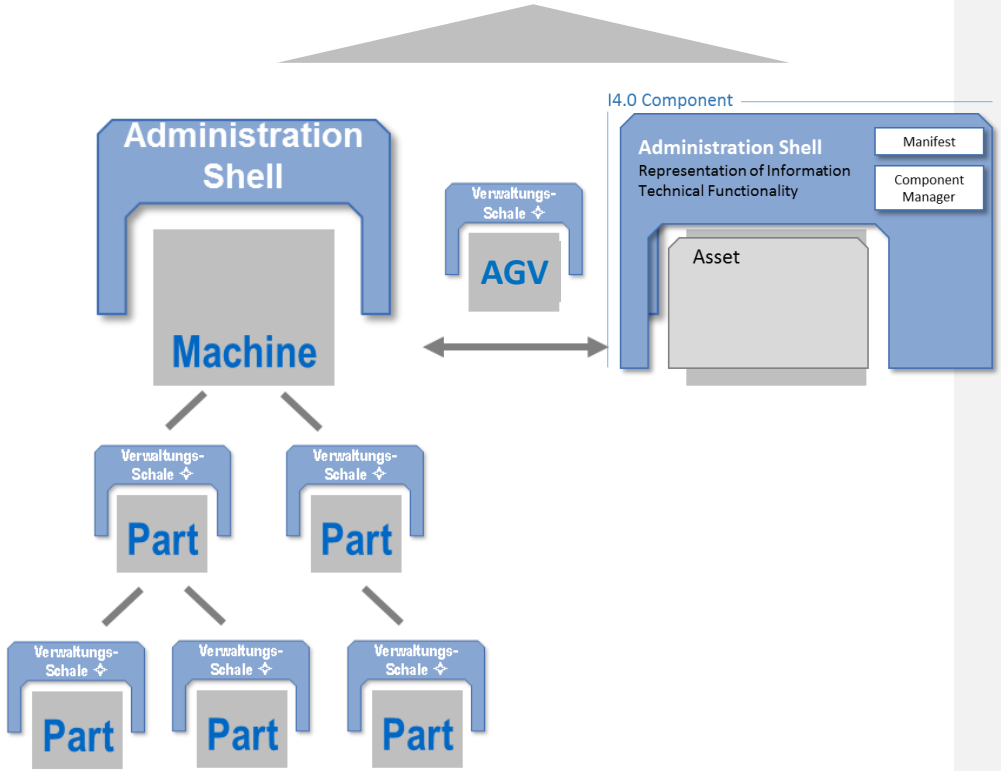
STANDARDIZATION COUNCIL INDUSTRIE 4.0

We have to translate real product objects into virtual images





Standardizing Industrie 4.0
The I4.0 Component



Administration Shell contains of:

- **Data** (→ manuals, runtime data)
- **Decentralized Functionalities**
- **Knowledge,** described in a common exchangeable **semantic** for e.g.
  - Knowledge about the I4.0 component
  - Knowledge about relations
  - Properties
  - Relations of Data and Informations
  - Etc.

Standardizing Industrie 4.0
General structure of the Administration Shell