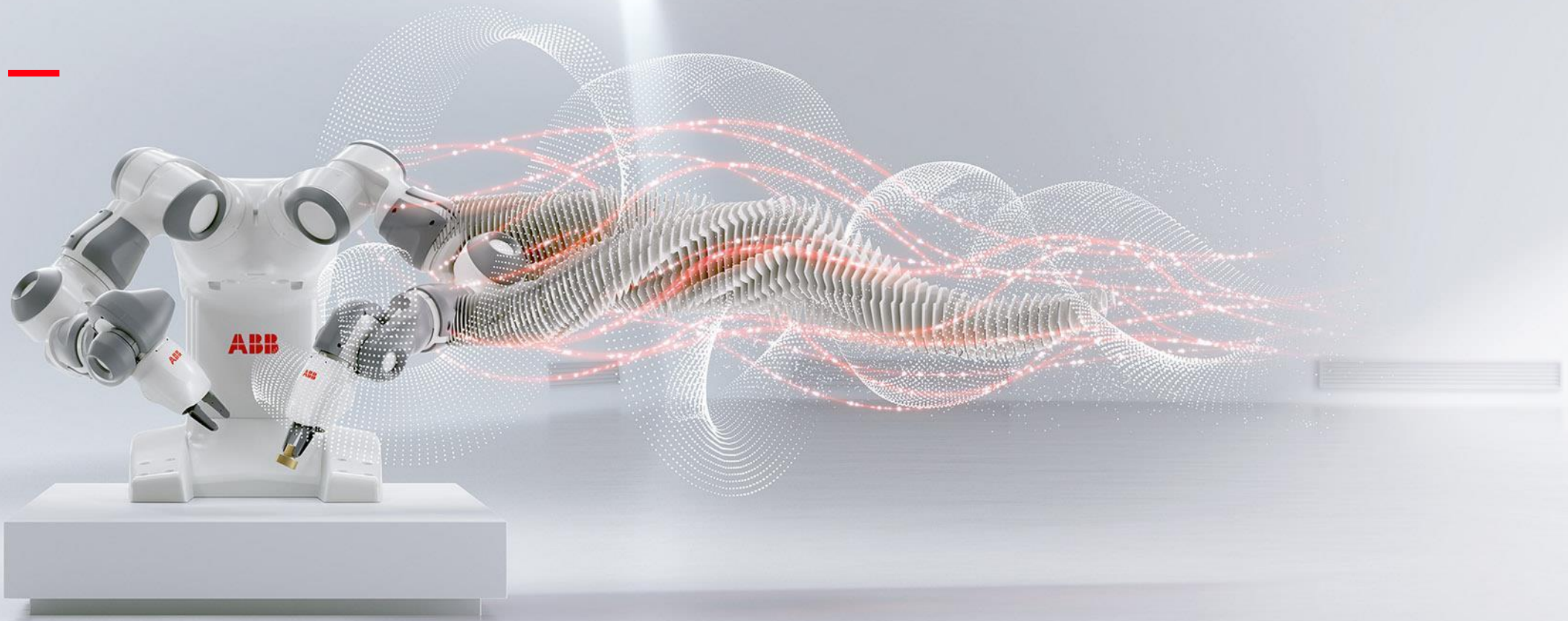


OCT 2019

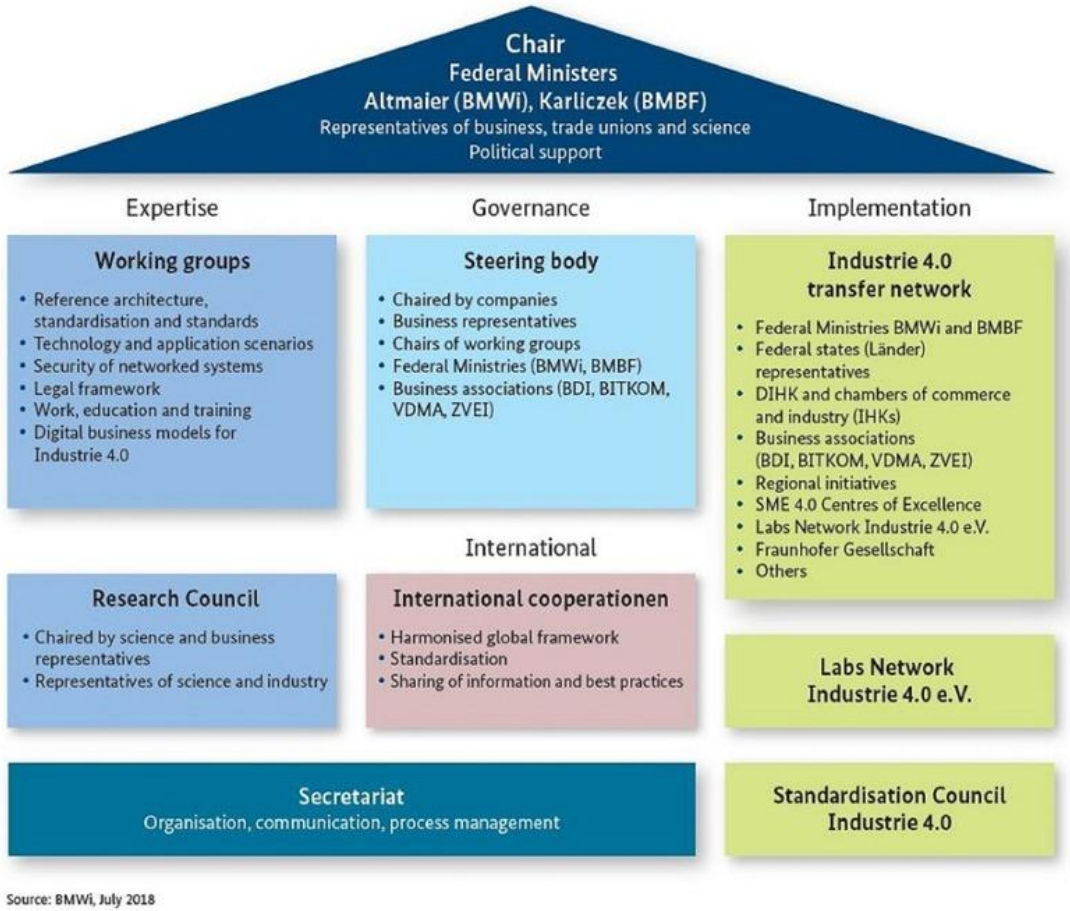
Plattform Industrie 4.0

Kai Garrels

Plattform Industrie 4.0

Germany's Industrial Internet Project

Plattform Industrie 4.0



Source: BMWi, July 2018

- ABB Ltd
- AIRBUS Group SE
- Atos Origin SE
- AUDI AG
- BASF SE
- Benteler International AG
- Bird & Bird LLP
- Bosch Rexroth AG
- Bundesamt für Sicherheit in der Informationstechnik
- Bundeskanzleramt
- Bundesministerium des Innern
- Bundesministerium für Bildung und Forschung
- Bundesministerium für Wirtschaft und Energie
- Bundesministerium für Arbeit und Soziales
- Bundesnetzagentur
- Bundesverband der Energie- und Wasserwirtschaft e.V. (BDEW)
- Bundesverband der Deutschen Industrie e.V. (BDI)
- Bundesverband Informationswirtschaft, Telekommunikation und neue Medien e.V. (BITKOM)
- Daimler AG
- Deutsche Kommission Elektrotechnik Elektronik Informationstechnik in DIN und VDE (DKE)
- Deutsche Telekom AG
- Deutsches Institut für Normung e.V. (DIN)
- EABB Consulting
- Endress+Hauser AG
- Ericsson
- ESR Pollmeier GmbH
- Festo AG
- Fraunhofer-Gesellschaft e.V.
- Fujitsu Technology Solutions GmbH
- GE Intelligent Platforms
- genua mbh
- Giesecke & Devrient GmbH
- HARTING Deutschland GmbH
- HDI-Gerling Industrie Versicherung AG
- Helmut-Schmidt-Universität Hamburg
- Hewlett-Packard GmbH
- HiSolutions AG
- Hochschule Ostwestfalen-Lippe
- HUBERT+SUHNER AG
- iABG GmbH
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- IG Metall
- IMA Klessmann GmbH
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- Noerr LLP
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- PSIPENTA Software Systems GmbH
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- SAP SE
- SCHAEFFLER AG
- Schneider Electric Automation GmbH
- secunet Security Networks AG
- SIEMENS AG
- SKW Schwarz Rechtsanwälte mbB
- Software AG
- T/S/C Fachanwälte für Arbeitsrecht mbB
- Technische Universität Berlin
- ThyssenKrupp AG
- TRUMPF GmbH
- T-Systems International GmbH
- Verband der Automobilindustrie e.V. (VDA)
- Verband Deutscher Maschinen- und Anlagenbau e.V. (VDMA)
- Voith GmbH
- Volkswagen AG
- Weidmüller Interface GmbH
- Wirtschaftsministerkonferenz
- Wissenschaftlicher Beirat der Plattform Industrie 4.0
- WITTENSTEIN AG
- Zentralverband Elektrotechnik- und Elektronik-industrie e.V. (ZVEI)
- ZF Friedrichshafen AG

Plattform Industrie 4.0

Germany's Industrial Internet Project

- Reference Architecture & Standardization
- Technology & Application Scenarios
- Cyber Security
- Legal Framework
- Labour, organization and education
- Digital Business Models

Source: BMWi, July 2018

- Automation & Electrical industry
- Machine Builders
- Process and Manufacturing
- IT Companies

- Academia
- Ministries for Research, Economy

- ABB Ltd
- AIRBUS Group SE
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2030 VISION FOR INDUSTRIE 4.0

Shaping Digital Ecosystems Globally

PLATTFORM INDUSTRIE 4.0

Autonomy

Scope for action delivers competitiveness and control of personal data in digital business models.

- Technology development
- Security
- Digital infrastructure

Interoperability

Cooperation and open ecosystems permit plurality and flexibility.

- Regulatory framework
- Standards and integration
- Decentralised systems and artificial intelligence

Sustainability

Modern industrial value creation ensures high standard of living.

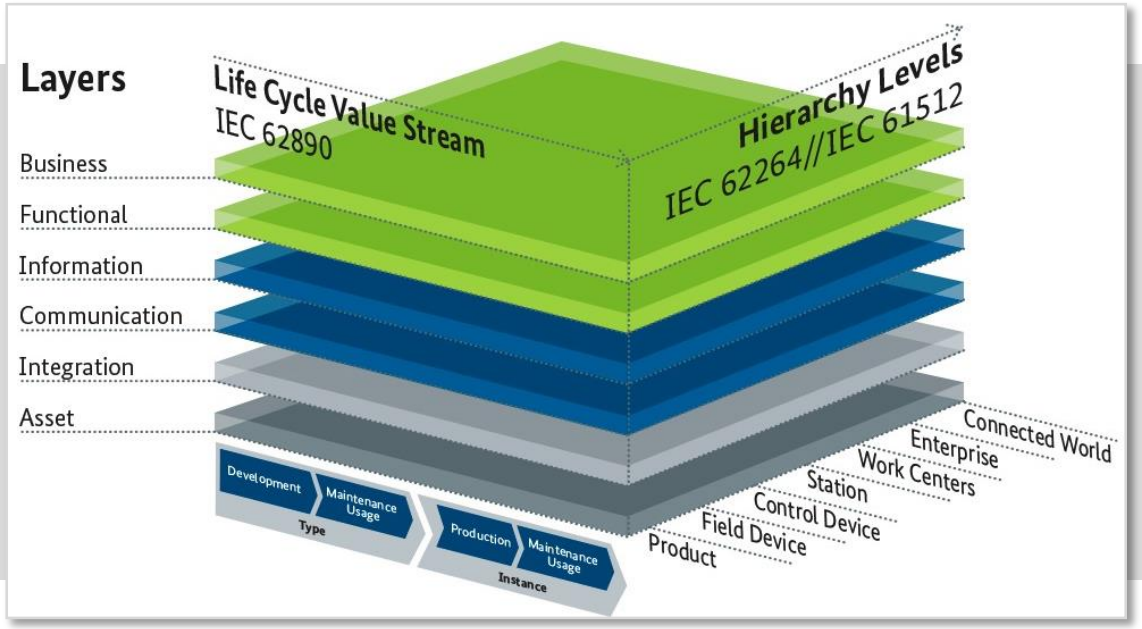
- Decent work and education
- Climate change mitigation and the circular economy
- Social participation

Reference Architectural Model Industrie 4.0

RAMI4.0 = guidance for Industrie 4.0

- **RAMI4.0** is a three-dimensional map showing the **most important aspects** of Industrie 4.0.

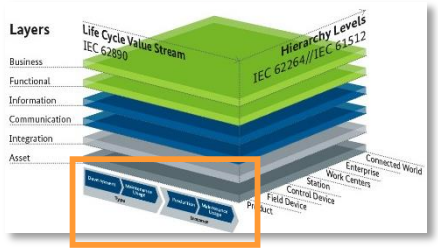
- **RAMI4.0** ensures that all participants involved share a **common perspective** and develop a **common understanding**.



Graphic © Plattform Industrie 4.0 and ZVEI

RAMI4.0 – first dimension

Product Life Cycle



The product: from the first idea to decomissioning.

Construction plan:

Development
Construction
Computer simulation
Prototype
…

Model maintenance:

Software updates
Instruction manuals
Product changes
…

Production:

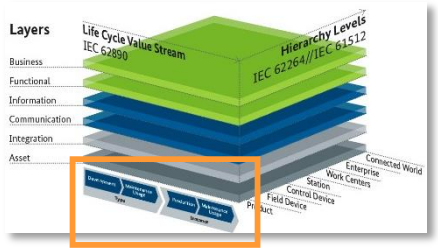
Product
Quality data
Serial number
…

Service:

Maintenance
Optimisation
Updates
Troubleshooting
Recycling
…

RAMI4.0 – first dimension

Product Life Cycle: Examples



Manufacturer

Development → Maintenance Usage (Type) → Production → Maintenance Usage (Instance)

System integrator

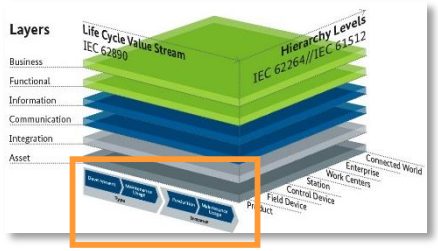
Development → Maintenance Usage (Type) → Production → Maintenance Usage (Instance)

Operator / end customer

Development → Maintenance Usage (Type) → Production → Maintenance Usage (Instance)

RAMI4.0 – first dimension

Product Life Cycle: Examples



Manufacturer

Development → Maintenance Usage (Type) | Production → Maintenance Usage (Instance)

Production
Product (motor)

delivery

System integrator

Development → Maintenance Usage (Type) | Production → Maintenance Usage (Instance)

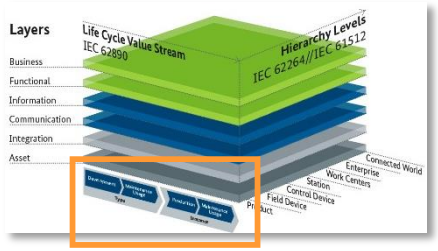
Production
Installation in the plant

Operator / end customer

Development → Maintenance Usage (Type) | Production → Maintenance Usage (Instance)

RAMI4.0 – first dimension

Product Life Cycle: Examples



Manufacturer

Development → Maintenance Usage (Type) → Production → Maintenance Usage (Instance)

Construction plan
Construction

Provide CAD data?

System integrator

D… → Usage (Type) → Production → Maintenance Usage (Instance)

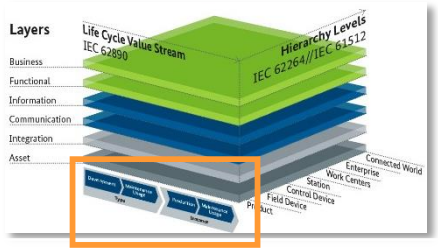
Construction plan
Engineering

Operator / end customer

Development → Maintenance Usage (Type) → Production → Maintenance Usage (Instance)

RAMI4.0 – first dimension

Product Life Cycle: Examples



Manufacturer

Development → Maintenance Usage (Type) → Production → Maintenance Usage (Instance)

System integrator

Development → Maintenance Usage (Type) → Production → Maintenance Usage (Instance)

Model maintenance
Software Updates

Operator / end customer

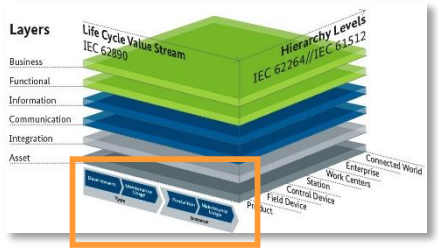
Development → Maintenance Usage (Type) → Maintenance Usage

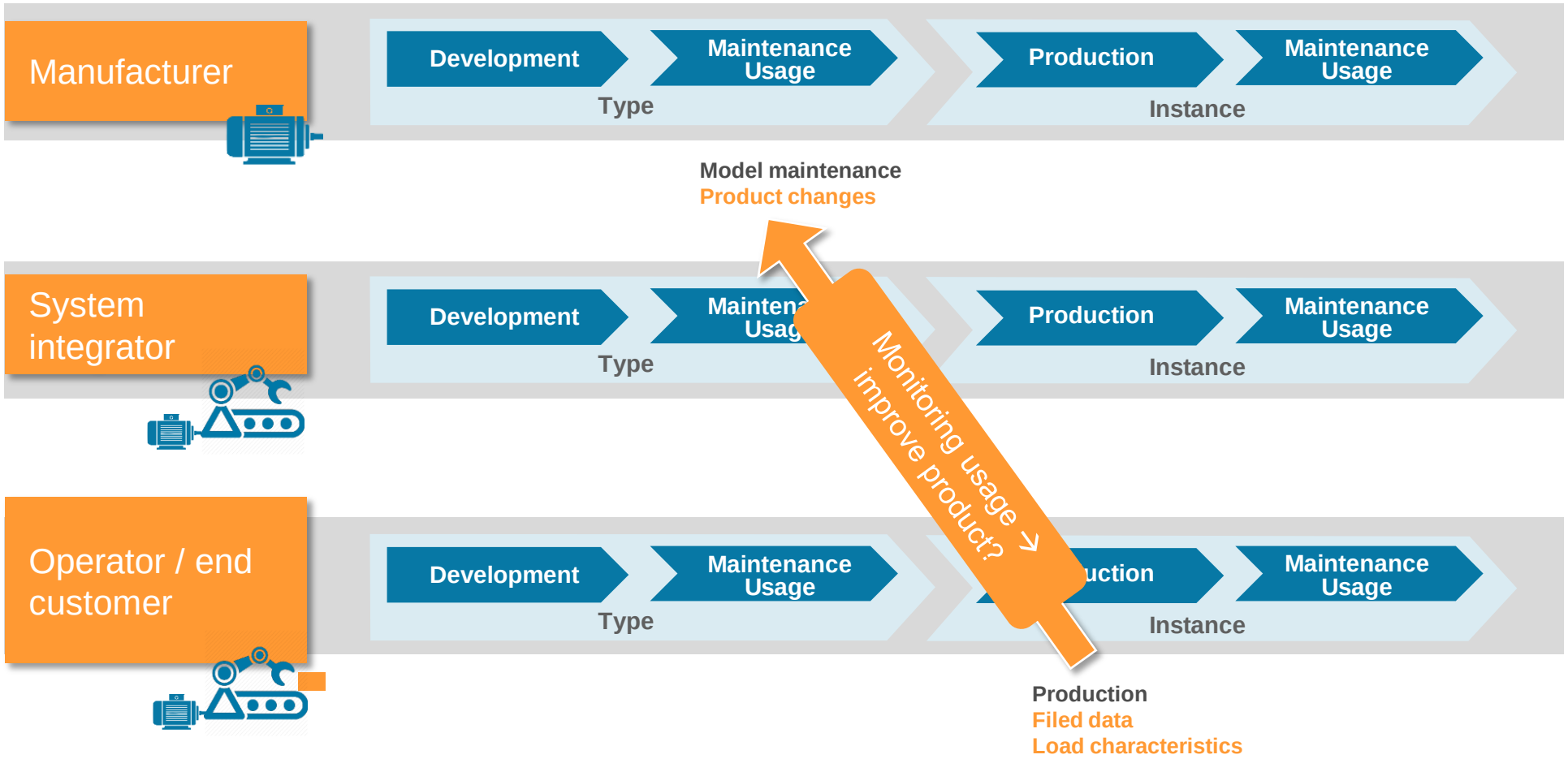
Sell updates?

Service
Maintenance

RAMI4.0 – first dimension

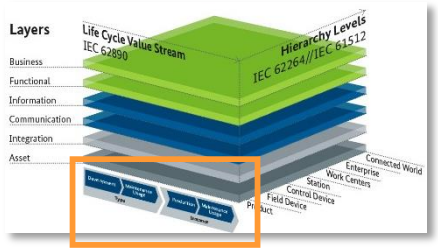
Product Life Cycle: Examples





RAMI4.0 – first dimension

Product Life Cycle: Examples



Construction plan:
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Product changes
…

Production:
Product
Quality data
Serial number
…

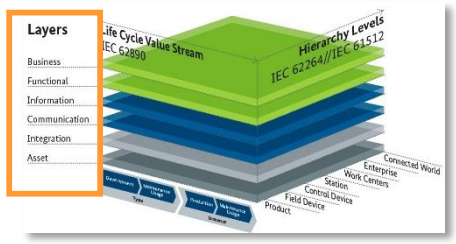
Service:
Maintenance
Optimisation
Updates
Troubleshooting
Recycling

Example: As a manufacturer of motors I can take two perspectives

- My **product and service offers** to my clients
- My **internal processes** and workflows

RAMI4.0 – second dimension

Basic questions about the business idea



Business	Organisation and business processes	What is the customer willing to pay for?
Functions	Functions of the asset	What is my product supposed to do?
Information	Necessary data	What data does my product have to provide?
Communication	Access to information	How do I or my customer access the data?
Integration	Integration of assets into the world of i	Which parts of my product are digitally available in the network?
Asset	“Things” in the physical world	How do I integrate my product with the process to move it in the real world?

Reference Architectural Model Industrie 4.0

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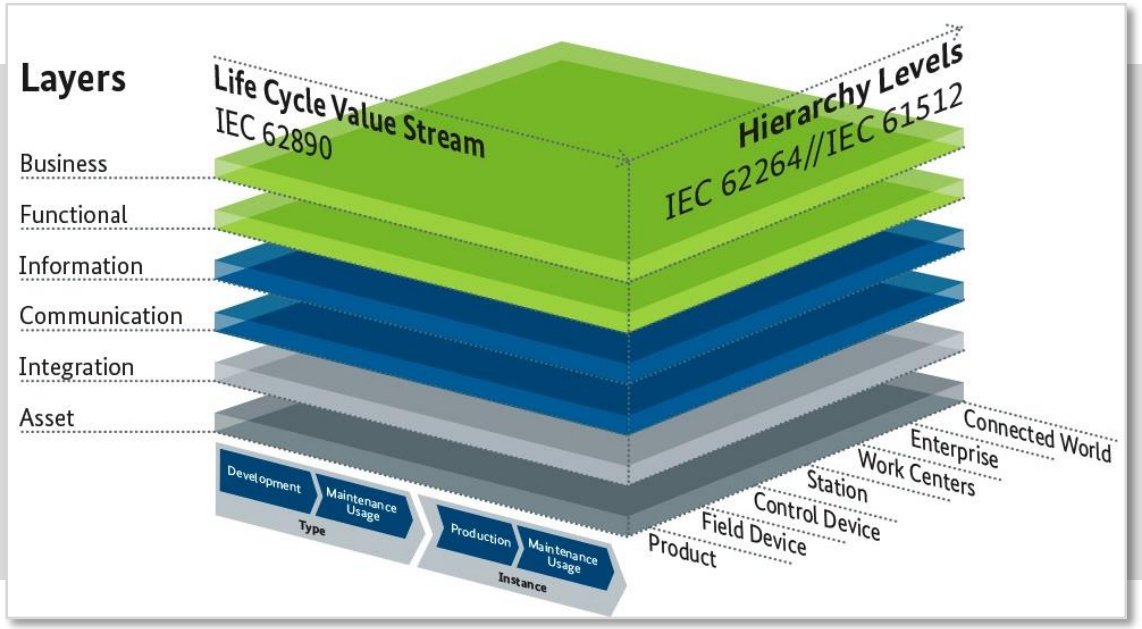


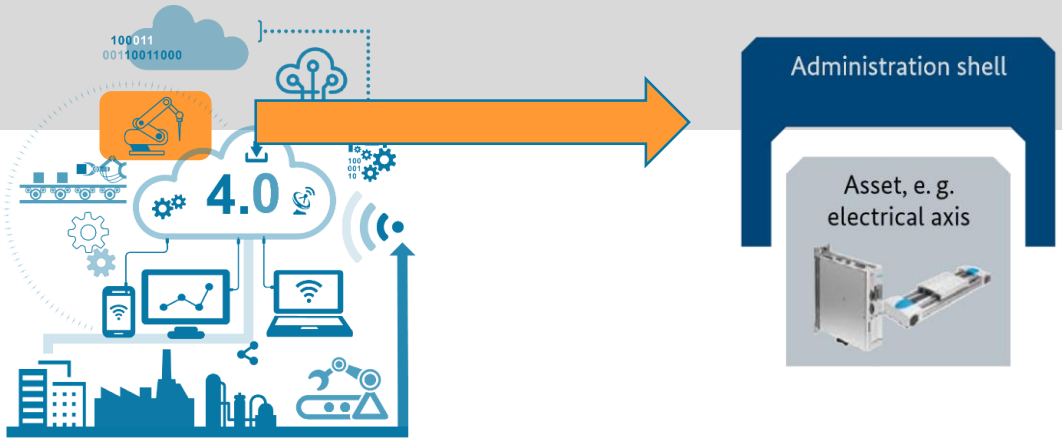
Industrie 4.0 components

Assets integrate into the IT world

Integration of *assets* into the world of information

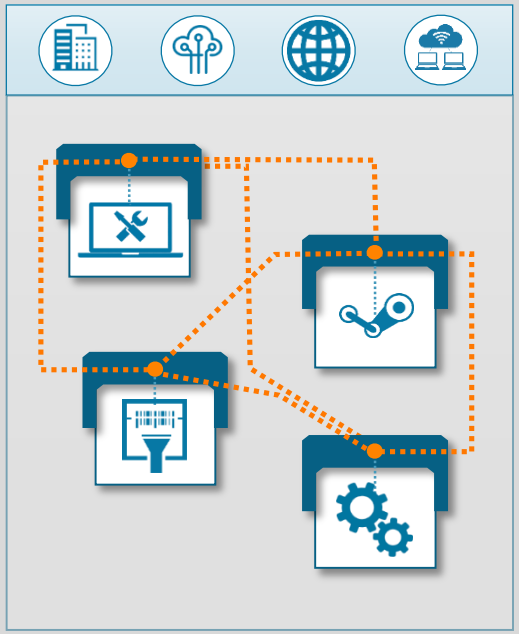
Asset = everything that requires a "connection" for an Industrie 4.0 solution

- Machines and their components
- Supply materials, parts and products
- Exchanged documents (e.g. drawings, wiring diagrams)
- Contracts
- Orders
- …



Industrie 4.0 components

The Administration Shell implements digital integration



The Administration Shell…

- integrates the *asset into Industrie 4.0 communication*.
- provides a *controlled access to all information* of the asset.
- is the standardised and secure *communication interface*.
- can also integrate *„passive“ assets* without a communication interface, e.g. via bar codes or QR codes.
- is *addressable* in the network and *identifies the asset* unambiguously

Administration Shell =

„Internet presence“

of an Industrie 4.0 component

Industrie 4.0 components

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Integration of *assets* into the world of information

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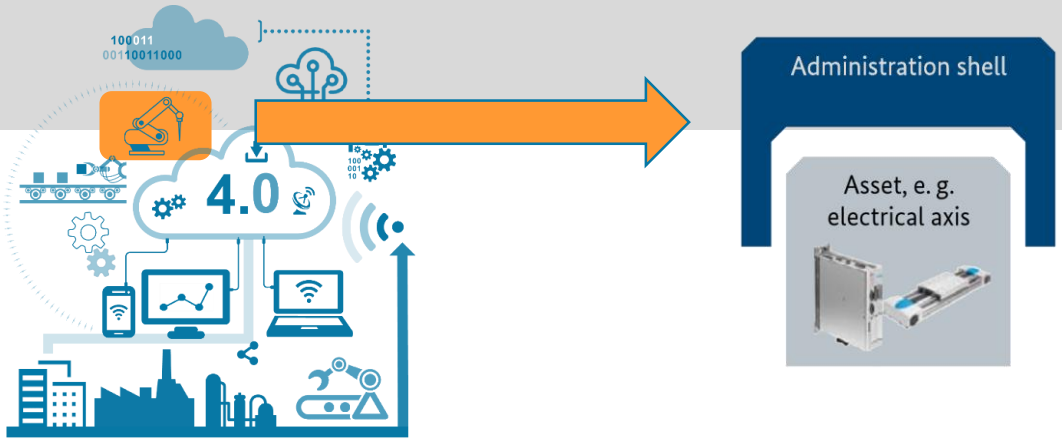

Industrie 4.0 components

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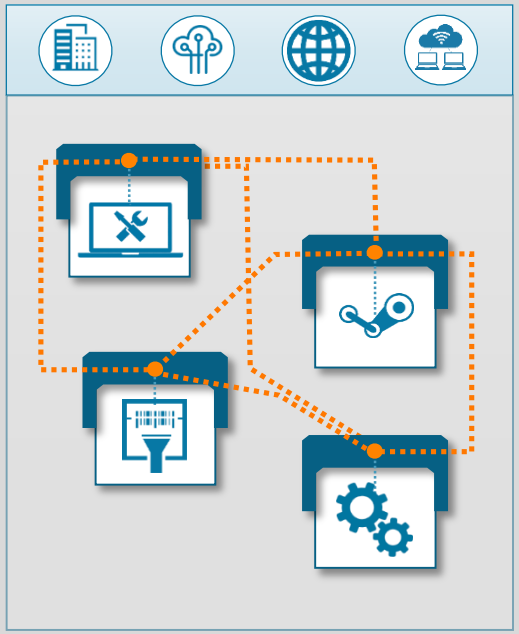

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Administration Shell =

„Internet presence“

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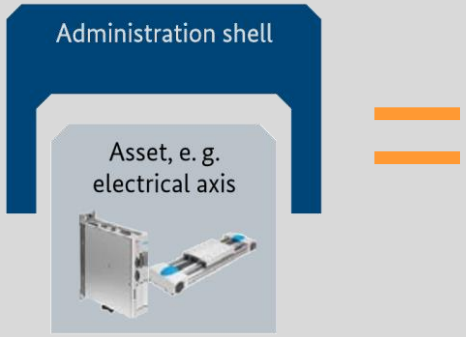
Details of the Administration Shell

The generic structure of the meta-information model



Administration Shell with its identifier (“Internet adress”)

- Header with asset identifier
- Body with submodels
- Submodels with properties

Access to information and functionalities

Administration Shell

ID Asset(s)

ID Administration Shell

Header

.. and others

Body

Submodel 1 e.g. energy efficiency

- Energy saving mode [1,2,3] → Data
- Cumulated energy [Wh] → Data
- Potential savings [%] → Function
- Property 1.1.1.2 → Function
- Property 1.1.1.3

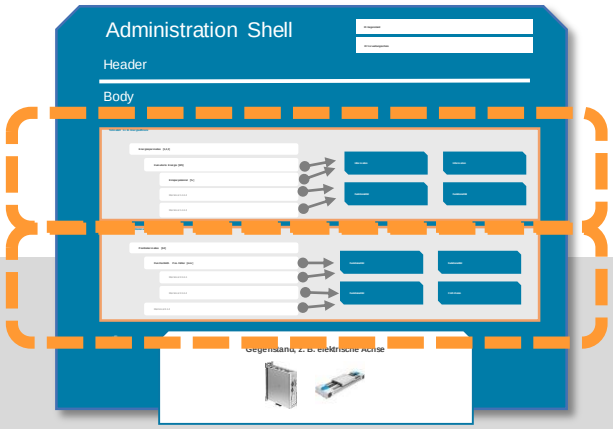
Submodel 2 e.g. positioning mode

- Positioning mode [0-2] → Function
- Average pos. error [mm] → Function
- Property 2.1.1.1 → Function
- Property 2.1.1.2 → CAD data
- Property 2.1.2

.. and others

Source: Plattform Industrie 4.0 illustration based on ZVEI SG Modelle & Standards

Details of the Administration Shell
Submodels



***Submodel* = aggregates information that belongs together**

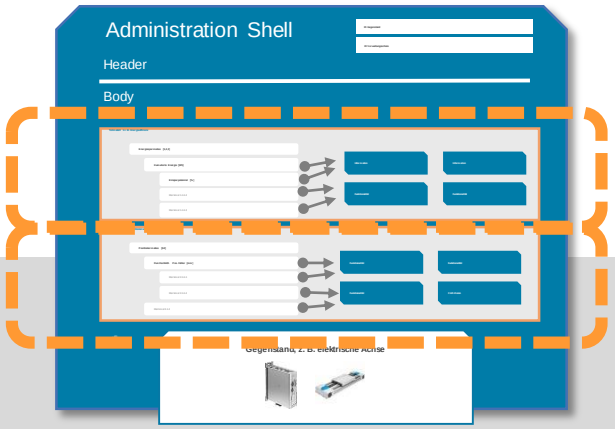
- *Submodels* combine different functional aspects of an Industrie 4.0 component
- *Basic submodels* (standardised): apply to many assets in the Industrie 4.0 world (e.g. catalogue data of products)
- *Free submodels*: agreed between partners in the value chain for a specific use case

Submodels should always be linked to a use case that creates value.

An Administration Shell may contain many submodels.

Aim: To develop one sub-model for each functional aspect.

Details of the Administration Shell
Properties



Submodels **contain properties**

"Properties" are interpreted here in a more general sense.

- *Product properties* in terms of IEC61360-1 or ecl@ss
- *Process variables* and parameters, telemetry data
- *References* to external data sources or files
- *References* to other Administration Shells and their parts (submodels, properties), also from external partners in the value chain
- *Capabilities* of the asset, description of method calls
- *Sets* of properties, e.g. lists or arrays

Example

Submodel „energy efficiency" contains the following properties
- Energy saving mode [1,2,3]
- Cumulated energy [Wh]
- Potential savings [%]

Submodel „positioning mode" contains the following properties
- Positioning mode [0-2]
- Average pos. error [mm]

Coordination of activities

Industry partners involved