

# Plattform Industrie 4.0

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RAMI4.0 – a reference framework  
for digitalisation

# An Overview

- ▶ Industrie 4.0  
*Background: What's new, really?*
- ▶ RAM I4.0 – an overview  
*Guidance for Industrie 4.0*
- ▶ RAM I4.0 in practice  
*What does digitalisation mean for my own company?*
- ▶ RAM I4.0 international  
*Collaborations and mappings towards a global standard*

# Industrie 4.0

## connecting business processes – across company borders

- ▶ Internet is available everywhere, simple and cheap.
- ▶ Devices are becoming intelligent.
- ▶ Using this in a smart way opens up a new world of services and functions.
- ▶ Industrie 4.0 connects all parties involved in business processes in the manufacturing and process industry.
- ▶ Information from suppliers, customers and within your own company is connected and transparently available.
- ▶ Workpieces and machines manage the production autonomously – flexible, efficient, resource-saving.
- ▶ There are transitions between companies and sectors.



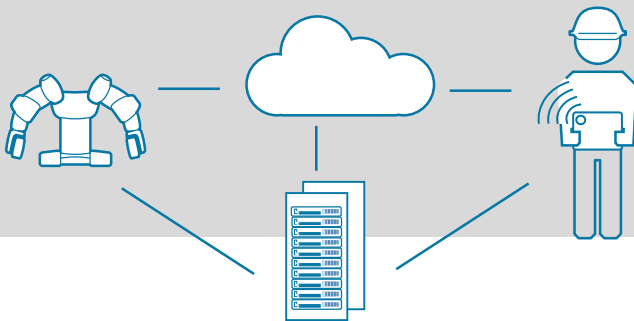
Graphic © Anna Salari, designed by freepik

# Industrie 4.0

## What's new, really?

That's already possible today

- ▶ The cloud
- ▶ The network
- ▶ Automation devices with Internet access
- ▶ Internet-based services



New ingredients

Uniform and sector-neutral standards for services and semantics

From Intranet to Internet



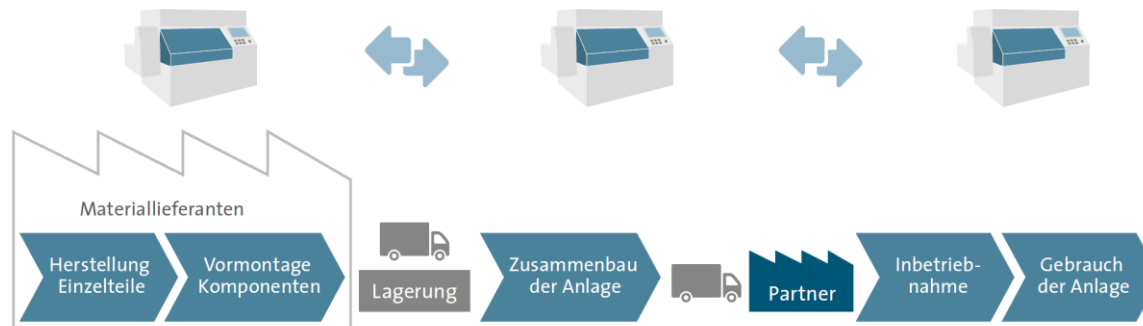
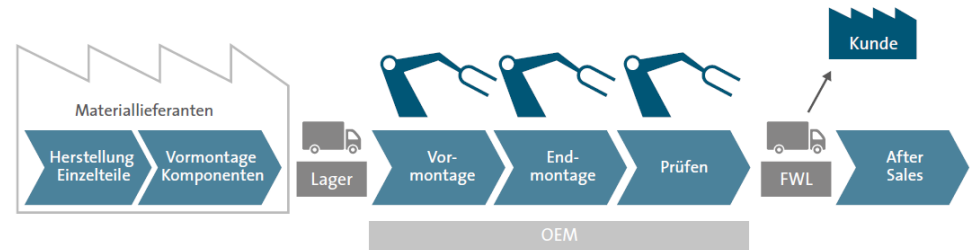
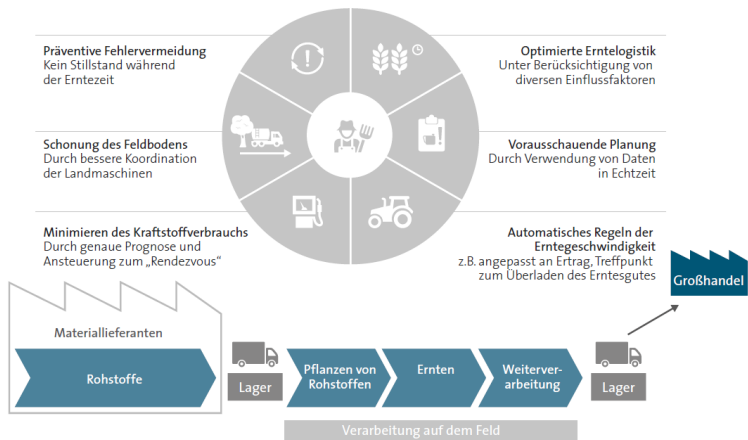
Industrie 4.0

- ▶ Exchanging information between value chain partners
- ▶ New business models and applications



**Added value created from information flow**

# Value chains across different sectors



# Common Standards

## Requirements for digitised industrial production

- ▶ **Common** communication structures: network and protocols
- ▶ **Common** rules for cyber security and data protection
- ▶ **Common** language including signs, alphabet, vocabulary, syntax, grammar, semantics, pragmatics and culture



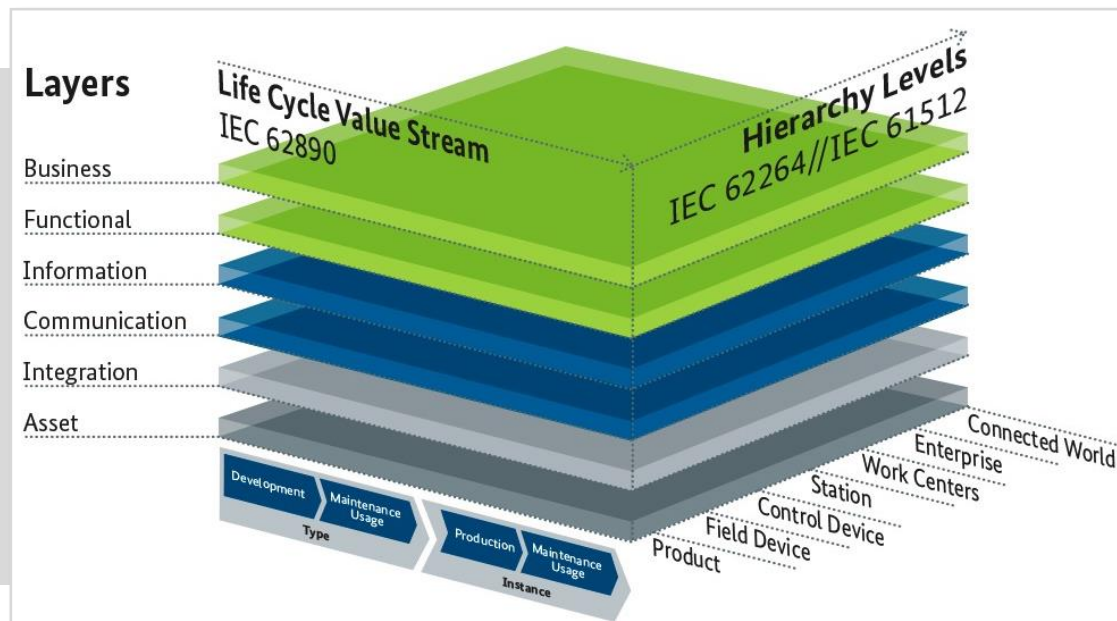
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# Reference Architectural Model Industrie 4.0

## 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**.

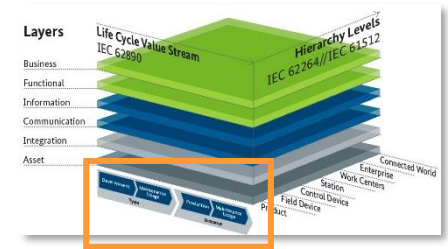




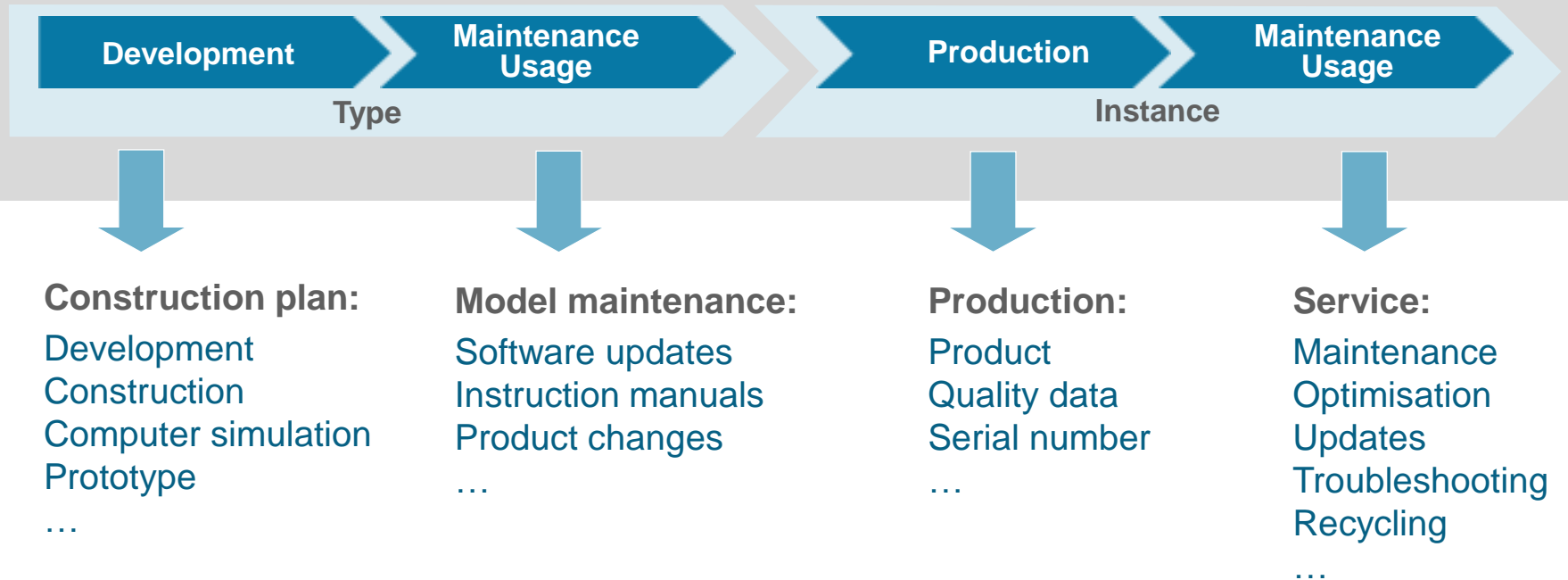
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# RAMI4.0 – first dimension Product Life Cycle

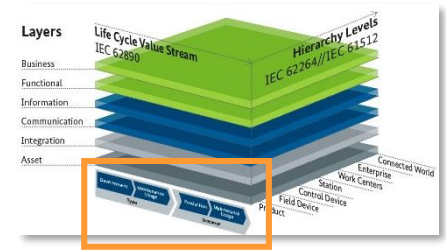


**The product:** from the first idea to decommissioning.




# RAMI4.0 – first dimension

## Product Life Cycle: Examples



Manufacturer




System integrator

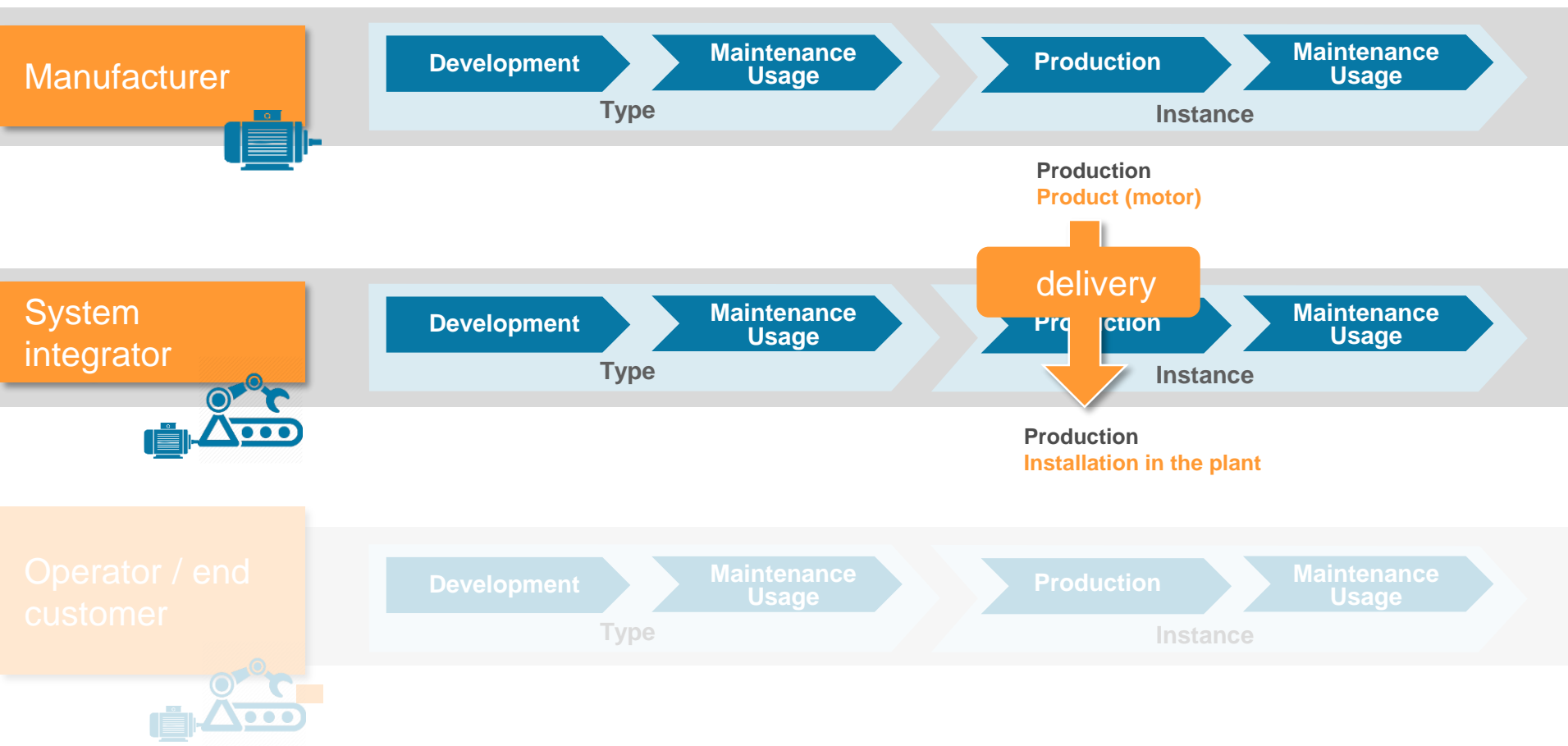
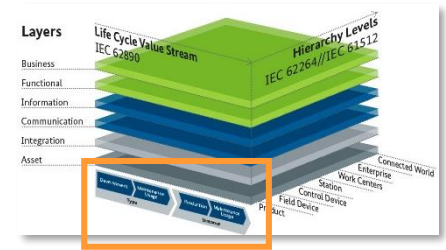



Operator / end customer



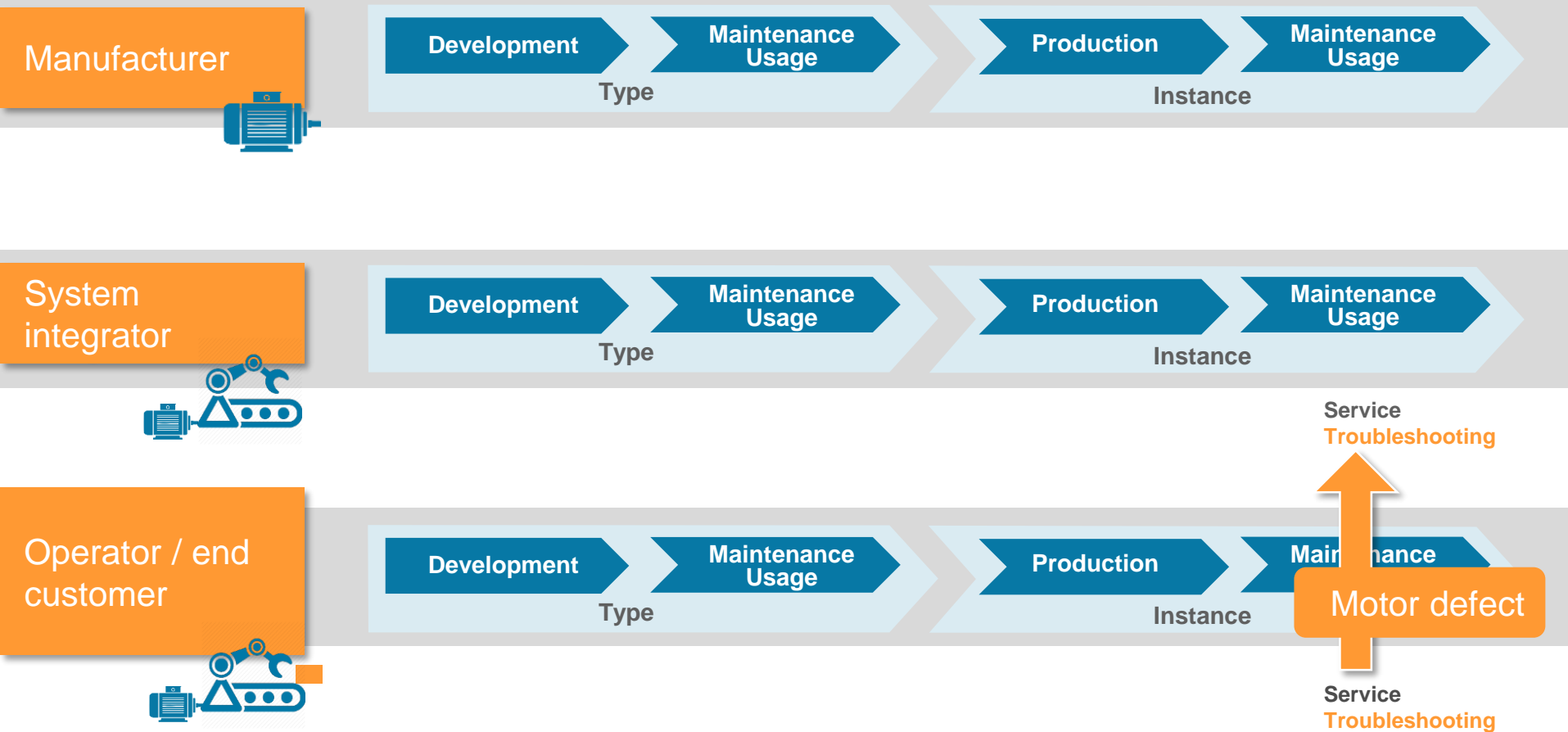
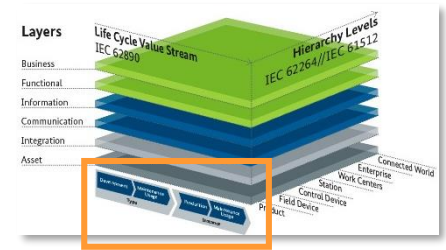

# RAMI4.0 – first dimension

## Product Life Cycle: Examples



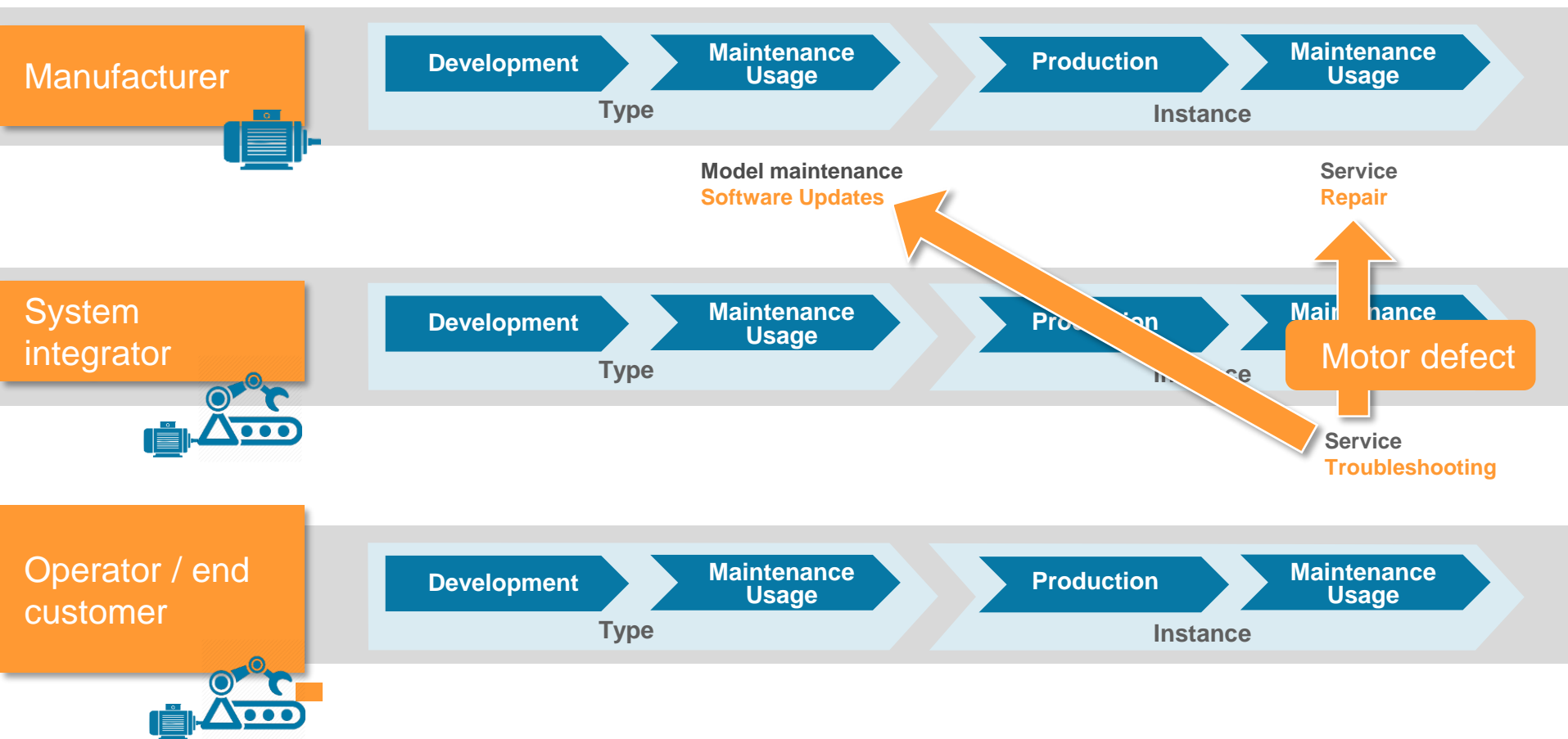
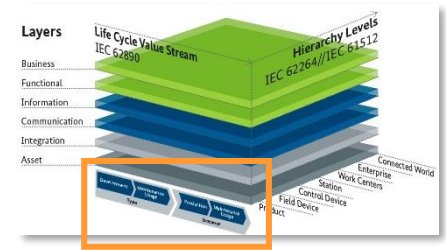
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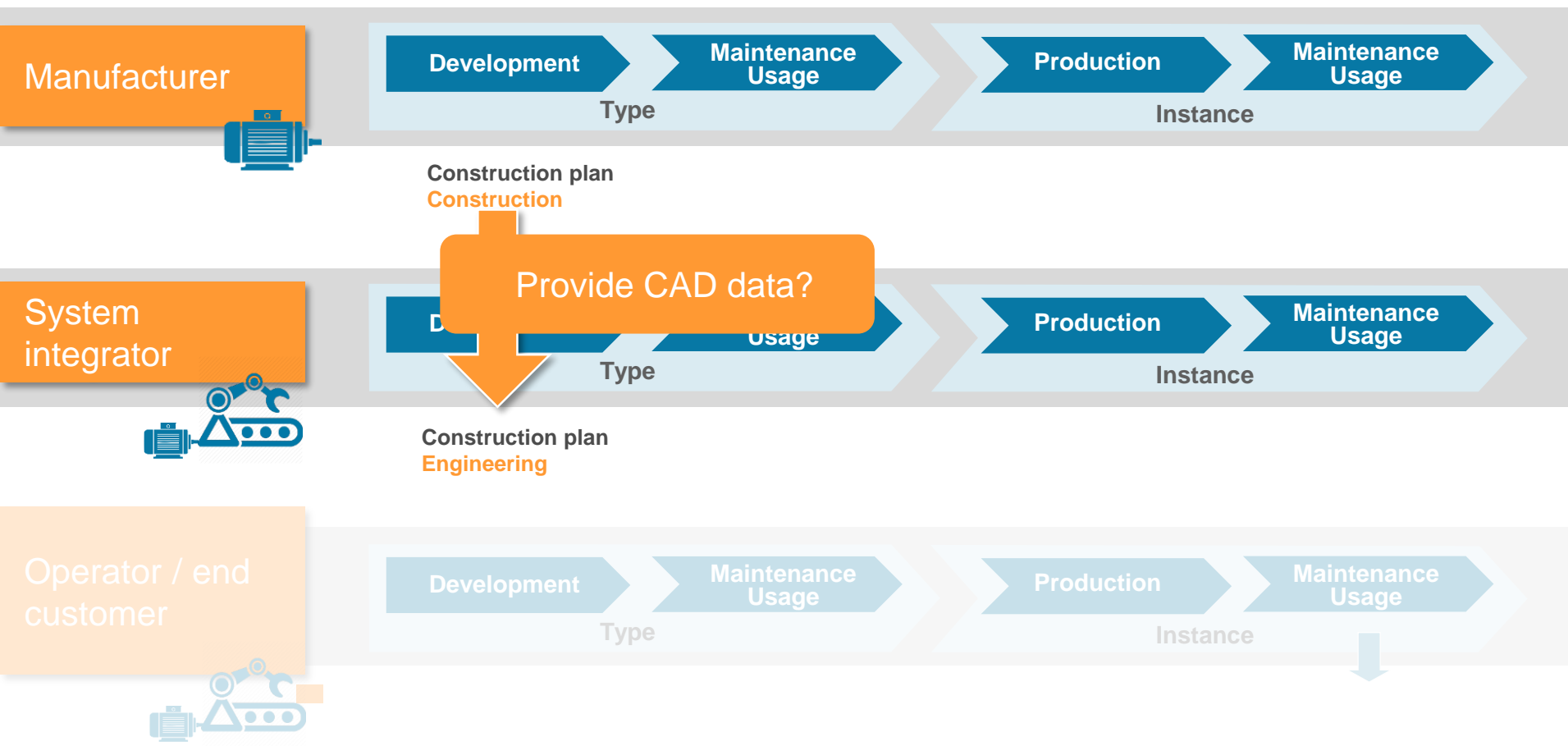
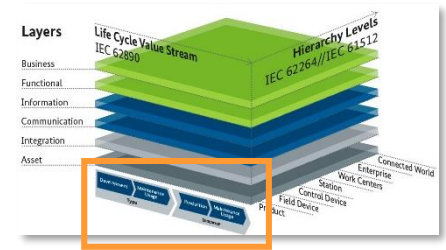
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## Product Life Cycle: Examples



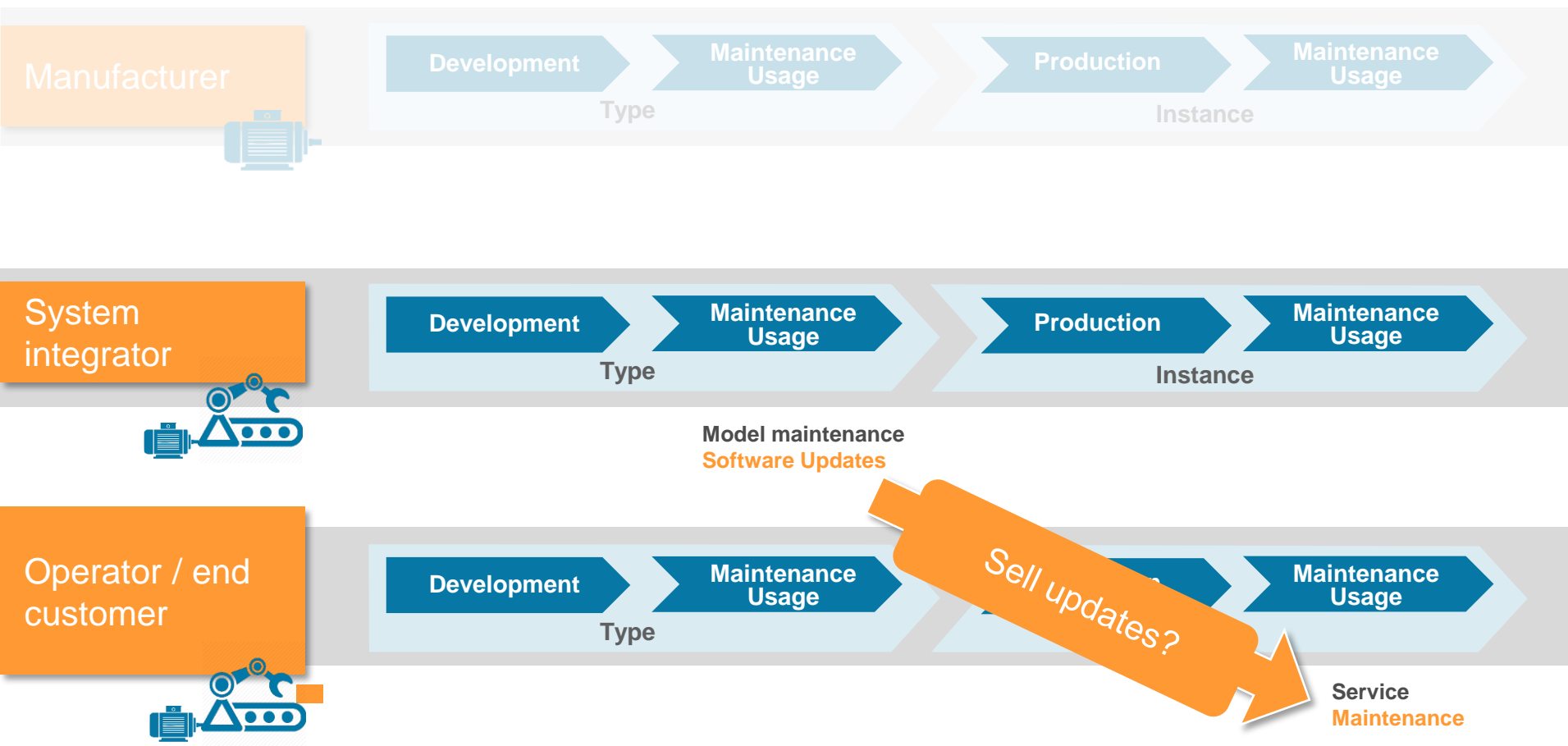
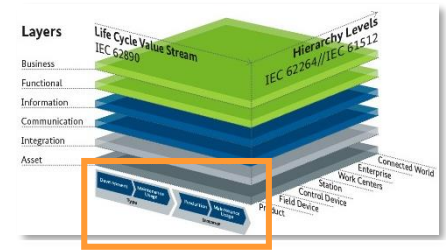
# RAMI4.0 – first dimension

## Product Life Cycle: Examples



# RAMI4.0 – first dimension

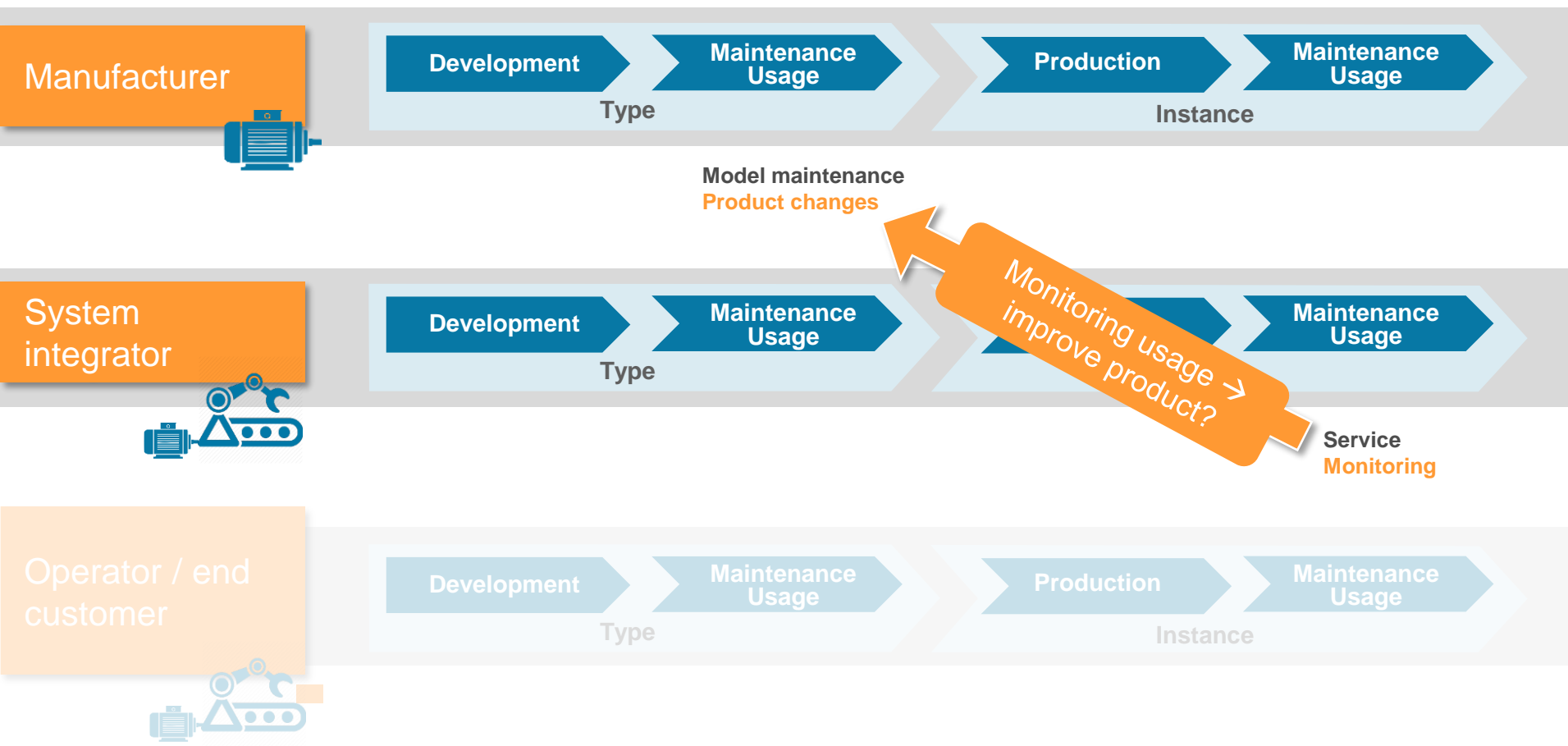
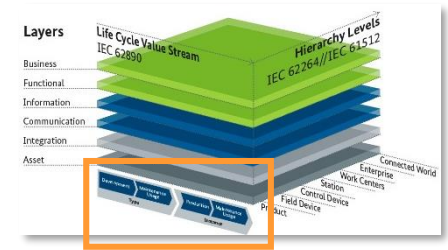
## Product Life Cycle: Examples





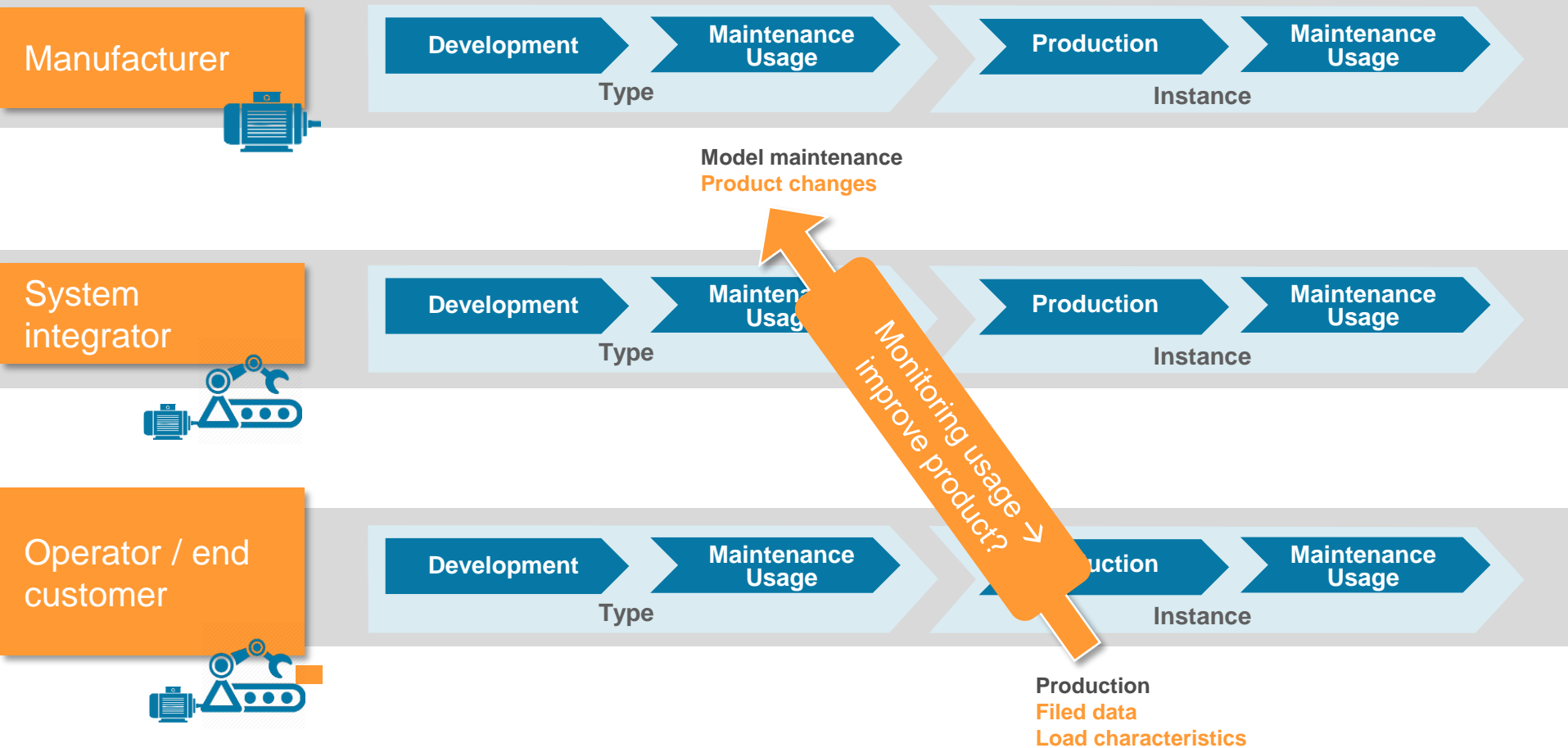
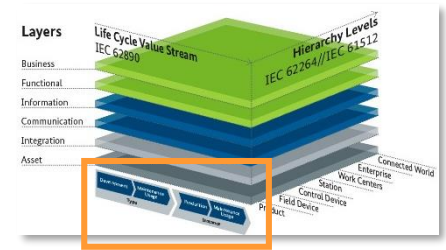
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## Product Life Cycle: Examples



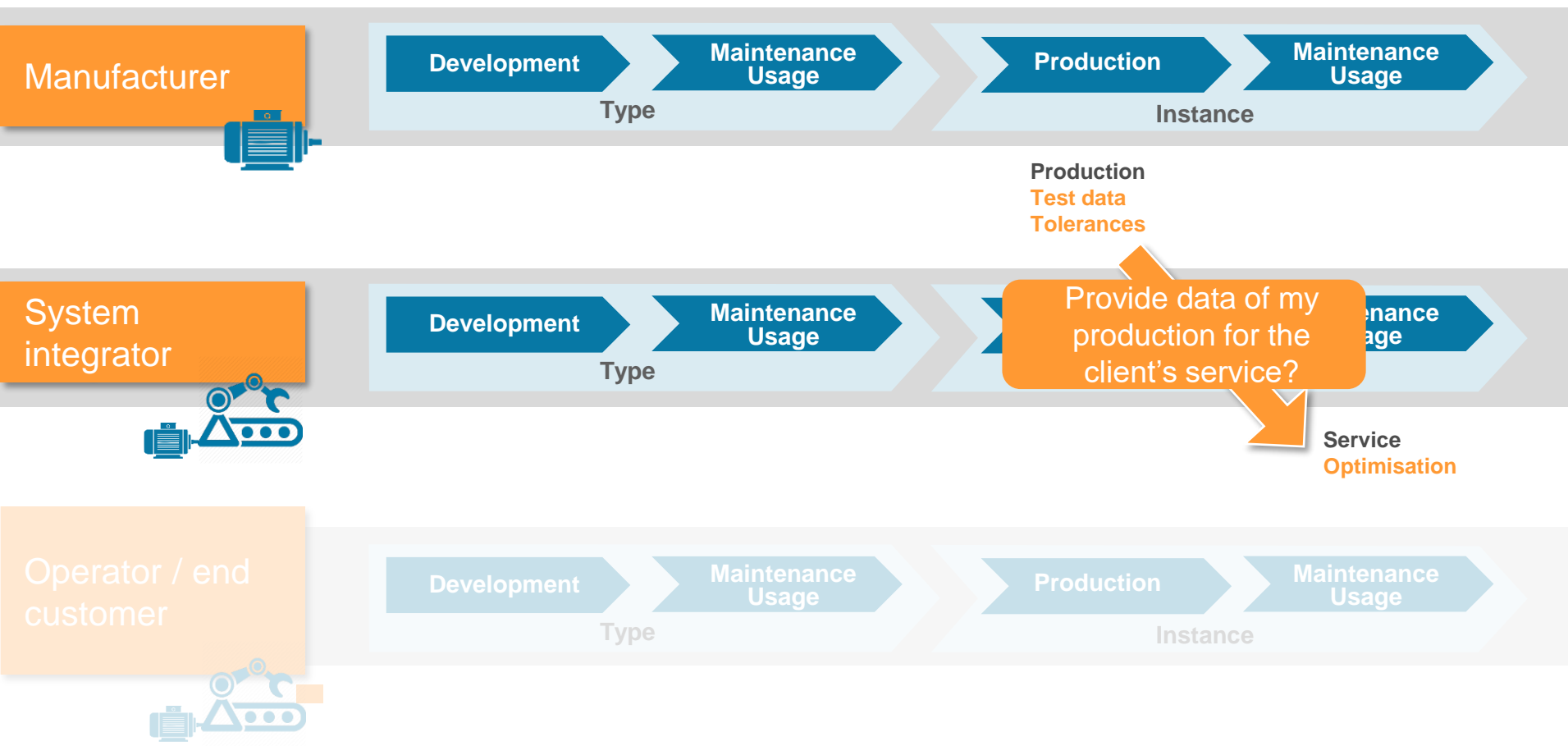
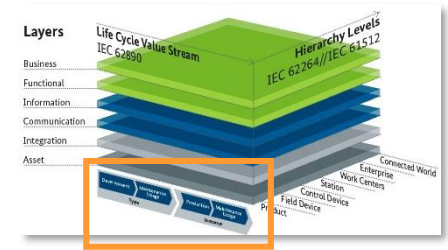
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## Product Life Cycle: Examples



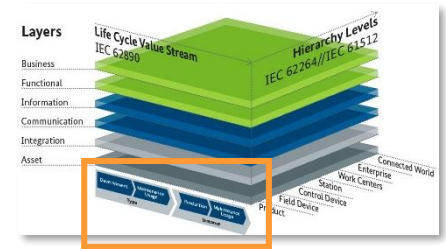
# RAMI4.0 – first dimension

## Product Life Cycle: Examples



# RAMI4.0 – first dimension

## Product Life Cycle: Examples



**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

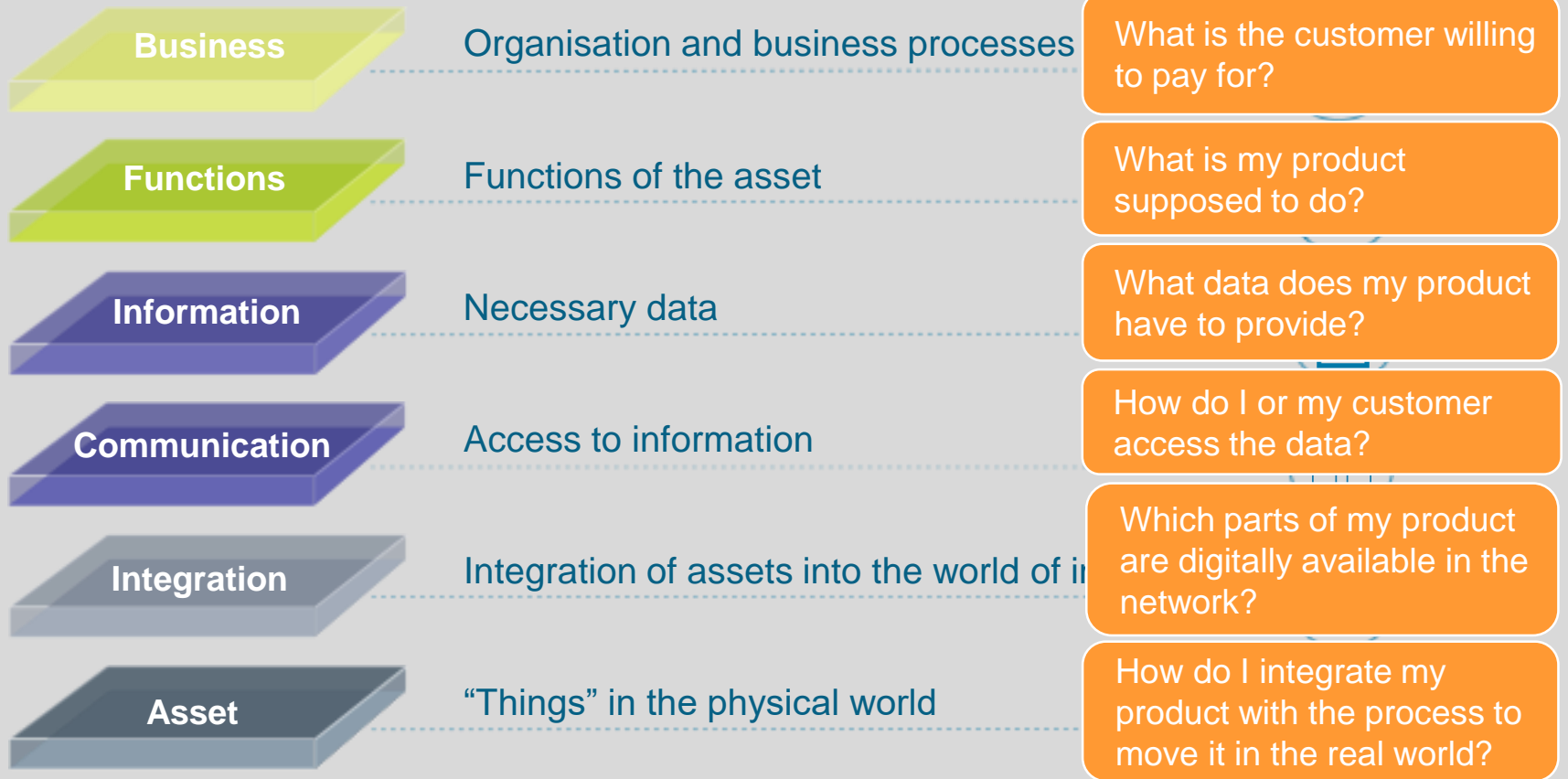
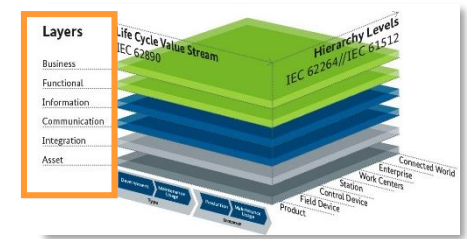


**Example: As a manufacturer of motors I can take two perspectives**

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

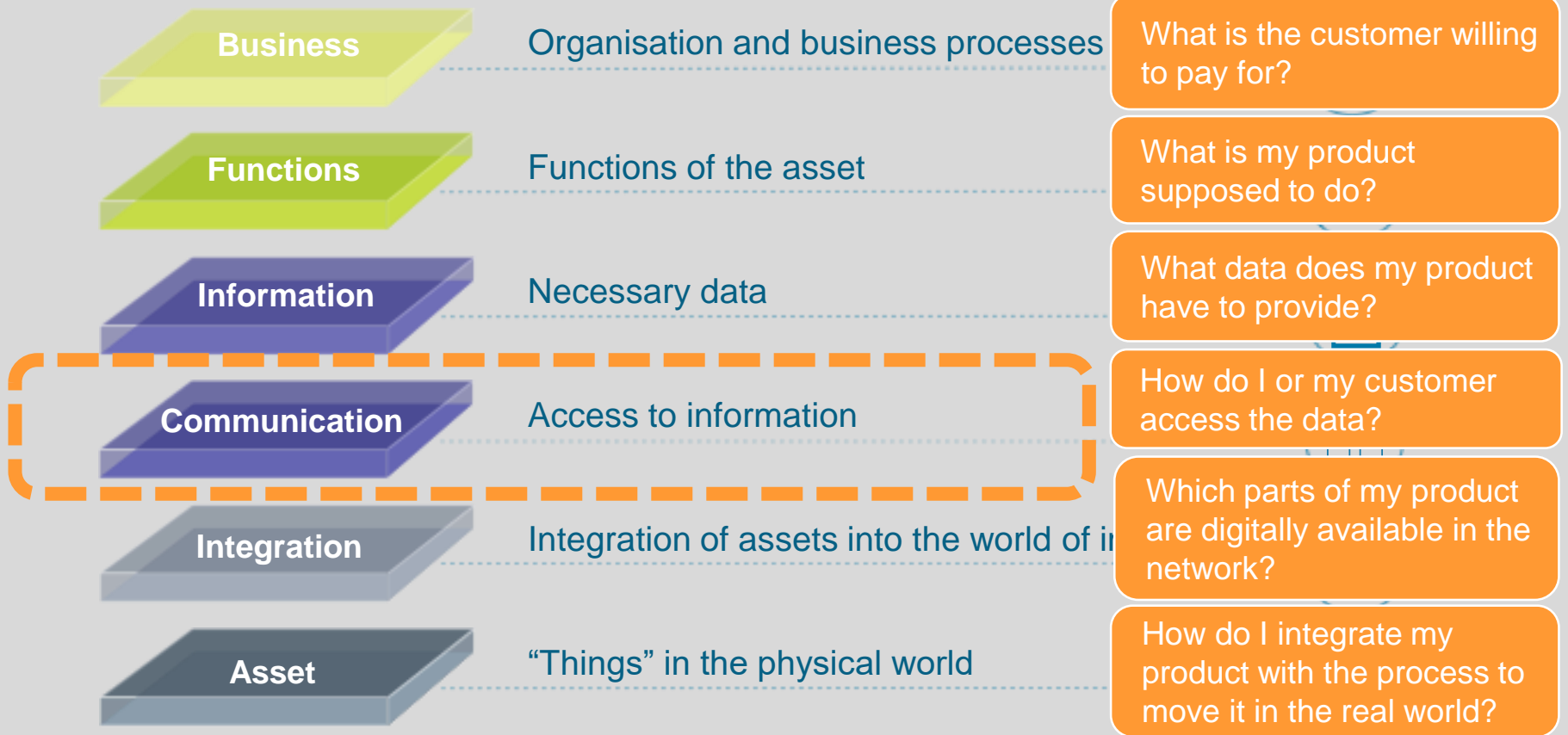
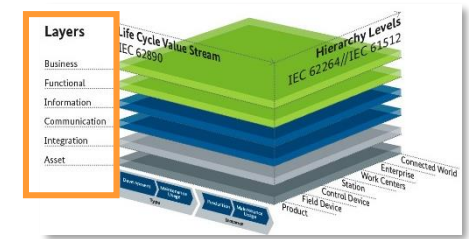
# RAMI4.0 – second dimension

## Basic questions about the business idea



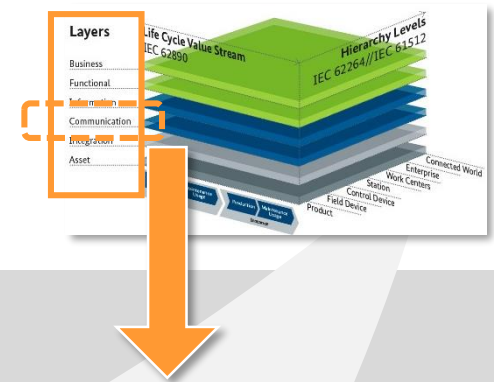
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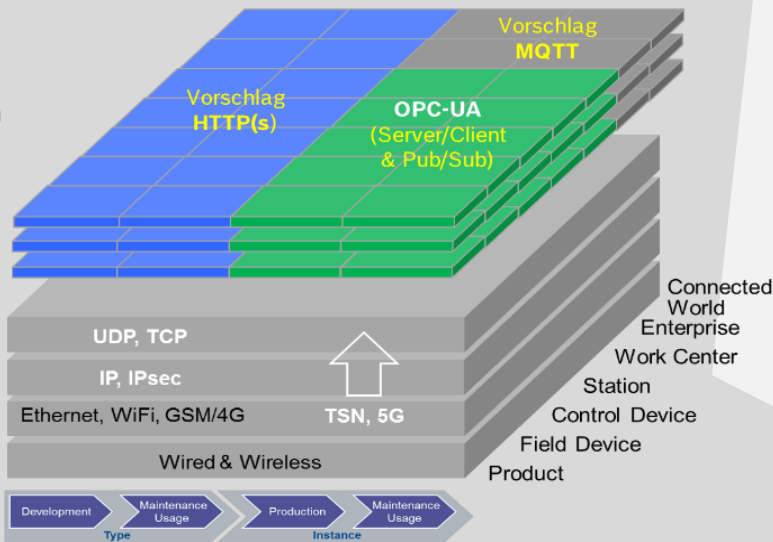
# RAMI 4.0 – Communication layer

## Agreements on communication



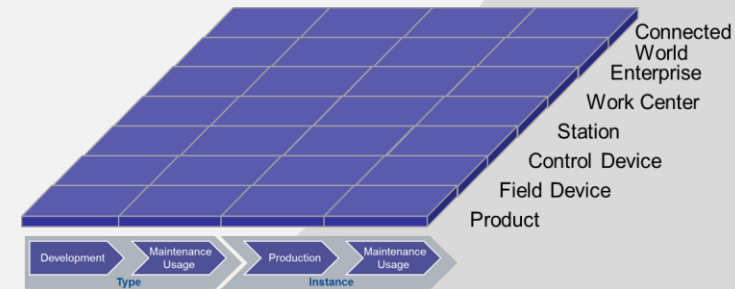
Communication layer with its individual ISO/OSI layers

OSI Schichten



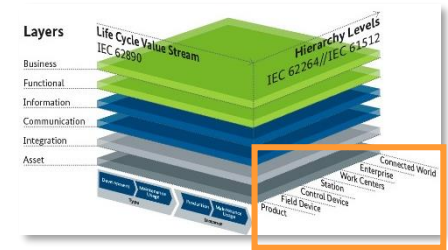
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Communication layer



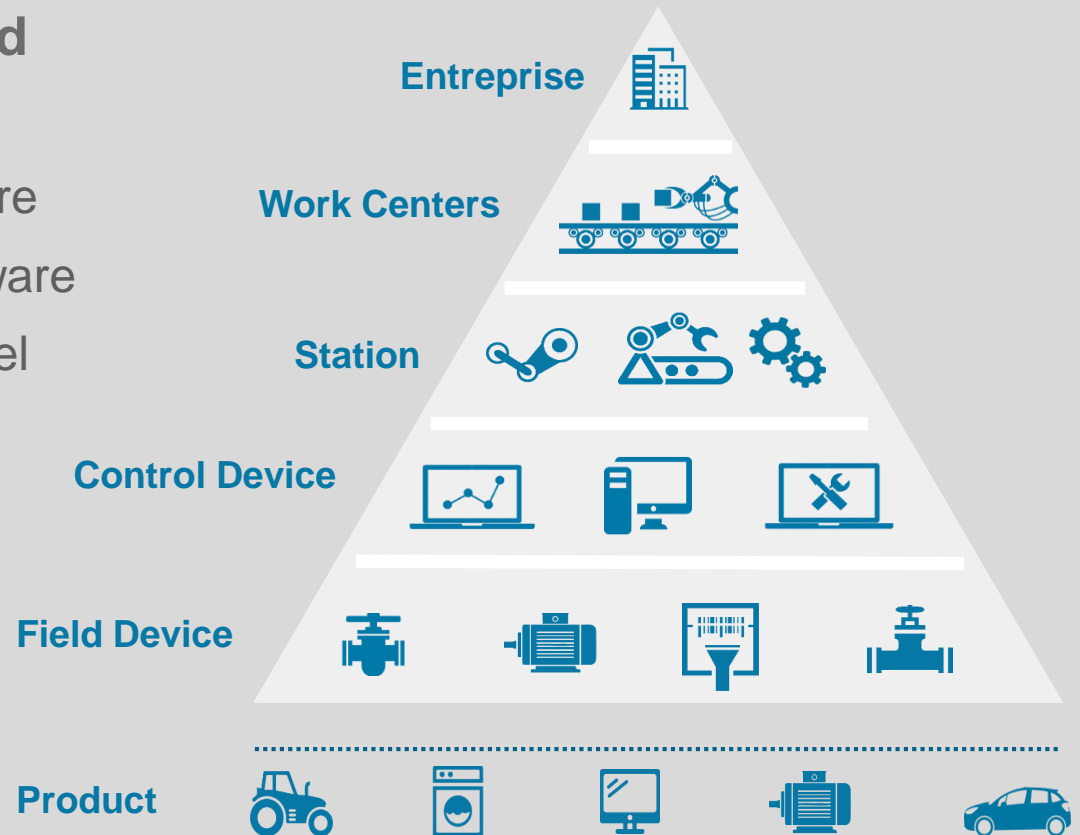
Basis for **standardized communication** between Administration Shells

# RAMI4.0 – third dimension Factory hierarchy: the old world



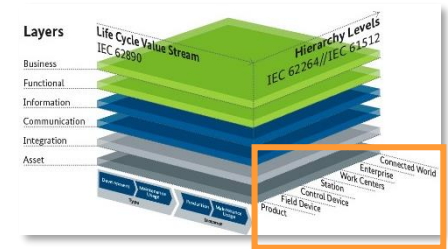
## Industrie 3.0 = the old world

- ▶ Hardware defines the structure
- ▶ Functions are linked to hardware
- ▶ Communication from one level to the other
- ▶ The product is isolated





# RAMI4.0 – third dimension Factory hierarchy: the new world



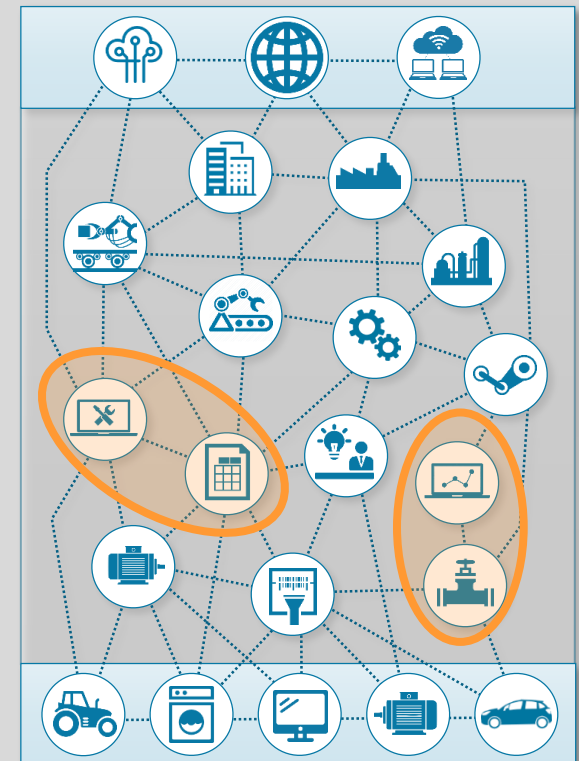
## Industrie 4.0 = the new world

- ▶ Flexible systems and machines; functions are distributed through the network.
- ▶ The network can cross company boundaries.
- ▶ Participants interact across hierarchical levels
- ▶ All participants are able to communicate with each other.
- ▶ Products are part of the network.

**Connected World**

**Flexible factory**

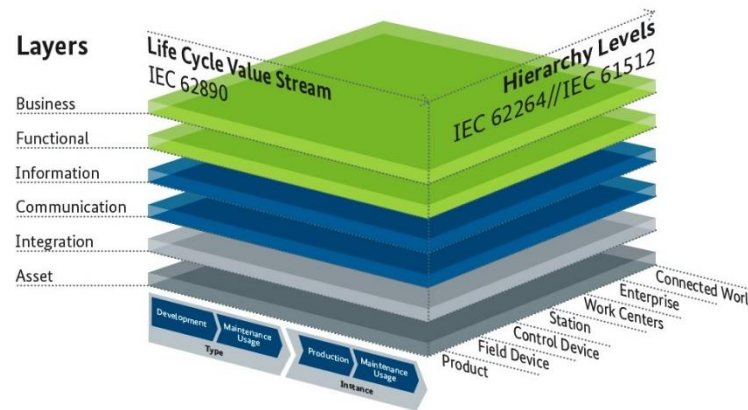
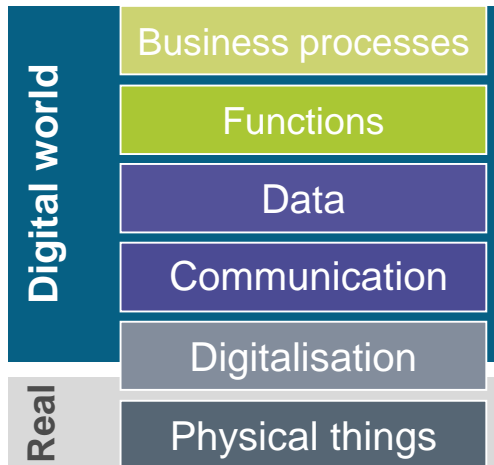
**Products**



# Reference Architectural Model Industrie 4.0

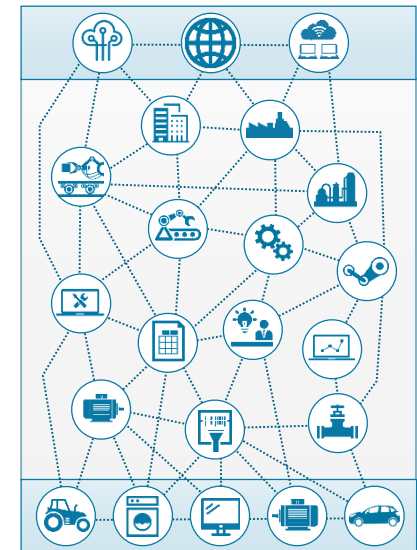
## RAMI4.0 = guidance for Industrie 4.0

### Architecture



### Product Life Cycle

### Hierarchy



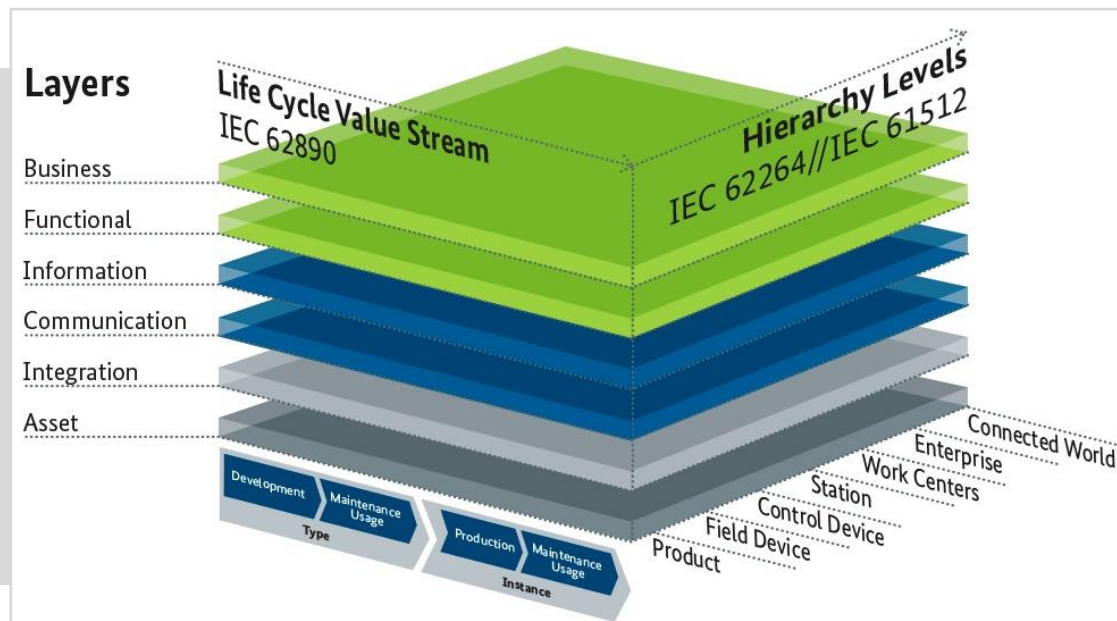
**Development, Production / Sales, Service**

**A solution space including a coordinate system for Industrie 4.0**

# Reference Architectural Model Industrie 4.0

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# Reference Architectural Model Industrie 4.0

## International cooperations: Towards a global standard



Successful mapping of the internationally approved pre-standard RAMI 4.0 (IEC PAS 63088) with nationally developed reference architectures of other countries

### USA:

- ▶ **since 2016:** collaboration with Industrial Internet Consortium (IIC)
- ▶ **2017:** Whitepaper: presentation and comparison of RAMI 4.0 & Industrial Internet Reference Architecture (IIRA)
- ▶ **2018:** strengthening bilateral cooperation
- ▶ **2019:** joint discussion on Industrie 4.0 component and Administration Shell



# Reference Architectural Model Industrie 4.0

## International cooperations: Towards a global standard

### Germany, France and Italy:

- ▶ Trilateral cooperation and joint working groups with Alliance Industrie du Futur (France) and Piano Impresa 4.0 (Italy) in several areas, including reference architectures

### China:

- ▶ **since 2017:** cooperation in several working groups
- ▶ **2018:** finalization of reports to harmonize RAMI 4.0 with the Chinese counterpart IMSA

### Japan:

- ▶ Initial harmonization of RAMI 4.0 and the Japanese counterpart IVRA



# Reference Architectural Model Industrie 4.0

## Further information

- ▶ The ZVEI explains RAMI 4.0 (video):  
<https://www.youtube.com/watch?v=fFIQ2o-5QLo>
- ▶ Whitepaper “Architecture Alignment and Interoperability” von Plattform Industrie 4.0 und Industrial Internet Consortium: <https://www.plattform-i40.de/PI40/Redaktion/DE/Kurzmeldungen/2018/2018-02-06-whitepaper-iic-pi40.html>
- ▶ Alignment Report for Reference Architectural Model for Industrie 4.0/ Intelligent Manufacturing System Architecture (IMSA – China):  
<https://www.plattform-i40.de/PI40/Redaktion/DE/Downloads/Publikation/hm-2018-manufacturing.html>
- ▶ DIN SPEC 91345:2016-04 - Referenzarchitekturmodell Industrie 4.0 (RAMI 4.0): <https://www.plattform-i40.de/PI40/Redaktion/DE/Downloads/Publikation/din-spec-rami40.html>

# Plattform Industrie 4.0

## Platform's Project Office

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