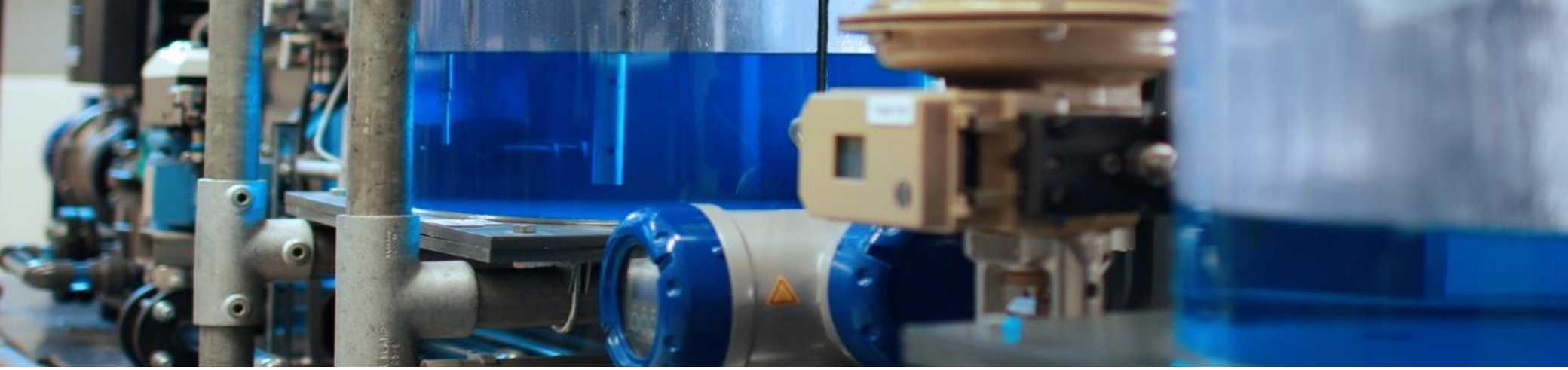


A Reference Architectural Model for Industrie 4.0

Ulrich Epple, RWTH Aachen

German-Czech Workshop on Industrie 4.0/Průmysl 4.0
Prague , April 11, 2016

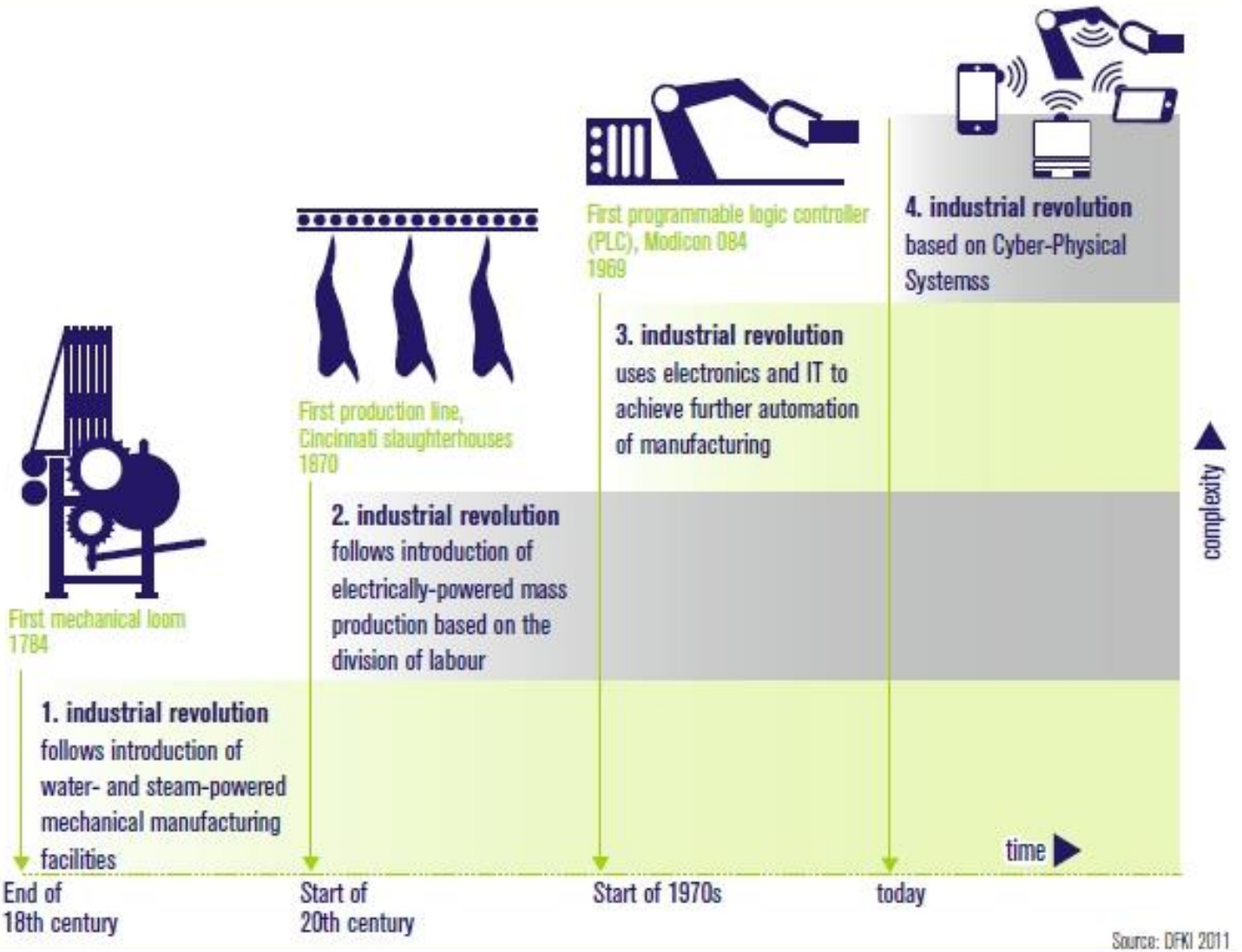
ACPLT Chair of Process Control Engineering
RWTH AACHEN UNIVERSITY

Modelling and Standardization
- an Essential Field of Research in Industrie 4.0

- industry political view
- the irresistible power of reference models
- identification of the relevant model landscape
- ordering and classification –
  the reference architectural models

The 4. Industrial Revolution

Figure 1:
The four stages of
the Industrial Revolution



Scientific Advisory Board

WHAT DOES THE FUTURE HOLD,

WHAT WILL INDUSTRIE 4.0 MEAN FOR US?

- People
- Technology
- Organization

Industrie 4.0:
A High-Tech initiative of the German government to make the industry ready for the 4. Industrial Revolution

offensive, constructive strategy:
- participate in the design of the new world
- get advantage of the change and the new possibilities

defensive, safeguarding strategy:
- be ready for unexpected developments
- prevent disruptive and destroying changes for
  - the working environment and
  - the enterprises

.....

technical challenges

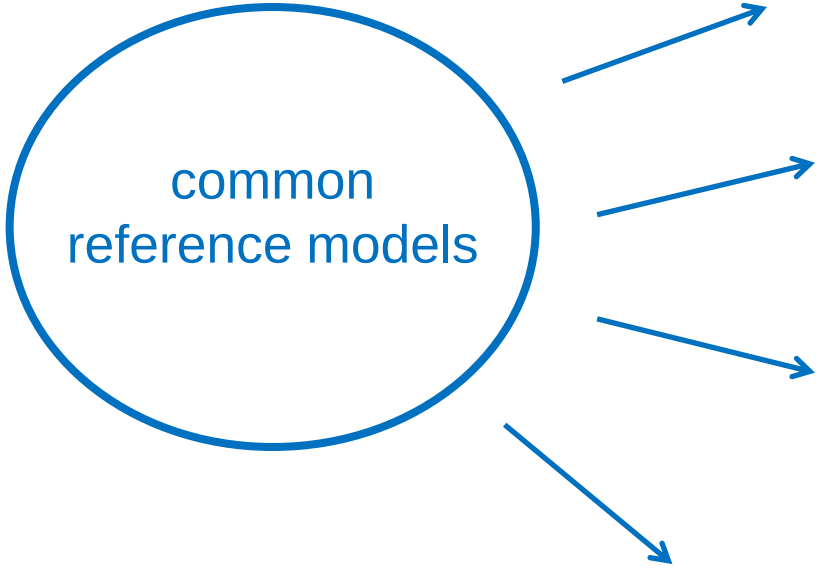
.....

to safeguard long-term development processes

to keep the technological basis and the systems open

.....

common reference models are very helpfull to tackle these challenges



assure a common comprehension
within the community

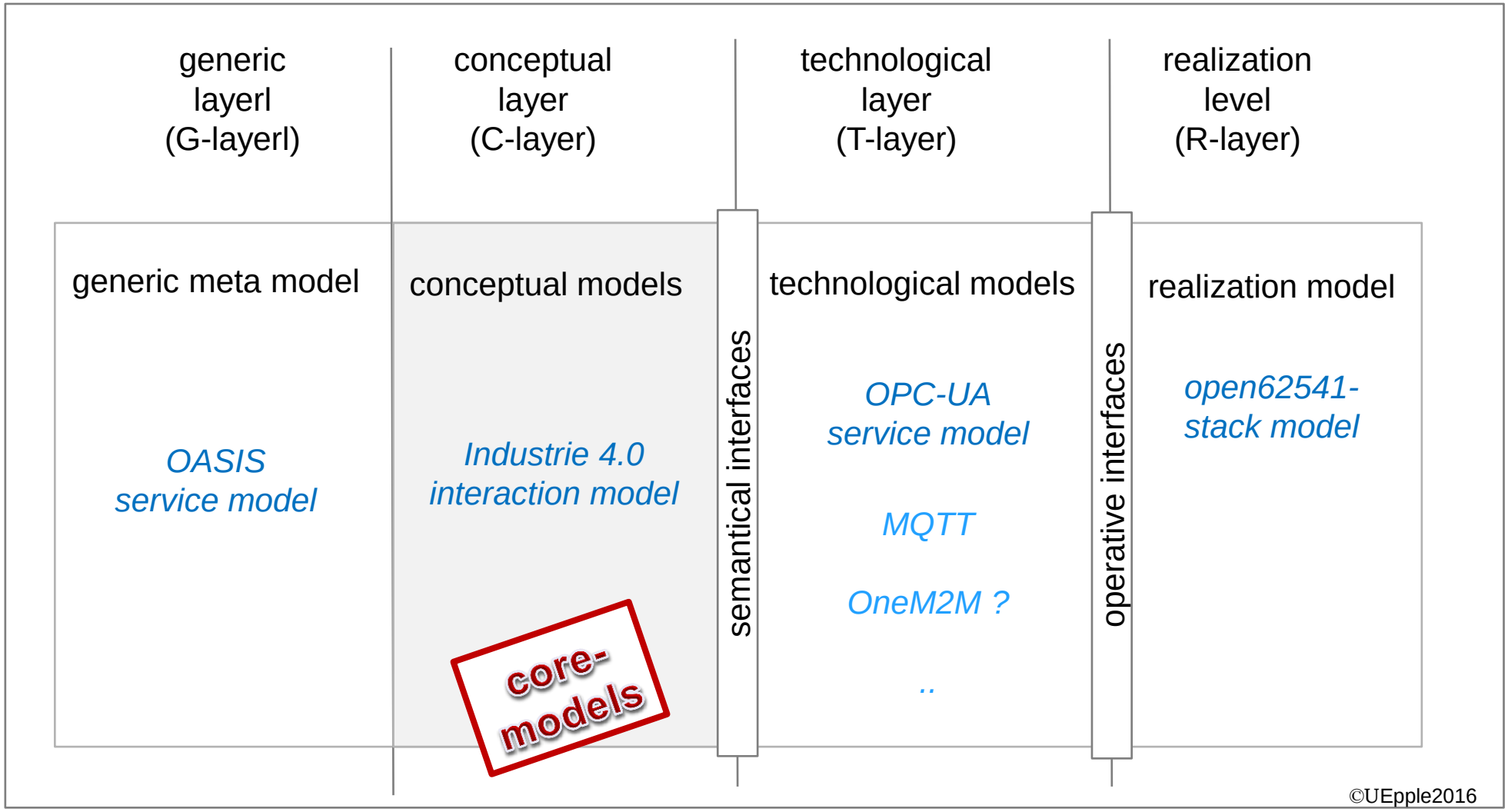
are natural objects for standardization

enable semantic interoperability

build stable construction elements
for the system architecture

can be used as functional prototypes for
software development and verification

Reference Models at Different Abstraction Layers



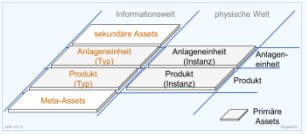
Conceptual Reference Models

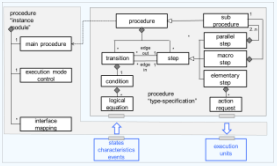
conceptual reference models

products

things

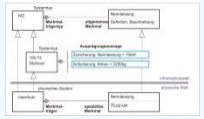
assets





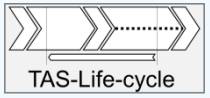
procedures

value chains



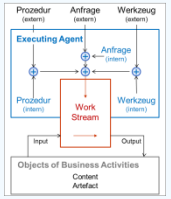
properties

life-cycles



I40-components

work streams

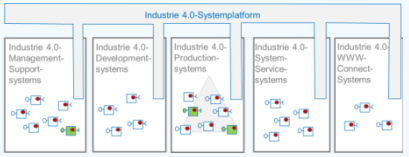


business-processes

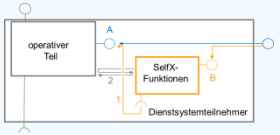
service patterns

service concepts

runtime platform



selfX-models



GMA FA7.21

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Outcomes (with Focus on Reference Models)

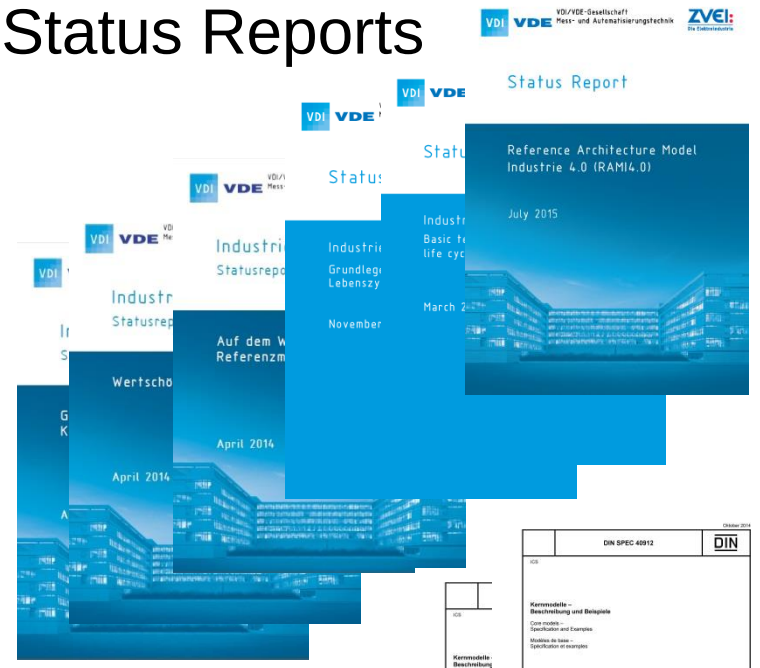
Plattform Industrie 4.0 , AG1, UAG1

ZVEI I40,SG2

K931.0.4 Kernmodelle
DIN/DKE Steuerkreis

GMA FA7.21

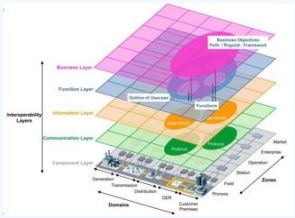
Status Reports



Standards

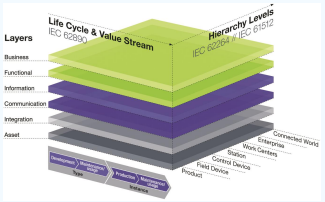
Relevant Reference Architectural Models

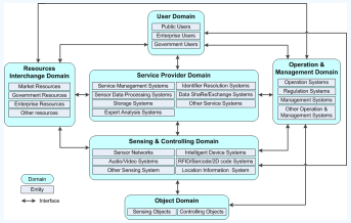
reference architectural models



SGAM
Layer-Modell

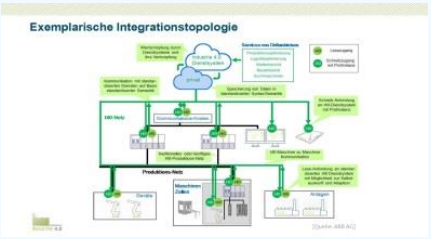
Reference Architectural
Model I40

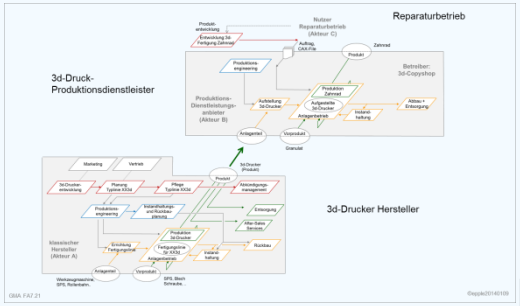




IoT-SRA

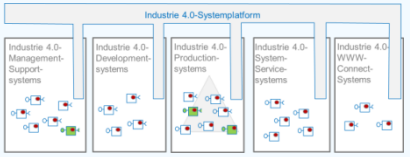
I40-Integration-
Topology Model



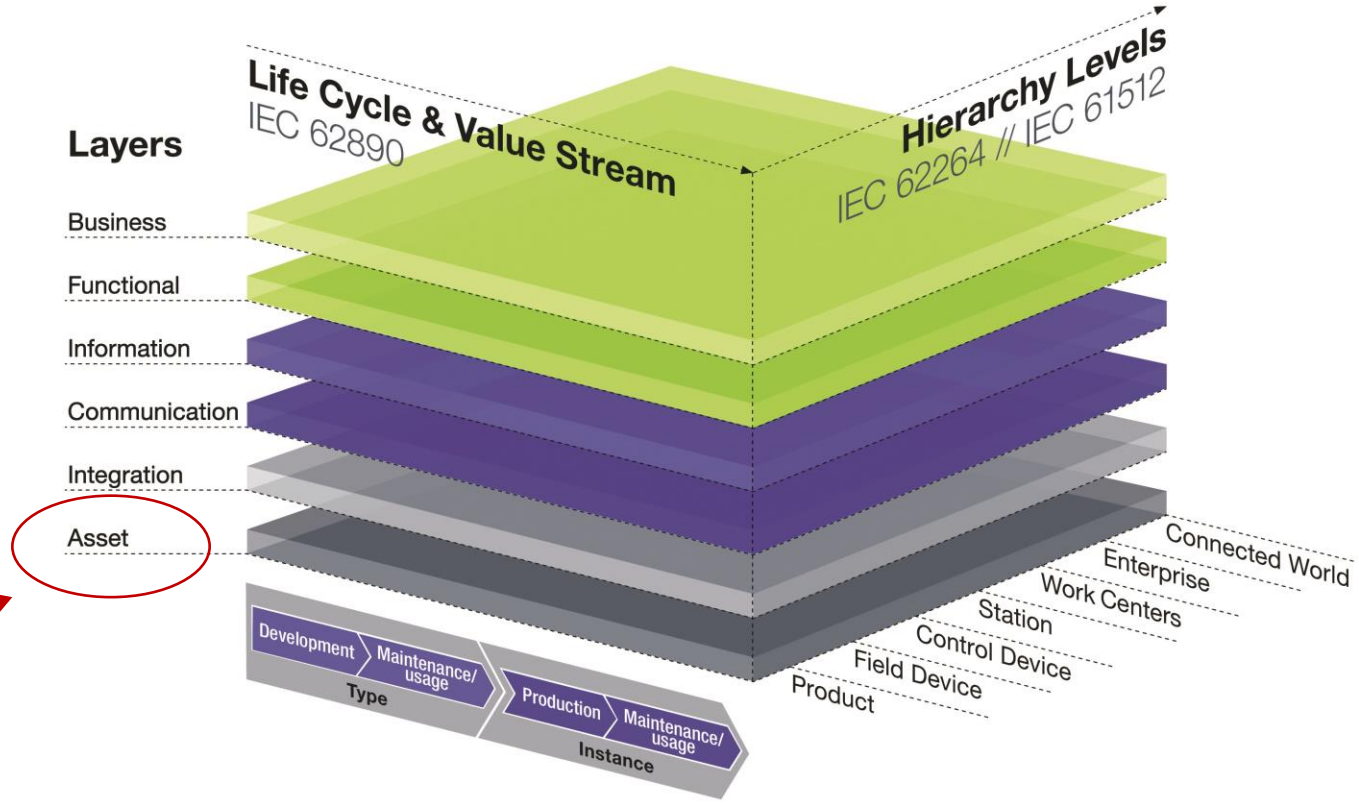


I40 Business Model
Architectural Model

I40 Platform Architectural Model

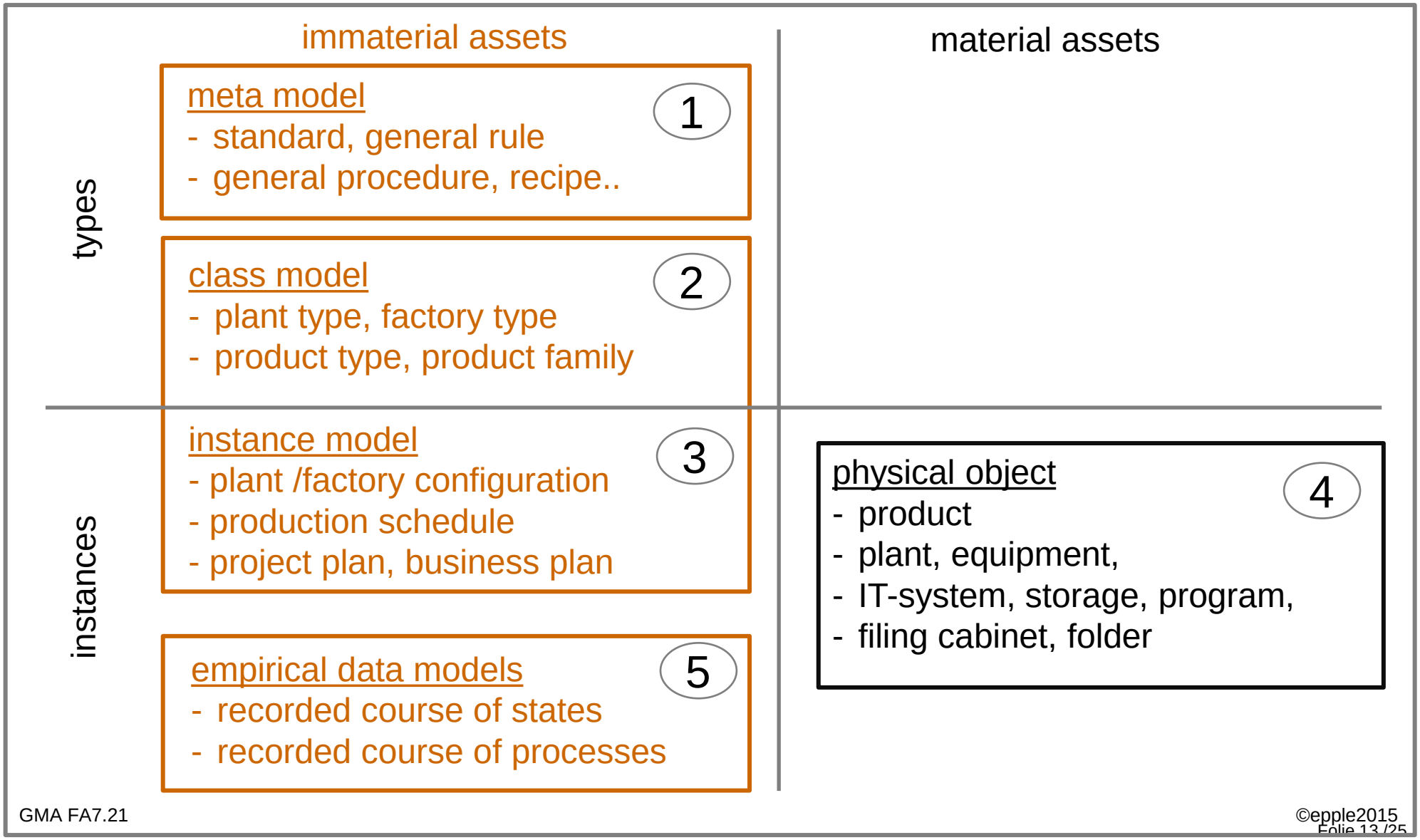


The Reference Architectural Model I4.0 (RAMI4.0)



special focus:

Asset Categories



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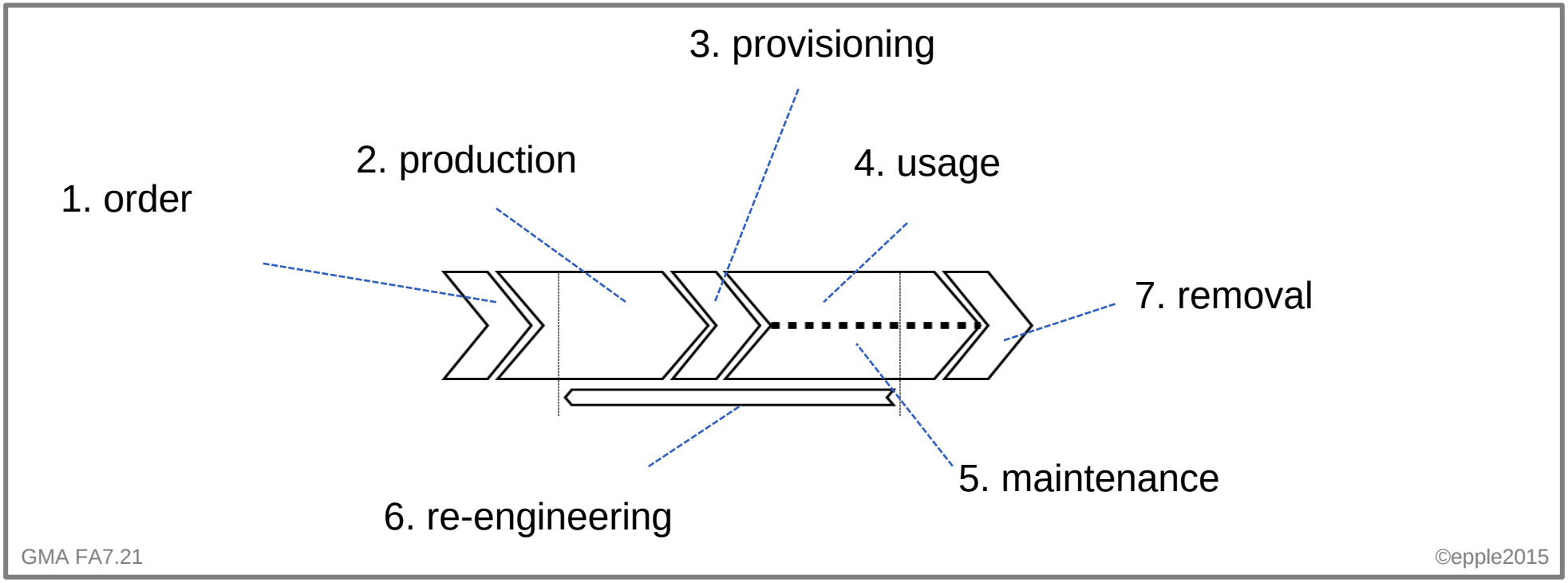
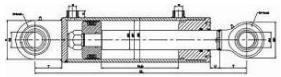
Common Life-Cycle Schema of Technical Assets



- every technical asset has its own life-cycle
- all technical life-cycles show the same basic structure

Life-Cycle of Type Assets and of Material Assets



construction → usage

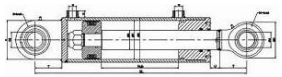
part type

construction → system integration → usage

part

GMA FA7.21

Life-Cycles of Aggregated Assets



construction

usage

part type

part libraries

construction

usage

machine type

machine libraries

construction

usage

plant type

production

construction

system integration

usage

part

construction

system int.

usage

machine

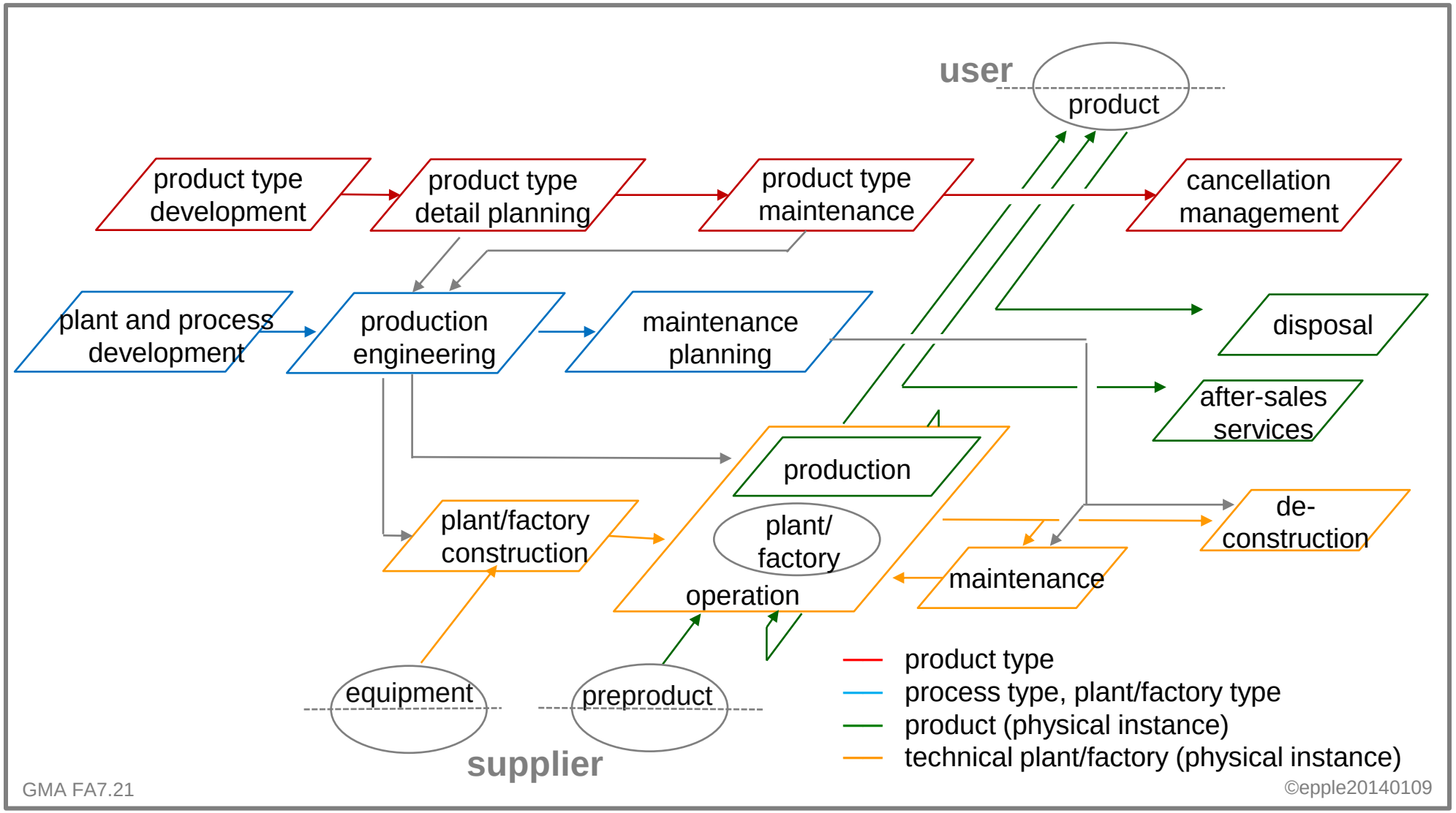
construction

usage

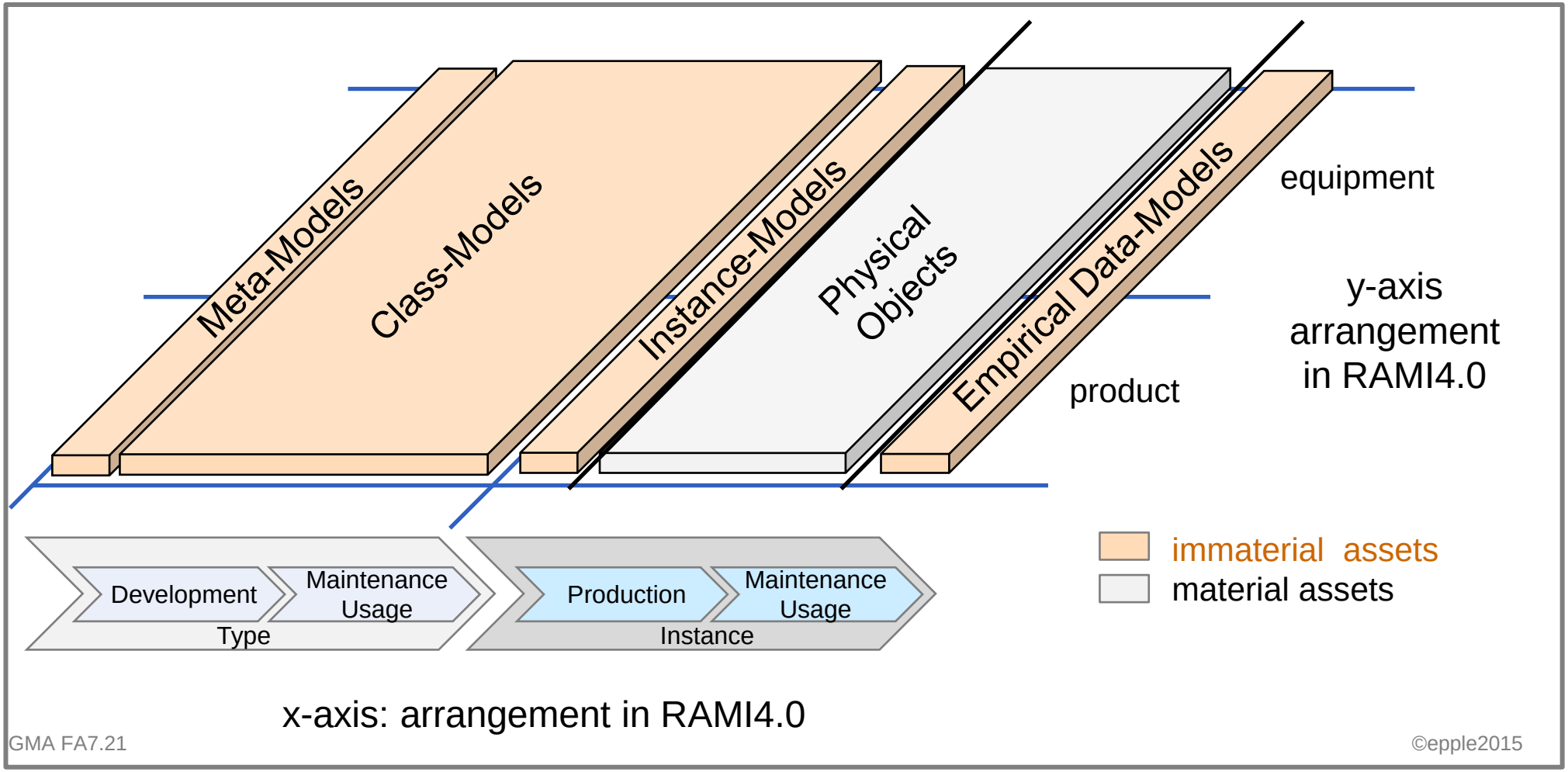
plant

GMA FA7.21

Life-Cycle Value Chains in Industrial Production



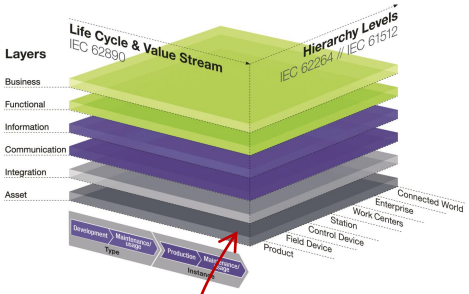
Arranging the Assets within the Basic Layer of the RAMI Model



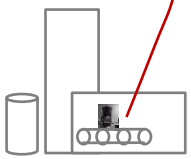
GMA FA7.21

Location of a Coffee Machine within Different Organization RAMIs

manufacturer

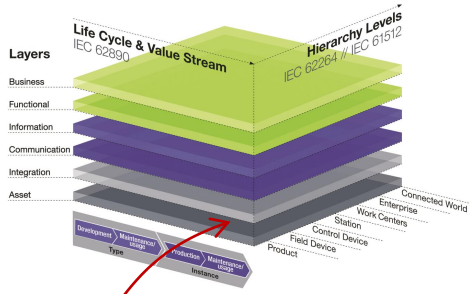


role: product
phase: production

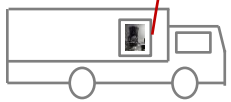


factory

logistics service provider

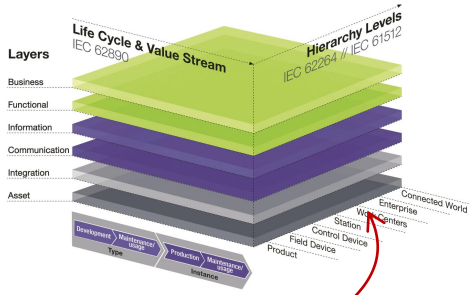


role: cargo (product)
phase: provisioning

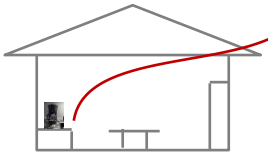


logistics system

my-household



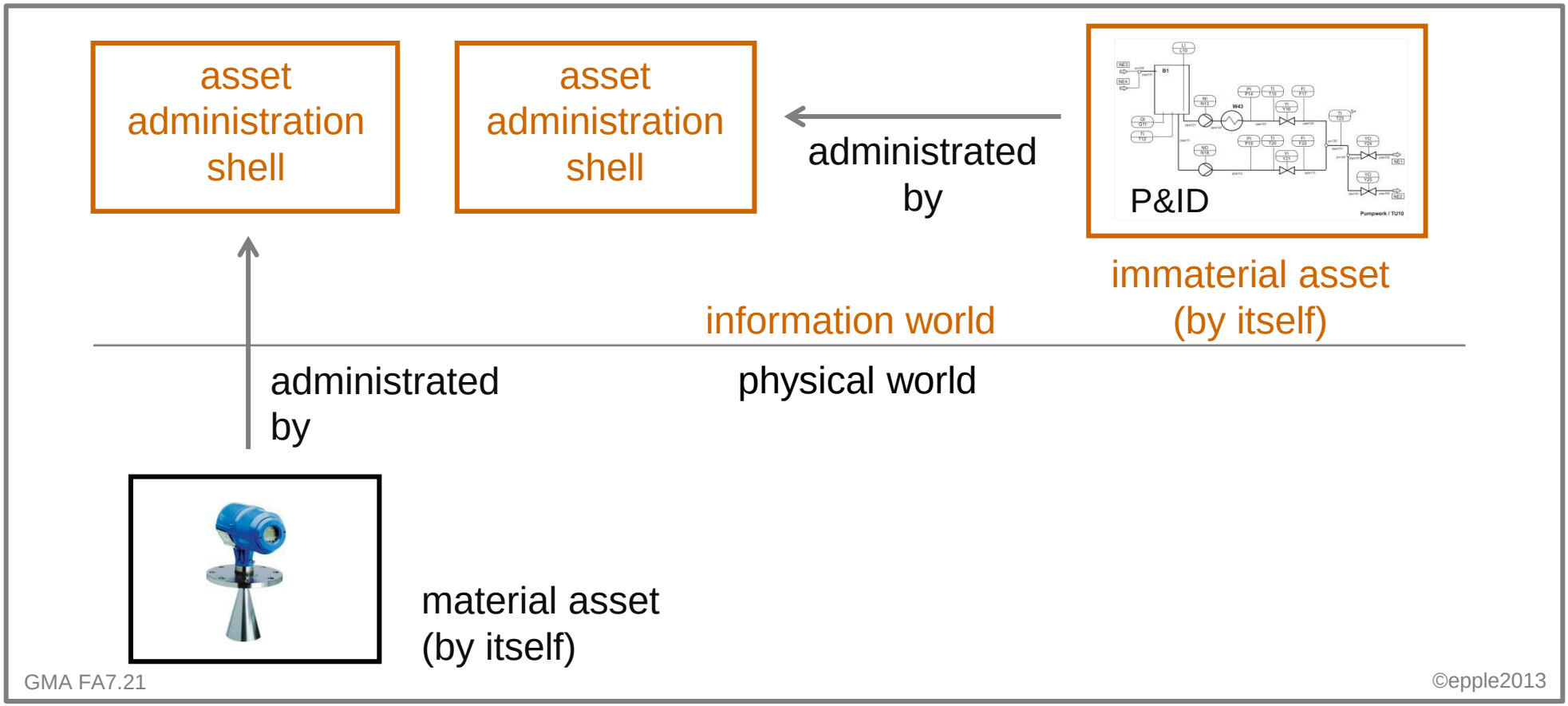
role: equipment
Phase: usage



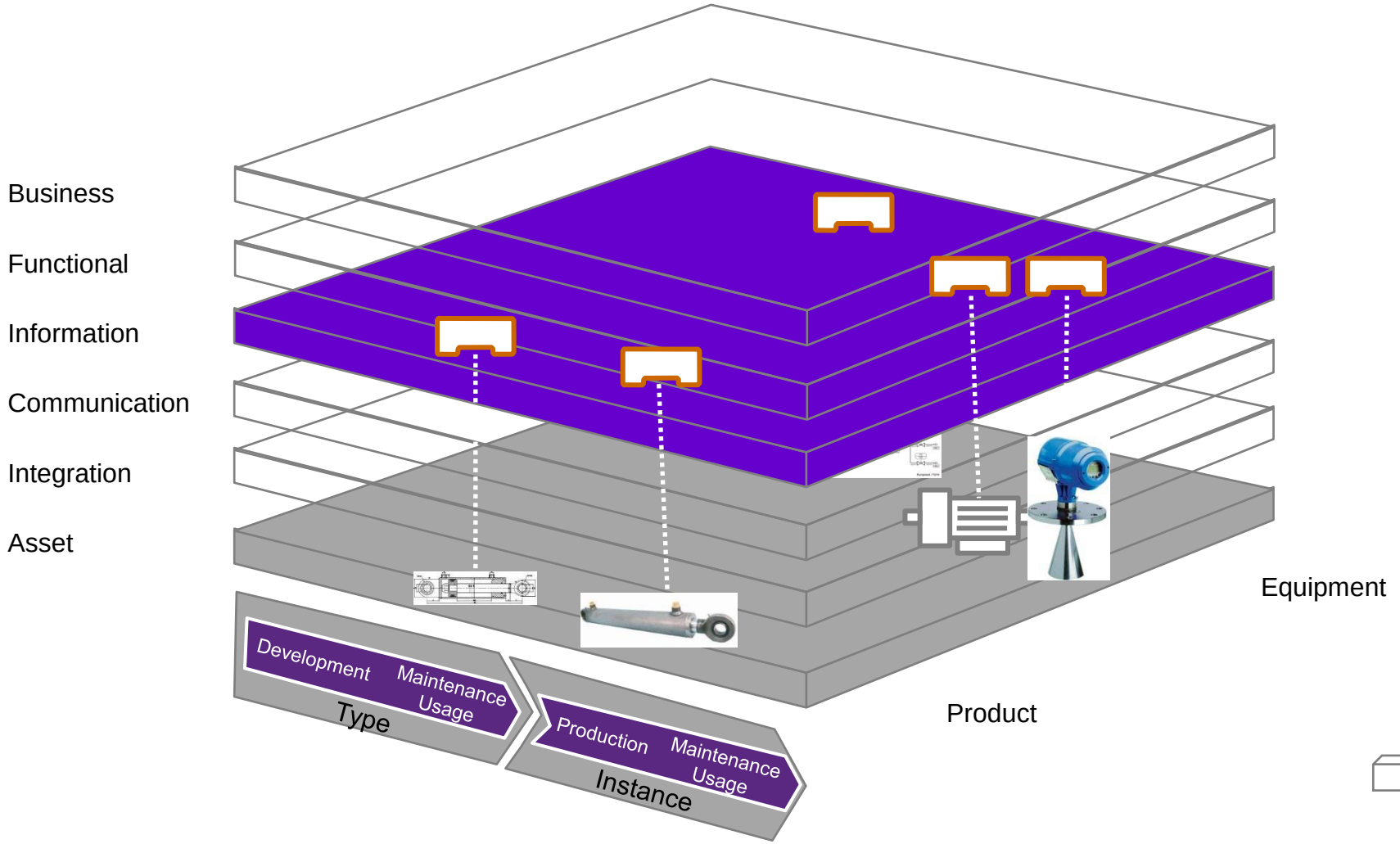
home

GMA FA7.21

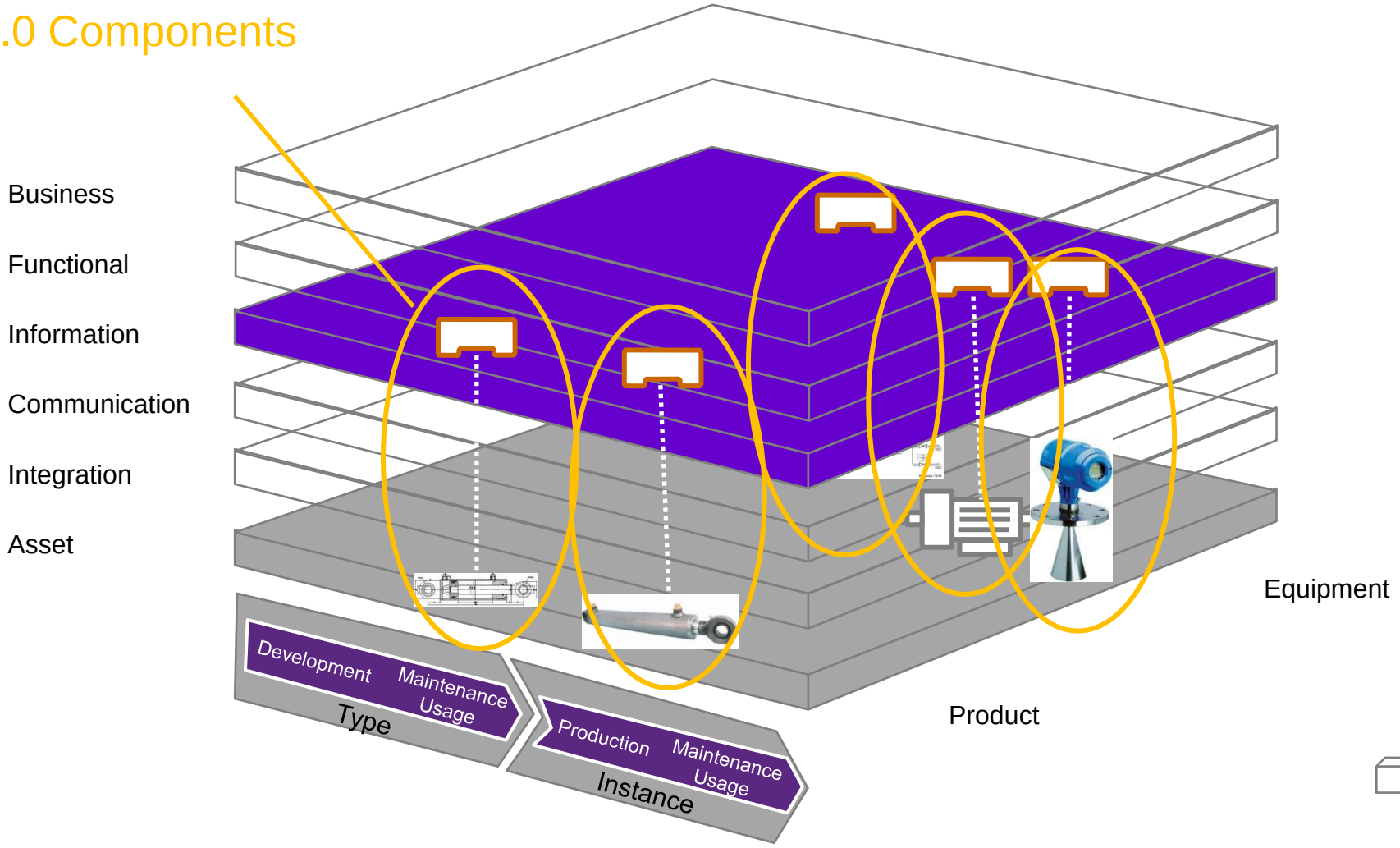
Separation of the Asset By Itself and its Administration Shell



Asset Administration Shells within the RAMI Architecture



I4.0 Components



openAAS

goal: unified model for the asset administration shell

integrated models:
- communication (I40 interaction model)
- property management (property value statement model)
- automated life cycle recording (life cycle model)
- ....

conceptual model + technological model + realization model

common understanding and functionality

operative interoperability

open source execution framework

Current Activities

what do we need urgently ?

a basis platform for the component model
(conceptual, technological and realization)

a legal frame work for the development and industrial usage of open IT standards.

Thank you for your attention.

Prof. Dr.-Ing. Ulrich Epple
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email: epple@plt.rwth-aachen.de