German Research Center for Artificial Intelligence GmbH

IN CONTEXT OF INDUSTRIE 4.0

Stephan Weyer

DFKI

EC HORIZON2020
Project Co-Funded by the European Commission
Grant agreement: 678556

German Research Center for Artificial Intelligence GmbH

MAYA – The Overview

36 months (10/2015 - 10/2018)

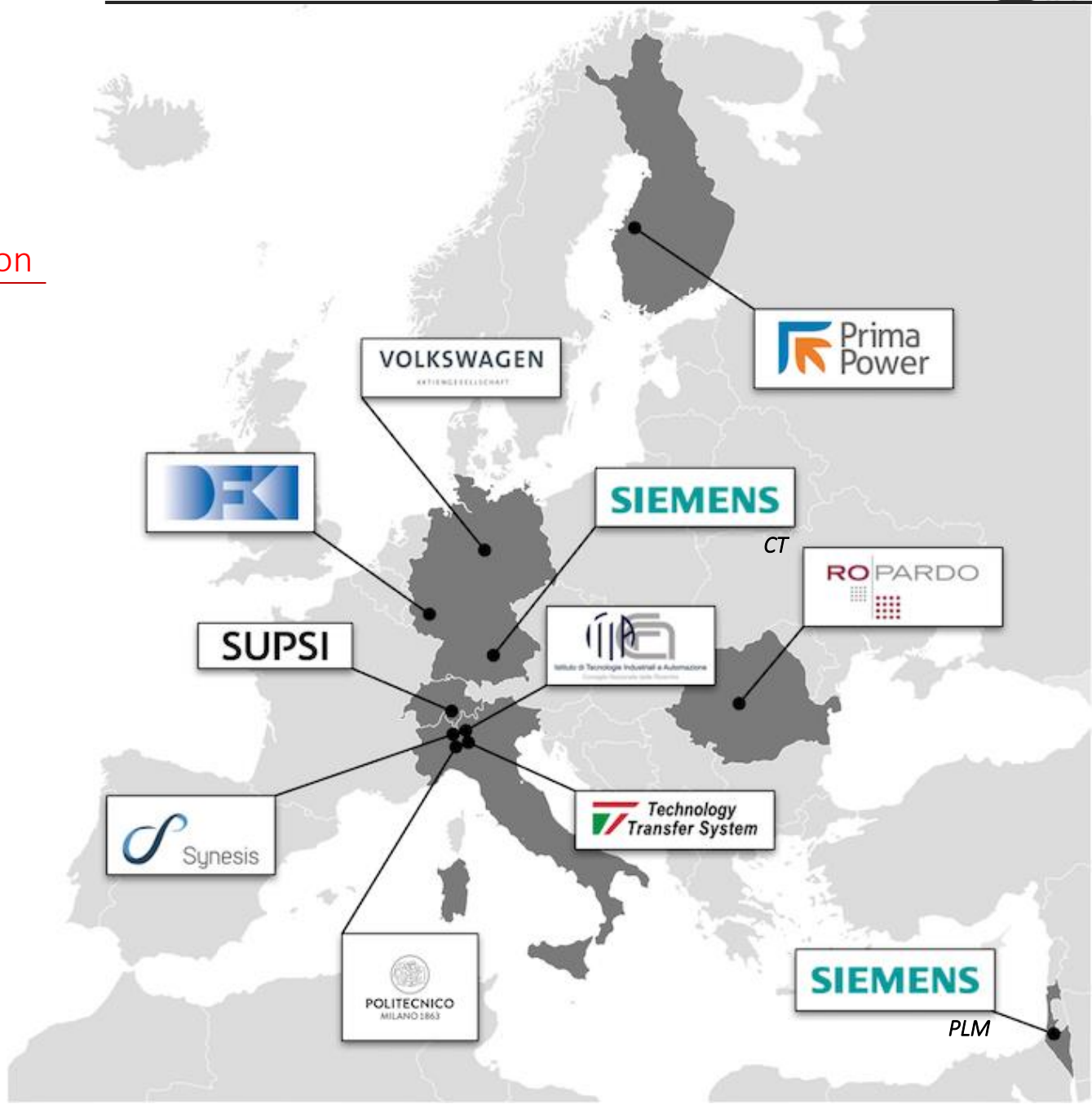
EC HORIZON 2020 | FoF 8

Grant agreement: 678556

The Goddess of Illusion

MAYA

Developing multi-disciplinary integrated simulation tools and methodologies for the design, engineering and management of **CPS-based (Cyber Physical Systems) Factories**



The context of Industrie 4.0

Initial Point „Industrie 4.0“

MAJOR FACTS

Factory and Value Chain
- International competition
- Rapid shortening of innovation cycles

Factory and Nature
- Increasing cost and competitive pressure
- Lowest resource consumption

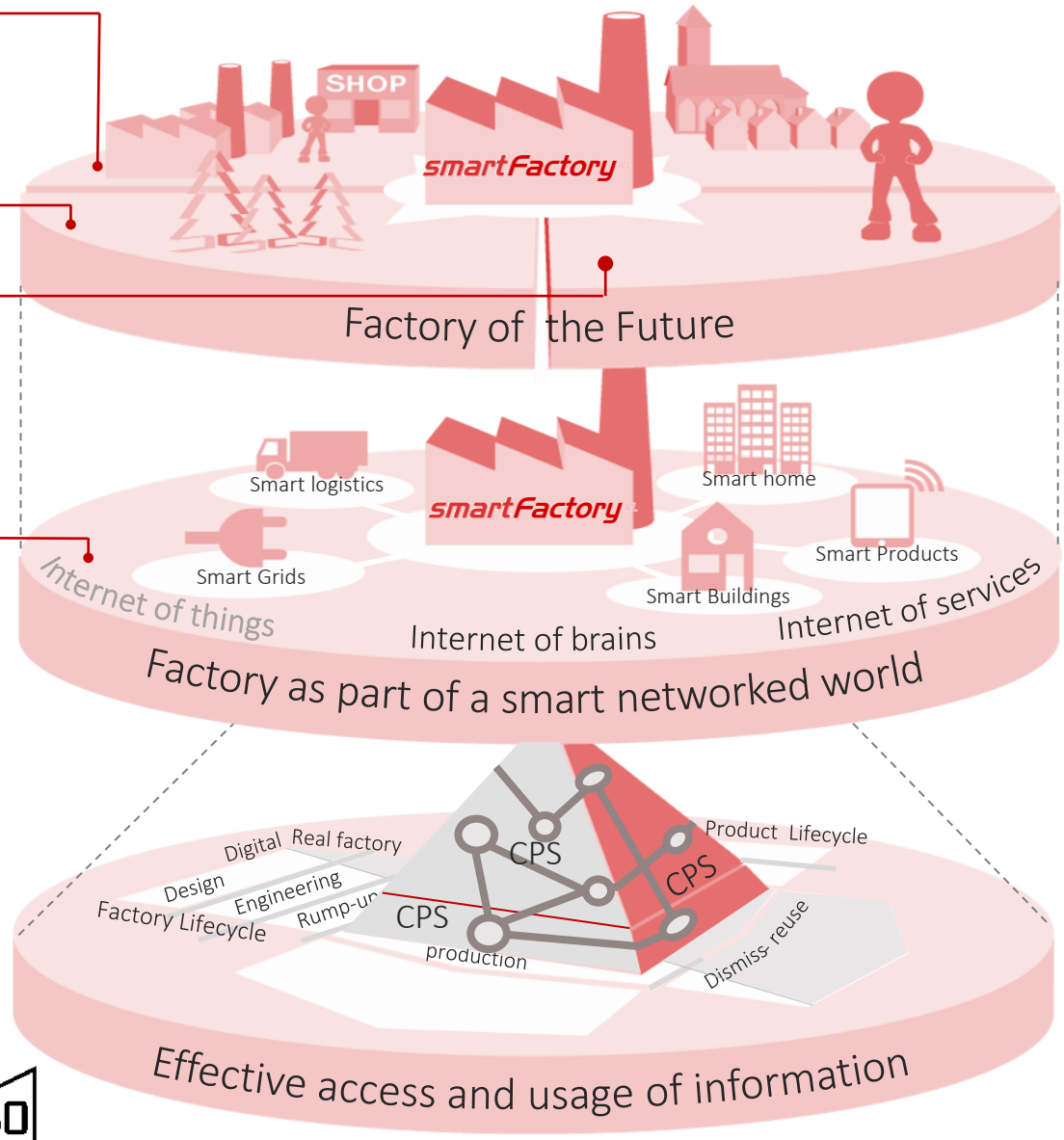
Factory and Humans
- High customer requirements
- Human oriented interfaces for workers

ENABLER

Prevalence of Internet technologies
- ICT revolutionize our daily life
- Factory as part of a smart networked world
- Merging of automation and ICT

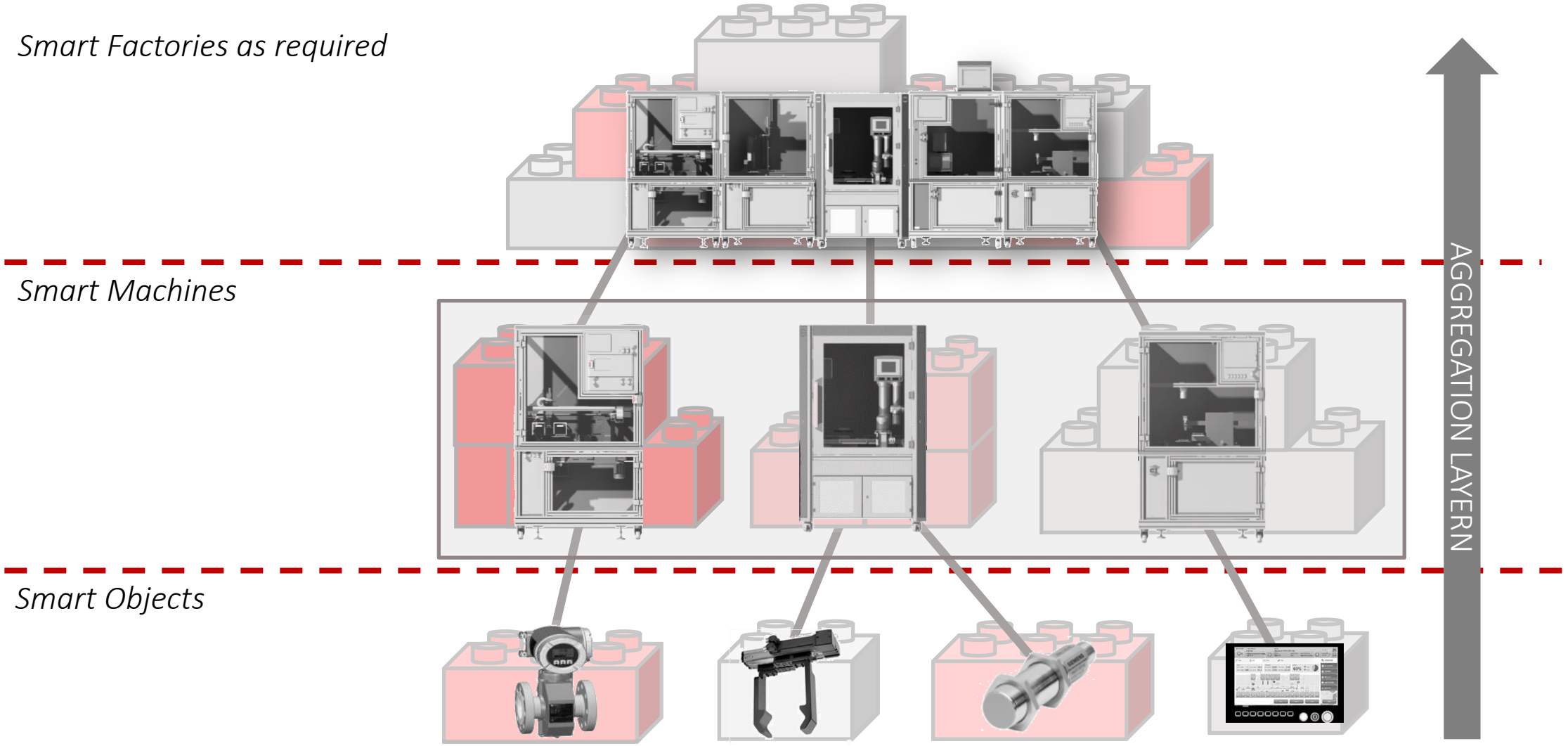
FORTHCOMING CHANGE

Future Factory Environment
- Mass customization with highly modular and flexible systems for quick changes (Network of multi-vendor production units)
- Prevalence of so-called “Cyber-Physical Production Systems”
- Smart Products and Advanced HMI
- …



Industrie 4.0

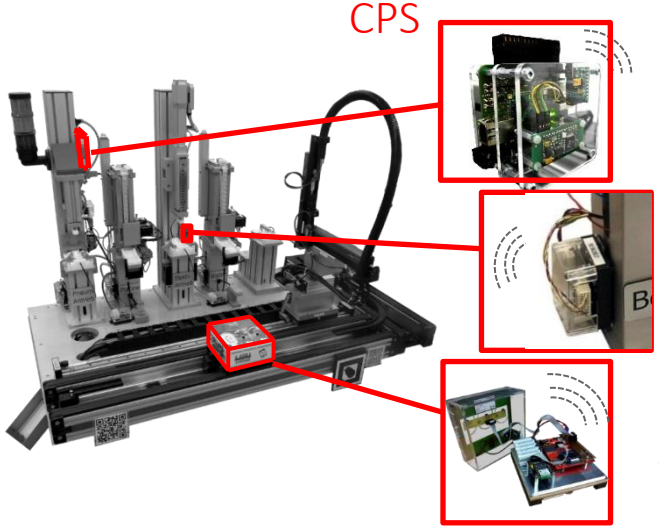
Highly modular and flexible systems enabled by ‘plug-and-play’-paradigm

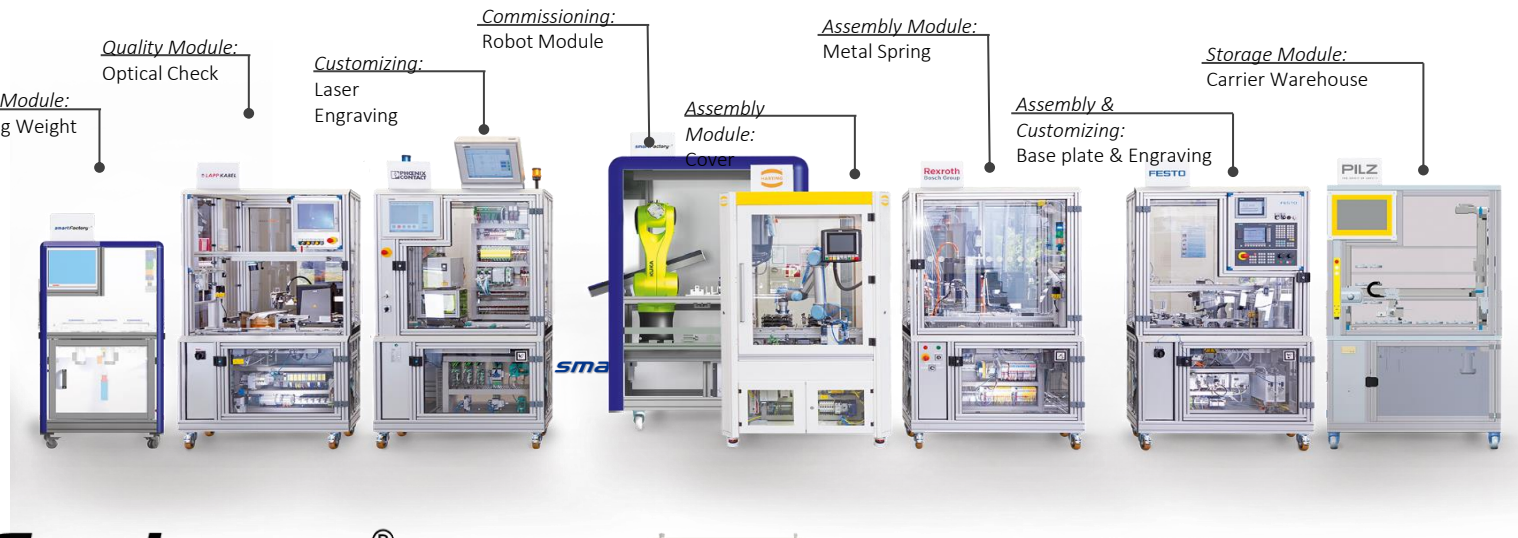


German Research Center for Artificial Intelligence GmbH

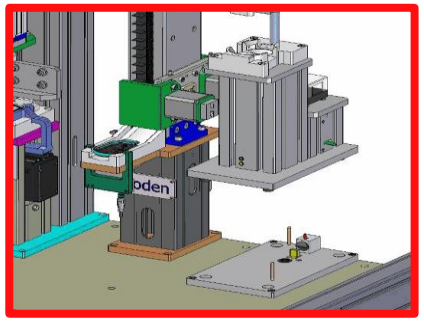
Sample Production Line

CPS

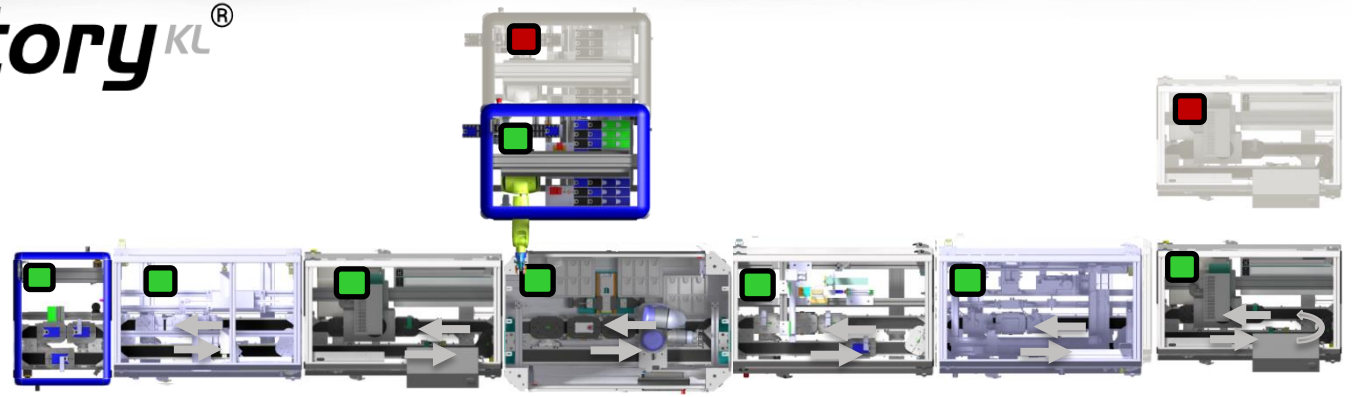




smartFactory KL®



PLUG-AND-PLAY ON ELECTROMECHANICAL LEVEL



New quality requirements! -> *enlarging plant*!

Urgent Order PO#27653 ! -> speed up process!

Engineering at the point of time

Changing demands of the market

Customization | Resource efficiency | Global Competition

ICT

Re-Engineering at the point of interest

REAL

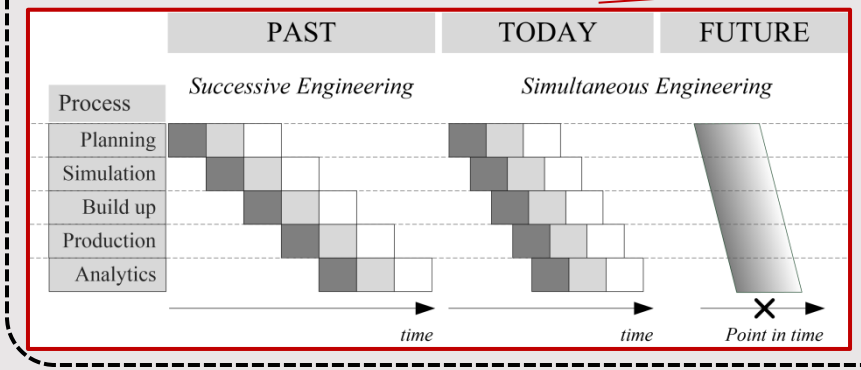
Production **Planning** → Production **Design** → Production **Engineering** → Integration and **Ramp-Up** → **PRODUCTION** → Production **Recycling**

Scalable CPS environment
Interoperability

DIGITAL

Simultaneous Engineering

PLM Tools and Concepts



Digital manufacturing tools

Digital planning of reconfigurations
Virtual Commissioning
Pre-Tests and Simulations
...

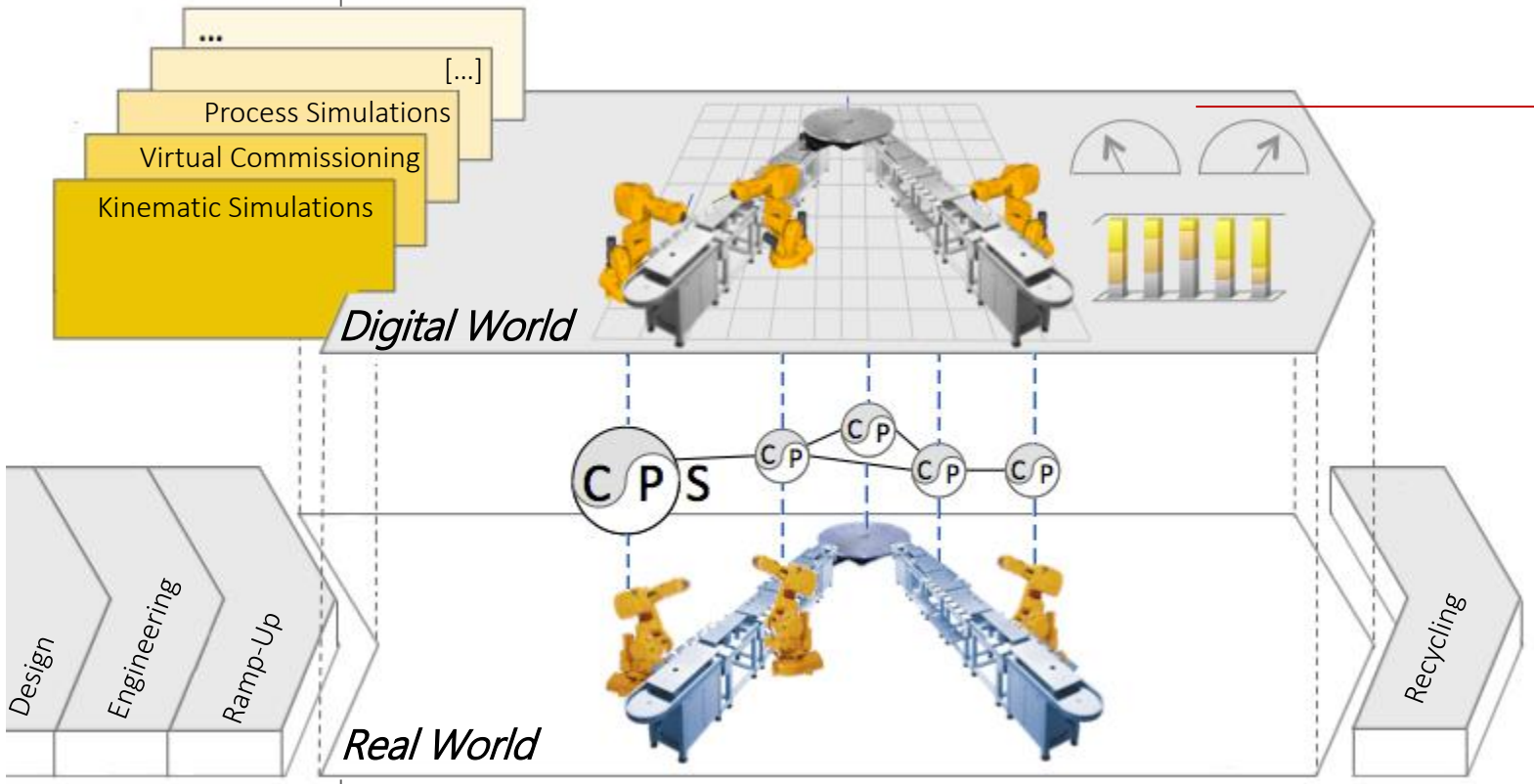
Digital Twin Concept

Seamless Integration of data

Overarching research issue

MAYA: Overarching research issue

Heterogeneous planning tools along PLM



Modularity via Plug' n Play on field device / module / … level
Vendor-independency for plant configurations
…

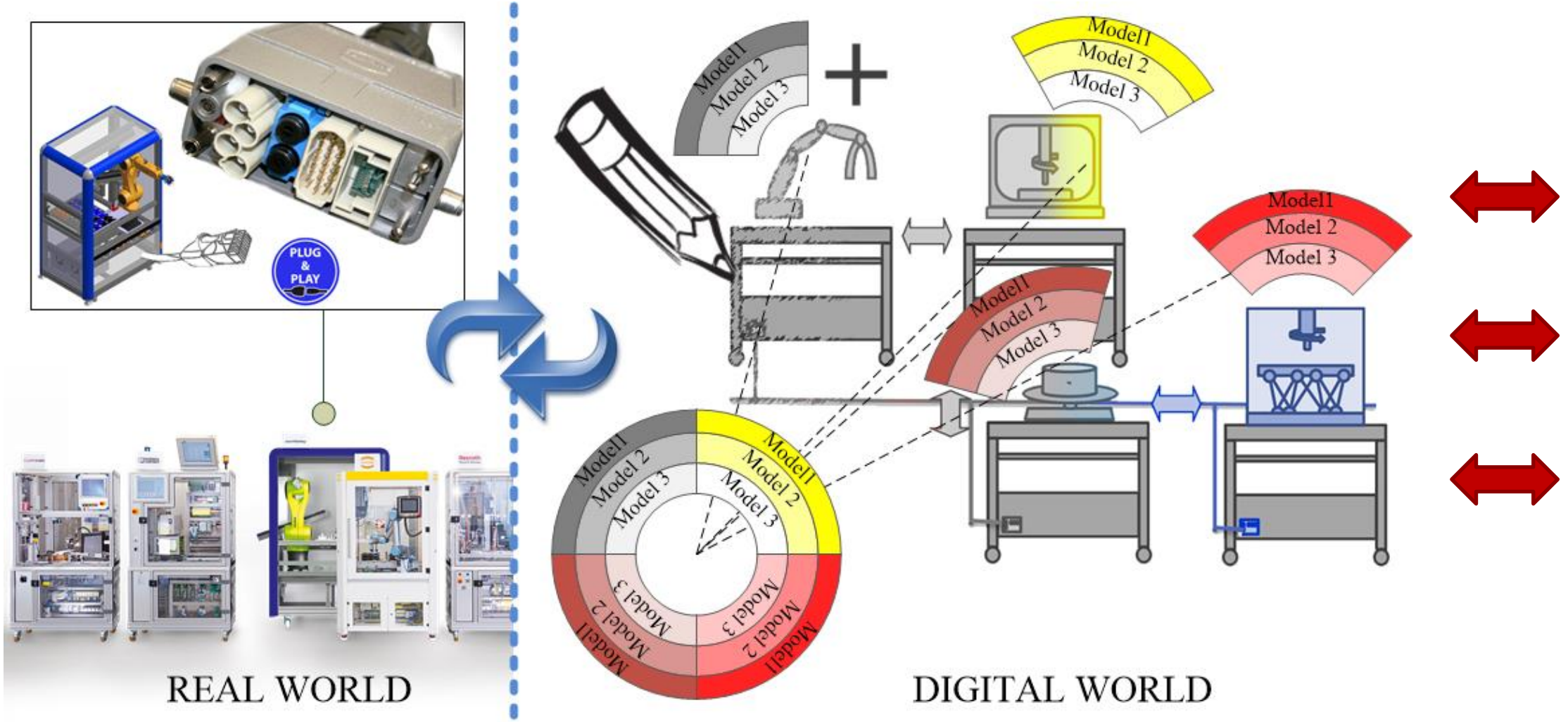
Digital Counterpart

→ Integration-ready components

- Providing relevant process data, models, behaviours, conditions
  -> decentralized on CPS level
  -> vendor-independent and open

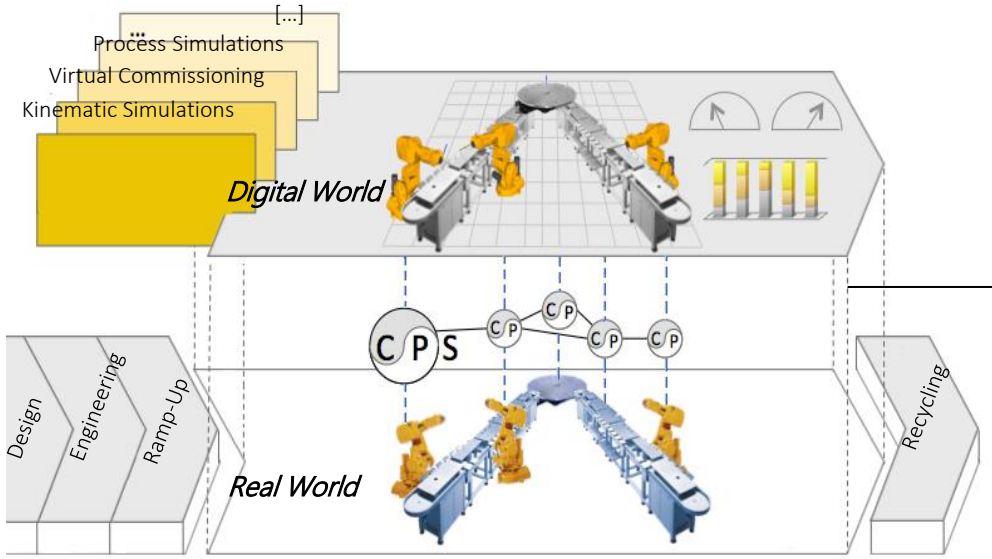
- Data Integration and bi-directional connection between PLM-tools and shop floor
  -> Platform-independent access

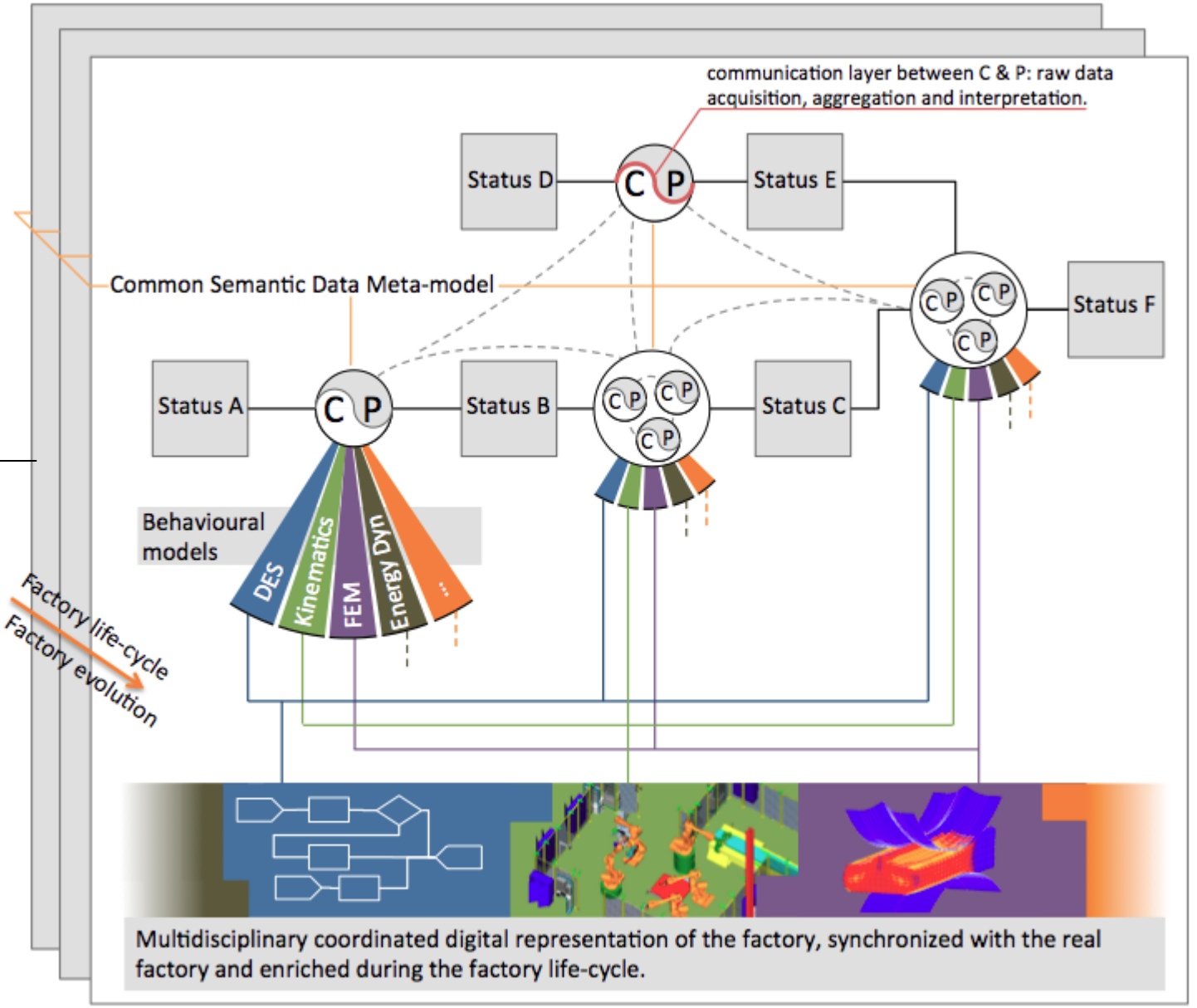
MAYA: Overarching research issue



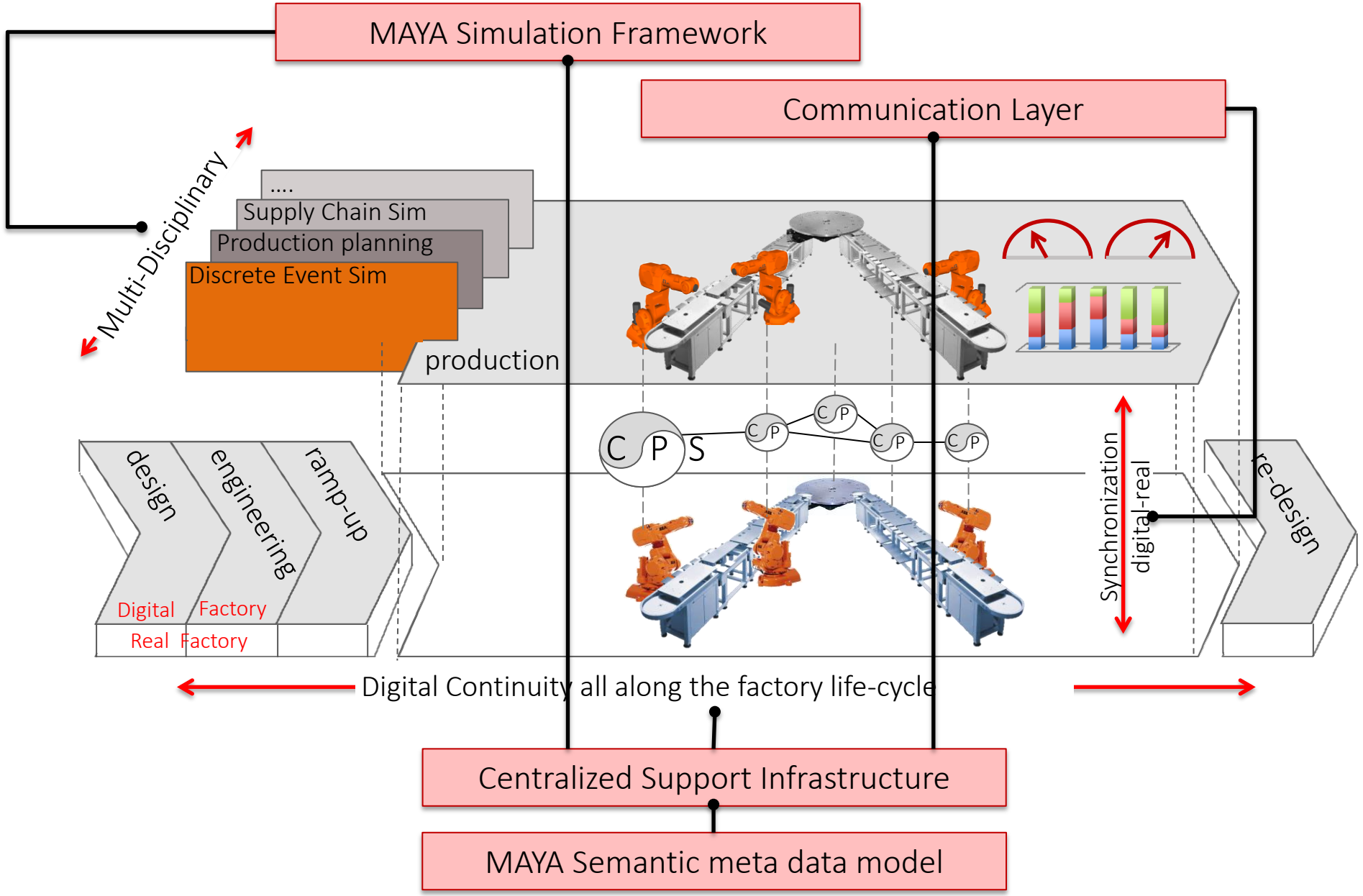
German Research Center for Artificial Intelligence GmbH

MAYA: Architecture Components





MAYA: Architecture Components



MAYA: Architecture Components

SIMULATION FRAMEWORK

CENTRALIZED SUPPORT INFRASTRUCTURE

SHOPFLOOR LEVEL

DIGITAL MANUFACTURING

Communication Layer

CPS data (online)

CPS data (offline and online)

DATA PROVISION

Library

CPS TEMPLATE III

CPS TEMPLATE X

...

create offline instance

Repository | Database

CPS INSTANCE I

CPS INSTANCE II

CPS INSTANCE III

DATA IMPORT (WEB SERVICES)

submit

update

update if online

online

CPS I

CI

OBJECT I

INSTANCE I

online

CPS II

CI

OBJECT II

INSTANCE II

offline

CPS III

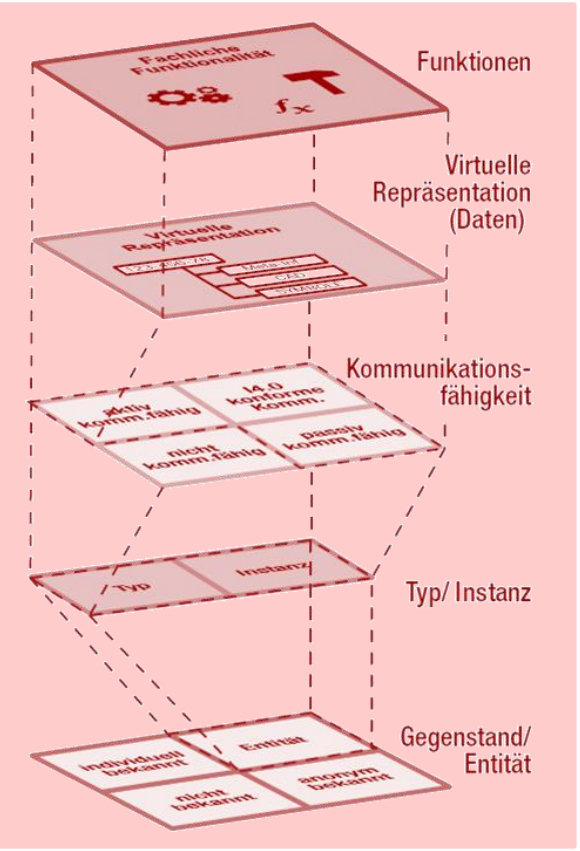
CI

OBJECT III

INSTANCE III

Instantiation of ***Semantic Meta Data Model***

INDUSTRIE 4.0 COMPONENT

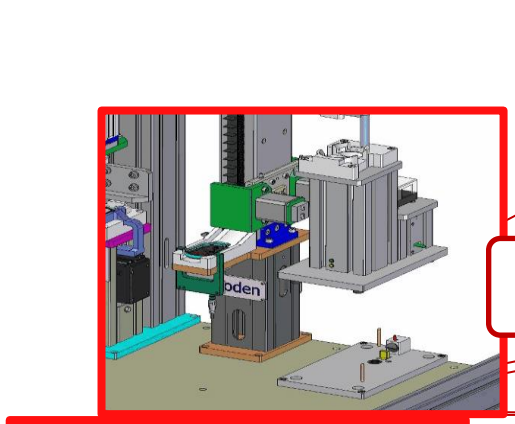


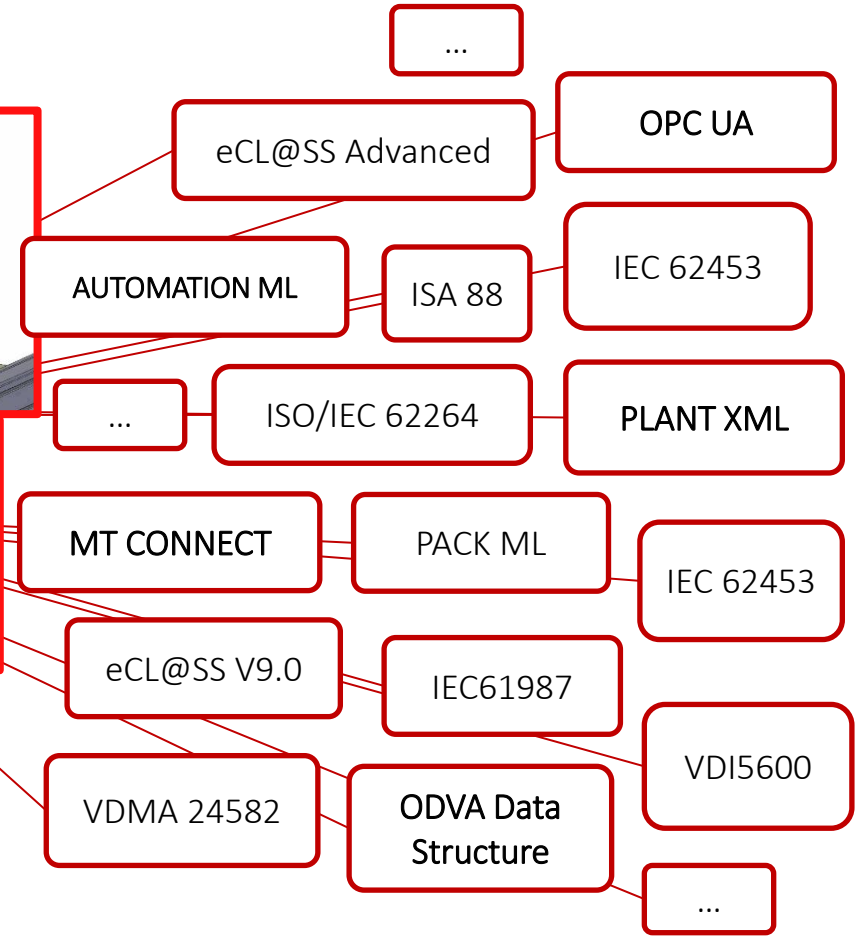
Semantic Meta Data Modell

MAYA Semantic meta data model

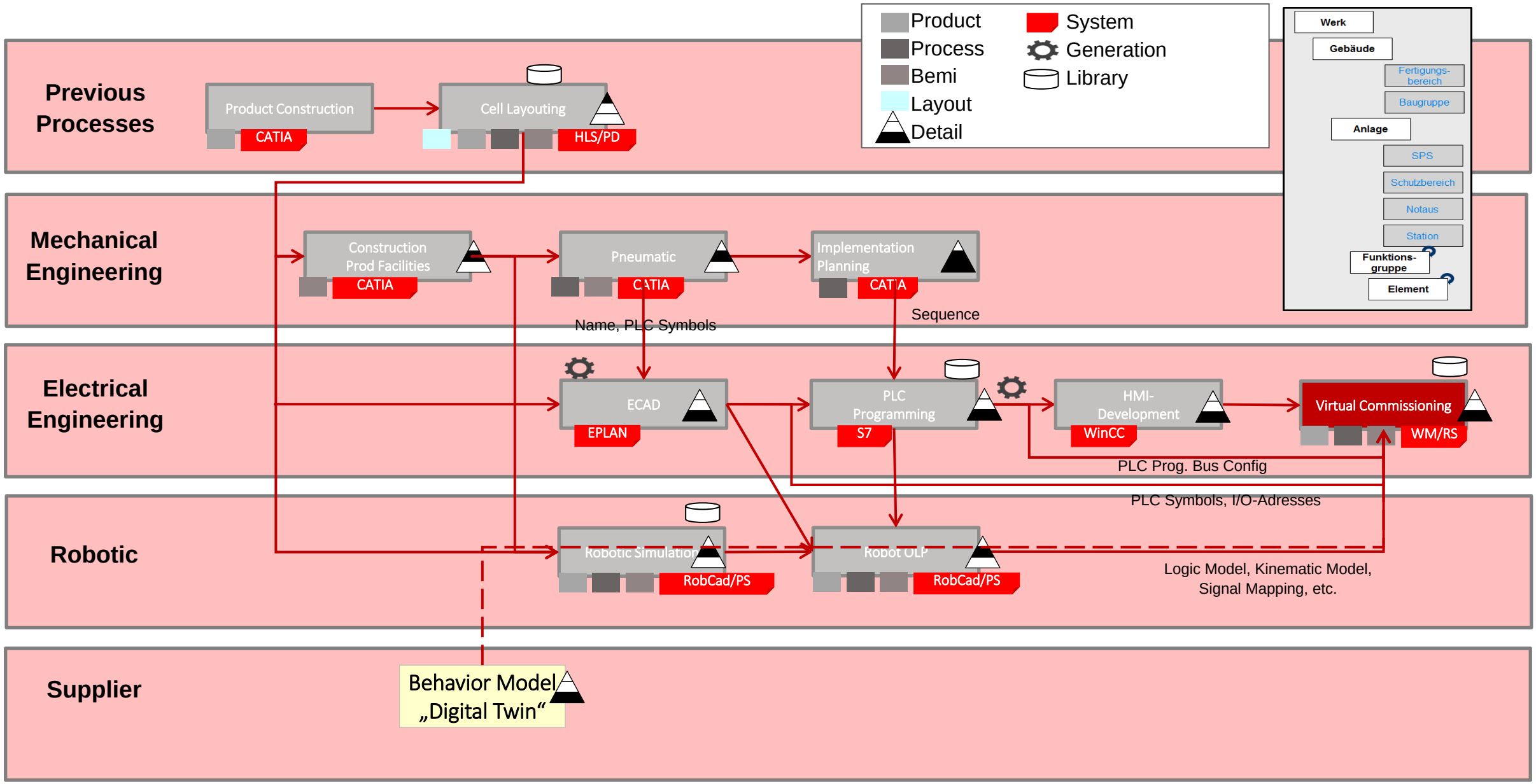
"MAYA will support digital continuity by developing a standardized, open semantic meta-model capable to fully describe the properties and functional characteristics of the CPS simulations models"

- Common understanding of CPS data, properties and interfaces that are relevant from its design till its integration and coordination
- Static and behavioural information
- Aggregation of existing open exchange data formats and information models, extending them when needed
- Template for a digital description of CPS components for technology provider (device vendors) for later use by different stakeholders

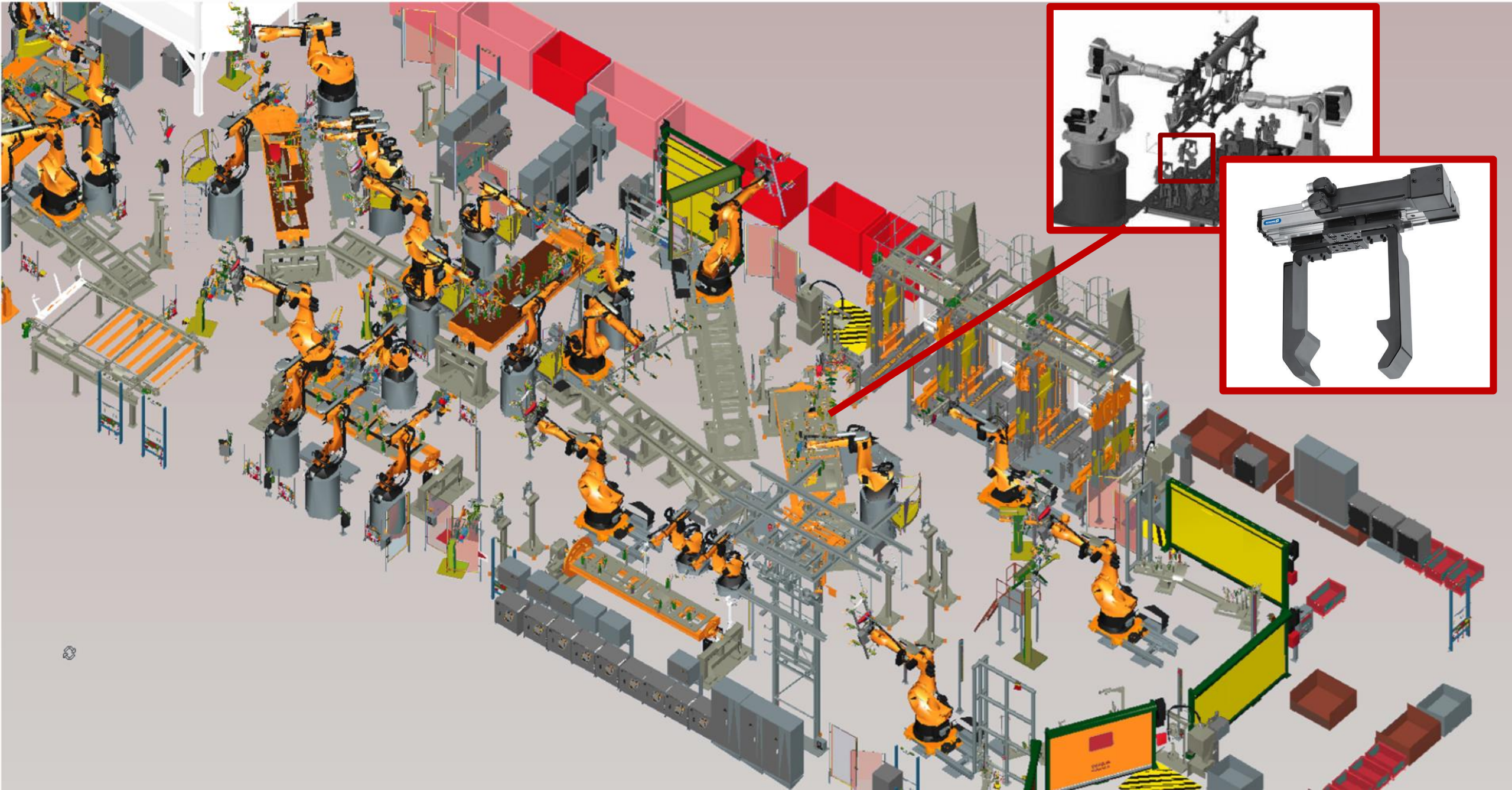




Example: Virtual Commissioning



Example 2: Reverse Engineering



German Research Center for Artificial Intelligence GmbH

Thanks for your attention :)

Dipl.-Ing.
Stephan Weyer

Researcher, Innovative Factory Systems
German Research Center for Artificial Intelligence (DFKI GmbH)

Tel.: +49 631 / 205 75 3408

Mail: stephan.weyer@dfki.de