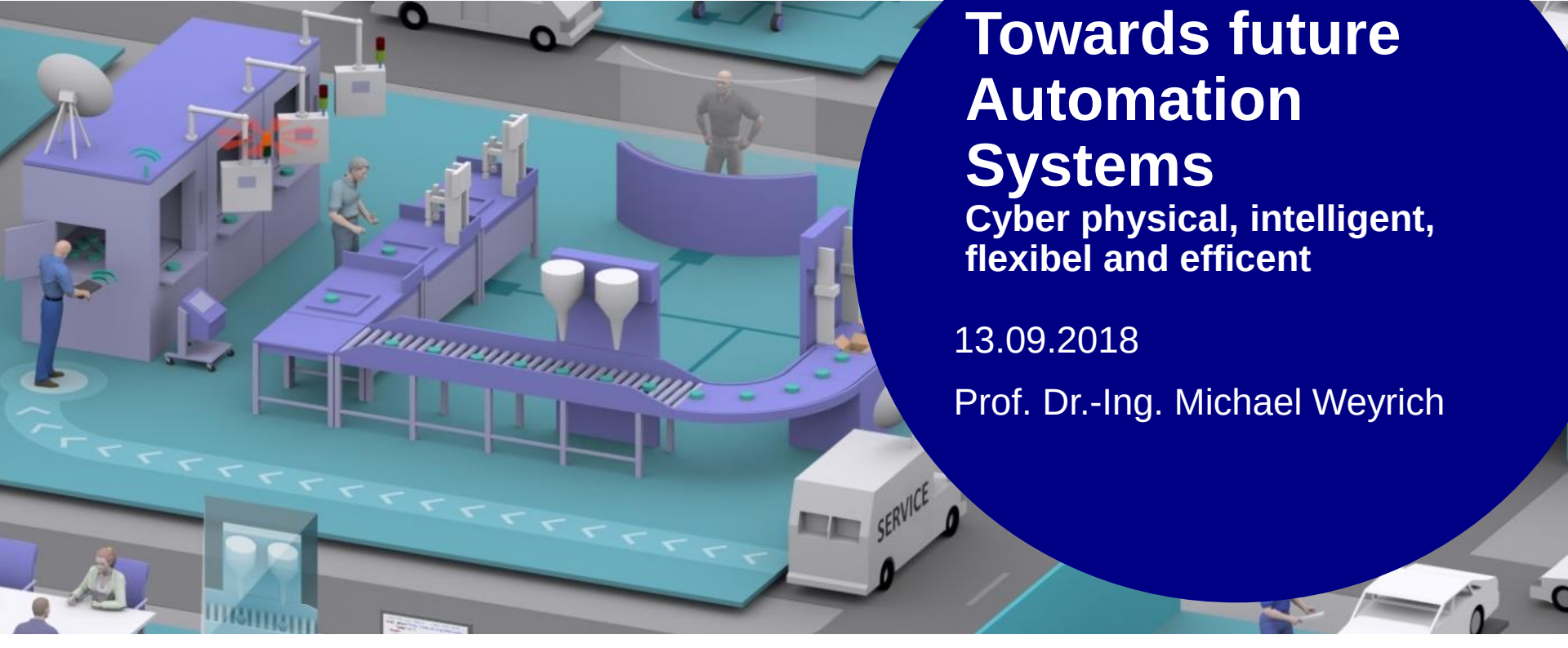
Universität Stuttgart
Institute of Industrial Automation and Software Engineering



Towards future Automation Systems

Cyber physical, intelligent, flexibel and efficent

13.09.2018

Prof. Dr.-Ing. Michael Weyrich

Agenda

Steps towards the future - a Maturity Model

State-of-the-Art

Future engineering - design moves to runtime

Examples of Application in Manufacturing

A Maturity Model for „Industrie 4.0“ and associated IT functionality

Pathways for future development for the manufacturing industry

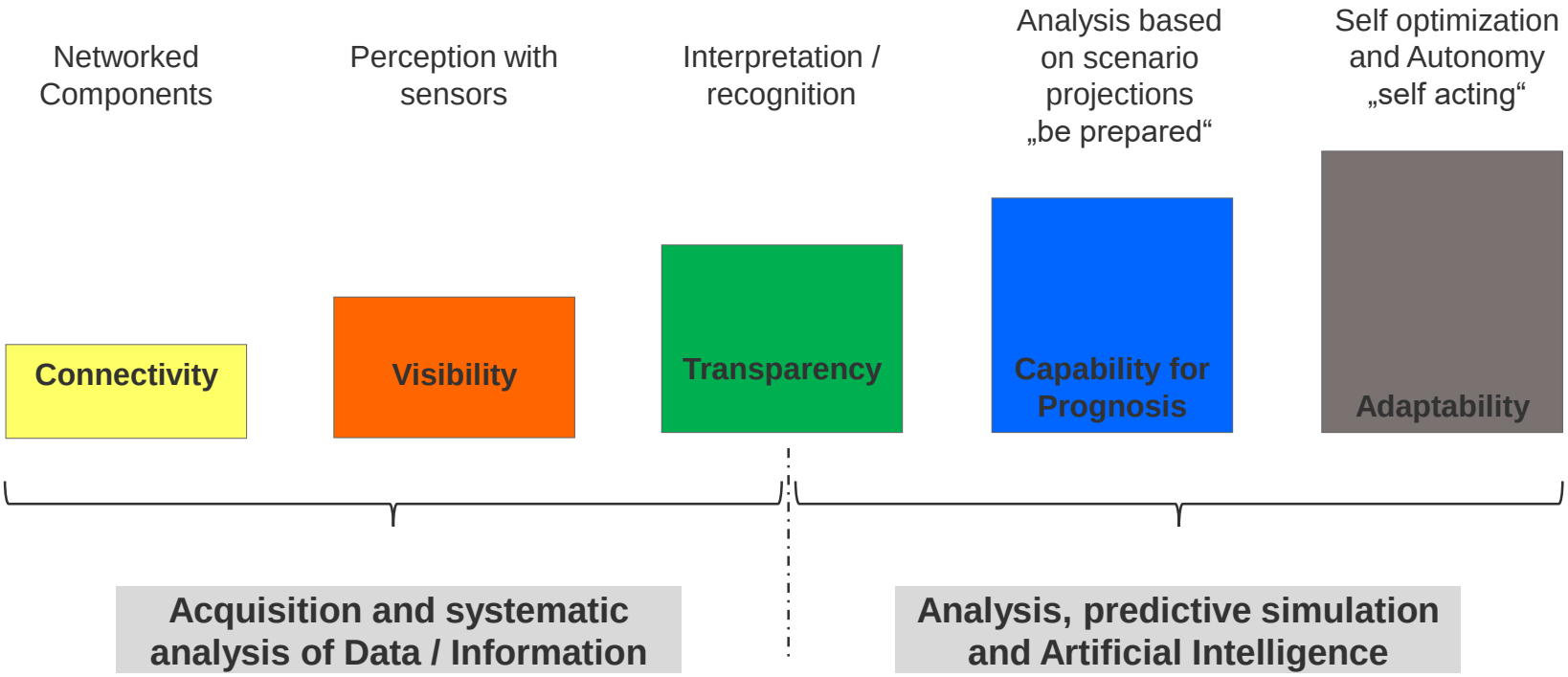


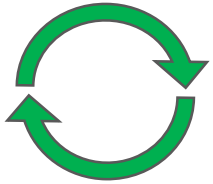
Fig.: Fusion of [Schuh et al 2017] and [Weyrich et al 2017]

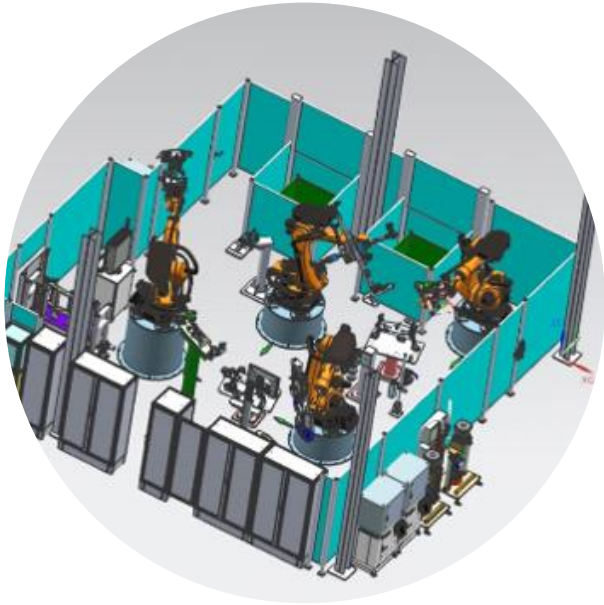
Cyber physical Systems - Composition of Software, Data, IT and physical devices

Physical

Cyber

(Source: http://media.daimler.com)



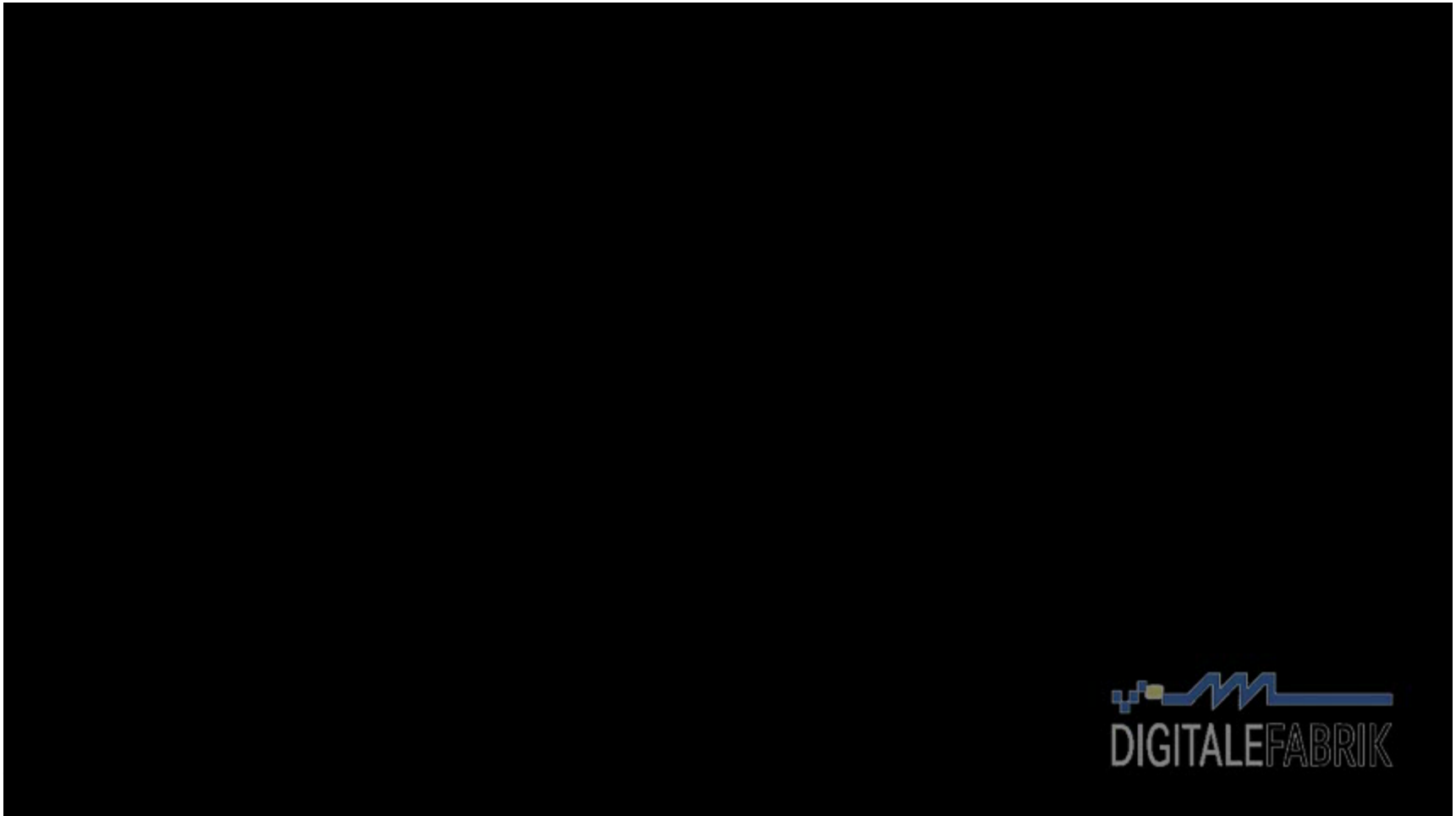


The very large Diversity, e.g. hundreds of sub-systems demand for a standard information model for functional groups, classification of components etc.

Complexity is created in practical application due to the linkage of components and interdependencies between the sub- domains / disciplines.

Body-in-White in Assembly Solutions

Video showing the State-of-the-Art in Industrial Application (Source Daimler 2018)

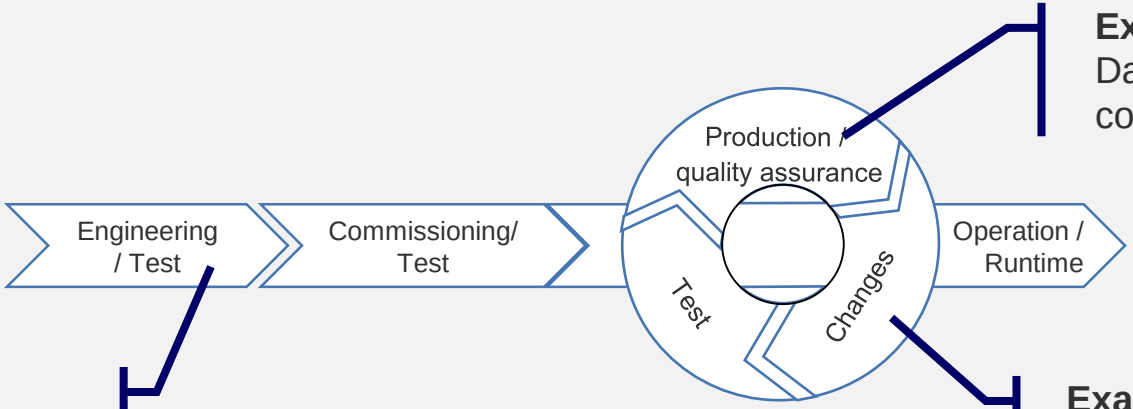


Digital Twin – Design moves to Runtime

How could the interchange be used between the cyber and physical world?

Today

Tomorrow



Example 3:
Data driven quality control in Operation

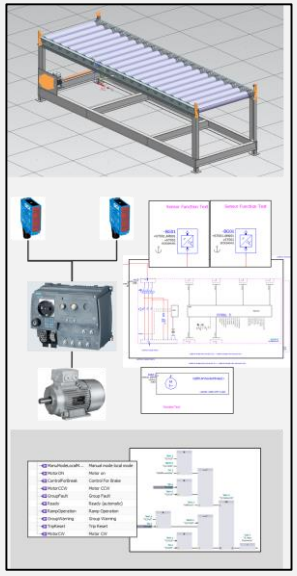
Example 1:
Configuration of systems and Engineering for Change

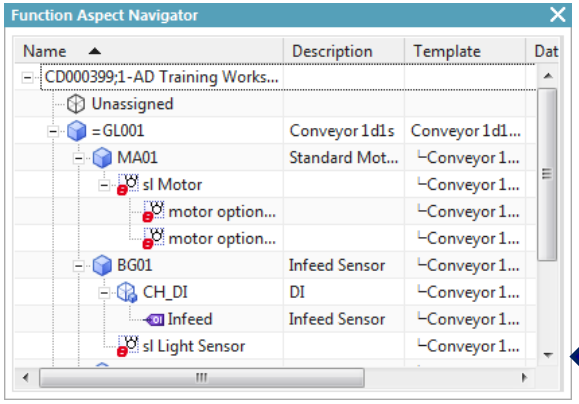
Example 2:
automatic changes in manufacturing

Example 1: Multiple Sub-domains / Disciplines

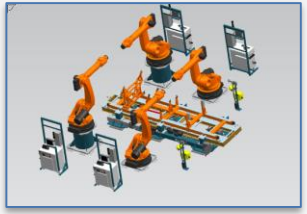
Manufacturing systems are designed using IT-based Engineering systems which support different views of the various mechatronic elements

Components

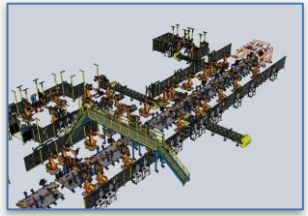




Station



Whole Line



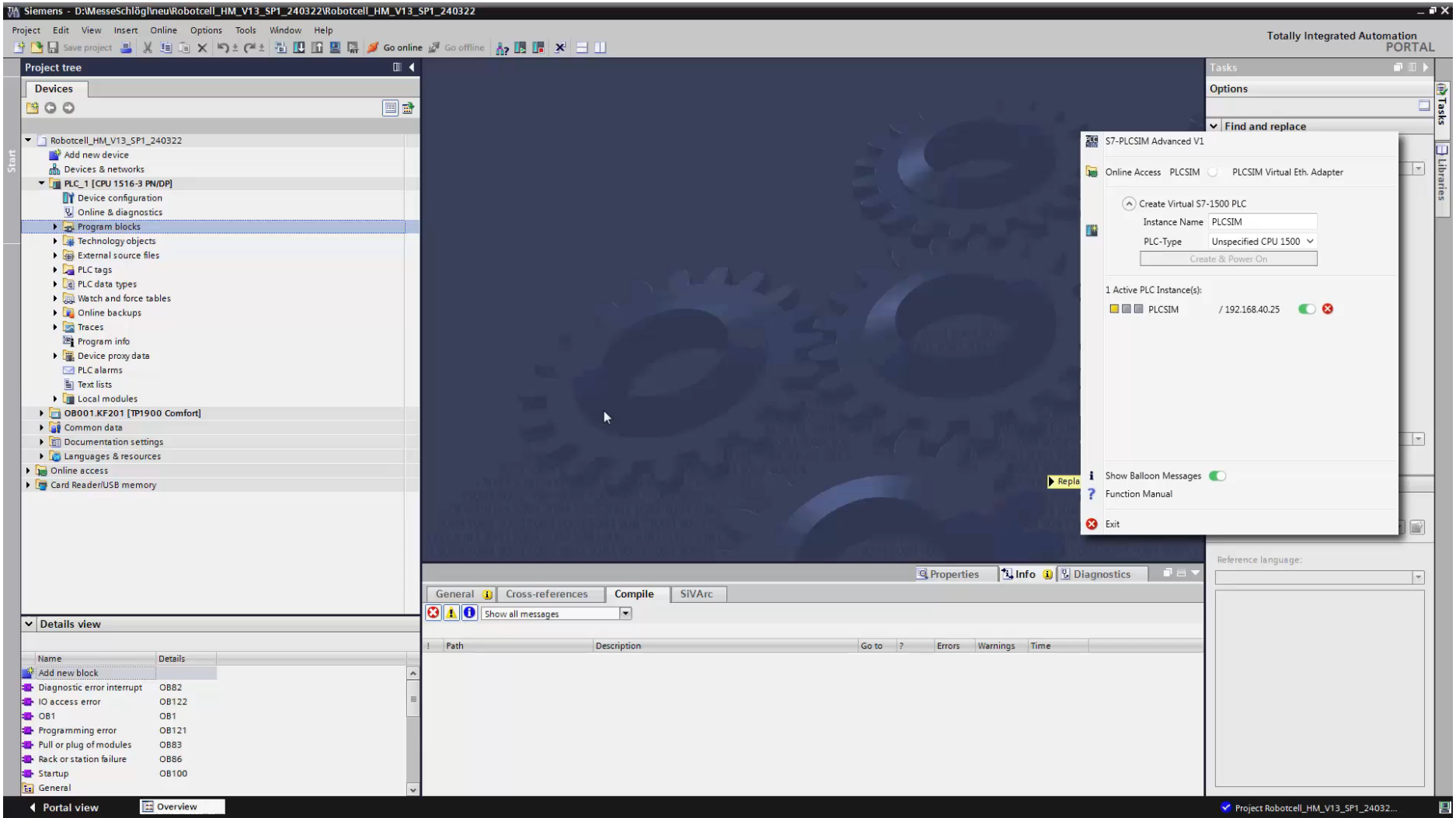
- Discipline mechanical Design
- Discipline Layout of plant
- Discipline Electronics electric
- Discipline Software for control

…

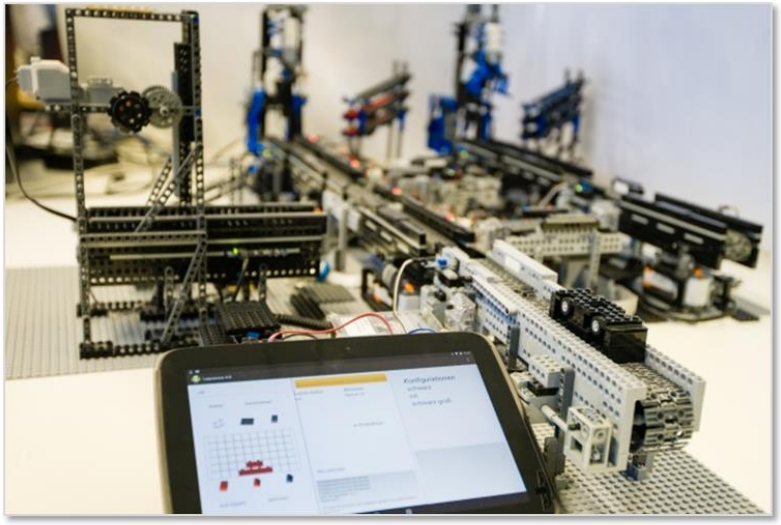
➢ **Challenge:**
How to synchronize the multiple legacies of the Engineering systems?

(Source: Siemens AG-Automation Designer)

Virtual Commissioning (Source Siemens, 2018 / Arena 2036)



Example 2: Decentral Control of automated manufacturing systems based on agent technology

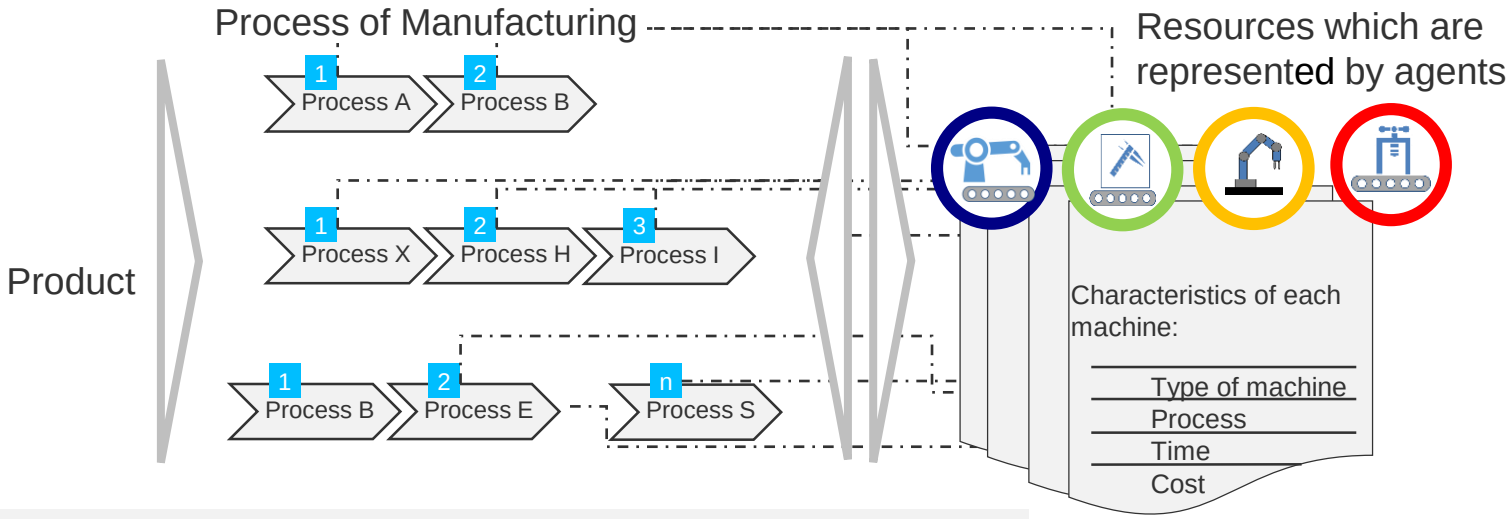


- Data processing ability: Level 2 – „Real time, **decentral**“
- Communication ability: Level 2 – „**Wireless**“
- Integration ability: Level 4 – „Objects managed as **Entity**“
- Perception ability: Level 2 – „**Detect objects** in the environment “
- Knowledge creation ability: Level 0 – „none“
- Reasoning ability: Level 2 – „**Algorithms based on rules**“
- Generalization ability: Level 0 – „none“
- Specialisation ability: Level 2 – „**Partially autonomy** of Modules“

Reference project on the Roadmap Industrie 4.0 of the Platform Industrie 4.0, see [Klein, Weyrich 2016]; [Faul et al 2018]

Example 2: Automatic Allocation of suitable Resources to the Process steps

The product chooses its resources depending on the process requirements



Challenges

- Resource communicate the status automatically using a semantic
- Agents control the allocation of process and recourses using the market place approach

[Klein et al 2018]

Smart Lego Plant

(Source IAS Univ. Stuttgart, 2018)

Arena 2036: On Campus of the University of Stuttgart

ARENA2036 - "Active Research Environment for the Next Generation of Automobiles"
The largest and leading research platform for mobility in Germany

- More than 300 scientific staff
- Area of 25 000 m^2

In ARENA 2036 IAS is involved in the research project "Flexible Production System" as a project leader in cooperation with industrial partners: SIEMENS, KUKA and TRUMPF

Summary

- Models for explanation
- Examples from research projects
- Next steps and frontiers

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