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

Connectivity

Perception with sensors

Interpretation / recognition

Analysis based on scenario projections „be prepared“

Self optimization and Autonomy „self acting“

Networked Components

Capability for Prognosis

Adaptability

Visibility

Transparency

Acquisition and systematic analysis of Data / Information

Analysis, predictive simulation and Artificial Intelligence

Fig.: Fusion of [Schuh et al 2017] and [Weyrich et al 2017]
Cyber physical Systems - Composition of Software, Data, IT and physical devices

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

Engineering / Test → Commissioning / Test → Operation / Runtime of production → Retrofit

Tomorrow

Example 1: Configuration of systems and Engineering for Change

Example 2: automatic changes in manufacturing

Example 3: Data driven quality control in Operation

© 2018, Prof. Dr.-Ing. Michael Weyrich, IAS, Universität Stuttgart
Example 1: Multiple Sub-domains / Disciplines

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

- 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?
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 resources using the market place approach

[Klein et al 2018]
Verteilte LEGO-Auto-Fabrik
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 m²

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

Prof. Dr.-Ing. Michael Weyrich
E-Mail: michael.weyrich@ias.uni-stuttgart.de
Telefon: +49 711 685 67301

Universität Stuttgart
Institut für Automatisierungstechnik und Softwaresysteme
Pfaffenwaldring 47
70550 Stuttgart
References


