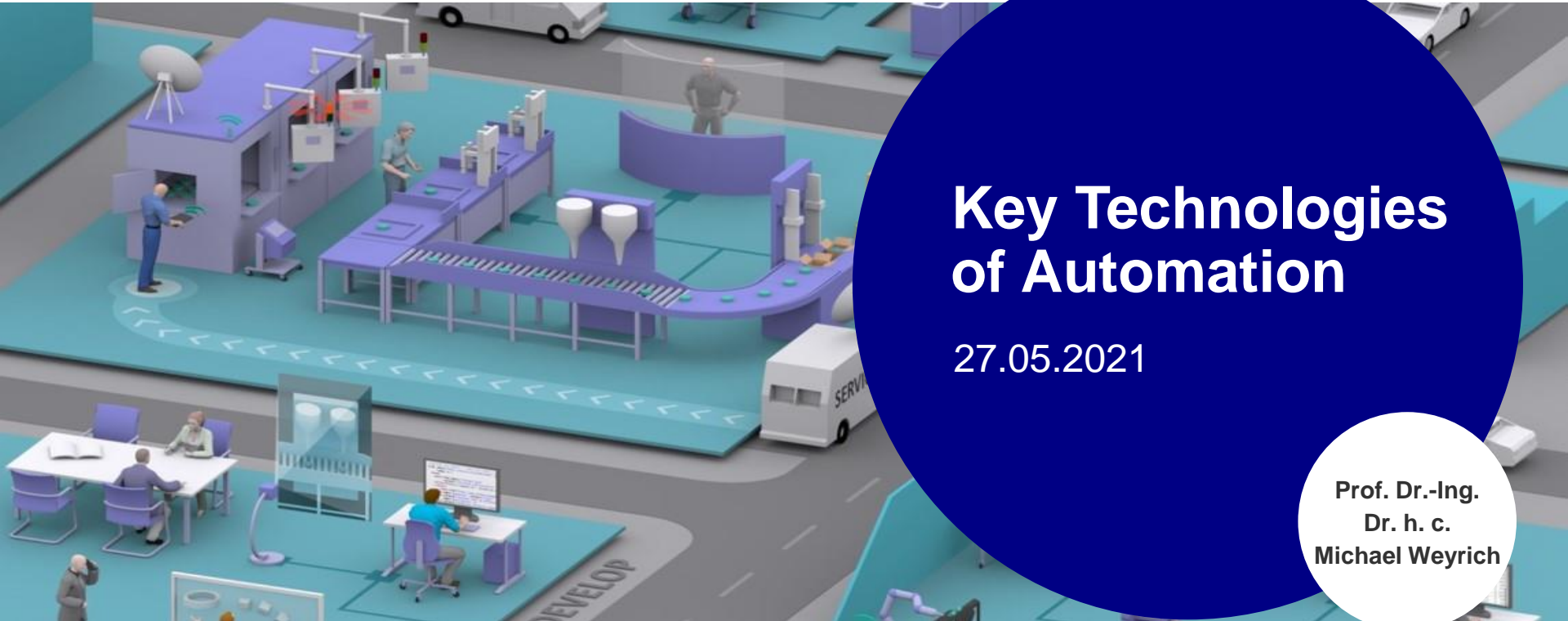**Universität Stuttgart**
Institute of Industrial Automation and Software Engineering

Key Technologies of Automation

27.05.2021

Prof. Dr.-Ing. Dr. h. c. Michael Weyrich

DonNTU – 100 Years Anniversary

Components of the Digital Twin and implemented technologies

A Digital Twin ranges from the development of the device type, the manufacture of the individual device, assembly and commissioning

A Digital Twin is a key concept for digitalization:

- It contains all the data of its objects which forms a source of truth
- It preserve data digitally from the beginning and continuously updates it.


[Ashtari et al 2019]
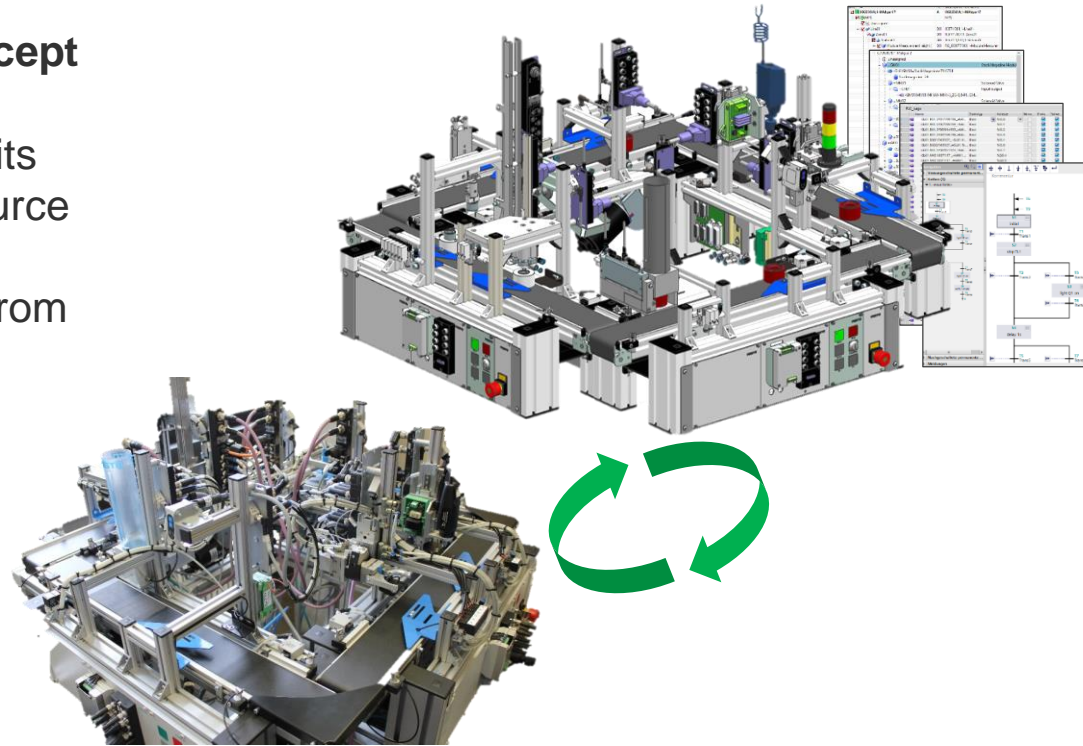
Digital Twin - physical and cyber representation

A concept to manage all generated digital models throughout their lifecycle

A model plant which is used to demonstrate the concept of Modularity an Digital Twin in the Arena 2036

Jointly build-up by IAS (Univ. Stuttgart), Siemens, Trumpf and Kuka
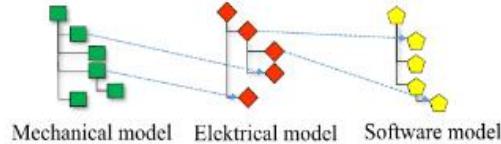
Manufactured Product

Welding Machine

Movable Robot

Head Control Unit

Intelligent Warehouse (iWarehouse)
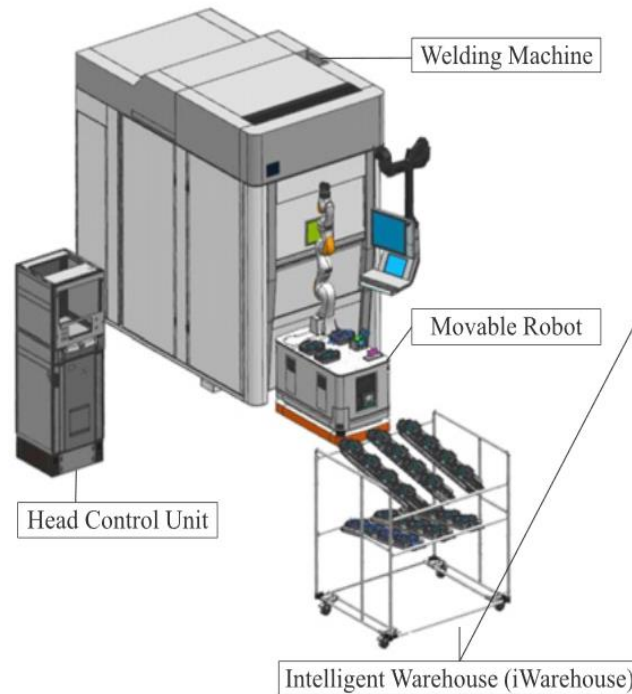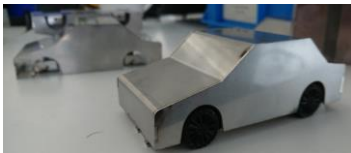
37 Sensors, 24 Actuators

[Klein et al 2019]

Components of the Digital Twin and implemented technologies

A Digital Twin consists of Models and associated interfaces to tools

University of Stuttgart, IAS, Prof. Dr.-Ing. Dr. h. c. Michael Weyrich

2021   4

[Ashtari et al 2019]
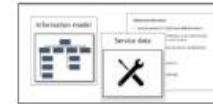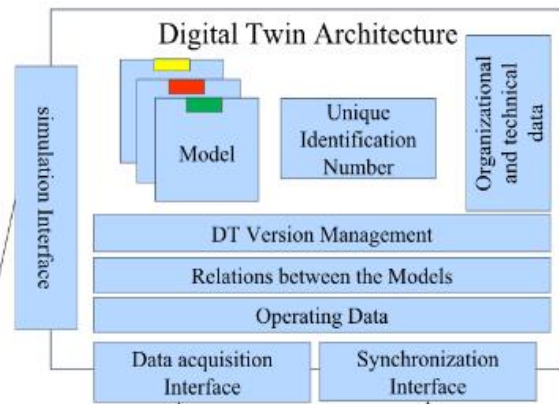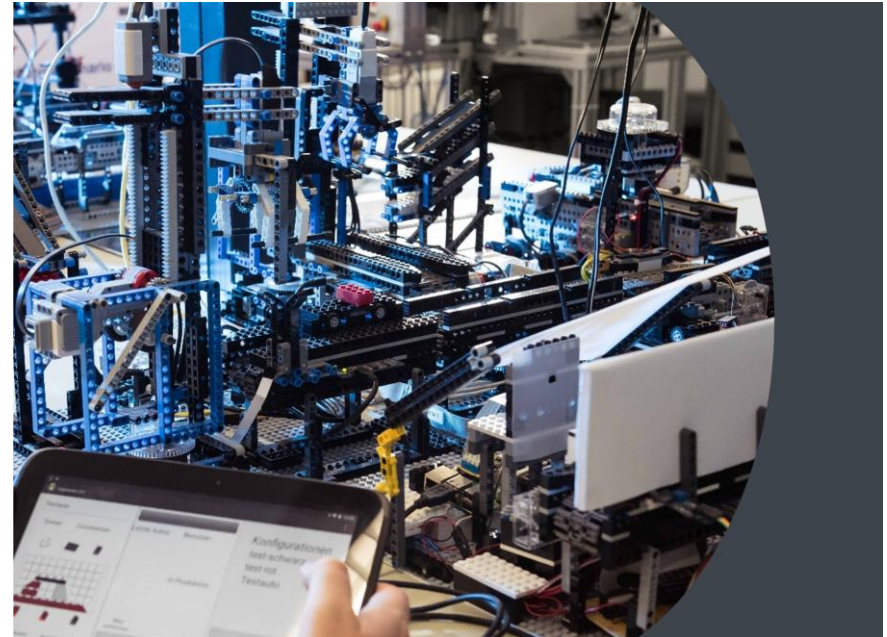
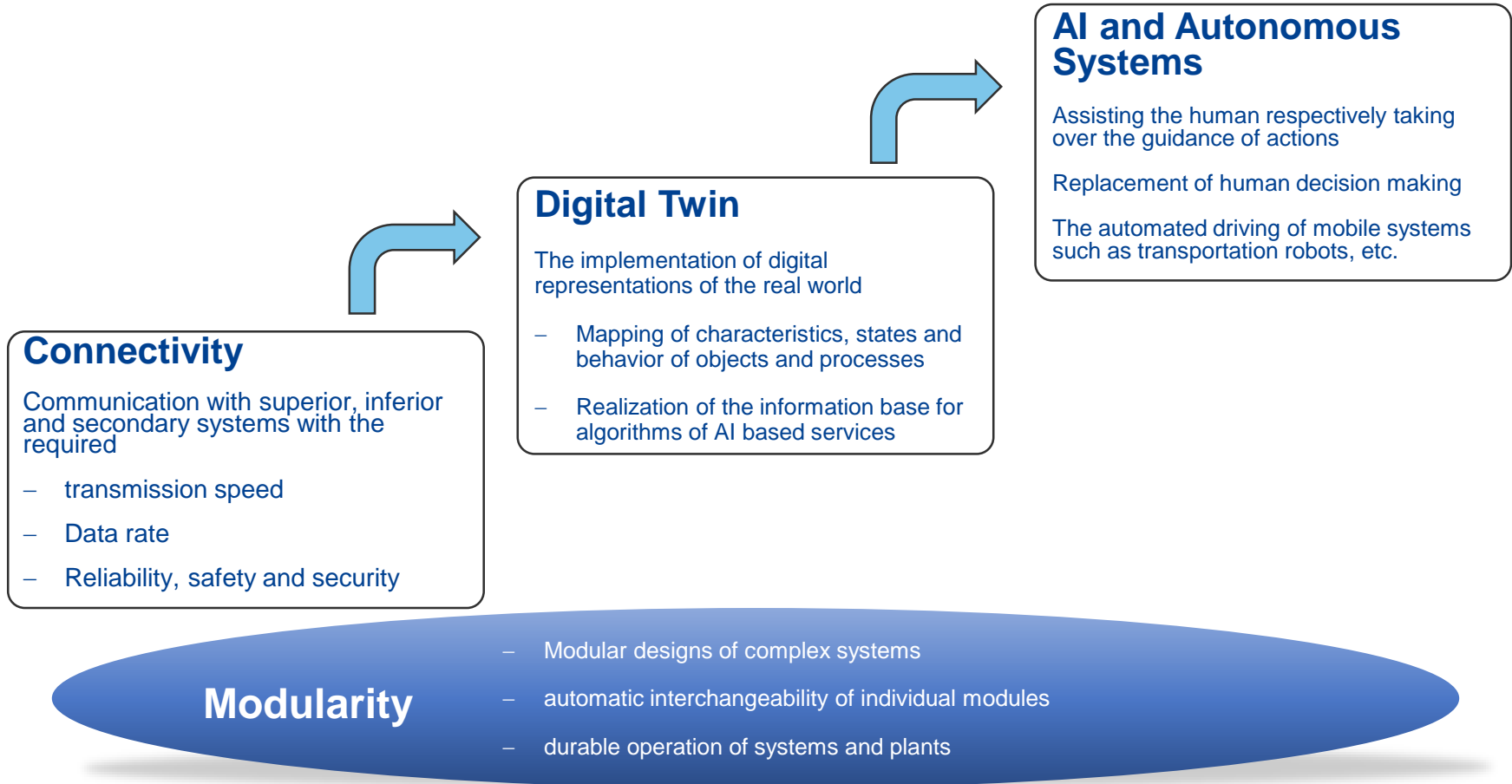# Intelligent Automation and Autonomous Systems

Are technical systems of tomorrow going to automate themselves?

Further Research topics based on AI

- Dynamic Intelligent Reliability

- Optimization of automation systems using machine learning

- Intelligent automation for user-oriented

- Decentralized, cooperative machine learning in automation

- Simulation of autonomy concepts

Enhancing automation technology – the four key elements of automation

Connectivity

Communication with superior, inferior and secondary systems with the required

- transmission speed
- Data rate
- Reliability, safety and security

Digital Twin

The implementation of digital representations of the real world

- Mapping of characteristics, states and behavior of objects and processes
- Realization of the information base for algorithms of AI based services

AI and Autonomous Systems

Assisting the human respectively taking over the guidance of actions

Replacement of human decision making

The automated driving of mobile systems such as transportation robots, etc.

Modularity

- Modular designs of complex systems
- automatic interchangeability of individual modules
- durable operation of systems and plants

References

[Klein et al 2019] M. Klein, B. Maschler, A. Zeller, B. Ashtari Talkhestani, N. Jazdi, R. Rosen, und M. Weyrich, „Architektur und Technologiekomponenten eines digitalen Zwillings", in *20. Leitkonferenz der Mess- und Automatisierungstechnik Automation 2019, 02.-03.Juli 2019, Baden-Baden*, 2019

[Ashtari et al 2019] Ashtari, B.,Jung, T.,Lindemann, B.,Sahlab,N.,Jazdi,N. Schloegl, W. and Weyrich, M.: Anarchitecture of an Intelligent Digital Twin in a Cyber-Physical Production System. AT– Automatisierungstechnik, 67(9) ,762–782.2019

[Mueller et al 2020] Mueller, T., Jazdi,, N, Schmidt, J.P., Weyrich, M: Cyber-Physical Production Systems: enhancement with a self-organized reconfiguration management, Procedia CIRP, 2020

[Ebert et al 2019] Ebert, C. and Weyrich, M. "Validation of Autonomous Systems," IEEE SOFTWARE, vol. 36, no. 9/10, pp. 15-23, 2019, 2019

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Thank you!

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