Publication series on Industry 4.0

Birgit Vogel-Heuser* and Ulrich Jumar

Scientific fundamentals of Industry 4.0

Wissenschaftliche Grundlagen von Industrie 4.0

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The term *Industry 4.0* has already been around for some years now. Nevertheless, principles and fundamentals are still not common knowledge and lack publications – especially outside the German-speaking community.

Starting with this AT issue, a series of contributions aims to lay the scientific foundation for Industry 4.0. It is not the goal of this series to provide papers that build upon each other, but to gather different aspects and views, and to provide these in a comprehensive way. Thus, the series gives an overview of the state of the art with a focus on the respective sub-aspects.

On the one hand, the definition of Industry 4.0 seems to be quite clear and comprehensive: Industry 4.0 refers to the intelligent networking of machines and processes for industry with the help of information and communication technology [1]. On the other hand, there are several definitions with different foci. Therefore, we would like to summarize the definition referring to Wikipedia and IEEE TASE [2] in the following:

- “Service Orientation: CPPS offering services via the Internet based on a service oriented reference architecture.
- Intelligent self-organizing CPPS providing the ability of CPPS to make decisions on their own (decentralization).
- The ability of CPS, humans and CPPS to connect and communicate with each other (interoperability):
 - Information aggregation and representation for the human in the loop during engineering and maintenance of aPS;
 - A virtual copy of CPPS on different levels of detail, e. g., from sensors and actuators to the entire CPPS (virtualization);

- Relevant process and engineering information for data analysis (real time capability);
- The ability to flexibly adapt to changing requirements by replacing or expanding individual modules (cross-disciplinary modularity).
- Big Data algorithms and technologies provided in real-time (real-time capability).
- Optimization of the manufacturing process based on these algorithms and data to increase Overall Equipment Effectiveness (OEE).
- Data integration across disciplines and along the life cycle based on standardized data models and a model driven modular engineering process.
- Secure communication enabling a worldwide network of aPS supporting economic industrial partnership across companies’ borders.
- Access to data securely stored in a Cloud/Intranet.”

We will start this series with the paper “Applying Knowledge Bases to Make Factories Smarter” by Felix Ocker, Christiaan J. J. Paredis, and Birgit Vogel-Heuser. Knowledge-based systems form a subclass of artificial intelligence, which serves as an enabler for Industry 4.0. The paper gives an overview of existing knowledge bases from the engineering domain as well as generic top-level ontologies that allow engineers to combine domain-specific knowledge bases. The series will continue in 2019 and 2020, covering various Industry 4.0 topics such as digital twins, system architectures for realizing an active administration shell, and testing of Industry 4.0 systems to name just a few.

This series can only be successful, if all researchers in this research area are willing to contribute and share their knowledge and recent results. Therefore, we look forward to more papers being submitted. Up to now, we thank Christian Diedrich, Ulrich Epple, Alexander Fay, Stefan Kowalewski, and Michael Weyrich, for their support, to name only the core team of this series’ initiators.

We would like to share the strength of the German platform “Industrie 4.0” internationally and reach the international community, too – this is why we publish this series in English and make it available open access.

*Corresponding author: **Birgit Vogel-Heuser**, Institute of Automation and Information Systems, Technical University of Munich, Munich, Germany, e-mail: vogel-heuser@ais.mw.tum.de
Ulrich Jumar, ifak Institut für Automation und Kommunikation e.V., Magdeburg, Germany, e-mail: ulrich.jumar@ifak.eu

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Prof. Dr.-Ing. Birgit Vogel-Heuser
Institute of Automation and Information
Systems, Technical University of Munich,
Munich, Germany
vogel-heuser@ais.mw.tum.de

Prof. Dr.-Ing. Birgit Vogel-Heuser is a full professor and director of the Institute of Automation and Information Systems at the Technical University of Munich. Her main research interests are systems engineering, software engineering, and modeling of distributed and reliable embedded systems. She is coordinator of the Collaborative Research Centre (CRC) 768: Managing cycles in innovation processes – integrated development of product-service systems based on technical products, member of acatech, chair of the VDI/VDE working group on industrial agents and vice chair of the IFAC TC 3.1 computers in control.

Prof. Dr.-Ing. Ulrich Jumar
ifak Institut für Automation und
Kommunikation e.V., Magdeburg, Germany
ulrich.jumar@ifak.eu

Prof. Dr.-Ing. Ulrich Jumar is head of the Institut für Automation und Kommunikation e.V. Magdeburg (ifak). His main research interests are modelling and simulation, as well as control theory in various fields of automation.