NEWS Dream Factory | Quarterly

Issue 14 | September 2014

Dear Readers,

after the Dream Car Report **„Big Data – Potential for the Controller”** has been completed, we would like to move on to the next big issue facing controllers. Our new focus for the Dream Factory is **„The Controller and Industrie 4.0”**.

Industrie 4.0 is the latest mega-trend in production and stands for intelligently networked factories and value creation chains. This creates new challenges for both controllers and their instruments and methods. Before we can analyze these challenges in greater detail, we need to make sure we understand precisely what the technology-driven topic of Industrie 4.0 means for controllers.

For this reason, we have dedicated this entire issue of the Dream Factory Quarterly to shedding light on the technologies behind Industrie 4.0. First, we show you the road to the fourth industrial revolution. Then, we take a closer look at those technologies which form the basis for Industrie 4.0. This includes an in-depth discussion of the role of “cyber-physical systems”. Finally, we provide insights into the issues which affect controlling and controllers.

We hope you enjoy reading this issue of the Dream Factory Quarterly.

Best regards,

Siegfried Gänßlen
Chairman of the ICV board

Prof. Dr. Heimo Losbichler
Deputy Chairman of the ICV board

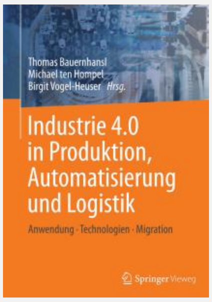
Prof. Dr. Dr. h.c. mult. Péter Horváth
Head of the ICV Dream Factory

Dr. Uwe Michel
Head of the ICV Dream Factory

Suggested Reading

The final report **„Recommendations for implementing the strategic initiative Industrie 4.0”** from the work group Industrie 4.0 provides a comprehensive overview of this topic. Headed up by Dr. Siegfried Dais (Robert Bosch GmbH) and Prof. Dr. Henning Kagermann (National Academy of Science and Engineering - acatech), this work group defined the areas of application and the research needs for Industrie 4.0 and presented its recommendations for implementation to German Chancellor Angela Merkel at the Hannover Fair 2013.

The book **„Industrie 4.0 in Production, Automation and Logistics”** by Prof. Dr.-Ing. Thomas Bauernhansl, Prof. Dr. Michael ten Hompel and Prof. Dr.-Ing. Birgit Vogel-Heuser discusses initial applications and important questions from the perspective of industry and describes, amongst other things, the challenges and demands upon IT using real-world examples. It deals with relevant elements from Industrie 4.0: from basic technologies through vertical and horizontal integration to cyber-physical systems.



Industrie 4.0 | The road to the fourth industrial revolution

„Industrie 4.0" refers to the fourth industrial revolution. The goal is the creation of intelligently networked factories and value creation chains which enable a more flexible, more efficient and more individually customized production (see Kagermann et al. 2013). Experts predict it will lead to increases in productivity of up to 50% (see Bauernhansl 2014). This increase in productivity should be achieved through the use of new technologies and the associated improved organization and performance management of entire value chains. Cyber-physical systems, the integration of the virtual (cyber) world and the real (physical) world into one internet of things, are seen as the major technology enablers of Industrie 4.0.

The First Industrial Revolution

The first industrial revolution took place at the end of the 18th century with the introduction of mechanical production plants. It all started with the development of the steam engine which allowed the heat energy contained in steam to be converted into mechanical work. This made it possible for machines to carry out manual tasks. Additionally, the use of steam engines led to vast improvements in transportation thanks to steam locomotives and steam ships.

The Second Industrial Revolution

The beginning of the 20th century saw the introduction of the main driver of the second industrial revolution: mass production based on the division of labor with the help of electrical energy. This is often discussed in conjunction with a revolution in the organization of labor. The main formative elements here were Henry Ford's assembly line in production and the principles of scientific management. This era was particularly characterized by the introduction of mass production across the entire electrical and automotive industries.

The Third Industrial Revolution

The third industrial revolution kicked in at the beginning of the 1970s and continues today. The main drivers were the growing use of electronics and information and communication technologies which enabled an increasing automation of production processes. This in turn led to further rationalization, on the one hand, and to very diversified serial production, on the other. It was the latter in particular which became more and more important as the seller's market transformed increasingly into a buyer's market.

The Fourth Industrial Revolution

The focus of Industrie 4.0 lies on the networking of production processes. Intelligent networking should allow value creation processes to be planned and managed in real time. This is achieved through so-called cyber-physical systems (CPS). CPS stands for the integration of embedded information technologies in objects, materials, devices, and the processes of logistics, coordination and management, as well as their networking (see Kagermann et al. 2013).

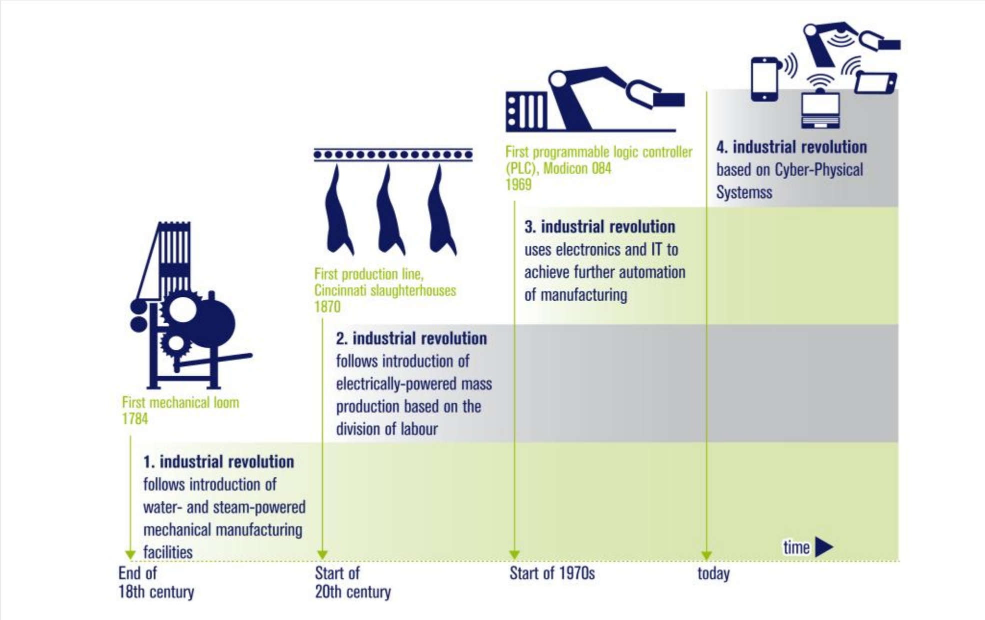


Figure 1: The four industrial revolutions (from Kagermann et al. 2013, p. 17)

Technological Foundations | Which fields of technology are shaping Industrie 4.0?

Industrie 4.0 is a topic which is heavily driven by technology. In order to understand the idea of intelligently networked factories and value chains, we first have to understand the functions of the technologies which enable this development. We would like to take this opportunity to explain the formative technologies fields of Industrie 4.0 and thus make the whole topic more tangible.

Within the auspices of a joint study, the Federal Association for Information Technology, Telecommunications and New Media (**BITKOM**) and the Fraunhofer Institute for Industrial Engineering (**IAO**) identified five technology fields which are shaping Industrie 4.0 (see Bauer et al. 2014, p. 18 and Figure 2).

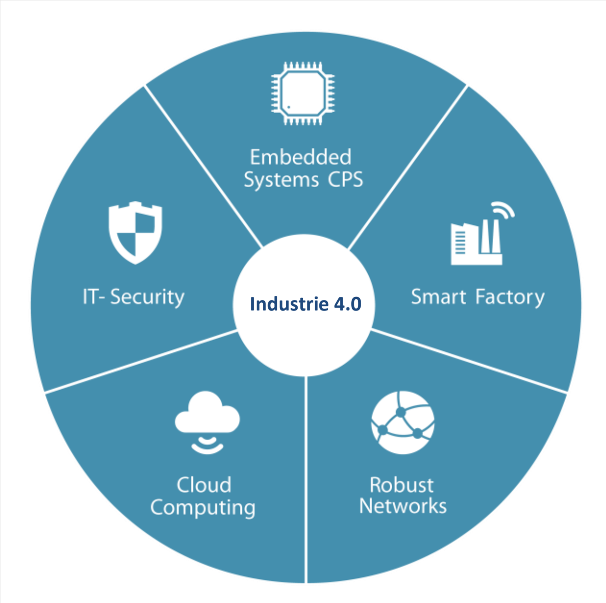


Figure 2: Formative technology fields of Industrie 4.0 (from Bauer et al. 2014, p. 18)

Embedded Systems and Cyber-Physical Systems (CPS)

The initial basis for intelligent networking within Industrie 4.0 is embedded systems which is the linking of autonomous, powerful minicomputers with different objects (e.g. machines or devices). Increasingly, these embedded systems are being networked with each other and with the internet, resulting in a merging of the physical world with the virtual one into cyber-physical systems.

This merging is made possible by sensors and actuators in the embedded systems. Physical environment data (e.g. temperature or pressure) is recorded by sensors and translated into electrical signals which are then processed by powerful minicomputers. Based on this processed data from the minicomputers, actuators convert electrical signals and affect the physical environment. This occurs through moving individual components of an object or by transmitting acoustic or visual signals.

Smart Factory

Cyber-physical systems can be used in different fields in order to facilitate the intelligent networking of objects and people, with examples being utilities management, traffic management, or assistance systems. If cyber-physical systems are deployed in factories, we call this cyber-physical production systems and a smart factory. Within a smart factory, machines and production employees are networked with one another. In the same way as in social networks, the machines and people of a smart factory can communicate with one another and exchange data.

Robust Networks

It is only through highly available and real-time communication networks that it is even possible to intelligently network a smart factory. These must guarantee the rapid and secure transfer of large amounts of data both inside and outside of the production environment. Wireless-based information and communication equipment allows people to be integrated into the communication network of the smart factory using mobile units (e.g. smartphones or tablets). However, in this context there is still a need for further R&D concerning the bandwidth, stability, availability and security of wireless networks.

Cloud Computing

Cloud computing is an IT platform with data, applications (apps) and different uses which enables products, machines and intelligent objects to connect to the cloud via communication networks. Compared with conventional servers, much larger quantities of data can be processed using cloud computing. Within the smart factory, this makes it possible to develop and use new methods for analyzing and optimizing the factory. Additionally, people within the smart factory can access the cloud and use the newly developed methods for analysis and optimization.

IT-Security

When it comes to information and communication networks, one particular area of concern is security. One the one hand, this pertains to securing the data of employees and business partners and, on the other hand, this refers to security on the industrial network. In the face of industrial espionage, there is a lot of sensitive data which can be accessed via the industrial internet or stored on the cloud and it is absolutely vital that this data be protected.

The Controller and Industrie 4.0 | Which questions must be answered by controlling?

In spite of the integration of principles of artificial intelligence, humans and their function as qualified decision-makers still remain the key factor in the production environment. However, it is predicted that their role and the content of their work will change fundamentally within Industrie 4.0 (see Spath et al. 2013). We want to use our work in the Dream Factory to find out what impact this development will have on controlling and the controller. In order to do so thoroughly and comprehensively, we will tackle four major questions (see Figure 3).

In spite of all the benefits which Industrie 4.0 promises, alongside the **opportunities** it is also important to view the **risks** inherent in this development and make them transparent. Based on concrete examples of real-world application, the aim is to show the potential benefits and at the same time identify the risks which, for example, arise from increased internal and external networking.

We can fully expect changes in **controlling processes and methods** to occur as a result of intelligent collection, recording and dissemination of data by objects and people. What is particularly interesting here is how the planning and budgeting process will change. A further area of focus could also be the changing relevance of different performance management indicators.

An important element of Industrie 4.0 is the sensor-based collection of data in real time. This raises the question of which **information potentials** are inherent in such a development for planning, performance management and monitoring and which functions they are particularly relevant for. After all, real time should only be introduced in those areas where it will actually lead to real improvements in efficiency.

When it comes to the role of the controller in Industrie 4.0, it is important to see how the **job profile** of controllers will change compared with today. Additionally, it is also important which skills controllers will need in the digital era in order to be able to complete their tasks optimally. Another question which needs to be answered is whether they will face competition from in-house data analysts or other similar functions.

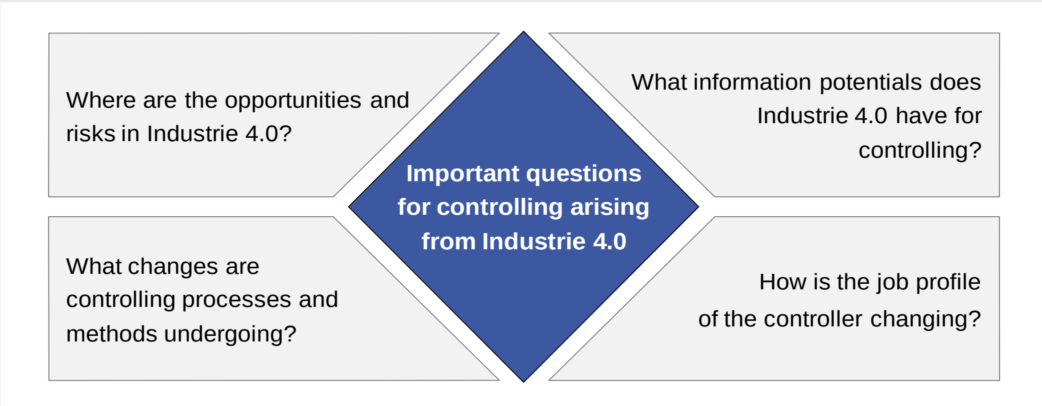


Figure 3: Important questions for controlling arising from Industrie 4.0

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Imprint

Publisher and Copyrights
International Controller Association
Dream Factory
Siegfried Gänßlen
Prof. Dr. Heimo Losbichler
Prof. Dr. Dr. h.c. mult. Péter Horváth
Dr. Uwe Michel
www.controllerverein.com/iw

Editing
IPRI gGmbH
Dipl.-Kfm. techn. Goran Sejdić
Königstr. 5
70173 Stuttgart
Phone: +49 (711) 620 32 68-8022
Fax: +49 (711) 620 32 68-1045
GSejdic@ipri-institute.com

Core team of the Dream Factory
Prof. Dr. Dr. h.c. mult. Péter Horváth
Dr. Uwe Michel
Siegfried Gänßlen
Prof. Dr. Heimo Losbichler
Manfred Blachfellner
Dr. Lars Grünert
Karl-Heinz Steinke
Prof. Dr. Dr. h.c. Jürgen Weber
Goran Sejdić

International Controller Association
Main Office
Münchner Str. 8
82237 Wörthsee
Phone: +49 (89) 89 31 34-20
Fax: +49 (89) 89 31 34-31
www.controllerverein.com
verein@controllerverein.com