Roland Heidel | Michael Hoffmeister |
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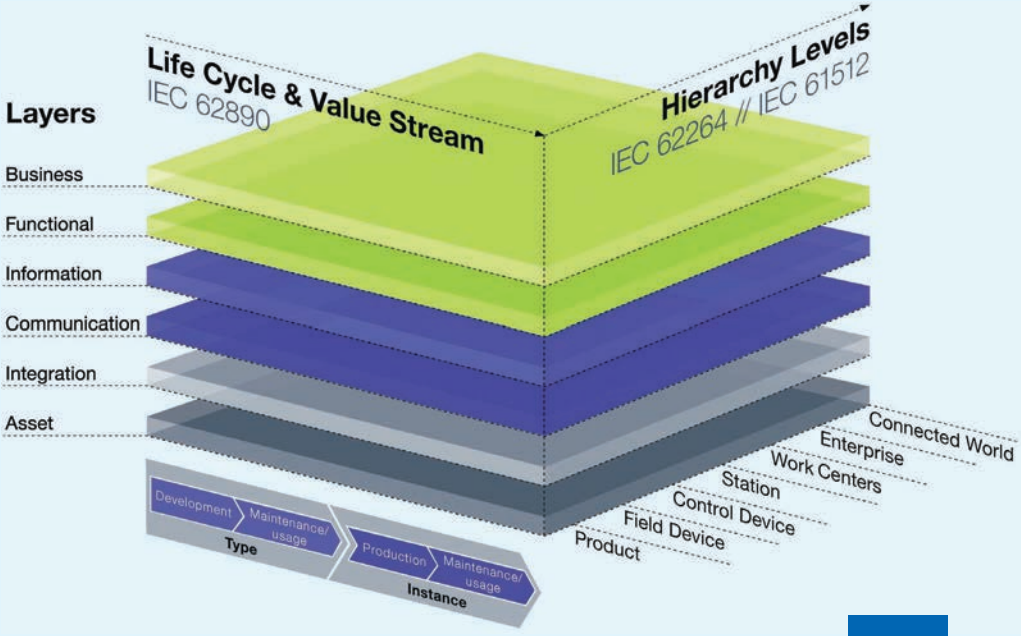
STANDARDIZATION COUNCIL INDUSTRIE 4.0

Industrie 4.0

The Reference Architecture Model RAMI 4.0 and the Industrie 4.0 component



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The Reference Architecture Model RAMI 4.0 and the Industrie 4.0 component

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Roland Heidel, Michael Hoffmeister,
Martin Hankel, Udo Döbrich

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About the authors

Roland Heidel

After completing his studies in electrical engineering, Roland Heidel started his career by working on the development of industrial communication systems at Siemens in 1977. He was a technical project manager for a joint project dealing with field buses for the industrial field communication system “Profibus”. He also headed multiple EU projects dealing with industrial automation technology with a particular focus on product data engineering. Heidel was head of an advanced development department and, until he left Siemens, was also head of the department “Standards & Regulations” for the divisions “Digital Factory (DF)” and “Process Industries and Drives (PD)”.

Until 2016 he was chairman of the standards committee IEC/TC 65 “Industrial -process measurement, control and automation”; for 12 years until fall 2014 speaker of the Industrie 4.0 Working Group 2 (Reference Architectures, Standards and Norms) and until 2015 speaker for its mirror committee in the ZVEI (Zentralverband Elektrotechnik- und Elektronikindustrie e.V., the German Electrical and Electronic Manufacturers’ Association). In 2019 he received the IEC 1906 Award. Heidel has run his own company, Kommunikationslösungen e.K, since 2015 and is active in numerous Industrie 4.0 working groups.

Dr. Michael Hoffmeister

Michael Hoffmeister studied information technology at the Karlsruhe Institute of Technology (KIT) and alongside this worked as a freelance developer of real time systems. He then became a researcher and project manager at the research institute Fraunhofer IPA in Stuttgart, where he completed his doctorate in 2012. Hoffmeister was a well-known consultant for large scale IT projects within the area of factory operation, machine integration and big data (SPC, APC, etc.). His research looked at intelligent machines, semantic technologies, big data and the integration of heterogeneous automation technologies. Since 2012 he has been in charge of portfolio management for the software tools of the components manufacturer Festo. He is currently interested in engineering platforms designed for mechatronic systems.

Dr. Hoffmeister has been driving the standardization of the general aspects of Industrie 4.0 since 2014 and has put particular effort into the specification of the Industrie 4.0 component. He is a co-author of DIN SPEC 91345 (an introduction to RAMI 4.0), leader of the ZVEI Models and Standards mirror committee and a member of other working groups in Germany and international standardization. Furthermore, he is chairman of the Working Group for the VDMA Specification 66415 (Vereinheitlichung Projektierungsinformationen Mechanik, Elektrik, Software, the harmonization of project engineering for mechanics, electrics and software).

Martin Hankel

Martin Hankel graduated in electrical engineering, focusing on control technology. He completed a further Master's degree in business marketing. He has held various positions at Hoechst AG, AEG and Schneider electric. Today Hankel is the project manager for Industrie 4.0 technology at Bosch Rexroth AG. His main responsibilities are the research and development of demonstrators, and the implementation in the company's own factories. Since 2012 he has been involved in multiple publications by the various committees dealing with the reference architecture for Industrie 4.0, such as Plattform Industrie 4.0, ZVEI, VDI, VDMA, DIN and DKE.

Udo Döbrich

Udo Döbrich started working for an advanced industry development division at Siemens in 1980 having completed his studies in information technology. He was responsible for testing and implementing new automation technologies, and their standardization. This task saw his notable contribution to the specification of Profibus. During the course of this project, it became clear that open communication alone is not sufficient to enable cooperation between different components of a plant. After working to create a profile of components capable of communicating and subsequently cooperating when in operation, Döbrich dedicated himself to the specification of a model for the configuration and parametrization of field devices in the form of the formal description language Electronic Device Description EDDL. He was also instrumental in this becoming the International Standard IEC 61804. It became clear that, in all phases, a plant requires a clear, formal description of the components' properties. Because of this, Döbrich joined the NAMUR and eCl@ss working groups, which specifed properties and essential property families for products. The results of his work were published in the standards IEC 61158, the IEC 61360 series and IEC 61784. As head of the IEC Working Group "Digital Factory", and using IEC TR 62794 and IEC TS 62832, he created the basic principles for modelling the data descriptions of components as they are used in Industrie 4.0.

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Foreword

German philosopher and publicist Richard David Precht has a bleak view of the digitalized world. He believes that it will soon lead to a society greatly influenced by Industrie 4.0, in which “robots” carry out the services once performed by slaves.

Only time will tell whether this will become reality. But what is certain is that in the internet of things and services, an infrastructure that is comprised of objects from the physical world must be sufficiently represented in the information world using clear rules. This is why the reference architecture model RAMI 4.0 and the I4.0 component have been the focal point of Industrie 4.0 from the very start.

As the number of documents stemming from different working groups from within the Industrie 4.0 Plattform increased, it became clear that a logical train of thought was required that could highlight the relationships between these documents and offer the reader an overarching view of the technology of Industrie 4.0.

This book brings together results previously only found in individual documents. Essentially, it deals with the characterization of “assets” in the information world by means of standardized properties, and with the rules for depicting information about a physical asset in the information world.

The authors would like to express their gratitude to all those who contributed to and proofread the contents of this book. The suggestions made regarding potential German and international standards within the context of Industrie 4.0 were particularly helpful. Because the topic of Industrie 4.0 spans multiple industries, it is possible that certain themes or issues are not sufficiently dealt with here, either because they would necessitate a book in their own right or because there is not yet sufficient research in these areas. The authors hope that this book makes it easier to understand the content already available from Plattform Industrie 4.0, ZVEI, VDI/GMA, VDMA and Bitkom, as well as the documents that will appear in future.

Berlin, April 2017

Dedicated to

Dr. Peter Adolphs †, Speaker of Working Group 1
of Plattform Industrie 4.0

Dr. Marcus Adams †, Secretary of Cenelec TC 65X

1 Introduction

When the term “Industrie 4.0” was coined in Germany in 2013, the ongoing trend of digitalization was brought to the wider public consciousness. A study published by acatech [1] presents the vision that, in simple terms, can be understood as such: The most important aspect of digitalized production is the cooperation between the components in a plant or configuration and not – as was previously thought – the mere exchange of data between components. Ideally, the elements that should cooperate with each other should be able to make their own way in the production line, i.e. the product to be created should be able to influence its own production. This approach promises more flexibility in the production process, allowing for customized mass production (lot size 1) that can compete with the costs of general mass production today. This approach helps streamline technological processes such as:

- automated and semi-automated engineering
- significantly improved interoperability
- ability of components to provide information
- temporal traceability and localization of relevant components
- more flexible production processes
- significantly improved maintenance
- greater transparency
- lower costs
- quicker set-up times with options for optimizing during the lifetime of a plant

The likelihood that many of these goals can be reached is high because Industrie 4.0 can be viewed as a part of the extensive work on IoTS[1] , which, as a collective term, stands for the digitalization of the world we live in.

In its essence, Industrie 4.0 is the comprehensive digital reflection of the physical world in the information world. To better understand what this means, typical industry requirements, the current state of technology and current technical trends are described in this book. For the sake of ease, the term Industrie 4.0 is mostly abbreviated to I4.0.

“Big data”, the analysis of data in the information world, is an example of one application of Industrie 4.0 that is not addressed in this book.

1 IoTS stands for “internet of things and services”.