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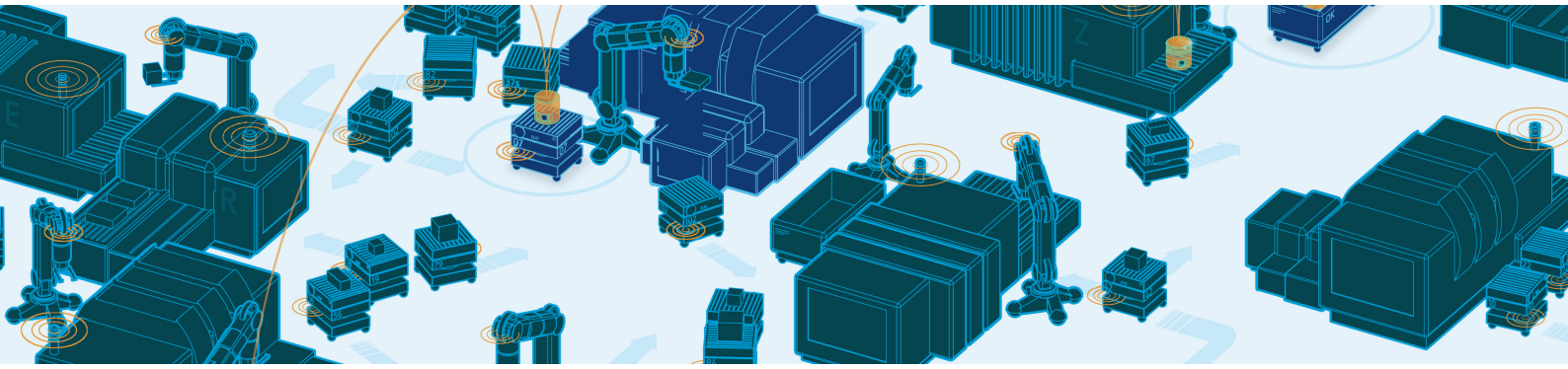


Industrie 4.0: The Reference Architectural Model Industrie 4.0 (RAMI 4.0)

RAMI 4.0 combines the crucial elements of Industrie 4.0 in a three-dimensional layer model for the first time. Based on this framework, Industrie 4.0 technologies can be classified and further developed.

RAMI 4.0 – Structure

The Reference Architectural Model Industrie 4.0, abbreviated RAMI 4.0, consists of a three-dimensional coordinate system that describes all crucial aspects of Industrie 4.0. In this way, complex interrelations can be broken down into smaller and simpler clusters.

• The "Hierarchy Levels" axis

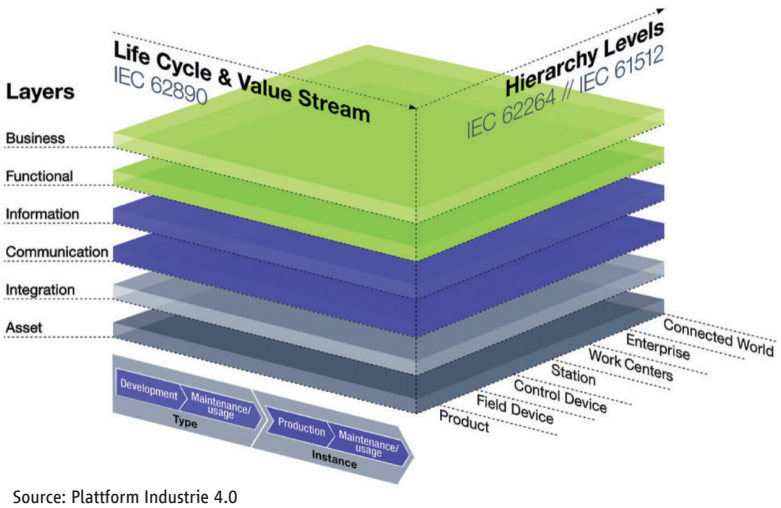
Indicated on the right horizontal axis are hierarchy levels from IEC 62264, the international standards series for enterprise IT and control systems. These hierarchy levels represent the different functionalities within factories or facilities.

In order to represent the Industrie 4.0 environment, these functionalities have been expanded to include workpieces, labelled "Product", and the connection to the Internet of Things and Services, labelled "Connected World".

• The "Life Cycle & Value Stream" axis

The left horizontal axis represents the life cycle of facilities and products, based on IEC 62890 for life-cycle management. Furthermore, a distinction is made between "types" and "instances". A "type" becomes an "instance" when design and prototyping have been completed and the actual product is being manufactured.

Reference Architectural Model Industrie 4.0
(RAMI 4.0)



Source: Plattform Industrie 4.0

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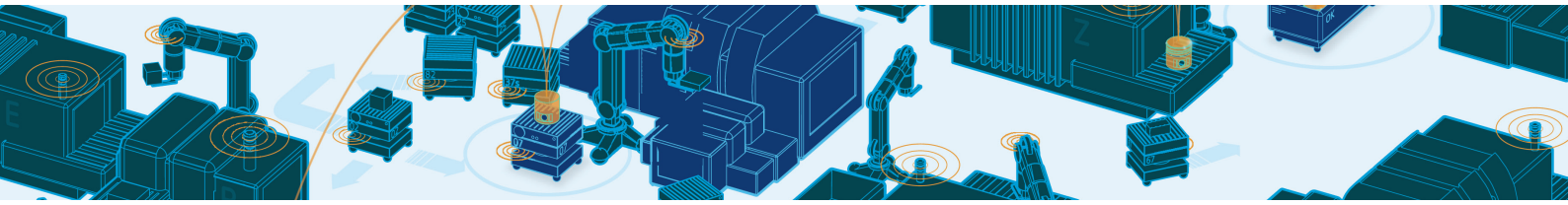

- **The "Layers" axis**

The six layers on the vertical axis serve to describe the decomposition of a machine into its properties structured layer by layer, i.e. the virtual mapping of a machine. Such representations originate from information and communication technology, where properties of complex systems are commonly broken down into layers.

Within these three axes, all crucial aspects of Industrie 4.0 can be mapped, allowing objects such as machines to be classified according to the model. Highly flexible Industrie 4.0 concepts can thus be described and implemented using RAMI 4.0. The reference architectural model allows for step-by-step migration from the present into the world of Industrie 4.0.

Benefits of RAMI 4.0

The model integrates different user perspectives and provides a common understanding of Industrie 4.0 technologies. With RAMI 4.0, requirements of sectors – from manufacturing automation and mechanical engineering to process engineering – can be addressed in industry associations and standardisation committees. Thus, RAMI 4.0 provides a common understanding for standards and use cases.

RAMI 4.0 can be regarded as a kind of 3D map of Industrie 4.0 solutions: it provides an orientation for plotting the requirements of sectors together with national and international standards in order to define and further develop Industrie 4.0. Overlapping standards and gaps can thus be identified and resolved.

The next steps

The reference architectural model provides the foundation for the next steps which are:

- **Identification:**

Identification is the necessary prerequisite for things to autonomously find each other within networked production. Different standards for this exist today. A unified solution has to be developed.

- **Semantics:**

A cross-vendor data exchange is necessary for communication between machines or between machines and workpieces. This necessitates unified semantics including a common syntax for data.

- **Quality of Service (QoS) for Industrie 4.0 components:**

Mission-critical services such as time synchronisation, real-time capability or reliability of Industrie 4.0 components have to be defined.

- **Industrie 4.0 communication:**

Plentiful communication connections and protocols exist. The most common examples are field busses based on Ethernet or OPC UA, a machine-to-machine communication protocol. Their suitability for Industrie 4.0 communications must be examined. This allows overlaps to be identified, preferred protocols to be defined and gaps to be closed.

Further Information:
For more details on Industrie 4.0 please visit our website www.zvei.org/industrie40

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