ANALYSIS ARCHITECTURAL MODEL OF INDUSTRY 4.0 (RAMI 4.0)

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In this paper the importance analysis existing complex reference architectural model of Industry 4.0 (RAMI 4.0) offers a good overview of the smart-factory architecture, but it leads to some limitations and a lack of clarity for the users.

The cyber-physical system (CPS) is the core concept of Industry 4.0 advocated by the German government for building smart factories to bring about the fourth industrial revolution. The term CPS was first introduced in 2006, when an National Science Foundation (NSF) workshop was held in Austin, Texas, USA. It was defined as ‘‘a system composed of collaborative entities, equipped with calculation capabilities and actors of an intensive connection with the surrounding physical world and phenomena, using and providing all together services of treatment and communication of data available on the network.’’[1] The CPS has attracted a lot of research attention. In addition to smart factories, many CPSbased applications have been built, such as healthcare, smart grid, smart transportation, smart home, smart buildings and smart cities.

The organisations BITKOM, VDMA and ZWEI decided to develop a new architecture model for the needs of Industry 4.0. For this, they took the Smart Grid Architecture Model as a basis. RAMI 4.0 is a three-dimensional model that describes Industry 4.0’s space (fig.1). On the horizontal axis, the layers include different views, such as assets, functional descriptions, data maps, etc.

This corresponds with the IT approach of grouping complex projects into subsystems. The other key criteria are the lifecycle (type) and service life (instance) of the products and production systems with the value stream they contain. The vertical axis represents the third type of key aspect, i.e., the allocation of functions and responsibilities within the factories or plants. The combination of a lifecycle and a value stream with a hierarchically structured approach for the definition of Industry 4.0 components is a special feature of RAMI 4.0. The model allows for the logical grouping of functions and the mapping of interfaces and standards .

The RAMI 4.0 model has six layers on the vertical axis and two on the horizontal axis. Beginning with the vertical axis, the first layer is the ‘Asset layer’, which shows the physical objects, such as metal parts, documents, archives, diagrams, humans, etc. One layer higher is the ‘Integration Layer’, where transformations and connections of the physical objects into a digital

world takes place. The components of the ‘Asset layer’ are connected with the digital world by the ‘Integration Layer’, which deals with the easy processing of information and can be considered as a link between the physical and digital worlds.

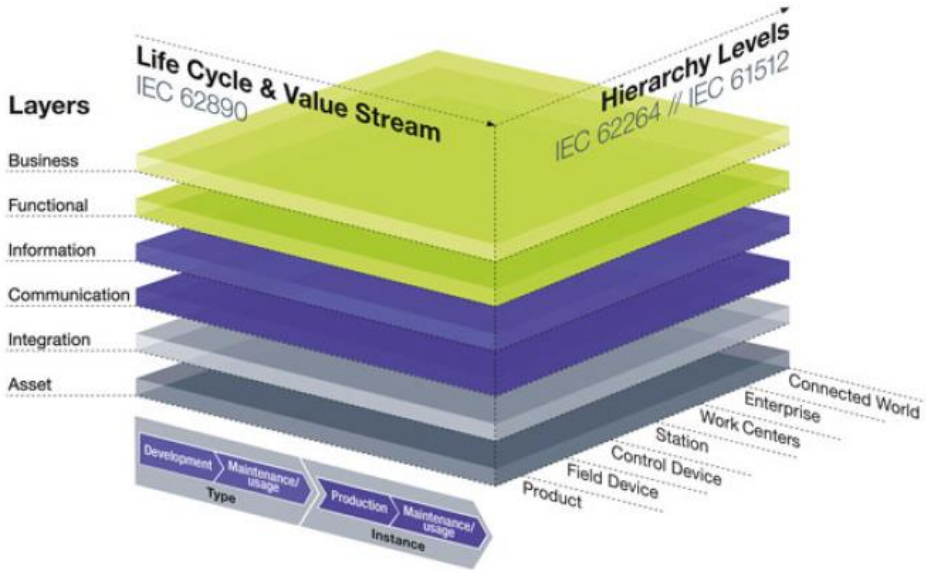

Fig. 1 Reference Architectural Model Industry 4.0 (RAMI 4.0)[2]

Based on a detailed analysis of the reference model RAMI 4.0 that includes all the elements of the vertical and horizontal axes, there is no exact definition with regards to how the individual elements inside each layer are interconnected with the elements. In our opinion, those interconnections are crucial and have to be defined when planning a new smart factory or upgrading an existing factory to create a smart factory. One of the other important aspects is the integration of digital twins and digital agents into distributed systems, and not as decentralised systems in each vertical layer. This part is still missing from RAMI 4.0.

References:

1. Madakam S., Uchiya T. (2019) Industrial Internet of Things (IIoT): Principles, Processes and Protocols. In: Mahmood Z. (eds) The Internet of Things in the Industrial Sector. Computer Communications and Networks. Springer, Cham (DOI:10.1007/978-3-030-24892-5_2)

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