

Overview



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Agile Service Engineering in IIoT Ecosystems

The trend towards the Industrial Internet of Things (IIoT) is very strong and irreversible. Is it driven by customer demand or rather by the idea that the new technological possibilities such as smart sensors and the handling of big data offer new business opportunities? Considering the industrial production domain, optimization in industrial production has thus far mainly targeted material, energy and cost. However, the potential of data, information and knowledge in industrial production is still widely unexploited. IIoT technologies, ranging from smart sensors and actuators, edge and cloud-based data storage and analytics up to informed decision support, promise to exploit this potential.

Throughout the world, various initiatives are aimed at following this approach. Germany has started this competitive race with its Industrie 4.0 initiative that claims to have disruptive effects at the business level. It may finally lead to the fourth industrial revolution. In Japan, similar ideas are pursued by the Robot Revolution Initiative and the Industrial Value Chain Initiative. There is one common need at the technological level: an open architecture for networked cyber-physical systems with agreed standards for communication (such as OPC UA) and information modeling (such as AutomationML or OPC UA companion specifications). Furthermore, these technological achievements enable the development of product-service systems. This means that in the future, automation products such as machine tools, robots, sensors or conveyors cannot be sold without being accompanied by software-based services. These services encompass or support capabilities for condition monitoring, preventive maintenance, machine learning or artificial intelligence, either close to the asset (edge processing) or in data centers (cloud processing). However, as the end user wants to use these capabilities for an entire production plant across individual, possibly heterogeneous plant components, the associated services have to fit together perfectly. Furthermore, cooperation is performed in order to achieve integrated services for entire production plants, maybe even integrating supply chains.

This has severe consequences for the whole engineering process for product-service systems:

- 1) The analysis and design for product-service systems must encompass the service engineering, too.
- 2) Service engineering has to consider the IIoT platform for which the services will be offered. In particular, this relates to the architecture and generic capabilities of the selected IIoT platform.
- 3) In order not to be "locked-in" to one IIoT platform vendor, it is preferable to support open standards for the communication and information modeling aspects of the services.
- 4) The service engineering must encompass the whole lifetime of the product including the usage and maintenance phase. As the IIoT platforms undergo revisions, too, an agile service engineering approach that is well synchronized with the version management of the associated product is indispensable.
- 5) Continuous and automated testing of the products including their services must be organized and carried out in order to master the complexity.

Likewise, the IIoT platforms have to be prepared for such highly flexible and open service ecosystems. There are no fixed use cases that can be clearly analyzed by surveying the future demands of customers. The customer base is not fully known and the known customers are not able to express their requirements as they learn from the capabilities of the rapidly emerging IIoT platforms. Hence, a product and development manager needs a service engineering methodology and tool to break down hypothetical use cases to IIoT platform requirements and map them to existing and emerging technologies and IIoT platform products.

Exploitation of the economic potential and promises of the IIoT will only be possible if the strategic importance of systematic engineering is understood, including the specifics of the emerging IIoT ecosystem landscape