

ISO 16355 in Software-Intensive Business

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Abstract: The Software-Intensive Business represents a shift from value creation in development of new products to a trend towards cross-industry enterprise networks and collaboration, including almost every industry. This also has an impact on the entire development process of products and services as it will be even more important to understand the real customer's demand. ISO 16355 is a standard based on Quality Function Deployment (QFD) for converting fuzzy customer needs into more-specific functional requirements. This research-in-progress paper examines the question of how ISO 16355 can be potentially used to support the development of new Software-Intensive Products and Business models.

Keywords: Software-Intensive Business, ISO 16355, Software-Product-Service Systems, Business Models.

1 Software-Intensive Business

Almost across all industries, the Software-Intensive Business represents a shift from value creation in development, production and marketing of monolithic products to a trend towards cross-industry enterprise networks and collaboration [1]. So-called Cyber-Physical-Systems open the door to the digital world, originally reserved mainly for pure software companies, even for manufacturing industry producing goods that are more tangible. Digital and analogue markets converge. The atomization of products and services, e.g. as bundled microservices instead of apps, raises the number of products and services and their providers. Thus, the strategy of offering only single products for more or less one or few nearly homogenous types of customers is outdated and replaced by hybrid product bundles offered on multi-sided markets. Platforms enable cooperation (i.e. development and sales) of the value creation partners. The digitization is leading to a sustainable change towards a common platform economy offering a huge potential for innovative business models, creating and satisfying customer needs for business success.

For this new field of research a group of international selected researchers established during a Dagstuhl seminar in May 2018 a new scientific discipline called Software-Intensive Business (SIB) [2, 3]. SIB studies organizational arrangements within

and between organizations in conjunction with methods and tools for value creation, capture, and delivery based on digital products and services [2]. By analyzing the Dagstuhl report, several challenges in Software-Intensive Business can be identified. We have arranged them in Table 1 according to their main areas they affect within SIB: the technical system (i.e. the cyber-physical system itself), the human/personnel side and the ecosystem connecting different partners.

Table 1: Challenges in Software-Intensive Business [2]

Cyber-Physical System	Human System	Ecosystem
Rapid development [e.g. 4]	Lack of knowledge of important stakeholders [e.g. 4]	Partners may be unwilling to change [e.g. 4]
Time pressure [e.g. 5]	Disruptive innovation is unpredictable [e.g. 4]	Subsidizing one side of the market [e.g. 4]
Data ownership [e.g. 4]	Need for mind shift [e.g. 4]	Increased need for coordination [added from 7]
System integration [e.g. 6]		

From an economical point of view, companies try to take an advantage of this changed situation by developing new disruptive products and services based on these new possibilities. However, a product or product-service-bundle can only be effective if it is able to serve real customer needs. Moreover, in order to guide the companies' efforts towards a constantly evolving and sustainable business, it is essential to really understand the potential customer needs. Not until this learning process is well established, companies are able to benefit from the new solution space in an innovative and promising way [8].

2 ISO 16355

The ISO 16355 offers a kit of methods and tools to assure customer or stakeholder satisfaction by identifying their most important needs. It represents a quality approach, whose main purpose is to establish a defined and repeatable product development process, based on definable targets, the involvement of all relevant customers and stakeholders and the focus on their real needs. ISO 16355 can be used independently of the domain or industry and has been successfully applied for hardware, service and software development [9]. As cyber-physical systems usually combine all three of these aspects as Industrial Software-Product-Service bundles [10], ISO 16355 has the potential to offer a toolset for the SIB domain. Thus, this paper poses the question of how ISO 16355 can be used to support the development of new Software-Intensive Products and Business Models.

ISO 16355 is based on a set of six main principles [9]:

- a) Prioritize information to focus
- b) Understand how to cause good quality
- c) Listen to the voice of the customer
- d) Observe the customers situation
- e) Capture information from other sources
- f) Improve internal communications through the transformation of information between perspectives

Obviously, these six main principles address several different aspects. The principles b)-e) seem to be distinct approaches to elicit the real customer needs. You can elaborate them by listening, observing, analyzing and/or considering preferably all possible sources. Accordingly, we summarize them as “Focusing on customer/stakeholder needs”. The ISO 16355 recommends tools like User Personae and Gemba visits in this area [9].

Principle a) is about a more methodical approach to handle the captured information. Customers pay the most for solutions to their most important problems. Thus, it is essential to prioritize the information obtained from the customer/stakeholders according to customer value. We deduce the second cluster “Prioritization” using e.g. tools like the Analytic Hierarchy Process and the Kano model [9].

Lastly, we have to take a closer look on principle f): Compared with the clusters we concluded before, this principle deals not (only) with the contact to the external stakeholders like the customers or partners. It is about the internal communications in particular. There is a gaining in importance about this factor, especially in the context of Software-Product-Service systems in Software-Intensive Business: There is a need to synchronize all development areas and teams and – moreover – to generate mutual understanding to improve the collaboration. So, the third cluster we worked out is “Collaboration”. ISO 16355 suggests the joint building of cause-and-effect diagrams and L-matrices like the House of Quality in this area

Figure 1 gives an overview of the identified ISO 16355 clusters adding some examples of tools mentioned in ISO 16355.

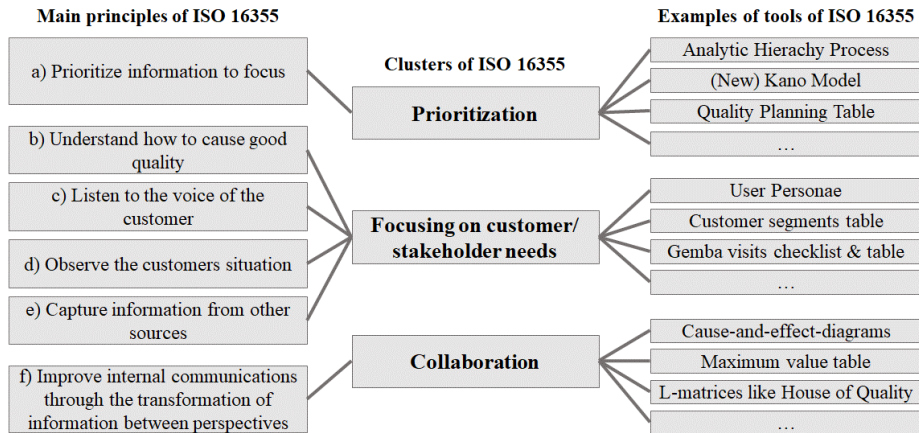


Figure 1: Clustering of ISO 16355 according to main principles of ISO 16355

3 ISO 16355 in SIB

In order to evaluate the general fit of ISO 16355 with Software-Intensive Business, we compare the ISO 16355 - clusters composed of its main principles and corresponding tools (Figure 1) with the challenges in Software-Intensive Business extracted from the Dagstuhl report (Table 1).

Regarding the first two entries in the first column, one has to consider concepts like the Minimal Viable Product: In case there are little resources regarding time and capacity, you have to focus on the really important requirements to satisfy the early users [11]. Apart from the general need to know the customer needs, it is essential to understand which of them are the very most important ones regarding the customer satisfaction and – based on this – to prioritize these top needs.

Regarding data ownership the actors have to find a compromise between privacy and need for data to solve the customers' problem. Up to now, it is not possible to give a “perfect answer” to this challenge, but at least you can say that a lot of communication and collaboration could help to generate a trustful environment. This positive environment should also be helpful to build a common sense of all development areas in the CPS to make system integration smoother. Eventually, prioritization and collaboration seem to be the most significant principles regarding the area of cyber-physical systems.

The lack of knowledge is critical concerning the human aspects within SIB. The mutual understanding of engineering and business benefit from communication and collaboration. In a perceived uncertain and disruptive environment, the focus on the solution-independent real customer needs can solve as a landmark. Nevertheless, enterprises have to develop a positive attitude towards making change, not seldom even requiring a bigger mind shift. Thus again, there is a need for intense collaboration and communication.

This positive attitude towards change is also required in the Ecosystem area: potentially unwilling partners in the ecosystem have to be persuaded. An ecosystem-wide change management, based on smoothly collaboration can serve as a solution. When attempting to establish an ecosystem, it is important to subsidize one side of the market. To accomplish this effectively, it is necessary to understand the needs of the corresponding market side.

Finally, one main problem field in the ecosystem research is the increased need for coordination. ISO 16355's cluster of collaboration is obviously needed for that. Table 2 gives an overview of the SIB challenges and the corresponding main clusters of ISO 16355.

Table 2: Fit of clusters of ISO 16355 to Challenges in Software-Intensive Business (SIB)

System	Challenges in SIB	Main clusters of ISO 16355
CPS	Rapid development	Prioritization
CPS	Time pressure	Prioritization
CPS	Data ownership	Collaboration
CPS	System integration	Collaboration
Human system	Lack of knowledge of important stakeholders	Collaboration
Human system	Disruptive innovation is unpredictable	Focusing on Customer/Stakeholder needs
Human system	Need for mind shift	Collaboration
Ecosystem	Partners may be unwilling to change	Collaboration
Ecosystem	Subsidizing one side of the market	Focusing on Customer/Stakeholder needs
Ecosystem	Increased need for coordination	Collaboration

4 Conclusion and outlook

As shown in this paper, the ISO 16355 and the field of Software-Intensive business share very much the same spirit. The main challenges in SIB and the main clusters of ISO 16355 overlap quite well.

However, as an ongoing research project, this paper represents only the starting point of a more in-depth analysis regarding the application of ISO 16355 in Software-Intensive Business. Most likely, the tools of ISO 16355 have to be enhanced and tailored to cope with the identified challenges in Software-Intensive Business. Due to its high importance within SIB, especially the collaboration side seems to need more in-depth analysis.

In order to develop an approach within the paradigm of customer centricity [12] to create innovative Software-Product-Service systems in the Software-Intensive Business, the identified clusters of ISO 16355 have to be concretized. The result could be a

conceptual framework of ISO 16355 for Software-Intensive Business consisting of three levels: the main principles/clusters, the conceptual/methodological approach (e.g. focusing on dealing with fuzzy development tasks in an incremental procedure), and detailed tools/instruments (e.g. incorporating tools for creativity management) [13].

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