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A competency model for the Product Management in Software-intensive Business

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Abstract: As digitization continues, nearly all industries have become software-developing entities. The distinction between software companies and the manufacturing industry is becoming increasingly blurred. This poses major challenges, especially for the product management of companies. Once un-disputed competencies of a company are threatening to become irrelevant, while others are becoming more significant. This contribution takes this development into account, by examining the influence of the Software-intensive Business on the necessary enterprise competencies and deriving a competency model from it. This competency model forms the basis for a competency matrix that allows practitioners to measure the specific competencies of their enterprise and can provide implications for their improvement. The competency model and the competency matrix were evaluated by experts from several industries in terms of relevance and applicability.

Keywords: Software-intensive Business, competency model, product management, software product management

1 Motivation

"Software is eating the world. "[An11] This quote by Andreessen illustrates the current influence of software on products and entire industries. New markets are created by software and in almost all industries, digital products are enabled from formerly pure-ly physical products by adding software [He18, Ho19]. This turns nearly all companies into "Software producing organizations" (SPOs), [Mä18] which have to develop products and establish them on the market in a new type of business, the "Software-intensive Business" (SiB) [Ho19, Bo18, WBB18]. The analysis, planning, implementation and control of product development and ma[rket entry activities are classically carried out by product management organizations [Ho17]. New challenges for product management arise due to the shift from physical to digital products. In addition to the analysis of customer needs, product management must also consider the positioning of the product in software

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ecosystems and the planning of short development cycles [Ho19, Ho17, HO18, Rö18]. Adapted competencies are needed to deal with these requirements.

Competency models represent all those competencies required to successfully cope with emerging requirements in a specific context [RK18, Dg16] and can support organiza-tions determining which competencies are required to achieve the specified strategic goals. This also enables organizations in SiB to perform a comparison between exist-ing and required competencies [RK18, SS05]. In this way, competency models offer target-ed control of competency development in order to adapt the company to changing conditions and new requirements [Bi17].

The development and marketing of Software-intensive products is of outstanding importance for companies in order to continue operating successfully on the market and to gain new customers through products with inspiring functions. In order to establish or further develop a product management unit that is capable of meeting the requirements of SiB, a company must initiate measures for the targeted development of competencies. However, there is currently neither a competency model that companies can use to analyze necessary and existing competencies, nor an overview of competencies or a list of requirements that are placed on product management organizations in the context of SiB. Therefore, companies in SiB are currently only in a lim-ited position to control and develop the competencies of their product management units in a systematic and targeted manner. As a result, companies with a competence deficit develop and launch new products on the market without taking the require-ments of the SiB into account and thus run a high risk of failing or giving up deci-sive competitive advantages. Based on these findings, there is a need for a competence model that shows companies in SiB the required competencies of product management units and enables to compare them with their own competencies. The aim of this paper is to develop a competency model that enables companies to compare the existing competencies of their product management units with the competencies re-quired in SiB by answering the following research question:

RQ: How can a competency model for product management in Software-intensive Business be designed and made accessible for practice?

2 Related Work

As already explained at the beginning, software is progressively used in industries of formerly purely physical goods, but the service sector is also increasingly penetrated by software [Ho19, Hu18]. Software thus represents the decisive value driver and enables new business models [KF17]. Therefore, not only companies like SAP or IBM provide software products anymore, but also companies with originally purely physical products are increasingly becoming SPOs [Mä18]. This new type of business, in which software plays a vital role, is increasingly found in the literature under the term SiB.

SiB was defined in 2018 as a new research field that crosses information systems, software development, and business arises from the collaboration of researchers and practitioners at the 2018 Dagstuhl Seminar [ABB18, SGH20, Ja19]. A company in SiB "creates, captures, and delivers value through digital technologies" [WBB18] and companies in SiB "create value through the development of new software technologies. When operating a platform, they often capture value through their established network of partners. When a software is shipped to and operated by a customer, the value is delivered" [WBB18]. Thus, SiB considers value creation, capture and delivery based on digital products [ABB18]. In nearly all industries SiB ensures a shift in value creation, from the development, production and marketing of monolithic products to cross-industry business networks and collaborations [SSH18, Ac11]. The SiB can be divided into the following three areas: Software System, Human System and Ecosystem [WBB18].

According to Pepels, product management as an organizational form of structuring concerns the planning, organization, execution, and control of all activities involving the introduction, maintenance, replacement, or discontinuation of products [Ac11]. Product management thus represents an interface and coordination function that must deal with both internal company interface problems with other functional areas such as research and development or sales and interface problems with entities outside the company such as customers and suppliers. Homburg distinguishes four basic tasks of product management that make up the product management process: Analysis, Planning, Implementation and Control [Ho17].

Various authors subsequently transported product management into the software industry, considering its specifics [HP09, EB14, Pe14]. In addition to science, software product management (SPM) is attracting increasing attention in practice. In this area, a number of detailed frameworks and process models have been developed, which extend, process and detail the scientific findings. A well-known form of such frameworks that have emerged from practice is used in this paper as a starting point for the considerations and is briefly described below:

In cooperation with many product managers from various industries, the International Software Product Management Association (ISPMA) has developed a framework based on the three SPM frameworks of Utrecht, Ebert and Kittlaus [KF17, Eb14]. In this way, both the view of practice and that of science are considered [KF17, Fr12]. The resulting framework provides a complete view of SPM [KF17]. The structure and contents of the SPM framework as well as extensive explanations can be found in Kittlaus and Fricker (2017) [KF17].

The Steinbeis Institute's Enterprise Competence Check (UKC) is based on comprehensive research into existing competence models and competence measurement methods [Or17]. It represents a tool for the analysis of corporate competencies [Or17]. It includes 24 competencies that are measured in the check [Or17]. As a generic model, the UKC can be used for different companies and use cases. The competencies of the UKC include corporate or organizational competencies and are less focused on individuals [Or17]. As

this paper examines the competencies for product management in the context of SiB, as an organizational unit, and not the competencies of individuals in product management, the development of the competency model in this paper is based on the competencies of the UKC. A more detailed description of the UKC and its structure can be found in Ortiz (2016) [Or17].

3 Method

The procedure for the development of a competence model for product management in SiB in this paper is based on the Design Science Research (DSR) approach [PTR07, HMP04]. Here, the seven guidelines of Hevner et al. serve as orientation. These guidelines are: "1. Design as an Artifact 2. Problem Relevance 3. Design Evaluation 4. Research Contributions 5. Research Rigor 6. Design as a Search process 7. Communication of Research" [30]. In addition to these seven guidelines by Hevner et al., this paper is primarily oriented towards the process model developed by Peffers et al. (design sci-ence research methodology, DSRM) [PTR07]. Since in this paper an artifact in the form of the competency model is developed and subsequently transferred into a competency matrix for application in practice as well as validated, the DSR approach and the use of the DSRM procedure model appear suitable in this paper.

The special features of SiB with its subareas Software System, Human System and Ecosystem, present product management with challenges that can be formulated into more specific requirements. To meet these requirements, product management must have a certain set of quality characteristics. Enterprise competencies represent an im-portant subset of these quality attributes. These must enable product management to meet the requirements of the SiB.

To develop the competency model and achieve the desired goal, the requirements for product management must first be determined. (see Fig. 1). This is accomplished with the help of a comprehensive literature research.

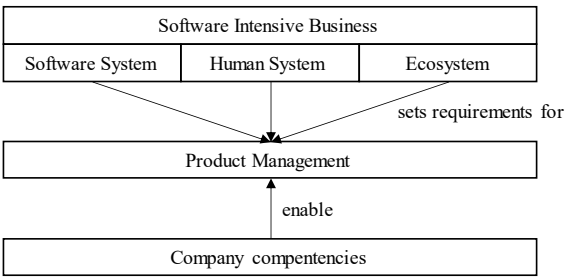

Fig. 1: Relationship between corporate competencies and product management in the SiB

This literature research is guided by the core activities of the SPM defined by ISPMA [15, 27]. In addition, the competencies contained in the UKC of Steinbeis Institute are used for the development of the competency model. Based on the obtained requirements and the identified competencies, the competency model for product management in the context of SiB is developed. For this purpose, the requirements are correlated with the competencies. To make the competence model accessible for practice, the model is transferred into a matrix and a questionnaire, which is presented to product management experts of different companies. By completing the questionnaire, companies will gain insight into the competencies needed in SiB. The questionnaire will also show the difference between the product management competencies needed in SiB and those available in the company. Furthermore, the applicability and relevance of the competency model for practice will be validated. This is followed by an evaluation of the results and an assessment of the competency model. In the following, it will be briefly explained how the procedure model of Peffers et al. is implemented in this work:

Identify problem and motivate: Companies must develop and market products in SiB successfully. To achieve this, product management units must have the necessary competencies to deal with the requirements of SiB. So far, no model exists that offers companies the possibility to compare their existing product management competencies with the competencies required in SiB in order to derive measures for an improved handling of the requirements. **Define objective of a solution:** The competency model aims to show which competencies are required by product management units in SIB. It is also intended to give companies the opportunity to compare the competencies available in their company with the competencies required in the SIB. **Design and development:** The competency model represents an artefact to be developed in this paper. The creation of the competence model is based on the obtained requirements of the SiB and the identified competencies. **Demonstration:** For demonstration purposes, the previously developed model will be prepared and transformed into a matrix for application in practice, which will be integrated into a questionnaire. **Evaluation:** To validate the competence model in terms of applicability and relevance in practice, the competence matrix is presented to experts of various industries in form of a questionnaire and evaluated by these experts. **Communication:** Publication of the results in this paper.

4 Competency Model for the Product Management in the SiB

The developed competence model comprises of two components: The first component represents 28 requirements that occur in the context of SiB for product management in companies. These requirements can be assigned to the three areas of SiB, the Software System, the Human System and the Ecosystem. Requirements in the software system mainly refer to the specifics of software, such as immaterial requirements [Ho19, HP09]. In addition, requirements are considered, that arise in the context of the definition of product properties or the business model around a product [MTL18, SSH18, JW18]. In

the field of the Human System, requirements could be identified that relate to interpersonal aspects, collaboration in temporally and spatially distributed teams, and to an agile orientation of an organization [Ho20, Sh14, KS18, HK20, Bl20, Hu18, Ac16]. Requirements could be assigned to the Ecosystem domain that depict collaboration and positioning in ecosystems and the associated opportunities and risks [Ho19, BSA13, VAH14, JH18]. Table 1 shows an excerpt of the 28 identified requirements.
In addition to these requirements, the competencies mentioned in the UKC of Steinbeis Institute were used as a second component [Or17]. The UKC distinguishes, in the context of the analysis of corporate competencies, four competence levels with six competence sections each. These four competence levels are differentiated into: Knowledge, Innovating, Implementing and Communicating [Or17]. A detailed description of the competency levels and the associated competencies can be found in Ortiz (2017) [Or17]. For the development of the competency model, generic competencies are necessary that can be applied to the specific context of product management in SiB, as an organizational unit. Since the UKC and its competencies can be used for different use cases and companies, and thus have a generic character, [Or17] these competencies represent an important component for the development of the competency model.

Area of the SiB	**Requirement**
Software system	Regular review and adaptation of the business model to changing conditions.
Human System	Make customer-specific information transparent for all parties involved.
Ecosystem	Knowledge about and positioning in possible roles in the ecosystem.

Table 1: Selected exemplary requirements to the product management in the SiB

To create the competency model, the identified requirements are correlated with the competencies. These correlations correspond to the degree of fulfilment of a require-ment by a competence and describes the intensity with which a competence contrib-utes to the fulfillment of a requirement. The development of these correlations and the structure of the competence model is based on the House of Quality (HoQ), as a com-ponent of Quality Function Deployment (QFD) [Ma20]. QFD itself is a customer-oriented quality method for planning and developing products and is defined in ISO 16355-1 [Ak92, Qf21]. The HoQ is a matrix representation that, in the context of QFD, contrasts customer benefits with the quality feature of a future product and relates them by evaluating the strength of the relationship between customer benefits and quality feature [HP09, Qf21, Sa11]. The HoQ then shows which quality feature fulfils which customer benefit, and to what intensity [Qf21, Sa11].

Analogous to the comparison of customer benefits and quality characteristics and their underlying matrix in the HoQ, requirements and competencies are compared in the competency model in this paper. The aim is to analyze which competencies are required by companies to satisfy the identified requirements. On the Y-axis of the matrix, the identified requirements are plotted according to their assignment to the three fields of the SiB. On the X-axis are the four competence levels of UKC, with their associated competencies. In the center, the degree of fulfillment of a requirement is represented by the competencies. The analysis of the influence a competence has on the degree of fulfilment of a requirement is based on the question "What influence does competence X have on the fulfilment of requirement Y?" and is differentiated into zero (no influence), one (weak influence), three (strong influence) and nine (very strong influence). This rating is also based on the scale of correlations in the HoQ [La20, Is15]. Figure 2 shows the general structure of the competence model for product management in SiB.

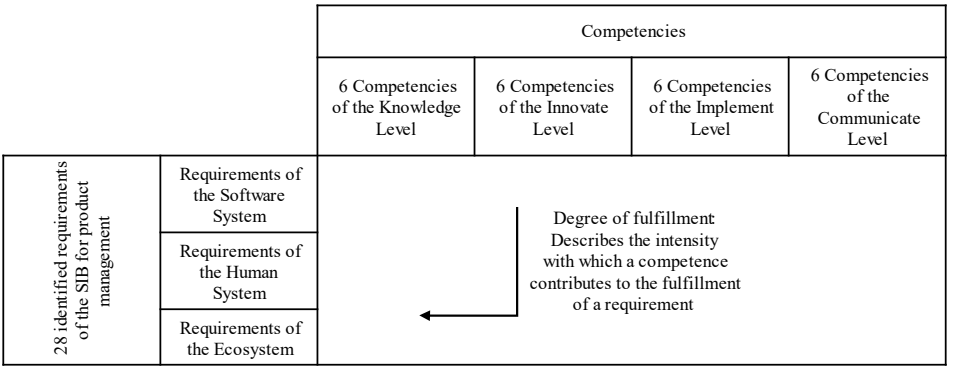

Fig. 2: Structure of the competency model

5 Evaluation

5.1 Demonstration

For usage and validation, the developed competence model must be made accessible to practice. For this purpose, the generic competence model is specified as a so-called competence matrix for application in practice. As described above, the competency model represents the degree to which the product management requirements in the SIB are met by the various corporate competencies. The competence matrix based on this enables practitioners to evaluate its own competencies in form of a target-performance comparison with regard to their suitability for product management in SiB and to identify potential for improvement. A questionnaire was developed for the application of this competence matrix in practice.

The purpose of this questionnaire is to show the differences between existing competencies of enterprise's product management units and the competencies needed in the context of SIB. To this end, the comparison between the target and actual state of product management competencies is carried out. On this basis, companies can develop measures to build up or reduce competencies.

For the formation of the competence matrix, the competence model is augmented by the specific competencies contained in the UKC [Or17]. These competencies are cor-related with the requirements, as shown in the figure below. This figure includes an extract of the matrix consisting of requirements (Y-axis) and competencies (X-axis) as well as the resulting degree of fulfilment of a requirement.

	Competence X has a … influence on the fulfillment of requirement Y.	Competence Level Knowledge					
		Resources			Learning		
		Technical / methodical knowledge	Technologies	Property Rights, Patents, Licences	Flexibility / Adaptability	R&D	Problem Solving skills
Human System	Ensure coordination & optimization of collaboration for spatially/temporally distributed teams.	1	0	0	9	1	1
	Implement agile forms of organization.	9	0	0	3	1	0
	Make customer-specific information transparent for all stakeholders	1	0	0	0	0	0
	Make the shared product vision internally transparent.	0	0	0	0	0	0
	Consider social networks in customer interaction & marketing.	0	0	0	0	0	0
	Ensure balance between time-to-market & pressure for the development team.	0	0	0	1	1	0
	Implement close coordination with development.	1	1	0	0	3	0
	Identify customer excitement requirements.	9	0	0	0	1	1
	Understand effect of requirement on customer.	3	0	0	0	1	1
	Putting the customer & success critical stakeholders at the center of product development.	3	1	0	0	3	0

Fig. 3: Extract of the developed competence matrix

The questionnaire submitted to professionals of various industries to asses the company's own product management competencies is based on an Excel document consisting of several spreadsheets. Spreadsheet 1 contains all relevant information needed by the survey participant to complete the questionnaire. Spreadsheet 2 con-tains the first questionnaire. Within this questionnaire, the identified requirements, based on their importance to the respondent's business, are rated. The rating follows the statement "The requirement is important for product management in our compa-ny..." and has the following five response options: 0: not important at all, 1: rather unimportant, 2: neutral, 3: rather important and 4: very important. The experts' rating of a requirement is multiplied by the respective correlation between requirement and competence in the background, based on the developed matrix. Starting from the products, column-by-column sums are formed for each competence. This results in values for the 24 competencies, based on the importance

of a requirement for the company of the expert surveyed and the correlations behind it, which represent the target state for the respective competency in the product management of the company. The following figure shows a simplified calculation of the target value.

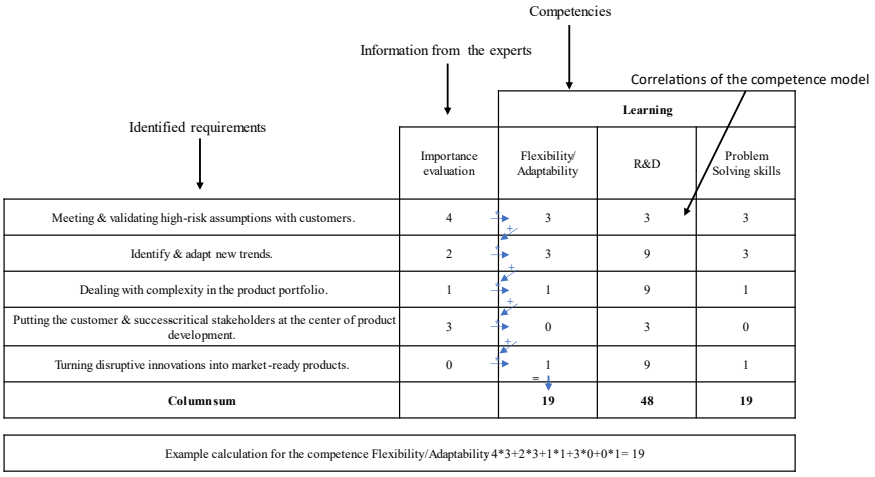

Fig. 4: Simplified calculation of the target value

Spreadsheet 3 comprises the second questionnaire. In this questionnaire, the same requirements are assessed again by the respondents. This second assessment questions to what extent the requirements are already fulfilled by the product management of the surveyed company and follows the statement "The requirement is...fulfilled by the product management in our company." Analogous to questionnaire 1, the following five answer options are available: 0: not at all, 1: rather not, 2: neutral, 3: good and 4: very good. Similar to questionnaire 1, column sums are also formed here. The values calculated from this represent the actual state of the respective competence in the product management of the company. The fourth spreadsheet contains the evalua-tion for the respondents. This evaluation includes the previously calculated target and actual values in the respective competence areas. In addition to the calculated target and actual values, the evaluation also includes the difference between the actual and target values. The difference is calculated as follows:

"Actual value of competence A" - "Target value of competence A"

Positive differences indicate a competence surplus (actual > target), they are colored green in the evaluation. Negative differences indicate a lack of competence (actual < target) and are colored red in the evaluation. The greater the difference between target and actual value, the stronger the intensity of the respective coloring. For a better understanding of the results, the last table sheet contains an overview of all compe-tencies with short explanations of the most important contents.

Based on this Excel document and the presented spreadsheets, the competence model is made accessible for various industries and offers companies the opportunity to evaluate the actual and target state of the product management competencies re-quired in SiB within their company. Based on the differences in the evaluation, com-panies should be encouraged to gain and implement measures to build up or reduce competencies in order to meet the SiB requirements that arise for product manage-ment.

5.2 Evaluation in practice

To validate the relevance and applicability of the competency model in practice, the competency model (based on the questionnaire explained in Chapter 5.1) was presented to product management experts from various industries as part of a qualitative survey. All the experts surveyed work in product management in their company. In order to validate the competency model in as many different industries as possible, care was taken when selecting the respondents to ensure that they differed according to the type of industry in which they work. Differences in terms of the size of the companies surveyed were also considered, based on the number of employees working in a company. Twelve experts were contacted for this purpose. The response rate to the questionnaires was 50 percent. Table 2 provides an overview of the industries in which the experts surveyed are active and how many employees their company has. The table only takes into account the experts who returned the completed questionnaire.

#Expert	Industry	Number of employees
1	IT	1,000
2	Automotive	235,000
3	Financial Services	150,000
4	Energy	12
5	Automotive	400,000
6	Automation	20,000

Tab. 2: Overview of the experts interviewed

To be able to specifically draw statements regarding the relevance and applicability of the competence model for practice, the respondents were presented with a further questionnaire after completing the first two questionnaires. The evaluation within the framework of this questionnaire is based on a five-part scale: "The statement ... 1: does not apply at all, 2: rather does not apply, 3: neutral, 4: rather applies and 5: fully applies." The complete questionnaire for assessing the applicability as well as the relevance of the

competence model for practice can be viewed at the following URL: https://bit.ly/3nZucMJ

The relevance of the competence model was evaluated positively by the respondents. This result is primarily due to the evaluations of the statements "I see the relevance of the requirements for my company", "The topic of Software-intensive Business is relevant for our company". Another predominantly positive assessment was that the competency model can support executives in understanding the necessary competencies and matching them with existing competencies, as well as that it provides added value to the respondents. Added value results from the clear presentation of the differences between target and actual values. It is also noted that the competency model can be used to derive content for job advertisements.

In addition to relevance, the applicability of the competence model is also rated positively. This is based on the positive evaluations regarding the comprehensibility of the requirements as well as the logical and comprehensible structure of the Excel document. Most of the respondents state that they have sufficient insight into their own company to be able to make a meaningful assessment.

Comments from the experts show that further requirements, e.g., around data analytics, should be included in the competence model. It was also noted that transferring the competence model into an online tool would make it easier to use and evaluate. While all respondents found the outcome of the competency model interesting, they were not surprised by the result. This can be attributed to the fact that the majority of respondents believe they have sufficient insight into their company to be able to make a meaningful assessment and therefore already have knowledge of competence differences.

6 Discussion

With the achieved results, the present work considers the research agenda of the SiB by contributing to closing the research gap regarding the management of software-intensive products [Ki18]. Nevertheless, the results are associated with some limitations regarding the significance, which will be pointed out in the following.

The identification of the requirements is based on literature research, which is based on a keyword search and the method of concentric circles. The concentric circle method can only identify sources older than the original work, which means that there is a risk that current sources have not been taken into consideration in this work. By adding a keyword search to the literature research, this risk was reduced and current work was identified on which to base this paper.

Furthermore, the correlations between the competencies and the requirements are based on information from the literature and the authors' assessments. These correlations

represent a crucial factor in the competency model, which is why the varification of the correlations should be validated by product management experts in practice.

The competence model could be made accessible for practice with an Excel document. However, the feedback from the experts shows weaknesses in the application of the competence model. Therefore, the competence model should be transferred into an online tool to make it more user-friendly.

The results of the survey confirm the practical relevance and applicability of the competence model developed in this paper. However, the validation of the competence model is based on a qualitative survey. The findings of this survey are therefore not generally applicable to all company contexts, even though an attempt was made to make a cross-section of companies from different sectors and of different sizes. In order to improve the general validity of the statements, the competence model should be presented to further product management experts from practice, within the framework of a quantitative survey. The transfer of the competence model into an online tool described above can support making the competence model accessible for a quantitative survey of many different companies.

7 Conclusion

With this work, a first step towards improving product management in this increasingly important industry was made by designing a competence model for product management in the SiB. With the competence matrix based on it, practitioners were also given a helpful tool for improving their own product management. By using the competence model and the competence matrix, companies can record and evaluate their product management competencies and derive measures for improvement based on the results. This enables product management units in companies to develop and market competitive, software-intensive products to ensure the sustained success of the business.
This work can thus form the starting point for further considerations of product management competencies in SiB. The data collection within this paper showed that there is further research potential, especially regarding the requirements of the SiB for product management. Exploiting this potential should be the aim of future research. Furthermore, in the rapidly changing context of SiB, requirements have a dynamic character and change over time. Therefore, the requirements and their relevance should be continuously validated to ensure keeping them complete and up-to-date.

The competence model in this paper shows companies differences between the target and actual state of their internal product management competencies. In order to provide companies with recommendations for action based on this evaluation, a framework of general measures for building up or reducing competencies should be defined for the individual competency areas. These general measures can support companies in deriving company-specific measures.

References

[ABB18] Abrahamsson, P., Bosch, J., Brinkkemper, S., Mädche, A. (eds.): Software Business, Platforms, and Ecosystems: Fundamentals of Software Production Research, Report of the Dagstuhl Seminar 18182, Jyväskyla, Göteburg et al., 2018.

[Ac11] Acatech (eds): Cyber-Physical Systems, Innovation Drivers for Mobility, Health, Energy and Production, Munich and Berlin, 2011.

[Ac16] Acatech (eds.): Die digitale Transformation gestalten, Was Personalvorstand zur Zukunft der Arbeit sagen, Munich, 2016.

[An11] Andreessen, M. : Why Software Is Eating the World. In: The Wall Street Journal, August 2011.

[Ak92] Akao, Y. : QFD. Quality Function Deployment, How the Japanese Turn Customer Wishes into Quality Products, Landsberg, 1992.

[Bi17] Bitkom e.V. : Praxisleitfaden Qualifizierung, Handlungsfelder und Gestaltungsansätze einer dynamischen Personal- und Kompetenzentwicklung im digitalen Wandel, Berlin, 2017.

[Bo18] Bosch, J.: Transforming To A Software Business. In: Abrahamsson, P., Bosch, J., Brinkkemper, S., Mädche, A. (eds.): Software Business, Platforms, and Ecosystems: Fundamentals of Software Production Research, Report of the Dagstuhl Seminar 18182, pp. 169-169. Jyväskyla, Göteburg u.a., 2018.

[Bl20] Blaß, M. : The agile transformation of the Hanseatic Bank, How a bank faces the new digital challenges. In: Hoffmann, S. (ed.): Digital product management, methods - tools - practical examples. pp. 227-246, Springer, Wiesbaden, 2020.

[BSA13] Barbosa, O., dos Santos, R. P., Alves, C., Werner, C. , Jansen, S. : A systematic mapping study on software ecosystems from a three-dimensional perspective, in: Jansen, S., Brinkkemper, S. , Cusumano, M. (eds.): Software Ecosystems, Analyzing and Managing Business Networks in the Software Industry, pp. 59-81, Cheltenham, 2013.

[Dg16] Deutsche Gesellschaft für Personalführung e.V. (eds.): Leitfaden: Kompetenzen im digitalisierten Unternehmen, DGFP-Praxispapiere, Leitfaden 02/2016, Frankfurt am Main, 2016.

[Eb14] Ebert, C.: Software Product Management, in: IEEE Software, pp. 21 – 24, 2014.

[EB14] Ebert, C. and Brinkkemper, S.: Software product management - An industry evaluation, in: The Journal of Systems and Software, 95, 2014, pp. 10 – 18, 2014.

[Fr12] Fricker, S.A.: Software Product Management. In: Mädche, A., Botzenhardt, A., Neer, L. (eds.): Software for People, pp. 2012S. 53 - 8. Springer, Berlin and Heidelberg, 2012.

[He18] Helenius, M.: Software Engineering evolution. In: Abrahamsson, P., Bosch, J., Brinkkemper, S., Mädche, A. (eds.): Software Business, Platforms, and Ecosystems: Fundamentals of Software Production Research, Report of the Dagstuhl Seminar 18182, pp. 175-175. Jyväskyla, Göteburg et al., 2018.

[HMP04] Hevner, A. R. , March, S. T. , Park, J. , Ram, S. : Design Science in Information Systems Research, in: MIS Quarterly, Vol. 28, No. 1, pp. 75 - 105., 2004.

[HP09] Herzwurm, G. , Pietsch, W. : Management von IT-Produkten, Geschäftsmodelle, Leitlinien und Werkzeugkasten für softwareintensive Systeme und Dienstleistungen, Heidelberg, 2009.

[Ho17] Homburg, C.: Marketingmanagement. Strategy - instruments - implementation - corporate management. Springer, Wiesbaden, 2017.

[Ho19] Hoisl, B.: Thinking products digital-first. How companies successfully design software-based product innovations. Springer, Wiesbaden, 2019.

[Ho20] Hoffmann, S.: Einführung in das digitale Produktmanagement, In: Hoffmann, S. (ed.): Digital product management, methods - instruments - practical examples. pp. 1-28, Springer, Wiesbaden 2020.

[HO18] Holmström Olsson, H.: From Managing Your Ecosystems to Repositioning Your Business. In: Abrahamsson, P., Bosch, J., Brinkkemper, S., Mädche, A. (eds.): Software Business, Platforms, and Ecosystems: Fundamentals of Software Production Research, Report of the Dagstuhl Seminar 18182, pp. 176-177. Jyväskyla, Göteburg et al., 2018.

[Hu18] Huber, W. : Industrie 4.0 kompakt - Wie Technologien unsere Wirtschaft und unsere Unternehmen verändern, Transformation und Veränderung des gesamten Unternehmens. Springer, Wiesbaden, 2018.

[HK20] Höbig, M. , Kubsch, C. : The development of an agile mindset in companies as a basis for organizational agility. In: Dahm, M.H.. , Thode, S. (eds.), Digitale Transformation in der Unternehmenspraxis, Mindset - Leadership - Akteure - Technologien, pp. 3-28, Springer, Wiesbaden, 2020.

[Is15] ISO 16355-1, Application of statistical and related methods to new technology and product development process - Part 1: General principles and perspectives of Quality Function Deployment (QFD), Geneva, 2015.

[Is21] ISPMA e. V., https://ispma.org/ispma-spm-framework-v-1-3/ (Accessed: 20.09.2021).

[Ja19] Jansen, S.: There's No Business Like Software Business: Trends in Software Intensive Business Research. In: Hyrynsalmi, S., Suoranta, M., Nguyen-Duc, A., Tyrväinen, P., Abrahamsson, P. (eds.), Software Business, Conference Paper of the 10th ICSOB 2019, pp. 19-27Jyväskylä, Finland, 18-20 November, 2019.

[JH18] Jud, C. and Herzwurm, G. : Challenges for IT product management through external platforms, In: Tichy, M., Bodden, E., Kuhrmann, M., Wagner, S. , Steghöfer, J.-P. (eds.): Software Engineering and Management, Lecture Notes in Informatics, Proceedings, pp. 195-198, Bonn, 2018.

[JW18] Jansen, S., Werder, K.: Executive Summary. In: Abrahamsson, P., Bosch, J., Brinkkemper, S., Mädche, A. (eds.): Software Business, Platforms, and Ecosystems: Fundamentals of Software Production Research, Report of the Dagstuhl Seminar 18182, Jyväskyla, Göteburg et al., pp. 164-165, 2018.

[Ki18] Kittlaus, H.-B.: Academic Structures and Terminology. In: Abrahamsson, P., Bosch, J., Brinkkemper, S., Mädche, A. (eds.): Software Business, Platforms, and Ecosystems:

Fundamentals of Software Production Research, Report of the Dagstuhl Seminar 18182, p. 179. Jyväskyla, Göteburg u.a., 2018.

[KF17] Kittlaus, H.-B., Fricker, S.A. : Software Product Management, The ISPMA-Compliant Study Guide and Handbook. Springer, Berlin, 2017.

[KS18] Kahya, M. D. and Seneler, C. : Geographical Distance Challenges in Distributed Agile Software Development: Case Study of a Global Company. In: 3rd International Conference on Computer Science and Engineering, pp. 78 - 83., 2018.

[La20] Lager, T. : Contemporary Quality Function Deployment for Product and Process Innovation, Singapore, Hackensack and London, 2020.

[Ma20] Madu, C. N. : The House of Quality in a Minute, A Guide to Quality Function Deployment, 3rd edition, Charlotte, 2020.

[Mä18] Mädche, A.: Position Statement. In: Abrahamsson, P., Bosch, J., Brinkkemper, S., Mädche, A. (eds.): Software Business, Platforms, and Ecosystems: Fundamentals of Software Production Research, Report of the Dagstuhl Seminar 18182, pp. 180-181. Jyväskyla, Göteburg et al., 2018.

[MTL18] Münch, J., Trieflinger, S., Lang, D.: Why Feature-based Roadmaps Fail in Rapidly Changing Markets: A Qualitative Survey. In: Hyrynsalmi, S., Suominen, A., Jud, C., Wang, X., Bosch, J.. , Münch, J. (eds.): Proceedings of International Workshop on Software-intensive Business: Start-ups, Ecosystems and Platforms (SiBW 2018), pp. 202-218. Espoo, Finland, 2018.

[Or17] Ortiz, M.: Qualitative Unternehmens-Kompetenzanalyse, Grundlagen, Inhalte und Anwenderführung des Steinbeis Unternehmens-Kompetenzchecks, Stuttgart, 2017.

[Pe14] Peine, K.: Situative Gestaltung des IT-Produktmanagements - Eine empirische Untersuchung. Diss. at the University of Stuttgart, Stuttgart, 2014.

[Pe16] Pepels, W. : Product Management. Springer, Berlin, 2016.

[PTR07] Peffers, K., Tuunanen, T., Rothenberger, M.A. Chatterjee, S. : A Design Science Research Methodology for Information Systems Research, in: Journal of Management Information Systems, Vol. 24, No. 3, pp. 45 – 77, 2007.

[Qf21] QFD Institut Deutschland e.V., https://qfd-id.de/qfd-defintion/ (Accessed: 07.09.2021)

[Rö18] Rösel, A.: Innovationsschub - Erfahrungen am Fallbeispiel IT Procuts. In: Tichy, M., Bodden, E., Kuhrmann, M., Wagner, S. , Steghöfer, J.-P. (eds.), Software Engineering und Management, Lecture Notes in Informatics, Proceedings, Bonn, 2018.

[RK18] Rost, M. and Kozica, A.: Organisational and individual competencies in the digital world of work - an integrated view. In: De Molina, Kaiser and Widuckel (eds.), Kompetenzen der Zukunft - Arbeit 2030, Als lernende Organisation wettbewerbsfähig bleiben, pp. 407-422. Freiburg, 2018.

[Sa11] Saatweber, J.: Kundenorientierung durch Quality Function Deployment: Produkte und Dienstleistungen mit QFD systematisch entwickeln, Düsseldorf, 2011.

[Sh14] Shi, M. : Key Success factors of Software-Intensive Product Development. In: Computer and Information Science, Vol. 7, No. 1, pp. 58 – 66, 2014.

[SGH20] Smolander, K., Grünbacher, P., Hyrynsalmi, S. , Jansen, S. : ACM SIGSOFT International Workshop on Software-Intensive Business: Start-ups, Platforms, and Ecosystems, in: ACM SIGSOFT Software Engineering Notes, Vol. 45, No. 1, pp. 18 – 20, 2020.

[SS05] Sonntag, K., Schmidt-Rathjens, C.: Requirements Analysis and Competence Models. In: Ganon, P., Klauser, F., Nickolaus, R., Huisinga, R. (eds.), Competence, cognition and new concepts in vocational education. Pp. 55-66. Springer, Wiesbaden, 2005.

[SSH18] Schönhofen, F., Schockert, S., Herzwurm, G.: ISO 16355 in Software-Intensive Business. In: Hyrynsalmi, S., Suominen, A., Jud, C., Wang, X., Bosch, J., Münch, J. (eds.): Proceedings of International Workshop on Software-intensive Business: Start-ups, Ecosystems and Platforms (SiBW 2018), pp. 158 - 163. Espoo, Finland, 2018.

[SSH18] Schönhofen, F. , Schockert, S., Herzwurm, G.: Das Business Model House of Quality. Evaluating Platform-Based Business Models with Quality Function Deployment. In: Tichy, M., Bodden, E., Kuhrmann, M., Wagner, S. , Steghöfer, J.-P. (eds.): Software Engineering and Management, Lecture Notes in Informatics, Proceedings, pp. 167-168, Bonn, 2018.

[VAH14] Valenca, G., Alves, C., Heimann, V., Jansen, S. and Brinkkemper, S. : Competition and Collaboration in Requirements Engineering: A Case Study of an Emerging Software Ecosystem, in: IEEE 22nd International Requirements Engineering Conference (RE), 2014, pp. 384 – 393, 2014.

[WBB18] Werder, K., Brinkkemper, S., Bosch, J., Cusumano, M.A., Herzwurm, G., Holmström Olsson, H., Hyrynsalmi, S., Kittlaus, H.-B., Kude, T., Margaria, T., Papatheocharous, E., Spinellis D., Tyrväinen, P. , Wang, X. : Working Group on Software-intensive Business Research: Definition and Roadmap. In: Abrahamsson, P., Bosch, J., Brinkkemper, S., Mädche, A. (eds.): Software Business, Platforms, and Ecosystems: Fundamentals of Software Production Research, Report of the Dagstuhl Seminar 18182, pp. 193-196. Jyväskyla, Göteburg et al., 2018.