The Future of Innovation Coaching in Product Engineering: A Systematic Approach to Deriving the Future Competence Profile and its Development through Strategic Potential Identification

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Abstract
Innovation Coaches assist organizations in harnessing their innovation potential in order to operate successfully in a rapidly changing and challenging environment. Especially in the context of agile approaches and distributed development projects, the approach of innovation coaching is a valuable contribution to the successful accomplishment of innovation projects due to a process-oriented support. This approach will face a series of new challenges in the future. Development leaps in digital media such as Virtual- and Augmented Reality, Machine Learning and speech recognition create new challenges, but also new opportunities in in product development collaboration. Uncertain are the future competence requirements of an Innovation Coach and the corresponding impact on academic education. This paper presents the research results, which are based on qualitative studies as well as empirical investigations, conducted in an innovation project with 48 participants. The main responsibilities, tasks as well as key competences of the existing Innovation Coaching approach could be derived and applied in a profile. Furthermore, the application of a future scenario and a trend based approach leads to a derivation of future scenarios which implies not only required competences of an Innovation Coach, but also a development and training roadmap for the education of future Innovation Coaches.

Keywords: Innovation Coaching, Scenario-management, Product Engineering, Competence Profiles, Strategic potential identification

1 Introduction and Motivation

Especially in the early phases of product development, the work of product development teams is characterized by continuous decision-making in the face of uncertainty (Chursin/Tyulin, 2018). The challenges are intensified by the company's goal to act flexible and appropriate in a dynamic market by implementing agile approaches, particularly in the field of mechatronic systems development (Schmidt et al., 2017). As a

result, product development departments are forced to develop innovative ideas faster in order to cope with the huge competitive pressure. This is precisely where Innovation Coaches go into action to enable and motivate the product development teams and help to develop or strengthen the culture of innovation (Albers et al., 2016). Furthermore, studies show that decisions made in the early phase of product development fundamentally determine the success of the products on the market (Jahn/Binz, 2009) as well as their quality, cost and development time (Pache et al., 2001). However, the high importance of the early phase is contrasted with a lack of structure in the procedures and uncertainty of decisions due to the great scope for development in the future (Jahn/Binz, 2009). The aim of this research paper is to develop a competence profile for the innovation coach of the future. Therefore, a systematic approach proposed by Marthaler is used (Marthaler et al., 2019). This approach translates the findings of the derived future scenarios into short-term, medium-term and long-term recommendations for action in the form of a roadmap. In detail, this structured approach enables the development and validation of competences over several consecutive generations based on environmental scenarios (Marthaler et al., 2019).

2 State of the Art

2.1 Innovation Processes in Agile Product Development

Innovation forms the base for entrepreneurial success on the market and has great economic importance. An idea and technical solution leads to an Invention, which can become an innovation by a successful market launch. (Schumpeter, 1939) This implies the satisfaction of all relevant customer needs, which can be derived with a product profile to identify customer-, user- and provider benefit (Albers et al., 2018). Therefore, many innovation processes, especially agile approaches, start with a systematic problem definition and an empathy phase. Various methods and creativity techniques exist to identify and understand the customer's pain or demand situation. (Plattner et al., 2011) In order to merge external information about the demand and requirements, some companies even implement approaches as open innovation and co-creation within their processes (Chesbrough, 2006).

To achieve increased efficiency within the processes, existing knowledge should be made available and be considered by the developers. Building upon this knowledge, technical solutions with high innovation potential can be created by following situationally adaptable structuring and agile elements of the ASD – Agile Systems Design approach. It is operationalized in selected, iterative activities within a generic metaprocess of Analyze, Identifying Potentials, Conception, Specification, Realization and Release. ASD is an approach for the development of mechatronic systems. It is implemented within the model of PGE – Product Generation Engineering, which describes the holistic understanding that the development of new product generations always bases on references. (Albers et al., 2017). ASD supports self-working development teams with the right degree of structured and agile methods for the analysis and the synthesis of systems (Heimicke et al., 2018).

2.2 Competences Profiles in Product Engineering

Due to new requirements for development teams through higher quality, time and cost pressure, the implementation of new competence profiles in order to integrate interdisciplinary knowledge should be considered (Levin et al., 2011). Competences are defined as cognitive abilities and skills available to individuals, in order to solve certain problems, as well as the associated motivational, volitional and social readiness and abilities in order to be able to successfully and responsibly use problem solutions in variable situations (Weinert, 2002). This leads towards an integrated understanding of competence profiles for the problem-solving competence of development teams. Especially because the developer´s work is mostly characterized by teamwork, diverse competences need to join for a successful collaboration within interdisciplinary product engineering teams (Niever et al., 2018).

2.3 Innovation Coaching

As the organizational and human aspects in development projects increase in importance, the need for more emphasis arises, which can be complied by coaching (Berg/Carlsen 2007). To develop highly motivated and well performing development teams the approach of Innovation Coaching in product engineering projects was developed (Albers et al., 2016). Extinctive research show that Innovation Coaching is the process-oriented support of people in product development projects by a coach. Particular focus is placed on teaching best practices and empowerment for situation-appropriate application. The goal is the development and effective integration of disciplinary and social key competences and the creative potential of the people and, as a result, the development of the innovation culture of the organization. The role of the coach is to prevent or handle problems, to solve thinking barriers by means of early preventive measures, and to guide people with focused personal and critical questions. Independent solution development and the promotion of the self-reflection as well as perception of the team is of central importance (Hahn et al., 2017).

2.4 Foresight in Product Development

The three-cycle-model of Gausemeier places foresight as the first of three subprocesses of product development (Gausemeier et al., 2014). On this occasion, methods make it possible to estimate and handle future development, with which entrepreneurial decisions can be made under uncertainty (Gausemeier et al., 2014). The literature distinguishes between three basic types of foresight – scenarios, trends and forecasts. According to Gausemeier, a scenario is defined as a picture of the future, consisting of coherent combinations of possible developments of influencing factors (Gausemeier/Plass, 2014). Herby, scenarios provide the broadest temporal foresight and are suitable for long-term future planning. In contrast, a trend is a perceptible direction of development of the reference value and is suitable for a short to medium-term future forecast (Heinrich et al., 2012). The shortest view into the future is provided by the forecast, which describes a clear and expected picture of the future on the basis of a

linear time series analysis (Siebe/Fink, 2006). The development of the scenarios follows the phase model of Gausemeier and Plass. The phase model consists of five phases (Gausemeier/Plass, 2014). Current research indicates a lack of a consistent process model that combines the activities of foresight with the activities of product development. The basis for this is the model of PGE – Product Generation Engineering. In order to derive first methodical approaches of such a combination of foresight in the product generation development (Albers et al., 2018). For this purpose, a methodological process model was developed within a first iteration, which combines several successive product generations through strategic identification of potentials, especially foresight (Marthaler et al., 2019).

Based on that, a next iteration of future scenario and trend based product engineering was proposed (Marthaler et al., 2019). This approach provides insights from the derived scenarios which are transferred into short-term, medium-term and long-term recommendations for action. The systematic approach is based on seven consecutive steps, which contain three different variants which are carried out according to the development goal. The most detailed variant, which is based on the derivation of market environment scenarios and product scenarios is the most suitable for this research. This variant is primarily to be used if the product developer's focus needs to be resolved from the current product properties and if development scopes with a high proportion of principle variation are permitted. This variation is suitable for deriving new customer- experienceable characteristics. In the second step of the systematic approach, a reference product is identified. For this, the current predecessor generation is used in the following and examined with regard to existing customer- experienceable characteristics and evaluated with a five-level scale (--,-,0,+,++) depending on their relevance. The third step is to identify potential future environmental potential and to derive new, currently unknown, customer-experienceable product properties for the future. To this end, market or technology environment scenarios are derived and relevant trends and forecasts are identified. Based on the extended catalogue of characteristics product scenarios can be derived in the fourth step for finding innovation potentials by means of a consistency analysis or by using a morphological box. To gain knowledge about the future development and relevance of the individual customer-experienceable characteristics, the need for change and the future robustness, are defined in the fifth phase, the potential assessment. Using a formula to examine the robustness, the potential of each customer-experienceable characteristics can be assessed in the sixth step dependent on the calculated parameters. This step allows to identify the innovation potential and the need for change. In the seventh step - the implementation of potential - the identification of the relevant subsystems with their innovation potential is processed. Ultimately, a development roadmap can be derived that addresses specific development tasks in defined search fields with high innovation potential for the product developers (Marthaler et al., 2019).

3 Research Methodology

3.1 Research Questions and Research Environment

To explore the approach of Innovation Coaching as well as requirements in the early phases of product development an innovation project with 48 participants, named ProVIL - Product Development in a Virtual Idea Laboratory, was used as a research environment (Albers et al., 2016). During the innovation project, which is implemented as a project work in the education model, master students in mechanical engineering developed a product with an industry partner in a three-month period. Innovation coaches, who are students in the fields of business administration and international management, accompany them. Guided by the ASD approach and predefined activities the student-teams develop inventions with high innovation potential within a short time thanks to the agile approach.

The state of the art indicates that the future competence profile of an Innovation Coach is still unclear. This emphasizes the need to identify future competences of an innovation coach and leads to the following research questions:

1) What are the key activities and responsibilities for Innovation Coaching along the agile innovation process during the project in ProVIL 2018?
2) Which procedure is necessary to derive future-robust requirements for Innovation Coaching based on foresight methods?
3) How will the competence profile of innovation coaching develop in the future due to new technologies and trends?
4) Which training and development roadmap for Innovation Coaching arises from the strategic approach?

The Live-Lab ProVIL 2018 serves as a basis to analyze the current competences of Innovation Coaching. To answer the first research question, weekly surveys and participatory observations were carried out. Subsequently, the reports of the participants were analyzed and evaluated. As a result, actual competences are identified to examine the current tasks and responsibilities of an Innovation Coach. In order to answer the second question the future management tool, the scenario-method, was being applied. The scenarios provide a basis to investigate the future requirements and competences of an innovation coach. The development of the scenarios bases on a literature review, surveys with experts in the field of Innovation Coaching and a workshop with four experts in the area of innovation processes.
For the purpose of answering the third and fourth questions, the strategic approach for potential identification (Marthaler et al., 2019) for each competence was applied to develop a future-robust competence profile and roadmap for Innovation Coaching of the future. Instead of customer- experienceable characteristics of a product, competencies of an Innovation Coach are examined and assessed according to relevance and future-robustness. Thus, a development and training concept for the education of future Innovation Coaches was developed and significant need for research derived.

4 Results

4.1 Key Competences of an Innovation Coach

Within the empirical studies, all ProVIL participants – the product developer and the Innovation Coaches – were asked about an Innovation Coach's core responsibilities. Every Innovation Coach described his or her role during the innovation process in a comprehensive report, which was analyzed in detail. These sources served as a basis to identify Innovation Coach's necessary skills and their corresponding core responsibilities.

During the empirical studies seven core competences were observed. The core responsibilities are completed through process-organization, communication skills, professional and methodical competence, teamwork, socio-emotional competence, innovation competence and leadership.
An essential competence of an Innovation Coach is to convey process knowledge adequately along the phases of the innovation process and to consistently verify it. Process knowledge refers to the knowledge of individual tasks regarding responsibilities, time restrictions, phase sequences and requirements. Knowledge about the sequence and the goals of the different process phases enables the coordination of meetings, subsequent coordination of results, communication with the client and coordination of time management with the help of project management tools. The necessity of a broad field of expertise, especially in the initial phases of the innovation process, goes hand in hand with the importance of the Innovation Coach's professional competence. Professional competence includes knowledge regarding the economic feasibility and customer benefit of ideas through the creation of business models, market analysis and competitive analysis. The methodological competence of the Innovation Coach includes the ability to apply working techniques and procedures and thus the ability to convey and apply methods. This includes, for example, the teaching and implementation of creativity techniques. The ability to work in a team encompasses motivating the team members to work effectively and cooperatively through team building activities. By carrying out personality analyses right at the beginning of the process, the Innovation Coach is able to identify the strengths and weaknesses of individual team members. This guarantees the minimization of possible barriers and conflicts during collaboration. Another key competence is the ability to facilitate communication by creating an open-minded culture, in which problems and suggestions can be addressed directly and effectively. This includes activities such as promoting communication between individual team members and facilitating creativity sessions. In order to recognize problems and conflicts the Innovation Coach needs a socio-emotional competence, namely, the ability to recognize and counteract problems in an early stage. Intercultural skills are also part of socio-emotional competence. This encompasses, recognizing and minimizing language barriers, promoting mutual understanding of different values, working methods and promoting self-reflection. Furthermore, the Innovation Coach promotes the innovation culture within the team by recognizing mindset barriers. Leadership skills are required in order to achieve the goals effectively and efficiently to influence team members'

behavior. This encompasses, for example, initiating conflict solutions and giving reactive feedback.

4.2 Scenarios of Future Innovation Coaching

A literature review, workshop and a qualitative survey serve as valuable inputs for Gausemeier's scenario-method (Gausemeier et al., 2014), which consists of five phases. The method starts with the preparation of the scenario field and its analysis through the identification of influencing factors followed by the development of key factors and projections. The fourth phase consolidates the dominant projections to scenarios which are then interpreted in the last phase. On this occasion, influencing factors have been collected, examined and prioritized resulting in key factors with the subsequent execution of projection development. Thus, the projection portfolios have been transferred into a consistency analysis to conduct the phase of scenario building. Applying the scenario-method, four possible scenarios result:

Scenario1: Inflexible and centralized end-to-end collaboration
Consistent, inflexible end-to-end (E2E) process organization and support by the Innovation Coach in central and permanent teams based on experienced knowledge under strict data protection requirements.

Scenario 2: Agile and centralized E2E collaboration
Consistent, agile and interdisciplinary process organization and support by the Innovation Coach in central and permanent teams based on open innovation approaches and influence through other interfaces with corporate divisions of a company.

Scenario 3: Smart, virtual and partial process organization
Agile and process-driven product development in central teams with partial involvement of the Innovation Coach and simultaneous implementation of smart methods based on intuition and artificial intelligence.

Scenario 4: Dynamic, virtual and with a holistic network
High innovation culture with agile processes and holistic networking of the team members through increased use of smart technologies and man-machine-collaboration. The team composition is dynamic and thus the involvement of the Innovation Coach is only partially required along the process.

4.3 Foresight Methodology to Derive Future Competences

The competence and scenario development is illustrated in a flow diagram in Figure 3, describing how to derive future competency profiles. In order to answer the third and fourth research questions, the methodology for strategy potential identification, which is outlined in 2.4., is applied to identify future competences (Marthaler et al., 2019). In the following figure the method is adjusted to the topic of Innovation Coaching.

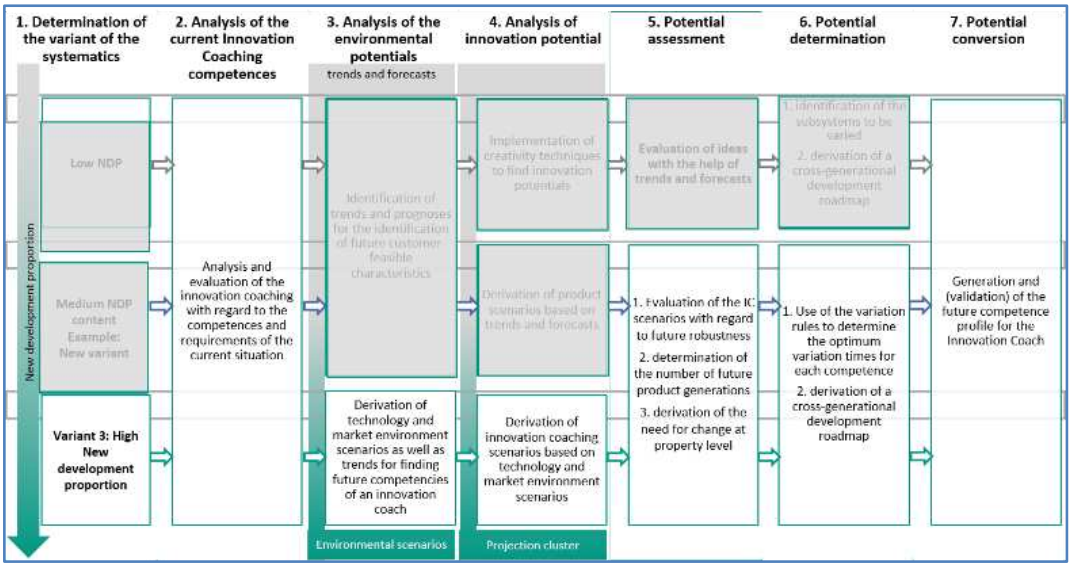

Figure 1: Systematic approach for strategic potential identification (Marthaler et al., 2019)

The definition of the variant (in step 1) was defined and specified as a premise. In the step 2 the actual competences of an Innovation Coach were identified (see chapter 4.1) and the results are illustrated in Figure 1. After determining the actual competences, the evaluation of the competences follows on a five-step scale (--, -, 0, +, ++). The third and fourth step serve to identify future environmental potentials in order to derive new future requirements and competences for the Innovation Coach. The scenarios illustrated in chapter 4.2 are examined and compared with the actual competences. Furthermore, trends are identified to consider not only the long-term development through scenarios, but also the short-term development. In order to determine which competences will be obsolete or relevant in each scenario, each competence is compared to the dominant and characteristic projections of each scenario. In the fifth step, the strategic potential is assessed by defining the two parameters, which describe the need for change and the future robustness. These parameters enable the regular monitoring of the future development and relevance of the tracked competences of the Innovation Coach and furthermore result in variation rules. In this way, the competences are examined with regard to their variation in a short-term, medium-term and long-term manner. This makes it possible to see which competences will remain unchanged in the future and which will need to be adapted in the next step through new training courses so that the Innovation Coach can continue to meet the requirements in the future. In the last step (step 7) of the potential implementation process, the results are discussed in form of a feedback discussion with doctoral candidates.
Applying this method, new competences are identified, which are to be outlined in section 4.4. The resulting findings are validated through research by comparing given findings to expected results, which are outlined in literature.

Openness competence
The Innovation Coach should ensure that the innovation process is not hindered and that the most important information is revealed. The main goal of open innovation is to promote awareness of the need to open up to external participants and transfer knowledge to innovation partners (Wagner/Piller, 2011).

Integration competence
Particularly in the context of open innovation, companies must integrate co-produced knowledge. This requires integration competence, which includes the transfer of heterogeneous knowledge from participants into a product solution, i.e. combining existing knowledge with new knowledge (Habicht/Möslein, 2011).
Digital literacy
Basic digital literacy refers to careful handling of personal data, usage of common software and interaction with artificial intelligence. The main goal is to strengthen digital interaction (McKinsey, 2018).
Networking competence
Networking and interacting with team members as knowledge carriers inside and outside the company is a decisive way to find innovative solutions. The implementation of innovations always requires target-oriented information and persuasion of different groups of people resulting in the ability to build and use networks (Schültz, 2014).
Overview competence
Overview competence compromises (technical) knowledge, experience and the competence to monitor different ideas of the involved people (knowledge and experience carriers) as well as the ability to assess the innovation potential (Ridder et al., 2005).

4.4 Derived Competence Roadmap

Applying the strategic approach (Marthaler et al., 2019) a future-oriented competence profile and roadmap for Innovation Coaching of the future can be derived through the calculation of the two key figures robustness and the need for change. Thus, a development and training concept for future Innovation Coaches serves as a basis for future research.
Figure 2 provides an overview of the potential of each competence throughout the next 10-15 years and the time to take action for training concepts. Furthermore, it illustrates the set of variation rules for each individual competence resulting from the calculation of the key figure future robustness and the need for change. The potential of a competence is particularly high if there is a high degree of robustness on the one hand and a high need for change on the other.

Competencies ↓	5 years	5-10 years	10-15 years
Prozess organization		middle-term variation	
Networking competence		middle-term variation	
Overview competence		middle-term variation	
Communication skills		middle-term variation	
Integration competence	early variation		
Digital literacy	early variation		
Professional and methodical competence			late variation
Collaborative skills	no variation		
Socio-emotional competence	no variation		
Innovationcompetence	no variation		
Leadership		middle-term variation	
Openness competence		middle-term variation	

Figure 2: Development and roadmap for Innovation Coaching competences

The ‘collaborative skills’, ‘socio-emotional competence’ and ‘innovation competences’ are not subject to any variation. This goes hand in hand with a low need for change and a high degree of future robustness. This means that the competences will last in the future as they are defined until now. The need to change, train or vary the competence is particularly low. When consolidated along the scenarios, the competences show a high degree of future robustness. Thus, the Innovation Coach is well equipped for future developments. The ‘process organization’, ‘network competence’, ‘overview competence’, ‘leadership’ and ‘openness competence’ show a medium-term variation. This indicates that in 5-10 years the competences need to be reviewed and revised. Since the network and overview competences were identified from an inconsistent evaluation of the process organization along the scenarios, it illustrated that process organization as it is defined in the actual competences can no longer be trained the same way in 5-10 years and thus requires different training concepts in the medium-term. Furthermore, the ‘integration competence’ and ‘digital literacy’ correspond to an early variation. That means that for the two competencies a valid training concept for the Innovation Coaches must be examined in the next step so that the Innovation Coach can face the challenges of the illustrated scenarios in a future-proven way. Professional and methodological competence are subject to late variation. The consequence is that the technical and methodical knowledge of Innovation Coaches - as it is defined now - will not be sustainable in the long-term. This implies to rethink the training process of both competences and to analyze what methodological competence will be needed in the future.

5 Conclusion and Outlook

Important driver for a corporate innovation capability are the skills, behavior and knowledge of the product developer. Due to this, the concept of Innovation Coaching supports the human in agile innovation process within the model of PGE– Product Generation Engineering by the mediation of problem-solving skills, supporting the application to situation appropriate methods and the conscious management of the team-development. Several technical, economic and cultural influence factors lead to dynamic requirements towards the competence of an Innovation Coach. Therefore, there is a need to examine which competence are required to cope with future challenges.

Applying the future scenarios and trends based approach for strategic potential identification of (Marthaler et al., 2018) a future-robust competence profile and roadmap for Innovation Coaching of the future results. Additional competences of a future Innovation Coach will be the *openness competence*, *Integration competence*, *digital literacy*, *networking competence* and the *overview competence*. The further goal is to develop a training concept for future Innovation Coaches. The development roadmap instructs which competences to develop, illustrates a systematic guide and gives short-term, medium-term and long-term recommendations for action. Pursuing research will focus on an adaptive teaching model to guide the training of the identified skills by applying the compiled development road.

References

Albers, A., Bursac, N., Walter, B., Hahn, C., Schröder, J. ProVIL – Produktentwicklung im virtuellen Ideenlabor [ProVIL – Product Development in a Virtual Idea Laboratory]. In Entwerfen, Entwickeln, Erleben Werkzeuge und Methoden in Produktionsentwicklung und Design, pp. 185–198, Dresden (2016).

Albers, A., Walter, B., Wilmsen, M., Bursac, N.: Live-Labs as Real-World Validation Environments for Design Methods. In DS92: Proceedings of the DESIGN 2018 15th International Design Conference, pp.13-24 (2018).

Albers, A., Heimicke, J., Walter, B., Basedow, G. N., Reiß, N., Heitger, N., Ott, S., Bursac, N.: Product Profiles: Modelling customer benefits as a foundation to bring inventions to innovations. Proceedings of CIRP Design, (2018).

Albers, A., Behrendt, M., Klingler, S., Reiß, N., Bursac, N.: Agile product engineering through continuous validation in PGE – Product Generation Engineering. Design Science, 3(16) (2017).

Albers, A., Bursac, N., Heimicke, J., Walter, B., Reiß, N.: 20 years of co-creation using case based learning: An integrated approach for teaching innovation and research in Product Generation Engineering. In M. E. Auer, D. Guralnick, J. Uhomoibhi (Eds.), Proceedings of the 20th ICL Conference. Springer, (2017).

Albers, A., Dumitrescu, R., Marthaler, F., Albers, A., Kühfuss, D., Strauch, M., Siebe, A., Bursac, N.: PGE-Produktgenerationsentwicklung und Zukunftsvorausschau: Eine systematische Betrachtung zur Ermittlung der Zusammenhänge. In: 14. Symposium für Vorausschau und Technologieplanung (SVT), Berlin (2018).

Berg, M. E., Karlsen, J. T.: Mental Models in Project Management Coaching. In Engineering Management Journal, 19(3), pp. 3-13 (2007).

Chesbrough, H.: Open Innovation - A New Paradigm for Understanding Industrial Innovation. In Chesbrough, H., Vanhaverbeke, W., West, J.: Open Innovation. Researching a New Paradigm, pp.1-15. Oxford University Press, (2006).

Chursin, A., Tyulin, A.: Competence Management and Competitive Product Development. Springer International Publishing, Cham (2018).

Gausemeier, J. und Plass, C.: Zukunftsorientierte Unternehmensgestaltung. Strategien, Geschäftsprozesse und IT-Systeme für die Produktion von morgen. Hanser, München (2014).

Habicht, H. und Möslein, K.M.: Kompetenzentwicklung für Open Innovation. In Leimeister, J. Marco; Krcmar, H.; Koch, M.; Möslein, K., Gemeinschaftsgestützte Innovationsentwicklung für Softwareunternehmen. Eul Verlag, Lohmar, S. 384–408 (2011).

Hahn, C., Albers, A., Stöckner, M., Niever, M., Walter, B., Kerres, R., Bursac, N.: Innovation Coaching in Foresight Processes for Distributed Product Development. In CERC 2017 Proceedings, ISSN: 2220 – 4164 (2017).

Heimicke, J., Reiss, N., Albers, A., Walter, B., Breitschuh, J., Knoche, S., Bursac, N.: Agile Innovative Impulses in the Product Generation Engineering: Creativity by Intentional Forgetting. Proceedings of ICDC18 (2018).

Jahn, T., Binz, H.: A Highly Flexible Project Maturity Management Method for the Early Phase of Product Development. In: International Conference on Engineering Design ICED Nr. 1, S.119-132 (2009).

Levin, G., Le Roy Ward, J.: Program Management Complexity. A Competency Model. Taylor and Francis Group, Boca Raton (2011).

Marthaler, F., Orsolani Uhlig, E., Marthaler P., Kühlfuss, D., Siebe, A., Bursac, N., Albers, A.: Strategische Potentialfindung zur generationsübergreifenden Produktentwicklung mit langfristigem Zeithorizont: Eine qualitative Studie im Live-Lab IP – Integrierte Produktentwicklung In: 5. Stuttgarter Symposium für Produktentwicklung (SSP), Stuttgart (2019).

McKinsey. (2018). Weiterbildung: McKinsey benennt fehlende Skills bis 2023.

Niever, M., Richter, T., Duehr, K., Wilmsen, M., Lanz, L., Walter, B., Albers, A. and Hahn, C.: “KaLeP: A Holistic Case-based Action learning Environment to Educate Successful Future Engineers”, Athens: ATINER'S Conference Paper Series, No: ENGEDU2018-2542 (2018).

Pache, M.; Lindemann, U.; Romer, A.; Hacker, W.: Zukünftige CAD-Systeme zum Skizzieren in den frühen Phasen der Produktentwicklung. In: CAD CAM Report (20/3). S.98-103 (2001).

Plattner, H., Meinel, C., Leifer, L.: Design Thinking: Understand – Improve – Apply. Springer, Heidelberg (2011).

Ridder, H.G., Bruns, H. und Hoon, C.: Innovation, Innovationsbereitschaft und Innovationskompetenz. In Arbeitsgemeinschaft Betriebliche Weiterbildungsforschung e.V., Kompetente Menschen-Voraussetzungen für Innovationen. Waxmann, Münster, S. 13–68 (2005).

Schmidt, T. S., Weiss, S., Paetzold, K.: Agile Development of Physical Products: An Empirical Study about Motivations, Potentials and Applicability. University of the German Federal Armed Forces. (2017).

Schültz, B.: Innovationsorientierte Personalentwicklung. Konzepte, Methoden und Fallbeispiele für die Praxis. Springer Gabler, Wiesbaden (2014).

Weinert, F.E.: Leistungsmessungen in Schulen. Beltz-Verlag, Weinheim (2010).