Available online at www.sciencedirect.com

ScienceDirect

Procedia CIRP 119 (2023) 495–500

www.elsevier.com/locate/procedia

33rd CIRP Design Conference

Product Digital-Platform-Business Co-Design: A Systematic Sprint Approach

Patrick Brecht[a,*], Sandra Keller[a], Manuel Niever[a] Carsten Hahn[a], Felix Pfaff[b], Albert Albers[b]

[a]*Karlsruhe University of Applied Sciences, Moltkestrasse 30, 76133 Karlsruhe, Germany*
[b]*Karlsruhe Institute of Technology, Kaiserstrasse 10, 76131 Karlsruhe, Germany*

* Corresponding author. Tel.: +49-721-925-2700; fax: +49-721-925-2361. *E-mail address:* patrick.brecht@h-ka.de

Abstract

In today's connected age, numerous companies that develop mechatronic systems in generations pursue a digital platform business model. Previous research created the SPDS – Smart Platform Design Sprint to provide product development processes with the necessary tool to build digital platform business models. The SPDS is a five-day method to discover and design digital platform business models. This research validates and further develops the SPDS to provide insights into the first practical application and evaluates the methodology's functionality by solving a real-world problem. More applications of the SPDS are needed to verify its robustness for improved generalization.

Keywords: SGE – System Generation Engineering; Digital Platform Business Model; Design Method; Evaluation; Live-Lab

1. Introduction

The world's top four brands (Apple, Microsoft, Amazon, and Google) are based on digital platform business models [1]. Apple's digital platform business model is often seen as best practice in the business-to-consumer (B2C) market [2]. Apple Inc. launches new product generations yearly, such as the annual release of the iPhone and iPad. These physical systems make four times more revenue compared to Apple's services (net sales, including advertising, cloud services and App Store) [3]. In product development, business models can be seen as part of the product [4]. Digital platform business models often only generate benefits together with their mechatronic systems. The model of SGE – System Generation Engineering is the common basis for describing processes and modelling system generations in product development processes [5, 6]. Nowadays, a widely used concept for developing and rapidly testing ideas is the Google Sprint or Design Sprint 2.0 [7, 8]. These methodologies answer essential business questions and validate initial ideas from user design to final developed prototype testing with customers [7]. Although there is a growth in utilizing digital platform business models, to the authors' knowledge applying or modifying a Design Sprint approach to extract digital platform business models has not been attempted previously [8]. So far, the Google Sprint includes no activities to build the platform-specific characteristics, such as identifying relevant participants or defining key interaction. Therefore, the SPDS – Smart Platform Design Sprint was proposed, a methodology for designing, analyzing, and testing digital platform business models by

2212-8271
10.1016/j.procir.2023.03.111

enriching the methodology with platform-specific design tools [8]. This paper evaluates the methodology and therefore, investigates the following research question: *"To what extent is the SPDS – Smart Platform Design Sprint suitable for the discovery and design of digital platform business models?"*

To answer this research question, the SPDS was validated by applying in the KaPIL – Karlsruher Platform Innovation Lab, a Live-Lab to design digital platform business models in cooperation with corporates and test related tools and methods [9]. The findings revealed necessary adjustments to the SPDS. The paper is structured as follows. The next section provides the theoretical framework, including the structure of SPDS. Next, the methodology of KaPIL is explained and showed how it was used to validate the SPDS. Finally, this paper concludes with a discussion and future implications for researchers and practitioners in a digital platform business environment.

2. Theoretical Framework

2.1. SGE – System Generation Engineering

According to Albers [10], in PGE – Product Generation Engineering a new mechatronic system can be described as the variation share of systems on the overall product level and be distinguished between subsystems. Therefore, every product development can be traced back to a mapping of elements of a reference system [11]. Developing and launching such product generations typically results in an immediate market benefit. However, there are also development activities, which lead to results not immediately offered on the market [6]. Those system development procedures on subsystem level are referred to as SGE – System Generation Engineering [5]. Based on the reference system, adaptation is done through carryover variation (CV), while new subsystems are developed through attribute variation (AV) and principle variation (PV) [5, 6]. Business models can be seen as part of product development [4]. Therefore, digital platform business models needs platform business design [8,9].

2.2. Platform Business Design

Essential platform design elements need to be considered to develop a sustainable and promising digital platform business model [12]. First, a platform is based on various feasible building blocks [13]. The platform's digital infrastructure can be understood as the platform architecture, constituting the basic structure for building interactions [13]. Second, the key interaction needs to be identified as it represents the platform's fundamental purpose enabling interactions between consumers and producers. To design an attractive and simple key interaction valuable to the user, the key components participant, value unit, and filter must be designed. Additionally, three functions are essential to enable key interaction on digital platforms: the pull effect, realizing easy interaction, and matching producer and consumer [13, 14]. Digital platform business model design decisions differ from product strategy decisions. Consequently, the Business Model Canvas [15] does not provide a fully comprehensive mapping of digital platform business models [16]. Platform business model design tools are summarized, for instance, as part of the Platform Design Toolkit 2.2 [17] or as the Platform Innovation Kit [18]. The canvases enable schematic mapping of diverse components of a platform business model [19].

2.3. SPDS – Smart Platform Design Sprint

The SPDS enriches the Google Sprint with platform-specific design tools expertise. The sprint is a structured framework to work on specific issues within a predefined timeframe and focuses on extracting digital platform business models. Within the five-day process, users design platform business models and validate initial ideas through analysis, design, prototyping, and final testing with customers guided by a facilitator or innovation coach [7, 8]. The advantages of the sprint application lie in reducing discussion cycles, increasing efficiency in the innovation process, promoting user-centricity, saving time and costs, promoting innovation culture, solving complex challenges, promoting entrepreneurial mindset, and reducing risks [7, 20, 21]. The Monday morning activities familiarize its user within an onboarding workshop with the particularities of platform business models, answer any questions the team might have regarding the sprint week, and focus on long-term goal setting.

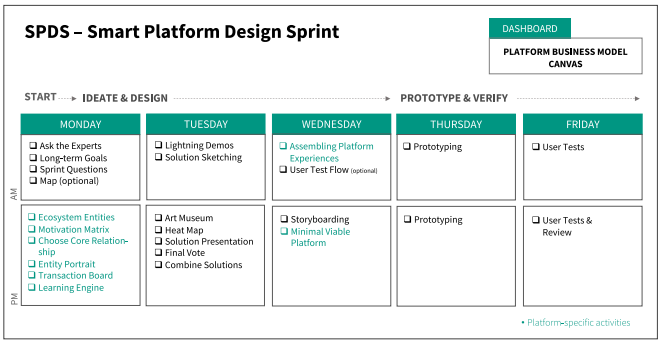

Fig. 1. SPDS – Smart Platform Design Sprint [8]

The focus of Monday afternoon lies in understanding the platform's ecosystem. Therefore, the team identifies the ecosystem entities by applying the *Platform Ecosystem Canvas* and analyses how and what value is exchanged between them or within the same entity. In this light, the team uses the *Motivation Matrix* as it shows the exchanged value on a single page, extracts information regarding relationships revolving around the platform's core interaction and reveals the entities' motivation to participate in the ecosystem. The team outlines various (potentially) occurring transactions in the core relationships in the *Transaction Board*. Understanding the platform ecosystem is completed by the *Learning Engine Canvas*, which introduces the challenges the entities face on the platform in the different customer journey phases. Within the *Lightning Demos* activity on Tuesday, the team spends time researching potential solutions and presenting their findings. Consecutively, the team members sketch eight variations of their best idea in eight minutes and proceed to create a solution sketch. The day ends with the selection process to choose the best solution in the afternoon. Wednesday focuses on assembling the platform experience by consolidating the information of all previous exercises and creating a platform

experience for the core entity with the *Platform Experience Canvas*. Thus, the team's mindset shifts to prototyping and testing the solution. The team has the option to create a *User Test Flow* as a basis for the *storyboard*. The *storyboard* reveals how the prototype must be built. The *User Test Flow* is an optional activity as the *Platform Experience Canvas* might already show relevant information for the storyboard. Wednesday exercises conclude with developing the *MVP Canvas*, which points out the prototype elements requiring testing and more specifically, how these are tested. Thursday revolves around building a lean digital platform prototype using, for instance, software to design mockups or clickable elements representing buttons on the platform. Finally, the SPDS concludes on Friday with five *user tests* involving customers.

3. Research Design

3.1. KaPIL – Karlsruher Platform Innovation Lab

The KaPIL was developed by combining the Live-Lab concept Product Development in a Virtual Idea Laboratory (ProVIL) with elements from Smart Education Concept and digital platform knowledge [8, 22]. KaPIL ran for 15 weeks with 18 students from the master's program in Industrial Engineering, International Management and Technology Entrepreneurship. Students were divided into four project teams working on real-world challenges, supported by innovation coaches, and using the SPDS to develop digital platform business models [8]. KaPIL was run on side and digitally due to the Covid-19 pandemic. The project teams were guided by software tools such as Trello and Miro, which depict the SPDS as a dynamic Kanban board.

3.2. Interview & Survey

The validation of the SPDS was done by applying methodological triangulation [23]. Triangulation is defined as follows: "Triangulation involves taking different perspectives on an object under investigation or more generally: in answering research questions [...]" [24]. In addition to the investigation of secondary data, the authors collected primary data through a mixed method of empirical quantitative surveys, qualitative interviews, and observations. Thus, a total of five surveys, two main surveys and three retrospective surveys, were conducted. The survey results should provide the necessary insights to design the knowledge transfer at the beginning of a platform-specific design sprint and focus on a holistic evaluation of the SPDS. The evaluation included gaining insights into the user behavior, looking at the applied methods and platform design tools in relation to the specific challenge, uncovering the limitations and improvement potentials, and uncovering the requirements within the platform business model design. Due to sufficient previous testing [7], the fourth and fifth sprint days were neglected during this research. In addition, the qualitative-empirical data collection included seven semi-structured interviews with selected innovation coaches and platform developers, and observations during the sprint period.

4. Results

In summary, the results of the quantitative and qualitative evaluation rated the SPDS as a helpful framework for discovering and designing digital platform business models, including identifying and defining the key players. The subjects rated on a scale of one (low) to five (high). According to the results, the SPDS enabled matching the provider and demand side (3.83), identifying the key interaction (3.78), promoting an easy interaction (3.61), and identifying and defining the value unit (3.56). Identifying possible monetization strategies (2.89), implementing a pull effect (2.78), defining filters (2.72), and a go-to-market strategy (2.56) received a medium to low rating. The remaining findings can be divided into the following categories: (1) evaluation of the SPDS (2) platform design tools, (3) knowledge transfer, (4) limitations and challenges.

4.1 Evaluation of the SPDS

These survey results confirm the findings obtained during the interviews and observations. In the run-up to the SPDS, the test persons were asked about the potential effects and reasons for implementing the SPDS in companies. Comparing the results highlights promoting user-centeredness as a key advantage in the application. The SPDS as a helpful methodology for discovering and building platform business models was rated as applicable by the subjects with (3.67) out of 5 points. In addition, the test persons rated the increase in efficiency in the innovation process with an average of (3.61) points. The suitability for solving complex challenges was rated (3.28), promoting entrepreneurial thinking (3.22), and saving costs (3.17), saving time was rated lowest with (2.94). The structured and time-restricted process seemed to have hindered completing defined tasks in the specified time and adapting them individually. The subjects also criticized the sprint week's workload (2.78). Another fundamental characteristic of the design sprint is the collaborative creation process. In this regard, the subjects agreed it increased team engagement through co-creation (3.87), promoted knowledge exchange (3.72), offered the opportunity to build new skills (3.78), enabled rapid familiarization with new topics (3.67), and promoted interdisciplinary collaboration (3.67). The subjects expressed a medium satisfaction level with the SPDS (3.0) with an associated standard deviation of 0.59, confirming the unanimity. Extracting subjective user satisfaction is another indicator revealing the SPDS's usability and potential for optimizations [25]. This dichotomy in satisfaction was confirmed by the results probing a repeat probability. 67 % of subjects were indecisive and "might" perform the SPDS another time while 17 % would not participate in an SPDS again. The remaining 16 % agreed to repeat it.

4.2 Platform design tools

This section gives insight into the test persons' usage behavior and examines the canvas suitability and experience. Furthermore, it evaluates the usefulness of including complementary methods. The repeated measurements regarding expertise showed a visible increase in knowledge and

a positive learning progress by applying the individual activities.

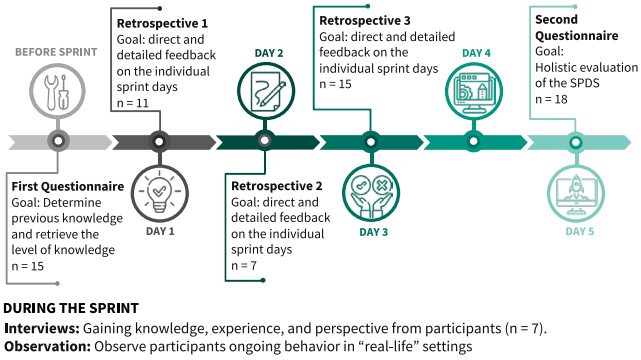

Fig. 2. Research Process

In this regard, on a scale of one ("no expertise at all") to five ("very high expertise"), subjects demonstrated high expertise in conducting the expert interview (3.78), *How Might We* question (3.67), and *User Test Flow* (3.56). In contrast, the lowest expertise was shown in the *Lightning Demos* (2.94), the *Art Museum* (2.83), and the *Learning Engine Canvas* (2.5). To verify the suitability of the used platform design tools, on the five-point scale ("very low efficiency" to "very high efficiency"), the highest efficiency on average is exhibited by the *Platform Experience Canvas* (3.44), the *Ecosystem Canvas* (3.33), and the *MVP Canvas* (3.17). In the value-added category, subjects ranked the *Ecosystem Canvas* highest. In addition, the *Ecosystem's Motivations Matrix* was easy understood (3.78), while *Transaction Board* was easiest to use (3.61). However, the *Learning Engine Canvas* had the lowest score in all four categories. The respondents recognized the need to include Personas (67 %) and integrate the BMC (61.11 %), the Value Proposition Canvas (VPC), and the Platform Business Model Canvas (PBMC) (33 %). These results were gained in the holistic mapping of the platform business model. 44.44 % of the subjects acknowledged the additional support by adding the BMC, 27.78 % regarding PMBC, and 27.78 % regarding PBMC. Only 16.67 % indicated no need for holistic mapping of the platform business model.

4.3 Knowledge transfer

The participants asked for supplemental knowledge transfer of SPDS activities before and on the sprint day, using a platform expert. In addition, the subjects preferred a platform design tools presentation by a competent facilitator. Essentially, the facilitator is responsible for guiding the team through the five-day process in a structured manner. The participants agreed on a scale of one to five ("very unimportant", "very important") and rated the ability as "rather very important". Furthermore, the facilitator should know the necessary method, have process knowledge and the ability to pass on the experience to the core team. Furthermore, the subjects rated the ability to adapt and iterate through the situational use of tools and methods as important. Organizing time and space were also rated by the subjects with 3.89 points. Given these results, it can be concluded a facilitator should enable the team to focus by empowering team members to generate promising results and eliminate concerns about "correct" execution through technical expertise.

4.3 Limitations and Challenges

The problem areas that emerged during the interviews, observations, and the theoretical analysis were included for a holistic evaluation. Five elementary challenges could be identified. First, the teams' lack of shared problem understanding hindered the SPDS’s implementation. Although the Monday morning activities did provide time to gain a common understanding, it proved to be insufficient. Second, it was demonstrated that the SPDS depended on methodological competence and process knowledge due to its platform-specific orientation. Difficulties resulting from inadequate leadership of the facilitators or innovation coaches were rated as rather inapplicable. These results confirmed the assumption that the SPDS, in contrast to the Google Sprint, requires in-depth methodological knowledge. Third, the available time was seen as a limiting factor. It was argued that the lack of time was a consequence of insufficient methodological knowledge and resulted in cherry-picking methods. Fourth, the results showed the multitude of methods exhausted the subjects, which occurred especially on Monday. Lastly, difficulties in transferring the skills to complex problems were identified. It must be considered that the university teaching environment at KaPIL were associated with certain restrictions, such as participant selection.

5. Discussion

This research was set out to evaluate the SPDS to design digital platform business models by applying KaPIL. Firstly, the new outline of the SPDS includes a more intensive preparation phase by extending the onboarding workshop to ensure a common problem understanding to guarantee a successful sprint run. Secondly, a platform business model dashboard is introduced to provide teams with a consistent and structured overview with all relevant components during the sprint duration. Finally, the inclusion of different canvasses. The sprint length remains five days.

5.1 Preparation

The onboarding workshop should continue to be implemented in the blended learning format as it was highly approved, but it should be led by a platform expert. Besides introducing special features of platform business models, the workshop should entail a SPDS presentation, including framework characteristics, functionality, goals, and expectations. Furthermore, it is relevant to introduce and explain platform design tools to strengthen methodological knowledge. In this context, the approach, the intended purpose in the application, and the desired result should be communicated to the participants. It is essential to clarify the problem statement to better assess the measure and objectives, which will ensure effective results with the SPDS. The joint problem definition provides the basis for the team’s collective understanding and

guidance through the sprint [26]. For teams with less market knowledge, the proposal is to use the *Ecosystem Forces Scan* to analyze and build a common understanding of opportunities and risks [18].

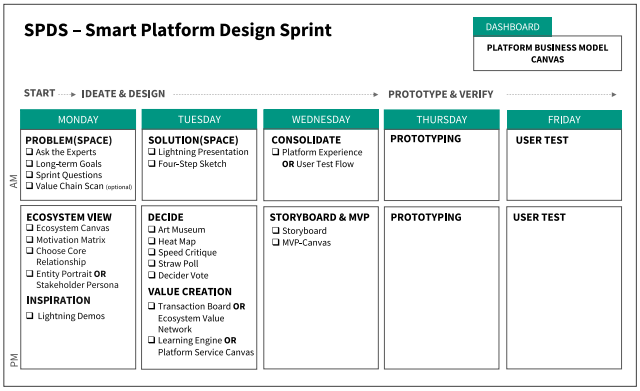

Fig. 3. Evaluated SPDS – Smart Platform Design Sprint

5.2 Methodical approach

While designing the process flow, three major changes were implemented. First, a dashboard is introduced to map the platform business model. Furthermore, and more balanced application of the platform design tools is created by shifting activities. In addition, selection options were introduced by integrating canvases from the Platform Innovation Toolkit to adapt the SPDS depending on the problem complexity and thus, achieve more flexibility. The SPDS is supplemented by a platform business model dashboard, which consolidates the gained knowledge step by step during the whole SPDS. Regarding the Monday morning activity, the first adjustment is to increase the time for drafting the HMW questions since a lack of prior experience by team members could impair rapid formulation. Regarding the mapping, a selection option is implemented via the *Value Chain Scan Canvas* of the Platform Innovation Kit. By mapping the current value chain and the relationship of the involved actors, current inefficiencies can be identified. Considering the *Ecosystem Entity-Role Portrait*, a Monday afternoon activity, it is possible to replace it with the *Stakeholder Persona Canvas* of the Platform Innovation Kit, which identifies user needs by mapping the gains and the pain points and services that could alleviate these pains. Another change in the afternoon is to postpone the *Transaction Board* and *Learning Engine Canvas* until Tuesday afternoon. At the end of Monday, the platform developers will have a rough overview and understanding of the actors and contexts operating in the ecosystem, inspiration for the next phase, and common problem understanding. On Tuesday, the morning can start with presenting existing ideas as the *Lightning Demos*. The morning should conclude with the *Four-Step Sketch* to generate solutions. Due to the *Transaction Board* and the *Learning Engine Canvas*, which were postponed from Monday, the afternoon is divided into two main activities. The biggest challenge of a platform designer is to design and build two key value creation engines, the transactional engine, and the learning engine. Accordingly, platform developers should first elaborate on the *Transaction Board*, channels, and contexts to facilitate interaction between actors. In this regard, the *Platform Value Network* is provided as an option to users. During the *Learning Engine Canvas* or the *Platform Service Canvas*, the platform idea is supplemented by the platform developers with support services. The *Platform Service Canvas* offers the possibility to understand potential user expectations and the platform's unique selling propositions by mapping the motivation, satisfaction drivers, and key resources. In this way, users are engaged and retained on the platform and matches created. Wednesday focuses on consolidating the platform experience in the morning with the *Platform Experience Canvas* and preparing for prototyping in the afternoon with the storyboard and the *MVP Canvas*. The two remaining days are unchanged as they are required for prototyping and user testing. At the end of the SPDS, the team is advised to hold a sprint retrospective as it provides the opportunity to reflect on the work, acknowledge the progress, appreciate achievements, and react on expressed concerns [26].

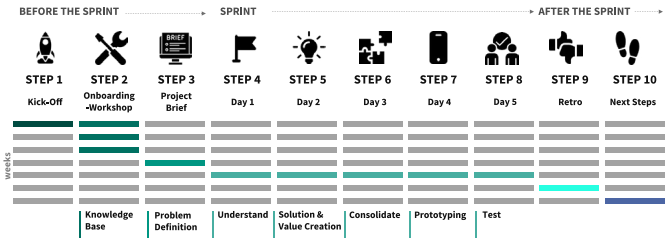

Fig. 4. Evaluated SPDS – Smart Platform Design Sprint Roadmap

6. Limitations & Future Research

The main limitation of the work is the partially low willingness to provide information and the varying willingness of the teams to participate. Another limitation is a small sample size of seven to eighteen test persons and seven interview partners for the data collection. The underlying research environment of KaPIL reduced confounding factors and, given the realistic character, simultaneously increased result transferability of the results into corporate practice. While it drew value for the practical application, it should be emphasized that the SPDS was applied in an educational setting. Factors like the potential lack of motivation, fixating on achieving results, or focusing on the learning experience could manipulate the research results and limit the external validity. Accordingly, grading and high extrinsic motivation could have influenced the results. Different conditions may apply to corporate implementations.

Furthermore, based on the negative feedback regarding the available time for the sprint, time adjustments are recommended to limit constraints, when possible, especially in an educational setting aimed at transferring knowledge. The evaluation of the SPDS could take place in a renewed implementation of the KaPIL. The aim is to verify whether the changes are effective and provide added value. Furthermore, the results suggested that the simplicity in applying the SPDS depends on the problem. The generality of this conjecture needs to be tested. In the future, a distinction between B2C and B2B could be made and, for example, an SPDS focusing on B2B business relationships could be established. Although

KaPIL replicates a real-world environment, the requirements for a teaching setting differ from those of a company. In this respect, further valuable insights could be gained regarding the practical applicability of the SPDS with the involvement of experienced facilitators. The SPDS can be used to enter the first step of the SPEC – Smart Platform Experiment Cycle, a five-step process to design, analyze, and validate digital platform business model [27]. However, further research is needed that scientifically validates the SPDS and SPEC in the field of developing mechatronic systems and digital B2B platform business co-design.

7. Conclusion

During KaPIL, the first-time applicability of the SPDS was tested based on real-world problems from business practice by master students. Advantages in promoting user-centeredness and knowledge exchange, value creation through collaboration, and the increased efficiency in the innovation process could be crystallized. Five main challenges with the SPDS could be identified, including the lack of a common problem understanding, the lack of methodological competence and process knowledge by the facilitator and platform developers, compliance with the time requirements, and the number of methods and transferability to complex problems. Thus, three major changes are recommended to overcome these challenges. (1) a more intensive preparation with the focus on building a common understanding, (2) restructuring certain activities, and (3) offering other more suitable options from the Platform Innovation Kit.

References

[1] Interbrand (2022) Report in Best Global Brands [Online. Available at: https://interbrand.com/best-global-brands/ (accessed 09 March 2023).

[2] Steur, A. J.; Bayrle, N. (2020): S-Curves in Platform-based Business – Facing the Challenge of the Tipping Point. Hg. v. PACIS 2020 Proceedings. Available at: https://aisel.aisnet.org/pacis2020/206 (Accessed 28 November 2022).

[3] Apple Inc. (2022) *Annual Report*. Cupertino, CA: Apple Inc.

[4] Albers, A.; Basedow, G. N.; Heimicke, J.; Marthaler, F.; Spadinger, M.; Rapp, S. (2020): Developing a common understanding of business models from the product development perspective. In: Procedia CIRP 91, p. 875–882. DOI: 10.1016/j.procir.2020.03.122

[5] Albers, A.; Rapp, S. (2022): Model of SGE: System Generation Engineering as Basis for Structured Planning and Management of Development. In: Dieter Krause und Emil Heyden (Hg.): Design Methodology for Future Products. Cham: Springer International Publishing, p. 27–46

[6] Albers, A.; Kürten, C.; Rapp, S.; Birk, C.; Hünemeyer, S.; Kempf, C. (2022): SGE – Systemgenerationsentwicklung : Analyse und Zusammenhänge von Entwicklungspfaden in der Produktentstehung.

[7] Knapp, J., Zeratsky, J., & Kowitz, B. (2016). Sprint: How to Solve Big Problems and Test New Ideas in Just Five Days. New York: Simon & Schuster Paperbacks.

[8] Brecht, P., Faßbinder, J., Hendriks, D., Stroebele, A., & Hahn, C. H. (2021). Rapid Platform Exploration - A Sprint to Discover and Design Digital Platform Business Models. Athens Journal of Business & Economics, 2021(8), 1-18. doi:https://doi.org/10.30958/ajbe.X-Y-Z

[9] Brecht, P., Reinbold, J., Niever, M., Hahn, C. H., Pfaff, F., Rapp, S., & Albers, A. (2022). KaPIL – Karlsruher Platform Innovation Lab: A Validation Environment to Design Digital Platforms and Test Related Tools and Methods. ATINER´s Conference Paper Proceedings Series No: CBC2022-0266.

[10] Albers, A.; Bursac, N.; Wintergerst, E. (2015): Produktgenerationsentwicklung – Bedeutung und Herausforderungen aus einer entwicklungsmethodischen Perspektive. In: Beiträge zum 3. Stuttgarter Symposium für Produktentwicklung (SSP). Stuttgart. Fraunhofer Verlag.

[11] Albers, A.; Rapp, S.; Spadinger, M.; Richter, T.; Birk, C.; Marthaler, F. et al. (2019): The Reference System in the Model of PGE: Proposing a Generalized Description of Reference Products and their Interrelations. In: Proc. Int. Conf. Eng. Des. 1 (1), p. 1693–1702. DOI: 10.1017/dsi.2019.175.

[12] Tura, N., Kutvonen, A., & Ritala, P. (2018). Platform design framework: conceptualization and application. Technology Analysis & Strategic Management, 30(8). p. 881-894. doi:10.1080/09537325.2017.1390220

[13] Parker, G. G., Van Alstyne, M. W., & Chaudery, S. P. (2017). Die Plattform Revolution: Von Airbnb, Uber, Paypal und Co. lernen: Wie neue Plattform-Geschäftsmodelle die Wirtschaft verändern. (1. Ausg.). Frechen: mitp.

[14] Jaekel, M. (2017). Die Macht der digitalen Plattformen. Wegweiser im Zeitalter einer expandierenden Digitalsphäre und künstlicher Intelligenz. Wiesbaden: Springer Nature.

[15] Osterwalder, A., & Pigneur, Y. (2010). Business Model Generation. New Jersey: John Wiley & Sons.

[16] Gawer, A., & Cusumano, M. A. (2015). How Companies Become Platform Leaders. MIT Sloan Ma-nagement Review. Summer 2015. p. 68-78.

[17] Boundaryless S.r.l. (2021). Platform Design Toolkit 2.2. User Guide. Available at: https://platformdesigntoolkit.com/toolkit/#download (Accessed 17. Oktober 2021)

[18] Walter, M. (2021). Platform Innovation Kit 5.0. Retrieved on 13. December 2021 from https://platforminnovationkit.com/shop/

[19] Engelhardt, S. v., & Petzolt, S. (2019). Das Geschäftsmodell-Toolbook für digitale Ökosystem. Frank-furt/New York: Campus Verlag.

[20] Contreras, G. S., Escobar, J. C., Cepa, C. B., Fernández, I. S., & Gonzáles, A. H. (2021). Project Accel-erator Methodology: Design Sprint. Contemporary Engineering Sciences. Madrid: HIKARI Ltd. S. 35-41. doi: https://doi.org/10.12988/ces.2021.91651

[21] Mount, J. (2016). How Design Sprint Save Us Time and Improve Results. Available at: https://www.linkedin.com/pulse/how-design-sprints-save-us-time-improve-results-jay-mount/ (Accessed 27. December 2021)

[22] Albers, A., Walter, B., Wilmsen, M. & Bursac, N. (2018). LIVE-LABS AS REAL-WORLD VALIDATION ENVIRONMENTS FOR DESIGN METHODS. In Proceedings of the DESIGN 2018. Barcelona, Spanien, 21.-24.05.2018 (p. 13– 24). Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, Croatia; The Design Society, Glasgow, UK

[23] Pflüger, J. (2021). Triangulation in der arbeits- und industriesoziologischen Fallstudienforschung. Kölner Zeitschrift für Soziologie und Sozialpsychologie, 64(1). p. 155-173. doi:10.1007/s11577-012-0159-4

[24] Flick, U. (2008). Triangulation. Eine Einführung (2. Ed.). Wiesbaden: VS Verlag

[25] Laugwitz, B., Held, T., Schubert, U., Schrepp, M., Ilmberger, W., & Tamm, N. (2009). Subjektive Benutzerzufriedenheit quantitativ erfassen: Erfahrungen mit dem User Experience Questionaire UEQ. In: Brau, H., Diefenbach, S., Hassenzahl, M.,

[26] Banfield, R., Lombardo, C. T., & Wax, T. (2016). Design Sprint: A Practical Guidebook for Building Great Digital Products. Sebastopol: O'Reilly Media.

[27] Brecht, P.; Niever, M.; Kerres, R.; Ströbele, A.; Hahn, C. H. (2021): Smart platform experiment cycle (SPEC): a process to design, analyze, and validate digital platforms. In: AIEDAM 35 (2), p. 209–225. DOI: 10.1017/S0890060421000081.