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Article

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KaPIL – Karlsruher Platform Innovation Lab: A Validation Environment to Design Digital Platform Business Models and Test Related Tools and Methods

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In the past decade, digital platform business models have gained significant worth as they differ in creating and capturing value compared to traditional linear business processes. Previous research developed the SPEC – Smart Platform Experiment Cycle, a process to validate digital platform business models to ensure their successful implementation. In this context, it is intriguing to investigate whether and how step (1) of SPEC can be expanded by other platform design tools. This study developed a Live-Lab, namely KaPIL – Karlsruher Platform Innovation Lab, to design digital platform business models and test related tools and methods. Applying the Design Research Methodology, the designed Live-Lab is created by implementing ProVIL – Product Development in a Virtual Idea Laboratory combined with the Smart Education Concept and digital platform business knowledge. KaPIL was applied with students from the Karlsruhe University of Applied Sciences in cooperation with the company STIHL to assess its efficacy, applicability, and validity. KaPIL can be used to design digital platforms and shows that the Platform Canvas, the Platform Business Model Canvas, and the Platform Design Canvas can expand step (1) of SPEC. In future research, more applications of KaPIL are required to validate its robustness and extend it to other digital platform methods and tools.

Keywords: *digital platform business model, live-lab, design research methodology, innovation process, validation environment*

Introduction

Over the last few years, it has become visible that digital platforms tend to dominate markets. The world's most valuable brands, such as Google, Amazon, Microsoft, and Apple, are based on digital platform business models. In contrast to many traditional pipeline companies, whose brand value has declined during the

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COVID-19 pandemic, digital platforms are recording positive, double-digit growth rates in their brand value (Interbrand 2021). Furthermore, platforms such as Alibaba, Facebook, and Airbnb have been founded in Asia and the United States of America, while Europe lags in creating platform businesses (Hosseini and Schmidt 2022).

One way to gain a foothold in the platform economy might be to transform existing pipeline business models of technology- and knowledge-based companies into platform business models. This transformation is trending as a recent study by the Federation of German Industries revealed: Many companies in the business-to-business (B2B) market are trying to transform their business model (Bundesverband der Deutschen Industrie e.V 2021). This focus on B2B business models might allow European companies to enter the platform business model realm competitively by using their expertise from their market segment to create new and powerful digital platforms. Research on this topic has further shown platforms fail before they achieve significant relevance (Yoffie et al. 2019). It shows that a systematic approach to designing platforms could help practitioners.

This paper is a response to Brecht et al. (2021), who deal with validating digital platform business models in their work. The authors designed the SPEC – Smart Platform Experiment Cycle, which requires practitioners to already have an existing platform business model mapped out to validate or refute through the smart experiment design and execution. To make the process more accessible to practitioners not meeting the requirement yet, the authors requested research on how they can reach the state of mapped out digital platform business model. The authors have highlighted the relevance of B2B platform business model creation. However, they did not indicate how creating those digital platforms can be fostered systematically. As a starting point for research, the authors recommend considering a streamlined process to ideate and design digital platforms and a suitable choice of tools and methods. This current research aims to develop and test a Live-Lab that fosters creating platform business models and verifying which available tools are best suited for the platform design. A Live-Lab is a research method enabling researchers to test methods and processes in a realistic setting while controlling specific conditions (Walter et al. 2016). Therefore, this paper answers the following research questions:

> RQI: Whether and how can step (1) of the SPEC - Smart Platform Experiment Cycle be expanded by other Platform Design Tools?
> RQ II: How can a Live-Lab be designed and executed with the objective to design digital platforms and test digital platform tools and methods?

The answer to these research questions was found by analyzing the Live-Lab ProVIL and the Smart Education Concept to design a validation environment. Based on these findings, KaPIL was designed and demonstrated with the challenges the company STIHL faced during digital platforms design. This paper is structured as follows. The first section shows relevant digital platform methods and tools as well as the structure of the Live-Lab ProVIL and the Smart Education Concept. The next section elaborates on the research design based on the Design Research Methodology (DRM) and the dimensions, variables, and evaluation metrics of the quantitative interviews. The consecutive result section shows how the Live-Lab requirements were applied in KaPIL and how the platform tools and methods fulfill their purpose as a designing tool for digital platforms. Finally, this research concludes with a discussion and future implications for researchers and practitioners aiming at designing digital platforms.

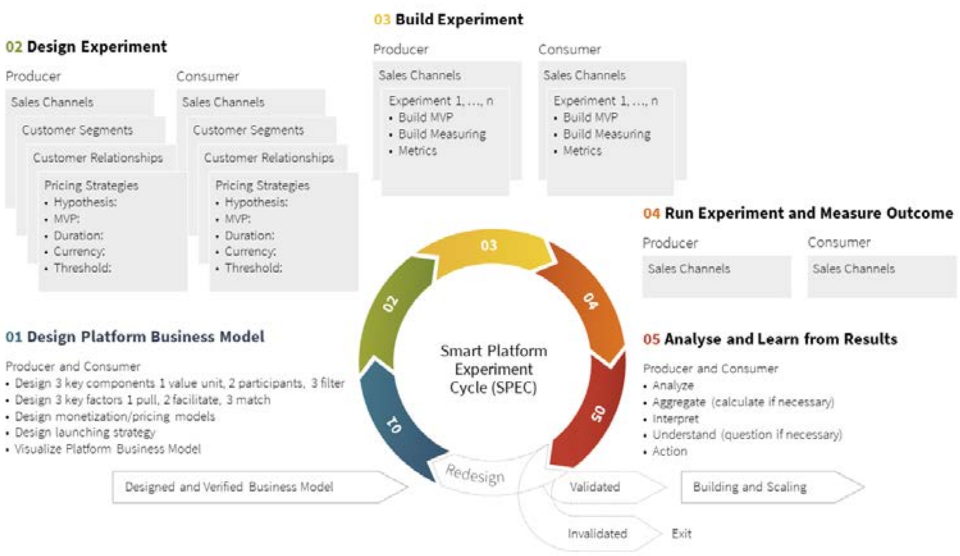
Literature Review

The following section provides a basic understanding of relevant theoretical aspects essential to this research. Therefore, it briefly introduces the validation framework SPEC and elaborates on platform design tools and different types of platform canvases. Finally, it also explains the Live-Labs method by introducing the ProVIL Live-Lab in detail.

SPEC – Smart Platform Experiment Cycle

The SPEC – Smart Platform Experiment Cycle is a validation process specifically for digital platforms tested in the Business-to-Consumer (B2C) sector (Brecht et al. 2021). It is an aggregated process based on the build-measure-learn feedback loop of the Lean Startup approach (Ries 2011), the Customer Development Process (Blank and Dorf 2012), the Four-step Iterative Cycle (Thomke 2003), and the core principles of platform design (Parker et al. 2016). The SPEC is divided into five steps, which are illustrated in Figure 1.

Figure 1. *SPEC – Smart Platform Experiment Cycle (Brecht et al. 2023)*

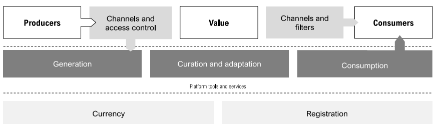


The starting point for applying SPEC is a verified business model. The first step consists of designing a platform business model. Here, the participants functions, and strategies for monetization should be defined and visualized. In the second step, experiments must be designed for the individual platform business model components to validate the hypotheses from the previous step. When designing the experiments, the order in which the building blocks are validated is determined and scheduled. In the context of digital platform business models, the designed experiments validate the platform user side, namely the sales channels, customer relationships, and pricing strategies. In step three, a minimal viable product (MVP) is built, for instance, as a landing page. The MVP represents the first solution to the customer's problem and should contain essential functions. Next, the experiments are conducted in the specified order. The results are measured, and observations on the specified measurement metric are collected. In the last step, observations are analyzed and learned lessons are collected. After this final step and depending on the results, the SPEC can be exited, leading to build and scale the platform or discard the business model entirely. Alternatively, the SPEC can be cycled through again to gain deeper insights into digital platforms.

Platform Design Tools

The following section presents platform design tools: (1) Platform Canvas by (Choudary 2015), which is part of the holistic toolset, (2) Platform Value Canvas and (3) Platform Business Model Canvas, which are part of the Platform Innovation Kit by (Walter 2015/2020) and, (4) Platform Design Canvas (Cicero, 2019), which is part of the Platform Design Toolkit (Cicero 2019). Figure 2 shows an overview of the four canvases. These four canvases were selected to be tested in KaPIL as suggested by (Brecht et al. 2021) to initially design digital platforms with SPEC. In 2021, an update of the Platform Design Toolkit and Platform Innovation Kit was available. This research was done with the older version of the tools, prior to the update.

Figure 2. *Digital Platform Tools based on Choudary (2015), Cicero (2019), Walter (2015, 2020)*



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Platform Canvas (PC)

Choudary's Platform Canvas visualizes the most relevant components of a digital platform, divided into ten building blocks. Accordingly, the three decisive activities are defining a value-creating interaction, constructing an infrastructure to realize this interaction, and mapping the strategies for value capture (Choudary 2015). Platform design with the Platform Canvas works as follows: Building blocks are used to represent the core interaction. The platform building block describes an infrastructure for value exchange between participants. Next, the role and the motivation of the two participants, producer and consumer, are defined. The fourth step identifies the offered value exchanged via the platform. The next step uses channels to enable participant access to the platform, for example, via a website or app. The platform controls producer access, so only producers with desirable behavior create content. While filters ensure relevant content displayed to consumers, the platform should provide producers special developer tools to facilitate creating value units. Once interaction and access mechanisms are determined, the infrastructure is built by defining tools, services, and platform activities. Tools and services are, for example, recommendation services and efficient search functions. The content should be curated and the display adapted to the user's individual need. Furthermore, a monetary or non-monetary currency used in the value exchange must be defined. Lastly, value capturing mechanisms concerning monetization strategies or pricing models should be described. (Choudary 2015).

Platform Value Canvas (PVC)

The Platform Value Canvas (PVC) is part of the Platform Innovation Kit by Matthias Walter and Simon Torrance. The toolkit encompasses a collection of seventeen canvases and tools. The Platform Value Canvas is a methodical approach to visualize a platform business model (Walter 2020). The canvas focuses on the platform stakeholders and the value propositions. The canvas has a circular structure and is divided into four quadrants. Producers represent the supply side, creating and offering value units via the platform. Consumers are the demanding entity who want to use value units. The owner owns the platform, provides the infrastructure, and defines all essential business model components. The fourth stakeholder group are partners such as suppliers and business partners who determine the successful implementation of the platform. The stakeholder group names at least one positive value proposition the platform delivers from their viewpoint. The next step defines value-generating transactions. At the center of the canvas, key components such as filters, algorithms, curation tools, main functions, and the mission of the business model are described (Walter 2020).

Platform Business Model Canvas (PBMC)

The Platform Business Model Canvas (PBMC) corresponds to a one-page dashboard mapping all essential building blocks of a platform business model. In addition to design, it can track the progress of the validation process. The PBMC is divided into three sections and fifteen building blocks. First, on the right side of the Canvas, six building blocks define how value creation takes place in the business model. Therefore, the three external participant groups, consumers, producers, and partners, must be identified, and their needs recorded. Then, a value proposition is created for each segment and adapted to their needs. It is divided into three components: (1) the core value unit, which is exchanged between consumers and producers. (2) the core mission of the platform, which states why the platform exists. (3) the unique selling proposition (USP), which differentiates the value proposition from alternative product solutions. Once the external participants and their value propositions are defined, the next step determines the touchpoints and experiences through which the platform participants are reached and connected in the ecosystem. Thus, it identifies the core network effects between producers and consumers and determines how the platform stimulates and promotes one-way and cross-side network effects (Walter 2020).

After all value creating elements are described, the canvas continues by defining the seven elements of value delivery on the left side of the PBMC, including the platform core services that support stakeholders in onboarding, matching, and exchange. Notably, it highlights how these services differ from the competition. In addition, it must identify which people and skills (e.g., employees) are needed to build and operate the platform. Another significant element is data. Data should be analyzed and determined which data flows represent the platform core and how they should be processed. Next, the canvas builds an infrastructure and identifies which core elements are required for the platform to function. Finally, it identifies key stakeholders relevant to creating, operating, and financing the business strategy, including key suppliers, investors, and supporters. The third area of the PBMC represents the value capture. In this area, it documents the cost structure with its essential cost drivers, accumulating about 80 percent of the costs, all revenue sources, and value-generating units such as sales and data. The last element is the core metrics, which defines the applied metrics to measure the platform's success. One criticism is that filling out the PBMC can be overwhelming due to the many details, especially at the beginning of the business model development. Therefore, it is recommended to use PVC before the PBMC. (Walter 2020).

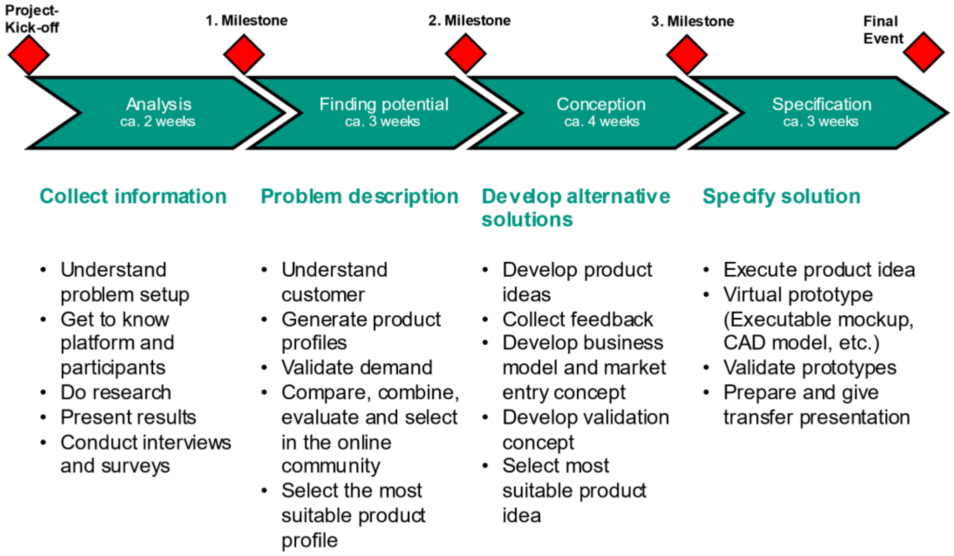
Platform Design Canvas (PDC)

The Platform Design Canvas (PDC) belongs to the Platform Design Toolkit by Simone Cicero. The toolkit contains a step-by-step guide for creating a platform business model, listing eight steps and seven modeling tools as aids (Cicero 2019). The canvas can be used alone or together with the auxiliary canvases of the toolkit's 8-step guide. The PDC structure is like Osterwalder and Pigneur's Business Model Canvas. Like the PBMC, it serves as a dashboard for quickly summarizing platform strategy and identifying platform and ecosystem potential (Cicero 2019). The PDC is divided into thirteen building blocks. The right side of the canvas depicts the partners, peer producers, and peer consumers. In the middle, the value propositions are elaborated. Cicero (2019) differentiates between the core value proposition and auxiliary value propositions. The core value proposition represents the primary benefit to the peer segments and defines the problem solutions. In contrast, auxiliary value propositions represent the secondary benefit relating to existing or new user groups. Simultaneously, coordination and transaction costs should be minimized. Therefore, the next building block defines what constitutes a good transaction and how high volume can be promoted. Additionally, the infrastructure and core components are listed, which are controlled by the platform owner and managed via policies. The PDC's left sides lists the services and capabilities the platform offers to partners, producers, and consumers. Lastly, other platform stakeholders and owners should be named. Cicero (2019) distinguishes two roles for platform owners: the owner role and the designer role. While owners manage the platform infrastructure, designers take responsibility for strategy design and sustainable business model development (Cicero 2019).

The Live-Lab: ProVIL – Product Development in a Virtual Idea Laboratory

Live-Labs are a research method based on applications in real-world scenarios and are classified between traditional methods such as field studies or laboratory studies. The method's main advantage is participants perceiving themselves as product developers, making them more critical of new processes and methods while focusing on the project's success (Walter et al. 2016). Live-Lab concepts usually provide results more easily transferable to the actual situation of the business partner (Walter et al. 2016). In contrast, field studies are case-specific, and thus, generalizing results is difficult (Walter et al. 2016). According to Albers et al. (2018a), by creating a Live-Lab focused strongly on real-world application, the research results gain external validity (Albers et al. 2018a). Hence, Live-Lab was chosen to answer the research question about the suitability of platform design canvases. The Live-Labs IP – Integrated Product Development and ProVIL – Product Development in a Virtual Idea Laboratory have been used for cooperative product development in academia in cooperation with the industry at Karlsruhe Institute of Technology (KIT) (Albers et al. 2018b). ProVIL was run for the first time in 2016 for four months. 32 students worked on a new product development challenge given by the project partner Porsche AG in the Smart Mobility field. Ten innovation coaches who were students from the study program "Industrial Engineering and Business [Administration]" at Karlsruhe University of Applied Sciences supported the students. These innovation coaches moderated virtual meetings, evaluated the students' results, and supported students using an innovation platform (Walter et al. 2016). To this day, ProVIL run seven times. Figure 3 shows an overview of the process model ProVIL.

Figure 3. *Process Model of ProVIL (Walter et al. 2016)*

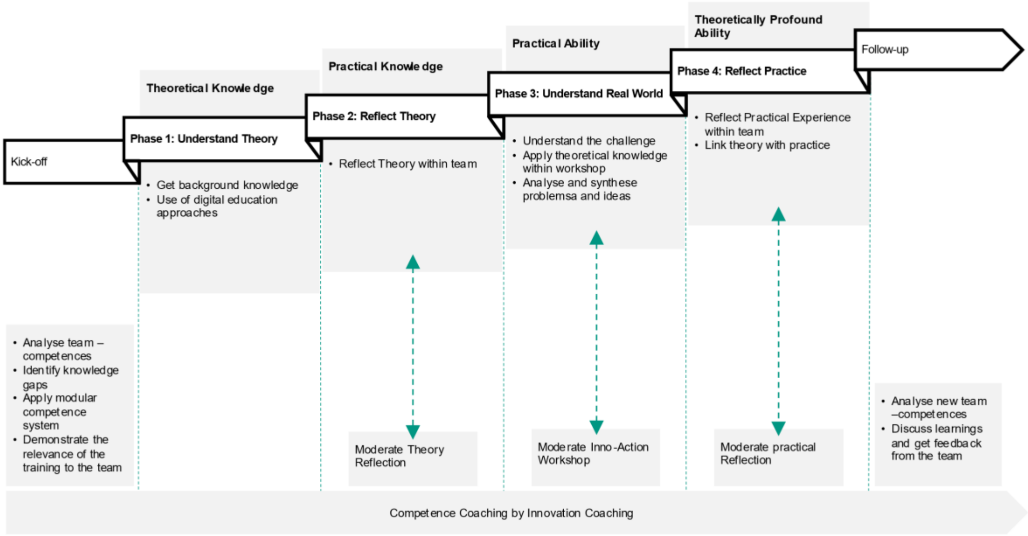


ProVIL included phases, in which the teams acted agile and independent with guidance from innovation coaches: First, there was a planning phase. Second, a two-week research phase allowing students to familiarize with the topic and the innovation platform. Third, in a three-week profiling phase the goal was to gain a comprehensive picture of the customers' needs and desires. Thus, the persona-method describing customers was used to derive product profiles matching potential solutions to the respective customers. Fourth, a four-week idea phase followed those generated ideas for the intended product development. Lastly, a three-week specification phase realized first product concepts by translating the ideas into presentable mock-ups (Walter et al. 2016).

Smart Education Concept

The hybrid learning concept incorporates the three elements of theory, practice, and reflection with the goal of transferring knowledge into ability (Niever et al. 2020). During the concept application, Massive Open Online Courses (MOOCs) are used to deliver theoretical knowledge to the students. The lecturer and discussion stimulated among the students provided practical knowledge. Then, students applied the newly gained knowledge to a practical, real-life problem (Niever et al. 2020). Niever et al. (2020) suggested a four-step process when implementing a hybrid learning concept (see Figure 4). The authors emphasized the benefits of promoted and moderated learning communities and the implementation of innovation coaches (Niever et al. 2020). They further highlight the importance of multidisciplinary teams.

Figure 4. *Smart Education Concept Based on Hybrid Learning (Niever et al. 2020)*



Research Design

Design Research Methodology

This section describes the process of designing KaPIL with the objective of testing platform design tools in the context of a real-world problem setup. This process is based on the Design Research Methodology (DRM) by (Blessing and Chakrabarti 2009). The stages are described in the following.

<u>Research Clarification (RC)</u>

The objectives of the research clarification (RC) are to help researchers gain insights into the current understanding, identify the research goals, and derive a research plan through literature reviews (Blessing and Chakrabarti 2009). Blessing and Chakrabarti (2009) refer to the output of each DRM stage as deliverables. Describing existing and the desired situation are modeled as networks of influencing factors in so-called reference models (Blessing and Chakrabarti 2009). Success criteria measuring the research outcome to evaluate the research need to be formulated. If it is not feasible to use those criteria in the research scope (e.g., if the effect happens after the research timeframe), other *measurable success criteria* are selected to serve as indicators of these success criteria (Blessing and Chakrabarti 2009). The research plan for this paper is displayed in Table 1. The initial reference model (IRM) describes the existing situation.

<u>Descriptive Study I (DS I)</u>

The Descriptive Study I aims at "identifying and clarifying in more detail the factors that influence the preliminary Criteria and the way in which these factors influence the Criteria" (Blessing and Chakrabarti 2009, p. 32). It is achieved through reviewing the literature about empirical research, undertaking empirical research, and through additional reasoning. In DS I, the Live-Lab, ProVIL is analyzed. The IRM from the RC phase and the preliminary criteria are used as a basis to generate an updated impact model, success and measurable success criteria. Success criteria refer to the ultimate research goal (Blessing and Chakrabarti 2009).

Table 1. *Research Plan Based on the Design Research Methodology (Blessing and Chakrabarti 2009)*

	Descriptive Study I	Prescriptive Study	Descriptive Study II
Research question (RQ)	*RQ* 1: Whether and how step (1) of the SPEC – Smart Platform Experiment Cycle can be expanded by other Platform Design Tools?* *RQ* 2: How can a Live-Lab be designed and executed with the objective to design digital platforms and test digital platform tools and methods?*		
Guiding question	What are requirements and key factors in implementing a Live-Lab to design platform business models?	How can we design and execute a Live-Lab that meets the necessary requirements?	How applicable is the derived process model and the four platform design canvases to solve real world challenges?
Methods	Literature review of the SPEC - Smart Platform Experiment Cycle	Action Research in the Live-Lab ProVIL – Product Development in a Virtual Idea Laboratory, Smart Education Concept and platform tools	Application of KaPIL process model and conducting of two surveys among KaPIL participants
Main outcomes	Reference Model derived (see section results)	KaPIL – Karlsruher Platform Innovation Lab a process model derived from ProVIL and Smart Education Concept (see section results)	Insights about conducting the Live-Lab KaPIL and the use of platform design canvases (see section results)

<u>Prescriptive Study (PS)</u>

The Prescriptive Study aims to systematically develop support regarding the DS I results (Blessing and Chakrabarti 2009). The support can take on many forms (e.g., guidelines, methods, or equations) and mediums (e.g., paper, software, or workshops) (Blessing and Chakrabarti 2009). It is limited in functionality but sufficiently developed to test the research contribution (Blessing and Chakrabarti 2009). In this research, the prescriptive study developed a process model describing the design and implementation of KaPIL.

Descriptive Study II (DS II)

The objectives of the Descriptive Study II is to identify through empirical evaluation "whether the support can be used for the task for which it is intended and has the expected effect on the Key Factors" (Blessing and Chakrabarti 2009, p. 38). Criteria are usability, applicability, and usefulness. The deliverables are success evaluation results and suggestions to improve the support, reference and impact models (Blessing and Chakrabarti 2009). For this research, the Live-Lab is conducted with a project partner resulting in students participating in surveys to evaluate the application of KaPIL and its influencing factors, such as the design canvas choices.

Empirical Method

Quantitative interviews are conducted with digital platform developers to investigate the suitability of the four canvases for platform design as part of the DS II. The research question is operationalized by deriving dimensions, variables, and evaluation metrics regarding each dimension. The first survey contained 30 questions, and the second survey 20 questions. Table 2 outlines the dimensions and variables of the two questionnaires. The reason for conducting two survey is twofold. Firstly, initial findings can be derived from the first survey and integrated into the next. Secondly, a second survey is necessary later to gain insights into the actual use and deployment of the tools. Another advantage is repeatedly investigating the same characteristics with the same participants, increases the representativeness of the results. This approach is a panel or longitudinal study (Goldstein et al. 2018).

The first dimension contains closed questions about the study participants' prior knowledge and usage behavior. To ensure the evaluation of only unbiased answers the first two questions contain two fictitious tools as response options. The second category analyzes individual preferences and ratings. The first survey assesses the learnability and evaluates according to the use purpose. The second survey investigates the reasons. The third dimension examines the participation, use, and collaboration with the modeling tools in the challenge context. Fourth, the design tools limitation are surveyed exploratively through the variables exploring the boundaries and specifics in the B2B environment. The last dimension contains demographic, for instance, the subjects' age, gender, and degree program. In the follow-up assessment, it is necessary to assess the results' external validity.

Table 2. *Dimensions, Variables, and Evaluation Metrics of the Quantitative Interviews*

Dimension	Variables	Question type	Scale	Evaluation	Survey 1	Survey 2
Knowledge & application	Knowledge	Multiple selection	Nominal	Frequency	X	X
	Frequency of use	Multiple selection	Nominal	Frequency	X	X
	Frequency of intensity	Scale (labeled)	Ordinal	Mean	X	X
	Time of application	Multiple selection	Nominal	Frequency	X	X
	Application context	Multiple selection	Nominal	Frequency	X	
Individual preference & evaluation	Favorite	Single selection	Nominal	Frequency	X	X
	Reasons for Favorite	Open question	Nominal	Text analysis		X
	Easy to use	Single selection	Nominal	Frequency	X	X
	Easy to understand	Single selection	Nominal	Frequency	X	X
	Ability to learn	Input number	Metric	Mean	X	
	Evaluation	Scale (labeled)	Ordinal	Mean	X	
Challenge	Challenge-participation	Single selection	Nominal	Frequency	X	X
	Selection Canvas in challenge	Multiple selection	Nominal	Frequency	X	X
	Selection Canvas regarding to challenge	Open question	Nominal	Text analysis		X
	Rating teamwork	Scale (labeled)	Ordinal	Mean	X	X
Limitation & critic	Limitation	Open question	Nominal	Text analysis	X	X
	B2B Specifications	Open question	Nominal	Text analysis	X	X
	Tools (Platform Design Toolkit)	Multiple selection	Nominal	Frequency	X	
	Tools (Platform Platform Innovation Kit)	Multiple selection	Nominal	Frequency	X	
Demographics	Course	Single selection	Nominal	Frequency	X	X
	Age	Single selection	Nominal	Frequency	X	X
	Gender	Single selection	Nominal	Frequency	X	X

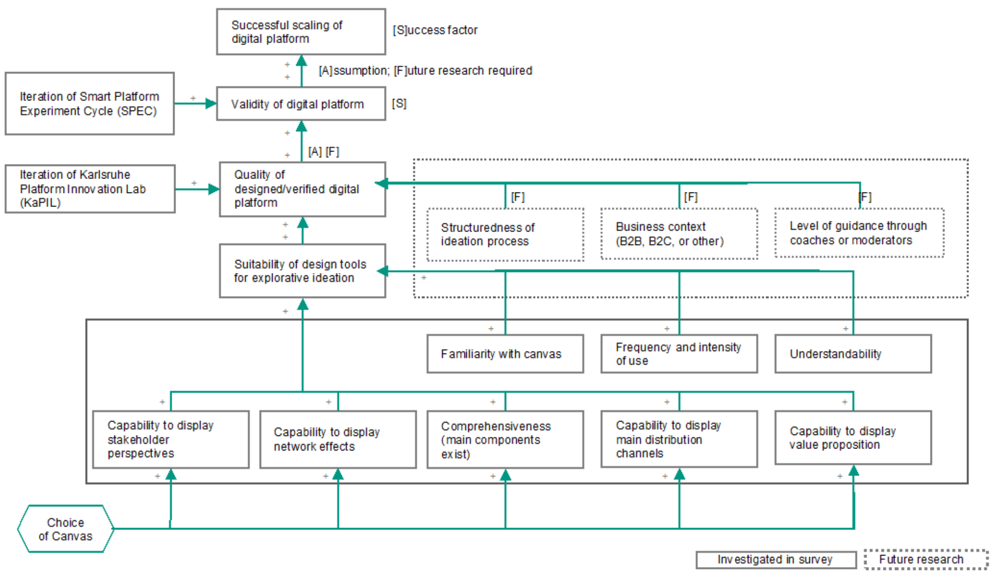
The sample of the surveys consists of 22 students from the master's programs International Management, Industrial Engineering, and Technology Entrepreneurship at the Karlsruhe University of Applied Sciences. The participants are between 20 and 29 years old. Since students participating in KaPIL are taught in platform business model design and are familiar with the four platform design tools presented in the theoretical part of this paper, they are suitable survey participants. Data analysis is done manually using statistical metrics. Nominal variables are evaluated using relative frequencies. The arithmetic means are calculated for metric variables and preference values with an ordinal scale. A quantitative content analysis evaluates the exploratory questions containing open-ended answers. This method assigns responses with the same text parts to a common category and evaluates frequencies (Döring et al. 2016).

Results

Live Lab – Requirements, Challenges, and Potentials

The reference model is mainly based on research by Brecht et al. (2021) and assumptions about the possible factors impacting the quality of designed business models (see Figure 5). It describes how key factors can influence other components towards scaling a platform. The research started with Brecht et al. (2021) regarding the SPEC, a process applied to validate a platform business model. Here, research can address how practitioners can evolve from a validated business model to a successfully scaled digital platform or how one gets a verified business model to enter the SPEC.

Figure 5. *Updated Reference Model Including Success and Measurable Success Criteria*

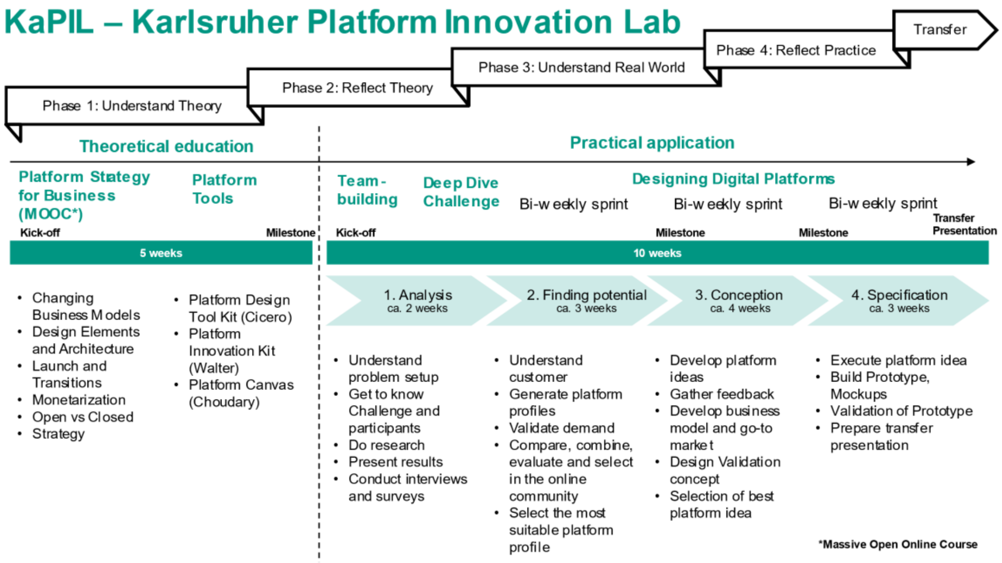


To investigate this matter, assume that the quality of a designed and verified platform business model depends on several factors such as suitable design tools for explorative ideation, structure of the ideation process, the business context of the application (B2B or B2C), and the level of guidance through coaches or moderators. The focus lies on the first factor – the suitability design tools. The authors defined several measurable key factors such as familiarity with canvas, comprehensiveness, and capability to display certain platform elements to investigate this factor in detail (see Figure 5). These key factors are used as a basis for the survey design.

Design and Implementation of KaPIL – Karlsruher Platform Innovation Lab

The authors adapted the Live-Lab concept and added elements from the Smart Education approach and special digital platform design tools as described in the theoretical part of this paper. Workshops and discussions among the researchers resulted in a process model (see Figure 6). The authors tested KaPIL empirically by collaborating with the company STIHL. The researchers collected quantitative and qualitative feedback data throughout the complete Live-Lab execution via digital surveys among participating students. It helped the researchers derive possibilities for improving the concept and validating parts of it.

Figure 6. *Process Model of the Karlsruhe Platform Innovation Lab (KaPIL)*



KaPIL ran for 15 weeks with 22 students from the master's program Industrial Engineering, International Management, and Technology Entrepreneurship. Students were divided into five project teams working on real-world challenges, supported by two coaches. Three of the five project teams worked on an exploration case and two project teams worked on a digital platform about to enter the market. KaPIL consisted of five and one-half theoretical sessions and ten and one-half practical sessions, each lasting about three hours. Students received homework after each session and were graded based on the final presentation regarding the designed digital platform and written report.

In contrast to other Live-Labs, KaPIL was run entirely digitally due to the COVID-19 pandemic. The researcher used software such as Microsoft Teams, Google Jamboard, Lime Survey, and Mentimeter. The teaching was supported by the Massive Open Online Course (MOOC) "Platform Strategy for Business" by Marshall van Alstyne (Van Alstyne 2020) and external speakers. Surveys among the students evaluated the course comprehensibility and other aspects of the lab. Students were taught the following contents: The importance of platform business models, their design and architecture, launching strategies, network effects, monetarization strategies, and advantages of closed vs. open design.

Survey Results Regarding Platform Tools and Methods

The first survey was conducted on December 16, 2020, and the second on February 3, 2021.To gain unbiased results, the first two questions contained two fictitious platform tools as test variables. In the familiarity study, the test variables were selected, leading to the exclusion of these data sets from the data analysis. Thus, the evaluation included 20 valid data records in the first survey. The second sample was composed of 18 valid data records with the same demographic characteristics. Four design phases are distinguished concerning the use of the canvases. These are based on the design phases of the Platform Design Toolkit by (Cicero 2019). It differentiated between the stages of development: exploration, strategy design, validation, prototyping, and scaling and growth. Exploration is the initial phase where developers first create a context to identify the digital platform and collect different ideas. In the second phase, strategy design takes place. A concrete platform strategy needs to be developed and gradually validated with the network participants. In the validation phase, the riskiest business platform strategy hypotheses are tested using an MVP, interviews, or surveys. After successful validation, the scaling and growth phase follows. Here, participants are acquired and activated while network effects are initiated and promoted between and within participant groups (Cicero 2019). The PBMC is most frequently applied in the first three phases. With existing platform business models, all canvases are used relatively frequently: 90% of the surveyed use the PVC, 85% the PBMC, and 80% the PC. Only the PDC was used by every second person. A statement on the earlier design phases was only meaningful in the second survey since test persons were in earlier design stages as part of the challenge.

Examining specifics in the B2B environment provided a clear picture in the first dataset. The following characteristics for customers in B2B market were mentioned: a smaller number of customers, the presence of direct and indirect customers, heterogeneous requirements, a different way of addressing customer(-s) and -acquisition, multi-personnel decisions, higher quality standards, and personal contact. According to the students, a particular challenge was accumulating enough customers to generate network effects in B2B markets. Another remark was relevant data protection, which is more crucial in the B2B than in the B2C context.

In addition, other decisive factors were collected. The most frequently mentioned challenge was identifying customers. Furthermore, there were difficulties in choosing a monetization strategy, collecting sufficient information in the B2B market, generating network effects, the strong competitive environment, and a lack of knowledge about players and value-added processes in the timber industry.

The evaluation of the results gives the following picture. The PBMC by (Walter 2020) was the favored tool among users and was considered the easiest to understand and use. It had the highest use frequency and the second-highest use intensity. At the time of the first survey, 80% of the sample was familiar with it. After that, the PVC was used second most frequently for mapping existing platform business models. On average, Choudary's PC received the lowest rating for all test characteristics. Based on the investigation results, the PBMC will initially be evaluated as the most suitable modeling tool for platform design. Table 3 shows an overview of the main results of the dataset.

Table 3. *Survey Results Regarding the Platform Design Canvases*

Variables	Scale	Metric	PBMC[1]	PVC[2]	PDC[3]	PC[4]
Preferred Canvas	Nominal	Frequency	67%	11%	17%	6%
Easy to use	Nominal	Frequency	50%	11%	28%	11%
Comprehensibility	Nominal	Frequency	61%	6%	28%	6%
Phase 1: Exploration	Nominal	Frequency	50%	33%	28%	22%
Phase 2: First Draft	Nominal	Frequency	44%	39%	11%	28%
Phase 3: Comprehensive Strategy	Nominal	Frequency	44%	28%	6%	0%
Phase 4: Existing Business Model	Nominal	Frequency	67%	67%	44%	61%
Stakeholder perspective	6-Value-Scale	Mean	4	3.8	3.2	3.5
Completeness	6-Value-Scale	Mean	5	3.5	4.1	3.7
Hypothesis collection	6-Value-Scale	Mean	4.5	3.6	3.8	3.6
Key Stakeholders	6-Value-Scale	Mean	4.8	4.5	3.9	3.3
Key Channels	6-Value-Scale	Mean	4.9	3.7	4,2	4.3
Value Proposition	6-Value-Scale	Mean	5	4.8	4.2	4
Network effects	6-Value-Scale	Mean	4.8	4.5	3.9	2.9

[1]Platform Business Model Canvas [2]Platform Value Canvas [3]Platform Design Canvas [4]Platform Canvas.

Discussion, Limitation, and Future Research

The research was set out to expand the first step of the SPEC – Smart Platform Experiment Cycle and develop a Live-Lab as a validation environment to design and test digital platform tools and methods. The method used for empirical research were online surveys. The advantage of this method is surveys took place independent of place and time during the COVID-19 pandemic. In addition, the standardized survey enabled a statistical evaluation of quantitative data to measure frequencies. The combination of closed and open questions enabled collecting quantitative and qualitative data. However, it was disadvantageous that no questions regarding the specific response behavior were recorded. Another difficulty was recruiting enough subjects (Bortz and Döring 2006, p. 260 f.). The subjects' characteristics and compliance with the scientific quality criteria of quantitative research determined the validity and quality of the survey results (Goldstein et al. 2018, p. 123). The research results were based on the knowledge gained from two time-delayed, quantitative surveys with students. However, in practice, the target group of the platform tools should include platform developers and entrepreneurs. Accordingly, it is necessary to examine to what extent test person characteristics match the target group characteristics to make a statement about the reliability and transferability of the test results. The study subjects were students. If one compares the student characteristics with the entrepreneurial characteristics, the following can be established: The students represent most of the entrepreneurial age group. A study by Statista GmbH about "Distribution of company founders in Germany by age group in 2019" showed around half of the entrepreneurs are between 18 and 34 years old (Statista GmbH 2020). Another entrepreneurial characteristic was working in a start-up or a company's innovation department, little time and money at hand but having capacities (Hell and Gatzka 2018). Students in the Technology Entrepreneurship master's program fulfilled these characteristics. They required to apply with a business idea or an existing company and were supported in starting or expanding their business throughout their studies. Furthermore, all the students in the challenge take on the role of a digital platform developer. However, due to the repeated, slightly modified survey implementation, the result reliability could be increased.

The following recommendations for future research can be derived. The findings, including the platform design, should be further validated concerning applicability in business practice, directly in startups for B2B platforms, or in the context of Live-Lab studies. According to Albers and Rapp (2022) the model of SGE – System Generation Engineering describes the development of new systems. Future research should investigate the interaction between the development of mechatronic systems and the development of digital B2B platform business models. Running KaPIL for the first time revealed the following insights. The applied software tools helped the researchers organize the lab, conduct polls, and collect feedback regularly. Students criticized separating theoretical and practical parts of the lab. Consequently, the practice part should commence earlier to create an overlay between theory and practice. Future research should show which canvases and platform design tools are adequate to design an initial platform business model and whether certain problem cases are more suitable for this setting.

Conclusion and Outlook

This research shows the Live-Lab KaPIL – Karlsruher Platform Innovation Lab can be used to design digital platform business modles through cooperation between academia and corporates and test related tools and methods. Furthermore, the Platform Design Canvas, the Platform Business Model Canvas by Walter (2020), and the Platform Design Canvas by Cicero (2019) can expand step (1) of

SPEC – Smart Platform Experiment Cycle. In the future, a more structured approach is needed to design digital platforms during the practical application of KaPIL. One possible solution might be to implement an explorative, quickly paced design sprint, for instance, the rapid platform exploration method called SPDS - Smart Platform Design Sprint (Brecht et al. 2023). Additionally, it should be supplemented by innovation coaching activities to guide the development teams (Albers et al. 2020). In future research, more applications of KaPIL are needed to validate its robustness and extend it to other digital platform tools and methods.

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