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Analysis Of Process Models For The Business Model Development Considering Special SME Requirements For Offering PSS

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Abstract

The continuous testing and redesign of current business models and the associated adaptation of increasingly customized value propositions are nowadays becoming more and more important for companies. Thereby the additional or integrated offering of services as new forms of hybrid value creation are gaining importance. Small and medium-sized enterprises (SMEs) in particular are still at the beginning of the challenge of successfully designing the transformation to offer product service systems (PSS), as they often lack time, technical and methodological resources. This paper first describes the derived requirements for a process model of PSS-oriented business model development for SMEs. The requirements result on the one hand from the research of current scientific publications on this topic and on the other hand from the analysis and evaluation of use cases from practice at SMEs. This is followed by an overview of current process models that deal with business model development and innovation. The identified process models are analyzed in terms of the considered phases, the used methods, and the industries of the potential users. Furthermore, they are examined for SME suitability on the basis of the derived requirements. By means of the comparison of the current process models and the requirements from the SMEs the necessity of an adaption and further detailing of the individual phases of the process models is pointed out. SMEs have to be able to apply these models independently. Finally, the article presents an initial approach specifying the development phase of PSS-oriented business models by means of detailed planning with a focus on the mechanical and plant engineering sector to support the users.

Keywords

hybrid value creation; business model development; process planning; product service systems; SME

1. Introduction

After the degree of digitization of SMEs has continuously increased in recent years, companies are now at an important decision point: as the current IFM study "Future Panel Medium-Sized Businesses 2020" [1] shows, SMEs have acquired a clearer understanding of digitization, In this insight digitization is not a self-contained target, but gives enterprises much more potential. During the first phases of digitization discovered potentials must be used and the skills acquired must be channeled in such a way that new innovative value propositions can be created. A solution approach that has already been discussed for three decades and addresses precisely this integration is the service transformation, i.e. the transformation of manufacturing companies towards providers of product service systems (PSS) [2]. A PSS is an integrated offer of one or more goods and services [3].While many companies and especially SMEs have long shied away from

initiating their service transformation, it has recently become apparent that digitization is acting as a driver in this process. By the measurability of usage data, new digital technologies enable, for example, more transparent and controllable service processes as well as innovative billing models [4]. It can be observed that SMEs are also increasingly making this change in strategy of a service transformation. For the development of PSS, a holistic systemic view must always be taken in order to define all relevant elements of a production and service system and their relationships to each other. The transformation process must thus be considered in direct connection with the possible ecological, technological, socio-cultural and institutional potential for change in the production and consumption system. Such a systemic view in the innovation process from classic business models to hybrid business models also creates challenges for developers, especially in SMEs. The paper explores the research question if existing process models for business model transformation meet the requirements for the business model transformation to offer PSS in producing SMEs. Therefore the needed requirements from practice which also can be observed in literature are derived in chapter 2. The literature review for process models and the synthesis of general phases for the transformation process is described in chapter 3. Also the analysis and the evaluation of the selected process models is contained. The last chapter summarizes the results in consideration of the research question and gives an outlook for further research.

2. SME requirements for process models for business model transformation to offer PSS

The Plan-Do-Check-Act (PDCA) cycle is an established model for changing processes, especially in SMEs [5]. With its phase-specific structure, it serves as a best-practice example and a possible basis of comparison for the requirements to be considered for a process model for the transformation of the business model. Therefore, it can be seen as a starting point for any necessary adjustments.

The PDCA cycle consists of four basic phases, which in turn can be divided into a total of six more detailed phases: At the beginning, the task or a problem must first be *identified*. This task is then *analyzed* so that solutions can be *developed*. The developed solutions can then be *implemented* and *evaluated*. Finally, the successful solution to the task must be *standardized* to ensure a sustainable solution to the task. [5] How extensive individual phases of the PDCA cycle are or whether they are complete depends on the requirements of the target group and the target context. Requirements for process models therefore relate not only to the phases themselves but also to the content that should be covered by the existing phases of the models. Thus, in the area of service development or servitization of a product, for example, it is necessary to include the customer as well as the structure of the company-specific processes or to involve employees in a participatory manner in order to avoid resistance to organizational and cultural change [6]. Further requirements for corresponding process models, thus often result from various implementation barriers that have to be overcome during the transformation process.

A transformation of the business model is particularly challenging for SMEs due to limited resources and competencies [7]. Within the ongoing research project, further requirements were derived from expert interviews and from workshops on topics such as lessons learned, customer journey, or stakeholder analyzes based on three different SME use cases. As a result, numerous important aspects were identified. These include, for example, a sufficiently long phase for explaining the topic and recognizing its benefits. In this way, interest in a transformation can be generated among all participants. In addition to interest in the topic, a process model should also generate an understanding of the company's own processes, potential, industries and customers right from the start. Above all, from the point of view of the application companies, a process model should also provide content to check whether certain minimum requirements prevail in the company or include methods to fulfill them. After the requirements that are specifically directed at the first phases of a process model, however, requirements also arose for the development phases. Here, it is necessary for SMEs that a process model contains best practices or concrete examples for inspiration, so that their own

creativity is stimulated and they can also think outside the traditional corporate processes. However, this also means that risks can be identified for both the existing business model and the new, innovative business model ideas. Only on the basis of known risks a well-founded decision can be made as to whether the company's own business model should be transformed.

If the planned transformation is also to be implemented, a process model should also cover more specific areas in terms of content and, in relation to the offering of data-oriented PSS, also provide information on how the existing data infrastructure must be adapted or what data infrastructure must be created. Another area that a corresponding process model should cover would be practicable assistance for contracting and pricing the newly developed offerings. The concepts developed within a process model should then also lead to a detailed process concept for implementation in order to get from the initial state to the target state step by step. The required qualifications of key personnel should also be identified. At the end of the process model, methods for anchoring the target state should also be shown.

Table 1: Special content and target requirements of SMEs for a process model for the transformation

Content and target requirements primarily based on SME-use-cases *A process model should …*
... include a sufficiently long phase for explaining the issue and recognizing its benefits, as well as generating interest in a transformation.
… generate an understanding of the company's own processes, potentials, industries, and customers right from the start.
... check whether certain minimum requirements exist or include methods to fulfil them.
... include best practices or concrete examples for inspiration.
... identify risks of the existing business model and also of the developed concepts.
… include information on how the existing data infrastructure must be adapted or what data infrastructure must be created.
... include workable guidance on contracting and pricing for new offerings.
... include a detailed process concept to get from the initial state to the target state.
... identify the required qualifications of key personnel.
... include methods for anchoring the target state.

In addition to the content requirements for process models summarized, the interviews and workshops already mentioned provided insights into cross-cutting requirements that apply independently of individual phases or content, e.g. how the content of the process model should be communicated or applied. This includes, for example, the approach of first initiating a process top-down via the management level of a company and then shaping the successful implementation bottom-up via the operational level in a creative and participatory manner.

From the perspective of the user of the process model, one of the mode requirements is that, wherever possible, content is conducted or conveyed within personal discussions between experts and SME stakeholders. In this way, employees of transforming companies feel more valued and can receive direct assistance even when problems arise. This also means, for example, that content of the process model should be easy to understand, especially in terms of language, so that employees with different skills and qualifications have the same opportunities to understand it. Content should also be transparent at all times with regard to its significance and its specific effects on the overall process. In this way, SMEs do not get the feeling that they could be wasting their valuable time senselessly. This also leads to the fact that content in the process model could be accomplished temporally as well as financially with low expenditure. In

addition, a process model should be implemented with change management methods and a lot of communication between all SME participants at the various company levels. In addition to the basic phase-specific requirement mentioned at the beginning, the mode requirements derived from use cases are summarized in Table 2.

Table 2: Special mode requirements of SMEs for a process model for the transformation

Mode requirements primarily based on SME-use-cases *Contents in the process model should ...*
… first be initiated top down at the management level and then developed and implemented sustainably bottom up at the operational level.
… be carried out or conveyed within personal discussions between experts and SME participants.
… be easy to understand, especially in terms of technical language.
… be transparent in terms of its importance as well as its specific impact in the overall process.
… be implemented at low costs in terms of both, time and money.
… be implemented with change management methods and a lot of communication between all SME stakeholders.

It has been shown in practice that SMEs are interested in a specific process model for PSS business model development, provided it meets their corresponding requirements. In the following, existing process models are therefore analysed and checked for their suitability.

3. Analysis of selected process models for the business model development

This chapter presents the procedure and the actual analysis of selected process models. Starting point was a literature research for process models for the business model development which, among others, also consider the offering of PSS.

3.1 Literature review

First of all, various criteria and boundary conditions for the literature research were defined. The research should be limited to process models that were published from 2010 onwards. This restriction addresses the requirement that explicit methods and technologies should be specified that are of interest for current production systems in consideration of the digitization. In addition, the literature, as mentioned above, should provide a process model with different phases and not only list points and facts that need to be observed. The researched papers were reviewed if they contain or name other process models in their work as foundational or state-of-the-art. The papers thus found are also reviewed against the criteria and, if they met them, selected accordingly for analysis. All in all 25 process models were collected and present the input for the actual analysis.

Before starting the analysis, a synthesis, based on selected process models is carried out. It aims to define general phases for the business model development, because many process models name and categorize their phases differently. The general phases are necessary to compare and jointly analyze the models. For this purpose, the steps of the four well-known process models *Business Model Innovation* [8], *Business Model Management* [9], *Developing Business Models: 55 innovative concepts with the St. Gallen business model navigator* [10] and *Business Model Generation* [11] are compared and the general phases for the analysis derived. In his approach, Schallmo considers the six steps of *idea generation, vision development, prototype development, business model development, business model implementation* and *business model extension* [8]. Wirtz and Daiser draw on a total of seven steps, ranging from *analysis*, *ideation* and *feasibility analysis*,

through *prototyping, decision-making* and *implementation* to *sustainability* [9]. The third model by Gassmann et al. specifies the four steps of *initiation*, *idea generation*, *integration* and *implementation* for the development of business models [10]. By developing business models according to Osterwalder and Pigneur, the five steps *mobilize*, *understand*, *design*, *implement* and *execute* are proposed and explained [11]. Based on the steps of these models, the following six general phases are derived for the analysis of the process models: *preparation*, *idea generation*, *design*, *evaluation and selection*, *implementation* and *sustainment*. The first phase *preparation* addresses activities which help to call attention and prepare the company for the start of the transformation process. The phases *idea generation, design* and *evaluation and selection* describe the creative process for new ideas, their design and evaluation. The implementation first in pilot areas and for pilot products and later for the whole company or business organisation happens in the fifth phase while the operation as well as the continuous improvement process of the business model is carried out in the last phase.

3.2 Conduction and evaluation

For the detailed analysis the steps of each researched process model for business model development are assigned to the general phases. During the assignment, each step is transferred to the general phases by noting the heading and a short description or keywords of the step for the corresponding phase (see Table 3). At the same time, it is also analyzed for each of the phases considered whether the process model mentions methods or tools that support the implementation of this step.

Table 3: extract of the analysis sheet

model / phase	preparation	idea generation	design	evaluation & selection	implemen-tation	sustainment
Lins et al. (2021) [6]	attention (1), requirement (2), current status (3)	creative phase (4)	prototyping (5), development (6)	contained in development	implemen-tation (7)	continuity (8)
Osterwalder and Pigneur (2011) [11]	mobilize (1)	understand (2)	design (3)	contained in design	implement (4)	manage (5)
…						

Table 3 shows an extract from the analysis sheet documenting the process models. It becomes clear that the models can all be assigned to the general phases. In some cases, several steps are assigned to one phase (cf. Lins et al. (2021) phase *preparation*) or 2 phases are addressed with one step, so that this step is valid for 2 phases (cf. Osterwalder and Pigneur (2011) phase *evaluation & selection*). In addition to the assignment, the two exemplary models suggest methods that support the implementation of the respective step. The Ability model, for example, mentions a best practice database for creating attention in step (1). Both models use the Business Model Canvas method, among others, to record the current status of the business model and prepare for a successful business model development project (cf. Lins et al. (2021) step (3) and Osterwalder and Pigneur (2011) step (1)). If methods are mentioned by the authors, they are listed in the analysis sheet and assigned to the phases as well as to the steps of the process models. All in all, by analysing the 25 process models all general phases are filled with steps even if some process models only cover a few phases of a complete transformation as evaluated hereafter. The results of the detailed analysis of the individual process models are transferred to a table that provides information on which of the general phases are taken into account in the models (see Table 4). An "X" means that the model includes at least one step that can be classified in the corresponding phase. The six phases are considered with different frequency (see Figure 1).

All models contain steps that can be assigned to the *design* phase, and 22 of the 25 process models consider the phase *idea generation*. Not quite as often the phases *preparation* (14 of 25), *evaluation and selection* (16 of 25), as well as the phase *implementation* (19 of 25) are addressed. The fewest models include process steps that can be assigned to the phase *sustainment*. The evaluation and selection of the business model ideas is already included as a step in the design of several models, but is then marked and highlighted in the analysis for both phases (cf. *Osterwalder and Pigneur* (2011) in Table 3).

Table 4: phases considered in the analyzed process models

model / phase	preparation	idea generation	design	evaluation & selection	implementation	sustainment
Amit und Zott (2015) [12]		X	X			
Amshoff (2016) [13]	X	X	X	X		
Boßlau (2014) [3]			X	X		
Bucherer (2010) [14]	X	X	X	X	X	X
Echterhoff (2018) [15]			X	X	X	
Echterhoff et al. (2017) (*project GEMINI*) [16]	X	X	X	X		
Enkel und Mezger (2013) [17]		X	X		X	
Eurich et al. 2014 [18]		X	X	X	X	
Frankenberger et al. (2013) [19]	X	X	X		X	
Gassmann et al. 2013 [10]	X	X	X		X	
Johnson (2010) [20]	X		X		X	
Köster (2014) [21]		X	X	X	X	
Lehner (2016) [22]	X	X	X	X		
Lins et al. (2021) (*project ABILITY*) [6]	X	X	X	X	X	X
Osterwalder und Pigneur (2011) [11]	X	X	X	X	X	X
Peitz (2015) [23]	X	X	X	X	X	
Pynnönen et al. (2012) [24]	X	X	X	X	X	
Rose (2015) [25]		X	X	X	X	
Schallmo (2013) [8]		X	X		X	X
Sosna et al. (2010) [26]		X	X		X	X
Teece (2010) [27]	X	X	X			
Van der Pijl et al. (2016) [28]	X	X	X	X	X	
Weiner et al. (2010) [29]		X	X		X	
Wirtz (2010) [9]		X	X	X	X	X
Wirtz und Daiser (2018) [30]	X	X	X	X	X	X

The evaluation of the general phases mentioned shows that the process models take into account about four general phases on average. At the same time, according to the evaluation, the individual process models have an average of 4.84 process steps. The most steps are proposed in the models Lins et al. (2021) with eight and Wirtz and Daiser (2018) with seven. The lowest number of steps in the process models is 3 (cf. [12,3,17,20,29]). Regardless of the number of steps, 16 of the 25 models explicitly mention methods and tools for a successful execution of the steps (e.g. [15,20,8]) and three others state at least supporting guiding questions or starting points for the transformation. A useful tool to support the idea generation as well as the elaboration and the design is the application of business model patterns. Five of the analyzed models suggest using patterns and contain possible samples of different business models of different branches (cf. e.g. [16,10]). These can be examples on actual business models as well as samples with abstracted models. Another way of assisting the successful passing through the phases of the process models is to provide a software tool that helps the users to transform their business models. Boßlau (2014) and Echterhoff et al. (2017), for example, provide tools in form of software programs that support the documentation und selection of business model design elements through stored content as well as their links and dependencies.

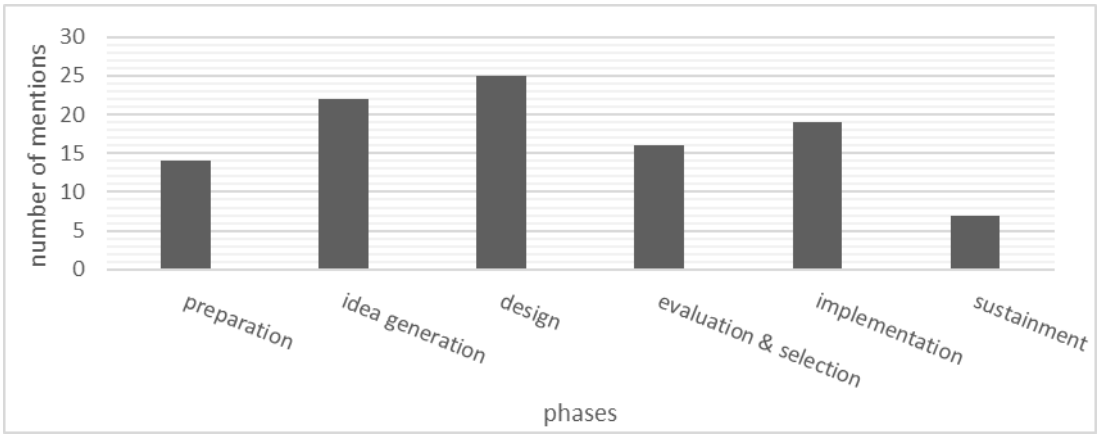

Figure 1: phases considered by the process models

3.3 Summary of the analysis results considering the special requirements

The analyzed process models cover all derived general phases with their respective process steps. Most of the steps can be assigned to the phases *idea generation* and *design*. Starting from these two phases in the transformation process, the number of models that cover the phases with their steps decreases both forwards and backwards. In accordance with the requirements for process models for producing SMEs derived in chapter 2, it can be stated that many models cover a large proportion of the phases for holistic transformation, which is particularly important for SMEs. Pointing out practical methods and tools that can be used in numerous models also supports the use and applicability of the models in manufacturing companies. This is also strengthened by the models that accompany the implementation of the steps of the process model in terms of software programs. Some of the process models have more detailed steps (more than 6 process steps), which partially range from raising awareness and documenting the current business model to operating the new business model (e.g., [6] and [30]). This supports the transformation of SMEs in particular, because the companies can understand the steps well and apply them better. Besides the detailed execution, the business model patterns and best practices are a good help and orientation for users of the process model. A more in-depth detailing of the patterns or of possible characteristics of business models to explicit process descriptions for parts or elements of the new business model in the form of specific process modules is not suggested in any of the analyzed models.

4. Conclusion

The procedure of a business model innovation is fundamentally similar to the procedure of certain improvement processes, whereby the occurrence of the preparation phase and thus ensuring the readiness for transformation is the most important adaptation and is in line with the special requirements of SMEs for offering PSS. The analysis has shown that there is already a large number of process models for business model development and innovation. The models cover the entire transformation process and provide numerous methods and tools, most of which can be used in an industry-neutral manner. However, comparison of the models with the specific requirements of producing SMEs shows that most of the models do not ensure a close support for the manufacturing companies and that there is no specific preconception of individual processes. This poses challenges for SMEs, since they often do not have the technical, human and time resources to work their way through the process models independently, parallel to their daily business. It is assumed that the generation of ideas is sufficiently supported by the known models and that these ideas can be used as input for a detailed planning. The detailed planning is initially to be implemented industry-specifically for the mechanical and plant engineering sector and, in particular, to support SMEs in designing and planning the implementation of new business models for PSS. To this end, standardized processes are to be derived and the necessary elements and resources for the design are to be defined. This detailed planning is intended to enable SMEs to move independently from their actual business model to their target or their desired business model. For a successful transformation of companies in the future, also other topics must be considered in more detail, which are either only touched by the analyzed process models or not considered at all. In addition to detailed planning, these include a risk management and a simulation of the effects of potential risks of the business models to be developed or transformed. Moreover, a user-friendly way of pricing PSS transparently and comprehensibly would meet with great approval among SMEs. Overall, it can be stated that many detailed process models for business model development and innovation exist, but they do not yet fully meet the requirements with regard to support the transformation of SMEs to a business model for PSS. Thus this suggests other approaches for considering specific phases of the transformation process more in detail.

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Biography

Dominik Lins (*1991) has been working as a research assistant at the Chair of Production Systems (LPS) at the Ruhr-University Bochum since 2016 in the field of production management. He earned a bachelor's and master's degree in mechanical engineering at the Ruhr-University Bochum. His primary research topics are the digitalization of production systems and product service systems.

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Christopher Prinz (*1985) studied mechanical engineering at the Ruhr-University Bochum. After receiving his doctorate in 2018 on the topic of knowledge management in production, he was named Academic Councilor at the Chair of Production Systems (LPS). As part of the chair management, he is responsible for the strategic development of the chair and the initiation and controlling of research projects.

Until 2009 **Bernd Kuhlenkötter** (*1971) was responsible for product management and technology at ABB Robotics Germany. In 2009 Bernd Kuhlenkötter took over the Professorship for "Industrial Robotics and Production Automation" at the Technical University of Dortmund. Since 2015 he holds the professorship of the Chair of Production Systems (LPS) at the Ruhr-University Bochum.