DESIGN PRINCIPLES FOR BUSINESS MODEL ANALYTICS TOOLS

Zur Erlangung des akademischen Grades eines
Doktors *der Wirtschaftswissenschaften*

Dr. rer. pol.

von der KIT-Fakultät für Wirtschaftswissenschaften
des Karlsruher Instituts für Technologie (KIT)

genehmigte

DISSERTATION

von

Dominik Augenstein, M.Sc.

Tag der mündlichen Prüfung:	12.11.2019
Referent:	Prof. Dr. Alexander Mädche
Korreferent:	Prof. Dr. Andreas Oberweis

Karlsruhe, November 2019

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1. Introduction

The only constant in the universe is change.

Heraklit (540-480 B.C.)

Since the history of mankind, humans have been subject to constant change. However, not only people, but also organizations have to face internal and external changes, e.g. disruptive changes of the environment. This is because for example an increasing global competition and new opportunities driven by a growing number of services and digitalization force companies to adapt their business models (BM) to new environments (Teece 2010). A BM is thereby the logic, how a company creates value. This is important for decision makers to define a suitable strategy for their business (e.g. Osterwalder and Pigneur 2013). Hence, an adaption of BMs can be more profitable for companies than creating a completely new BM, because they can reuse some of the existing BM structures and do not have to create new structures. As a result, best practices and processes can be kept, which fulfill different requirements, which are using these best practices. On the other side, also radical changes in BMs can make sense, which are often caused by disruptive changes (Chesbrough 2010). Furthermore, next to traditional products, also services become more and more important in companies' strategies. This is because consumers are more than ever able to compare products and services of the markets. Therefore, companies have to rethink their traditional way of doing business (Piccinini et al. 2015). As a result, companies increasingly concentrate on redesigning BMs and focusing for instance on digital services these days (Ostrom et al. 2015). To support business modeling, several methods, techniques and tools exist (Ebel et al. 2016). One of the most well-known is the Business Model Canvas (BMC) of Osterwalder and Pigneur (2010).

Although BMs become more and more important in different research disciplines such as strategic management, entrepreneurship or marketing, there is still a huge potential for research inter alia in the field of information systems (Pagani 2013; Veit et al. 2014). Having a closer look at the often cited BM Canvas of Osterwalder and Pigneur (2010), it becomes obvious that the focus of the concept is rather strategic and less focused on the operationalization of the defined BMs. Thus, different advancements and frameworks of this canvas have been suggested to make the concept more operational (e.g. Lindgren and Rasmussen 2013). This is because in current BM concepts like the BMC (Osterwalder and Pigneur 2010) or the BM cube (Lindgren and Rasmussen 2013) the abstraction level is quite high. These concepts focus mainly on the strategic view of a company and are top-down oriented (Osterwalder and Pigneur 2013). So far, on the one hand side, information systems (IS) research is understanding that a strategy has to be implemented in the structures and value creation down to the operational level of an organization. On the other side, IS research started to link the operational level to the rather strategic BM level and emphasizes the importance of making BMs more operational (Bonakdar et al. 2013; Di Valentin et al. 2012). They want to stress also the need of a bottom-up approach of business modeling. This can gain great potential for the already mentioned transformation of BMs (Bowersox et al. 2005, pp. 22), but can also provide a new perspective on the current business model. Whether you are looking at a BM transformation or solely want to record the current business model, appropriate BM representations are needed (Veit et al. 2014). In the following, these needs will be derived and presented more detailed.

The first sub-chapter in the following will give a more detailed motivation about the challenges of this thesis. This will be followed by the research gap of this thesis, where the different aims of this thesis will be explained in detail. Additionally, the research goal of this thesis and the related research gaps are outlined. This will be formulated in the research questions in a separate sub-chapter, too. The “Thesis Overview” sub-chapter will then give an overview of the research questions, where they are answered, what basics are needed and how this will be done. Finally, the chapter is concluded by a summary.

1.1. Motivation

Having a look at strategy research with a specific focus on strategy execution, Richardson (2008) stresses the need of supporting the execution of strategic frameworks. Richardson (2008) further claims that a BM is neither a strategy nor a table of actions to execute the strategy (see also Di Valentin et al. 2012; Morris et al. 2005). This raises the question, how to improve the executability of BMs impacting operational levels of organizations in order to fulfill the path of strategy to execution (Alt and Zimmermann 2001; Zott et al. 2011). In special, there is a need to develop the functionalities of BMs for humans to support them and increase the comprehension of BMs (Doz and Kosonen 2010). This means, that the BM is not too complex to create and easy to understand for the users (Osterwalder and Pigneur 2010). Current BM approaches have several limitations with regards to their operationalization (Alt and Zimmermann 2001; Doz and Kosonen 2010; Veit et al. 2014; Zott et al. 2011). One limitation is that existing non-specific BM approaches are more focused on strategy and have less operational character (Osterwalder 2004). This means that BMs only provide a biased and subjective overview of an organization as they are built manually from top-down. In order to provide a more holistic view, information of operational levels can be included, as it is the original character of the BM approach as a management tool (Al-Debei and Avison 2010).

In general, management literature regards BMs as a communication platform. Like a blueprint in the construction sector, a BM should provide a rapid overview of the current way of value creation and the related elements (Osterwalder and Pigneur 2010). While a blueprint provides a fast overview, which is even for novices easy to understand, not all BM representations are providing such a good and understandable overview. Anderson et al. (2006), Kundisch et al. (2012) or Zolnowski et al. (2014) are only some examples for representations, which have another view on comprehension as for instance the Business Model Canvas of Osterwalder and Pigneur (2010) has. However, a good comprehension of the BM is important for all involved persons. Without a common comprehension, people may have a different mental model of the way, the organization creates value. This can lead to conflicts or people talking about different things. Furthermore, a deep comprehension of the BM is important for strategic decisions. Without such a comprehension, a transformation can be unsuccessful because the initial situation is not understood well enough. Furthermore, the time of decision makers is limited. A representation should therefore provide a fast and comprehensive overview of the value creation as for instance the BMC does (Osterwalder and Pigneur 2010). As a result, BM comprehension can be improved for decision makers.

Closely combined with the comprehension of BMs is their objectivity and correctness. Thereby, wrong information in a BM can lead to misunderstandings or, in the worst case, to a mistrust of the users. This is furthermore critical for strategic decisions. Normally, such long-term strategic decisions have to be based solidly and the initial information and data should be reliable. However, most of the existing BM approaches have an error-prone and subjective method for modeling a BM. For instance, the BMC provides leading questions to fill out the different categories like key partner or customers (Osterwalder and Pigneur 2010). However, different decision makers assume different information as important as well as true and sometimes also conflicts of interest play an important role. As a result, such a top-down modeling is not an objective base for any strategic decision because of the subjective biases. As an example, a wrong or subjective base for a BM transformation could lead to a suboptimal target state. This is even true, if all the business modeling steps are followed correctly. Furthermore, if two or more persons are modeling the same value creation, the models and focus might differ. The related questions thereby are; which model is correct or is the closest to the real value creation or even if both models are wrong? As we have seen, these discussions need a lot of time in everyday business and can threat the corporate peace. A more objective approach, perhaps with technical support, can lead to an improvement of this situation and is possible with today's wealth of functionalities and possibilities (e.g. Ebel et al. (2016)).

Next to this challenge, more challenges in business modeling exist. Important main challenges in the topic of BM as management tool are mostly related to an increased user support for modelling, consideration of operational levels as well as challenges emerging from BM transformation and innovation (e.g. Wirtz (2013b)). However, it is not possible to cover all these challenges in one thesis. Literature research and related studies show the lack of related functionalities of BM approaches or name them as weaknesses of the approach (e.g. Veit et al. (2014)). Although there is enormous potential to develop comprehensive BM tools that meet current needs, there is still a lot to be done. So far, existing tools have focused primarily on supporting business modeling rather than the challenges described above. The following sub-chapter looks at these challenges in more detail and describes the research gaps more precise.

1.2. Research Gap

The literature shows that existing approaches to business modeling and the tools associated with them have limitations. One limitation is that some of these artifacts can be considered very complex, as much time has to be spent on modeling (Osterwalder and Pigneur 2010). This depends on the degree of abstraction of the approach. Therefore, a lot of effort is required to properly use some of these artifacts or approaches. Some examples of such approaches are the “Value Management Platform - VDMbee” or the “BM Cube” of Lindgren and Rasmussen (2013). Using that approaches takes longer to enter the correct data compared with the BMC. A motivation for Osterwalder and Pigneur (2010) for the BMC was to be able to model rapidly and without a comprehensive instruction. The BMC is very intuitive and there is no need for a comprehensive introduction. However, this is at the expense of a high level of abstraction and less expressivity of the approach. Next, if one looks at the existing approaches to business modeling, one can see that they are incomplete. On the one hand, they can be described as incomplete because they are created by humans and it is in the nature of humans that they have a subjective view on a company's value creation. On the other hand, the necessity of a certain abstraction, which constitutes the nature of a "model", makes it important to decide to concentrate on certain points. In general, if a decision maker has less information about the value creation, the quality of his decisions decreases. This means that the special focus in BMs also influences the quality of decision-makers' decisions. Additionally, the existing BM approaches are decoupled from the operational level of a company, at least from the perspective of BMs as a tool for management. For most researchers, a BM is a management tool that is created from top to bottom and is intended to gain as much information as possible for the purpose of strategic decisions (e.g. Osterwalder and Pigneur (2010)). This approach is in contrast to the original aim of BMs to function as a mediator between different layers in a vertical and horizontal direction (Raps 2009; Al-Debei and Avison 2010). A further limitation of existing BM approaches is that the value creation of a company can shift quickly as organizations have to adapt rapidly to new demands. This results in a quick outdating of the existing BM. According to this, BMs have to be updated in a regular way, which means a certain degree of effort for the organizations. While a change of BMs can be seen and modelled rapidly in the BMC, the BM Cube might need some more time for an update. However, if a BM is outdated, it is useless as a basis for strategic decisions. This means that companies must make these efforts in order to have a correct BM and thus a correct basis for decision-making. Such objectivity of the BMs depends on several factors. One factor is the objectivity of the data, which is important for a correct BM.

To sum it up, existing BM approaches lack in objectivity and comprehension of the users. However, these points are important for decision makers, who use BMs as a strategic management tool. For example, using BMs to support a transformation, companies have to model the existing and the target state of the BM of a company. However, for the current state, companies are only able to provide a top-down view of the value creation. As mentioned, this current state is built manually and therefore subjective. It depends heavily on the knowledge of the modeler and can be biased, next to the fact that business modeling can be a consumption of time. Surprisingly, business modeling is still a manual process that is not only costly in terms of time but also does not fully exploit the potential of enterprise data. In many companies, information systems contain a large data pool of relevant information for the BM of an organization. Modern companies are largely driven by information systems, such as systems for Enterprise Resource Planning, Business Process Management, Business Intelligence, Customer Relationship Management or Supply Chain Management. Since these systems store large amounts of data, companies can use these large databases as a base for business modeling. As a result, the top-down approach of business modeling could be enriched through data support and a bottom-up approach. For example, the information of an enterprise resource planning system can be used to fill out different categories of the BMC like suppliers, customers, resources, costs, revenues, or sales channels. This allows an increased objectivity of the BMs. So, it is remarkable that business modeling is still a manual approach and is only partially supported by tools, while technology (e.g. business process mining) and data suitable for data-driven BM generation and increased objectivity of BMs are available.

Besides the objectivity of BMs, already mentioned is that the quality of BMs is influencing the strategic decision-making of managers. Even a high quality of BMs cannot guarantee that the derived strategy is correct. The quality of a derived strategy is furthermore biased by the users' comprehension. Lindgren and Rasmussen (2013) stated that there is a need to “fully understand the levels, dimensions and components of the business models thoroughly“ and to be “able to communicate, work and innovate with business models at these levels“ (Lindgren and Rasmussen 2013, p. 158). It is important that a user understands the BM at all levels of a company. Recent research has provided several enhancements to the BMC and new frameworks to improve user understanding. (Ebel et al. 2016). Through detailed information across different company levels the comprehension should be increased (e.g. Lindgren and Rasmussen (2013)). However, this topic of increased understanding is still at the beginning of "huge, unexplored possibilities" (Lindgren and Rasmussen 2013, p. 158). Further research should be done to increase the comprehension of users, to enable good communication about the value creation and to be able to derive good strategies for a company.

Overall, the weaknesses of existing BM approaches and the gaps in the scientific literature highlight two points in this work: A lack of objectivity of the BMs, even if suitable methods and data were available, which would make such an increase in objectivity possible. Moreover, a lack of understanding assistance, mentioned in various works but not fully resolved. It should be added that there are other gaps, but due to the limited period of time of this work project, not all can be taken into account. Therefore, I will focus on the gaps that are considered very important both in a literature review and in practical interviews. Derived from these gaps, I will present the research goal of this work in the next sub-chapter.

1.3. Research Goal

In the last years, the focus on BMs as management concept strongly increased. There is much work done in the field of business modeling and some researcher would mention the BMC of Osterwalder and Pigneur (2010) as a milestone of business modeling. However, as shown above, and as literature shows (Veit et al. 2014; Ebel et al. 2016), there are huge gaps existing, which avoid BMs to be used more effectively in an organizations management. It is true that the BMC is often used in practice and is also highly cited. However, BM research shows a lack of providing tools that have an objective and easy-to-understand view of a company's value creation. As a result, this thesis aims to address the following main goals:

(1) Understanding the characteristics of BMs, especially the variety of the concept, the influences as well as the limitations.
(2) Increasing the objectivity of BMs through the use of company data and a bottom-up business modeling approach.
(3) Developing design principles, which support users' comprehension of the business model to enable a more precise strategy derivation and a common communication base.
(4) Providing a common tool, which is considering an increased BM comprehension and is including a data-driven bottom-up BM generation.
(5) Validating the meta-requirements, design principles and tools by empirical evaluation in the lab and field .

The overall research follows a design science research (DSR) approach by Vaishnavi and Kuechler (2015). As an abstract goal, the developed business model concept should be similar to a blueprint in the construction branch: It should be easy to understand, even for novices, and it should be correct. Similar to the construction branch, where the blueprint enables building a house correctly, safely and in a certain period of time, the derived BM approach should provide a management tool, which is also correct and easily understandable. The BMC is a solid base for such a project, as it is easy to comprehend and even users without knowledge in business modeling should be able to fill out a BMC.

1.4. Research Questions

As mentioned, this thesis is focusing on two main challenges. One key challenge is to make business models more comprehendible through a complete and easy comprehendible view of a company's value creation (Alt and Zimmermann 2001; Zott et al. 2011). Another task is the quality of BMs. It is important that it reflects the actual value creation process as correctly and completely as possible. Since that time, huge amounts of data are available in companies, e.g. in an operative company system or aggregated in decision-oriented business intelligence systems. Each challenge alone holds great potential for improvement. Objectivity and comprehensibility also have common elements. It is easy to understand that a BM or the added value it contains is easier to understand if it contains no confusing contradictions, e.g. due to errors. Thus, the correctness of a BM can influence the understanding of BM users. However, if BMs are modeled from top to bottom and by humans, errors and contradictions may occur. If a person other than the modeler takes a look at the model, he may be confused. A user of the BM could fully or highly understand a company's value creation. If the BM is wrong, he may not trust the BM completely. In summary, the objectivity of BMs can influence the understanding of users. And it is also conceivable that the understanding of users can have an influence on the accuracy and objectivity of users. This underlines the need for a composite analysis of the objectivity and understanding of BMs. As a consequence, I want to answer the following overall research question (RQ):

RQ: Which design principles need to be followed to increase business model objectivity and users' business model comprehension?

In order to answer this question, I will use a design science research (DSR) approach, as already mentioned. This DSR project will contain three main cycles. Cycle one will answer the question of an increased BM objectivity and will therefore answer the following sub research question (RQ1):

RQ1: Which design principles need to be followed to support data-driven business modeling from information systems to increase the objectivity of BMs?

The second design cycle is focusing on the comprehension aspects of BMs. The main aim is to increase the users' comprehension of a business model and to enable a common communication platform, where users with different levels of BM experience are included. Therefore, I answer the second research question (RQ2):

RQ2: Which design principles need to be followed to increase users' business model comprehension?

The last cycle will have a look at both concepts and their interplay. It will be shown, how both concepts will work and what relationships and influences are existing. The previous cycles had a separate focus on the two concepts. This cycle will have a focus at the interplay and relations of these concepts. This will be finally included in a BM analytics tool. In consequence, the third research question (RQ3) is:

RQ3: How does a combination of design principles increase the objectivity and comprehension of business models?

These questions will be answered in the following chapters. Therefore, the following sub-chapter will give an overview of these chapters and the thesis.

1.5. Thesis Overview

As already mentioned, the DSR methodology, which will be described later, provides a structure of the project, which can also serve as a structure for this thesis. This thesis overview is part of **chapter one**, which gives an introduction to the topic of business modeling as well as current challenges in business modeling. Identified are two major challenges, which are a lack of BM objectivity and comprehension. Therefore, this chapter provides an introduction, shows the gaps in current research and displays the aims of this thesis. Furthermore, the research questions of this project are described.

This is followed by **chapter two**, which gives an introduction to the foundations of business modeling and an overview about the related work. Important to know is that this chapter provides all basic information, which is necessary to understand the BM concept and the related tools. The questions hereby are: “What are conceptual foundations to understand the business model concept?” and: “What does one need to know about BMs”. In this second chapter, information about BM theory is given as well as information about the development of the BM construct. Additionally, it is shown, how BMs work as a management concept, which BM tools are existing and the state of the art of BM artifacts through a comprehensive literature review. Thereby it is shown, how the literature review was conducted, what were the results as well as the impact on BM research.

In **chapter three**, the design science research approach is described more detailed, as this is the overall methodology of this thesis. In general, the DSR approach as a method is described as well as the special instantiation of the DSR method in this chapter. This is followed by a methodological description of the single parts of the DSR stages. All in all, this thesis contains three DSR cycles, which are described in this chapter three.

As initiation of the DSR process and as **chapter four**, the problem awareness is described. Next to the impact of the conducted literature review and the review of other researchers, also explorative studies were done. Thereby, an overview of the cases is provided and added to the results of the literature review. Together, the impact on BM research with special focus on the objectivity and comprehension is shown.

Chapter five provides then an overview of the first design science cycle. In this cycle, the objectivity of BMs is in the focus. First, the requirements and design principles for an increased BM objectivity are described. Next to this, a concrete instantiation is presented, which shows the BM Analyzer 1.0, a BM Mining tool, as one outcome of this cycle. This tool and the design principles where thereby evaluated in two evaluation rounds, which were also presented.

The insights of this first design cycle will also influence **chapter six**. In this chapter, the second design cycle is described, which focuses on the comprehension of BMs. Again, related meta-requirements and design principles were formulated. The concrete instantiation is an experimental tool, which was used in a lab experiment to evaluate the design principles. Outcomes of this design cycle are concrete tool functionalities, which should help to increase users' comprehension of a BM.

In the last design cycle three in **chapter seven**, both concepts of objectivity and comprehension are combined and investigated. The meta-requirements and design principles were updated and investigated for interferences. Furthermore, they were instantiated in one common tool: The BM Analyzer 2.0, which can be used by companies. To show the functionality of this tool, a show case was conducted, which was solved with the tool.

The results of all three design cycles were then discussed in **chapter eight**. Thereby, the evaluation data, the field evaluation and the experimental results are critically regarded. Finally, the overall research results were viewed in a more detailed critical way.

The thesis closes with **chapter nine**. In this last chapter, a conclusion was drawn and the theoretical, as well as the practical contribution, was displayed. It finishes with the limitation and future work and a last summary of the whole thesis.

This thesis overview can be regarded comprehensively in the following figure.

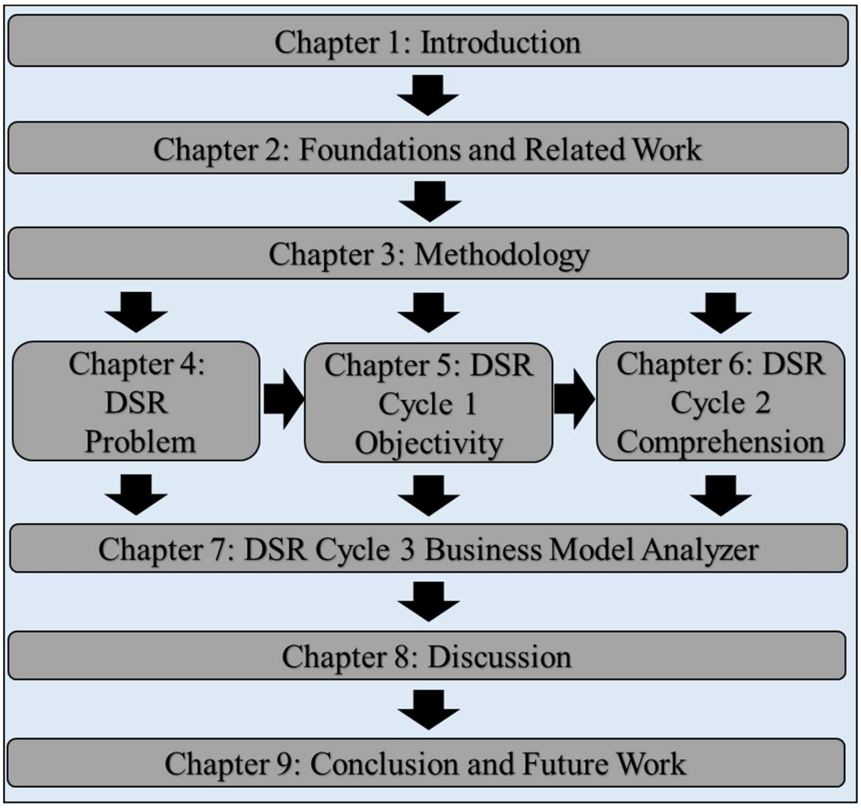

Figure 1: Overview of the Thesis

1.6. Summary

As seen, lots of research is done to provide suitable BM concepts for the management. This should help decision makers to derive strategies easily and to keep an overview of the current value creation. However, existing approaches face different challenges as for instance the objectivity and comprehension of BMs. In the case of the objectivity, business modeling is often a manual top-down process, which is error-prone and highly subjective. An increased objectivity should increase for example the correctness of BMs. Data can support such a bottom-up creation of BMs and can be a good alternative next to a single top-down approach. A combination of both, top-down and bottom-up, might gain lots of possibilities and an increase in objectivity. Besides this, also the comprehension of users is important. A BM should function as a communication base. Furthermore, it should provide an easy and understandable overview of the value creation of a company. Thereby, comprehension is closely related to the quality of derived strategies. Only a good understanding of BMs can help decision makers to derive strategies correctly. This directly influences the competitive standing of an organization in the market. As a result, concrete demands are an increase of objectivity and comprehension of BMs. Therefore, this thesis aims to increase the objectivity and comprehension through a design science research project. As a base for that serves the Business Model Canvas of Osterwalder and Pigneur (2010). This will be used as a base for the concrete BM tool. This tool instantiates the related design principles for objectivity and comprehensions and uses the advantages and structure of the Business Model Canvas. In the next chapters will be shown, how this can be done and what concrete functionalities are included. This chapter provided therefore an introduction about the overall topic and showed, why it is important to increase the objectivity and comprehension of BMs. Furthermore, a comprehensive overview of the thesis is given. The following chapter two will then provide information about the foundations of BMs and related work.

2. Foundations and Related Work

Business Model research is an interdisciplinary research field, looking at the organizational structures, resources and their relations in a company and its environment. In general, it is settled as a mediator between the strategy and the operational layer (Al-Debei and Avison 2010), shown in the following figure. The BM thereby forms the link between corporate strategy and business processes through building a common communication platform.

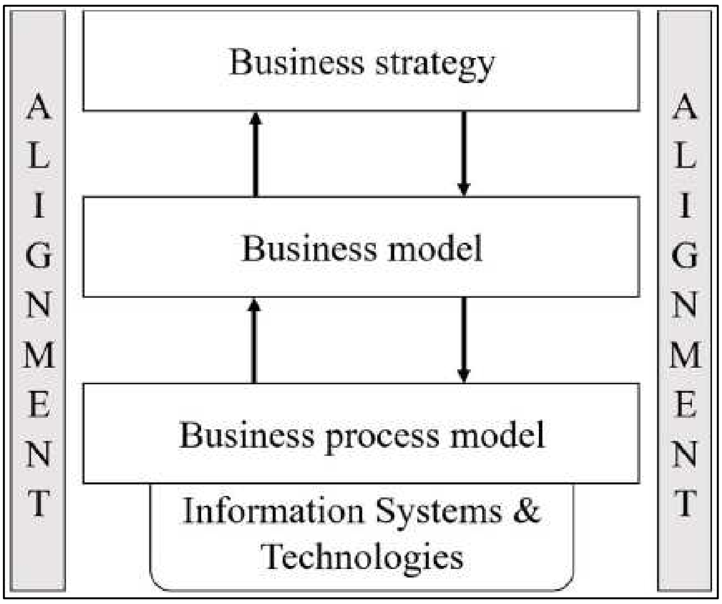

Figure 2: Business model environment (based on Al-Debei and Avison (2010, p. 371))

This alignment causes many important challenges when research is shifting from a more functional and operational towards a strategic view (Wirtz 2011). One challenge hereby is that these different views are strictly limited and only little research is done to overcome these borders. From the perspective of the strategy level, this raises the question, how BMs can be more operational, for example to function as a communication platform. It is important for executives that their strategy is broken down and understood by the operational layers, because lots of strategy decisions fail on the implementation. On the other side, the operational layer with its activities need to reflect the daily business practices. The question hereby is, how to use the operational data to give the executives a short but meaningful and objective overview of the situation? As a consequence, it is important to get a broad overview of the conceptualization and related work, done in the field of business modeling and also looking at the history of current BM research.

Therefore, the first sub-section provides an overview of the theory of BMs. Next, the history and development of the BM concept is shown in the second sub-section. The following sub-chapter then shows the practical use of BMs in organizations as well as the view on BMs as a management concept. Closely related to this is the next sub-section which gives an overview of the BM tools that exist today. Both sub-chapters influence the literature review in the following sub-sections: At first, an overview of the literature review is presented. Then provides an overview of the results, followed by the resulting impacts on BM research is provided and finally summarized. The purpose of this chapter is to provide a basic understanding of BMs in research and practice.

2.1. Conceptual Background

To describe the BM concept, an abstract and simplified view is not sufficient enough (Knyphausen-Aufseß and Meinhardt 2002). It is rather an integrated BM view, which is considering basis approaches next to a narrow approach of intersections between the terms “business” and “models”. The different schools of thoughts are as well combined as the different insights of BM research. Together, they build a holistic BM definition. To get an overview of the different BM views, this sub-chapter contains the following information, represented in the following figure.

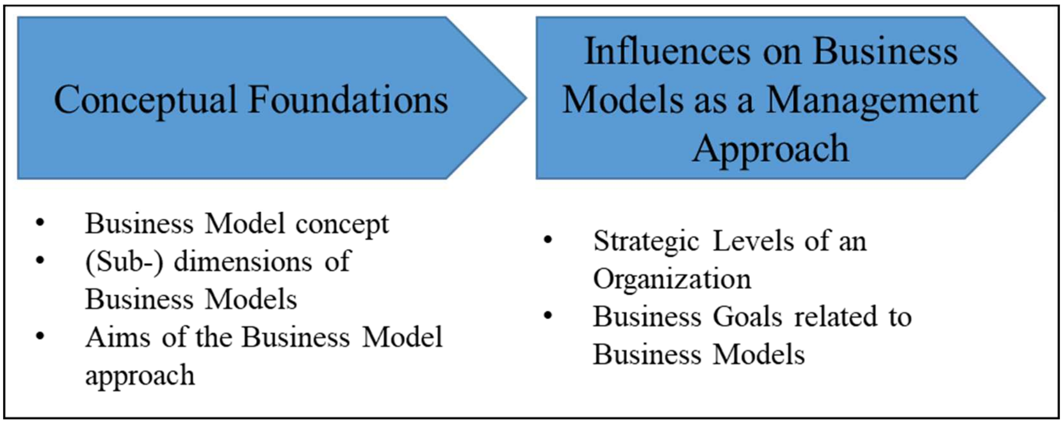

Figure 3: Important Factors of Business Model Theory

This sub-chapter should give important information related to the BM concept. It is important to understand the different views on BMs and the dimensions, included in the BM concepts.

As already mentioned, although BMs and their definitions can differ enormously, there are intersections, which nearly all BMs contains. These dimensions emerged in the beginning of the BM concept as a strategic approach and are developed further. As a result, four main dimensions with overall eleven sub dimensions exist, which are also considered in the BMC (Alt and Zimmermann 2001; Osterwalder and Pigneur 2010; Wirtz 2011). These main and sub dimensions are shown in the following (adapted from Hamel (2002)):

Product/Service: The Business Model builds the architecture for the products and/or services a company offers (Timmers 1998). These are the main contributions for the customer and essential for the value creation of a company. The company has thereby the chance to create superior customer value, e.g. through a low-cost product/service or through differentiation (Afuah and Tucci 2003).

Customer Interface: The heart of any BM are customers, because without them, no company can survive for long. The challenge of an organization is to demand the different needs of customers or customer groups. As a result, different sub-categories are important for the understanding of the value creation: The target customer, the customer relationship and the channels to serve the customer (Osterwalder and Pigneur 2010).

Infrastructure Management: The business model considers also important factors of the infrastructure of a company. Related to the value chain of Porter (2001b), this “is the set of activities which a firm performs, how it performs them, and when it performs them” (Afuah and Tucci 2003, pp. 3–4). This includes all important key resources, key activities and the key partnerships of an organization.

Financial Aspects: This is related to the performance of the different elements of the BM. As mentioned above, the set of activities of an organization is valued according “how it performs them” (Afuah 2004, p. 9). As a result, a BM is also the “description of the potential benefits for the various business actors; and a description of the sources of revenues” (Timmers 1998, p. 4). In special, this includes the revenue and pricing, the costs as well as the capital as three sub-characteristics.

Further Aspects of BMs: Depending on the level of the BM and the partial view of the value creation, also strategical aspects can play a major role as well as external conditions. Especially for BMs with a very abstract view on the value creation in relation to the whole industry, these aspects are important (Hedman and Kalling 2002).

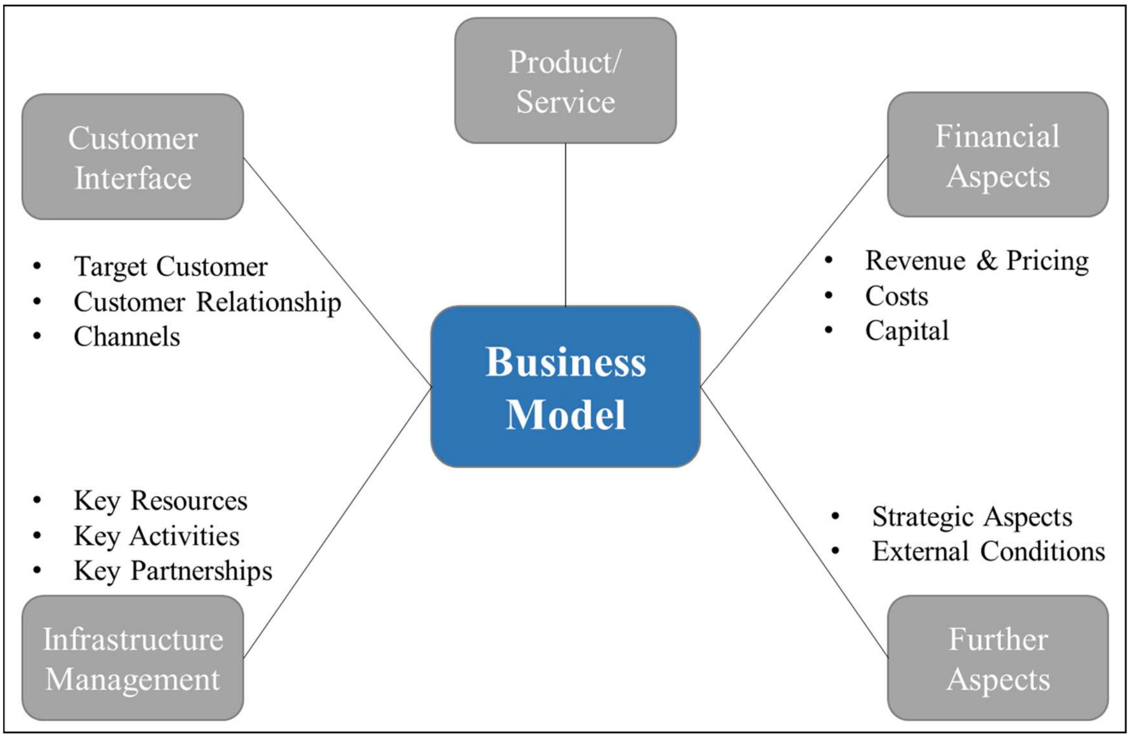

Figure 4: The four BM dimension and its eleven sub-dimensions (according to Hamel (2002))

As it can be seen, the four dimensions and the related sub dimensions shown in the figure above are strictly combined with several definitions of BMs of different researchers. Each researcher put a special focus on the BM and considers such a partial model as important model or fact for their research. Furthermore, one has to look at the goals and the history of a (partial) BM to understand its usage and meaning. Apart from the BM definition, existing approaches try to achieve a clear and transparent representation of how a company creates value (Kinder 2002; Akkermans and Gordijn 2003; Kley et al. 2011). In general, BM should enable a mediation between strategic and operational levels as shown above. However, they still have a very abstract and strategical view on the BM as mediator (Di Valentin et al. 2012; Osterwalder et al. 2005). Different types of flow in BMs are identified: Flow of goods, representing the way of products, ownership and risk; flow of information as well as flow of funds (Berman 1996; Rosenbloom 2012). If one considers partial BMs as part of a higher-level BM, these three types of flow between different partial models cause interaction relations of the model and represent its development (Magretta 2002; Wirtz 2011).

Regarding the BM dimensions, the categories “Key Activities” and “Key Resources” would build partial models, which have links between each other. This is because the resources are used in the activities or at least addresses the same questions of customer relationship and revenue streams (Osterwalder and Pigneur 2010). The intention in practice as well as in theory is to show the interaction of BM parts and the development of the whole BM. Consequently, changes in environment and the related development could be regarded better (Wirtz 2011). In general, not only steady BMs are regarded in BM theory, also BM changes are considered. After disruptive changes in a company’s environment (e.g. collapse of the “new economy” bubble) a BM innovation is necessary, as Chesbrough (2006), Zott and Amit (2007), Zott and Amit (2010), Johnson et al. (2008) and Gambardella and McGahan (2010) explored in their research. Their work provides approaches for BM innovation and adaption to new situations of companies. The implementation of BM innovation in a company should thereby be done in a structured management process (Johnson et al. 2008; Zott and Amit 2010). As design elements, they propose information about the flow of goods, information and funds and consider effects of activities in the innovation process (Zott and Amit 2007, 2010).

Next to this, it is important to know, that the level of BMs can differ. As a result, each level can have different demands on BMs. This is important for the understanding of the literature review in the following, which is using different BM levels as a base of categorization. However, it is important to understand the background between these different levels. This is closely related to the different demands within an organization and the environmental surrounding. After the breakdown of the New Economy, Afuah described four internal strategy levels and one external level (Afuah 2004) of an organization.

The lowest level is the **level of relationship** of an organization. Included herein is the network character of a BM. The BM itself as well as its elements are not separated, but linked with internal and external elements. As a result, this level investigates the relationship between these elements. Furthermore, the management of these relations and the resulting activities are in the focus. Hedman and Kalling (2002, p. 113) state that a BM is built of “causally related components”. They stress additionally the meaning of this view in dynamic changes of BMs, because BMs have to be seen as a network. Changing the network at one point can also have effect on the other elements (Osterwalder et al. 2005).

Next to this level, the **functional level** exists, which is related to the value chain of Porter (2001b) or at least of the different functional areas. In such a functional area, the strategic positioning of the value proposition is translated into a concrete table of actions. Strategic demands of the levels above are translated on this level into concrete actions. Here, as well, it can be seen that the BM is a series of activities that a company carries out at the individual levels (Afuah and Tucci 2003; Afuah 2004).

Above the functional level, the **business level** exists. In the focus of this level are the different BMs of a company. Thereby, a company can have more than one BM, because the company can for example fulfill the demands of more than one market. Each BM describes then the satisfaction of a customer demand in a specific market or of a specific customer segment (Stähler 2002). The goal is to increase the transparency of the management of the different BMs (Wirtz 1999; Osterwalder and Pigneur 2010).

The highest internal level is the **corporate level**. It defines the strategy how a company operates on the market. Thereby, overarching strategies for the business model(s) of a company are determined. Product or service differentiation as well as cost leadership are only some examples for these strategic decisions. Also the integration of the business processes is important to achieve a good interaction between the different possible BMs of a company. However, it is important to note that the whole value creation of a company is not only the sum of these BMs (Afuah 2004). All BMs have to stick to the overall goals and visions of the organization. This stresses also the need of BMs to function as the mediator of these strategic demands and the business process levels (Al-Debei et al. 2008).

Also important, but an external level is the **environmental level**. It results from the value constellation character of a BM. The environment of a BM is not always stable, but sometimes exposed to strong changes (e.g. Chesbrough (2006)). Hedman and Kalling (2002, p. 113) highlight hereby “the cognitive, cultural, learning and political constraints on purely rational changes”. Therefore, the environment of a company is also to be considered in order to decide on the right corporate strategy and to define the right set of value-added steps (Porter 2001b).

Related to these different strategy levels are also different goals of an organization, which are described as the demand of BMs. This is linked to the dimensions of BMs and the fact that BMs can fulfill more than one goal (Bieger et al. 2002). The overriding goal can be seen as ensuring the profitability and continued existence of the company. Regarding the BM as a mediator between the operational and strategic level, subordinate goals are existing. Related to this, the important goals for this thesis are characterized in the following figure. One has to add, that through different views and demands more and different goals can exist, too.

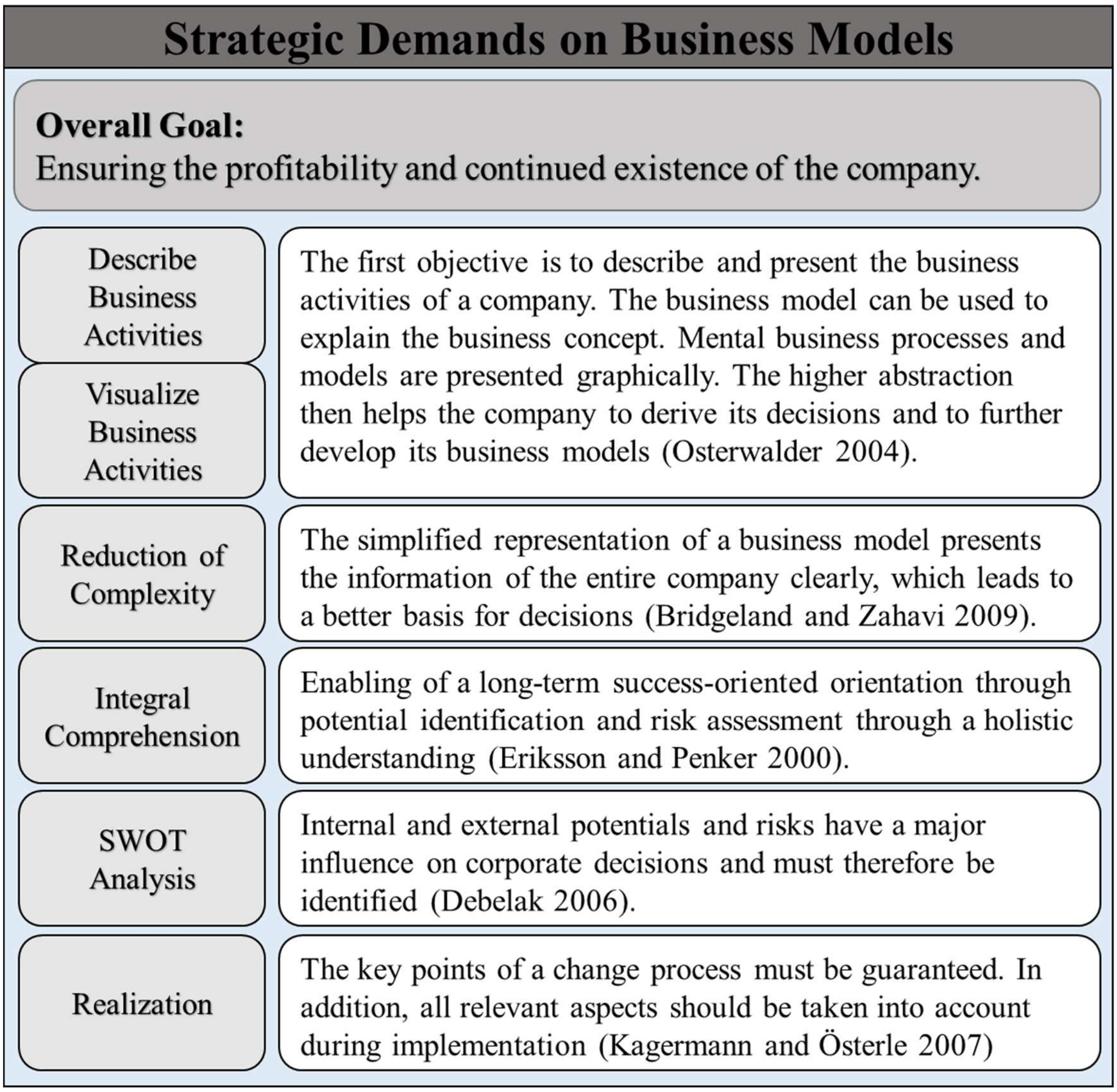

Figure 5: Strategic demands on BMs (according to Eriksson and Penker (2000), Osterwalder (2004), Debelak (2006), Kagermann and Österle (2007), Bridgeland and Zahavi (2009))

Next to these strategic goals, BM approaches can focus on different levels of an organization, which are also important for the literature review in the following. One main task of BMs is the description of all relevant aspects of the value creation and its proposition (Osterwalder and Pigneur 2010). Sometimes, the relevant aspects cannot be regarded directly on the company level and a more detailed view on a lower level is important. This unique selling point can lay in a specific business unit or even on the product or service level (Afuah and Tucci 2003). On the other side, it can make sense to regard the company in a more holistic view including the interactions between the external factors. In this case it is necessary to have a look at the industry level (Wirtz 2011, 2013b). As a result, the BM artifacts can be classified according to the different levels. The following table gives an overview of the criteria and the characteristics.

Level	Characteristic
Industry Level (Porter 2001b) (Afuah and Tucci 2003)	• Including external factors and environmental conditions • Strategic Management Aspects • Overview of the surroundings of the company, but also internal aspects
Company Level (Afuah 2004) (Wirtz 2011, 2013b)	• Excluding environmental conditions, but selected external factors (customers, suppliers) are included • Contains three essential factors: o Resources o Activities o Market Positioning
Business Unit Level (Afuah 2004)	• For large or complex companies, a look on business units makes more sense • Focus on the function of one or more business units and their value proposition
Product/Service Level (Wirtz 2011) (Ding et al. 2014)	• Direct focus on the offered product and/or service • Different segments of the value creation are regarded • The profitability of an organization can be viewed

Table 1: Business Model Levels and their Characteristics

Depending on the application context of the BM artifact, the appropriate level has to be selected. For a classification of the BM artifacts, also the objectives of the BMs are important. Bieger and Rüegg-Stürm (2002) describe eight dimensions of BM goals. They also mention that these dimensions are not strictly separated. So it is possible that a BM artifact is fulfilling more than one dimension. However, this also implies the challenge of various interpretations. This is because different use cases are thinkable, which leads to misunderstandings (Wirtz 2011). Nevertheless, Bieger and Rüegg-Stürm (2002) found similarities in the structure of BMs and were able to formulate eight dimensions of BM objectives, shown in the following table.

Business Model Objectives	
Organizational Concept	Competence Configuration
Cooperation Concept	Revenue Concept
Coordination Concept	Performance Concept
Concept of Growths	Communication Concept

Table 2: Business Model Objectives (according to Bieger and Rüegg-Stürm (2002))

These eight dimensions imply the objectives of the BM approaches. In addition to these eight dimensions, there are also other approaches existing (e.g. Osterwalder and Pigneur (2010)). In general, these approaches want either improve the configuration of the relations or of the single resources and competences (Bieger and Rüegg-Stürm 2002; Wirtz 2011). Also different activities or measures of BMs can be derived.

Existing BM research describe six procedural objectives, which should fulfill procedural objectives (e.g. Osterwalder (2004)). These objectives are shown in the following and are also used in the following literature review as classification criteria.

Activity	**Description**
Describing Business Activities (Osterwalder and Pigneur 2010)	• Concrete and full description of business activities • Especially focusing on the activities on company and lower levels • Mental processes and interactivities are described • Consolidation of information on management level

Visualize Business Activities (Wirtz 2013b) (Osterwalder and Pigneur 2013)	• Business activities can (but not necessarily need to) be visualized. • Support of the decision making process • Graphical representation possible
BM Realization (Kagermann and Österle 2007)	• For BM reconfiguration or after disruptive changes • Overview of relevant change process factors • Support implementation of the new BM
SWOT Analysis **(**Debelak 2006)	• Internal and external focus on potential of the organization • Representation of chances and risks as external factors • Internal factors are the strength and weaknesses
Supporting Holistic View (Eriksson and Penker 2000)	• Comprehensive overview of different decision making scenarios • Support potential identification
Reduce Complexity (Bridgeland and Zahavi 2009)	• Support of strategic management level • Abstract information necessary about: o Processes o Competences o Resources o Finance o Competition • Reduction of complexity through an aggregated view

Table 3: Activities of Business Models

Again, BMs can fulfill more than one of these BM activities. All these characterizations are closely related to BMs, even if some of them also can be used to categorize other approaches. In general, it makes sense to divide the degree of the tool according to its instantiation and the position on a scale between a theoretical construct and practical artifact type. This classification should show the degree of applicability. A construct is a more theoretical and abstract artifact, while of course a tool is very practical and well instantiated. In between are the models and the methods. A method is also practical and easy to implement, but not necessarily implemented yet. A model is between construct and method and rather theoretical oriented, but offers a good overview of the individual elements, which can then be formulated as a method and instantiated as a tool. Each paper can only be assigned to one instantiation. The following figure gives a short overview of the single terms and the degree of instantiation. One has to add that this figure reflects only an order of the terms, but does not give a detailed value of the degree for each term. As an example, a tool is not twice as practical instantiated than a method, it has only a higher degree of instantiation.

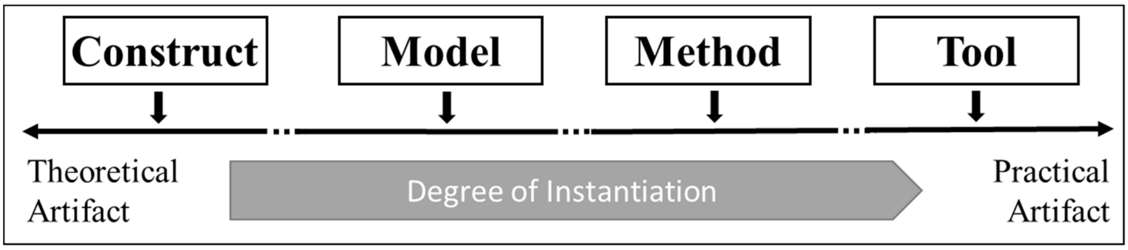

Figure 6: Degree of Instantiation of the BM Artifacts

To sum it up, the term “Business Model” is not easy to understand. A narrow view can hereby give a first but very abstract understanding of the term BM. However, only with a deeper focus on the various definitions of BMs and all influencing factors, one can get an understanding of the conceptual foundations. Closely related to the conceptual foundations of BMs is also the development of the BM construct, which is shown in the following sub-section.

2.2. Development of the BM Construct

Business Models have a long tradition as term in BM management theory, although the independent BM concept was preceded by a long conceptualization phase. BMs as management concept, especially with a strategic focus, needs knowledge of the origin of the BM term. For that, this sub-chapter will give an overview of the historical development of the BM concept and will then present three classifications of these BM concepts.

The development of the BM concept is often closely linked to the so called "New Economy" of the period between 1998 and 2001 (Wirtz 2013b). However, the term "Business Model" is much older and goes back to the year 1957 as a scientific concept (Osterwalder et al. 2005). However, the use of this term is very unspecific and there is no common research emphasis at that time. The real origin of the concept goes back to the 1970s and was mainly used in information technology research (Zollenkop 2006). As a result, the term "Business Model" was used till the 1990s mainly to describe a landscape of systems in an organization (Ghaziani and Ventresca 2005). This means that the origin of the BM concept was mainly differentiated from information modeling theory, which is focusing on the information flows in enterprises (Deelmann 2007). This is important, because the increasing interest in information technology in practice also pushed the BM concept in the first years of the 1990s. More and more research streams influenced thereby the BM concept. The break-through of the BM concept came with the establishing of the internet. Through that, the BM concept moved from describing the landscape of systems in an organization towards the focus to describe the whole organization. However, not only in practice, also in research "business modeling" was of growing interest. Since 1995, a strong growing number of publications in the area of BMs is observable (Wirtz 2011). Although the BM concept was used in practice and theory very often, no common BM definition was founded (Magretta 2002). With the demise of the New Economy at the end of 2000, the understanding of business models also changed. The significance of the business model changed from a universal term to one focusing on organizations. Two new concepts emerged: An organizational-theoretical approach (since 1995), focusing on building an organization and a strategic management approach to lead an organization (after 2000). The BM concept as strategic management approach was mainly focusing on strategic corporate structuring, business model innovation and value creation (Zollenkop 2006). In the early years, the focus of research was mainly on developing the theory of BMs with a strategic view. Around the year 2010, the use of BMs as strategic management concept emerged and with it artifacts that should support managers of strategic management (Osterwalder and Pigneur 2010). More and more decision makers understood that BMs can be a helpful tool to support strategic management decisions. Still today, the BM concept is very famous if one has a look at the number of new publications in this field. Although the BM concept has a long history, the role of BMs as a strategic management concept is quite young and still lots of research potential is existing (Ebel et al. 2016). Thereby, the single BM concept approaches are not just existing beneath each other. They furthermore influence each other and especially the history of BM as technology oriented approach characterizes the differentiated organizational and strategic approaches. Therefore, I will provide a closer look at the three approaches. In the following figure, the history of the three approaches is conflated.

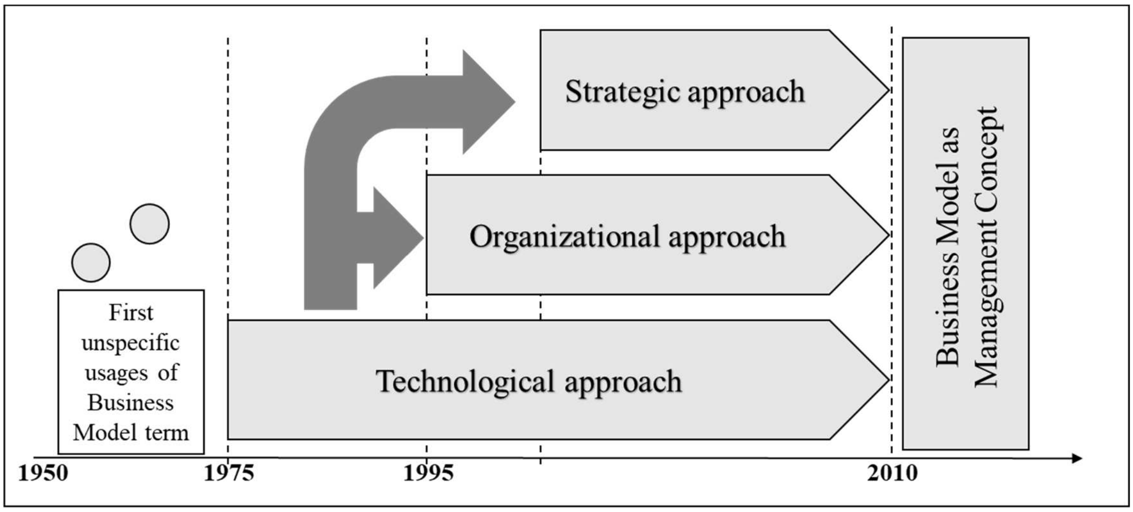

Figure 7: Overview of the history of the BM approaches (according to Wirtz (2011, p. 20))

Technological BM approach: This approach is mainly characterized through the modeling of the business especially in the electronic business. Not only the flow of data also cost reduction is a main task of this approach (Zollenkop 2006). Thereby, the view is strictly closed to the company with only some exceptions to the industry. As mentioned, this view also regards concepts of the electronic business. As a result, this approach targets to describe main aspects of the electronic business. Later and with the advent of the internet, the focus of this BM approach was extended to the technological aspects of presenting internet-based business models. With the modeling of the E-business, the technological BM approach describes an operative task of the system modeling and is heavily characterized through functional aspects (Zollenkop 2006). Through the changed market and competition conditions with the emerge of the E-business, traditional business concepts were not transferable to the internet. Thus the task of the BMs changed from the presentation of system-relevant aspects to the first steps of modeling the new business idea for e-business (Wirtz 2013b). The most important representatives of this approach are among others Timmers (1998), Hedman and Kalling (2002) as well as Afuah and Tucci (2003). From this point, the two mentioned new approaches emerged and coexisted next to the technological BM approach (Wirtz 2011).

Organizational BM approach: This is one of the two approaches, which emerged out of the technological approach. In contrast to the strategic approach, this approach emerged around the year 1990 before the clash of the New Economy. The focus of this approach is mainly on the different parts and aspects of an organization and the relations. This means a representation of the architecture of an organization and contains central elements like the design of the organization, the centralization of decisions as well as human resources planning (Al-Debei et al. 2008). The overall corporate design determines the size and type of composition of various units. In contrast, both horizontal and vertical shifts of responsibility will be investigated in decision centralization. In job planning, requirement profiles are defined for the corresponding roles in an organization (Wirtz 2011). In this context, a holistic corporate structure and a general understanding of learning are also defined. Finally, interaction paths as well as planning and control systems are fixed in the connection structures (Wirtz 2013b). The most important representatives of this organizational approach are among others Treacy and Wiersema (1997), Linder and Cantrell (2000) and Tikkanen et al. (2005).

Strategic BM approach: The youngest of the three approaches is the strategic approach, which emerged around the year 2000 (Wirtz 2013b). Chandler (1962) recognised at a very early stage that the concept of strategy is closely linked to the administrative structure of a company. In his work, he describes how strategic considerations are reflected in the corporate structure and thus links the strategic and organizational basic approach at a very early stage. Because of the close connection to the organizational approach this strategic approach emerged at nearly the same time like the organizational one. Nevertheless, the view differs from the pure organizational approach. Not only through a more general view and the focus on industry-wide aspects compared to a closed view of the company does the strategic approach seem to be suitable for a business model management concept by establishing a link between the business models and the strategy. The broad perspective of the approach also takes competition components into account. Innovations are also increasingly being addressed in this thematic area, which can also be seen as a basic approach (Hamel 2002). Furthermore, the value creation logic, the value generation by different actors as well as the meta core competencies within the dynamic capabilities of a company are essential factors of this strategic approach (Wirtz 2013b). The most important representatives of this strategic approach are next to others Hamel (2002), Magretta (2002) as well as Afuah (2004).

As it can be seen, over the last 70 years, different BM approaches emerged, which all have a special focus. The selection of one of this approach is depending on the field of application. For this work, the most important approach is the strategic BM approach, which is reflected for example in the Business Model Canvas. The next sub-section will then have a closer look on BMs in organizations.

2.3. Business Models in Organizations

Over the years, business models have evolved from showing small aspects of a business to an integrated management concept. The implementation of such a business model approach can lead to a company's success (Osterwalder and Pigneur 2010). Therefore, not only a strong growth of the business model concept can be seen in theory, but also increasingly in practice. One of the reasons for this is that a business model can raise entrepreneurial questions and challenges to an abstract level so that they can be dealt with quickly and easily. Thus, business models also become an integrated management approach for the achievement of corporate goals (Magretta 2002). However, business models are not just part of a company’s strategy configuration and need to fit into the other parts of an organizational system. BMs are furthermore a connector between different parts and cross-functional elements (Al-Debei and Avison 2010). An important factor for understanding these relations and the different elements, visual representations can help to increase comprehension. As a result, an overview of the visual representation of BMs in organizations is given in the following.

Visual Representation of Business Models

When considering the value generation of a company, also a concrete visualization is in the foreground. Some approaches are therefore developed in a way that they are easy to be filled out and understandable rapidly like the BMC (e.g. Osterwalder and Pigneur (2010)). However, also non-intuitive BM approaches are existing, which should give a very detailed view on the value creation and can be extended through other dimensions like business processes or environmental details (Lindgren and Rasmussen 2013). In general, key elements such as a superordinate corporate design, decision centralization or connecting structures can be represented, which is reminiscent of the functional roots of the business model approach (Al-Debei et al. 2008). During the development of BMs as a management tool (and before) a number of BM representations emerged, serving different purposes and domains in management's business modeling, like the "strategic business model ontology" (Samavi et al. 2009) or the "causal loop diagram" (Casadesus-Masanell and Ricart 2010). One reason for managers using such visual BM representations are the benefits for the organization like an enhanced understanding or as a common communication platform. This is because visual representations can help people from different backgrounds, like developers and managers to communicate about the same topic in a way that each participant understands the subject (Osterwalder et al. 2005). Akkermans and Gordijn (2003) argue additionally that such a common base of understanding of all stakeholders allows for an increased accuracy of the analysis of an organization's potential profitability and builds a base for requirement engineering. Regarding an organization not as static but as a dynamic system, a visual representation can also gain benefits. Through the visualization it is possible to "experiment" with the model and simulate different possibilities of future business models (Chesbrough 2010; Täuscher and Abdelkafi 2017).

Over time, the number of representations grows and scholars started to classify them along different criteria. For example Kundisch et al. (2012) proposed a holistic classification framework to structure these visual representations. Täuscher and Abdelkafi (2017) also present cognitive aspects for BM representations with limitations to organizations in dynamic changes. They found out that existing BM representations differ in the terms of the concept of the BM, the approach for representation of the BM as well as the notational elements and the terminology (Täuscher and Abdelkafi 2017). Exemplarily, some representations of (partial) BMs and the value creation are shown as an illustration in the following figure.

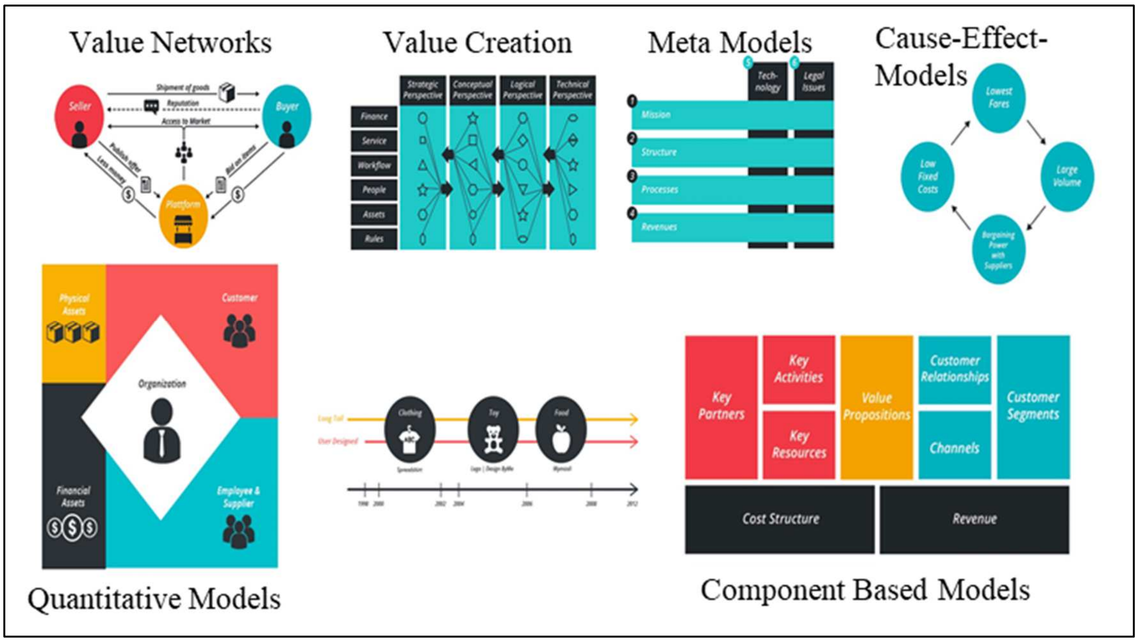

Figure 8: Examples of Business Model Representations (Beha et al. 2015)

Again, these representations have common elements in terms of the lenses through which these BMs can be viewed. The focus of a BM is always on an organization in relation to the degree of abstraction of the BM (e.g. industry, company or business unit level). Closely linked to this is also the single view on BMs. This means that BMs are viewed from a certain point, usually the focus of the organization or its partners (e.g. consulting) on the value creation of the organization in a kind of self-affirmation. This shows additionally that this view is very subjective and biased. This is not only a challenge from the top-down view, but also from a bottom-up view, which is still focusing on internal or organizational information and therefore looking through the lens of the organization. In general, the element view on the organization is enlarged through a causal and a transactional view (Täuscher and Abdelkafi 2017). This increases the scope of the business towards a more holistic view (Zollenkop 2006). On the one side, these common elements can be seen as a huge limitation of BMs, because the single view can mislead to a self-righteous acceptance that the business is running well. This is because filling out for example the BMC is based on the knowledge and the intention of the modeler (Osterwalder and Pigneur 2010). On the other hand, these abstractions and boundaries are important to get a quick and easy overview of the own value creation. This also describes the focus of BMs as a management tool and the included specific views. Using a BM as a management tool means, one has a common target to fulfill, which is described on a high level as the ensuring the profitability and thus the survival of a company in competition (Magretta 2002). Therefore, the BM approach and its representations focus on several aspects of this overall target. Already mentioned is the comprehensive view of the BM which should also support an integral understanding of the value creation of a company. Representing the aspects of the value creation and the different interactions and flows are essential for a good comprehension as well as a fast decision making for managers (Osterwalder and Pigneur 2010). One example is the representation of the value creation in the Business Model Canvas of Osterwalder and Pigneur (2010). Through this holistic comprehension, also advantages and disadvantages can be identified much faster, which leads to a better use of the potential of the organization (Linder and Cantrell 2000). On the other side, BM representations and approaches should be easy to understand and should focus more on the reduction of complexity (Bridgeland and Zahavi 2009). This should also support the fast understanding of the users and the suitability as a management tool. Thereby, a too high abstraction should be avoided. A focus on business activities can act as a suitable possibility to sharpen the senses of the managers for the operational level. A visualization that does justice to an appropriate degree of abstraction can also help here (Osterwalder and Pigneur 2013). Approaches, which see BMs not as a static approach but as a dynamic representation of the current state of an organization may include also the view of relevant factors for these dynamic changes. This should ensure a suitable adaption of the BM to the new environments (Kagermann and Österle 2007). Combined with the role of BMs in organizations, the following sub-chapter will have a look how exactly the BM functions as a management concept in organizations and what important work is existing so far in order to be able to increase the BM concept.

2.4. Business Models as a Management Concept

With the emerging of World Wide Web and its use in the mid of the 1990s, also the BM concept gets an increasing popularity in the range of management. Several authors now propose to use BM concepts for the management of a company (e.g. Osterwalder (2004)). In particular, the bursting of the dotcom bubble in 2000 motivated scientists to question why some of the companies were still successful and others failed (Burkhart et al. 2012). With the emerging information and communication technologies, also new BM configurations are thinkable. This multiplies the existing range and numbers of different BMs enormously (Timmers 1998; Osterwalder 2004). The existing BM concepts try to support a sharing of a common understanding of the value creation of a company and to further develop them (Osterwalder et al. 2005; Burkhart et al. 2011). As a result, through the emerge of many different BM concepts, also many different definitions for BMs arise. These definitions vary over time due to different points of view like in e-business, computer science, information systems as well as management (Timmers 1998). Although there is existing such a huge number of definitions for BMs, none of them results in a common description, of what a BM really is. This describes Porter as: "The definition of a business model is murky at best" (Porter 2001a, p. 73). As a result, several authors such as Gordijn et al. (2000), Petrovic et al. (2001) or Veit et al. (2014) introduce their own definitions of BMs. Due to this amount of definitions for BMs, I used the following definition, which seems to be most adequate for this thesis, as it shows the different flows of value creation and the dependencies in a BM. The definition of Timmers (1998) defines a BM as:

"An architecture for the product, service and information flows, including a description of the various business actors and their roles; and a description of the potential benefits for the various actors; and description of the sources of revenue".

To support the creation of BMs, research developed a rich pageant of modeling methods, representations and tools (Ebel et al. 2016). To represent BMs, scholars developed more than twenty BM frameworks with different purposes and in different fields of study (Lambert 2010; Wirtz 2011). As a common feature, all of these frameworks have six key decision areas (Morris et al. 2005) and 17 different evaluation criteria for the classification of the BMs (Burkhart et al. 2011). Besides these BM features, further aspects are existing and well investigated. Pateli and Giaglis (2004) defined eight sub-domains for BMs, which are still existing in current literature as research streams (see also Wirtz (2013b)). One sub-domain shows the "definition" of BM concepts and "the purpose, scope, and primary elements of a business model" (Pateli and Giaglis 2004, p. 306). The definition of the BM term additionally comprises a delineation of the BM concept from others such as strategy and business processes concepts (for example Timmers (1998) or Magretta (2002)). Alt and Zimmermann (2001) also proposed a component-based description of BM concepts. Another research stream deals with classifying BMs in taxonomies. Therefore, different criteria are specified such as customer relationship or the pricing policy with the aim to assign the BMs according to a typologies set (e.g. Veit et al. (2014)). The next sub-domain is “conceptual models” which are exploring the relations between the different components (e.g. Gordijn et al. (2000)). The fifth research stream considers “design methods and tools”. They are meant to support the BM development through the usage of methods, standards, languages and software (e.g. Mouratidis et al. (2011)). Another research stream in BM theory is focusing on “adoption factors”. These adoption factors have either a positive or a negative effect on the BM development. The factors are used as criteria for orientation and not for assessing BM success. This is in contrast to the research stream “evaluation models”. These models are used to evaluate BMs according to viability, feasibility and profitability. As a result, these evaluation models offer criteria for an ex post analysis, while the mentioned adoption factors provide criteria for an ex ante analysis. Additionally, Hamel (2002) defines several “questions to ask “ as criteria for an evaluation in his BM concept. The last sub-domain is focusing on the “change methodologies”. They take up the challenge of achieving a systematic procedure for changing existing BMs or selecting new ones e.g. to use innovative technologies (e.g. Linder and Cantrell (2000)). Osterwalder et al. (2005) confirm these eight sub-domains, as they present in their work the evolutionary development of the BM concept, which encompasses similar fields of research. Additionally, since 2012 and the increase of research in business modeling as management method, the research streams are more specified and lots of different BM concepts emerged.

The Business Model Canvas

Among these BM concepts, the most well-known representation approach is the “Business Model Canvas” (BMC) by Alexander Osterwalder (2004). The BMC serves two key purposes. First, the BMC structures a BM of a company in a standard and easy-to-use template along key dimensions such as key partners, activities, resources, value propositions, customer relationships, channels, customer segments, as well as cost structure and revenue streams. Included in the BMC is a value creation process, which is based on the Value Chain of Porter (2001b). The Value Chain is a linear approach and focused on single activities as well as potential advantages of the market. The following figure shows Porter’s Value Chain and the related primary and secondary activities.

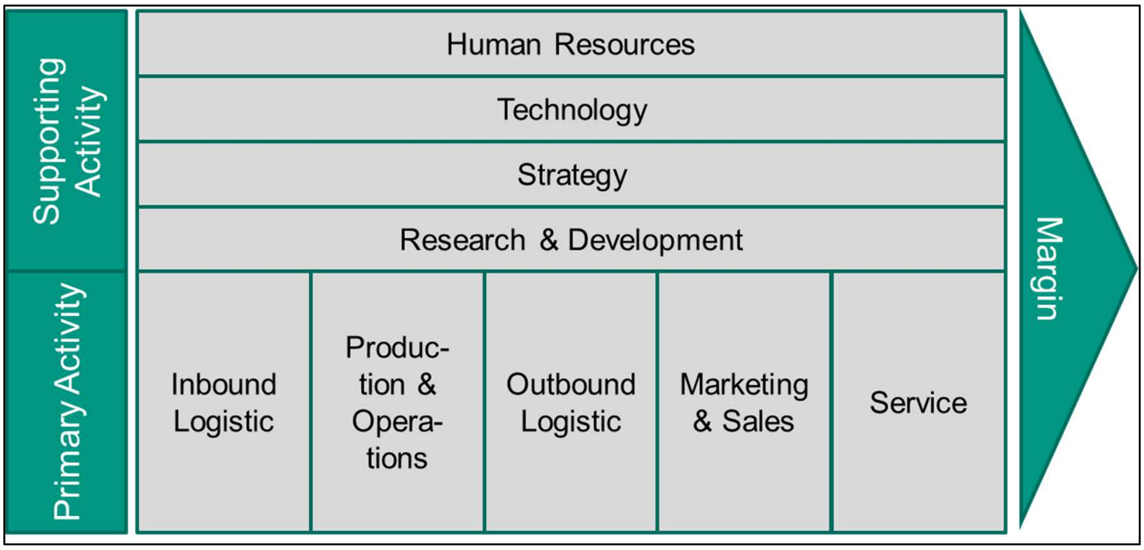

Figure 9: Porter's Value Chain (Porter 2001b)

In the approach of Porter (2001b), the Value Chain is divided into two groups of activities: “Primary” and “Secondary or Support Activities”. The primary activities show the process of generating revenue for a company. The figure shows these primary activities which are: “Inbound Logistics”, “Operations”, “Outbound Logistics”, “Marketing and Sales” and the fifth element “Service”. These elements are not arranged in an incidental way. Rather, the order is intended to reflect the natural value creation process of organizations (Wirtz 2011). These primary activities are completed through support activities, which are also called secondary activities. These support activities should reflect all activities that are necessary to carry out the primary activities (at least in the long term). Thereby, these secondary activities are not directly enlisted in the value creation process. However, they reflect a preservation of the primary activities and its elements as well as the whole value creation. As important factors of these support activities, the following elements can be named according to Porter (2001b): “Firm Infrastructure”, “Human Resource Management”, “Technology Development” as well as the “Procurement”. The Value Chain enables for example developing strategies for competitive advantages. On the one side, a competitive advantage can be created through costs. Following this strategy, a company tries to outperform other companies through a cost leadership. On the other side, a competitive advantage can also be created through differentiation. Thereby, the offered product and/or service differs from the competitors supply significantly and implies a suitable degree of a unique position. This is important to know, to understand that this Value Chain can function as a base for different BM concepts and development. Also the Business Model Canvas (Osterwalder and Pigneur 2010) is based on the Value Chain. Thereby, the influence of the Value Chain on BMs in general can be seen as very stringent (Müller-Stewens and Lechner 2005).

A central aspect of a company's value creation is the "value creation logic", which shows all important value creation processes (Zott et al. 2011). This concept of the value creation logic is based on the early findings of Normann and Ramirez (1993) in their work: "From Value Chain to Value Constellation". The focus here is on the orientation of a market offering that is created in a cross-company network (Normann and Ramirez 1993). This new approach with a value creation focus achieved great attention over the years and especially in the already mentioned "new economy" (Kagermann and Österle 2007). This value constellation approach has a specific view of the enterprise architectures to describe the value creation process in more detail in is therefore considered also in the BMC (Osterwalder and Pigneur 2010).

To support practitioners in using the BMC, Osterwalder and Pigneur (2010) provide a set of guideline questions for each field in the BMC. Therefore, another purpose of the BMC is to provide a moderation method for the process of representing the BM and to serve as a basis for discussion for practitioners. The following figure shows the mentioned BMC template and its different categories.

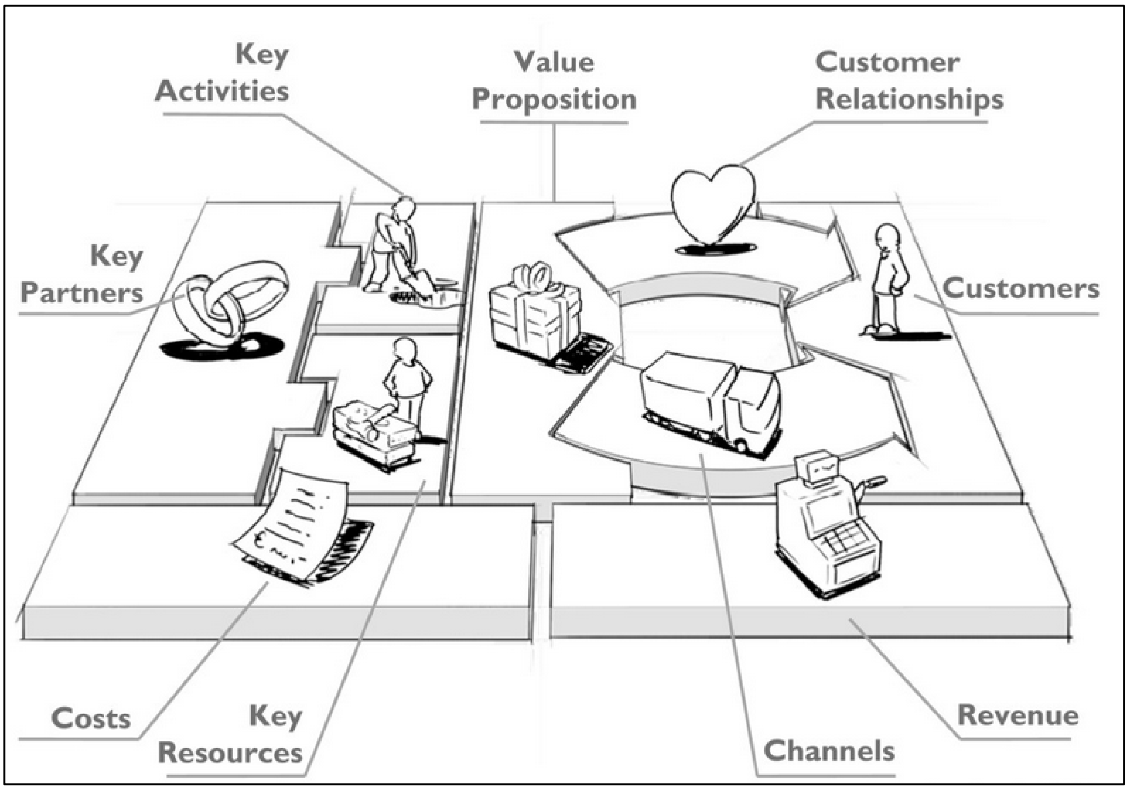

Figure 10: Business Model Canvas (Osterwalder and Pigneur 2010)

As it can be seen in the figure, the BMC contains nine different categories, which are described in the following. This description of the category is thereby based on the book of Osterwalder and Pigneur (2010) named "Business Model Generation":

- **Customer segments:** To demand the different specific needs of each type of customer, these types can be separated and clustered into groups by different attributes. Based on this, decisions on which groups of customer should be served (e.g. mass market vs. niche market) can be done.
- **Value proposition:** The creation of added value for the customer is the main objective of any company. In this category, the company's products and services are described. Thereby, value can have a quantitative (e.g. price, performance or risk) and qualitative view (e.g. customization, accessibility or usability).
- **Channels:** Channels connect the different customer segments with the value proposition. A channel defines, how on organization can reach a customer segment to provide a service or deliver a product. These channels can be internal in the company (e.g. website, retail store), external through a partner channel (e.g. wholesale distribution) or can be mixed depending on the customer segment.

- **Customer relationships:** For the different customer segments different kind of relationships make sense. These can vary between a personal assistance and other personal address or a self-service and highly automated impersonal service.
- **Revenue Streams:** They include the various pricing mechanisms. The aim is to discover that amount of money which different customer segments are willing to pay for the value the company offers (e.g. licensing, asset sale).
- **Key resources:** Important intellectual, physical, financial or human resources for the companies' value creation is shown in this category.
- **Key activities:** This is similar to the category "Key Resources". That activities are represented here (e.g. production, supply chain management, problem solving), which are of high importance for the value creation.
- **Key partnerships:** This can include competitors as well as non-competitors, but also joint-ventures or buyer-supplier relationships. Important for the identification of key partners are also their activities related to the organization.
- **Cost structure:** This category summarizes all (important) costs, which are important for the value creation and occur at one of the categories.

The introduction of Osterwalders ontology for BMs in Osterwalder (2004) and Osterwalder and Pigneur (2010) provided a widely accepted conceptual representation for BMs. As in the past the concept of the balanced scorecard was used for such long-term strategy implementations (Bourne et al. 2003; Norreklit 2000; Speckbacher et al. 2003), Osterwalder extends the four dimensions to nine dimensions in his BMC (Osterwalder 2004). He and other researchers also focus on ontologies to order relations between the BM elements (Osterwalder 2004; Osterwalder et al. 2005; Ilayperuma 2007). With his ontology, he prepares the way for a new way of business modeling, as his work is cited many hundreds of times (Lucassen et al. 2012). As a result of this success, researchers add further dimensions to transform the flat canvas to a multidimensional cube. Thus, the categories of the BM canvas are rearranged in a way that they reflect the interlinks and should inter alia support the management in implementing a strategy (Lindgren and Rasmussen, 2013). This reflects the logic how value is created more detailed but also with more modeling effort (Lindgren and Rasmussen 2013). However, these approaches are mainly top-down approaches, as they focus mainly on strategic dimensions and the view of the decision makers (Osterwalder and Pigneur 2010). They admit that these views are not always objective and operational data gains lots of information about how a company is really creating money. Therefore, a bottom-up view should also be included. New technologies and possibilities like business intelligence and data mining can extent the existing top-down approach of Osterwalder (Veit et al. 2014).

Business Model Analytics

Due to the growing amount of data, simple data analysis techniques and systems such as Manufacturing Execution Systems are reaching their limits. And the amount of data collected and stored is growing at a phenomenal rate. Individual industries, such as the financial sector, have already considered techniques for managing these huge amounts of data. However, these techniques are a mixture of statistical techniques and file management tools (Brachman et al. 1996). In the course of time, new generations of techniques and tools have evolved to cope with the gigantic amount of data (Tsai 2013). In the field of process modeling for example there are successful approaches and tools existing that make it possible to analyze the huge amounts of process data in order to derive new insights (Günther et al. 2008). For example, a process mining method can detect an error in the process flow. The analysis of data or data analytics is not a new scientific phenomenon, but is practiced in different areas of science and practice (Fayyad 1996). Thereby, data analytics can be seen as a kind of "knowledge discovery" in different databases and can be defined as "a variety of activities for making sense of data" (Brachman et al. 1996, p. 42).

In general, such a data analytic function can have different goals. For this thesis, two main goals are in the foreground: Discovery and verification (Bose and van der Aalst 2009). First of all, "verification" should help users to confirm their assumptions (Brachman et al. 1996). As an example, a user can assume, that "supplier A" is a key partner in a BM. The analytics system can confirm this by analyzing the related data. "Discovery" in contrast should not verify existing knowledge, but should create new knowledge for instance through finding new patterns (van der Aalst et al. 2004). Important thereby is, that an analytics model can also be descriptive in a way, that is supports the comprehension of users (Brachman et al. 1996). This is closely related to the aims of the thesis of an increased objectivity and comprehension. This means, that an analytics tool has influence on objectivity and comprehension both. Examples for such analytic methods are classifications or regressions, which can provide new information about the amount of data. In general, related tools can be distinguished between their level of specification and their functionality. Single-task tools are mainly specific and focus on one data mining process step in order to discover new knowledge (Brachman et al. 1996). Tools with multiple functions are often more generic and contain a wide range of data analytic functions. Visualization, data retrieval or clustering are only some examples for typical functions of these analytic tools (van der Aalst et al. 2004). These tools support more of the data analysis process and simplify embedding the discovered knowledge into an application that the business user can leverage. This is especially true for business modeling and related analytical functions as it can be seen in the following chapters.

As a result, it can be seen that BM research is very various and more and more research is done in this field, especially since the shift in 2010 towards a management concept (Wirtz 2011). Besides theoretical research and the investigation of definitions, also lots of research was done in designing BM tools and frameworks. An overview of this research will be given in the next sub-section. Afterwards, the literature review about the current findings and the gaps in the existing research of the last years will be presented.

2.5. Business Model Tools

In general, realizing a business model concept in a BM tool can for example support the development of enterprise applications or the evaluation and change of current business processes in organizations (Gordijn et al. 2000). Furthermore, it can also foster the communication between different departments like business and IT (Osterwalder et al. 2005). Through the increasing formalization of BMs and the ability of the BM concept to analyse the current value creation of a company, BM tools are becoming more and more in the focus of companies (Zott and Amit 2007). An active system thereby can easily determine the content, structure and governance of interactions of an organization. Therefore, BM methods and related tools are often used in management to understand and analyse the current way of the value creation of a company (Veit et al. 2014). Additionally, these concepts and tools are often used to support the strategical decision-making (Osterwalder et al. 2005). More and more academic publications are thereby focusing on the BM concept and the implementation in tools (Burkhart et al. 2012). However, there is still a huge gap in the implementation of the existing BM methods in concrete tools, as it will be shown in the following sub-section (see also Veit et al. (2014)). As a result, the most concepts consider mainly generic aspects and are in general hold very generic instead of demanding industry specific questions. Today, the BM concept defies strongly an easy conceptualization (Veit et al. 2014). As prerequisite for an adequate tool support of business modelling, a theory-based formalization and conceptualization is essential (Teece 2010). In the field of representing knowledge about the value creation in BMs, several approaches are existing: Informal text approaches e.g. from Kshetri (2007), structured text approaches e.g. from Sosna et al. (2010), morphological BM representations e.g. from Kley et al. (2011) or ad hoc graphical BM representations e.g. from Kinder (2002). Additionally, authors like Akkermans and Gordijn (2003) define conceptual models and represent a related semantic in a graphical representation, which they call BM representation. The advantage of such a morphological representation is that BMs can be represented consistent and traceable (Zott et al. 2011). As major topic in BM research, a diverse number of approaches is published (Kundisch et al. 2012). Thereby, different advantages like facilitating tasks, comprehension and communication of BMs are attributed (Osterwalder et al. 2005). Also BM Innovation (Chesbrough 2010) or requirements for supporting information systems belong to these developments (Eriksson and Penker 2000). In general, the existing BM representations differ immensely from each other and some of them even contradict another one. Through a further development of the existing BM representation approaches, the BM research can become more cumulative and theoretical BM results can be transferred more easily into practice which increased the success of business modeling in general (Veit et al. 2014). Besides this, also morphological representations are necessary to support a tool supported business modeling (Osterwalder et al. 2005). The current status of the available tools is limited to a narrow visualization and only provide rudimentary support for controlling the financial aspects of BMs (examples are the e3-value editor[1] and the Business Model Toolbox[2]). One exception is the “Business Model Wizard6”, which has

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[1] https://www.e3value.com/software/

[2] https://bmtoolbox.net/

the functionality to integrate market data and is so able to evaluate a BM and the related processes (Di Valentin et al. 2012). However, all tools only use basic and rudimentary functions, as mentioned above. Different tools can differ greatly. What they have in common are some similar elements (e.g. the six key decision areas (Morris et al. 2005) or the 17 evaluation criteria for classification of the BMs (Burkhart et al. 2011)). Also similar dimensions are existing, as Al-Debei and Avison (2010) describe:

(1) Value Propositions: It describes all offered products or/and services of an organization focusing on the customer groups (Osterwalder and Pigneur 2010).
(2) Value Architecture: This represents all core resources as well as capabilities to perform the necessary key activities to satisfy customer demands and offer all the products and services (Timmers 1998).
(3) Value Network: It shows all relations between company and key partners as well as stakeholders, represented in a network (Al-Debei and Avison 2010).
(4) Value Finance: Included are revenue streams, cost structures, as well as pricing methods of a company and the economic configuration (Timmers 1998).

Although they have common elements, more than twenty different BM frameworks focusing on a wide range of purposes for the usage and fields of studies (Lambert 2010). The situation changed with the introduction of ontology for BMs by Alexander Osterwalder (2004). Before this concept, mainly the balanced scorecard was used for long-term implementations of a company’s strategy (Norreklit 2000; Bourne et al. 2003; Speckbacher et al. 2003). Osterwalder used the balanced scorecard and extended its four dimensions through five more dimensions and developed the Business Model Canvas (Osterwalder and Pigneur 2010). Next to him, other researchers focused on ontologies with the goal to order the relations between the BM elements (Osterwalder et al. 2005; Ilayperuma 2007). However, the BMC was the most successful approach and represents a new way of business modelling, as Alexander Osterwalder is cited many hundred times (Lucassen et al. 2012). As a result, scientists are adding further dimensions to transform the flat canvas into a multidimensional cube. For example, the categories of the BMC will be rearranged to reflect the interlinks and, among other things, support management in implementing a strategy (Lindgren and Rasmussen, 2013). BM tools, which are using the cube approach are for example the “NEFFICS platform[3]” or the tool of “VDMBee[4]”. Both tools have a different view on the value creation of a company and include role collaborations, value proposition exchanges as well as activity networks. This implicitly represents the logic, how a company creates value much more detailed but on the cost for a higher modelling effort (Lindgren and Rasmussen 2013). The tool developers see herein the advantage to bring the BMs closer to the operational layer through the connection of different elements of the model. As mentioned, these are only two examples for BM tools. Next to these tools, other representations focalize on specific tasks and limit their view to this task level (Peters et al. 2015). These representations are usually only suitable for a certain task and therefore difficult to generalize. However, these extensions and improvements are at the expense of simplicity and transparency in contrast to the BMC approach (Osterwalder and Pigneur 2010). But as soon as more demands are placed on a business model than a quick overview, for example the design of a new business model, the BMC is no longer sufficient. Instead, other BM approaches are existing, which are very diverse. To characterize them, the integrated BM components (Wirtz 2013b) can help to categorize the different approaches. The components can be divided into three main categories as they are “strategic components”, “customer and market components” as well as “value creation components”. Next to these components, many business model tools provide a monitoring feature. Craig Barrow (1990) defined a set of guidelines for the implementation of such information systems. He focused thereby on the aggregation of data, which is highly relevant for monitoring key performance indicators (KPI) using enterprise resource planning (ERP) system data. One of the most popular researchers of monitoring is Stephen Few. In his work “Information Dashboard Design: The effective visual communication of data” he gives a comprehensive overview of dashboard systems (Few 2006). In this book included is not only the history of information dashboards, but also the characterization of different monitoring tools, their requirements and common mistakes for dashboard (tool) developments. This is also highly related to BM tools as some of them provide also some kind of monitoring dashboard, at least in a broad view (e.g. Lindgren and Rasmussen (2013)). These

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[3] http://neffics.eu/platform/

[4] https://vdmbee.com/work/value-management-platform/

features can be enlarged through the work of Eckerson (2011). With his research he covers the different aspects of dashboards and the possibility to use them to improve the performance of an organization. A special case of this use is the use in BMs. As a result, these principles build a guideline for designing BMs with monitoring features and are often used not only for BMs, but in general for designing dashboards. Smith describes in the paper “Data Dashboard as Evaluation and Research Communication Tool” the important purposes of designing dashboards as well as their use (Smith 2013). Additionally, she describes the developing process of information dashboards, including design requirements, the usability as well as display settings (Smith 2013).

Overall, the goal of the researchers is to monitor important information of a company. However, this important information does not always lie on the presentation plate. Often it is necessary to aggregate a huge amount of data to extract the important information. With focus on information systems, Kopetz (2011) provides a set of design principles with a focus on data aggregation. Also Few provided another research publication for data aggregation (Few 2013). In his work he additionally tutors visual design abilities that are necessary to develop a BM with monitoring features. Next to this, Salvadori (2009) gives an overview of the technical possibilities for an automated data analysis. In his description, such automated data analyzing processes are often related with an instrumentation and control. As a consequence, a data acquisition in a process control is normally accomplished through a close observation at the pertaining object or observation point (Salvadori et al. 2009). This reveals also the challenge of different levels for the data acquisition. Normally, the levels close to the BM layer are highly relevant. Sometimes it is also thinkable that even data on a very operative level (e.g. machine data if the machine is a key resource) is important. For such a data acquisition, Bahga and Madisetti (2012) describe in their work “Analysing massive machine-maintenance data in a computing cloud” key challenges for the implementation of a (BM) dashboard including machine data. Additionally, they provide several solutions and exemplary approaches for such an analysis of machine data. One year later, Spath looks next to others through the IT lens and analyzed the possibility for an IT integration into an industrial production (Spath 2013). Through the widespread and huge availability of technical infrastructure in the time of digitalization, lots of new possibilities for analyzing tools emerge for industry and research both. Related tools for this thesis are shown in the following figure. In the focus is the BMC, which is also used as a base for this thesis. The BMC is a further development of the value chain (Porter 2001b). The BMC itself is a base for further developments like the BM Cube (Lindgren and Rasmussen 2013). Next to concrete tool examples, also important functionalities are shown in the figure. For a more comprehensive overview about all tools, the following sections provide a tool categorization of current research approaches.

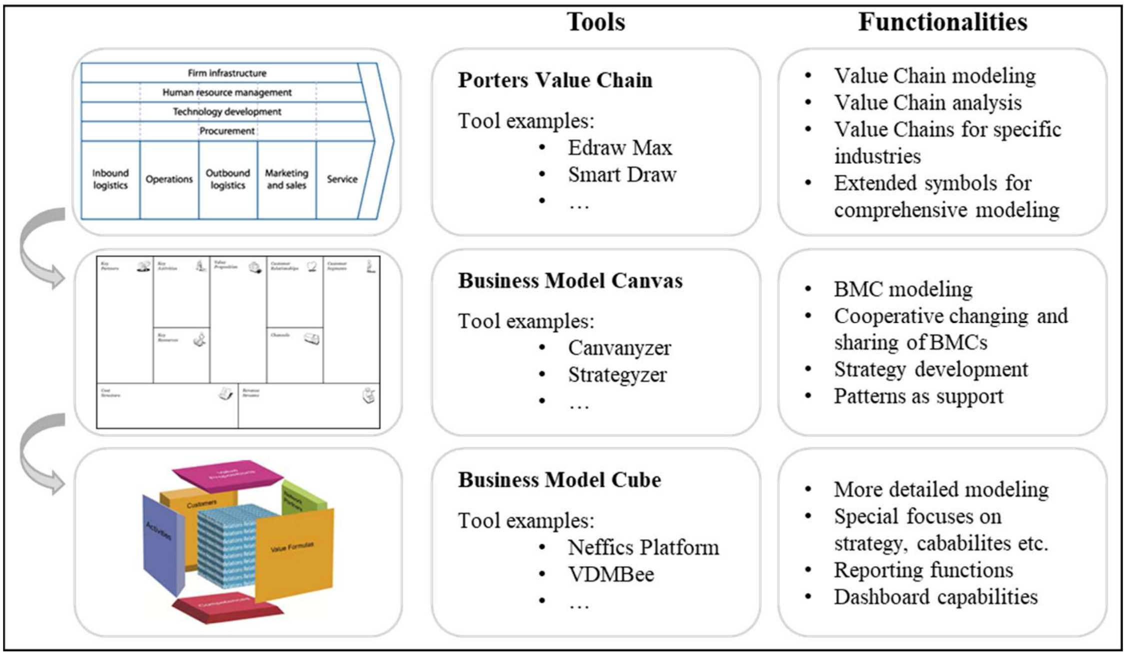


Figure 11: Business Model Canvas and related Tools (Porter 2001b; Osterwalder and Pigneur 2010; Lindgren and Rasmussen 2013)

All in all, one can see that not only research in business modeling is various, but also in the field of developing BM tools. Thereby, the research lenses are not divided equally, but are rather clustered at some specific topics. The advantages for this are that these specific topics are well researched and one can use lots of knowledge, resulting from these research areas to design for example an own BM tool. Thereby, the knowledge can not only be used for practical tools, but also build a strong theoretical knowledge base. On the other side, and this can be seen as great disadvantage, lots of fields are only rarely researched. For example Veit et al. (2014) as well as Ebel et al. (2016) show this lack of research in their taxonomy, which are made only some years ago. This lack is existing still today, as I will show in the following sub-chapter with another literature review about BM tools. As it can be seen there, still big gaps for research are existing and still the research is closely focused on some special topics. Through increasing globalization as well as rapid changing demands on the BMs of organizations, adapting BMs or creating new ones is essential for the survival of these companies. Especially, concerning current trends like digitization or trends of smart factories, the developed approaches are too limited or too far away of these current topics. So the BM tool and in general the BM lacks of connecting the operational with the strategical layer, as it will be one finding of the next sub-chapter. Developing as well as transforming a business model is very challenging for companies. As a consequence, the literature review will shed light into the topic of the state-of-the-art of BM research. This literature review will have a specific focus on the various types of BM artifacts. The following sub-chapter will present a comprehensive and systematic overview of the different BM artifacts and research findings including methods, constructs and models as well as the concrete instantiations. The results will then be used in this dissertation as a starting point next to insights from practice. Furthermore, these insights are used in a design science research approach to develop a business model tool. In general, the insights can also be used independently as an agenda for future research projects. The following sub-chapters will show, how this will help to strengthen the IS view in current business modeling as a theoretical contribution and builds a base for future tool developments as a practical insight.

2.6. Literature Review: State-of-the-art in BM Artifacts

The previous sub-chapters give an overview of the existing literature in business modeling and supporting tools. Combined with the chapter before, it gains a good overview of this topic. Nevertheless, the question was raised, what is the state of the art of current BM tools? This is important, because through fast changing environmental conditions and other external effects, companies are forced to adapt their BMs steadily to new situations (Chesbrough 2006; Teece 2010). This adaption is important, because it helps the companies to defend their current position in the market against other competing organizations. This is why the current findings of BM research and existing BM artifacts are moving more and more into focus of corporate decision-makers. The main focus is thereby the description of the value proposition of a company through BMs, as well as the related BM elements like key partners or customer groups and their relations (Zott et al. 2011). The already mentioned Business Model Canvas of

Osterwalder and Pigneur (2010) is only one example for a well-known BM artifact. It is not only used often as a paper-based possibility to describe a BM, but also instantiated completely or as a base for a concrete tool (Lindgren and Rasmussen 2013). Such artifacts in business modeling are therefore important, because the approaches of BMs themselves are described as “tool of alignment” (Al-Debei and Avison 2010, p. 374). They combine the different levels of an organization, which is important for example to implement strategic decisions on the lower and more operational company levels. Additionally, related literature emphasizes the importance of an artifact-centric BM research (Ebel et al. 2016). Lots of research is done in the past concerning the wide area of business modeling. If one runs a key word search in BM artifact-centric publications for example in the repository EbscoHost, it results in thousands of publications (e.g. 85.434 publications only for the key word “business model”).

However, currently no comprehensive overview is existing, which shows the different types of artifacts of the last years of research. Thereby, such an overview needs a concrete structure to value the different approaches. Hevner et al. distinguish between the terms “concept”, “method”, “model”, and “instantiation” (Hevner et al. 2004). Moreover, beyond the different types of artifacts, we do not know much about the specific intentions of artifacts, e.g. in relation to the specific BM objectives supported and the specific capabilities they contain. In this chapter, I want to shed light on the existing artifacts for business modeling. This should not only help to investigate the existing situation, but also lead to further research work as promising focal points of research. The IS research is at the beginning of an era in which BMs are becoming a focal topic. (Veit et al. 2014). Additionally, El Sawy and Pereira observed that IS research is shifting from the process focus and the design of IT artifacts towards a holistic BM research with BM artifacts (El Sawy and Pereira 2013). Therefore, I investigate the existing BM and value proposition methods and tools of the past six years with this literature review. This time period is limited to six years, because only during this time BMs are used as a strategical approach for managers to represent the value creation of a company (Wirtz 2011). Before that, BMs were only seen as a more functional or theoretical organizational approach (e.g. Afuah (2004)) and focused less on the demands of the strategic management. To shed light into this topic, I conduct a systematic literature review using the approach of Webster and Watson (2002). This approach is not only cited very often. It provides also an excellent structure for the execution of such a literature review. I answer thereby the leading question for this literature review:

"What is the state-of-the art in BM artifact research and how can BM artifacts be classified in a taxonomy?"

I see this systematic literature research as promising, as it has a wide focus on the state of the art, e.g. in the area of business models, and generally clearly informs the investigation of particular topics. In this review, I develop a search strategy and define a set of criteria for the selection of relevant scientific papers. Furthermore, I create a framework for the reporting and the analysis of the founded papers. In this review, I investigate the following aspects:

1. Existing knowledge about the BM artifacts.
2. Types of BM artifacts that are studied.
3. Classification of the BM artifacts.
4. Specific skills, the BM artifacts offer.

These aspects should not only enable an overview of current artifacts and the capabilities in the business model field. I want also to consider the different motivations for the importance of doing research in this field. Additionally, this should give some suitable connecting factors for future research projects. As a consequence, I use a step-wise approach regarding these aspects. First, I used the search terms: "business model OR value proposition model OR value constellation model" to find all relevant research with the focus on business models as a specified value proposition or directly value propositions as well as value constellation models. This is directly connected to the classification of BMs as a specification of value constellation models as shown above. For this review, I use the "EBSCO data base" because of the reason that it contains a large amount of highly cited papers. This includes also the leading IS journals (e.g. the AIS Senior Scholars' Basket of Eight) as well as conference proceedings of the IS discipline (e.g. the International Conference of Information Systems (ICIS) or the European Conference of Information Systems (ECIS)). Next to these large conferences and journals, also some niche journals are included. I decided for this, because it is likely that these niche papers contain relevant articles with a very specific focus on a challenge. It is thinkable that such a specific solution can be abstracted and is suitable for a wider range of challenges in business modeling. Some of these papers would not be submitted on a large conference for the reason of its highly specification, but on conferences with a clear and highly specified focus.

This first combination of search terms results in a huge amount of BM and value proposition literature in general. As a result, I have to reduce the huge number of papers through further key word combinations. As special focus of this review, I want to shed light especially in the area of BM artifacts. As a result, the search term “artifact” and the notation “artefact” make both sense. Next to these words, also “tools” and “software” are key words, which are promising to describe an implemented BM approach. Finally, I also think that the term “method” describes a possible approach in the field of business modeling, which is indeed not implemented, but builds a base for a possible BM artifact. As a result, I include the second search string part: “tool OR software OR artefact OR method OR artifact”.

This combination of search strings reduces the amount of papers increasingly. However, still a high number of possible papers is existing. For that, I defined a third part of search string, focusing on the strategic character of BMs since 2012. Before the year 2012, most of the BM approaches and the term itself had a very functional character (Timmers 1998; Afuah and Tucci 2003). They were mostly a theoretical-organizational concept (Linder and Cantrell 2000; Tikkanen et al. 2005), with less focus on supporting the management of a company to connect the strategy and the operation levels. Between 2010 and 2012, the importance of BMs as management tool with strategic focus rises. One example of a strategic management tool that was developed at this time is the BMC, which has already been introduced and is widely recognized in theory and practice as a suitable support tool for managers (Osterwalder and Pigneur 2013). Following this cognition, I added a third part to the search string. This includes the terms “strategy” as well as “management” as following search string part: “strategy OR management”.

As a consequence, these three string parts described above, should exclude all of the papers with less relevance to BM artifacts. Finally, the search string for the literature review is the following:

(business model OR value proposition model OR value constellation model)

AND (tool OR software OR artefact OR method OR artifact)

AND (strategy OR management)

Applying this search string in the EBSCOhost database leads to 8.218 articles. This seems to be quite a high number, but it still contains papers, which are not written in English and are published before 2012. As mentioned, the reference date “2012” is important, because before BM literature and related artifacts do not directly link to the strategic management approach (Wirtz 2013b). Furthermore, the conditions for companies changed, for example through the high increase of the amount of data and related challenges. As a result, the approaches might not be suitable enough for the current demands. Next to the language and the year, another exclusion criterion is that each paper is reviewed (which is the case e.g. in journals like in the basket of eight). As a consequence, I only look at peer-reviewed journals with available references in English language. Altogether, these principles should ensure that only papers are included, which guarantee a specific quality level. As a result, only 577 papers were left, which is still a high number. After reading the first papers, I found out that some papers are grounded on the business process level as they describe for instance in the title or abstract. This is, because business processes can also be considered in BMs, for example in the category “key activities” (Osterwalder and Pigneur 2010). So these papers refer their business process approaches to the BM level, because they want to have a holistic view. Though, this is not the view, I want to consider in this review. Therefore, I do a twostep hand sort method. As first step, I scan all paper titles and exclude that ones, which already reveal a process focus. Through this first step, I could already exclude around 300 papers. As second step, the remaining papers (around 250) are scanned according to their abstract. Only papers relevant to this literature review, in particular BM artifacts, are preserved. Through this exclusion, only 80 papers are left and have a relevance for the detailed investigation in the literature review. This can be seen in the following figure, as well as the overall exclusion process.

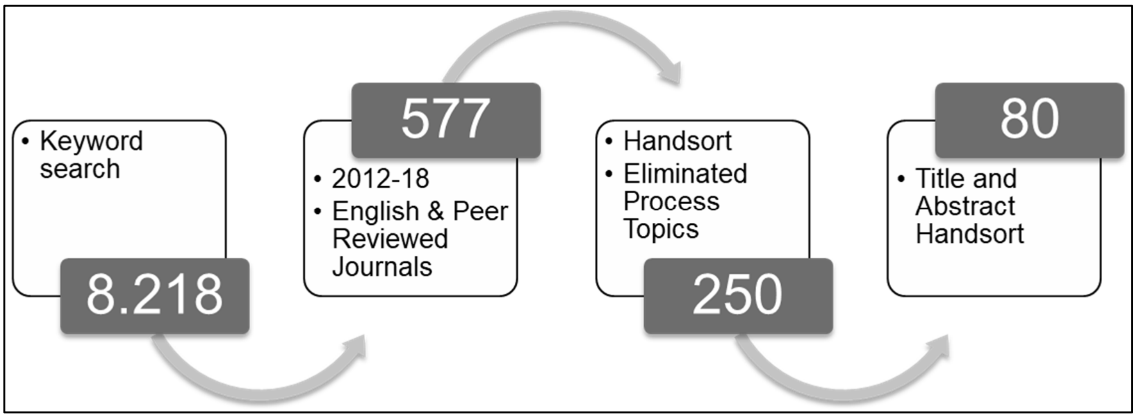


Figure 12: Overview of the Literature Review Process

These remaining papers are in the focus of this literature review. All papers are read completely. I then decide, if the paper contains suitable insights for BM artifacts as well as their capabilities and if they are included in the taxonomy. If it is the case, I rate them according to different types, levels, goals, measures and capabilities according to the approach of Nickerson et al. (2017). These different categorization features are described in the chapter before and build important classification categories for BMs (Wirtz 2013b). As a result of this step, I could include more than 40 artifacts as well as the related capabilities.

Since the purpose of this literature review is to categorize the existing BM artifacts and associated capabilities in relation to different dimensions, I perform existing classifications and derive additional skill requirements (according to Nickerson et al. (2017)). In particular, I use existing definitions for the different categorizations. For the "level of artifact" I use next to others Afuah and Tucci (2003) and for the business model related "goals" of the artifact, Bieger and Rüegg-Stürm (2002), which also provide the "measures and activities" a BM artifact fulfills. As there are no suitable categorizations for the BM artifact "capabilities", I followed a different approach according to Nickerson et al. (2017). Following his method, first one has to define requirements for the capabilities of the BM artifacts. These requirements should be on the one side suitable enough to describe the artifact as detailed as possible. On the other side, they should not be too specific, so that the approach is eloquent enough but is terminating. The result of this approach is a final taxonomy of possible BM artifact capabilities. Following this approach, I choose first five different papers randomly and extract all BM capabilities, described in the papers. The result is a first term classification of the BM capabilities, which is a base for the next iterations (according to Nickerson et al. (2017)). Using this base, I add the other papers step by step. Thereby, I compare the capabilities in the classification with the ones described in the single papers. If a capability is not in the list, I add it to the classification. This leads to the result that I get a classification list of all capabilities of the around 40 papers, which is also suitable to categorize future papers and their artifacts according these capabilities. The final classification list contains 13 terms, which abstract the artifact capabilities of the papers. 13 seem suitable, as they are not too much and too detailed, so that further paper can be categorized and the artifacts can be compared among each other. Furthermore, this number seems likely, as further work of other researchers shed light to the challenge that most of the artifacts only cover a small range of possible capabilities (e.g. Veit et al. (2014)). On the other side, 13 terms seem not to be too less, so that the list has not to be updated each time a new work is published, because the capability is not in the list yet. Important during the classification process is also that for example synonyms are detected and classified correctly. Consequently, I pay high attention to the comprehension of the different capabilities, their meaning and the definition in the papers. This is important, because there is a likelihood that two paper use disparate terms with the same meaning. As a result, I try to cluster these synonyms or terms with a similar meaning very carefully. So I ensure that I only cluster terms, which are really synonyms and describe the same capability. Additionally, I classified the terms according the common purposes “Modeling, Decision Support and Implementation Support” of BMs (see also Osterwalder and Pigneur (2010) and Wirtz (2011)) to get a better overview of the capabilities.

As I have already mentioned, I derive several dimensions for the artifacts of BMs, similar to other approaches like Ebel et al. (2016) and according to the process of Webster and Watson (2002). In the foundations chapter the dimensions are described. These dimensions are used afterwards in the next sub-section to categorize the papers and discuss the results.

Results of the Literature Review

In the following, the results of the classification are represented and discussed through morphological boxes. First I present the classification of the BM artifacts according the defined criteria, without focusing on the detailed capabilities. These capabilities are clustered in this first morphological box towards their overall aims: “Modeling – Decision Support – Implementation Support”. As mentioned, a paper can have capabilities of more than one category. After this first taxonomy, I present a second morphological box with more details to the single artifact capabilities, which I derive from the approach of Nickerson et al. (2017). This is because the description of the tool functionality is very broad and hardly to describe in general. This will be shown later. First, the following morphological box should give an overview of the BM artifacts.

Characteristics	Category			
Artifact Type	Construct 27%	Model 27%	Method 19%	Tool 27%
Level of Artifact	Industry Level 34%	Company Level 40%	B Unit 11%	Product 15%
BM Goals	Organizational Concept 27%	Coord. Concept 15%	Perform. Concept 15%	Others 43%
BM Activities/Measures	SWOT Analysis 31%	Holistic View 26%	Visualize Activities 19%	Others 24%
Artifact Capabilities	Modelling 46%	Decision Support 33%	Implement. Support 21%	

Table 4: Morphological Box of BM artifacts

The morphological box shows a nearly equal distribution across the type of artifacts. Only the type “method” has a lower number than the others. As described above, no metric statements are possible, but only ordinal scaled statements. This makes it possible for all artifacts to have a high degree of implementation with very little difference, even with an equal distribution. Nevertheless, it seems that only half of the over 40 papers really contain an artifact with a high implementation degree. Around 54 percent, representing the “constructs” and “models”, have a lower degree of instantiation. So even at this point of the taxonomy, one can say that there is a high potential for research to develop more tools, because the demand seems to be very high (see also Veit et al. (2014) and Ebel et al. (2016)).

In contrast to this, the level of artifacts shows a strong focus on the high company levels. The majority of the artifacts focus on the company level (40%) as for example the BMC does, too. On the second place, the industry level is (with 34%) strongly in the focus of the BM artifacts. As mentioned, in this view the company view is enlarged through external dimensions to get a holistic view. Only around one quarter is focusing on lower organizational levels. One reason for this can be that lover levels can be very specific and therefore hardly to generalize in a tool. It is also thinkable that these levels are covered through other tools and systems. For example, an ERP system can give adequately information on a product or service level, e.g. the number of sales. As these levels are not in the main focus of the strategic management, there is no need for abstraction of this information, because the managers of this levels are familiar with these numbers and may have their own consolidation methods. To sum it up, this can be a hint that successful BM tools should focus more on the higher levels, as the research interest lays here or at least the most papers are published there. On the other side, this may contain also a chance to develop an artifact on the lower levels to satisfy specific demands of users from this stage.

Looking at the fulfillment of the BM goals, again the numbers are equally distributed, except the organizational concept. Each fourth paper has the goal providing an artifact supporting or representing the organizational concept. Thereby and in contrast to the two previous exclusive criteria, to which an artifact may only be assigned to one characteristic, BM artifacts can have more than one objective. It is thinkable that distribution is guided through the demands they should fulfill. As the artifacts have also a strong practical motivation to satisfy the demands of the upper management, it seems that these are the most concerns of strategy of the past years. Again, this reflects also the challenges of globalization and digitization with their great organizational impacts.

Looking at BM activities, the SWOT analysis is the most integrated activity with the highest percentage (31%). This is followed by the goal of supporting a holistic view (26%) and visualize the BM activities (19%). The high percentage of the SWOT analysis can be described possibly with the level of the artifact on the one side. As many approaches focus on a high company level, the SWOT analysis (or related methods, which value internal and external factors) seems to be essential. One reason for this is that such SWOT analyzes are often used in higher management levels to get a fast overview of the strengths, weaknesses, opportunities and threats. This is also combined with the holistic view. Also the holistic view can be described through the fact that most of the artifacts are on a high company level, were such a holistic view is essential.

After all, artifact capabilities are again unevenly distributed, while more than one classification of an artifact to one capability is possible. Almost half of the articles focus on (business) modeling, while only a third focus on decision support and even less on implementation support. Modeling at the first stage means just the representation of the current value creation. This can be done graphical, but also other possibilities are used, like the Business Model Canvas. This BMC approach uses a table for the description of the value creation. It is noteworthy that only a third of the artifacts focus on decision support. As the mentioned challenges of globalization or digitization force companies to adapt their BMs, a decision support can give safety for the decision makers and can increase the likelihood of still being successful. Even less tools focus on the implementation support. A defined strategy is useless, if it is not fully and correctly implemented. An implementation support function in an artifact could help to implement such a strategy on operational levels. As it can be seen, current (answered) demands are mainly on the modeling focus and to a small degree in the decision support focus. This hardly contradicts existing literature and demands that warn against underestimating current challenges (e.g. Wirtz (2013b), Spath (2013) or Bauernhansl (2014)).

In summary, the taxonomy on the one hand shows an even distribution of research on the artifact type and the fulfillment of BM objectives. On the other hand, the artifact level and the activities as well as the artifact capabilities are not evenly distributed. This does not mean per se that there is a lack of research on the parts with a lower percentage. It may also be conceivable that these parts are less "important" to explore and that research should focus more on the other parts. However, in view of current trends and the faster changes in environments mentioned above as well as the corresponding adaptation of BMs (Chesbrough 2006; Teece 2010), there is a lack of research in at least some areas. The most diverse for this development of changing environments are artifact capabilities. Only a third and less than a quarter of the research focuses on decision support and implementation support, which should be the focus to challenge these trends. For BM activities, this means that BM implementation should be given greater focus, too. Only three papers have dealt with this topic so far. Last but not least, according to the demand of Veit et al. (2014) more artifacts have to be implemented in tools. These tools should help managers and in general decision makers to successfully adapt their BM to the new circumstances. This could be a response to the fact that the majority only use the BMC, which is good for representing the current BM of a company (Osterwalder and Pigneur 2010, 2013), but does neither provide a decision nor an implementation support. This can also be seen in the following morphological box, which shows the distribution for each skill.

Capability Class	Capability			
Modeling	Potential Identification 34%	Monitoring/ Visualization 24%	Analysis/ Validation 23%	Others 19%
Decision Support	Optimization 34%	Planning 32%	BM Innovation 18%	Risk Management 16%
Implementation Support	Factor Utilisation 42%	Implementation 32%	Change Management 13%	Simulation 13%

Table 5: Morphological Box of the Artifact Capabilities of Business Models

As the previous morphological box showed, the capabilities of BMs are not distributed equally. This morphological box shows more details about the capabilities. It can be seen again that even the single capabilities of each group are not divided equally. Looking at the first class "Modeling", most of the work concentrates on identifying and monitoring potential and on analysis. In terms of BM adaptation or innovation, these are good prerequisites for maintaining a company's status quo as a starting position. In this context, a good decision-making support would be in the search for the right strategy for BM adaptation. And the morphological boxes seem to support these trends: About one third concentrates either on optimization or on planning. Half of the rest is focused on BM innovation and risk management. These skills form a good base for BM adaptations. However, looking at the absolute figures, there are only 25 papers in 2012-2018, which are an artifact for decision support. Even fewer papers (16) focus on implementation support and of these only one third on the implementation process itself. Most papers look at factor utilization and only 13% focus on change management or simulation. So if one defines an adaptation or innovation process as: "Analysis of the status quo (modeling) - Define target state (decision support) - Transform current BM into target BM (implementation support)", the first process step is well researched and good artifacts exist. However, BM lacks the research to find a good strategy and the support of an artifact as well as the transformation to the goal.

However, the results of this study must be interpreted with some limitations in mind. First, I interpret the BM concept as a strategy or management concept (Wirtz 2013b). Therefore, I have set a time frame between 2012 and 2018. Of course, it is conceivable that there will be further work focusing on strategic management and thus also on artifacts. Nevertheless, I assume that the results on this limitation will be highly valid, as the vast majority of articles focusing on BMs will be published as a strategic management concept after 2012 (e.g. Ebel et al. (2016)). Secondly, the focus of this work was on BM artifacts. It is also conceivable that there may be other articles that offer a solution to these requirements without mentioning software, tools, artifacts or models. Third, the presented artifact capabilities are based exclusively on the articles of this taxonomy. Therefore, it is conceivable that additional capabilities are not covered by this taxonomy. As a result, there may be a need for capabilities that are not included in the taxonomy but are of high interest in theory and practice. Finally, a taxonomy is not perfect and has subjective insights (Nickerson et al. 2017). It can only be useful at best. Not every dimension of the taxonomy is relevant to every artifact and more than one categorization is suitable for some artifacts. Therefore, it offers only one direction in which future research can lead. All in all, the results have a great impact on current BM research, as it will be shown in the following section. This impact is not only reason for me, to develop an own BM artifact, focusing on the research gaps, it also can provide some paths for future research of the BM community.

Impacts on the Thesis Project

Business modeling is of huge interest by theory and practice both. Especially for the higher management levels of organizations, the BM concept is of great interest. However, this taxonomy shows similar to other studies (e.g. Ebel et al. (2016)) that there is still great potential for tool support. Of the many hundreds of papers I have looked at, only about 40 papers offer an artifact that supports management in business modeling. Maybe, more tools are existing in practice. However, this knowledge is not written down (and even not evaluated) so that research can build on it. Furthermore, the existing artifacts are mostly related to aspects of the status quo of a company. This is good for defining a starting position for BM adaptions. However, neither the transformation phase, nor the implementation phase is supported adequately, as this taxonomy shows. The question is, how companies want to master the growing globalization and other fast changing demands on BMs. BM research may provide therefore a huge potential and possibilities, but without providing suitable artifacts. It seems as the implementation of the knowledge is a task, which practice should fulfill. This approach seems to fail, because practice and the market seem to be at the threshold of disruptive changes (Spath 2013; Bauernhansl 2014). BMs and related artifacts can be a key for these challenges. All relevant questions can be answered on an abstract level using the BM concept. This means that BMs artifacts can provide a structured management tool for decision makers to achieve the aims of the organization (Magretta 2002). Key for success is thereby the focus on a sustainable business modeling. This includes a diversification of the supply, enforcing of changes as well as the realization of innovations (Wirtz 2013b). Base for this is the focus on relevant information through an adequate abstraction. This means also that a high quality of information is necessary. Through this information, it is possible to support and to better understand a transformation. This information can provide insights for the status quo of a company. Furthermore, it can help to define a suitable target state for the organization, as well as a supervision of the overall transformation process. This gains the possibility for companies to attract new customers or change the current production of services (Magretta 2002). Such changes on existing BMs are an essential part of BM management and it helps to keep the market position and answers the fast changing demands (Linder and Cantrell 2000). It is truth that nearly each company is (occasional heavily) adapting the BM to pay attention to technological changes or customer demands (Wirtz 2011). Thereby, the following factors play a huge role: “Sustainability”, “Factors of Success”, “Strategy Development”, “Adoption”, “Strategy Realization” and the “Continuity between the different company levels” (Linder and Cantrell 2000; Magretta 2002; Wirtz 2011; Osterwalder and Pigneur 2013). But how are these requirements met with current BM artifacts? The literature review as well as related papers (e.g. Ebel et al. (2016)) show that only some of this factors are met, as it can be seen in the following figure. With the current approaches, it is possible to keep a sustainable focus on the current value creation and to identify existing BM potentials because the majority of the papers have a holistic view and are on an abstract level. However, they fail on strategy development, realization and adoption as they only can provide a status quo of a company, but do not help in decision making or implementing the defined strategy. As mentioned various times, this is essential for managers today, as they have to pass great challenges (Spath 2013). Good news is that existing approaches support the continuity between the different levels to a certain, but high degree. Decisive for that is the holistic view as well as that artifacts that are more on the business unit or product and service level.

The result of this literature review shows essential point for my research. Although the adoption of BMs as well as to strategy related tasks as the implementation are of great interest of the management (Spath 2013), existing artifacts are focusing mainly on the visualization and validation of BMs. Great strengths of the current approach are in potential identification, which is essential for an adequate strategy definition. What is missing are features and capabilities, which support the decision making and the implementation. Additionally, not only for BM research, it is important that the right information with a high quality is identified and used (Wirtz 2013b). With my research I would like to close these gaps by developing a business model analysis tool. How I will do this is described in the following chapter. In the next sub-section, I will give a conclusion about the related work, the literature review and the resulting challenges.

2.7. Summary

As mentioned, the BM concept is very powerful and can be used as mediator between different company levels (Al-Debei and Avison 2010). Therefore, it is important to understand all influencing factors, backgrounds and foundations of BMs to use them in a proper way. As different definitions of BMs are existing (e.g. Timmers (1998), Tikkanen et al. (2005) or Osterwalder and Pigneur (2010)), BMs can be used in a wide range of challenges of an organization. For such a use it is important to understand the theoretical background behind the concept. Therefore, the different theoretical views and dimensions, which are influencing BMs, were described in the first sub-chapter as well as the different BM schools and the business goals. As it is important to understand the development of the BM construct and its origin, the second sub-chapter showed this development over time and the different functions BMs had. This was continued by the meaning of BMs for organizations. Not only in theory, also in practice BMs have great impact and are often used as a strategic management concept (Osterwalder and Pigneur 2010). The overall goal of these BMs is to secure the profitability of an organization.

In general, the BM concept is very powerful especially as a management tool (Magretta 2002). Especially, the Business Model Canvas of Osterwalder and Pigneur (2010) became very famous for such a management tool in theory and practice both. Many further developments are based on this approach and it is often used because of its degree of abstraction and fast modeling process (Lindgren and Rasmussen 2013). Also some practical tools are using this approach. However, BM research is not as far as it could be, at least concerning the development of BM tools (Veit et al. 2014). Several gaps exist for future research like the improvement and further development of existing BM artifact approaches to business modeling. Next to this and because there is little work to support decision-making and implementation: Development of artifacts and in particular tools from existing research to support decision-making and implementation. In summary, there is great potential in the field of BM artifacts (Ebel et al. 2016) and both practice and theory will benefit from the realization of existing and new knowledge in this field. In summary, suitable BM concepts and tools have to be found, so that organizations can master new demands. This thesis focus on an improvement on the BMC through a design science research approach. In the following chapter, I will give an overview of this design science research project.

3. Methodology

Increasing users’ comprehension and objectivity of BMs requires several aspects as described in the previous sections. Looking at the many facets of BMs, not only technical aspects are important, also the user is in the foreground. Due to that, the research approach “Design Science Research (DSR)”, which is often used in IS research is appropriate to find suitable requirements and design principles for a BM analytics tool. The following chapter will provide an overview of Design Science Research in field of IS research. Following to this, the concrete DSR project of this thesis will be presented. Thereby included are the three DSR cycles. Finally, this chapter concludes with a summary.

3.1. Design Science Research in IS

Looking at Design Science Research as a research method, its’ origins emerged in the early 1990s and still great interest in this research approach is existing (Peffers et al. 2007). During this time Herbert Simon excelled as the intellectual DSR pioneer (e.g. Walls et al. (1992), Gregor and Jones (2007)). In his work, Simon (1996) proposed the alignment of design science to consider and determine “how a thing should be”, which is in contrast to the alignment of natural science, which is researching, “how a thing is”. This approach of natural science is still suitable for research disciplines like physics or social studies. This orientation is based on the aim to discover and explain a phenomenon (e.g. gravity) and the related influencing factors (March and Smith 1995). In contrast to this, DSR has the focus on the development of an artifact. Having the roots in engineering, one can say that the DSR constructs such an artifact (Iivari 2007). In contrast to the approach of natural science, DSR aims to solve a problem and does not have the claim to understand or to describe it (Hevner et al. 2004). Furthermore, DSR is using a cyclical approach (Vaishnavi and Kuechler 2015). This can also be seen as engineering, since the PDCA (plan-do-check-act) or Deming cycle functions similarly in principle and is widely used in practice today (Deming 1982). In his work a continuous improvement process for the quality management is described. This can be seen similar to the DSR approach. The DSR approach aims not only to produce knowledge about tasks and providing suitable artifacts. The goal of DSR is also to evaluate the artifact and improve it (March and Smith 1995; Vaishnavi and Kuechler 2015). Proportional to the interest of the IS research community, the DSR approach was changed several times. For example Nunamaker et al. (1990) propose a process with five stages: In the first stage, the researcher should create a concept for the planned system. As step two, the architecture of the system should be constructed. Stage three proposes the analyzing and the prototyping, closely connected to stage four: Building the desired system. As last step, the evaluation of the system is in the foreground. These steps are closely related to each other and should be performed in an iterative process (Nunamaker et al. 1990).

As already mentioned, the claim of DSR is not (only) to precisely determine and explain a certain phenomenon. At the same time the resulting design theories of an DSR project are of a predictive nature (Gregor and Jones 2007). This is because they provide recommendations for creating a feasible and effective design process (Walls et al. 1992). Furthermore, a DSR project can provide innovations at many different contribution levels for practice as well as for the research association. This is also recognized by Gregor and Hevner (2013). As a result, they developed a framework for DSR knowledge contributions. Along the innovativeness they decide between four stages: An (1) *invention* is providing a new solution for a new problem. (2) *Improvements* are providing a new solution for a confessed problem. An (3) *exaptation* is the other way round and is adapting a known solution on new problems. Last and with lowest innovativeness is a (4) *routine design* providing a solution for a confessed problem, which is already known. As it can be seen, the four stages are arranged according to their innovativeness. Naturally, inventions have the highest likelyhood to extend the existing knowledge through related results. In contrast to this, a routine design does not provide that much amount of new knowledge and should therefore be avoided (Gregor and Hevner 2013).

Next to this level of contribution, also different components of a design theory should be considered. Walls et al. (1992) already defined in the early years of DSR a set of components, if a researcher wants to deliver a theory as an outcome of the DSR project. If ones defines a target class to which a design theory is applying to it is called “meta-requirement”. One talks of a “meta design” if an artifact class is fulfilling these meta requirements. Next to this, “kernel theories” can help for defining the problem.

And last, a set of “testable hypotheses” of the design theory can be proofed through a suitable evaluation (Walls et al. 1992). The following figure will show again the different steps and components of a DSR project.

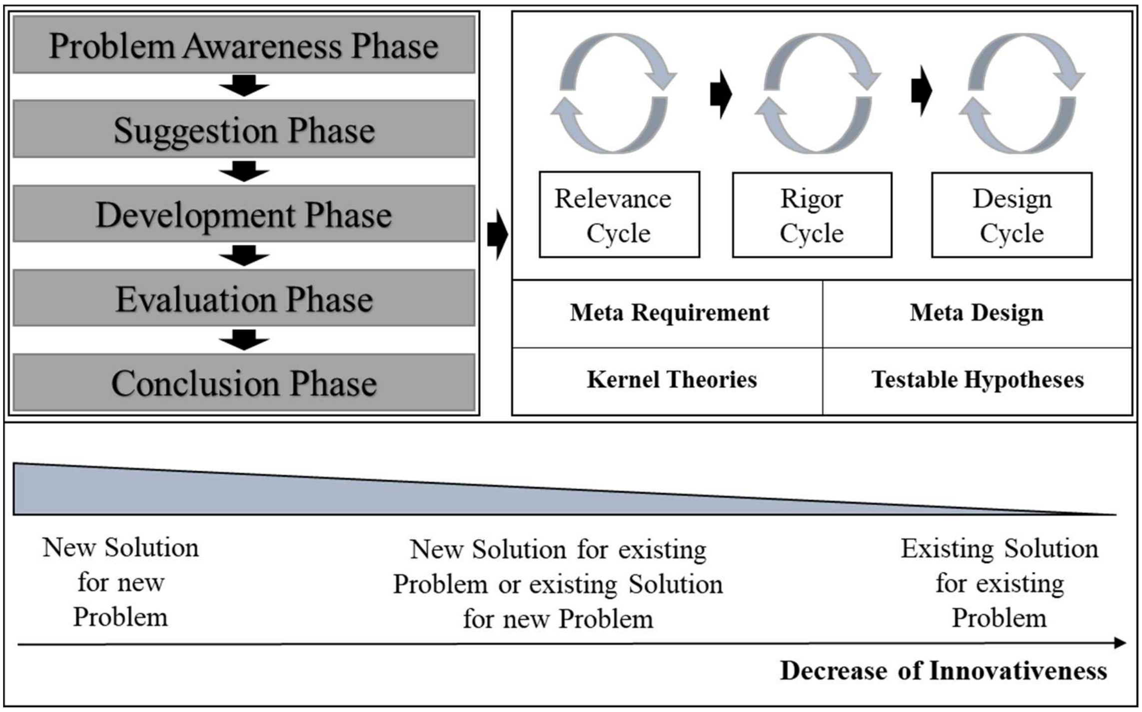


Figure 13: Steps and Components of a DSR Project (according to Walls et al. (1992), Hevner (2007), Gregor and Hevner (2013) and Vaishnavi and Kuechler (2015))

One aspect of the DSR project is the already mentioned evaluation of the hypotheses. This is important for proofing a certain DSR theory or a specific design principle in order to differentiate suitable contributions for the academic community (Walls et al. 1992). For example Vaishnavi and Kuechler (2015) provide an evaluation step in each full DSR cycle, which will proof the results of the research. Venable et al. (2016) provide therefore an enlargement for the evaluation in the DSR process through four steps. Next to other advantages, these steps can provide a lot of information at an early stage of the project. These evaluation steps do not need to be followed one by one at all time. Sometimes some of the evaluation steps can be done together as an “evaluation package”, as it is meant for example in the method of Vaishnavi and Kuechler (2004) or other researchers. The following “Framework for Evaluation in Design Science Research” shows the important questions one has to evaluate during a DSR project.

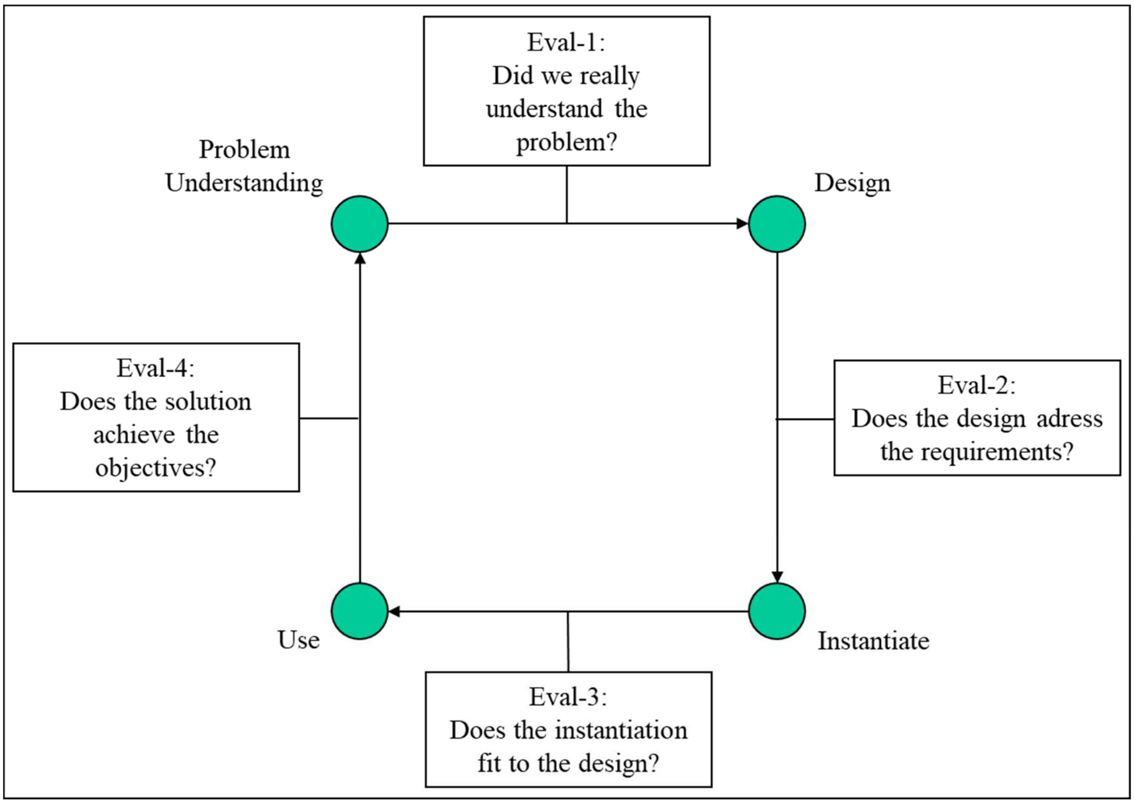


Figure 14: Framework for Evaluation in Design Science Research (Venable et al. 2016)

Like other methods, design science research has some limitations. First of all, one limitation is the artifacts quality, resulting of the project. Of course, a professional who has done software development many years before is better able to define software that meets a user's needs. As a result, a software designer would always be able to design a software in a higher quality than a researcher given a limited space of time and even limited capital. This is also true, although a researcher is using methods to collect demands of individuals for such a software and a good usability. As a result, the designed artifacts of a DSR project is always a kind of prototype, which should be also considered in the evaluation (Hevner and Chatterjee 2010). One solution to this is the evaluation of the artifact through a technical experiment. In a synthetic environment, one can measure the artifact performance (Peffers et al. 2012). Remarkable is that only 10 of 148 studies evaluated such an artifact in a real-world experiment to show the suitability of the artifact to the demands (Peffers et al. 2012). This challenge is seen as an imbalance of relevance, as for example Sein et al. (2011) notice. They see DSR mainly as a method, which is strongly focusing on the artifact building and less focusing on the evaluation. As a result, they demand an increasing degree of sensitivity for the interactions with organizational context and the needs of employees (Sein et al. 2011).

Furthermore, DSR has a special view on projects, which limits it to other usages. Most of the DSR artifacts were evaluated mainly against the criteria of utility or value, but not against the utility from the view of the employees, which will use the system in the future (Järvinen 2007). Additionally, DSR mainly produces design knowledge and is initiated by the interest of researchers to find technical rules for a certain problem. So, DSR can be seen more as a solution to construction or performance improvement problems (Järvinen 2007). This means that DSR is not generally usable. For challenges like producing knowledge to guide an organization how to modify a system, other approaches seem to be more suitable (Järvinen 2007). Nevertheless, for the right usage, the DSR approach seems to be very suitable. In order to design a BM Analyzer tool, such an DSR approach fits perfectly to the characteristics and the challenges like evaluating the artifact in practice will be mastered too. How I will do this in detail in this work is shown in the following sub-chapter.

3.2. The Design Science Research Project

As the goal is to design a BM Analytics tool, I apply a DSR approach, as described above. I followed the DSR approach of Vaishnavi and Kuechler (2015). Deriving the principles for such a tool is not a stringent approach following a concrete table of actions. It is furthermore a process with many uncertainties. The DSR approach provides therefore a concrete procedure to perform a project with such uncertainties and has different advantages (Järvinen 2007). First of all, the tool can be evaluated against its value, which means that it really generates a benefit for the users in terms of objectivity and understandability. Second, a DSR project increases design knowledge in form of a concrete mining method and several design constructs for a BM Analyzer tool. Third, it solves an innovation problem and improves the performance of existing BM solutions, as the results will show. And finally, new knowledge is generated and evaluated through the project. Furthermore, this knowledge is directly used in the different cycles of the project.

In general, this DSR project consist of three cycles. This is because each cycle is based on the “knowledge” and experiences of the previous cycle. This means, that a learning mechanism is included in the whole project. As a result, one cycle would not be enough (Vaishnavi and Kuechler 2015). On the other hand, a higher amount of cycles does not guarantee a significant improvement of the results. Concerning this and the limited time of a PhD project, I decided for three DSR cycles. Each cycle contains four stages, except the last cycle, which also has a conclusion stage, according to the description of Vaishnavi and Kuechler (2015). In an earlier work (Vaishnavi and Kuechler 2004), they already described these general steps of a DSR project, which is shown in the following figure.

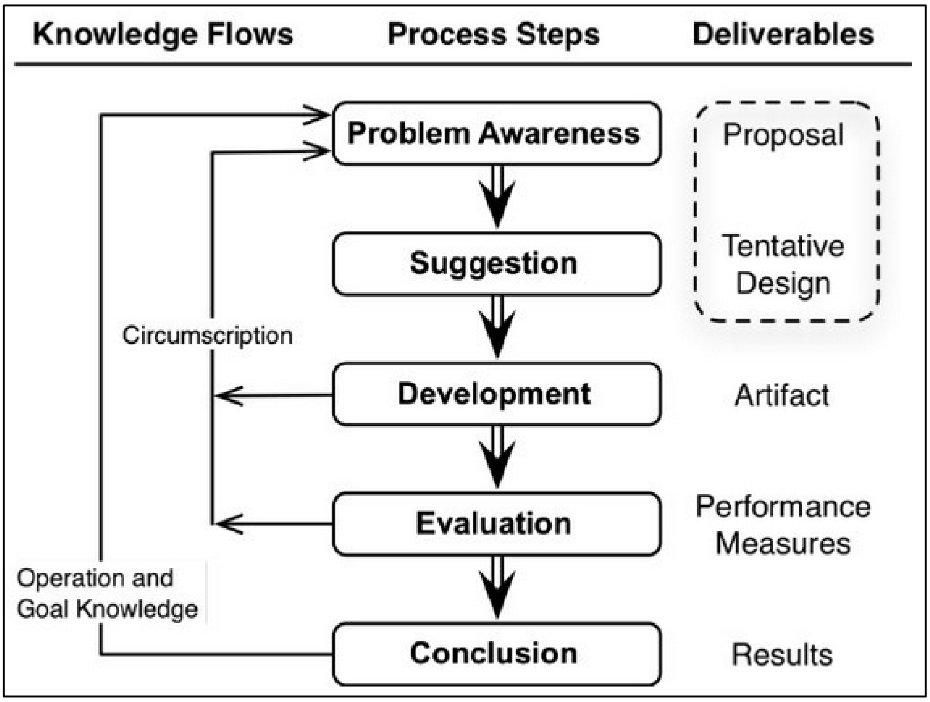


Figure 15: General Steps of Design Science Research (Vaishnavi and Kuechler 2004)

As it can be seen in the figure, each cycle starts with a problem awareness phase. In this step, the demands of the project will be developed as well as the aims, the outcome should fulfill. This is concluded by a suggestion phase and by a development phase. Up to these steps, the requirements, design principles and possibly a first artifact are described. This will be explained in more detail in the following sections. At the development phase it is possible to jump back to the problem awareness phase, e.g. if one recognizes that the problem of the project is not understood suitable enough. After the development phase, the artifact can be evaluated according to its value or performance. If a certain degree of quality is achieved, the DSR projects results in a conclusion, where the findings can be described and published. However, it is possible to do another round. The evaluation results can thereby help to update the problem awareness, which can result in an adaption of the requirements, design principles or the artifact.

As mentioned already, for designing a BM Analyzer tool I decided for a three step approach containing field studies and lab experiments. These three steps are cyclic and build on the knowledge on the previous cycle(s), according to the approach of Vaishnavi and Kuechler (2015). Starting point is the literature review, presented above as well as qualitative interviews with industry partners to consider also the needs of industry. Each cycle is finished by an evaluation step, where I proofed the different design suggestions. The following figure gives an overview of this DSR project.

General Cycle	First Design Cycle	Second Design Cycle	Third Design Cycle
Problem Awareness	• Literature Review • Interviews with Industry Partners	• Analyzing the results of Evaluation Cycle 1 • Update Problem Awareness	• Analyzing the results of Evaluation Cycle 2 • Update Problem Awareness
Suggestion	• Design Principles (DPs) for BM Objectivity	• Design Principles (DPs) for BM Comprehension	• More detailed specification of DPs based on the results of Cycle 1 and 2
Development	• BM Analytics Tool 1.0 in Microsoft PowerBI	• Running Experimental Prototype	• BM Analytics Tool 2.0 in Microsoft PowerBI
Evaluation	• Field Evaluation	• Experimental Lab Evaluation	• Case Study Evaluation
Conclusion	• Design Knowledge • BM Objectivity Features	• Design Knowledge • BM Comprehension Features	• Design Knowledge • Extended BM Tool

Figure 16: Research Cycles of the DSR Project (following Vaishnavi and Kuechler (2015))

As shown in the figure, cycle one is strongly focusing on the increase of BM objectivity. Main goal is to find meta-requirements and design principles for a more objective BM creation through data support. This is followed by the second cycle, which is focusing on an increase of comprehension of BMs. Different design principles should help to increase the comprehension of users. This is evaluated in a lab experiment, where I evaluated the single design principles. The last cycle is a compound cycle of the BM mining and comprehension. There, I created the BM Analyzer Tool 2.0, which is using company data and principles for an increased comprehension. Outcome of the whole project is not only design knowledge of building a BM mining tool or increase the comprehension of BMs. Also a concrete tool is resulting, which can be used in companies. The single cycles will be described more detailed in the following.

DSR Cycle 1: BM Analytics Tool – Focus Objectivity

I did the first round of the DSR project focusing on a data driven retrieval of a BM. This round is divided in two cycle parts “Cycle 1a” and “Cycle 1b”. Similar to Venable et al. (2016) and consequently following the suggestions of Vaishnavi and Kuechler (2015), it is possible to do more than one cycle, in this case regarding the aspects of an increase of objectivity of BMs. As already mentioned, the cycle starts with the retrievals of the literature review as well as with the explorative interviews of our industry partners. As interview partners I selected six decision makers on management level because of their knowledge in business modelling. The duration of the interviews was around half an hour each. With all industry partners I had a BM related project. Focus of the interviews was their opinion about possible improvements of the BMC to be able to support business modeling better, according to their own estimation. The insights from these interviews are then compared with the insights from literature to find a common set of requirements. Through this procedure, it is possible to not only have theoretical insights, but also concerns and challenges from a practical point of view. Looking at the industry partners, I select them because of their knowledge in business modeling as well as for the access to real-world data sets. Outcome of the exploratory interviews are the weaknesses of the BMC according to the estimation of the partners. Based on the literature review and with the input from the industry partners, meta-requirements and design principles for an increased objectivity for BM retrieval are formulated. As a result, the suggestion step of “Cycle 1a” provides a set of meta-requirements, design principles and a technical conceptualization for the BM Tool for an increased objectivity through a data-supported modeling. The leading questions for each category of the BMC, which are described in the work: “Business model generation. A handbook for visionaries, game changers, and challengers” of Osterwalder and Pigneur (2010) build a base for this. As already mentioned, this work is widely accepted in theory and practice and is often used in concrete projects. The resulting first prototype is then evaluated against the top-down approach, modelled by the executives of the industry partner. Furthermore, employees of the company modelled their view of the BM of the industry partner. This was also compared with the top-down approach of the executives of the industry partner. This “Cycle 1a” is shown together with “Cycle 1b” in the following figure.

	Cycle 1a	Cycle 1b
Problem Awareness	• Literature review • Interview with industry partners	
Suggestion	• Data-driven retrieval of the BM Canvas leading questions for each category	• Updated BM Mining with an increased mining logic and more precice selection of appropriate data
Development	• Business Model Analytics prototype under the consideration of the design principles	• BM Analytics Tool 1.0 in Microsoft PowerBI
Evaluation	• Field evaluation with executives of industry partner to determine BMC top-down • Comparing top-down approach with the data-driven bottom-up	• Field evaluation with executives of second industry partner (top down BM retrieval) • Comparing top-down approach with the data-driven bottom-up
Conclusion		• Design knowledge for • BM Objectivity Features

Figure 17: DSR Cycles for an increased BM objectivity (following Augenstein and Fleig (2017))

The “Cycle 1b” is then based on the findings of the previous “Cycle 1a”. In the suggestion phase, the mining logic is updated in order to find more appropriate data for the BM Mining. The design principles and meta-requirements are still the same and needed no adaption, but the prototype was adapted to the insights. As a result, outcome of the development phase is the BM Analytics Tool 1.0. This tool was again evaluated with another industry partner than the partner of “Cycle 1a”. As conclusion, not only design knowledge for BM Mining is created, also a BM Analyzer Tool, which can retrieve a BM in a (semi-)automatic way from appropriate company data. As shown above, for an increased business modeling, not only objectivity of the BMs is important, also the comprehension of users of the BM is necessary. This is shown in the second cycle in the following section.

DSR Cycle 2: BM Analytics Tool – Focus Comprehension

Comprehension of BMs is not only a theoretical problem, but also important for organizations. In order to develop functionalities for a tool to increase users' comprehension, I had a closer look at existing capabilities and similar approaches on related research streams as well as the mentioned explorative interviews with industry partners. As mentioned above, interview partners were six decision makers on management level because of their knowledge in business modelling. Similar to the first cycle, the second cycle is divided into two sub-cycles "2a" and "2b". In the "Cycle 2a" I have a closer look at the comprehension features and the usability in an organization.

As mentioned already, the BMC builds a base for this second cycle. Together with the insights from "Cycle 2a" as well as the general insights of cycle 1, I formulate meta-requirements for an increase of users' comprehension of BMs. Additionally, I investigated different existing BM representations and their characteristics. This all results in a set of design principles for an increased BM comprehension. For an evaluation of these design principles, an experimental tool was build, implementing these principles. The tool was evaluated in a lab experiment. A lab experiment was suitable, because there I was able to create the same conditions for different groups and examine exactly the effect of the different design principles on the participants' comprehension. The result of this second cycle are again not only design knowledge or concrete requirements for an increased BM comprehension. Furthermore, concrete functionalities can be used for a BM tool with increased comprehension or in special for the BM Analyzer tool. This can be seen in the following figure, which gives an overview of this second DSR cycle.

	Cycle 2a	Cycle 2b
Problem Awareness	• Analyzing the results of DSR Cycle 1 • Update Problem Awareness	
Suggestion	• Increased comprehension through a BM network representation and KPI support	• Using insights to update the design principles and to formulate a concrete tool (functionality)
Development	• BM network represen-tation, considering relations and dashboard elements	• Running Experimental Prototype, regarding the design principles
Evaluation	• Feasibility Study with industry partner to detect the usability of the design principles	• Lab Experiment to evaluate the comprehension of the BM prototype/increased functionalities for BM comprehension
Conclusion		• Design knowledge • BM Comprehension Features

Figure 18: DSR Cycles for an increased BM comprehension (following Augenstein and Fleig (2018))

The next sub-chapter will give an overview of the last DSR cycle. In this last cycle, the findings of the previous two are combined to one BM Analyzer tool with an increase of objectivity and comprehension.

DSR Cycle 3: BM Analytics Tool 2.0

Based on the previous two cycles, this DSR cycle three aims to combine the two goals of objectivity on the one side and comprehensibility of BMs on the other side. The difference to the first and the second cycle is that this DSR cycle three has only one cycle. This cycle starts with the problem awareness, based on the insights on the previous cycles as well as the insights from the beginning. These insights from the beginning are the results from the literature review and from the interviews. In this step, the findings from the evaluations and the feedback during these sessions play an important role, in particular for the user-friendliness of the tool. After updating the problem awareness, the suggestions of the previous cycles are checked and updated where appropriate. However, the main point of this step is to search for intersections between the meta-requirements and design principles of the first two cycles. This is because in the previous cycles these meta-requirements were only mapped on the depending design principles. However, it is also thinkable that these meta-requirements can also be mapped on the design principles of the other cycle, e.g. meta-requirements of BM comprehension may also fit on design-principles of BM objectivity. Following this step, the BM Analyzer Tool 2.0 is implemented in Microsoft PowerBI, with a special focus on the data-driven BM retrieval as well as the increased comprehension of BMs. This can be seen in the following figure.

	Cycle 3
Problem Awareness	• Analyzing Results of Cycle 2 • Update Problem Awareness
Suggestion	• Detailed specification for an increased objectivity and comprehension of BMs. • Derivation of related meta-requirements and design principles

Development	• Implementation of BM Analyzer Tool 2.0 in Microsoft PowerBI, focusing on:
	  • Data-driven BM retrieval
	  • Features for an increased BM comprehension

Evaluation	• Show case with real world data and special focus on a precise traceability of the individual steps of the BM representation for an increased BM objectivity and comprehension
Conclusion	• Design Knowledge • BM Analyzer Tool 2.0 with specific functionalities for objectivity and comprehensibility of BMs

Figure 19: DSR Cycle for a BM Analyzer Tool

In the evaluation phase I use a show case to interpret the results. Based on suitable data, the whole process of the data-driven BM retrieval can be showed in detail. Also it gives a good insight in the concrete representation of the tool, considering the design-principles for an increased BM comprehension. Finally, this DSR cycle three as well as the whole DSR project results in an increased design knowledge for building a tool with increased comprehension or data-driven BM retrieval or both. Furthermore, it provides a BM Analyzer Tool, which is usable in today's companies. Included is thereby also a concrete BM representation as well as a BM mining logic, which can be used individually, too. These results as well as these two sub-chapters are summarized in the following sub-chapter.

3.3. Summary

In this chapter, the design science research project of this thesis is described. This thesis does not only want to increase the design knowledge for an increase of BM comprehension or for a data-driven BM retrieval. It furthermore wants to provide a BM Analyzer Tool, which has functionalities to cover these aims. Furthermore, the tool should be ready to use in today's companies. Therefore, I provide an overview of the used methods in this chapter. In chapter 4.1 I first give a general introduction to DSR projects to make clear, why such a DSR project is suitable for the already presented research questions. Main advantages of the DSR approach are not only an improved understanding of the single problems. Also the cyclic approach provides a suitable approach for finding a tool, which is really fitting to these problems. Therefore, I run three DSR cycles, while the first two cycles were divided each into two smaller cycles. Through that, it is possible to evaluate the findings in theory and practice both. The advantage of a theoretical evaluation, e.g. through a lab experiment is that one can control for the set-up and the conditions. On the other side, a practical evaluation shows the practical use of the tool unembellished. Through that, also insights can be made, which are not observable during a lab experiment. Examples for such insights can be the behavior of the users or single comments, which show, where still a lack of functionality or usability exists. In chapter 3.2, the single steps of the DSR cycles are presented, following the DSR approach of Vaishnavi and Kuechler (2015) (see also Vaishnavi and Kuechler (2004)). The first cycle focuses on the data-driven retrieval of BMs. Main aim is to increase the objectivity of BMs through a bottom-up approach in contrast to the existing top-down approach. Such a top-down approach can be error-prone and subjective. Through a data-support, it should be able to increase the objectivity of BMs. The following DSR cycle two focuses on the comprehension of business modelers. A good comprehension of the own business model is important to define a correct strategy of an organization. The found meta-requirements and design principles should therefore help to increase the understandability of BM users. This cycle as well as the previous DSR cycle are resulting in the third cycle. The task of this last cycle is to combine both concepts to a tool and show its functionality on a case study. The outcome is not only an increased design knowledge. Also a usable tool, called BM Analyzer (2.0), is result of this DSR project and can be used in a wide range of companies.

To sum it up, this chapter showed the method of this thesis and how the DSR project is performed. At some sections, it may have more a character of an overview. This is important in order not to get lost in individual details. More and more detailed information is given at the following single chapters, related to the different DSR cycles. In the next section, a closer look on the problem awareness will be provided.

4. DSR Problem Awareness

As first step of this Design Science Research Project, the problem awareness should be clear. Already stated is the overall research question: "*How can a business model analytics system be designed in order to increase business model quality and users' business model comprehension?"* The drivers for this question are more a combination of the demands of theory and practice both and is more located at the interface of both. Furthermore, other trends and new possibilities of theory and practice enable new solutions for these problems. For this reason, both views are presented in this chapter. On the one hand side, I will show the impacts of the literature review on the problem awareness. On the other side, I will show different case studies, which are providing impact for these challenges. This is done in the next two sub-chapters. In section 4.3 I will then show the impacts on BM research and conclude in a summary at sub-chapter (4.4).

4.1. Impacts of the Literature Review

In chapter two, the literature review is conducted and gives a good overview of current challenges in business modeling related artifacts. However, not only as insights in the related work, also for the problem awareness, this literature review plays a major role. In order to avoid redundancies in this chapter, we will only have a look at the results of the literature review and at the influence of the problem awareness. Since 2012, business modeling is of growing interest for theory and practice, especially for the management.

All in all, one can argue that existing work on BM artifacts is diffuse and not well structured. Out of the presented 40 artifacts, only 11 are implemented as tools. As Ebel et al. (2016) already mentioned, there is great potential for new tools, which support business modeling and the related persons. However, most of the tools are only supporting the modeling of the status quo. In a time of fast changing environments (Chesbrough 2006), it is not enough to just model the status quo, but also to support decision making and the implementation. As a consequence, the literature review and related work (Veit et al. 2014) revealed some research gaps. In particular, these are at first: Improving and developing existing BM artifact approaches concerning business modeling. The insights of the literature review about the BM Artifacts showed a strong focus on existing artifacts on the company level with a strong modeling view. The role of BMs is thereby seen as just another management tool or method like a SWOT analysis or just a report of import KPIs. However, a business model is more than just a plan of actions. It provides the logic of how value is created (Johnson 2010) and fills the gap between the strategic and the operational level (Al-Debei and Avison 2010). This means on the one hand side that these levels should be linked more closely to each other and that also information is used, which is generated on the operational level. Current approaches are seen as management approach, which should be filled through the information of (strategic) management (Osterwalder and Pigneur 2010). However, operational data can provide valuable information for strategy too. In this data, lots of information is included about the actual value creation logic. This data should be used for business modeling to provide a diverse and more detailed view for the management. Another point is that in theory, a BM should function as combining platform for the different company levels (Al-Debei and Avison 2010). However, looking at the BM activities and capabilities, the majority is not focusing on this goal. For example, only 24 percent of the articles are focusing on a monitoring or visualization. This can be a base for a communication platform, but it is not said that all users really understand the BM and the value creation logic behind the model. In contrast to this, a construction plan is easy to be understood and provides insights even for novices. Furthermore, only few work is done in decision and implementation support. A development of artifacts and especially tools out of existing research of decision and implementation support, for example in the area of BM Innovation, which has a look at disruptive changes, is important. Through that, a BM can become a powerful tool with more capabilities just than a single and one-sided modeling of the current value creation. This view is also supported by the insights of the following case studies in the next sub-chapter.

4.2. Insights from real-world Cases

Not only literature, also real-world case studies show several demands for improvements of existing BM knowledge and artifacts. These demands are not settled in one specific industry, but across several branches, as the following case studies will show. First of all, the financial industry has a demand of an increase of BM capabilities, especially towards a transformation and analysis tool. Traditional banking and the established network of their branch offices is in danger of young and fast start-ups, which renounce such a branch network. Such Fintech (abbreviation for financial technology) companies are fast and agile service provider for financial services, which put huge pressure on existing banks and other financial institutes. As a result, these traditional institutes need to adapt their BM or to rethink the whole concept and might build new business models from scratch. Using existing BM approaches like the BMC is not enough for such (incrementally) changes. As the following figure shows, 35 publications, related to the financial branch, are assigned to different categories of the BMC by identifying the main theme of the respective study.

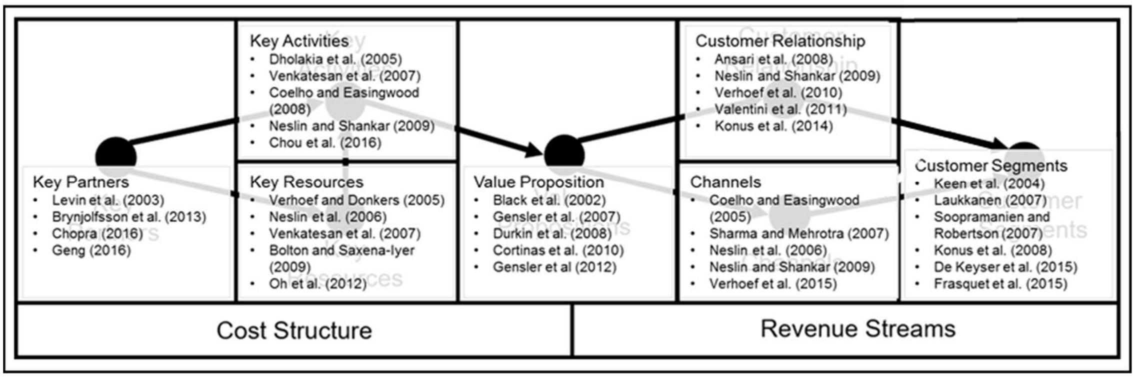


Figure 20: Matching Case Studies to the BMC

Concerning key partners, Brynjolfsson et al. (2013) propose a new interplay among retailers and supply chain partners to leverage new technologies. Second, Neslin and Shankar (2009) provide an exhaustive list of company activities in their multi-channel management decision (MCMD) framework. Third, Neslin et al. (2006) consider resources as part of their framework for multi-channel customer management and they propose questions for future research on this matter. Konuş et al. (2014) analyze the effects of channel elimination on the customer relationship, while Valentini et al. (2011) observe the customer behavior over the whole customer lifetime.

Related concerns of the financial branch are across the categories or even at intersections. In order to be able to classify the case studies correctly and thus meet the requirements of the financial sector for better support, the existing BMC or other BM concepts must be expanded. A view that goes beyond the individual categories or explicitly represents the relationships and interfaces between the categories must be permissible. This is not only valid for the financial branch. Also in other industries like the manufacturing industry, such a support of BM is essential.

Not only in the manufacturing industry, new trends force changes of the BM of a company. For example, smart factories, the internet of things or in Germany “Industry 4.0” are forcing companies to adapt their BMs towards these new situations. These changes are global changes and demand in some extend incrementally changes. Of course, one can add here that industry always need to change. However, comparing the challenges of the last fifty years with today, the changes seem to be more disruptive and demand new concepts for business modeling (Johnson et al. 2008). One stream of BM research is focusing on disruptive changes as for instance through smart factories (Baden-Fuller and Haefliger 2013). Implementing principles of a smart factory in the value creation stream of an enterprise can mean great challenges (Soder 2014). This is why such scenarios provide lots of insights for the demands of such BM changes. The following table provides an overview of either implementing a LEAN production or a smart factory. One has to add, that although these cases are published, they are not peer-reviewed, which limits the expressiveness in a scientific view. However, the cases reveal lacks in (practical) transformation projects.

Scenario	Company	Source	LEAN	Smart Factory
Transformation to a Lean production	SEW-EURODRIVE GmbH & Co KG	(Soder 2014)	**X**	
Transformation to an Industry 4.0 production	SEW-EURODRIVE GmbH & Co KG	(Soder 2014)		**X**
Innovative plant and assembly concept	Daimler AG	(Steegmüller and Zürn 2014)		**X**
Change process of introducing Lean	Jaguar AG	(Business Case Studies LLP n.n.)	**X**	
Industry 4.0 manufacturing	Siemens AG	(Büttner and Brück 2014)		**X**
Lean Manufacturing	Visteon Deutschland GmbH	(n.n. 2002)	**X**	

Lean, sustainable manufacturing (Rcell)	Grand Rapids Chair Company	(Miller et al. 2010)	**X**	
Lean, sustainable manufacturing (Recycling)	Grand Rapids Chair Company	(Miller et al. 2010)	**X**	
Lean, sustainable manufacturing (Optimized supplier)	Grand Rapids Chair Company	(Miller et al. 2010)	**X**	
Pilot plant for Industry 4.0	TRUMPF GmbH + Co. KG	(TRUMPF GmbH + Co. KG 2016)		**X**
Application of value stream mapping for Lean operations	An Indian motorcycle company	(Seth and Gupta 2005)	**X**	
Predictive Maintenance	Daimler AG	(Manhart 2014)		**X**
Putting Lean Principles in the Warehouse	Menlo Worldwide Logistics, LLC	(Bartholomew 2008)	**X**	
Lean Material-Handling System	Delphi Corp.	(Marchwinski 2003)	**X**	
Toothbrush Plant Reverses Decay in Competitiveness	Procter & Gamble Service GmbH	(Marchwinski 2004)	**X**	

Table 6: Case Study Analysis

As shown in the picture, ten scenarios are focusing on the introduction of a LEAN production and five on a smart factory. These scenarios are important for the thesis, because on the one side, the LEAN principles stand for a structured transformation or strategy derivation. A BM can hereby provide a suitable platform for such a strategy development. On the other side, the smart factory strategy derivations are less structured and more complex. A BM should give hereby a comprehendible overview about the value creation and should build a platform for the strategy derivation. As a result, a BM tool should be able to support strategy derivations even in unstructured situations. This means, that even in complex scenarios, the value creation should be understood. The current approaches suffer thereby from disadvantages because they are time-consuming as well as biased and often not the suitable persons are invited to the business modeling sessions. This makes transformation processes and strategy derivations time-consuming, too. Furthermore, biased BMs can lead to biased strategy derivations. This can lead to wrong decisions. Especially for transformations, also a high objectivity of BMs similar to a blueprint in the construction branch is necessary. Furthermore, the insights of these cases are interesting. While all LEAN production implementations were successful, only some cases focusing on smart factory can provide a success at some parts. Looking at the small numbers, no general trend can be derived. However, interestingly look the characteristics of the cases. The cases focusing on the LEAN concept show a high similarity. Furthermore, LEAN management and the implementation is widely research and described in management literature (e.g. Charron et al. (2015)). As a consequence, different concepts are existing and managers can follow a structured approach or at least principles for such an introduction. In contrast to this, the introduction of a smart factory is not as easy as that. This is on the one hand, because the concept of smart factories is not existing as long as the LEAN philosophy. On the other hand, the introduction of a smart factory demands in some extend a more disruptive change than the LEAN management does. However, a company cannot decide for just waiting for concepts to implement a smart factory. Competitors might overtake them and their market shares. As a result, all companies have to face these challenges and have to find individual solutions and adaptions of their BMs. Having a look at the capabilities of the BMs shown in the literature review, existing approaches mainly focus on the capture of the status quo. This focus is thereby subjective and error-prone, as the business modeler inserts the important information. However, not only for transformations, a solid data base and platform for decisions are important to find a suitable strategy, not only for implementing a smart factory. Furthermore, disruptive changes of the BMs should be supported in an adequate way. So far, only 18 percent out of the 40 analyzed BM artifacts provide such a disruptive change. Only slowly, this topic is of growing interest. An early work of such a BM Innovation provides Chesbrough and Rosenbloom (2002). However, this work is only a first approach and till today, there is great potential for future research in this area (Wirtz 2013b). In special, a solid data base for decision making as well as a wider view on the value creation is important to make correct decisions in a transformation phase and to challenge even disruptive changes. This is also shown together with the insights of the literature analysis in the following sub-chapter.

4.3. Impact on Business Model Research

The insights of the literature review as well as from the case study analysis showed concrete gaps in current BM approaches. Similar to other studies (e.g. Veit et al. (2014) or Ebel et al. (2016)), the full potential of existing technologies and capabilities is not used. Companies need a support through artifacts to face the current challenges. This is important, because the challenges for example through digitization are getting more and more complex and many side constraints have to be considered. Just using a BM approach like the BMC is not suitable enough. On the contrary, a BMC artifact should be like a business dashboard, showing important data and facts objectively and comprehensively. Next to the practical demands, also theory is heavily interested in an increased BM knowledge (Wirtz 2011). As one example, the research stream of BM Innovation is at the beginning of a period, where practice demands theoretical approaches to face the challenges of disruptive changes (Baden-Fuller and Haefliger 2013). However, the literature review shows thereby that existing approaches are mainly focusing on modeling and visualization of the current value creation (see also Ebel et al. 2016). Deep analyzes or simulations are only rarely supported (Lindgren and Rasmussen 2013). Furthermore, the use of company data is not enough included in these approaches. Moreover, employees' knowledge is the only source of information, which is used to fill out a BM. Also theory demands a BM to function as a combining platform of different company levels (Al-Debei and Avison 2010). Similar to a construction plan, the BM should show rapidly and in an understandable way, how value is created. As a consequence, requirements need to be defined for such an integrating platform, as well as for an objective and comprehensive BM to be able to face also complex challenges.

For this thesis project, several demands emerge from this problem analysis. First of all, there is a huge need for an objective business modeling. As mentioned, BMs serve as a communication platform similar to a blueprint. Osterwalder and Pigneur (2010) therefore provided the BMC, which should gain a fast and holistic overview about the value creation process. However, filling out the BMC is a manual approach, which is subjective and biased. Different approaches try to overcome this weakness, like for example the BM Cube (Lindgren and Rasmussen 2013). This is under the cost of a time consuming modelling which is furthermore not totally unbiased. As a result, a concrete demand for the increase of the objectivity of BMs are principles, which should enable value creation view with low biases and subjectivity on the one side and a modelling effort similar to fill out a BMC on the other side. As a result, the existing approaches should be enlarged towards a multi-view and data-supported business modeling. Thereby, the BM should not be built only on information of a company. It should be furthermore an amendment through the existing top-down approach, which is based on the manager and its' knowledge. Second, also the BM as a common platform for different stakeholders of a company is important. Therefore, the BM approach should be changed towards an increased comprehension. For example, the BMC is focusing on a fast business modeling with a high degree of abstraction (Osterwalder and Pigneur 2010). This is a good approach to get a fast and high-level overview of the current value creation of a company. However, for deeper analyzes or as a base for a transformation, this approach is not powerful enough. This is because a BM is more than just its single elements (Eriksson and Penker 2000). Different researchers stress the importance of the different flows of goods, services and information (e.g. Timmers 1998 or Afuah and Tucci 2003). Furthermore, capturing the value and make it understandable for the user is of great interest (Afuah 2004). Remarkable is, that for such value capturing different approaches exist, like for example dashboards (Few 2013). To sum it up, through the intense use of the BMC, the flows in BMs as well as the value capturing is not considered adequately (Lindgren and Rasmussen 2013). However, they can have great influence on users comprehension (Linder and Cantrell 2000; Few 2006). As special demand in order to increase users' comprehension is therefore the inclusion of the relations between the elements and a suitable representation of the value capturing. As a consequence, more advanced approaches with a special focus on the users' comprehension should be put in the foreground. With that, the BM approach should be decoupled and brought in the focus of different company levels, too. This is because complex BM changes like for example the introduction of a smart factory or the internet of things demands a great interplay of all levels of a company. Through an advanced BM approach, such a platform can be created, which is similar to a construction plan in the building sector. Another demand is that business modeling should be done more tool supported, as the literature review shows. Analyzes and simulations could be supported automatically by related algorithms. And even concepts of other disciplines like business process mining could be used to provide a powerful BM tool. Veit et al. (2014) ask, why tool support is not provided more in the different articles of existing research. As a result, more tools should be developed in order to use existing data and tool functionalities to disburden managers and decision makers. For sure, these are only some challenges and gaps, current BM research has to handle. However, these challenges seem to be very urgent, as literature addresses and practice demands, shown in the case studies above.

4.4. Summary

Companies are facing more and more complex challenges and have to adapt their BMs adequately. However, existing research is not that far or is focusing on other topics than on the increase of the objectivity and comprehension of BMs. However, existing case studies show that companies are facing more and more complex situations. In these situations, a single view on the value creation is not enough and even details matter. A BM approach, which is considering an increased comprehension and objectivity can help for instance to derive a strategy for the introduction of a smart factory. The scenarios of this chapter showed, that finding such a strategy is not always successful. With the following design principles, I want to provide a common communication platform, which should support these demands. In special, practice demands powerful approaches to be able to face disruptive and groundbreaking challenges. Even for smaller adaptions, existing approaches gain potential for improvements. Furthermore, existing literature goes beyond and asks, why not more or better artifacts are created and work is done to support business modeling (Veit et al. 2014) - a topic, which is very central for decision makers and managers and which is often the base for strategy developments. This thesis will address the mentioned challenges of an increased objectivity and comprehension of BMs. In the following the three different cycles will focus on these gaps and will provide solutions for an increased BM objectivity and comprehension. Furthermore, a tool is instantiated, which should support also practice to establish an enlarged business modeling in their organizations.

5. Examining Principles for BM Analyzer - Focus Objectivity (Cycle 1)[5]

Current approaches for a BM derivation are largely based on manual top-down procedures. These are also subject to several weaknesses. The current approaches suffer from disadvantages because they are time-consuming as well as biased and often not suitable persons are invited to the business modeling sessions. The manual derivation of BM is usually a time-consuming process that does not fully exploit the full potential of the large databases in the enterprise information systems (IS). As a result, the underlying idea of this chapter is to enrich the manual approaches, which derive a BM top-down from the strategy through a bottom-up approach which uses data as a base. Huge organizations use several systems like an “enterprise resource planning (ERP)”, a “business process management” or a “customer relationship management” (Augenstein and Fleig 2017). In general, also Microsoft Excel spreadsheets or still paper-based approaches are used to store the relevant data of a company and support for instance an ERP planning. All these approaches store a large amount of data, which can also be used as a data foundation for such an automatic bottom-up creation of a BM of a company. As an example, an ERP system can contain all relevant information to fill out the single categories of a BMC. This includes all information for the categories of Osterwalder and Pigneur (2010) like: Customers, suppliers, resources, revenues, costs, or sales channels as well as business processes. A second point is that manual BM approaches are likely to provide BM representations that are highly subjective and often personally biased. Since the information in these approaches is based on top-down input from individuals, the resulting BM representations may not be entirely objective. Third, the missing objectivity of BMs prohibits the comparison of two or more BMs with themselves. However, a data-based BM approach should increase comparability between different business models. In summary, it can be said that these challenges of current BM approaches lead to a considerable potential for improvement. Therefore, this chapter concentrates on the question (Augenstein and Fleig 2017), which design

[5] Based on Augenstein and Fleig 2017; Augenstein et al. 2018a; Augenstein et al. 2018b

principles need to be followed to support data-driven business modeling to increase the objectivity of status-quo business model creation?

As a base I use the BMC of Osterwalder and Pigneur (2010). To mine the categories of the BMC, I derive a set of techniques, an ER-model for the data as well as an algorithm to detect the relevant information for the BM categories from different data sources like transaction data (e.g. van der Aalst et al. (2007) and Li et al. (2008)). As data sources, ERP system data can be used as well as information, which are not stored in ERP systems, but are available on a reliable base in the company. Examples for such a data base are Excel sheets and even reliable paper based approaches (e.g. invoices or account statements). To use this data and consolidate it, current BM research insights are included into the BM Mining approach. The focus is thereby on the offered products and/or services and all related data. The result is an easy to use approach, which proxies a BM to a certain level and considers a high quality and reliability of the data sources.

Therefore, this chapter provides first an overview of the (meta-) requirements of a BM Mining tool in the following sub-section. Related to this, the next sub-section gives an overview of the derived design principles. Both sub-chapters are also published (Augenstein and Fleig 2017). Sub-chapter 3 shows then the instantiation of these design principles and in sub-chapter 4 the functionality of the tool is described as well as a refinement in sub-chapter 5. Sub-chapter 6 shows then, how the BM Mining approach answers the demands of organizations and the relation to theoretical perspectives (sub-chapter 7). Finally, the evaluation shows the reliability of the algorithm in sub-chapter 8 and concludes with a summary in the last sub-chapter.

5.1. Requirements

The use of the Business Model Canvas is quite common in the management departments of an organization (Osterwalder and Pigneur 2013). I additionally found out that business modeling is not done objectively and mainly in a top-down approach. This is strongly depending on the knowledge of the decision maker and is very error-prone. Also existing research approaches display challenges such as adapting and changing BMs after changes in environmental conditions (Chesbrough 2007; Veit et al. 2014). To sum it up, using the BMC as a base seems to be highly promising, because of its wide use in business. One weakness of the BMC is the missing evaluation step (Osterwalder and Pigneur 2010). As a result, one does not know, if the BM reflects the current value creation of a company correctly. To overcome this weakness, organizational data of different reliable company sources can be used to build a data-driven BM. This data provides a comprehensive overview of an organization and the related value creation. The data therefore has to be reliable and of high quality, which I call “appropriate”. Another criterion for the data is that it provides detailed information about the value creation and the output, reflected in the products and services. One challenge, related to this is the identification of the appropriate source of data, which contains the important information with a high quality and reliability. As a result, I formulate the first meta requirement (MR):

MR1: To enable bottom-up creation of a business model, appropriate data needs to be identified and accessed.

Related to this first meta requirement is also that the results are comparable with each other. Normally, the bottom-up approaches are combined with the top-down approaches. As a result, both approaches have to be comparable. Additionally, a company can contain more than one BM. It can be important to compare also these different BMs. Next to this internal comparison, also a benchmarking with competitors is possible through a well-defined structure. As mentioned, BMs have to be changed according to internal and external changes of conditions. A comparison of the current state of the BM with the target state also requires a good structure of the data. This is, because a BM is an “architecture for products, services and information flows” (Timmers 1998, p. 4) and therefore provides a structure of relations between the elements. This structure has to be adapted in the data model. A structure of data is not only important for answering the demands of BM theory. It can also support the comprehension of users. As a result, I address the second meta requirement:

MR2: To guarantee the comparability of top-down and bottom-up business model creation approaches, the extracted data should be structured in a unified way.

As mentioned, company data can provide a huge amount of information. This contains the thread that the user is overloaded with information. Furthermore, a BM should give a fast and abstract approach of the current value creation (Osterwalder and

Pigneur 2010). This demands a consolidation of the data in a way that the user has the company information in an aggregated form. Together with the structure of meta requirement two, a rapid overview of the value creation can be retrieved. As a result, the user's comprehension is supported and only relevant data is shown. This is reflected in the third meta requirement:

MR3: To report only relevant information, the collected data should be aggregated.

Together, these three meta requirements provide the possibility of a reliable and fast data mining. Advantages are not only a support of the user and an increase of the comprehension of the user. These meta requirements support also another method to retrieve a BM next to the manual top-down approach. Through a clear structure and a certain degree of abstraction as well as the use of high qualitative and reliable data, this bottom-up approach can help companies in their business modeling sections. Furthermore, these meta requirements can be used to build a tool, which is monitoring the BM of a company over a period of time or constantly. The already mentioned meta requirements are shown concise in the following table. The next sub-chapter shows, how I translated these meta requirements in concrete design principles for a BM Mining algorithm and related tool functionalities. These functionalities will result in the BM Analyzer tool, shown in the third DSR cycle.

ID	Meta-Requirement	Description
MR 1	Appropriate data for bottom-up business model creation should be identified and accessed	To enable bottom-up creation of a business model and guarantee a certain level of quality, appropriate data needs to be identified and accessed.
MR 2	To guarantee comparability of top-down and bottom-up business model creation approaches, extracted data should be structured in a unified way.	To guarantee the comparability of top-down and bottom-up business models, the extracted data should be structured in a unified way.
MR 3	Data should be aggregated along a defined structure.	To report only relevant information and avoid an information overload, the collected data should be aggregated.

Table 7: Meta Requirements for BM Mining (Augenstein and Fleig 2017)

5.2. Design Principles

The mentioned meta requirements of the last sub-section can be translated into concrete design principles. How this can be done is shown in this sub-section, which is adapted from Augenstein and Fleig (2017). In the previous section, one demand was the use of the appropriate data for the mining algorithm. This appropriate data should not only include a reflection of the value creation logic of a company. It should have a well-defined structure, so that on the one side users can understand the BM easier and on the other side the demand of BMs on a relational flow between the elements is fulfilled. This can be done through a unified ontology of the BM as a foundation. As a result, I demand the first design principle (DP1):

DP1: A unified business model ontology should be provided as a foundation for BM Mining.

One possibility to define such a structure through an ontology is the BMC as a base, because it is often used in practice and cited frequently (Lucassen et al. 2012). The category and the product/service focus can build a strong base for such an ontology. The used information and data can be structured along this ontology. Therefore, it is also important to find the relevant data. As mentioned, the data should be reliable and of high quality. This demands a good repository of all relevant data sources, which covers a wide range of data sources in companies. This has not necessarily to be an ERP system. Also other "pseudo-systems" can build a strong data source. One important point for such a data source decision is also the easiness of data extraction. This is because even a well maintained system is useless, if one cannot extract the relevant data. Therefore, I demand in the second design principle:

DP2: A repository of all relevant BM data sources should be established, which should also allow the extraction of all BM-relevant source data of it.

After the data extraction, normally a huge amount of data is containable. As a result, consolidating the data is important to avoid an information overload for the user. Furthermore, the space of the BM is limited and even some information is redundant. As it is an aim of the BM to give a fast and abstract overview of the value creation of a company (Osterwalder and Pigneur 2010), a consolidation algorithm has to be defined. The criteria for such an algorithm can be different elements or views of the BM that provide a holistic overview. So the algorithm has two functions. First, it should contain calculation and consolidation functions to aggregate the relevant data of BMs according to the depending structure. Second, it should contain merging logics to recombine data and to exclude redundant information. This is formulated in the third design principle:

DP3: Suitable calculation and consolidation functions should be provided for a BM aggregation and merging logics should enable a recombination of data.

Merging these three design principles with the meta requirements, one can see, how the theoretical demands are transformed into concrete design principles. Still the aim is to find an algorithm, which is rapidly and reliably showing the BM of a company using the data and all available information of the organization. The following table shows the relations between the design principles and the related MR. In the next sub-section, the concrete instantiation of these design principles is shown. The goal is to derive functions for a BM Mining tool, which enable a bottom-up creation of a BM through data. This tool can be regarded in the third DSR cycle.

DP	Design Principle	Related MR
DP 1	Provide one unified business model ontology as a foundation.	**MR 2 & 3**
DP 2	Establish a repository of relevant BM data sources and allow extraction of BM-relevant source data from it.	**MR 1**
DP 3	Provide calculation and consolidation functions to aggregate BM relevant source data, as well as merging logics to recombine the data.	**MR 3**

Table 8: Design Principles for BM Mining (Augenstein and Fleig 2017)

5.3. Instantiation

The provided design principles above give a good structure for a possible business model mining tool. However, one has to keep in mind that just following these principles can lead to a tool, which is not really fulfilling the prerequisite of a mining tool. As a result, it is possible to extract data from an ERP system, consolidate it and then just show the most important information for each category of the BMC. This would lead to a Business Model, which is containing unrelated elements in each category with the thread that elements are included, which do not have any relation to the provided product or service of the company. As already mentioned, next to the defined requirements and design principles, also the requirements from BMs, which were defined over the last decades, need to be considered. This is important to know, if one wants to instantiate a BM tool. This prerequisite as well as the design principles lead to the following figure for the data mining in a BM context.

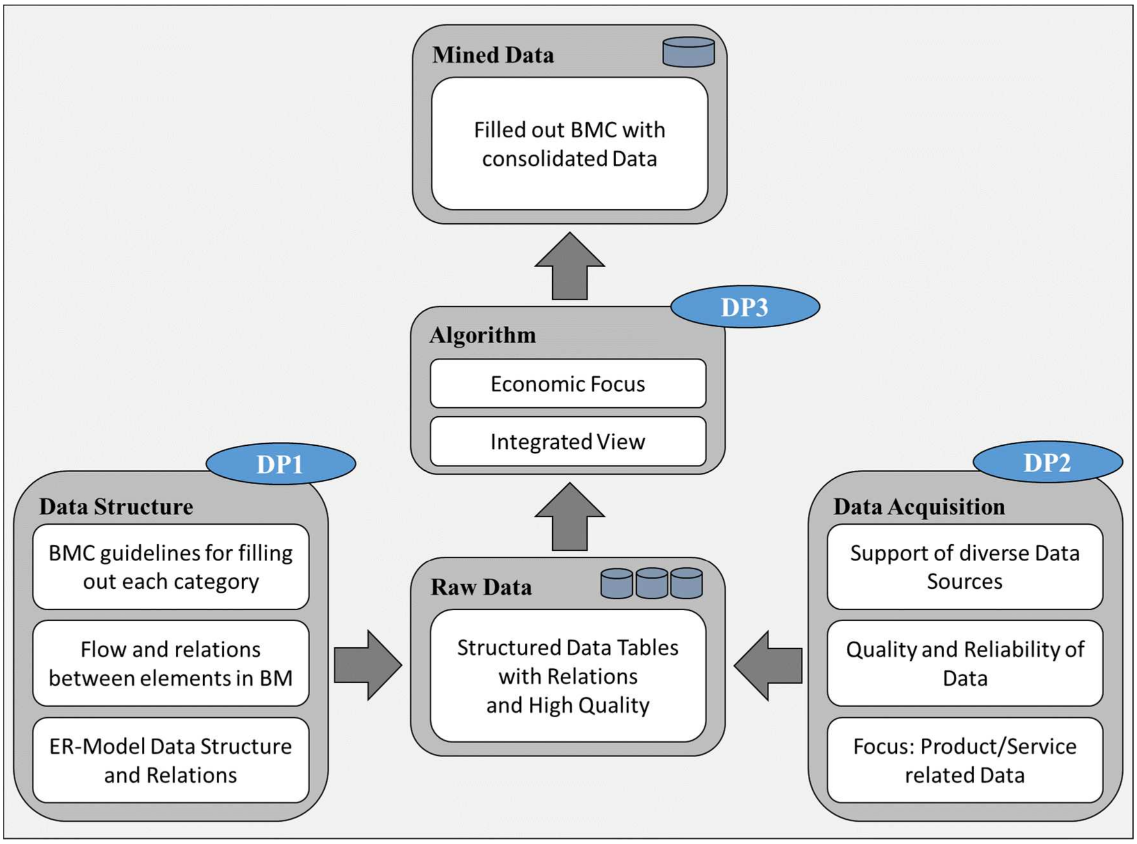


Figure 21: Overview of the Data Mining

The first element of this data mining scheme is the data structure, which is also mentioned in the first design principle. Important for this structure are first of all the guidelines for filling out the Business Model Canvas, provided by Osterwalder and Pigneur (2010, pp. 20–41). For each category, they provided prerequisites and leading questions, which should help the user to be able to fill out the BMC rapidly and correct. Furthermore, they provide an order how to fill out the BMC so that the flow of goods, services and information is considered (Osterwalder and Pigneur 2010). This is important, as it enables to see the information in a holistic view. As a result, a structure of data has to consider this flow and the relations between the elements. This is because the BM shows the value creation of a company (e.g. Afuah and Tucci (2003)). Focus of this value creation is the provided product or service for the customer. As a result, in the center of the BM is the depending product or service, the related set of activities of the company and "how it performs them" (Afuah and Tucci 2003, 3 f.). This must also be reflected in the structure as well as in the contained elements and their interrelationships. This is considered in the third element "ER-Model Data Structure and Relations" of the data scheme.

As important as the structure is the data itself and its acquisition. The optimal prerequisite would be to have a well-maintained ERP system with all relevant information for such data acquisition. Unfortunately, this is often a wishful thinking, as I have learned from numerous interviews with employees of our partner companies. In reality, many companies have either one or more ERP systems, which are rather poorly maintained, or they have no ERP system and use an Excel or paper based planning. This is an important demand for the tool, as it should enable a data acquisition from all of these sources. This means, that not only data from ERP systems should be includable, but it should be also possible to consider Excel data and even paper based data. Many small sized companies (with less than 9 employees and less than 2 million € earning each year) do not use an ERP system and are doing their planning paper based or with Excel. However, these companies should be considered too as their number is very high. Between the years 2014-16, around 2 million of such small sized companies exist in Germany and nearly two third of the employees work in small and medium sized companies which account one third of sales in Germany (Destatis 2016). For that reason, the mining tool should operate on a system, which is independent from a specific ERP system and SQL servers to consider a huge mass of companies. Next to this, also the quality and reliability of data must be ensured. Not only for paper based data, also Excel and ERP system data need to be consistent and right. Since the input of data into these sources is also done with human interaction and is not fully automated, false or duplicate information is possible. As a result, it has to be ensured that only correct data is included as only a correct and reliable input can lead to a correct output. One possibility to ensure this quality is for example a double check of the data. Another point for the data acquisition next to the quality is also the amount of data. Current systems and algorithms are very powerful in consolidating data, but they have limits too. To ensure nevertheless a highly automated approach, the data acquisition should focus only on the relevant product and service data and the data related to it. This means that the ER-Model and the data structure should be considered for the acquisitions. As an example, it does not make sense to use the data of partners, which do not have part in the value creation of the products or services (e.g. tax managers or lawyers). This information might be important, but for a BM Mining they have only subordinate importance.

Considering the structure and the demands for the data acquisition will lead to an amount of raw data, which is ready to be mined. The mining algorithm thereby needs to be economic focused (for instance reducing costs or maximize revenue), as this is also a prerequisite of strategic business modeling (Wirtz 2013b). Nevertheless, also other maximization criteria are thinkable, for example the increase of customer satisfaction. Also the algorithm needs a holistic view which a BM demands. As already mentioned, it does not make sense to mine the important elements separately for each BM category. This could possibly lead to the exemplary situation that the mentioned tax managers and lawyers are the most important key partners, as the company is earning the most with saving taxes than with the actual product of service. This could be interesting too and such value creations are thinkable, but this does not have many in common with the origin of the BM (Osterwalder and Pigneur 2010).

The final outcome of this data aggregation would be a pre-filled Business Model Canvas with elements from the bottom-up data. As a result, each category contains the elements, which have the greatest importance for the provided product or service under the consideration of a maximization of earnings. Furthermore, one can be sure that all elements have a relation to the primary value creation through this products or services. This avoids the situation that only elements with the highest impact for a category are shown, which would mislead the original character of a BM as a strategic management tool. As an example, a fuel station is not only selling oil, but also beverages and cigarettes. A separated algorithm would define the fuel selling as key activity. However, most of the earnings are made with selling cigarettes and beverages, which is not (always) directly related to the oil selling, because people also just stop to buy cigarettes or drinks. Of course this is not the fault of the algorithm, but of the interpretation. However, a holistic algorithm would consider this and is providing only information about the important products or services of a company.

In the following, the single parts: “Data Structure”, “Data Acquisition” and the “Mining Algorithm” of the BM Mining are described more detailed. This should help to understand the functionality and the logic behind the algorithm more detailed.

Data Structure

One part of the mining algorithm is the data structure. As already mentioned, BM literature provides a clear structure and mentions that a BM is “an architecture for products, services and information flows” (Timmers 1998, p. 4). As a result, each BM contains such a flow, which should be also considered in the algorithm, because this flow reflects the relations between the elements. One example of the BMC is the “value proposition - channel - customer segment” relationship. The channel describes, how a value proposition is “delivered” to a customer segment. This is, because the BMC has some roots in the value chain of Porter (2001b). In this value chain, the primary and secondary activities are divided and it is easily observable that the primary activities follow a clear order. The product goes through this process, which represents a flow of product. At the same time, also relations between the supporting activities exist like a flow of service or a flow of information. This flows are transferable to the BMC, as it is shown in the following figure. An illustration of possible flows in the BMC are given in the following figure. One has to add that this is only one possible flow of product or services and the relations to the costs and revenue streams are not included.

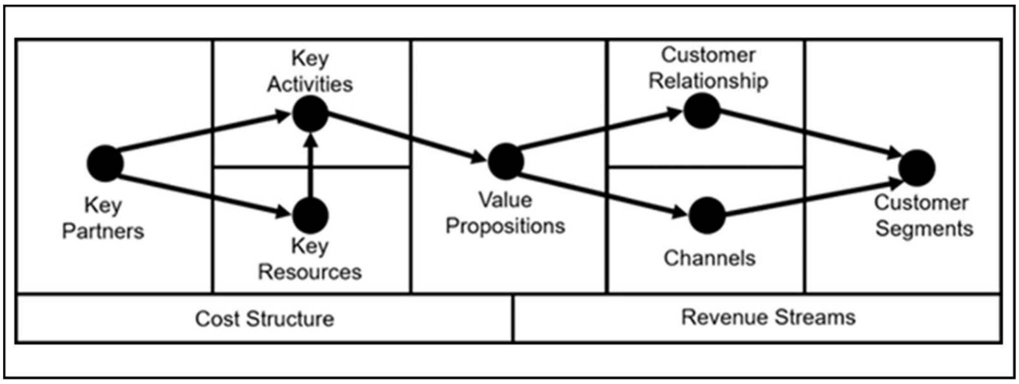


Figure 22: Flows in the BMC derived from the Value Chain (according to Porter (2001b)

Directly combined with the flow in the BMC are the specifications of Osterwalder and Pigneur (2010) in their book “ Business model generation”. For each category of the BMC they provide leading questions like “Who are our most important customers?” (Osterwalder and Pigneur 2010, p. 21) or “For what value are our customers really willing to pay?” (Osterwalder and Pigneur 2010, p. 31). Additionally, they provide examples for each category. The related table in the attachment gives an overview of these categories, leading questions and examples.

The third important element of the data structure is also the ER model of the different elements of the BMC. On the one side, this also includes the relations between the elements and in an abstract way the flow in the BM, as already described. On the other hand, it describes the logic of the value creation with the focus on the “ core products and/or services the organization offers” (Al-Debei et al. 2008, p. 7). As a result, the ER Model of the data structure contains on the one hand side the categories of the BMC, the relations between the categories, derived from Porter’s Value Chain (Porter 2001b) as well as the (key) elements, derived from the “Business Model Generation Handbook” of Osterwalder and Pigneur (2010). This is shown in the following figure, which is divided into the three main parts “Create, Capture and Deliver” of the value (Osterwalder and Pigneur 2010). The ER-Model for the creation and delivery part are fully illustrated. For the sake of clarity, the elements “Cost” and “Revenue” of the capturing part are not linked to the single elements of the other two parts. In general, all elements of the creation part have an influence bigger or equal zero on the costs and similar to this, all elements of the delivery part have an influence bigger or equal than zero on costs. This is why not each single element of these parts are linked to the cost or revenue elements.

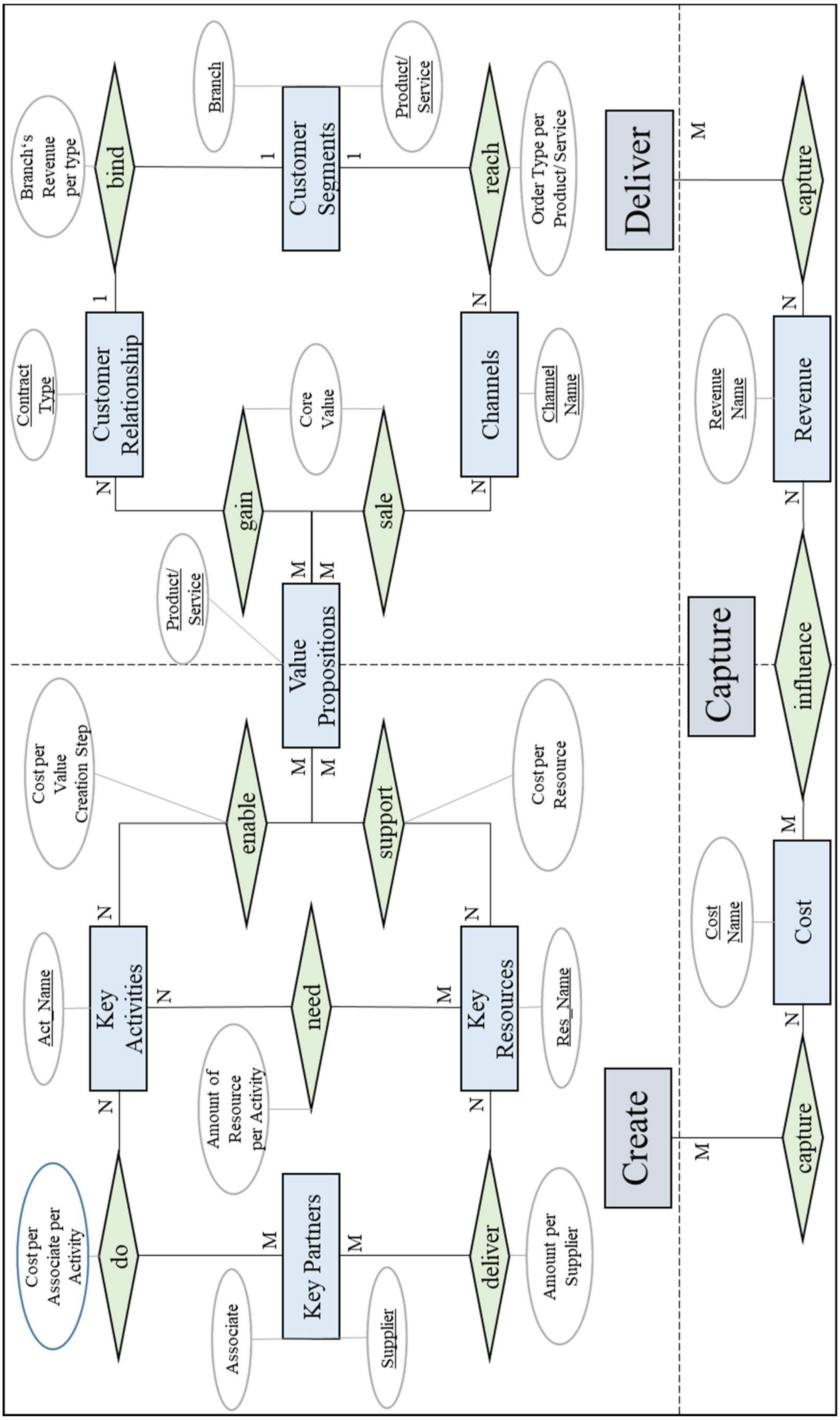


Figure 23: ER Model of the Data Structure (according to Porter (2001b) as well as Osterwalder and Pigneur (2010))

Data Acquisition

As mentioned before, the desired state for a BM Mining would be to extract the high reliable data of an ERP system of an organization. However, this is a pipe dream at the moment, because even companies using an ERP system have problems with data consistency and sometimes parallel existing ERP systems, as I learned from the interviews with our industry partners. This challenge could be mastered through different actions and a BM Mining out of the ERP system would manageable. The bigger challenge is that most of the small and medium sized businesses do not even use an ERP system, as a study shows (Leyh and Betge, A., Strahringer, S., 2015). Only around 21 percent of the small and medium sized companies say that they are using a standardized ERP software at the moment (around 12 percent have not made an announcement) (see Leyh and Betge, A., Strahringer, S. 2015, p. 17). This means that around two third of these companies are using a pseudo-system or a paper-based system, on the natural assumption that every company is doing an ERP planning. For the data acquisition, this means special challenges, as described in the following table.

ERP System / Methods	Examples for Providers	Possible Place of Operation	Degree of Automati on	Advantages for BM Mining	Disadvantages for BM Mining
Integrated ERP solutions	Infor, Oracle, Sage, SAP	Mainly medium and big sized companies	High	High reliability Standardized Tables	Different ERP systems coexisting, data consistency and extraction
Subsystems and specialized solutions	Datev, Microsoft, myfactory, Scopevisio, webclapp	Mainly small and medium sized companies or specified companies	Middle-High	Good reliability, possible lower number of entries	Different ERP systems coexisting, data consistency and extraction human mistakes
Pseudo-Systems	Microsoft Excel and similar programms	Possibly in all company sizes, e.g. shaddow IT	Low	Easy data extraction, lower number of entries	Data quality and reliability, likelyhood of human mistakes high
Paper-based solution	none	Micro-enterprises	Low	Low number of entries	Data quality and reliability, likelyhood of human mistakes high, data digitization

Table 9: ERP Systems and Methods and their aptitude for BM Mining (adapted from Leyh and Betge, A., Strahringer, S. (2015) and interviews with industry partners)

Looking at the high numbers of small and medium sized companies, which are not using an ERP system, special challenges for the data acquisition, especially for the quality and reliability are existing. They are rarely using ERP systems. This means that high quality and reliable data is not ensured per se. As a result, the algorithm should not only be able to use ERP data, but also transactional data in a flat file from any reliable source. As a result, I decide for a BM Mining algorithm, which is suitable for Microsoft Excel sheets and ERP systems both. This is included in the tool later, but can used independently by users, which are not willing to use the tool but the BM Mining algorithm. This algorithm will be presented in the following.

Algorithm for BM Mining

Using the BMC provides a suitable frame for the algorithm, as it implies the flow of goods and services which provides an order to gradually fill in the individual categories (Osterwalder and Pigneur 2010). As mentioned, the important data is represented through all information related to the offered product and/or service of the company. The following algorithm, written in a pseudo-code should give an aggregated overview of the most important products and/or services of a company. It includes the mentioned structure of the data and fulfills the demands of the design principles. It should represent in an abstract, but more understandable way, what the BM Mining algorithm is doing. As mentioned, focus of this algorithm is a high revenue of the company. For other organizations like non-profit organizations, another criterion might be more suitable. However, this can be easily included in the algorithm, too.

Algorithm for BM Mining

Input

Relevant Company Data related to Products or Services.

Begin

Search three largest products/services according to the highest turnover;
Set result as reference products/services;

// For Customer Segments:

Search three biggest branches, which are buying at least one reference product/service according to the highest turnover;
Include result and reference products/services in Customer Segment;

```
// For Channels:
    Search for each reference product or service the type of order with the highest
            turnover;
    Include result in Channels;
    Connect with reference product/service;

// For Customer Relationship:
    Search for each branch the type of contract according to the highest turnover of
            the depending contract type;
    Include results in Customer Relationship;
    Connect with reference product/service;

// For Value Proposition:
    Define core value of each branch – product/service relationship;
    Include result and reference product/service in Value Proposition;

    If (core value = tangible/ real value)
        Connect core value with the related type of order;
    Else
        Connect the core value with the related contract type;

// For Key Activities:
    Search for each reference product/service the activity with the highest costs;
    Include result in Key Activities;
    Connect activities with the related reference product/service;

// For Key Resources:
    Search for each reference product/service the resource with the highest costs;
    Include result in Key Resources;
    Connect resources with the related reference product/service
            and with the related activity;

//For Key Partner:
```

```
    Search for each key resource the supplier with the highest turnover;
    Include result in Key Partner;
    Connect supplier with the related key resource;

    If (external cost for key activity > 0)
        Search for each key activity the partner with the highest value share;
        Include result in Key Partner;
        Connect partner with the related key activity;
    Else
        Include String "No Key Partner" in Key Partner;
// For Cost
        Include all costs related to all included elements;
// For Revenue
        Include all revenue related to all included elements;
End
```

Table 10: Algorithm for BM Mining

As it can be seen, the algorithm is starting from right to the left of the value chain or the depending flow in a BM. First it starts with the definition of the important products and/or services of the company, which are called the reference products/services. In the algorithm, the most important branches were defined according their turnover. Characterizing for this algorithm is that only that branches are considered, which are related to the reference product/services. Based on these reference offers, also the depending order types are represented in the category channels. Next, for each branch the related contract type is chosen. The value proposition builds the heart of the BM and connects the creation part with the delivery part of the BM. For the creation part, again the reference products/services are represented. This is important, because on the one hand it represents the value offering. On the other side it can easily reflect customer segments. By the way, one can see through this the close relation of the customer segment and value proposition (Osterwalder and Pigneur 2010). The customer segment is some kind of external view on the value proposition. Additionally, the core value is included in the value proposition. As it is hard to decide for an algorithm, if the value is tangible or not, this characterization must be directly included into the data. However, the refinement of the tool in the sub-chapter 5.5 shows a possibility for automatically generate this information. Next to the value proposition, also the key activities and key resources are defined through the costs per activity as well as per resource. Finally, the key partners are searched. The most important suppliers were defined through the largest turnover. If partners are existing, they are decided for their highest value share on the key activities. For the sake of clarity, the categories cost and revenue are described very high level in the algorithm. In general, they can be easily retrieved from the data and are available as they are a criterion for selection. It is also thinkable to include more important costs and revenues. Furthermore, all found elements are combined with the other related results in the model after each step. This reflects the data structure of the business model and has some advantages. One advantage is that it increases the comprehension of the BM, as it can be seen in the next chapter. Another advantage is that with this structure, changes can be detected faster. If for example a key activity changes, this has directly effect on the key partners and maybe on the key resources. The algorithm can then easily detect the new related partners and include it automatically in the tool. If an information system is directly linked to the tool, one can maintain the BM over a period of time. This is shown exemplarily in the following figure, which is also containing sample data to better understand the algorithm. In the following subchapter, the functionalities of the tool are then shown exemplarily with abstract terms. The cost and revenue categories are included but not in the focus of this illustration.

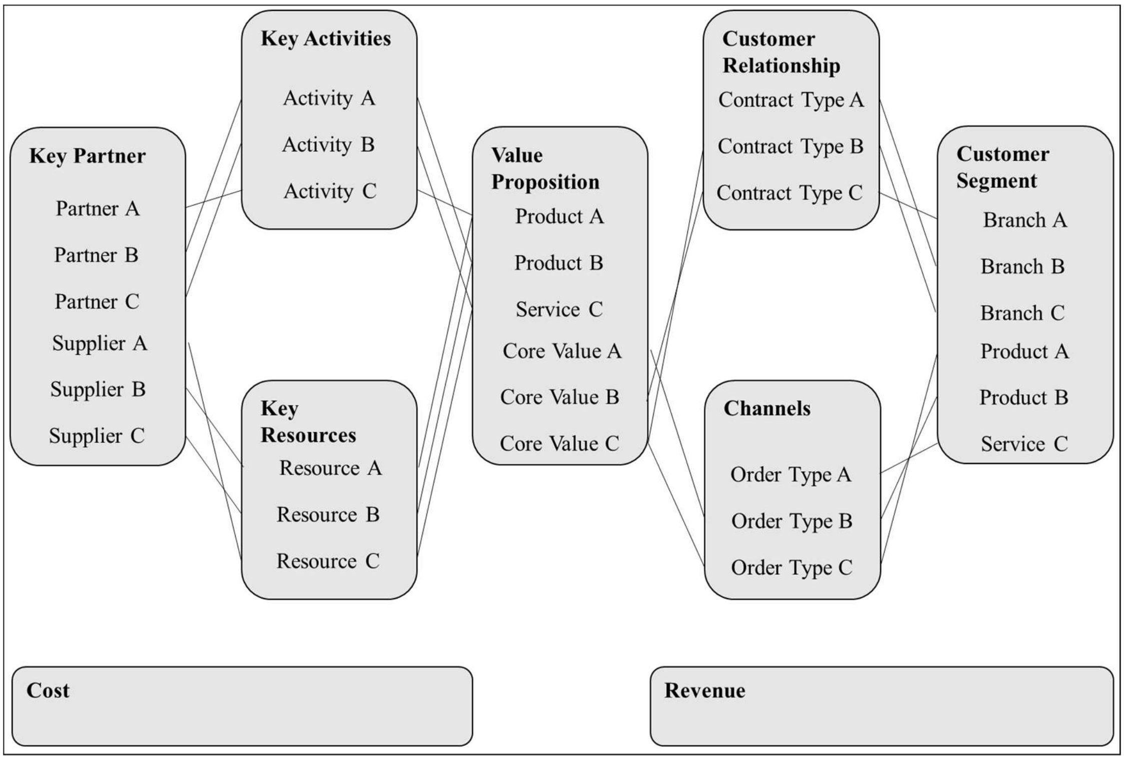


Figure 24: Visualization of the BM Mining Algorithm

5.4. Functionality of the Tool

Next to the already presented algorithm, I will also give an introduction to the functionality of the tool and its implementation. The BM Analyzer is implemented in Microsoft PowerBI, which allows for inserting different data sources like Microsoft Excel, but also data from an SQL Server or from the web. This should ensure that also ERP systems can be included. One has to add that this limits the automation mechanism and adaptions have to be made in the tool, so that the represented data is similar to the algorithm. For the example in the following figure, I used Excel tables with the relevant, but abstract information, as demanded in the algorithm. The tool represents this information according to the data structure of the BMC and the ER Model. As demanded, it also has an economic focus on the data and the inclusion criteria. This can be seen in the following figure.

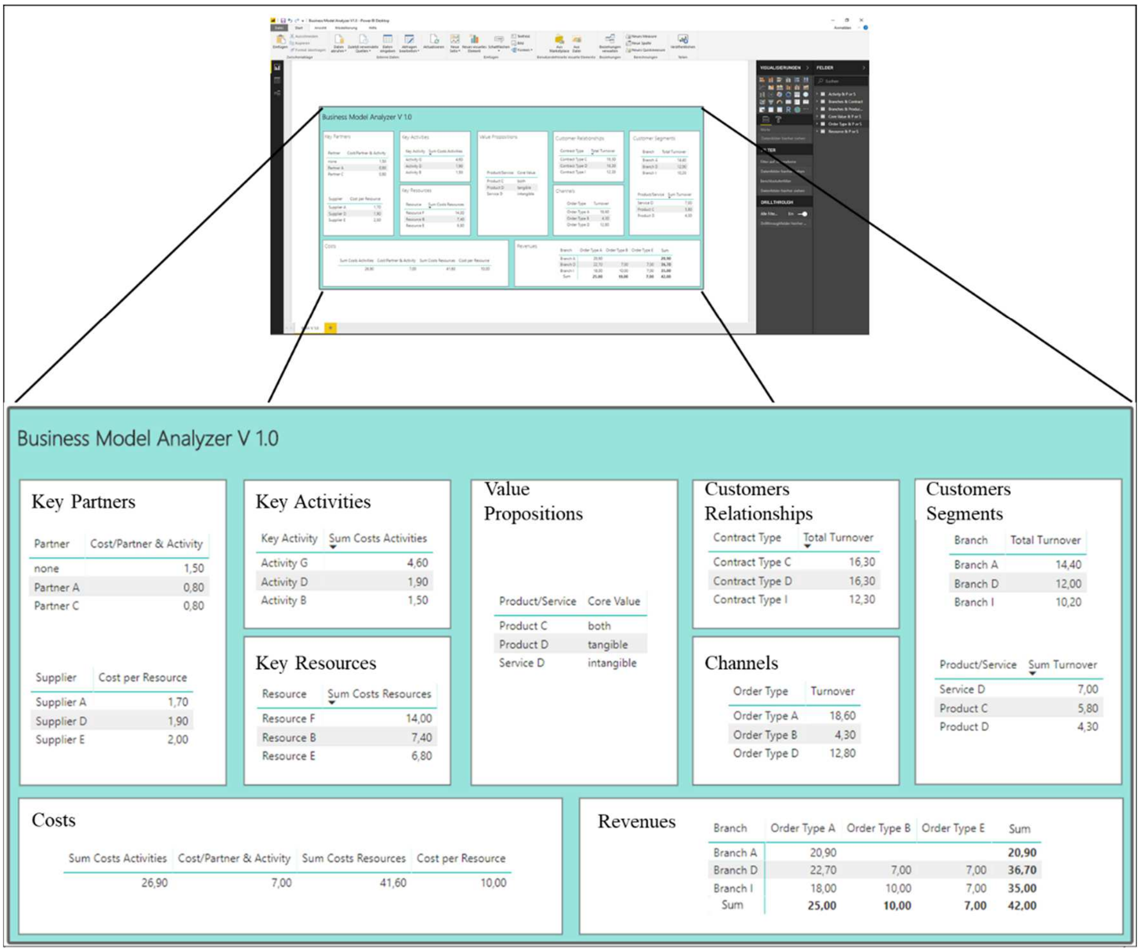


Figure 25: Screenshot of the BM Analytics Tool 1.0

As presented in the figure, one can see the different categories of the BMC and the top three elements for each category according to its economic value and the relation to the most important products or services. In this example, the most important products were “Product C” and “Product D” as well as the most important service “Service D” according to their value. Related to this are the order types and the core values of each product or service, as well as the branches, key resources and activities. Related to the branches as well as to the core value are the contract types, which represent the customer relationship between the company and the customer segments. On the left hand side, one can see the most important key partners and the suppliers for this BM. Additionally, important value captures are included. For the costs and revenues, the economic values, which builds an evaluation criterion for selecting the elements, are represented. As a result, this BM Analytics Tool V1.0 gives an abstract overview of the functionality of the tool as well as the objective elements, retrieved by the data.

However, for the value proposition category, also subjective elements can play an important role. This is shown in the following sub-section.

5.5. Refinement of the Tool

The presented BM Mining Algorithm can help companies to retrieve their BM from their own data as shown above. Thereby, all categories of the BM Canvas can be filled out with this data. This results in the creation of a bottom up model of the value creation of a company. In the focus is the value proposition towards the customer, which the algorithm describes as objective elements. But the algorithm has already shown that additional information must be provided and that human intervention is necessary in order to distinguish between objective and subjective values. In general, easy to retrieve are the objective values of a company, which are often accompanied by hard facts and KPIs. However, for some BMs it makes sense to describe also the subjective values, as for example the objective value is not decisive for the purchase. For example, a specific smartphone can be chosen instead of the good price or the functions, but for lifestyle or social status reasons. Some companies even focus on these subjective values as a strategy of diversification. In the following, I describe an enhancement of the existing BM Mining tool and the algorithm. It is not included in the tool so far, because it needs another kind of information, which is differing from the data from the BM Mining algorithm. This can make the use of the algorithm complex and it is likely that people are not willing to take this huge effort. Furthermore, it is against the “character” of a BM, to get a fast overview of the current business (Osterwalder and Pigneur 2010). Another reason is that the character of subjectivity is defined differently by different people. As a result, this can be a reason for arguing against the BM and could possibly lead to a rejection of this proposal for the value creation of the company. Nevertheless, I will present the enlargement as a possibility for further value proposition mining and to answer the demand of Ebel et al. (2016) to use the full potential of current technical possibilities. This approach is taken from Augenstein et al. (2018a), which was a joint project with the University of Kassel, presented as a short paper at ICIS 2018.

“Johnson et al. (2008) as well as Demil and Lecocq (2010) describe that correctly defining the status quo business model of a company needs an exhaustive description of the current value creation mechanisms. Next to traditional approaches such as the Business Model Canvas (BMC) of Osterwalder (2004), data-driven approaches emerge as valuable alternatives (Augenstein et al. 2018b). With data from enterprise systems such as enterprise resource planning (ERP), a current status of the value creation process of a company can be rebuilt objectively. Such systems capture structured data about the core BMC categories customers, resources, suppliers, costs, revenues, or sales channels as well as key activities. However, a key challenge is to (semi-) automatically extract the value proposition (VP) of a company, as this information is usually not kept in ERP systems. This is because a simple information retrieval of a web page can lead to wrong or too less/much information or one decides for uninteresting data related to the case one has to solve. Data Mining and a related describing algorithm can lead to an objective degree of abstraction of the relating value proposition. We will retrieve such an algorithm through scanning hundreds of web pages and find common elements, which can lead to such a describing algorithm for retrieving a more objective VP. Osterwalder and Pigneur (2010) define this VP as *"[…] the reason why customers turn to one company over another. It solves a customer problem or satisfies a customer need" (Osterwalder and Pigneur 2010, p. 22).* This information can only be identified in organizational IS if one focuses on the offered products, services or bundles. However, there are many existing sources a company publicly provides to inform their customers about expected benefits of a product or service. Moreover, such data covers rather latent information on the customer value. On the other hand, companies and especially startups need to communicate their offering to customers and other stakeholders. Therefore, they rely on mainly unstructured textual data such as business plans, pitches, or online descriptions. To find a describing algorithm to mine the VP, we "mine" and classify information from unstructured textual data to achieve a close description of a company's VP and to realize a complete data-driven status quo of a firm´s offerings. Therefore, this extension aims to improve the value proposition mining. However, mining qualitative elements of the value proposition like customers' benefits from ERP data is difficult. As a consequence, we want to enhance the BM Miner through an intelligent information extraction system which collects qualitative VP data automatically from web pages and classifies it accordingly. "Intelligent" means hereby that the system follows patterns and learns to extract data from web pages with new patterns. From a scientific point of view, we enlarge the basis of design knowledge for data-driven BM approaches. Furthermore, building such tools enables practitioners to make subject decisions of latent VP data more fact-based and objectively, which might create interest in domains such as venture capital investing or M&As." (Augenstein et al. 2018a, pp. 1–2)

Data

"We use the information of 492 homepages of different companies in the Internet of Things category on the startup database CrunchBase (www.crunchbase.com) to create a VP taxonomy and train the classifier. We see the number of 492 companies as adequate because we can consider different facets and various ways of presenting the VP on homepages. We want to mention that we do not use this data for evaluating/validating our approach. We focused on companies with only one product or service because some companies have more than one BM, which makes it hard to collate the elements to the respective model. The addressed industries contain several categories to include a broad range of VPs. For the taxonomy, we created a semantics related to the value proposition of a company. Thereby, we focused for example on the customer wants and needs (i.e. problem), the customers value, the problem solving, the product or service and many more. For each category, we searched the related terms on the webpage manually and created a common taxonomy the classifier can use. For the BM Mining tool of cycle one, we used ERP data from our industry partners for all categories except the "Key Activities". For this category, we used process mining algorithms to find the relevant information for the BM. We thereby focused on various processes of the company. Generally, we followed the generic structure of Osterwalder and Pigneur (2010). Consequently, we ensure that the mined BMC is similar to the traditional BMC approach to support a better comparability between the different approaches and the gold standard in the evaluation. The advantage of this approach is the possibility of data triangulation with the different forms of qualitative and quantitative data and the different data acquisition techniques including transactional data from ERP systems and interviews with different groups of people in the companies (e.g. Remus and Wiener 2010). One has to add that this transactional data is not the same data, used in the BM Miner but additional data specialized on the VP of a company.

Conceptualization

In this section, we propose our meta-requirements and tentative version of design principles for our value proposition miner. As mentioned before, we want to create an intelligent information extraction system which collects value proposition data automatically from websites. We decided for websites because we see herein the biggest chance to collect "subjective" VPs. As mentioned, other sources like business reports or ERP data contain VPs too, but these are more abstract and rarely represent the reasons why people decide for the product or the service. However, this is reflected in the webpages, which need to address the users with their needs appropriately. "Intelligent information extraction system" means hereby that the system follows patterns and learns to extract data from websites with new patterns. Analyzing 200 webpages of the companies, we discovered that the presentation and proposition of the value differs enormously among each other. While some companies for example use the starting page to present the value with concrete bullet points, some others hide the information in a text on separate pages. In general, the representation of the value proposition varies not only between qualitative, quantitative or both elements but also between the representation of the value proposition. This makes it difficult to collect the relevant data tool-supported without a clear structure of this information. However, the automated collection of the data in an efficient way is important because the user is not prepared to accept long performance times for the data extraction and also the correctness of the results plays an important role. In general, a web crawler cannot be configured individually for all web pages, but it should be usable for each single web page without any further effort. As a result, we demand the first meta-requirement (***MR1***) that for a data-driven value proposition appropriate data needs to be found and collected tool-supported e.g. through a web-crawler.

MR1: To enable data-driven creation of the value proposition, appropriate data needs to be identified and collected tool-supported.

As mentioned above, each company presents their value proposition on a homepage differently. To be able to compare different value propositions and to refer the descriptors to a document for indexing the facts contained therein, a structure of the data is necessary. A controlled indexing for example in an ontology can build a data set which can show individually the value proposition of a company. At the same time, the whole amount of data can build a base to train web crawler for finding the relevant information on very specific or unstructured web pages. Besides this, it is important to structure extracted data for users to increase their comprehension about the content of the data (Augenstein et al. 2018b). So, we propose that extracted data should be structured intelligently and uniformly in the second meta-requirement (***MR2***).

MR2: To guarantee comparability of different value propositions, the extracted data should be structured in a unified way.

Next to the structure of the data, the amount and level also plays a huge role for the understanding of the user. The amount of data should be reduced to reflect the logic how a company creates value on a suitable level (Osterwalder and Pigneur 2010). Therefore, the relevant data needs to be aggregated (Augenstein and Fleig 2017), as we demand in meta-requirement three (***MR3***). It is also important to aggregate the information to not get an incomprehensible ontology. A comprehensive ontology can also build the base for ontology learning.

MR3: To chronicle only relevant elements of the value proposition, the collected data should be aggregated.

To build an intelligent information extraction system which collects value proposition data automatically from websites, the meta-requirements must be translated into concrete design principles. As one goal is to collect the data tool-supported, appropriate schemata to derive the value proposition from data need to be defined. Using an ontology to describe the value proposition and the necessary data helps to focus on the relevant information on a website (**DP1**). A web crawler can then retrieve this data automatically from the website (**DP2**). However, the web crawler might find a lot of relevant information depending on the web page. As demanded in MR2 and MR3, this raw data should not be presented to the user directly but should be appropriately prepared and be usable. To enable a comparability of the data and to present only relevant data to the user, it needs to be structured. Therefore, a machine learning classifier will be enabled to classify the raw data into the appropriate knowledge representation schema (**DP3**). On the one side, value propositions of different companies or BMs can be compared with each other. On the other side, the user can access the complex information more easily. As mentioned, the value proposition miner should get a kind of intelligence to be able to find all value proposition information on web pages. This is because not all companies describe their value proposition on the start page, but the information is distributed to one or more special pages. A non-intelligent web crawler might miss some of this information. With artificial intelligence, the web crawler should learn while extracting web pages and should therefore be able to cover a wide spectrum of different kind of value propositions on web pages. An ontology learning method (**DP4**) will thereby help him to find the relevant new categories. Therefore, an intelligent algorithmic word embedding approach (e.g. word2vec) should enable the value proposition miner to identify and learn novel sub-categories of the ontology independently. Such approaches use two-layer neuronal networks to reconstruct the linguistic context (i.e. meaning) of words (Mikolov et al. 2013). As a result, the more web pages are scanned, the more accurately it can identify the relevant information." (Augenstein et al. 2018a, pp. 5–7)

Design Principle	Related MR	Description
DP 1	MR1	For an identification of appropropriate data, a value proposition ontology needs to be created.
DP2	MR1	An unstructured data crawler collects the appropriate data to create a data-driven value proposition.
DP3	MR2 & 3	For structuring the collected data, a machine learning classifier will be enabled.
DP4	MR3	Ontology learning methods will be approached to chronicle only relevant value proposition elements.

Table 11: Description of design principles and related meta requirements (Augenstein et al. 2018a)

Instantiation

"To instantiate our proposed design principles into an IT artifact, we first created an OWL ontology with the open source ontology editor Protégé (www.protege.stanford.edu). We then build a Python-based web crawler on the Scrapy framework (www.scrapy.org) with which we crawled the unstructured textual descriptions of the startups' value propositions. We then hand-labeled each of the startups' descriptions following the categories of our ontology that was initially developed. All data is stored in a relational SQL database. After this, we preprocessed the data through tokenization, normalization (stemming and lemmatization) and noise removal (e.g. markup data etc.). This data is then used to train a machine learning model. Therefore, we build a Naïve Bayes algorithm on the Python-based machine learning framework TensorFlow (www.tensorflow.org). Naïve Bayes constitutes a probabilistic classifier that is based on the "Bayes Theorem" (Murphy 2012). One of the main assumptions of Naïve Bayes is the conditional independence of the data features. This means that Naïve Bayes does not consider any correlations between a set of features that constitute a class variable. Features in our context (i.e. text classification) constitute single words. The presence of features is used to predict a certain class. To do so, words are represented in a 2-dimesional word document term matrix also known as Bag of Words (Thang et al. 2010). In the next steps, we will implement a Word2Vec algorithm to automatically identify new categories for the ontology as we proceed the mining process. Additionally, we created a web application as GUI to visualize the mined VPs to users. This can be seen in the following figure." (Augenstein et al. 2018a, p. 7).

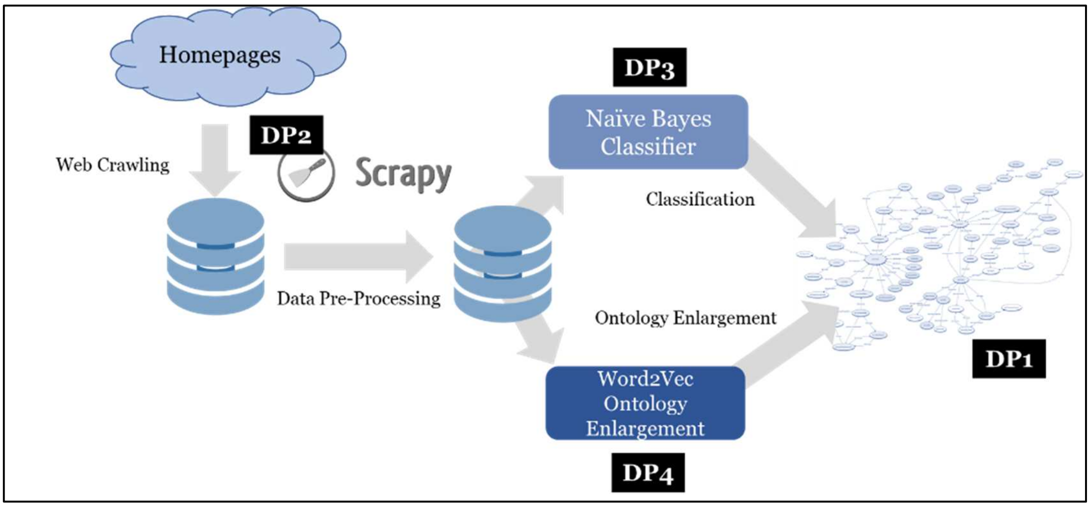


Figure 26: Architecture of the Value Proposition Mining Tool (Augenstein et al. 2018a)

"Through this approach I want to extract the VP of a company automatically. However, I think that human input should not be excluded, as previous studies (e.g. Augenstein et al. (2016)) have shown. One reason is that some people have special and important knowledge. Therefore, I decide for a semi-automated approach: First, the VP Miner proposes a set of VPs. Then the user can change elements and it is possible to add or to delete elements. The result is a set of VPs which is created bottom-up through mining different information sources like web pages and which is evaluated top-down through decision makers.

Interim Conclusion

For decision makers, BMs are very important to make good decisions for example during a transformation phase. With this research project, I want to provide an effective and efficient modeling method, which is advantageous compared to existing approaches in terms of effort, objectivity, flexibility, and costs. In this work, I present a novel and innovative approach to explore design principles to improve my and other existing approaches of BM mining with focus on qualitative VPs retrieval. My artifact automatically discovers the VP of a company through the company's own web page. In my DSR project we use Osterwalder's (2004) BMC as a representation of BMs which is widely accepted by scientists and practitioners. I started to build an ontology and a web crawler which automatically extracts the value proposition of a company's homepage. Therefore, I scanned 200 web pages by hand and built an ontology. By relying on companies' data as a bottom-up approach, I target the satisfaction of an increased objectivity for the representation of the value creation. Furthermore, I want to increase the correctness of a company's BM and decrease the modeling effort for users." (Augenstein et al. 2018a, p. 8).

5.6. Evaluation

In order to evaluate the functionality of a BM tool with increased objectivity as well as the related design principles and meta-requirements, I decided for a field experiment. The advantage of field experiments is that the artifact can be tested in real world conditions. An artificial system, for example in a lab experiment, would not proof the suitability and function in a real world environment. Furthermore, the artifact needs real world data from companies. If one would create such a set of data, one would not know, if the artifact can create a BM, which is reflecting the correct value creation of a company. To evaluate this first design cycle, I introduced the evaluation framework of Venable et al. (2016) in the methodology section. As a first step, I carried out a literature search, which was supplemented by further studies and interviews confirming these needs. For the evaluation of the meta-requirements and design principles and the implementation, I first did a field experiment with an industry partner. The aim is to show that an algorithm only based on the leading questions of Osterwalder and Pigneur (2010) to fill out the BMC is not suitable enough, although the requirements and design principles are fulfilled. The results confirm this assumption and show the need of implementing the design principles in a more complex algorithm, considering also the characteristics of BMs in general and the specific characterizations of the value creation of a company. As a result, I did another round in this DSR cycle one and sharpened the algorithm as described above. In this algorithm, also the specific characterizations as well as the flows of goods, services and information is implicitly considered. Based on this new algorithm, I did another evaluation round for the BM Analyzer tool with a second industry partner, to show that the solution really fits to the objectives of this first design cycle. The results of this evaluation round significantly shows an increase of objectivity as shown in the following sub-sections.

Evaluation of the Algorithm Cycle 1a

In the first round of this DSR cycle one, a field experiment was conducted. The main focus of this field experiment was to evaluate the current BM creation approach of Osterwalder and Pigneur (2010), which is the base for the meta-requirements and design principles. As industry partner for this evaluation step, I decided for a manufacturing corporation. The industry partner has around 6.000 employees, is operating in more than 16 countries and is specialized in producing domestic appliances. 21 experts in business and business modeling participated with an average work experience around 8.5 years. The different departments are shown in the following table.

Department/Profession	Number of Participants
Employee Controlling	4
Employee Team Logistics Execution	2
Employee Quality	2
Consultant Finance & Business Intelligence	9
Employee Sales & Distribution	4

Table 12: Profession of the Participants

The interviews have taken place at the meeting rooms of the company and lasted between 15 and 30 minutes. After a short introduction into the topic of business modeling and the purpose of the interview, the task for the participants was to fill out the BMC to the best of their knowledge and without any help. Then the gold standard was created with four senior managers having more than 10 years working experience in this company each. Outcome was the gold standard of the value creation of the company, shown in the following figure.

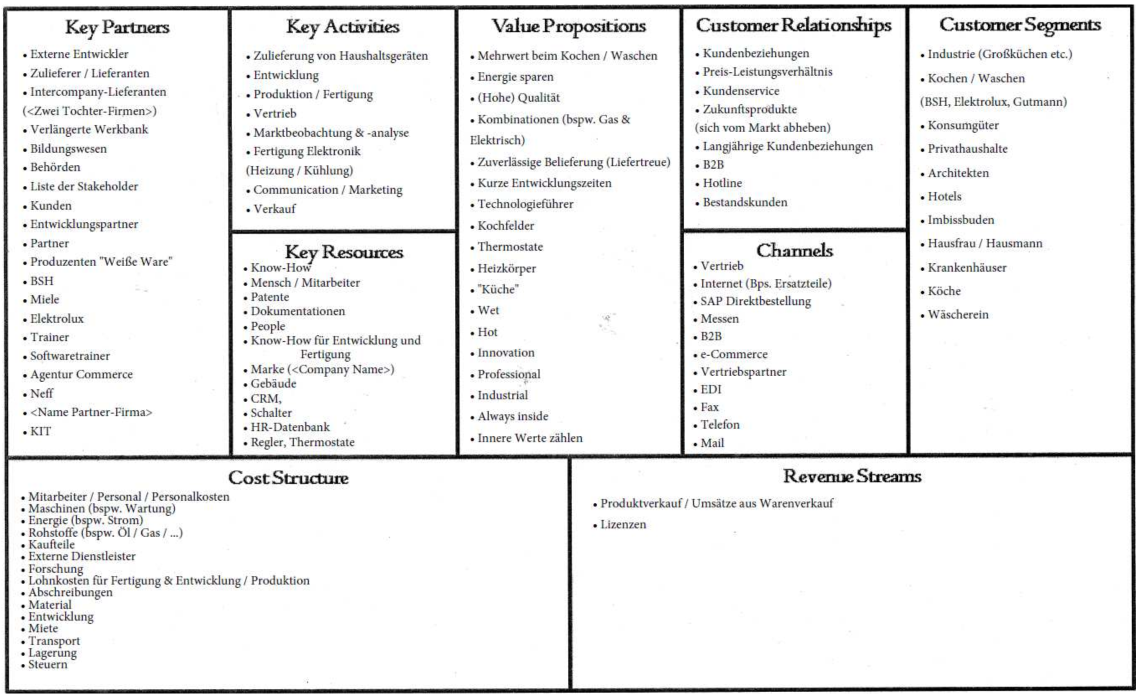
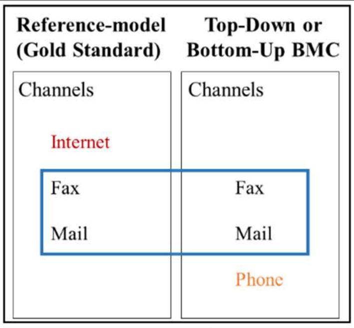


Figure 27: Gold Standard of the Evaluation Cycle 1a

As last step, the data-driven BM was derived from the data of the SAP R/3 system. For each category, the leading questions of Osterwalder and Pigneur (2010) were used to derive the related elements for each category of the ERP system. For example, for the “Key Resources” the most important elements according to their value were detected. This is in contrast to evaluation cycle 1b, where the algorithm, presented above is used.

As metrics for evaluation 1a and 1b, I used “Accuracy, Precision, Recall and F1-Score” (van Rijsbergen 1980). Accuracy thereby means the ratio of the number of "correctly" named elements to the number of <u>all elements</u>. Precision is similar to accuracy. However, the ratio of the number of "correctly" named elements to the number of all <u>named elements</u> is measured here. A “named element” or “direct hit” is defined as element, which is included in the gold standard and named by the top-down (or similar by the bottom-up) approach. Recall corresponds to the proportion of "correctly" named elements to the sum of these and non-named elements (all gold standard elements). F1-Score is calculated as the weighted average of the metrics precision and recall. Therefore, this score considers both false negatives and false positives. Especially in cases of an uneven distribution, F1-Score is usually more useful than accuracy. In the following, a calculation example is given for the category of channels. In the gold standard included are the elements “Internet, Fax and Mail”. In the fictive top-down (or bottom-up) approach, the elements “Fax, Mail and Phone” are named. As direct hits or correctly named elements, “Mail and Fax” result. Not named is “Internet” and wrongly named is “Phone”. The following figure contains next to the exemplary calculation also the adapted formulas of the four metrics.



Metric	F1-Score
Formula	2*(Recall * Precision) / (Recall + Precision)
Calculation	2*(0,67*0,67)/(0,67+0,67) = 2/3 = 0,67

Metric	Accuracy	Precision	Recall
Formula	(correctly named elements) / (all elements)	(correctly named elements) / (all named elements)	(correctly named elements) / (gold standard elements)
Considered Elements	(Fax+Mail) / (Fax+Mail+Internet+Phone)	(Fax+Mail) / (Fax+Mail+Phone)	(Fax+Mail) / (Internet+Fax+Mail)
Calculation	(1+1)/(1+1+1+1)= 2/4=0,5	(1+1)/(1+1+1)=2/3=0,67	(1+1)/(1+1+1)=2/3=0,67

Figure 28: Exemplary Calculation of the Evaluation Metrics

These metrics are used in the following to evaluate the results of the interviews and the BM from the ERP systems. Important is the number of correct elements, which implies also the number of incorrect elements as difference between the number of total elements and correct elements. A correct element is thereby defined as an element of a BMC of the interviews (top down) or as the data-driven BMC (bottom up) which is also included in the gold standard (direct hit). The results are shown in the following table.

Table 13: Results of the Field Experiment Cycle 1a

Category \ Metrics	Interview_Accuracy	Interview_Precision	Interview_Recall	Interview_F1_Score	Algorithm_Accuracy	Algorithm_Precision	Algorithm_Recall	Algorithm_F1_Score
Key Partners	3,11%	20,00%	51,80%	28,86%	1,24%	0,00%	20,00%	0,00%
Key Activities	10,48%	19,00%	76,00%	30,40%	12,07%	19,00%	87,50%	31,22%
Key Resources	10,48%	22,00%	60,25%	32,23%	4,35%	7,00%	25,00%	10,94%
Value Proposition	17,30%	21,00%	51,94%	29,91%	1,85%	6,00%	5,56%	5,77%
Customer Relationship	23,50%	20,00%	58,75%	29,84%	0,00%	0,00%	0,00%	0,00%
Channels	6,30%	27,00%	51,00%	35,31%	0,00%	0,00%	0,00%	0,00%
Customer Segments	12,81%	19,00%	61,73%	29,06%	0,00%	0,00%	0,00%	0,00%
Cost Structure	1,32%	16,00%	63,20%	25,54%	2,08%	2,00%	100,00%	3,92%
Revenue Streams	2,51%	8,00%	85,33%	14,63%	1,96%	2,00%	66,67%	3,88%
Total	**9,76%**	**19,11%**	**62,22%**	**28,42%**	**2,62%**	**4,00%**	**33,86%**	**6,19%**

The table shows the results of the interview-based top down BMC and the data-driven bottom up BMC. As mentioned, the participants directly inserted their results in the BMC template. The numbers of the top down BMC are average numbers of all 23 BMCs, derived from the interviews. The coding and matching was done by three different independent researchers individually to avoid a bias of the author, resulting in the figure above. Having a look at the results, one can see that just using the key questions of Osterwalder and Pigneur (2010) to derive suitable information from companies' data is not suitable enough when having a look at the metrics. On the one side, to many elements are extracted from data (e.g. Key Partners 32 113 hits) or no correct elements are extracted (e.g. channels with 0 direct hits). At the same time, the employees performed in nearly all metrics and categories better. However, these results do not mean that the approach fails in all cases. The results also reflect the correct elements in the metrics related to some categories of the bottom up approach. As a result, the metrics reveal on the one side that just implementing the leading questions of Osterwalder and Pigneur (2010) does not lead to an increased objectiveness of BMs. This is what I expected at the beginning of this experiment. As result, some more logic is necessary, to consider the specifics of a BM of a company and to show only relevant information. However, the result still indicates that using the BMC approach is one key component for a BM analytics algorithm as the bottom up approach and the top down approach achieve results in the same range, at least in some categories. This means also that the meta-requirements and the design principles are not wrong in any case, but they failed with this kind of implementation. Therefore, I did another round in the design cycle one as a kind of cycle 1b and tried to improve the implementation of the design principles.

Evaluation of the Algorithm Cycle 1b

As shown, the evaluation of the algorithm of the previous cycle 1a shows that only implementing the leading questions of Osterwalder and Pigneur (2010) is not sufficient. In the cycle 1b, I propose an improved approach, which should reflect the value creation of a company correctly. This improved approach can be seen above in the algorithm and the related information. The evaluation was done similar to the evaluation cycle 1a, described above with a new industry partner and with the Business Model Analyzer 1.0. As this is a new industry partner, one cannot directly compare the results of cycle 1a and 1b. The new industry partner sells stamping products for automotive and medicine industries, has around 150 employees and is settled in 3 continents. Again, a gold standard was created together with the management of the company. This is shown in the following figure.

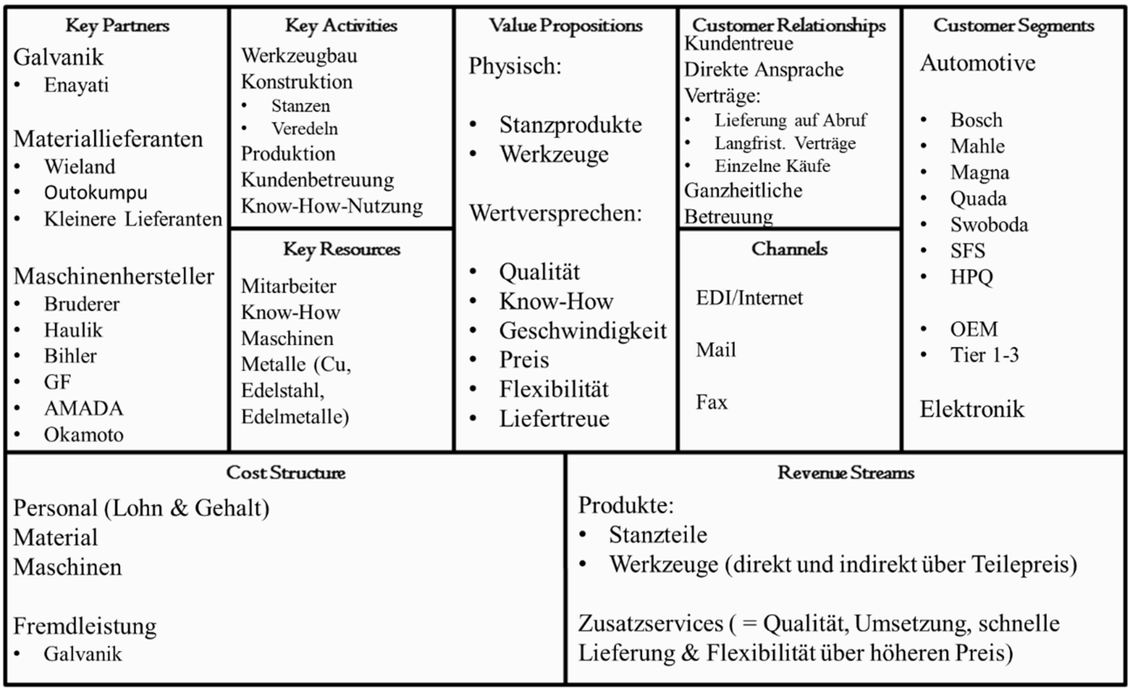


Figure 29: Gold Standard Evaluation Cycle 1b

Then, together with the employees, the top-down BMCs were created and the algorithm as well as the tool was used to derive the data-driven bottom up version of the BMC. This was done similar to cycle 1a: The interviews have taken place at one meeting room of the company and lasted between 15 and 30 minutes. After a short introduction into the topic of business modeling and the purpose of the interview, the task for the participants was to fill out the BMC to the best of their knowledge and without any help. Then the gold standard was created with strategic management. Outcome was the gold standard of the value creation of the company. As last step, the data-driven BM was derived from the data of the ERP system. For that, the advanced algorithm, described in the sub-chapter above, was used. This is shown in the following figure.

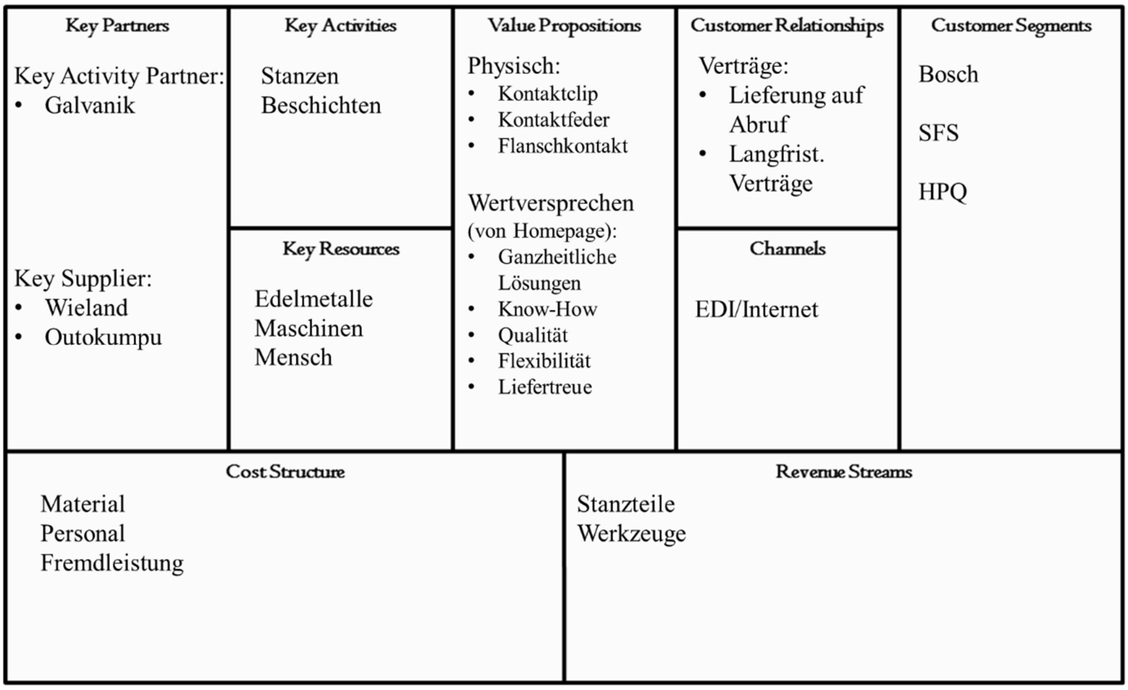


Figure 30: Business Model mined with the BM Analyzer 1

In this evaluation round 1b, I asked nine BM experts of the industry partner, which is operating in the manufacturing industry. They all had leading positions in the upper management level. The results in the following show that this was a good decision, as they were able to give answers with a high accuracy, precision, recall and resulting F1-score. Of course this was under the cost of the number of interview partners, as this company with 150 employees does not have that many managers in such high positions. Similar to the previous cycle, I did the interviews with each manager separately. Before, I had a meeting with the strategic management to define the gold standard in a workshop. The data-driven BM was finally derived from the ERP system of the company. Afterwards, I analyzed the data and calculated the measures for the top-down and bottom-up BMCs according to the metrics of the cycle 1a. Focusing on the top-down BMCs, I built an average for each category to be able to compare the results. These results are shown in the following table. On the left part of the table, the metrics for the top-down BMC (interviews) are shown. The right part of the table displays the metrics of the data-driven bottom-up BMC (algorithm).

Table 14: Results of the Evaluation Cycle 1b

Category \ Metrics	Interview_Accuracy	Interview_Precision	Interview_Recall	Interview_F1_Score	Algorithm_Accuracy	Algorithm_Precision	Algorithm_Recall	Algorithm_F1_Score
Key Partners	40,46%	64,54%	62,96%	56,62%	66,67%	100,00%	66,67%	80,00%
Key Activities	40,00%	83,33%	44,44%	55,21%	40,00%	100,00%	40,00%	57,14%
Key Resources	53,33%	81,11%	60,19%	66,17%	75,00%	100,00%	75,00%	85,71%
Value Proposition	44,36%	68,15%	53,40%	58,93%	55,56%	83,33%	62,50%	71,43%
Customer Relationship	20,55%	48,15%	25,93%	31,63%	33,33%	100,00%	33,33%	50,00%
Channels	54,81%	80,74%	62,96%	66,85%	33,33%	100,00%	33,33%	50,00%
Customer Segments	55,19%	67,41%	77,78%	67,09%	50,00%	100,00%	50,00%	66,67%
Cost Structure	46,85%	69,44%	58,33%	61,93%	75,00%	100,00%	75,00%	85,71%
Revenue Streams	56,30%	94,44%	59,26%	68,57%	66,67%	100,00%	66,67%	80,00%
Total	**45,76%**	**73,03%**	**56,14%**	**59,22%**	**55,06%**	**98,15%**	**55,83%**	**69,63%**

As displayed in the table, both groups achieved notable results. Having a look at the total numbers, one can see that the algorithm performed better in terms of accuracy, precision and F1-Score. At least ten percentage points difference can be regarded. Only for recall, both groups performed nearly the same. The highest values achieved the algorithm in the metric “precision” for the different categories. Remarkable is that also the employees achieved a good result in this metric. This means that employees and the algorithm both do not mention to a certain degree more elements than included in the gold standard. However, also the other values are remarkable and also the employees seem to be well informed and have huge knowledge about the value creation of the company.

The most important results of this evaluation of cycle 1b are as follows: The improved algorithm achieved a remarkable result looking at the metrics accuracy, precision, recall and F1-Score. Although the algorithm has to compete against department heads, it outperformed them. This is remarkable, because in a company with around 150 employees one can assume that the department heads have a close link to the upper management and a common view of the value creation. And this is also proofed by the results of this evaluation. They achieved high values for each single metric. However, the algorithm performed better and achieved in total the same or higher values. I see this as a proof of the suitability of the algorithm to represent the value creation of a company closely to the view of the upper management, represented by the reference model. This contains different advantages. First of all, as reliable company data is used, the algorithm selected that data, which is really fitting to the view of the management and which can be seen as objective. As a result, this algorithm provides an objective overview of the value creation closely to the view of the upper management. Next to this, one has to consider the modeling time. If this tool is closely linked with a suitable data source, one can retrieve such an objective business model much faster from data than model it from scratch. Additionally, it can be adapted, so that it fully reflects the view of the management with low costs of modeling time. Also important is the fact that the meta-requirements and design principles seem to support the retrieval of a more objective BM from data. Through the consistent break-down of the meta-requirements to the design principles and the implementation of these design principles according to the DSR approach, a tool is created, which considers these principles and performs well. Of course, further evaluation rounds may make sense and one can proof the suitability of the tool in companies with different sizes or of other branches. Nevertheless, in this case the tool performs well and seems to be supporting a more objective business modeling as shown in this chapter.

5.7. Responding the Demands of Organizations

In the problem awareness phase as well as in the motivation, the demands of organizations on objectivity was clearly pictured. With this BM Mining approach and especially with the concrete tool functions, these demands were addressed. Through this solution, it is possible to enlarge the time-consuming, manual and error-prone top-down business modeling process through a data-based and (semi-) automated bottom-up approach. Through that it is possible to derive the value creation of a company from the company data, which contains valuable information about the real value creation of a company and is not biased through personal goals. Furthermore, it is thinkable that this approach can be used in combination with the top-down approach. This would lead to a BM, which has objective and fact based information, combined with more subjective and hard to retrieve data from the management. This leads to a wider view on the value creation of a company and can also increase the trust into the solution of the BM. As business modeling in workshops is often combined with long discussions (as I found out in interviews), a data-base can increase the trust of the participants of these workshops and time can be used to more important tasks. In special, the demand of a concrete tool and a mining algorithm is also demanded, which can be used in today’s organization. However, not only the demands of an organization are fulfilled, also theoretical demands are addressed.

5.8. Responding the Demands of Theoretical Perspectives

Different researchers address the missing tool support for specific BM tasks. This design science research cycle provides design knowledge for designing a BM Mining tool. In particular, the BMC, which concentrates primarily on the abstract representation of value creation (Osterwalder and Pigneur 2010), will be used and expanded into a more objective logical representation of how a company creates value. In special, the important input data is defined and structured, which can also be used in other fields, e.g. providing a common business model / business process mining. These insights extend the existing knowledge in business modeling and data analytics both. Researchers can use this knowledge to further extend and sharpen the mining algorithm or to define algorithms specified to a special industry, for example the financial industry. Also the design knowledge for a BM Mining tool can be used or the functions can be included into other tools. This satisfies also the demand of an increased tool support (Veit et al. 2014). In general, an increased objectivity has also influence on other variables. For example, an increased objectivity can also lead to an increase of users' trust or comprehension, which can be investigated in the future. Furthermore, a mining approach provides a faster aggregation of information as a person is able. In special, the mining algorithm can gain insights in the structure of company data from a management view. These insights can be used for data analytics and to be able to understand better the data structure of a company.

5.9. Summary

This chapter gives an overview of the increase of the objectivity of BMs. The included mining algorithm provides a possibility for data-driven bottom-up business model mining. Through that, the existing top-down approach, which is time consuming and error-prone, is enlarged. Both, the bottom-up and top-down approach can be used to get a holistic view of the value creation of a company. Objectivity is demanded from theory and practice both. Through the solution, a BM mining tool can be used in practice and design knowledge extends the existing theoretical knowledge. Additionally, the mining algorithm can be used separately in a specific tool or as insights into data analysis. It demands in special the meta-requirements of this design cycle and of the problem awareness. Therefore, this chapter starts with the definition of the meta-requirements and the derivation of related design principles. It continues with the concrete instantiation and the tool functionalities. As there is a limitation of the mining of the subjective elements of the value creation, an additional enlargement of the tool is provided. Also the impacts in the theoretical and practical demands are shown. Finally, a comprehensive evaluation is done to show the demand of the single requirements of this first DSR cycle. In the following chapter, the increase of BM comprehension is investigated in a second design cycle. In design cycle three, both concepts of objectivity and comprehension are combined to a BM Analyzer tool, which should support organizations and should generate (design) knowledge for theory.

6. Examining Principles for BM Analyzer - Focus Comprehension (Cycle 2)[6]

In today's business environments, companies are forced to adapt or renew their business models in a short period of time (Teece 2010). Understanding the current BM of a company is essential to maintain its market position and define adequate strategies (Magretta 2002; Chesbrough 2007). So far, several BM frameworks and artifacts have been developed to support decision makers in defining the current BM of a company (Ebel et al. 2016). However, only a few tools implicitly consider the comprehension of users. One example is the Business Model Canvas (BMC) of Osterwalder and Pigneur (2010), which has a good comprehensibility, but only through an abstraction that represents a business model on a simple level. The BMC is typically filled out in a workshop format with a group of experts and then presented and used by many different stakeholders in organizations. The understanding of BMs is important as a basis for communication and unites the views of different interest groups. As a result, one could advance the BMC, which already provides a good communication base. Similar to a blueprint in the construction branch, an advanced BMC could function as an easy plan, which shows the current condition of the value creation of a company in form of a BM.

Today, the view of the BMC and in general most of the BM approaches is mainly focused on a strategic level (Osterwalder 2004). This has the consequence that operational views are not represented suitable enough in the BM approach. However, there is still room for improvement as a basis for communication or for the understanding of interest groups at these operational levels. Similar, Lindgren and Rasmussen (2013) state the need to "fully understand the levels, dimensions and components of the business models thoroughly" and to be "able to communicate, work and innovate with business models at these levels" (Lindgren and Rasmussen 2013, p. 158). As a consequence, an advancement of the BMC framework could support the users' comprehension throughout the strategy and the operational levels of the organization and provides a common communication platform about the value creation similar to a blueprint. This was also one thought of the founders of the BMC

[6] Augenstein and Mädche 2017; Augenstein et al. 2018b; Augenstein and Fleig 2018

(Osterwalder and Pigneur 2010). In the last years, different improvements of the BMC as well as new BM frameworks focused on the increase of comprehension between the operational and strategical levels through more detailed information about the process of the value creation (such as Lindgren and Rasmussen 2013; Ebel et al. 2016). However, still "huge unexplored possibilities" are existing in this topic (Lindgren and Rasmussen 2013, p. 158).

I will take that up and focus on the aspects of a better understanding of the users of BMs. Next to the existing focus of BMs on strategic views (Osterwalder 2004), a challenge for the BM understanding of a user is also the low transparency between the elements (Reuver et al. 2013). To solve this problem, I focus on the question, according to Augenstein and Fleig (2018):

Which design principles increase users' business model comprehension?

The current research in the research area of BM comprehension is still at an early stage, however, related disciplines like business processes and others provide suitable input to solve this challenge. To find a solution, I rely on the Business Model Canvas and formulate related meta-requirements and design principles for an advancement of the BMC in order to increase the BM comprehension (Alt and Zimmermann 2001; Doz and Kosonen 2010; Zott et al. 2011; Veit et al. 2014). From a scientific point of view, I do not only develop design knowledge for an increased BM comprehension, but provide also functionalities and show possibilities to design BM tools with increased comprehension. This should help also practitioners to develop artifacts for their needs. Furthermore, it should support the understanding of a company's individual way of value creation. Through this, they should be able to make better decisions through this improved knowledge.

In order to answer the mentioned research question, the chapter is consisting of the following sub-chapters. Chapter 6.1 starts with the meta-requirements for an increased BM comprehension. This is followed by the design principles in chapter 6.2. As a base, literature was conducted, as well as interviews and the knowledge of the previous design cycle one. Using these design principles, a tool was created, which is shown in chapter 6.3. The function of the tool is to evaluate the different design principles in a lab design. It could be used in practice too. However, a huge effort would be necessary to adapt the tool to a specific company. Therefore, I decide to just include the functionalities in the common BM Analyzer in cycle three, which also contains the design principles of the BM Mining from the previous chapter. In this chapter, I will also show the responds on the theoretical (chapter 6.4) and practical (chapter 6.5) demands of an organization. The tool is evaluated in a lab experiment (chapter 6.6) as well as in a qualitative field study with an industry partner. This chapter concludes then with the summary (6.7), which is containing an overview and the most important findings of this second DSR cycle.

6.1. Meta Requirements

Industry demands an increase of comprehension of BMs in order to function as a communication platform (Osterwalder and Pigneur 2010). Current theoretical approaches as well as practical inventions provide a solid base for such a communication platform and a support of business modelers. For example, the BMC provides a base, which is suitable to be improved towards a holistic comprehension of the value creation (Osterwalder and Pigneur 2010). In order to increase BM comprehension compared to the traditional BMC, I derive several meta-requirements. Thereby, I define BM comprehension analogous to the established business process comprehension. Both, business process modeling and business modeling have the demand in terms of comprehension, to make the (value creation) processes and activities understandable. As a result, comprehension means, how BMs “can be designed so that comprehension of these models can be maximized” (Recker et al. 2014, p. 200). During the evaluation interviews of the previous cycle with my industry partners, it came out that employees do not necessarily understand the initial value creation of a company. This is a threat, because during communications or for strategy derivations, the initial value creation of a company should be understood to a high degree. Otherwise, wrong decisions or ineffective communications are a thinkable consequence. As a result, there is a need to increase the comprehension of business modelers and the users of BMs. Existing literature is addressing this need, too: Richardson (2008) claims that BMs should not be mixed up with a strategy plan or a table of actions for a strategy implementation (also Morris et al. (2005) and Di Valentin et al. (2012)). Al-Debei and Avison (2010) demand a special role for the BM in an organization. For them the BM should mediate between different levels of a company, especially the strategic and operational level. Therefore, it is important that the BM is understood by stakeholders from both levels. This is similar to the example of the blueprint of the construction branch. Thereby, the involved persons (e.g. site manager or architect) of the “strategic” level of the project as well as from the operational layer (e.g. construction workers) should understand this construction plan and should be able to talk about the same things. Otherwise the building would not be save or would collapse. Similar to this, the BM should function as a platform for organizations. In special, there is a need of BMs to be comprehensible for the operational and tactical as well as the strategic levels of a company (Al-Debei and Avison 2010). Essential for this is an increased BM comprehension through adequate BM frameworks or artifacts. Thereby, a BM should explicitly delineate the process of the value creation of the organization, as well as the related elements and the dependencies (Rosenbloom 2012). As a result, the meta-requirement (MR) four is formulated, which demands the capture of the whole value creation process and highlighting the interdependencies between the included elements, (following Augenstein and Mädche (2017), Augenstein and Fleig (2018)):

MR 4: The value creation process of a company and the interdependencies between the elements should be made explicit.

Another aspect of a comprehension of the value creation is the measure of success through KPIs (Pauwels et al. 2009). KPIs and numbers in general enable an assessment of the current way of value creation as well as the identification of strengths and weaknesses. They give a feeling about the condition of a company or a special business unit of it. Therefore, KPIs are often included in BM frameworks (e.g. Lindgren and Rasmussen (2013)) or are at least not explicitely excluted. Also the BMC contains two value capturing categories, which are “costs” and “revenue”. These two categories give a good overview of the important costs for the key activities and resources as well as an overview of the turnover of the value delivery (Osterwalder and Pigneur 2010). However, these are not the only important KPIs, which are thinkable for a company. For example, Lindgren and Rasmussen (2013) extend the BMC also for a reason of an increased assessment of the value creation. As a result, KPIs seem to be very important for understanding by evaluating the company's position. In addition, it provides a basis of trust for users when the data reflect their assumptions. This was also seen in the previous design cycle for an increased BM objectivity. There, data plays an important role and is a decision criterion for important elements. As a result, I consider an explicit measure of the BM's value creation flow as an important fact for increasing the users' comprehension of BMs. This is demanded in the fifth meta-requirement, according to Augenstein and Fleig (2018):

MR 5. Extending the core value capturing concept of BMC should be enabled.

In their work, Osterwalder and Pigneur (2010) directly address this "value capturing" with focus on the cost and revenue category. However, also a time-dependent value capturing is thinkable. The basic idea is that the values or KPIs of a company are not static, but updated steadily and therefore to be adjusted. Examples can be external changes in boundary conditions and many more (Demil and Lecocq 2010). As a consequence, a certain KPI has not only a current value, but also a "history", represented through the values over time. This history of data can be used to derive future trends or tendencies of the KPIs and values. As a result, they can help to derive suitable strategies for organizations. As an example, one can have a look at the sale rates of a certain product. If they decrease, marketing efforts can be done or the product will not be sold anymore. As a result, such trend lines can support the strategy definition and can help to understand the BM over a period of time more detailed. As a result, an integration of the courses of the KPIs over time could increase the comprehension of BMs (Lindland et al. 1994; Overhage et al. 2012). So I demand the meta-requirement six, according to Augenstein and Fleig (2018):

MR 6. A time-dependent information of value capturing should be supported.

To sum it up, an increased users' comprehension and changes in existing BM approaches can provide benefits for companies as they can derive better decisions and have a common communication platform. Similar, Lindland et al. (1994) argued that "not even the most brilliant solution to a problem would be of any use if no one could understand it" (Lindland et al. 1994, p. 47). Making the relations between the elements and the interdependencies explicit can increase the comprehension of BMs. Additionally, further KPIs and a time-dependent representation of it can increase the trust and comprehension of users of the BMs. These meta-requirements are shown again in the following table. Afterwards, design principles are derived from these meta-requirements in the next sub-chapter. They should help to translate these meta-requirements in concrete design decisions and a concrete instantiation in tool functionalities.

ID	Meta-Requirement	Description
MR 4	The value creation process and interdependencies of elements should be made explicit.	It should be easier to understand the relations between the different business model elements and the value creation flow, because the user has more and deeper information.
MR 5	Extending the core value capturing concept of BMC should be enabled	It should be possible to extend the core BMC value capturing dimensions with additional KPIs. So the user can evaluate the BM and decide rapidly based on this values.
MR 6	Time-dependent information of value capturing should be supported.	Changes of the values should be explicit, so the user can value them and see the direction, the values are heading to.

Table 15: Overview of the meta-requirements for BM Comprehension

6.2. Design Principles

Using the meta-requirements, a BM framework could be designed in a way that the users' comprehension is increased and provides therefore a communication platform similar to a blueprint in the construction branch. In order to build a suitable tool, design principles can help to formulate design demands on the concrete functionality and representation. In the meta-requirement MR4, there is a demand of making the relations between the different elements of the BM more explicit. In a concrete tool, the elements could be linked according the concrete value creation process. This has several advantages. One advantage is that this provides a very comprehensive view on the value creation process and effects of changes on one element can also be regarded easier on the related elements (e.g. pay-offs). On the other hand, it provides an overview without the challenge of an information overflow. Naturally, all elements of a BM are related with each other in a direct or indirect way. For example, a key partner performing an activity can have influence on the satisfaction of customers. In the BMC, these elements are not very close concerning the position in the canvas (key partners are on the left side, customer segments on the right). Linking these elements would not be sufficient as this could lead to an intransparent network. However, every value creation process implicitly states that every key activity influences customer satisfaction (e.g. Porter

(2001b)). As a result, I demand the fourths design principle (DP) 4, according to Augenstein and Fleig (2018):

DP4: Visualize dependencies between business model elements along the value creation process to make value creation process and interdependencies of elements explicit.

Next to the relations, also a demand of KPIs and their changes over time is addressed in the previous sub-chapter. Not only financial values are thinkable to be included as KPIs, also functional KPIs like lead time or number of working hours can provide valuable information. In addition, not only strategic level data can be important, but operational data can also provide appropriate information. In the field of business process mining, it is understood that even this operational data can provide valuable information for the strategic management, if prepared in an aggregated form. Such an extension of the value creation is addressed in the design principle five, according to Augenstein and Fleig (2018):

DP 5: Provide an extended value capturing concept following a business dashboard approach to allow an evaluation of a BM for users of the tool.

The basic idea for the instantiation of this design principle is that users can define that KPIs, they need for their work. Furthermore, the key performance indicator trend can be shown through suitable diagrams like in a dashboard. I decided for line diagrams, as they are very common in today’s business. However, other diagram styles are suitable too and are related on the field of application and users’ desires.

This KPIs can be defined by the user themselves concerning their needs. Additionally, the course of time of the KPIs will be pictured through diagrams like in a dashboard. However, the advantage of line diagrams is the possibility to do and picture predictions on the data to forecast trends (e.g. ARIMA prediction). All in all, these two design principles are shown in the following table. It is shown additionally that meta-requirement four directly relates to design principle four. For the meta-requirements five & six, the design principle five aggregates both needs in one common principle. As mentioned, these principles function as a base or translator for the meta-requirements to instantiate them into concrete tool functionalities (or even an independent tool).

ID	Demand	Design Principle
DP4	MR 4	Visualize dependencies between business model elements along the value creation process to make value creation process and interdependencies of elements explicit.
DP5	MR 5 & 6	Provide an extended value capturing concept following a business dashboard approach to allow an evaluation of a BM for users of the tool.

Table 16: Overview of the Design Principles for BM Comprehension (Augenstein and Fleig 2018)

6.3. Instantiation

As instantiation of the design principles, different possibilities are thinkable. Together with my industry partners, we evaluated different possibilities of instantiation and for sure, there is not only one correct solution. However, I decided for a solution, based on the BMC, as this approach is often used in theory and practice both. Especially in transformation projects, the BMC provides a good base for the current situation as well as a target setup. However, not all categories are directly affected by such a transformation project. As it will be shown later in the evaluation sub-chapter, the industry partner decided for a representation of only that categories, which are important for a transformation. The focus was set on these categories, because the transformation project was very complex and through this focus, redundant information could be fade out. The following figure shows the (anonymized) BMC of the industry partner.

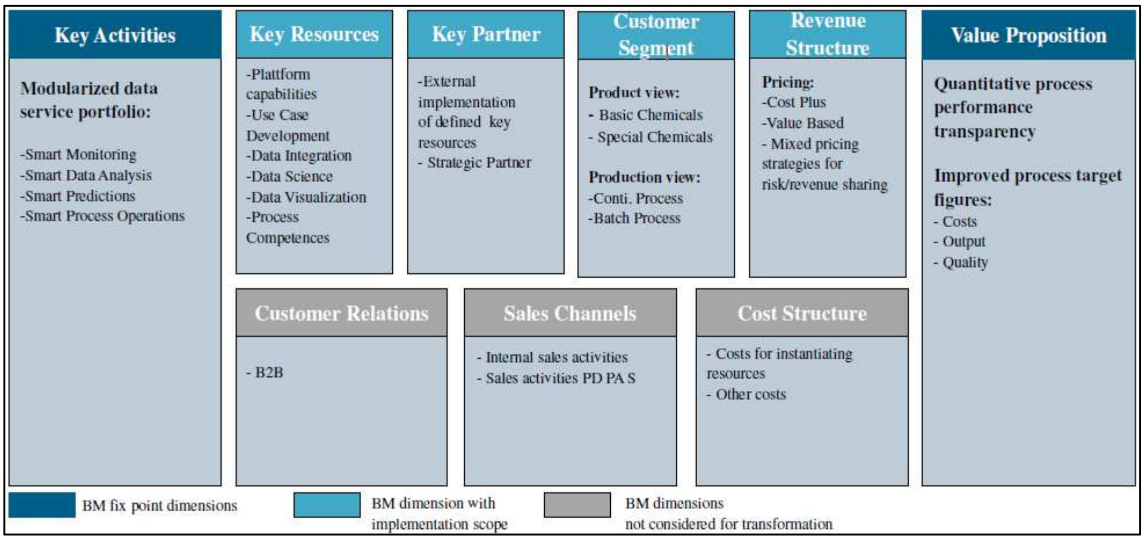


Figure 31: Exemplary BM of the Company Partner

As it can be seen in the figure, the dark and the light blue categories are important for a transformation, while the grey categories are not directly (but indirectly) affected by a transformation. The information of the blue categories is then used to build a semantic network, containing the categories as well as the elements of each category. Furthermore, the elements are connected with each other to demand the requirement of design principle four. Additionally, a KPI section is added to show all important values for the transformation. This demands design principle five for an increased value capturing. On the left hand side in the following figure, one can see an extract of the BM of the business partner. Black knots represent the categories, while grey knots are concrete elements, instantiated in the category. Related elements are furthermore combined with an arrow. On the right side of the figure, one can see the extended value capturing. Not only cost and revenue KPIs are included, but also further important values. Through that, more precise adaptions should be possible.

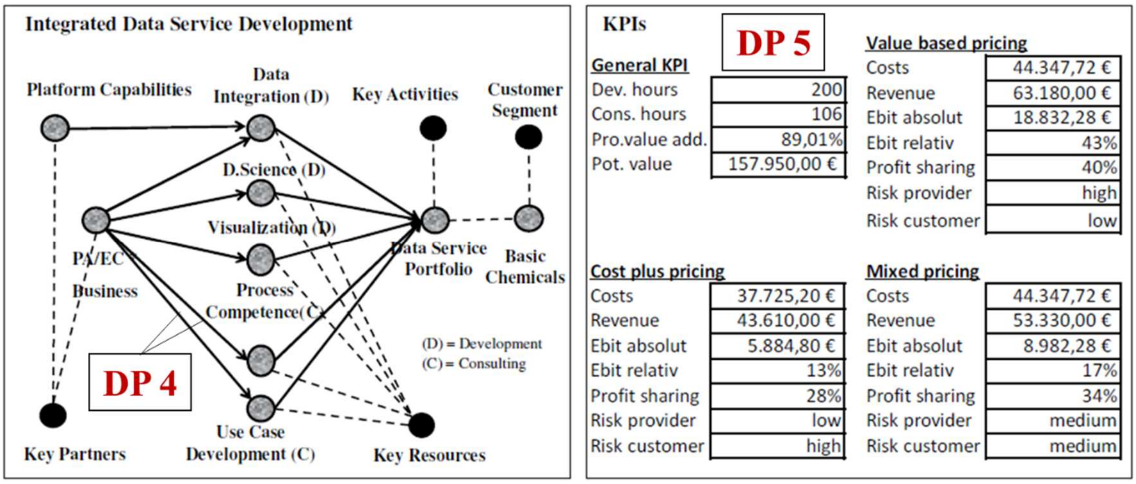


Figure 32: Instantiation of design principles for increased BM Comprehension

As shown in the evaluation phase, described below, the users liked this increased value capturing and the relations between the elements. However, they criticized disadvantages compared with the representation of the BMC. This is why I decided to go back to the BMC representation and use it as a base for the experimental tool. In this experimental tool, the design principles four and five are included. To show the concrete relations between the elements, one can click at one element and directly sees, which elements are successors and predecessors and how they are related. Furthermore, the influence of the elements on the KPIs is included. Additionally, another KPI section is included next to the cost and revenue sections. In this section, further KPIs can be considered. Clicking at a KPI will not only show the related elements, but also the course of the values in a graph. This is shown in the following figure, which represents the experimental tool. As example, it is clicked on the element "revenue of patents". Shown are the related elements and the course of the KPI over the last year.

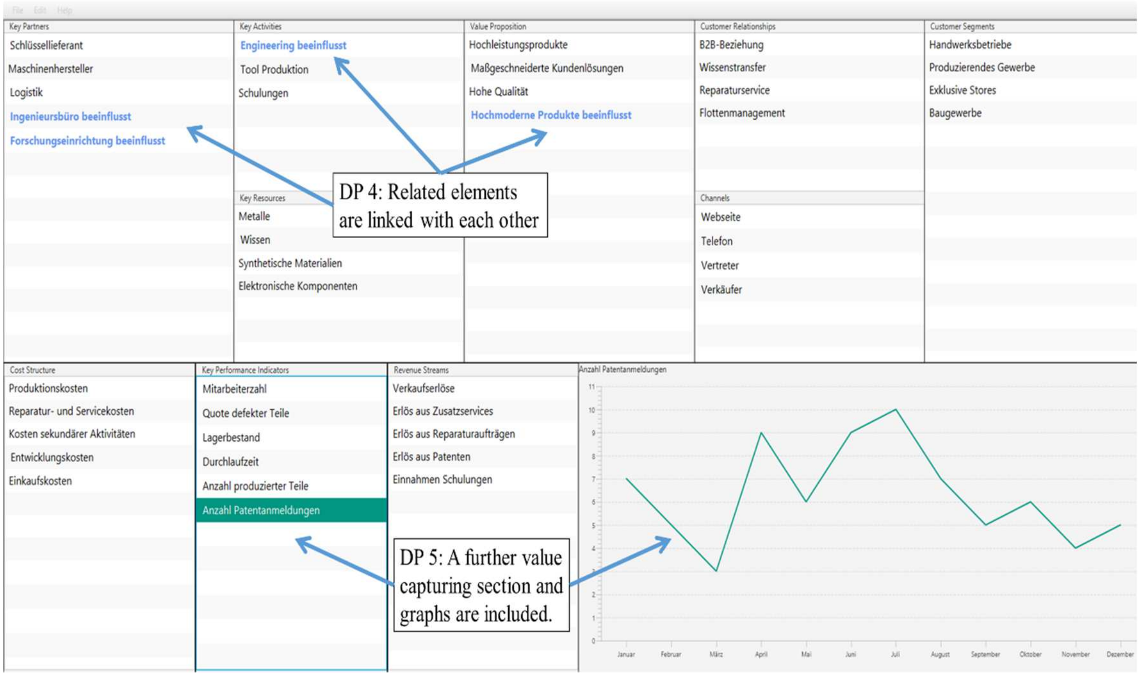


Figure 33: Instantiation of the Experimental Tool.

In section 6.6., the results of the evaluation will be shown. There the effect of the design principles and the tool on users' BM comprehension is delineated. In the following sub-chapters, the responds on the demands of theory and practice will be shown. Evaluation

The evaluation of BM comprehension can be done in two different ways. One possibility is to investigate an increase of comprehension in a real world environment. The advantage for this is to be able to survey in a real world setting the effect on modelers and their actual use. The second possibility is to do an experiment in an isolated setting, with controlled conditions. The advantage thereby is that the effects can be revealed clearly through the controlled situation. As a result, an evaluation in a natural environment and an evaluation in a lab experiment would show the effect of the provided design principles in real world settings as well as in a separated setting.

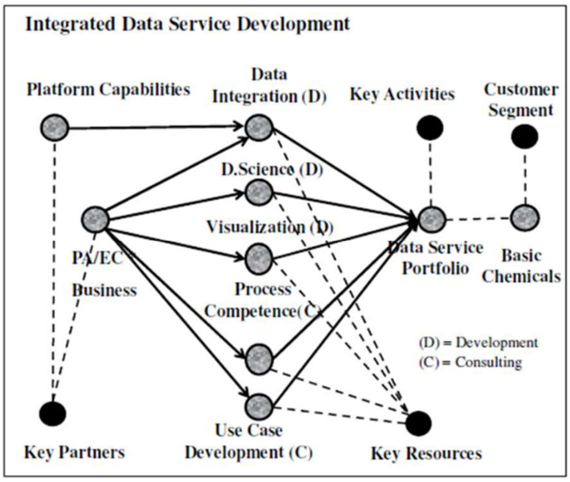
In the methodology, I introduced a framework for evaluation in a DSR project according to Venable et al. (2016). The first evaluation step in this process is the literature review, as well as further studies and interviews. This has confirmed these needs. In order to show that the design meets the meta-requirements and that the instantiation fits the design, I use the results of the real world evaluation, which I conducted together with my industry partner. As a final and most important step, the evaluation of the solution, I conducted a laboratory experiment to make the impact clear. This is shown again in the following figure. In the next sections I will first present the evaluation in the real-world experiment and finally the laboratory experiment.

6.4. Experiment for BM Comprehension Evaluation

In the following, a real world experiment and a lab experiment to evaluate the design principles are conducted.

Real-World Evaluation

Both evaluation goals of showing that the design meets the requirements and that the instantiation fits to the design will be shown in a real-world environment. As business partner I choose a consulting company, because of their knowledge in business modeling and their various projects in this branch. The consulting company is related to production and chemical industry and is part of a stock company with more than 350.000 employees all over the world. Background of the study is a transformation of a customer in the chemical industry. The transformation case wants to shift the current value creation towards an improved value creation. The consultants recorded the current situation and defined a target situation together with the customer. Both situations were inserted into the BMC and transformation solutions and decisions were derived. Another group of consultants inserted the current and target situation into a network independently from the other group. The network contained all categories of the BMC, but the difference was, that the related elements were linked with each other. Through a BM analysis, suitable decisions and a transformation strategy were derived from both groups. Then both groups came together, compered and discussed about the results. This situation fits perfectly, because through that I can show that the design principles meet the requirements. In special, the clear relations between the elements should increase the comprehension of the BM users about the value creation and the BM flows of an organization. Furthermore, an increased value creation should help to derive decisions more easily and more precise. Therefore, I decide to capture the current state in an abstract version of the BMC. The categories were still kept, but the flat canvas was changed into a semantic network. Furthermore, the value capturing was increased and represented in a special KPI dashboard. For the sake of data protection only a small part of this transformation will be shown in the following part. Furthermore, all values are randomized. The extract of this project is focusing on the change of an integrated data service development towards an outsourcing of this service. The following figure shows the current status of the company in the related semantic BM.



KPIs

General KPI	
Dev. hours	200
Cons. hours	106
Pro.value add.	89,01%
Pot. value	157.950,00 €

Value based pricing	
Costs	44.347,72 €
Revenue	63.180,00 €
Ebit absolut	18.832,28 €
Ebit relativ	43%
Profit sharing	40%
Risk provider	high
Risk customer	low

Cost plus pricing	
Costs	37.725,20 €
Revenue	43.610,00 €
Ebit absolut	5.884,80 €
Ebit relativ	13%
Profit sharing	28%
Risk provider	low
Risk customer	high

Mixed pricing	
Costs	44.347,72 €
Revenue	53.330,00 €
Ebit absolut	8.982,28 €
Ebit relativ	17%
Profit sharing	34%
Risk provider	medium
Risk customer	medium

Figure 34: Real-World Evaluation - Current BM of the Organization

As it can be seen in the figure, key partners, activities and resources as well as the customer segments are represented in a framework and linked with each other. This fulfills the demand of the meta-requirement 4 “The value creation process of a company and the interdependencies between the elements should be made explicit.”, as well as the requirement to visualize them according to the corresponding design principle. It furthermore shows that it is possible to model the value creation of a company in such a way and it is not confusing people. Furthermore, the value capturing is represented through a separate KPI section, which fulfills the demands of the meta-requirements 5 and 6 as well as the related design principle 5. Again for the sake of clarity, the graphs of the KPI values are not shown in the figure, but were done in the project.

The comprehension of users is checked through the derivation of a suitable target model of the company, related to the current BM. As a task, the customer develops together with the consultants a suitable target model. Afterwards, the involved persons give qualitative feedback about this approach as well as their understanding. I decided for qualitative feedback, because it is difficult to measure the actual increase of comprehension. This is because each project is different and even small changes can cause huge effects, which make a comparison of the different projects impossible. Furthermore, the feedback could be used for further improvements and to detect challenges in usability. Based on the BM of the actual state, a target BM is created, focusing on the outsourcing of the data service development as strategic decision. This is shown in the following figure.

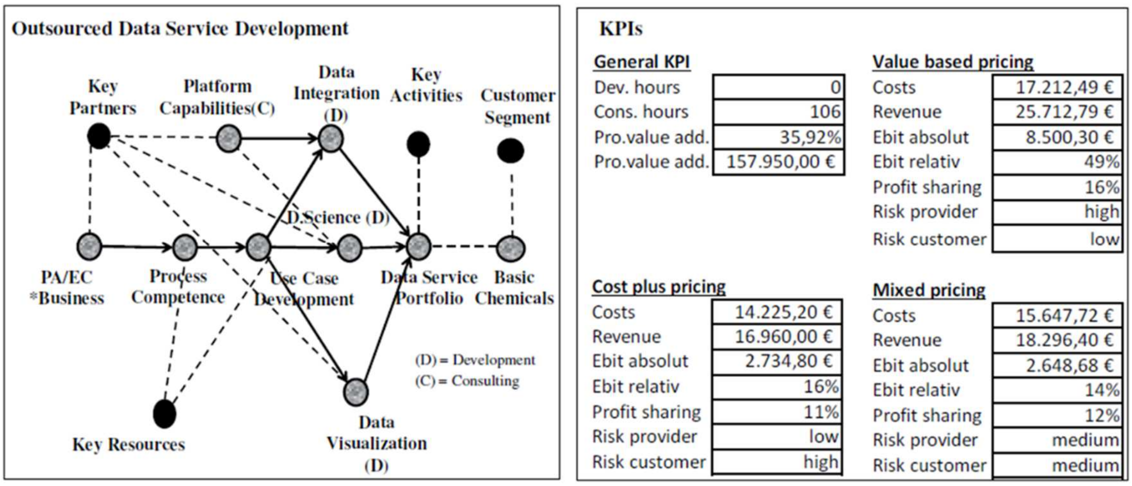


Figure 35: Real-World Evaluation - Target BM of the Organization

The feedback of the consultants and customer is very various and increased the further development of the tool. However, they can be summarized in several advantages and disadvantages of this BM representation and on the users' comprehension.

Advantages	Disadvantages
• Illustrating structural changes and alternatives increases comprehension of users. • Increased transparency through different focus dimensions • Impacts (e.g. through dynamic changes) could be regarded more easily. • Connections between elements allow for a faster understanding of the weakness and gaps of the BM. • Through the KPI section, statements about the current position and trends can be made easier. • The representation allows for different configurations, which is supporting the definition of a target state.	• Increasing complexity compared to the BMC. • Difficult to highlight the focus dimensions. • Still a static consideration of the dimensions. • For a transformation, more dimensions or a wider focus would be suitable. • Bigger (modeling) effort than using the BMC. • Comparing two BMs, transparency decreases. • Additional illustrations provide no benefits and decrease transparency.

Table 17: Qualitative Results of the Experiment

As a summary of the feedback of the users one can see that the relations between the elements and the improved value capturing are seen very positively. Different advantages of these aspects are mentioned and it seems that the perceived comprehension of users increases. Especially for finding gaps or for considering different alternatives, the instantiated design principles seem to provide a benefit. On the other side, users complain about the representation of the value creation. Some name directly that the BMC seem to be more suitable to represent the value creation and has less effort and a lower complexity. Others name a general weakness of BMs, which is that BMs only provide one view of the value creation. Especially for a transformation project, they named that more and different views are necessary to make correct decisions. All in all, the design principles seem to work out very positive on users perceived comprehension. Furthermore, it seems suitable to use the BMC as a base as users are used to it and provides a suitable framework for business modeling. As mentioned, in this evaluation step, only the perceived comprehension is investigated. In the following section, a lab experiment should proof an increase of comprehension through the instantiation of the design principles in an experimental tool.

Lab Experiment for BM Comprehension Evaluation

After the real-world evaluation I will show an increase of BM comprehension through the use of specific tool functions. In more details, I want to investigate an effect of increasing the level of advancement (instantiation of different design principles) on the comprehension of users of an organization’s business model. Furthermore, I will proof that the solution really achieves the objectives of an increased BM comprehension. Therefore, I will have a special focus on the design principles 4 and 5. For the proof of an increased BM comprehension, a lab experiment was conducted. The characteristics of this lab experiment will be shown in the following section.

Testable Hypothesis: For the evaluation I formulate four testable hypotheses with regards to DP4 related to the relations between the elements and DP5 related to an advanced value capturing including visualizations and further KPIs:

H1: The basic Business Model Canvas (BMC) positively influences users’ BM comprehension compared to a textual description of the BM.

H2: The effect of the experimental BM tool extension through relations (DP 4) on users' BM comprehension is stronger than the effect of the basic BMC.

H3: The effect of the experimental BM tool extension through further KPI-based value capturing (DP 5) on users' BM comprehension is stronger than the effect of the basic BMC.

H4: The effect of the experimental BM tool through relations and further KPI-based value capturing (DP 4+5) on users' BM comprehension is stronger than the effect of the basic BMC.

To detect these effects in the lab experiment, different control variables are included. In the experiment, I control for the demographic information, the participants' expertise in business modeling and dashboards, the level of profession and the major of the participants. The related research model is represented in the following figure. There the examination of the effect of different tool configurations on the user's BM comprehension is shown. The design principles were instantiated in an experimental tool together with a student to detect the effects on users' comprehension. I thereby think that adding functionality following DP 4 and DP 5 relates positively to the BM comprehension of users. I assume that there is an increase of comprehension, regarding H1, H2 and H4 as well as H1, H3, and H4.

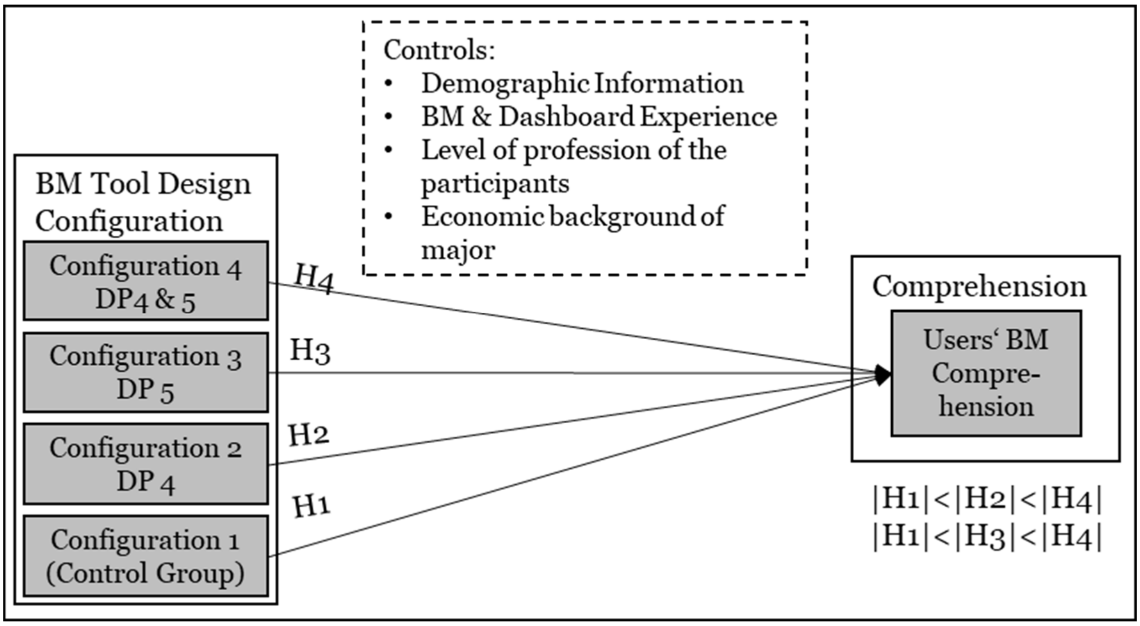


Figure 36: Research Model for BM Comprehension

Measurement: I distinguish between the measurement of the independent, the dependent variable and the control variables. The independent variable is a directly controllable variable in the functionality configuration. It will be measured through a gradual measurement. There exist three levels: Level one is the basic level; level three accordingly the maximum level. I will then measure the levels through a discrete measurement. The dependent variable is a discrete variable, which is defined here as the number of right questions. It will be measured quantitative through a questionnaire analysis. The questions were derived from case studies of real world cases. I will compare the number of right questions with the total number of questions and calculate a rate of correctness. I thereby see this rate proportional to the comprehension of the user's. Last, the control variables were already mentioned. I control for the demographic information, the BM & dashboard experience, the level of profession of the participants and the economic background of major, to achieve a comparability between the different configurations.

Experimental Design: I design this experiment as a between-subject design, where participants are assigned to one fix group, which is not changing. First I start with group one, which has the basic BMC and additional text-based information. Then I continue with group 2 and 3, which has only one feature of the BM Analyzer (either the relations between the elements (group 2) or the KPI support (group 3)). Finally, I investigate the performance of group 4, which has the complete functionality (relations and KPIs). Thereby, I have to add that each participant can take part in only one session.

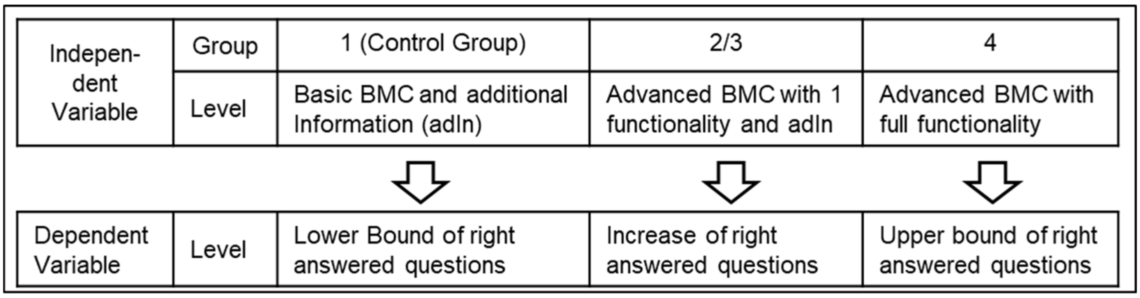


Figure 37: Experimental Rounds and Dependencies

As it can be seen in the figure above, I assume an increase of correct questions proportional to the increase of functionality of the advanced BMC tool. This reflects also my hypotheses H1-H4, mentioned above.

Data Collection-Sample: For collecting the data, 240 people take place in the experiment. Through that, the weak convergence criterion for statistical analysis is more than fulfilled, as 60 people per group take place. The participants are bachelor and master students of mixed professions across the groups. I decided for heterogeneous groups, because otherwise it is possible that one group is consisting only of economists and another group only of biologists. With mixed groups, diverse thinking and problem solving is distributed equally. Furthermore, the gender is distributed nearly equally.

Data Collection-Expiration: Before the experiment, each student is assigned to one specific date and therefore to one special group (between subject design). At that specific date, the students are assigned to separated cabins, where they can find a computer. At the beginning of the experiment, they get a general introduction into taking part at lab experiments (e.g. turning mobile off etc.). Then they get task specific information about the experiment and a first introduction into the BMC and the different categories. I check for their understanding through related comprehension questions. Then the real task starts and the students get all important information. At the same time and after a few minutes for orientation, they have to scan the information and answer questions. It is supposed that they answer the questions with the help of the information, as this information is necessary to give correct answers. In a specific period of time they have to answer correctly as much questions as possible. After this, they have also to answer qualitative questions. Finally, they get a debriefing and their rewards, which is a show-up fee and a payment for their correct answers.

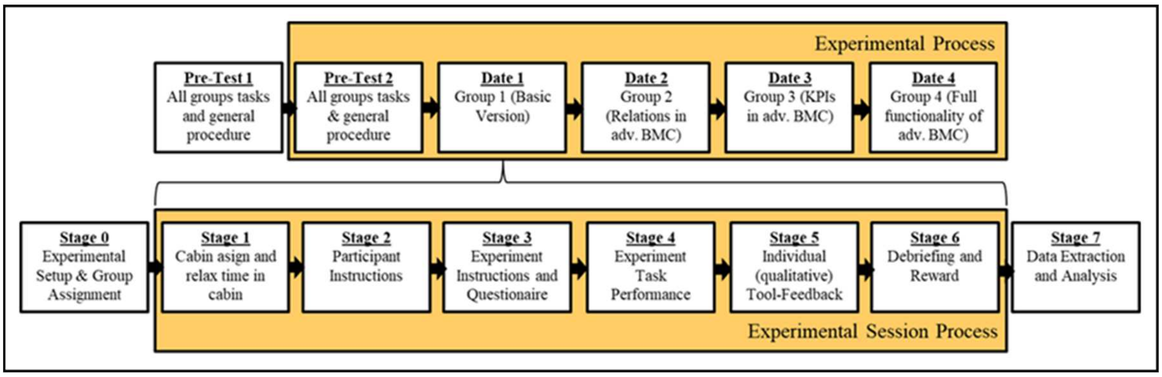


Figure 38: Illustration of the Experimental Process

The figure shows again the process of data collection. In the first step, the participants are assigned to their cabins. Then they get a general introduction into the experiment and get general information (stage 2). After this, the case and detailed information about the experiment are given, e.g. what a BM is, information about the material and so on. In stage 4 they have to perform the experimental task and have to answer 30 questions, which are divided into 10 general questions, 10 questions about relations in the BM and 10 about KPIs in the value proposition. For each right question, they will get 0,3 monetary units. In the next stage, they have to answer qualitative questions (similar to Figl et al. (2013); Recker et al. (2014) and Figl (2017)). For this, they become additional 5 monetary units as a kind of show up fee. Finally, the experiment is over and the participants are paid.

Experimental Questions: During a session, the participants have to answer similar questions of three categories (see appendix). The first category are general questions and each group should answer the same amount of questions in average the same. The second category are questions about the relations between the elements. Groups with a tool support for relations between the elements should perform better than groups without tool support. Category three contains questions about the key performance indicators of the BMs. Similar to category, groups with tool support should perform better than groups without tool support.

Results: In the following, the results of the data analysis are presented. As mentioned, I want to demonstrate a positive relationship between provided functionality in the form of instantiated design principles and the number of correctly answered questions as a proxy for users' BM comprehension. The figure shows the results and the relationship of the three different question categories as well as of the sum of all questions. As mentioned, the relation between group 2 and 3 will not be investigated. Therefore, each graph contains two regression lines (linear regression (y=m*x+b) of the average number of right questions per each configuration and the R2 regression quality), each for the relation of group 1, 2 and 4 as well as group 1, 3 and 4.

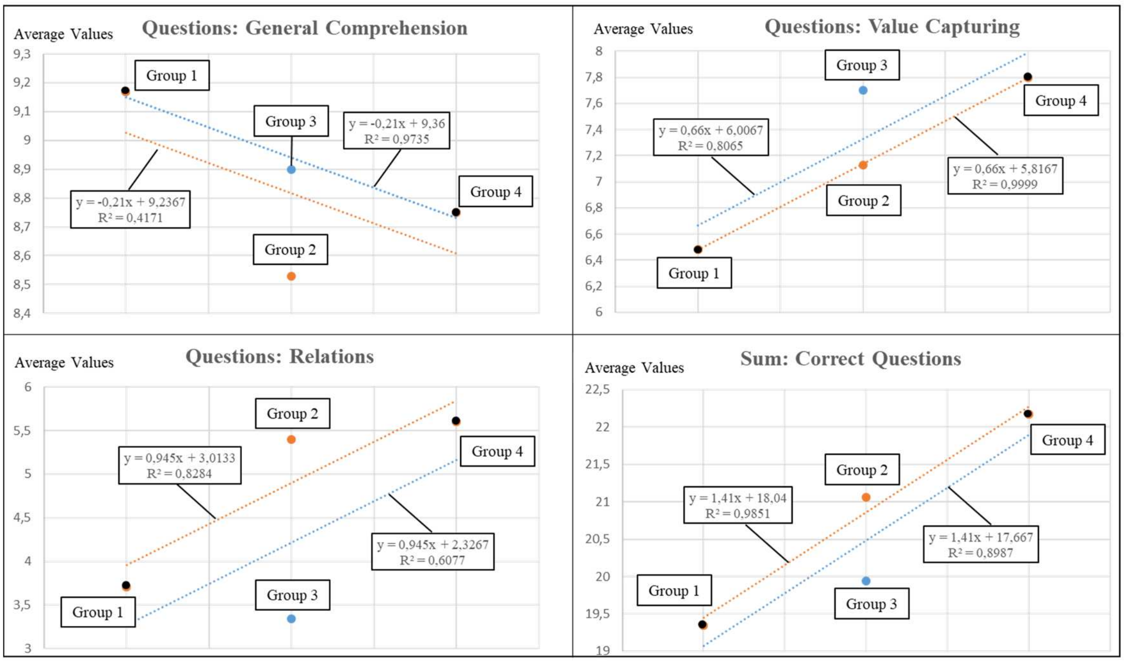


Figure 39: Results of the Evaluation

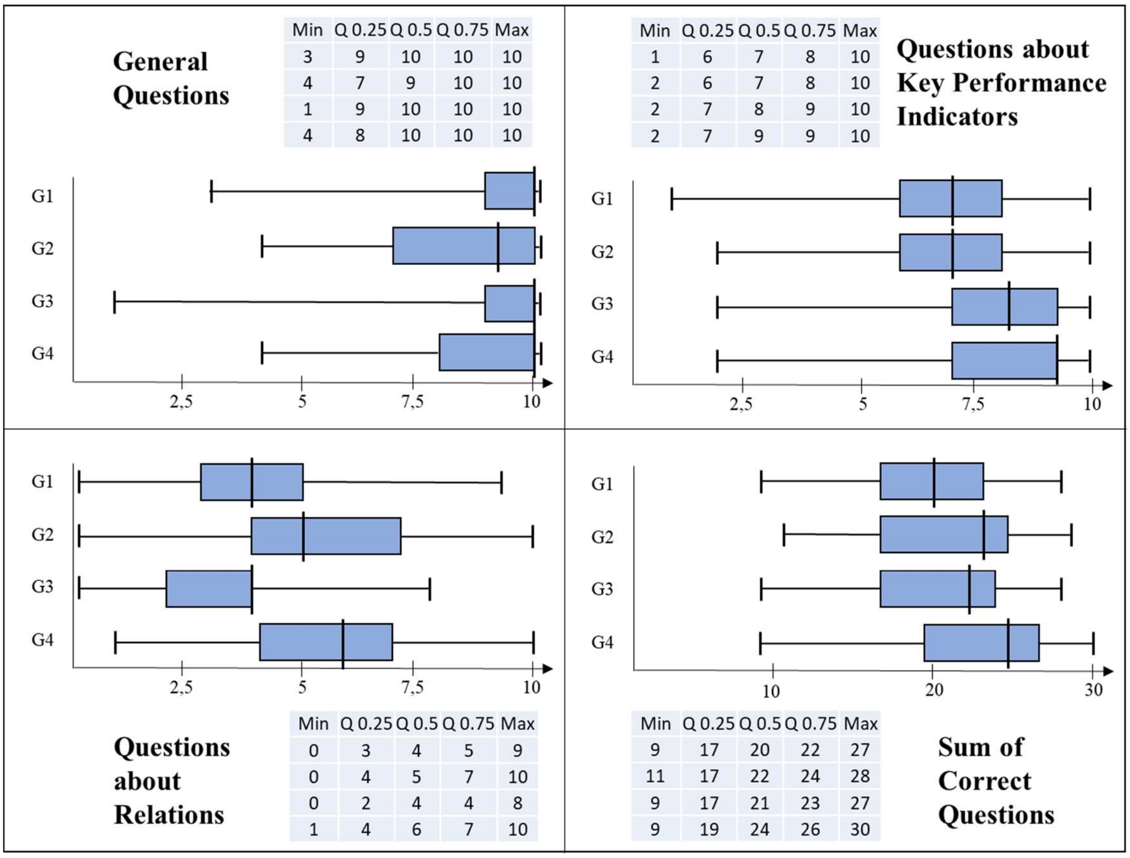


Figure 40: Data of the Evaluation

Overall, one can see that a higher functionality of the tool correlates with a lower average of answered questions. It seems that a traditional BMC without any features is the most suitable framework to answer general questions about the value creation of a company. However, it is also thinkable that there is a learning effect or an information overload, if one has to answer such general questions with the BM Analyzer tool. Participants with no tool support for DP4 (group 1 and 3) are significantly worse than people with tool support (group 2 and 4).

Participants with no tool support for DP 5 (group 1 and 2) answer less questions correct than people with tool support (group 3 and 4). Interestingly, group 3 (with tool support for relations) performs much better than group 1. Showing the relations between elements positively seem to positively influence KPI comprehension. From the sum of correct answers per group it can be seen that groups 2 and 3 perform better than group 1. Group 4 with tool support performs best. The t-test shows also significant differences.

HX	HY	t-Value	df	P	</>	α
H1	H2	-2,722	116	0,007	<	0,010
H1	H2	-5,479	116	0,000	<	0,001
H2	H4	-2,373	139	0,019	<	0,050
H3	H4	-8,032	139	0,000	<	0,001

Table 18: Results of the t-test

The analysis of the results was carried out with a powerful independent sample test. The prerequisites for carrying out such a test are fulfilled (two different groups from which a sample is taken. The values should be similar; ideally, both distributions are bell-shaped and symmetrical). Alternatively, the weak convergence criterion is fulfilled.) One can see in the table a difference between each pair of configurations which are significant according to the results of the table above. This means that the observed effect sizes have a huge effect. Additionally, this significant result is based on a huge sample size used in the lab experiment. This fulfils the central limit theorem as a prerequisite of using the t-test in this case. Following the table and the data, the results support significantly the hypothesis that with a higher tool support, more questions are answered correctly. With that, I assume a higher comprehension of the participants. The results prove furthermore the hypotheses and the relations between the hypotheses |H1|<|H2|<|H4| as well as |H1|<|H3|<|H4|.

This means that the solution is really demanding the requirements of this design cycle. As stated at the beginning, the comprehension of BMs should be increased. I defined suitable meta-requirements and related design principles. These design principles were instantiated in an (experimental) tool. The results show now that this tool and therefore, the related design principles and meta-requirements are really increasing the comprehension of users of BMs. The effect is even increasing when the design principles are combined, compared to the single use of one design principle. To sum it up, using these functionalities or design principles increases the comprehension of users. Furthermore, the design knowledge is proofed and can be used in academic literature und studies. Together with the practical evaluation, the tool functionality provides a good support to derive strategic decisions out of such a BM framework, as both evaluated tasks are strongly inspired by practical tasks. This will be summarized and shown again in the next sub-chapter.

6.5. Responding the Demands of Organizations

Business model comprehension is an important point for organizations. Often used is the analogy of the construction branch. There, a construction plan provides a rapid overview of the whole project. Even novices rapidly understand such a blueprint and can derive suitable tasks. It furthermore provides a communication platform, where each stakeholder has a common view on the project. In the same way, a BM should function in an organization. Through the design principles and the concrete instantiation, the value creation and the different flows of information, goods and services are visible. One gets rapidly an idea about the value creation and can assess the strengths and weaknesses of the value creation through an enlarged value capturing. All in all, the increased comprehension has some advantages for the users next to the advantages of a common communication platform. A BM often functions as starting point for a strategy derivation or as current state of a transformation. As the problem awareness phase has shown, big projects fail, because they are to complex or the management instruments are not suitable enough to provide a sufficient view. Through the increased comprehension, users understand the value creation of a company better and can derive better decisions based on that, as it will be shown in the following evaluation chapter. This means that the likelihood of a successful transformation or strategy derivation can be increased. Furthermore, and together with the design principles, concrete functionalities and the BM representation can be used in BM tools of organization. These functionalities will be used additionally in the BM Analyzer 2.0, as shown in chapter seven. Companies can use this tool and with that the functionalities of an increased comprehension. Furthermore, this solution for increased BM comprehension has also impact on theoretical demands, shown in the following sub-chapter.

6.6. Responding the Demands of Theoretical Perspectives

As already mentioned, existing approaches like the BMC are mainly focusing on a fast and abstract representation of the value creation of a company (Osterwalder and Pigneur 2010). In the foreground is the fast creation of the BM, which should provide a fast overview of the value creation. Originally, the BM can be seen as a mediator between different layers of a company (Al-Debei and Avison 2010). The found design principles enable not only an increased comprehension of the value creation of a company. They provide also a framework for mediating between the different levels. This means not only for practice that the different levels are linked and multiple views are integrated. It provides also further insights in management research as it supports the users to understand the business in a holistic view and to integrate several viewpoints. Next to this, also the knowledge of BM representation and designing dashboards for (business model) management is increased. Similar to process model comprehension (Figl et al. 2013; Figl 2017), this work provides insights into influencing factors on users' comprehension. To show this satisfaction of the theoretical and practical demands, the following evaluation chapter will give an overview of the evaluation of the requirements and design principles.

6.7. Summary

In this chapter I provided an overview of the second design cycle of my DSR project. In the focus of this cycle is the increase of users' BM comprehension. This is important, because BM approaches are often used as a communication platform as well as for derivation of a company's strategy. Therefore, a high degree of users' understanding is important to make successful decisions and to satisfy the demand of BMs as a mediator between the strategical and operational level. In order to achieve these demands, I first collected the related requirements from theory and practice and formulated three meta-requirements for an increased BM comprehension. Main demands are an increased visibility of the relations between the elements and KPIs as well as an increased value capturing. These meta-requirements were then transferred on related design principles. These two design principles should provide a guideline for an instantiation of the meta-requirements in concrete tool functionalities. I therefore built an experimental tool to evaluate the effect of the design principles on the comprehension of users. Following the approach of Venable et al. (2016) for the evaluation of DSR projects, I performed a lab experiment as well as an evaluation in a real-world setting. In such a real world setting, the design principles and meta requirements were tested on a real-world project. Different insights were collected, not only for BM comprehension but also for business modeling in general. These insights were considered in the instantiation of the tool. In the lab experiment, participants have then to perform a task, inspired by real-world task in an organization, especially for strategy derivations. The results significantly show that an increased tool support, using the design principles increase the comprehension of the participants, and they could perform better than with less tool support or even with no tool support. All in all, this design knowledge can be used for an increase of BM comprehension. The insights as well as the functionality will then be combined with the results of the first design cycle. In the next design cycle, both concepts of an increased BM objectivity and comprehension will be used to build a BM Analyzer tool. This supports decision makers in the derivation of suitable strategies. Additionally, it provides lots of insights for science, as there are many gaps, which are shown through the literature review and the interviews with the practice partners.

7. Instantiation of the BM Analyzer 2.0 (Cycle 3)

Both concepts, the increase of objectivity and of users' comprehension, are important for a successful business modeling. Even considered separately, these approaches offer a wide range of opportunities to better support business modeling and the stakeholders involved. However, using these concepts together provides a wide range of synergetic effects, which supports users additionally. In general, using enterprise data to retrieve an objective BM of a company is not different from the approach of a dashboard, which should interact between individuals and the different information systems of a company (Few 2006). Thereby, the included data is represented through visual features to reduce the time for users to understand them (Yigitbasioglu and Velcu 2012). Therefore the certain degree of abstraction as well as the number of visual objects in such a representation is important (Heaps and Handel 1999). Furthermore, analytic features are more and more included into such representations (Zeithaml et al. 2006). As it can be seen, not only in business modeling, but also in other disciplines the concepts of data support through company data and the comprehension of this data are closely connected (Few 2013). Not only because of this, considering both concepts together make sense and provides a holistic view of the value creation of a company. You could even say that: Data is unimportant, if it is not used and it will be only used, if it is understood and presented in a proper way (Heaps and Handel 1999). On the other side, comprehension naturally needs an issue, which should be understood and which can be generated as instance through data processing. Therefore, the two concepts of an increased objectivity and comprehension of BMs will be combined in the following. In the next section, the meta-requirements of the first two cycles will be regarded in an overarching view. This is followed by the related design principles. Next, the concrete tool instantiation of the BM Analyzer Tool will be regarded more detailed. A show case will then provide an overview about a use of the tool. This results in a conclusion, where the main findings of this third cycle will be described and summarized.

7.1. Meta Requirements

As shown in the chapters above, objectivity of BMs and an increased users' comprehension provide great benefits, but also need to fulfill some requirements. The evaluations furthermore showed, that these requirements and principles meet the demands of the problem awareness phase. However, these requirements cannot only be seen separately, but in combination with each other. As cycle one and two showed, the single results provide a benefit for business modelling. However, they provide also a benefit, if one combines both concepts. In the following table, the six meta-requirements for BM objectivity and comprehension are shown again.

ID	Meta-Requirement	Description
MR 1	Appropriate data for bottom-up business model creation should be identified and accessed	To enable bottom-up creation of a business model and guarantee a certain level of quality, appropriate data needs to be identified and accessed.
MR 2	To guarantee comparability of top-down and bottom-up business model creation approaches, extracted data should be structured in a unified way.	To guarantee the comparability of top-down and bottom-up business models, the extracted data should be structured in a unified way.
MR 3	Data should be aggregated along a defined structure.	To report only relevant information and avoid an information overload, the collected data should be aggregated.
MR 4	The value creation process and interdependencies of elements should be made explicit.	It should be easier to understand the relations between the different business model elements and the value creation flow, because the user has more and deeper information.
MR 5	Extending the core value capturing concept of BMC should be enabled	It should be possible to extend the core BMC value capturing dimensions with additional KPIs. So the user can evaluate the BM and decide rapidly based on this values.

MR 6	Time-dependent information of value capturing should be supported.	Changes of the values should be explicit, so the user can value them and see the direction, the values are heading to.

Table 19: Meta-Requirements for increased BM objectivity and comprehension

One can see easy that these requirements do not belong to only one objective, either objectivity or comprehension. For example, meta-requirement three demands an aggregation of data along a defined structure. This belongs to the objective of an increased objectivity. However, also the comprehension of users' comprehension could be influenced. One could argue that a well-ordered BM is supporting users' comprehension better than a BM with no structure. Such interferences between the meta-requirements of the different objectives become more clear in the following section, where the meta-requirements are combined with all related design principles.

7.2. Design Principles

Arranging the meta-requirements with the related design principles reveals that both concepts of objectivity and comprehension are closely connected. In the following table, all design principles are shown again. These design principles are realized in one tool, called the "Business Model Analyzer" (Version 2.0). As shown in the table, the design principles demand the requirements from both concepts of BM objectivity and comprehension. For example, design principle one demands a unified BM ontology. This is not only related to meta-requirements 2 and 3, but also to meta-requirement 5. This is because an enlargement of the value capturing needs a certain structure or "logic" how the BM can be enlarged. Not only for design principle 2, also for the others, different meta-requirements are related, as it is shown in the following table. In the next sub-chapter, the instantiation of the BM Analyzer 2.0 will be shown.

DP	Design Principle	Related MR
DP1	Provide one unified business model ontology as a foundation.	MR 2, 3 & 5
DP2	Establish a repository of relevant BM data sources and allow extraction of BM-relevant source data from it.	MR 1 & 5
DP3	Provide calculation and consolidation functions to aggregate BM relevant source data, as well as merging logics to recombine the data.	MR 3 & 4

DP4	Visualize dependencies between business model elements along the value creation process to make the value creation process and interdependencies of elements explicit.	MR 2 & 4
DP5	Enrich the business model with additional key performance indicators and suitable visualizations following a dashboard approach in order to allow for extensible value capturing measurement.	MR 5 & 6

Table 20: Design Principles for increased BM objectivity and comprehension

7.3. Instantiation

To instantiate all design principles in one common tool, I decided for a solution in the program Microsoft PowerBI. This tool is widely spread in today's enterprises and highly compatible with different data files. Furthermore, it is easy to handle and I see this as a benefit for users' acceptance.

For instantiating the tool, different sets of data and information are important. An information system layer can provide such information. Thereby, not only ERP systems can build such a "layer", also Excel sheets or other data contains the necessary information. In the bottom-up view, this data is then aggregated according the categorization. Suitable algorithms and a data structure enables such an aggregation. Next to this bottom-up view, the knowledge of the modeler or the top-down view is still important as this tool is not fully automated. Besides the knowledge of the modeler, also goals of an enterprise and additional top-down knowledge (e.g. knowledge of previous projects) can be considered. All this together enables an increased objectivity of BMs. Next to this, also the interdependencies between the BM elements as well as the knowledge for increasing the value capturing of the BM are important. They build the parts for an increased users' comprehension of the BM. This is summarized in the following figure. Also included are the design principles and their relation to the different elements in the figure.

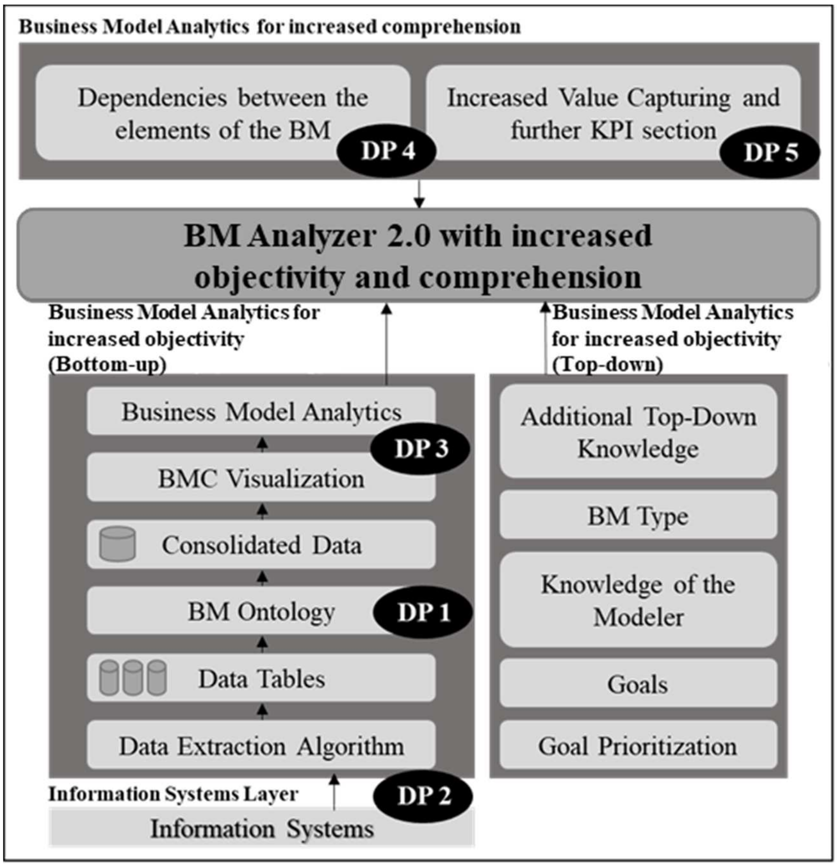


Table 21: Theoretical Instantiation of the BM Analyzer 2.0

In order to instantiate these principles, the already mentioned Microsoft PowerBI software is used. In different "sheets", similar to an Excel sheet, the BM can be represented in a way that it supports the goals of objectivity and comprehension. As data input, several Excel tables with data are necessary, which can be created in each ERP system or which is already existing in an enterprise. For the case that an enterprise has totally unstructured data, one can orientate at these sheets. As a result, the tool is fast and easy to use by just providing the important data. Furthermore, the tool provides several degrees of freedom to set a specific focus on a certain area of a company or to have a broad view about the whole value creation.

A base for the structure builds the already mentioned Business Model Canvas of Osterwalder and Pigneur (2010). For the increased objectivity and the data mining algorithm, chapter five as well as the following sub-chapter provides all the necessary information. For the sake of clarity and to avoid redundancies, it will not be described in detail in this section. For the increase of comprehension, the different categories of the BMC are therefore decoupled to make the dependencies visible. Different possibilities to show these dependencies are possible: Either it is possible to show the dependencies between the different categories or the dependencies between single elements. For the enlarged value capturing different possibilities are existing, too. The trivial solution would enable a further value capturing category. A more detailed solution is shown in the following figure. Clicking on one element opens a related sheet with further values and more information about the composition and the relations between the elements. This can be done for each element or just for the value proposition as central spot for such a BM. The following figure provides a "Look and Feel" about the final BM Analyzer Tool 2.0 according to the findings of Augenstein et al. (2018b). Dependencies are shown between the categories for the sake of clarity. For the value capturing, the non-trivial solution is chosen: The data for the value proposition is shown. More details and the single functions are presented in the following case study validation. In this validation sub-chapter, the BM of a car manufacturer is used as a practical validation example.

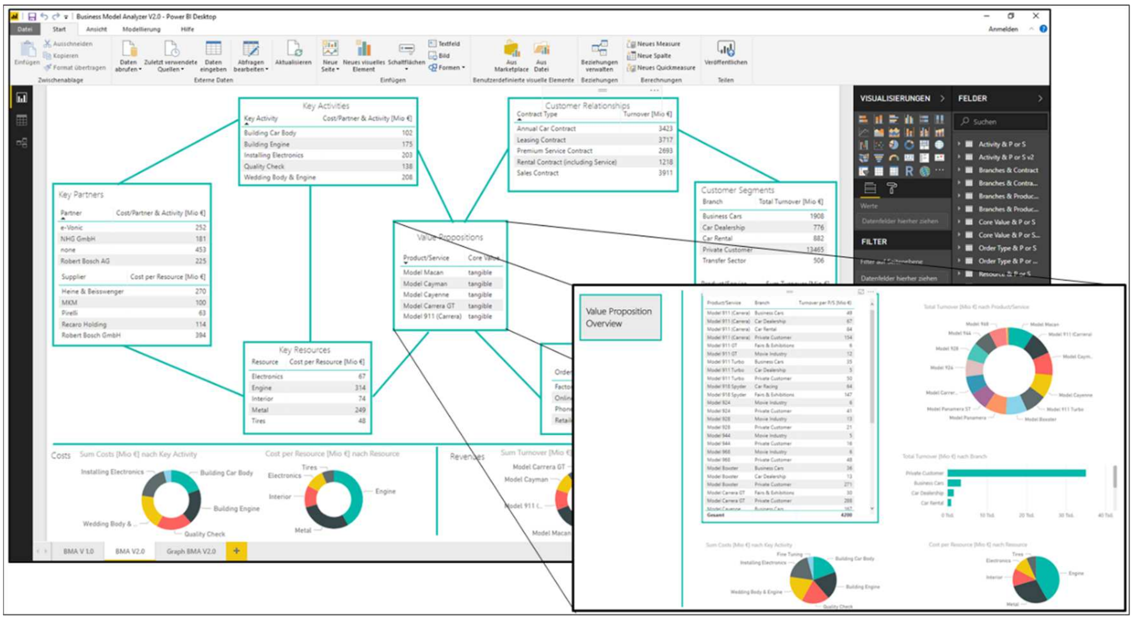


Figure 41: Look and Feel of the BM Analyzer 2.0

7.4. Show Case

In the previous chapters, different field and lab evaluations showed the fulfillment of the goals of an increased BM objectivity and comprehension. This sub-chapter should serve as validation for combining both concepts in one tool and to show the functionality of the tool. In the attachment one can find the relevant data in the related tables for this validation. As case study, I decided for a car manufacturer and have a look at the overall BM of this enterprise. The car manufacturer has around 30.000 employees all over the world and has a revenue of 23,5 billion € per year. The case data contains information about the different sold car models as well as important supplier and customer segments (see also the attachment). The data is open available as stock corporations have to publish their annual reports. To make the BM non-trivial, I decided to return the top five elements through the mining algorithm instead of just returning the top three. However, this is only to make the case more interesting. The algorithm is returning results in the same degree of quality for each “top x“ mining decision. It is also thinkable that the user of the tool is deciding for the top five products, but then filtering for the top three partners and so on. In this case study, the top five products, which are all tangible, are the models “Macan, Cayman, Cayenne, Carrera GT and 911”. Related to these products, the other top five elements are determined. For example, the top five branches are “Business Cars, Car Dealerships, Car Rental, Private Customer and Transfer Sector”. The tool enables additionally for each section an improved filtering for more detailed information or to have a special look at one certain aspect of the results. Through these different views, the algorithm cannot be called automated, but semi-automated. However, it was considered during the implementation that the user can change and define different focus on the result.

Next to the semi-automated data aggregation, also the relations between the different elements can be drawn. This can be done between each element, as I have shown in the evaluation phase in chapter 6. In this case study, I decided for the relations between the categories for the sake of clarity. However, it would be no problem to draw relations between the elements. The following figure shows the tool as well as the results of mining the data according to the defined mining algorithm of chapter 6. Furthermore, the KPIs of the value capturing section are shown as graphs. This should increase the comprehension, as the lab experiment showed. For detailed information, one can click on each category, which opens a new sheet with the related data.

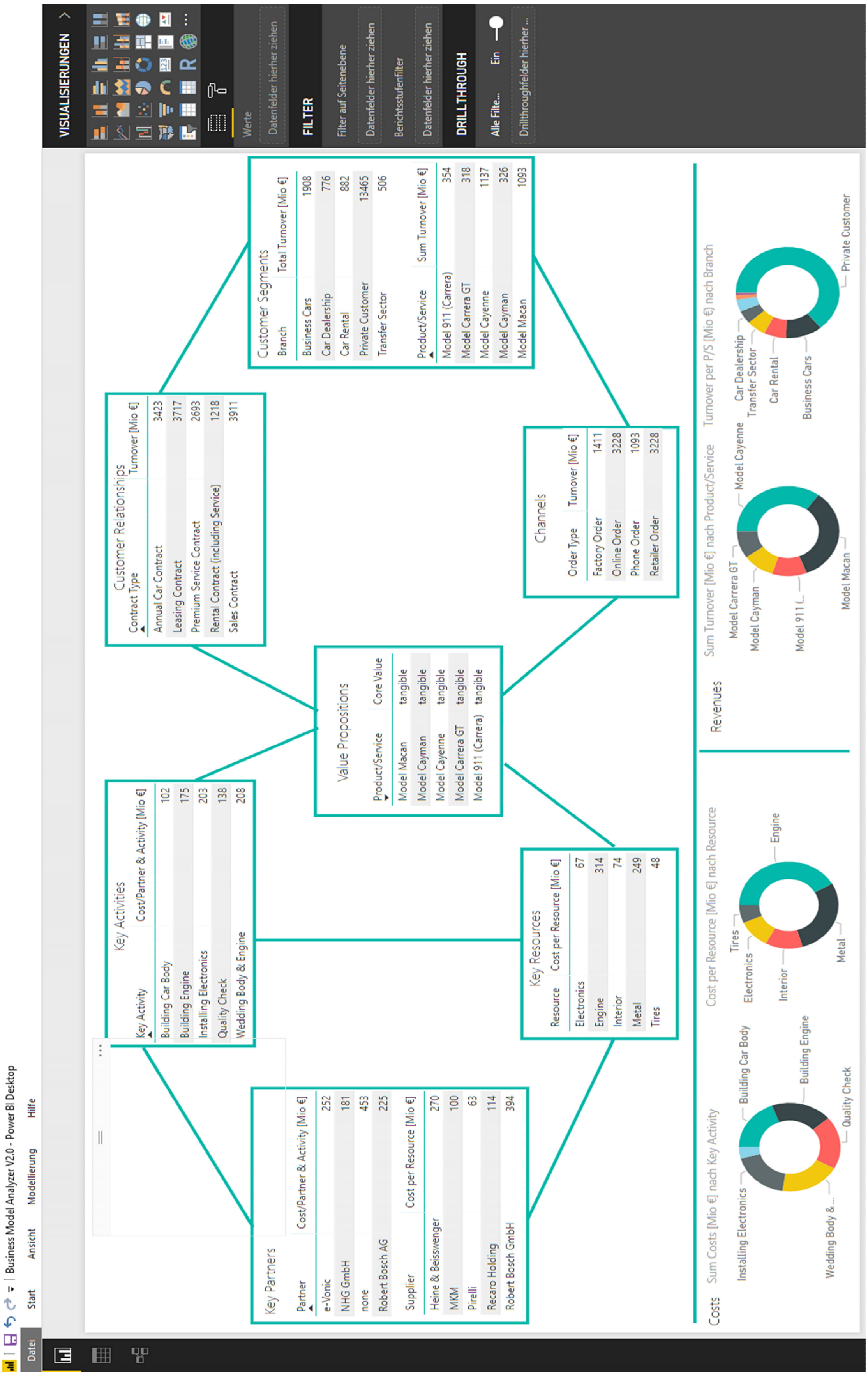


Figure 42: Results of the BM Analyzer 2.0

In this figure, one can see rapidly, what the most important key activities, customers, partners and so on are (according to their value). However, sometimes this is not enough and one wants to have more detailed information about the different values. For example, for defining a new product strategy, more information about the current value proposition would make sense. For such a purpose, one can click on the value proposition category and the related data sheet will open.

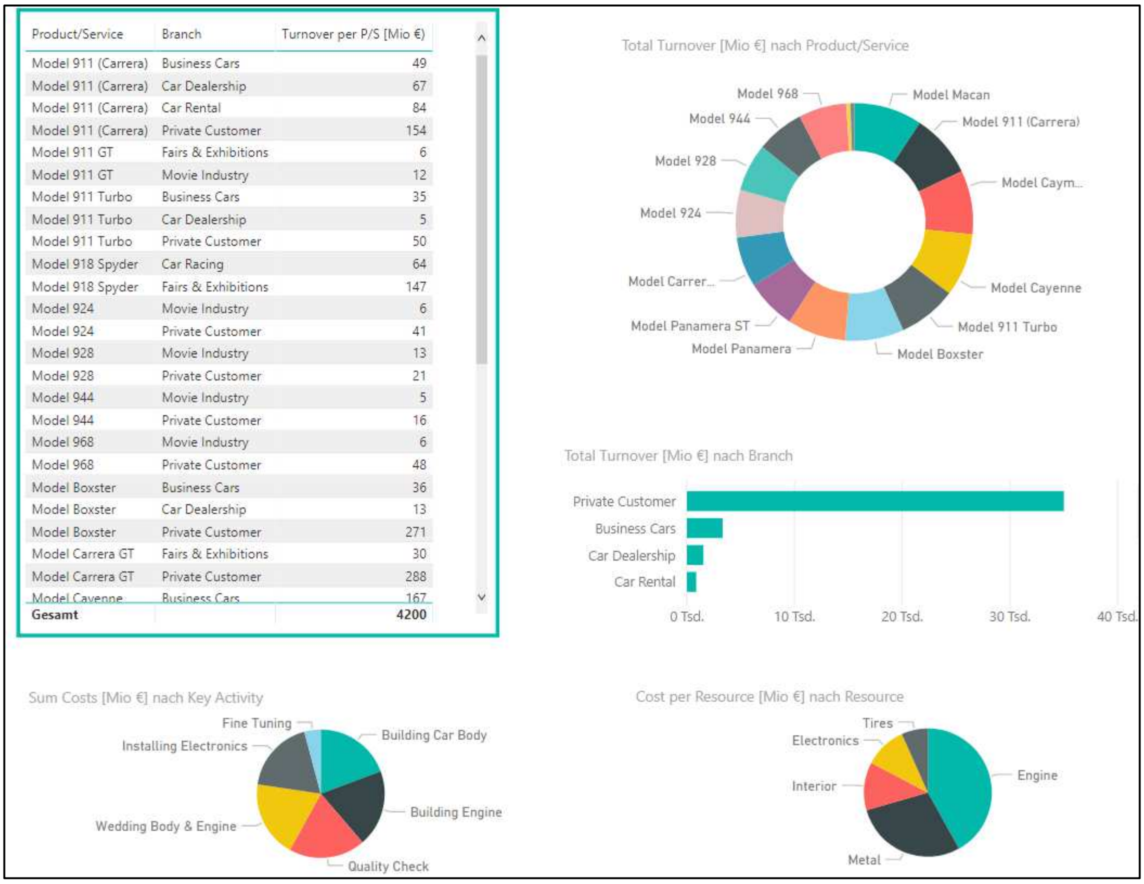


Figure 43: BM Analyzer 2.0 Focus on the Value Proposition

In this view, information about the turnover of each product per branch is shown and the total turnover per product as well as the relations of the costs of the activities or resources. However, this is only an example, how such data can be displayed. The tool allows for more detailed information or for other representations and dashboard styles.

To sum it up, providing the appropriate data allows for a fast mining of the current BM of a company with an increased objectivity. The functions for showing the dependencies as well as for an enlarged value capturing increase the users' comprehension of the BM as shown in the lab experiment.

7.5. Summary

This chapter shows that the concepts of objectivity and comprehension can not only be used separately, but also in combination. Having a look at the meta-requirements and design principles, one can see that many interferences are existing, which are likely to increase the results. However, each individual result provides a benefit for the user. This is why I implemented it in the BM Analyzer 2.0. This tool enables a joint increase of objectivity and of the users' comprehension according to the previous results. The validation section shows exemplarily that the BM of a company can be mined easily and that it can be displayed according to the design principles, which should increase the comprehension of the user.

Having a closer look at the tool, it is as easy to use as programs like Microsoft Excel, but provides different functions, which enable a high degree of freedom for having a look at the data. As a result, data can be regarded very detailed through related graphs and through having a closer look at the data. On the other side, also a fast view of the current value creation is possible. Such a fast view can save time, but provides the necessary information about the value creation as Osterwalder and Pigneur (2010) and others showed. One has to mention that this is only a semi-automated approach. This means that humans are still part of this mining process and therefore influencing the objectivity of the result. Furthermore, the result is depending on the knowledge of the user and finally, the user has to interpret and to use the result in an appropriate way. In the following chapter, all weaknesses of the DSR project will be discussed more detailed. In the last chapter, a conclusion will be drawn with all results, impacts and further research possibilities.

8. Discussion

Naturally, the design theory in the previous chapters has some limitations, which will be discussed in the following sub-chapters. Thereby, the different aspects and limitations of the evaluation data will be discussed as well as the overall research results. In addition to the overall research results, their fit into the research gaps will be presented. In general, limitations are important to be aware of the possibilities the solution provides but also of the gaps. Future work can overcome these gaps and related weaknesses.

8.1. Discussion of Evaluation Data

In order to verify the design principles for an increased objectivity and comprehension, a design science research project is conducted with different evaluation steps. These evaluation steps can be classified either in lab experiments or in field studies. Additionally, a literature review was conducted to determine the state of the art in this field of research. In the following, the different types of evaluation and the related data will be discussed.

Discussion of Literature Review Data

At the beginning of the design science research project in the phase of the problem awareness, a literature review was conducted. The aim was to examine the current state of literature as well as existing tool capabilities. As mentioned, the focus of the review "business modeling" is of growing interest for theory and practice, both. Especially for management this topic plays a major role. The literature review makes several contributions to BM literature. First of all, the classifications give an overview of the existing artifacts related to BMs. As it is shown in similar studies (e.g. Ebel et al. 2016), the full potential of tool capabilities is not used. Having a look at more than 100 papers, only around 40 artifacts could be classified, which provide management support in the field of business modeling. However, by only looking at a selected number of data bases, it is possible to miss relevant data and artifacts. Second, existing research and related artifacts are focused only on aspects related to the status quo modelling of a company. Only a low number of artifacts focus on decision support or implementation support. Again, it is possible that further capabilities are existing in data bases, I did not have a look at. However, I decided for huge data bases, which include articles from the most important journals of IS discipline, as mentioned above. Last, I developed a classification for the capabilities of the artifact, which can be used as a base for future reviews or as features for new artifacts.

Next to the selection of data bases, the literature review and the related data have some more limitations. First of all, I interpret the BM concept as a strategical concept for the management (Wirtz 2011). Therefore, I defined a time frame between 2012 and 2018 which can be seen as that period of time, where business modeling is in the focus of management (Wirtz 2013a). However, further work before 2012 could be existing, focusing on strategic management and with that also further artifacts. As one example, the work of Osterwalder and Pigneur (2010) is published in 2010 but would be excluded from the results. However, one can argue that their work can be seen as starting point for BMs as management concept and some time is needed to establish this topic. As a result, the timeframe 2012 till today still seems valid. Consequently, I assume still a high validity of the results of the study, as the majority of articles with strategic management focus is published after 2012 (e.g. Ebel et al. 2016). Second, the focus of the literature review lays on BM artifacts and synonyms. Nevertheless, possibly more articles are existing, which provide a solution to the mentioned demands without naming them software, tool, artifact or model. Furthermore, the study focuses on the amount of papers and not the amount of tools. It is possible that one paper is focusing on more than one tool. To solve this, I paid special attention to the number of tools. Otherwise the paper count cannot be seen in a metric way. Next, the artifact capabilities of the review are based only on the articles of the classification. As a result, additional capabilities may not be covered by this classification. So there may be a need for skills that are not considered in the classification but are of high theoretical or practical interest. In general, a classification is not perfect and can have some subjective insights (Nickerson et al. 2017). In the best case it only can be useful. Furthermore, not each dimension of the classification is relevant for each artifact and more than one categorization is suitable for some artifacts. As a result, the literature review provides only a direction for future research. As one example, future research activities can have a closer look at ecosystem BMs, which follow a different logic. Thereby, it is also thinkable to compare traditional approaches with them.

To sum it up, the literature review in business modeling has some limitations, which do not differ heavily from other studies. Conducting the literature review, I paid great attention to these weaknesses to retrieve a useful classification. This classification is one base for the design cycles of this DSR project. One part of this project are also the field evaluations, which are discussed in the next section.

Discussion of Field Evaluation Data

Using a field study as a method provides a lot of advantages for research. First of all, practical insights can be collected and the solution can be tested in a real world setting. This is of particular importance for tools that solve a problem for users, but are not used by them. Otherwise users can build shadow IT systems, which might not have the same impact as the tool does. Second, field studies can be very complex and unforeseen events might occur. This is on the one hand side positive, as it is a kind of stress test for the tool. On the other hand, the real world experiment is hard to control, especially for complex settings. Therefore, it is important to design the experiment in a way that as much variables as possible can be controlled. This is under the cost of practical relevance. The worst outcome would be to design an artificial situation, which would not occur in the real world. Testing such an artificial situation would not make any statement about the real world. At the same time, the artificial situation cannot be seen as lab experiment, because it is still impossible to control for everything. As a result, a field experiment has to be implemented in real world as natural as possible.

Next to this challenge, the data could be influenced by the participants. This is true for lab experiments, too. So the participants might guess the intent of the study and can try to support the result. Controlling for that is important, but sometimes it is hard to achieve. As a result, the data can be biased not only by the experimenter, but also by the participants. Additionally, in a field study, the knowledge of the participants is hard to control when they should perform complex tasks. These tasks are often comprehensive and therefore it is not possible to control for the knowledge in all affected areas. On the other side, the data of the field experiment is likely to be more valid as real world data. Compared to a lab experiment, where the data is fictive, the data of real world experiments is more objective, for example using such ERP data, like I did in the study. Of course, ERP systems have to be filled out correctly. However, most ERP systems are coupled with other IS systems and have to be correct, for example for tax controls. As a result, I assume a high validity for the mined data of the first design cycle. However, there remains still a bias of the participants for the collected top-down data. And even the “gold standard” is biased through the knowledge of the interviewed persons. Nevertheless, the advantages of these field studies overcome the weaknesses, as it is hard to test this in a lab experiment with fictive data. One reason for this is that there is only a limited period of time, the participants can have a look at the data and understand it. As a result, they will not be able to make as precise statements as employees of a company can do. To sum it up, field experiment data has some limitations. However, also lab experiments are limited, which will be shown in the following section.

Discussion of Experiment Results

Lab experiments are often conducted, if the experimental setting needs to be controlled. And indeed, laboratory experiments offer a good opportunity to investigate effects separately. So lab experiments for example are conducted, if a real world experiment seems to be too complex to control. What lab experiments and field studies have in common is that the data can be biased not only by the experimenter, but also by the participants. In general, field experiments and lab experiments seem to be complementary in some points. While a field experiment has a high external validity, a lab experiment only investigates a theoretical impact or an impact in a separated situation. One can say that lab experiments have a high internal validity. One reason for this is that many variables can be controlled, like gender or major. However, special challenges exist for the second design cycle of this study, which is focusing on the BM comprehension (Augenstein and Fleig 2018). First of all, the BMC can be filled out by different participants. Different persons can have a different view on the content and at the same time, these views are not fully objective. Another challenge is the perception and mental skills of participants. For participants with a fast perception or which are working often with the BMC, the additional information can be obsolete for them. A further limitation is also a decrease of abstraction in the strategic view (Augenstein and Fleig 2018). And finally, as the BMC is designed as strategic management tool, more operational design principles might dilute such a strategic role. This has to be considered, when having a look at the evaluation data from the lab experiment. In the following sub-section, the overall research results will be discussed in addition to this section.

8.2. Discussion of Overall Research Results

The insights in the area of BM research seem to be tremendous. Both fields of BM objectivity and comprehension seem to be very large and worth to be studied each. Different researchers focus on a wide range of aspects and research gaps. However, under specific points, these can be classified along a set of criteria, which makes it more easy to get an overview of existing research gaps (e.g. Veit et al. 2014). Some researchers want to give a rapid overview of the current value creation (e.g. Porter 2001b or Osterwalder and Pigneur 2010), while others try to model even details of a BM to be able to provide a holistic view on all aspects (e.g. Lindgren and Rasmussen 2013). Consequently, most of them focus on a very close field of research, mainly regarding the status-quo of a company or adapting the BM after disruptive changes (e.g. Johnson 2010). Related functions and capabilities of the artifacts are mainly limited to these research focus. Furthermore, most of them miss to consider the role of BMs as mediator between the strategic and operational level. By providing related meta-requirements and design principles, this study tries to overcome these weaknesses.

In total, two major research gaps were identified in this study, addressed in the design science research project. Further researcher like Veit et al. (2014) or Ebel et al. (2016) point in the same direction. First, one focus is on the objectivity of BMs. As the BMC is used very often in today's business and easy to use (Osterwalder and Pigneur 2013), it should be very reliable. This is because it builds a base for strategies and provide lots of information (Osterwalder and Pigneur 2010). However, the BMC is filled out by hand and therefore subjective and biased. Surprisingly, no study is focusing on the mining and the increase of the objectivity of BMs. Some approaches are using ERP data (e.g. Lindgren and Rasmussen 2013), but only for the reason to avoid modeling effort and without the aim to aggregate data in that way business process mining does. Second, while business process comprehension is in the focus of researchers (e.g. Figl et al. 2013; Figl 2017), no studies are focusing on BM comprehension. This is surprising, because a BM can be seen as a kind of dashboard and several work is existing to support users' comprehension of dashboards (e.g. Few 2006; Yigitbasioglu and Velcu 2012). To sum it up, this doctoral thesis is regarding the overall research question of: "How can a business model system be designed in order to increase business model objectivity and users' business model comprehension?".

Therefore, different research challenges where answered through this doctoral thesis, as shown in the following figure.

	Research Challenge	Doctoral Thesis
1	Increase of objectivity of Business Models	Conducting design cycle one to develop related meta-requirements and design principles. Combining these principles with principles of comprehension.
2	Increase of comprehension of Business Models	Conducting design cycle two to develop related meta-requirements and design principles. Combining these principles with principles of objectivity.
3	Development of an advanced Business Model Tool	Instantiation and combination of the design principles from DSR cycle one and two. Outcome is the BM Analyzer 2.0 considering principles of objectivity and users‘ comprehension.
4	Evaluation of the artefact in real-world and lab experiments	Conducting a lab experiment and several field experiments to show the validity of the found design principles with high internal and external validity.

Figure 44: Congruence of the Research Challenges and the Doctoral Thesis

As a result, the selected method of design science research is highly supporting the answering of all research questions of this thesis. Furthermore, the outcome of this DSR project is a BM tool, which can be used in today’s companies to improve business modeling. For an evaluation, both lab and field experiments were conducted. This provides an internal and external validity both, which is the demand on such a research design: It should “have reasonable degrees of both types of validity” (Bhattacherjee 2012, p. 38).

Internal validity: This belongs to the causality of the results of the studies. A higher degree is proportional to the ability of changing the independent variables and studying their effects on the dependent variables (Bhattacherjee 2012). In the lab experiment, the independent variable of comprehension is changed and the effects are observed. This proofs the validity of answering the research gaps through the described design principles.

External validity: This belongs to the generalizability of the results of the studies. Bhattacherjee (2012) remarks that field studies “tends to have broader generalizability than laboratory experiments where artificially contrived treatments and strong control over extraneous variables render the findings less generalizable to real-life settings where treatments and extraneous variables cannot be controlled" (Bhattacherjee 2012, p. 38). As a result, I conducted several field experiments to show the general validity of the design principles for an increased objectivity and comprehension. The outcomes and insights are furthermore easy to be adapted in an enterprise setting and realized in an artifact.

To sum it up, this doctoral thesis does not only provide evaluated design knowledge and a BM tool, it answers also present research questions and practical demands.

8.3. Summary

As described, different kinds of evaluation have different advantages and disadvantages. This is discussed in this chapter as well as the answering of the different research questions through a design science research project. As shown, this DSR project does not only provide design knowledge for business model research. The outcome is also evaluated design principles and a practical BM tool with high internal and external validity. This outlines the quality of the described research project and shows the limitations of this thesis project. In the following chapter, a conclusion is drawn and future work is described.

9. Conclusion and Future Work

To conclude the DSR project together with this doctoral thesis, the research will be summarized in this chapter. Several contributions in increasing the objectivity and users' comprehension of BMs were made during this study. Therefore, a conclusion about the DSR project will be outlined in the following sub-chapter. Next, the theoretical along with the practical contribution of this DSR project will be described. Additionally, the limitations of this work as well as possible starting points for future research will be provided. Finally, this thesis ends with a brief summary of the whole DSR project and the most important insights.

9.1. Conclusion

This DSR project aims to increase the objectivity and comprehension of BMs. The outcome should be not only increased design knowledge in this field and a better understanding of the whole phenomenon, but also a BM tool, which is supporting users in creating objective BMs and a comprehensive business modeling. To achieve these goals, a design science research (DSR) project was conducted to formulate suitable requirements and design principles. As a first step, I conducted a systematic literature review for the problem awareness. Additionally, insights from my practice partners were used to find a sharp problem definition. The results of these theoretical and practical insights were used to formulate the research questions for this project. Additionally, the systematic literature review provided a classification about existing BM artifacts and their capabilities. Related to this, different additional research gaps could be identified, which cannot be considered in this thesis due to the limited time. Therefore, I selected that research gaps, which are most suitable to the theoretical and practical demands both. One outcome of the literature review was that only a few artifacts for business modeling are existing and most of them mainly focus on the creation of the status quo of a company. However, nearly no artifact tries to increase the objectivity of BMs or has a specific focus on supporting the comprehension of users. This is in contrast to the theoretical and practical demands, which see the BM as a base for (strategic) decisions. Therefore, a BM can be seen like a blueprint of the construction branch, which is easy to understand and contains well-grounded data like calculations or local restrictions.

As a next step, this problem awareness was used to formulate related requirements for this DSR project, according to Vaishnavi and Kuechler (2015). The first design cycle is thereby focusing on the objectivity of BMs. The second design cycle focuses on the increase of the BM comprehension. For both goals, depending meta-requirements were formulated to address the related research gaps of literature as well as from the industry partners. Within these two cycles, the meta-requirements were translated into concrete design principles. These design principles are in turn translated into concrete artifacts. As a last step of each cycle, an evaluation phase was conducted. In several lab and field experiments, the internal and external validity was ensured. At the same time, a potential for optimization could be found. As a result, the artifact and the design principles could be updated. The evaluation phases revealed a significant improvement of objectivity and comprehension of BMs both. Especially the lab experiment with 240 participants showed that the two design principles increase the comprehension of users proportionally. Combining both principles even increased the results of just using one design principle. As a result, a linear trend could be detected, and both design principles were considered in the final artifact. The field experiments with different industry partners revealed on the other side that using company data is suitable to create a BM bottom-up in addition to a single top-down business modeling. The data significantly show an increase of accuracy, precision, recall and F1-score through the use of the tool. This is why these design principles were considered in the final tool.

In cycle three, the BM Analyzer 2.0 artifact was built, using the design principles of cycle one and two. Interestingly, one could not only see dependencies between the meta-requirements and design principles of one goal, but also across the different goals. The built BM Analyzer is a tool in Microsoft PowerBI, which is ready to use and contains different features for a business modeling with increased objectivity and comprehension. Company data can be inserted easily, and the related BM is displayed rapidly. Furthermore, different functions exist to set a special focus on details or to show dependencies between the elements. As a result, the outcome of this DSR project is not only a BM artifact with increased objectivity and comprehension of the user. Equally, the design theory in business modeling is enlarged, and some gaps of the literature review could be closed as well. Theory and practice can use these insights to improve their work or as a starting point for new research projects. This is also part of the following to sub-chapters, where the contributions, limitations, and possible starting points for future work are described.

9.2. Contribution

The outcome of this DSR project is on the one side a practical artifact, which contributes to the demands of our industry partners and practice in general. On the other side, also design theory in form of meta-requirements and design principles as well as answering theoretical demands provide a theoretical contribution. Both, the theoretical and the practical contribution will be shown in the following sections.

Theoretical Contribution

By addressing the research questions, this doctoral thesis provides several theoretical contributions. In general, the design science research approach provides a balance between the relevance and rigor of BM research. Conducting a DSR project contains the threat of a high rigor, but low relevance. Therefore, the problem awareness phase and the evaluation phases contain practical and theoretical attributes, so that this DSR project overcomes the disadvantage of low relevance. Furthermore, as shown in the literature review, only a few BM artifacts are existing in BM literature. Therefore, this thesis project applies the often used DSR approach in a field, where fewer tools are developed with such an approach. Through that and the demonstrated validity and reliability of the approach, the thesis contributes to theory by illustrating the external and internal validity according to Bhattacherjee (2012). As second contribution one can name the meta-requirements and design principles for designing an objective and comprehensible BM tool, which are discussed and evaluated in this thesis. In literature, still lots of research potential is existing, while in related fields related gaps are already closed. As a result, the results and approaches from related fields are transformed and applied, like insights from business process model comprehension (Figl et al. 2013). Third, the application of the DSR project together with industry partners can be a leading example, how design principles can be applied in practice. Many DSR projects are performing the evaluation steps only in experimental settings. This means that the setting is artificial and does not necessarily need to reflect the reality. Whether the design principles meet practical demands cannot be proofed. In this doctoral thesis, the experimental evaluation is combined with field studies. Through that, the design principles and requirements can be tested in a company's environment. This means that the resulting design principles and the BM Analyzer 2.0 tool are tested in a theoretical and practical setting, both. This provides evidence for suitability and usability of the tool in practice, too. As the fourth point, the doctoral thesis contributes to the design knowledge in business modeling. More specifically, for the fields of BM objectivity and comprehension, design knowledge was created and evaluated. This design knowledge fits into existing knowledge of related fields like dashboard design (Few 2006, 2013) or data analytics (van der Aalst et al. 2004; van der Aalst et al. 2007). Additionally, some researcher observed these phenomena in similar or very specified fields (e.g. Osterwalder and Pigneur 2010; Figl et al. 2013; Figl 2017). However, observing the design principles for an increased BM objectivity and comprehension was not done so far to this extent and with this special focus. As a fifth contribution, general knowledge of business modeling was created. As mentioned, BMs contain a flow of goods and services as well as information (Timmers 1998). Some of the approaches and especially the BMC does not explicitly show these relations between the single elements (Osterwalder and Pigneur 2010; Kajanus et al. 2014; Joyce and Paquin 2016). Existing approaches, which are considering the relations are often very specific, lots of modelling time is needed or relations do not consider the value creation flow (e.g. Lindgren and Rasmussen 2013). Through the consideration of Porters value chain, the abstraction degree of the BMC and the structure of the data, relations between elements can be created in a comprehendible way as shown in cycle two of this thesis. As a result, not only the awareness on these relations between the elements is increased, also design principles to consider these relations are provided.

To sum it up, this DSR project provides lots of theoretical contributions. However, also practical contributions can be mentioned, which is shown in the following sequence.

Practical Contribution

As mentioned above, this DSR project does not only contribute to theory but also to practice. First of all, the resulting BM Analyzer 2.0 tool contributes most obvious to practice. This tool is easy to use and through the insert of company data, a BM can be displayed rapidly. Furthermore, it supports users' comprehension as I showed in different evaluations. Suitable functions provide a business modeling even for users with less experience in business modeling. Company partners show great interest in this topic and the tool. Second, the design principles and tool functionalities guide companies to build their own BM tool to their needs. Additionally, the information from the projects and evaluations can improve their own project knowledge and might improve the quality or success of the implementation of an own tool. Thereby, the design principles can be used separately, and separate functions can be included in different tools. Third, the insights from the increase of BM objectivity can help companies to rethink their strategy definition. As the BMC is highly subjective, but is often used as support for strategic decisions, companies have to rethink the knowledge base, on which they do such strategic decisions. A more objective base, even without using the tool, would be thinkable to increase the quality of the strategic decision. Fourth, already mentioned was the aim to increase the comprehension and use company data to achieve a BM tool, which functions similar to a construction plan: Different levels of experience as well as different levels of the company should have a common base to talk about the value creation. Through the increase of comprehension, companies can check, if the tool is suitable as such an internal communication platform. If this is the case, employees can benefit from the increased understanding and can communicate more specific about BM topics.

As a result, this doctoral thesis provides several practical and theoretical insights. However, there exist not only advantages, but also some limitations. Some of these limitations can be overcome in future research, which is shown in the following sub-chapter.

9.3. Limitation and Future Work

It is the nature of each research project that not only advantages are existing. To some extent, each project comes to a limitation. These limitations have to be considered to interpret the results of the research.

First, the DSR project has been conducted with only a limited number of industry partners. Although these partners have different backgrounds like the branch (automotive, chemical industry, consultancy etc.), they only have generalizability to some extent. However, the evaluations and points of measurements are distributed across a time period of more than 24 months. This seems appropriate concerning the internal validity, as the cause and effect measurement is distributed across the different points of time. This fulfills the temporal precedence criterion of research results (Bhattacherjee 2012). Additionally, a lab experiment was conducted to provide an external validity and to be able to generalize the results. As a consequence, the different field evaluations and the lab experiment enable a generalization of the results on other organizations as well as other points of time or in another context (Bhattacherjee 2012). However, further lab experiments or field studies with different backgrounds or experimental settings can support the generalization of these results and the design theory of this project.

Second, the evaluation of the BM comprehension was performed not only as a field study but also in a lab experiment. Although 240 people participated, all of them were students, without having a BM experience for many years. As a result, the design principles might not have that huge effect on BM experts. Future work can have a look at this and if the effect is proportional to the level of knowledge of the participants. During the experiment, each group consisted of students, which have the same overall level of BM experience so that the results are reliable. This was ensured by mixing the backgrounds of the students together. However, it could not be excluded that some of them were getting in touch with business modeling, for example through an internship. I tried to overcome this through the huge number of participants. To fulfill the law of large numbers and the weak convergence criteria, at least 30 people were necessary per group. I had 60 participants per group, which seems to be suitable to overcome this weakness. In general, all indicators were proofed as reliable and appropriate to measure the defined constructs. To show a relation between the different groups, I used a linear regression. This linear regression seems to be suitable only in the range between having no support and having support through the two design principles, as the data supports this assumption. However, it is thinkable that comprehension is not linearly proportional to the number of supporting functions or design principles. A high number of functions probably confuses the user and the effect of an increase of comprehension is low. Future work can have a look at this phenomenon and find the point, where the linear function is to be replaced through a logarithmic function.

Third, the Value Proposition Miner was introduced to overcome the weakness of mining the subjective value proposition of a company. While the objective value proposition of a company can be mined through the presented algorithm, the subjective value proposition is often not included in ERP data. The Value Proposition (VP) Miner uses therefore the information of the homepage of a company. However, in its current form, this VP Miner has some limitations: First of all, if a company has more than one BM, the system cannot relate the VP elements to one specific BM. Second, in contrast to the more objective ERP data, information on web pages are also human-made and therefore not fully objective. However, I assume that the data on homepages is checked by more than one person and therefore more accurate compared to the traditional BMC modeling process by only one person. Additionally, the web crawler only understands the English language so far. As many web pages also have an English version, I assume the lack as low. Future work can have a look at this challenge and extend the system through multiple languages. Future research can also complete, evaluate and improve the current approach. It is conceivable that the complete BM Miner will function as a decision support system. Thus, the BM of a company can be observed steadily and changes in the value creation can be detected rapidly. Additionally, one can get more insights into the influencing factors of the meta-requirements and the environment which lead to these meta-requirements. Some possible research questions to answer are: How does a BM change over a period of time? How does an automated method save and show these changes to users?

Fourth, the results of the literature review study have some limitations. First of all, I interpret the BM concept as a strategical or management concept (Wirtz 2011). Therefore, I set a time frame between 2012 and 2018. Of course, it is thinkable that further work is existing, focusing on strategic management and with that also further artifacts. Additionally, the work of Osterwalder and Pigneur (2010) is from the year 2010 and would be excluded from the results. It should be added that their work can be seen as a kind of starting point for BMs as management tools and naturally some time is needed until this topic was established. So the timeframe 2012 until today still seems to be suitable. As a result, we assume a high validity of the results concerning this limitation, as the huge majority of articles with a focus on BMs as strategic management concept is published after 2012 (e.g. Ebel et al. 2016). Second, the focus of this work was on BM artifacts. It is also thinkable that there are more existing articles, which provide a solution to the mentioned demands without naming them software, tool, artifact or model. Furthermore, the amount of papers and not the amount of tools was analyzed. It is thinkable that one paper is dealing with more than one tool, which I paid attention to. Otherwise, the paper count could not be used in a metric way. Third, the presented artifact capabilities are based solely on the articles of this classification. Therefore, it is conceivable that additional capabilities are not covered by this classification. As a result, there could exist a demand of capabilities, which are not included in the classification, but are of high interest by theory or practice. Last but not least, a classification is not perfect and has subjective insights (Nickerson et al. 2017). It can only be useful in the best case. Not each dimension of the classification is relevant for each artifact and more than one categorization is suitable for some artifacts. As a result, the classification provides only a direction, in which future research can lead. For example, future research can have a look at ecosystem business models, which follow a different logic as the regarded BMs. In this case, it is also thinkable to compare these and the traditional BM approaches. As a result, I encourage for a future artifact development a more detailed research in the related field to get a detailed overview of the particular requirements.

Fifth, the research question was "How can a business model system be designed in order to increase business model objectivity and users' business model comprehension". Even though the doctoral thesis has a look at both concepts, only the third design cycle is considering both concepts together. The first and the second design cycle is looking individually at one of the two concepts. Although, both concepts are influencing each other and both cycles were performed at the same time, the concepts were not created together. As a result, insights from one concept was influencing the other concept and the other way round, but there was no explicit investigation of both concepts together. Only cycle three did have a look at the combination of both concepts. Future work can have a closer look at combining these concepts and defining new set ups for using the concepts. However, I assume that looking at these concepts individually is important too. BM objectivity and BM comprehension are related but need not necessarily be applied together. Therefore, looking at a solution, which is considering both would not lead to the single insights of each aim.

To sum it up, possible starting points for future work are existing. In this doctoral thesis, I tried to overcome most of the weaknesses and limitations. However, it is in the nature of research that each project has borders and due to the limited time of the thesis project, not all aspects could be influenced. In the following sub-chapter, this and the doctoral thesis in general will be summarized.

9.4. Summary

In order to increase the objectivity and comprehension of BMs, I conducted this DSR project. The results are remarkable, as they show that even a few changes in the design of BMs and related tools can increase the comprehension and objectivity of BMs significantly. The main research question of this thesis was thereby: “How can a business model system be designed in order to increase business model objectivity and users’ business model comprehension? “. In order to answer this question, I conducted a design science research approach with three cycles. Chapter one of this thesis tried to draw attention to the most important challenges of business modeling and the related sub-research questions for this thesis. This was followed by chapter two, which provided an introduction to the foundations of business modeling and which gives an overview of the related work. Also included in this chapter was the literature review, which serves as a base for the problem awareness phase of the DSR project. This DSR project is described more detailed in chapter three as part of the methodology chapter. As a first step in the DSR project, chapter four provides an overview of the problem awareness of this project. In chapter five to seven, the three cycles of the research project were conducted. Thereby, meta-requirements and design principles for an increase of BM objectivity and comprehension were formulated and instantiated in an increased BM tool. Chapter eight discusses then the results of this design science project and the final chapter nine gives an overview of the theoretical and practical contributions as well as the limitations and future work.

As an outcome, the results show that the found design principles increase the objectivity and comprehension of BMs. In order to increase the objectivity of BMs, company data was used to create a BM from this data as a kind of bottom-up approach in comparison to the top-down approach. Such a top-down approach is common in today’s business modeling. As a consequence, both views complete the holistic view on the value creation of a company through this semi-automatic approach. Besides this, also design principles were formulated to increase users' comprehension of BMs. In the foreground stands the visualization of the implicit relations between the elements and an increased value capturing. Results show that people can make decisions more precise and are able to understand the flows of goods, services, and information better. All in all, the outcome of this thesis is not only an increased design knowledge and related principles. Also a BM tool, the "Business Model Analyzer 2.0" is resulting, which was tested and evaluated during the DSR project. This tool is ready to use and contains different functions for a semi-automated creation of BMs of a company as well as considering the principles for an increased BM comprehension. Both, the theoretical and the practical contribution should engage research as well as companies to deal with the topic of BM objectivity and comprehension as well as to develop supporting artifacts for business modeling. Thereby, the different challenges and possibilities to do research in business modeling should motivate this research, as Aristoteles remarks:

> *Joy at work makes the work turn out excellently.*
>
> Aristoteles (384-322 B.C.)

Abbreviations

BM	-	Business Model
DP	-	Design Principle
DSR	-	Design Science Research
ERP	-	Enterprise Resource Planning
IS	-	Information System
KPI	-	Key Performance Indicator
MR	-	Meta Requirement
PDCA	-	Plan-Do-Check-Act
RQ	-	Research Question

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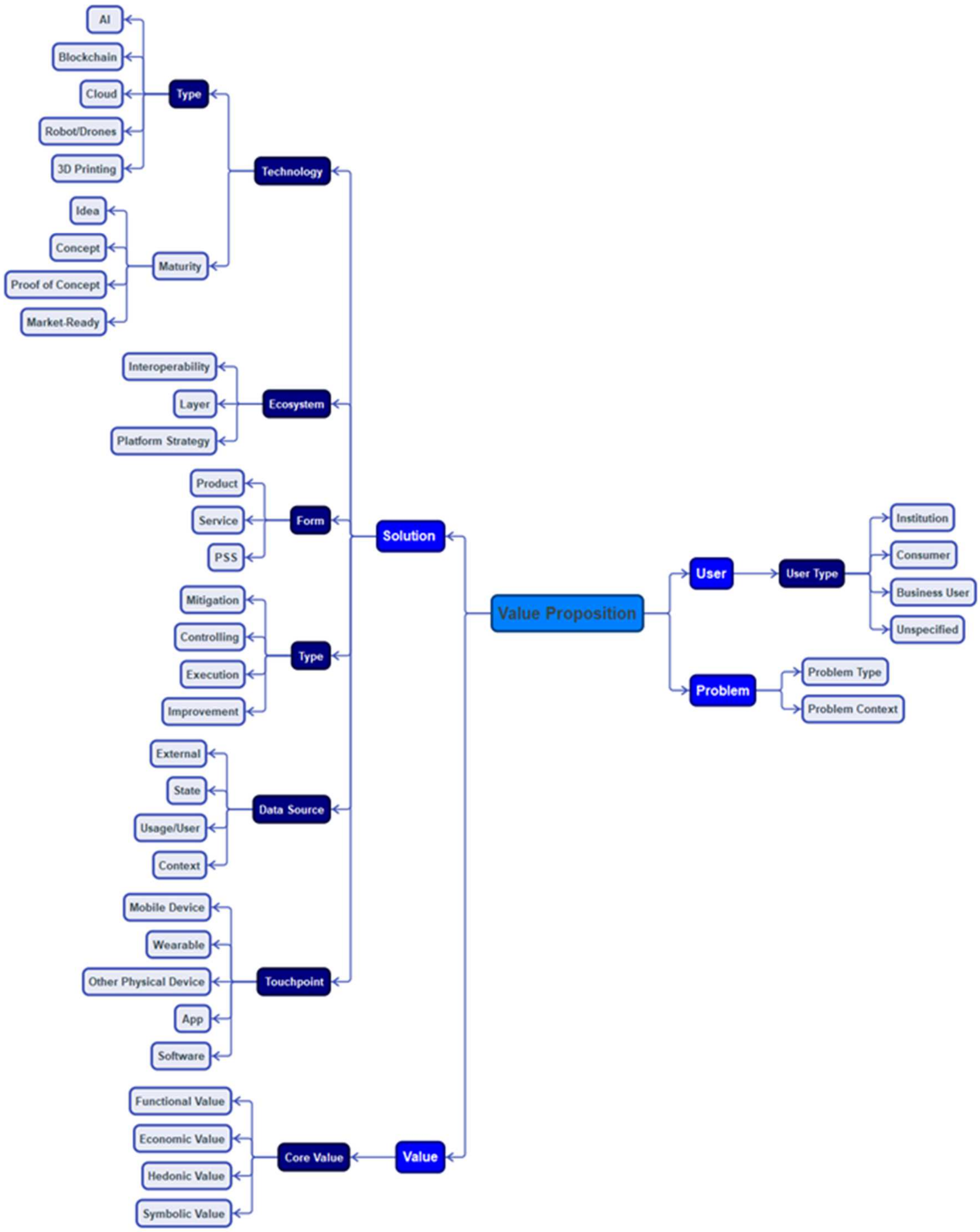
Attachment A: Data of the Literature Review

Paper	Artifact Type				Level of Artifact				BM Goals								BM Activities/Measures						Artifact Capabilities															
	Construct	Model	Method	Tool	Industry Level	Company Level	Business Unit Level	Product Level	Organizational Concept	Cooperation Concept	Coordination Concept	Concept of Growths	Competence configuration	Revenue Concept	Performance concept	Communication concept	Describing business activities	BM Realization	SWOT Analysis	Supporting holistic view	Reduce Complexity	Visualize Activities	**Modeling**	Representation/Comprehension	Creation	Monitoring/Visualization	Potential Identification	Analysis/Validation	**Decision Support**	Planning	Optimization	Risk Management	BM Innovation	**Implementation Support**	Simulation	Factor Utilisation	Change Management	Implementation
Aid et al. 2014 [14]				X	X				X			X							X	X			X			X	X											
Aldea et al. 2017 [29]				X		X			X										X			X	X			X	X	X	X	X	X							
Asif et al. 2016 [30]				X		X			X	X					X				X	X		X							X	X	X	X		X	X	X		
Bankvall et al. 2016 [31]			X			X				X						X				X			X			X	X	X						X		X		
Barquet et al. 2013 [32]			X			X			X									X					X					X										
Batocchio et al 2017 [33]				X		X									X				X	X			X	X		X	X											
Bleicher and Stanley 2017 [34]		X			X										X				X				X	X			X							X		X		
Boillat and Legner 2013 [35]	X					X			X		X										X	X	X			X	X							X				X
Chesbrough 2015 [15]	X				X				X											X			X				X		X	X			X					
Coita 2017 [36]	X					X			X					X					X										X		X							
Dahlgaard et al. 2013 [37]		X				X			X		X		X					X					X	X					X	X	X		X	X			X	X
De Leonardis & Rocci 2013 [38]	X					X								X					X				X					X	X		X	X						
Denning 2016 [39]	X					X			X												X	X	X				X	X						X		X		X
Deszczynski 2018 [40]			X		X					X	X					X				X	X		X				X							X			X	
Ding et al. 2013 [23]		X						X						X							X	X	X	X		X	X							X				X
Dwivedi & Chakraborty 2015 [41]			X		X						X			X			X		X	X			X	X		X	X	X	X	X								
Evans and Johnson 2013 [42]				X		X			X										X				X				X	X	X			X	X					
França et al 2016 [43]		X			X				X	X									X	X			X					X	X	X			X					
Giessmann & Legner 2016 [44]		X						X						X					X				X				X		X		X			X		X		
Grublješic and Jaklic 2015 [45]	X						X		X							X	X					X							X	X				X			X	X
Huang 2016 [46]		X				X			X	X	X		X			X	X	X				X	X	X		X	X	X										
Iriarte et al. 2018 [47]		X				X							X						X										X		X		X					
Joyce and Paquin 2016 [48]				X	X				X		X					X				X		X	X	X	X			X	X				X					
Kajanus et al. 2014 [49]				X		X						X		X					X				X			X	X	X										
Kim et al. 2017 [50]	X							X						X					X				X				X		X			X						
Kleber and Volkova 2017 [51]			X		X							X		X	X				X										X	X	X			X		X		
Kozlowski et al. 2017 [52]				X				X	X								X		X	X		X	X			X	X		X	X	X							
Krook and Baas [53]	X							X			X		X						X	X			X			X	X		X		X			X		X		
Levina & Vilnai-Yavetz 2015 [54]				X	X							X							X				X			X	X	X										
Lüttgens and Diener 2016 [55]			X		X				X			X		X					X	X	X		X		X		X		X	X		X						
Nguyen 2015 [56]	X						X				X				X						X	X												X	X			X
Podmetina et al. 2017 [57]	X						X		X				X							X			X		X		X							X		X		
Prikladnicki and Audy 2012 [58]		X						X	X		X								X			X	X			X	X		X	X		X						
Remane et al. 2016 [59]				X	X								X		X		X			X		X	X	X				X	X	X	X		X					
Rayna and Striukova 2016 [60]			X		X						X				X					X	X		X	X		X	X		X	X	X							
Shaked et al. 2013 [61]	X						X							X					X				X					X	X		X	X						
Singh et al. 2016 [62]		X				X									X					X			X			X		X										
Siqueira and Pitassi 2016 [63]		X				X			X												X		X		X			X										
Szabó et al. 2015 [64]		X					X							X					X				X			X			X		X							
Vaz et al. 2012 [65]				X	X					X	X					X				X		X	X			X	X		X	X	X			X		X		
Wirtz and Daiser 2017 [66]			X			X			X											X	X		X		X				X				X	X				X

Attachment B: Value Proposition Ontology



Attachment C: BMC related Questions and Examples

Category	Related Questions	Examples
Key Partners	Who are our Key Partners? Who are our key suppliers? Which Key Resources are we acquiring from partners? Which Key Activities do partners perform?	Kind of Partnership Supplier Associate
Key Resources	What Key Resources do our: • Value Propositions require, • Our Distribution Channels, • Customer Relationships • Revenue Streams require?	Physical vs. Intellectual vs. Financial Human Type
Key Activities	What Key Activities do our: • Value Propositions require, • Our Distribution Channels, • Customer Relationships • Revenue Streams require?	Production Problem Solving Platform/Network
Value Propositions	What value do we deliver to the customer? Which one of our customer's problems are we helping to solve? Which customer needs are we satisfying? What bundles of products and services are we offering to each Customer Segment?	Product/Service Price Brand/status Design Core Value
Customer Relationships	What type of relationship does each of our Customer Segments expect us to establish and maintain with them? Which ones have we established? How costly are they? How are they integrated with the rest of our business model?	Degree of Automation Contract Type Acquisition Type Boosting Sales
Channels	Through which Channels do our Customer Segments want to be reached? How are we reaching them now? How are our Channels integrated? Which ones work best? Which ones are most cost-efficient? How are we integrating them with customer routines?	Direct vs. Indirect Partner vs. Own Delivery Order
Customer Segments	For whom are we creating value? Who are our most important customers?	Mass vs. Niche Market Branch Multi-sided platforms
Cost	What are the most important costs inherent in our business model? Which Key Resources are most expensive? Which Key Activities are most expensive?	Cost vs. Value driven Fixed vs. Variable Costs Economies of Scale
Revenue	For what value are our customers really willing to pay? For what do they currently pay? How are they currently paying? How would they prefer to pay? How much does each Revenue Stream contribute to overall revenues?	Asset Sale Usage Fee Subscription Fees Licensing

Attachment D: Comprehension Questions of the Lab Experiment (DSR Cycle 2)

General Questions	What costs are not considered in this business model? What key activity does the company "Hyko Tools" have in addition to tool production and engineering? Which statement is correct? (2 x) Which is not a distribution channel of the company? Which category does the "repair service" belong to? What service does the company offer its customers to maintain good customer relationships? How many value propositions does the company have? Which of the following groups is not a Hyko Tools customer group? Which is NOT a revenue stream from Hyko Tools?
Questions about Relations (DP4)	Which value proposition is NOT directly related to the production tool? Which relationship is wrong? What do the machine manufacturers have a direct influence on? Which elements each have only one connection to another element (connections to the key figures do not count)? Which elements are indirectly connected via a third element? Which statement is not correct? Which two elements are NOT connected by a third element? Which element has no predecessor? Which element of Customer Relationships has the least connections to other elements? How many relationships/connections (other than to metrics) does the High Quality element have?
Questions about KPIs (DP5)	Which statement is true? (3x) What is the most accurate statement of sales revenue? Which statement applies to repair and service costs? What is the trend in the costs of secondary activities for 2018 based on the trend from 2017? Which ratio seems to be inversely proportional to production costs? How many maxima does the curve of the number of employees have (without marginal maxima)? Between which key figures is there a similarity of the curves? What is the development of revenues from repair orders between April and October 2017?

Attachment E: Items of the Lab Experiment

Construct	Item
Familiarity with Business Models	Overall, I am very familiar with Business Models. I feel very confident in understanding the value creation process represented in a Business Model. I feel very competent in using the Business Model Canvas for business modeling.
Business Model Comprehension	Multiple Choice Questions
Perceived Usefulness	Using system would enable me to accomplish tasks more quickly. Using the system would make it easier to modify business models Using the system to modify business models would increase my productivity. I would find the system useful to modify business models
Perceived Ease of Use	Learning to operate the system BM tool would be easy for me. I would find it easy to get the system BM tool to do what I want it to do . I would find the system BM tool easy to use. I would find the system BM tool to be flexible to interact with.
Element Interactivity	The range of functions (relations between elements) offered by the system is adequate. I use all of the functionality (relations between elements) available in this system. In terms of the features (relations between elements) of the tool that provide the information you need, using the tool made you: Very dissatisfied-very satisfied The performance and functionality (relations between the elements) of this system is highly inadequate.
Model Coherence KPIs	The range of KPI functions offered by the system is adequate. I use all of the KPI functionality available in this system. In terms of the KPI features of the tool that provide the information you need, using the tool made you: Very dissatisfied-very satisfied The performance and KPI functionality of this system is highly inadequate.
Comprehension Task Performance Comprehension Task Efficiency	Individual/Specific Questions
User‘s characteristics	I find it easier a)to learn facts / b) to learn concepts I prefer the idea of a) certainty / b) theory I am more likely to be considered a) careful about the details of my work / b) creatice about how to do my work. When I have to perform a task, I prefer to a) master one way of doing it / b) come up with new ways of doing it.
Knowledge Construction (Learning Motive)	I feel that nearly any topic can be highly interesting once I get into it. I come to most (refresher) courses with questions in mind that I want answered. I find I am continually going over my work in my mind at times like when I am on the bus, walking, or lying in bed and so on. I like to do enough work on a topic so that I can form my own conclusions before I am satisfied.
Mental Effort Variant A	How much mental and perceptual activity was required to perform previous tasks? How much time pressure did you feel during the task? How insecure, discouraged, irritated, stressed, and annoyed did you feel during the task? How successful do you think you were in accomplishing the goals of the task?
Task Complexity Variant A	I found this to be a complex task. This task was mentally demanding This task required a lot of thought and problem-solving I found this to be a challenging task
Demographics	Please specify your age Please specify your gender Further Questions to Semester etc.

Attachment F: Data for Case Study Validation (DSR Cycle 3)

Product/Service	Core Value	Sum Turnover [Mio €]
Model 911 (Carrera)	tangible	354
Model 911 Turbo	tangible	90
Model 911 GT	tangible	18
Model Boxster	tangible	317
Model Cayman	tangible	326
Model Cayenne	tangible	1.137
Model Carrera GT	tangible	318
Model 918 Spyder	tangible	211
Model 928	tangible	34
Model 968	tangible	54
Model 944	tangible	21
Model 924	tangible	67
Model Macan	tangible	1.093
Model Panamera	tangible	107
Model Panamera ST	tangible	53

Product and Services:

Product/Service	Core Value	Sum Turnover [Mio €]	Rank
Model 911 (Carrera)	tangible	354	3
Model 911 Turbo	tangible	90	9
Model 911 GT	tangible	18	15
Model Boxster	tangible	317	6
Model Cayman	tangible	326	4
Model Cayenne	tangible	1.137	1
Model Carrera GT	tangible	318	5
Model 918 Spyder	tangible	211	7
Model 928	tangible	34	13
Model 968	tangible	54	11
Model 944	tangible	21	14
Model 924	tangible	67	10
Model Macan	tangible	1.093	2
Model Panamera	tangible	107	8
Model Panamera ST	tangible	53	12

Branch and Contract Type:

Branch	Product/Service	Turnover per P/S [Mio €)	Total Turnover [Mio €]
Private Customer	Model 911 (Carrera)	154	2.693
Private Customer	Model Carrera GT	288	2.693
Private Customer	Model 911 Turbo	50	2.693
Private Customer	Model Boxster	271	2.693
Private Customer	Model Cayman	224	2.693
Private Customer	Model Cayenne	726	2.693
Private Customer	Model Macan	774	2.693
Private Customer	Model 928	21	2.693
Private Customer	Model 968	48	2.693
Private Customer	Model 944	16	2.693
Private Customer	Model 924	41	2.693
Private Customer	Model Panamera	50	2.693
Private Customer	Model Panamera ST	30	2.693
Business Cars	Model 911 (Carrera)	49	477
Business Cars	Model 911 Turbo	35	477
Business Cars	Model Boxster	36	477
Business Cars	Model Cayman	14	477
Business Cars	Model Cayenne	167	477
Business Cars	Model Macan	131	477
Business Cars	Model Panamera	45	477
Car Rental	Model 911 (Carrera)	84	294
Car Rental	Model Macan	108	294
Car Rental	Model Cayman	102	294
Car Dealership	Model 911 (Carrera)	67	194
Car Dealership	Model 911 Turbo	5	194
Car Dealership	Model Boxster	13	194
Car Dealership	Model Cayman	47	194
Car Dealership	Model Cayenne	10	194
Car Dealership	Model Macan	17	194
Car Dealership	Model Panamera	12	194
Car Dealership	Model Panamera ST	23	194
Transfer Sector	Model Cayenne	190	253
Transfer Sector	Model Macan	63	253
Car Racing	Model 918 Spyder	64	64
Fairs & Exhibitions	Model Carrera GT	30	183
Fairs & Exhibitions	Model 911 GT	6	183
Fairs & Exhibitions	Model 918 Spyder	147	183
Movie Industry	Model 928	13	42
Movie Industry	Model 968	6	42
Movie Industry	Model 944	5	42
Movie Industry	Model 924	6	42
Movie Industry	Model 911 GT	12	42

Order Type:

Product/Service	Order Type	Turnover per Type [Mio €]	Turnover [Mio €]
Model 911 (Carrera)	Retailer Order	290	354
Model 911 (Carrera)	Online Order	64	354
Model 911 Turbo	Retailer Order	37	90
Model 911 Turbo	Online Order	53	90
Model 911 GT	Factory Order	18	18
Model Boxster	Retailer Order	293	317
Model Boxster	Online Order	24	317
Model Cayman	Retailer Order	276	326
Model Cayman	Online Order	50	326
Model Cayenne	Retailer Order	938	1137
Model Cayenne	Online Order	199	1137
Model Carrera GT	Retailer Order	258	318
Model Carrera GT	Online Order	43	318
Model Carrera GT	Factory Order	17	318
Model 918 Spyder	Factory Order	211	211
Model 928	Factory Order	34	34
Model 968	Factory Order	54	54
Model 944	Factory Order	21	21
Model 924	Factory Order	67	67
Model Macan	Retailer Order	593	1093
Model Macan	Online Order	260	1093
Model Macan	Phone Order	203	1093
Model Macan	Factory Order	37	1093
Model Panamera	Online Order	38	107
Model Panamera	Phone Order	69	107
Model Panamera ST	Online Order	24	53
Model Panamera ST	Phone Order	29	53

Key Activities:

Product/Service	Key Activity	Partner	Cost/Partner & Activity [Mio €]	Sum Costs [Mio €]
Model 911 (Carrera)	Building Engine	Robert Bosch AG	2	18
Model 911 (Carrera)	Building Car Body	NHG GmbH	4	18
Model 911 (Carrera)	Wedding Body & Engine	none	1	18
Model 911 (Carrera)	Installing Electronics	e-Vonic	9	18
Model 911 (Carrera)	Quality Check	none	2	18
Model 911 Turbo	Building Engine	Robert Bosch AG	2	13
Model 911 Turbo	Building Car Body	NHG GmbH	1	13
Model 911 Turbo	Wedding Body & Engine	none	3	13
Model 911 Turbo	Installing Electronics	e-Vonic	4	13
Model 911 Turbo	Quality Check	none	3	13
Model 911 GT	Building Engine	Robert Bosch AG	1	6
Model 911 GT	Building Car Body	NHG GmbH	1	6
Model 911 GT	Wedding Body & Engine	none	1	6
Model 911 GT	Installing Electronics	e-Vonic	2	6
Model 911 GT	Quality Check	none	1	6
Model Boxster	Building Engine	Robert Bosch AG	15	63
Model Boxster	Building Car Body	NHG GmbH	20	63
Model Boxster	Wedding Body & Engine	none	7	63
Model Boxster	Installing Electronics	e-Vonic	11	63
Model Boxster	Quality Check	none	9	63
Model Cayman	Building Engine	Robert Bosch AG	22	62
Model Cayman	Building Car Body	NHG GmbH	13	62
Model Cayman	Wedding Body & Engine	none	11	62
Model Cayman	Installing Electronics	e-Vonic	7	62
Model Cayman	Quality Check	none	9	62
Model Cayenne	Building Engine	Robert Bosch AG	37	253
Model Cayenne	Building Car Body	NHG GmbH	19	253
Model Cayenne	Wedding Body & Engine	none	57	253
Model Cayenne	Installing Electronics	e-Vonic	67	253
Model Cayenne	Quality Check	none	57	253
Model Carrera GT	Building Engine	Robert Bosch AG	31	131
Model Carrera GT	Building Car Body	NHG GmbH	10	131
Model Carrera GT	Wedding Body & Engine	none	35	131
Model Carrera GT	Installing Electronics	e-Vonic	15	131
Model Carrera GT	Quality Check	none	17	131

Model Carrera GT	Fine Tuning	FT-Tune	23	131
Model 918 Spyder	Building Engine	Robert Bosch GmbH	5	95
Model 918 Spyder	Building Car Body	NHG GmbH	16	95
Model 918 Spyder	Wedding Body & Engine	none	19	95
Model 918 Spyder	Installing Electronics	e-Vonic	22	95
Model 918 Spyder	Quality Check	none	15	95
Model 918 Spyder	Fine Tuning	FT-Tune	18	95
Model 928	Building Engine	Robert Bosch GmbH	2	12
Model 928	Building Car Body	NHG GmbH	3	12
Model 928	Wedding Body & Engine	none	3	12
Model 928	Quality Check	none	4	12
Model 968	Building Engine	Robert Bosch GmbH	2	11
Model 968	Building Car Body	NHG GmbH	2	11
Model 968	Wedding Body & Engine	none	3	11
Model 968	Quality Check	none	4	11
Model 944	Building Engine	Robert Bosch GmbH	2	11
Model 944	Building Car Body	NHG GmbH	2	11
Model 944	Wedding Body & Engine	none	4	11
Model 944	Quality Check	none	3	11
Model 924	Building Engine	Robert Bosch GmbH	3	17
Model 924	Building Car Body	NHG GmbH	6	17
Model 924	Wedding Body & Engine	none	4	17
Model 924	Quality Check	none	4	17
Model Macan	Building Engine	Robert Bosch GmbH	83	401
Model Macan	Building Car Body	NHG GmbH	56	401
Model Macan	Wedding Body & Engine	none	104	401
Model Macan	Installing Electronics	e-Vonic	105	401
Model Macan	Quality Check	none	53	401
Model Panamera	Building Engine	Robert Bosch GmbH	13	57
Model Panamera	Building Car Body	NHG GmbH	25	57
Model Panamera	Wedding Body & Engine	none	7	57
Model Panamera	Installing Electronics	e-Vonic	5	57
Model Panamera	Quality Check	none	7	57
Model Panamera ST	Building Engine	Robert Bosch GmbH	5	27
Model Panamera ST	Building Car Body	NHG GmbH	3	27
Model Panamera ST	Wedding Body & Engine	none	5	27
Model Panamera ST	Installing Electronics	e-Vonic	5	27

Model Panamera ST	Quality Check	none	1	27
Model Panamera ST	Fine Tuning	FT-Tune	8	27

Key Resources:

Product/Service	Resource	Supplier	Cost per Resource [Mio €]	Sum Costs [Mio €]
Model 911 (Carrera)	Engine	Robert Bosch GmbH	27	38
Model 911 (Carrera)	Metal	Heine & Beisswenger	2	38
Model 911 (Carrera)	Tires	Pirelli	1	38
Model 911 (Carrera)	Electronics	MKM	3	38
Model 911 (Carrera)	Interior	Recaro Holding	5	38
Model 911 Turbo	Engine	Robert Bosch GmbH	9	16
Model 911 Turbo	Metal	Heine & Beisswenger	1	16
Model 911 Turbo	Tires	Pirelli	1	16
Model 911 Turbo	Electronics	MKM	2	16
Model 911 Turbo	Interior	Recaro Holding	3	16
Model 911 GT	Engine	Robert Bosch GmbH	2	7
Model 911 GT	Metal	Heine & Beisswenger	1	7
Model 911 GT	Tires	Pirelli	1	7
Model 911 GT	Electronics	MKM	1	7
Model 911 GT	Interior	Recaro Holding	2	7
Model Boxster	Engine	Robert Bosch GmbH	23	42
Model Boxster	Metal	Heine & Beisswenger	2	42
Model Boxster	Tires	Pirelli	3	42
Model Boxster	Electronics	MKM	5	42
Model Boxster	Interior	Recaro Holding	9	42
Model Cayman	Engine	Robert Bosch GmbH	22	48
Model Cayman	Metal	Heine & Beisswenger	5	48
Model Cayman	Tires	Pirelli	8	48
Model Cayman	Electronics	MKM	7	48
Model Cayman	Interior	Recaro Holding	6	48

Model Cayenne	Engine	Robert Bosch GmbH	132	248
Model Cayenne	Metal	Heine & Beisswenger	48	248
Model Cayenne	Tires	Pirelli	26	248
Model Cayenne	Electronics	MKM	32	248
Model Cayenne	Interior	Recaro Holding	10	248
Model Carrera GT	Engine	Robert Bosch GmbH	10	39
Model Carrera GT	Metal	Heine & Beisswenger	7	39
Model Carrera GT	Tires	Pirelli	2	39
Model Carrera GT	Electronics	MKM	11	39
Model Carrera GT	Interior	Recaro Holding	9	39
Model 918 Spyder	Engine	Robert Bosch GmbH	6	16
Model 918 Spyder	Metal	Heine & Beisswenger	1	16
Model 918 Spyder	Tires	Pirelli	2	16
Model 918 Spyder	Electronics	MKM	3	16
Model 918 Spyder	Interior	Recaro Holding	4	16
Model 928	Engine	Robert Bosch GmbH	2	6
Model 928	Metal	Heine & Beisswenger	1	6
Model 928	Tires	Pirelli	1	6
Model 928	Interior	Recaro Holding	2	6
Model 968	Engine	Robert Bosch GmbH	2	8
Model 968	Metal	Heine & Beisswenger	2	8
Model 968	Tires	Pirelli	1	8
Model 968	Interior	Recaro Holding	3	8
Model 944	Engine	Robert Bosch GmbH	3	7
Model 944	Metal	Heine & Beisswenger	2	7
Model 944	Tires	Pirelli	1	7
Model 944	Interior	Recaro Holding	1	7
Model 924	Engine	Robert Bosch GmbH	7	13
Model 924	Metal	Heine &	2	13

		Beisswenger		
Model 924	Tires	Pirelli	1	13
Model 924	Interior	Recaro Holding	3	13
Model Macan	Engine	Robert Bosch GmbH	123	379
Model Macan	Metal	Heine & Beisswenger	187	379
Model Macan	Tires	Pirelli	11	379
Model Macan	Electronics	MKM	14	379
Model Macan	Interior	Recaro Holding	44	379
Model Panamera	Engine	Robert Bosch GmbH	13	47
Model Panamera	Metal	Heine & Beisswenger	8	47
Model Panamera	Tires	Pirelli	2	47
Model Panamera	Electronics	MKM	15	47
Model Panamera	Interior	Recaro Holding	9	47
Model Panamera ST	Engine	Robert Bosch GmbH	13	27
Model Panamera ST	Metal	Heine & Beisswenger	1	27
Model Panamera ST	Tires	Pirelli	2	27
Model Panamera ST	Electronics	MKM	7	27
Model Panamera ST	Interior	Recaro Holding	4	27

Attachment G: Publications

Schönthaler, F; Augenstein, D.; Karle, T. (2015): Design and Governance of Collaborative Business Processes in Industry 4.0. In *Proceedings of the 17th IEEE Conference on Business Informatics*, Lisbon, Portugal

Augenstein, D.; Citak, M.; Ullrich, M.; Vetter, A. (2016): Experience Report: Social BPM Lab enhanced with participation of professionals. In *Modellierung 2016*, Bonn, Germany

Augenstein, D. (2017): Intelligente Geschäftsmodellierung. In Hi:Tech Campus

Augenstein, D.; Fleig, C. (2017): Exploring Design Principles for a Business Model Mining Tool. *38th International Conference on Information Systems (ICIS): Transforming Society with Digital Innovation*, Seoul, Korea

Augenstein, D.; Maedche, A. (2017): Exploring Design Principles for Business Model Transformation Tools. *38th International Conference on Information Systems (ICIS): Transforming Society with Digital Innovation*, Seoul, Korea

Augenstein, D. (2017): Building an intelligent business model transformation tool. In *Proceedings of Informatik 2017*, Chemnitz, Germany

Fleig, C.; Augenstein, D. (2017): Developing a Business Model Transformation Tool. *6th Karlsruhe Service Summit 2017*, Karlsruhe, Germany

Augenstein, D. (2018): Herausforderung Industrie 4.0 meistern – Ein praxisorientierter Ansatz zur Transformation von Geschäftsmodellen. In *Industrie 4.0 Management*, 15-18

Fleig, C.; Augenstein, D.; Maedche, A. (2018): KeyPro - A Decision Support System for Discovering Important Business Processes in Information Systems. *International Conference on Advanced Information Systems Engineering*, Tallinn, Estonia, 90-104

Fleig, C.; Augenstein, D.; Maedche, A. (2018): Tell Me What's My Business – Development of a Business Model Mining Software. *International Conference on Advanced Information Systems Engineering*, Tallinn, Estonia, 105-113

Augenstein, D.; Fleig, C.; Mädche, A. (2018): Development of a data-driven business model transformation tool. In *Proceedings of Designing for a Digital and Globalized World: 13th International Conference, DESRIST 2018*, Chennai, India

Augenstein, D.; Fleig, C. (2018): Towards increased business model comprehension – principles for an advanced business model tool. *European Conference on Information Systems (ECIS)*, Portsmouth, United Kingdom

Fleig, C.; Augenstein, D.; Mädche, A. (2018): Process Mining for Business Process Standardization in ERP Implementation Projects – An SAP S/4 HANA Case Study from Manufacturing. *16th International Conference on Business Process Management (BPM)*, Sydney, Australia

Fleig, C.; Augenstein, D.; Mädche, A. (2018): Designing a Process Mining-Enabled Decision Support System for Business Process Standardization in ERP Implementation Projects, *Business Process Management Forum: BPM Forum 2018*. Sydney, Australia

Augenstein, D.; Fleig, C.; Dellermann, D. (2018): Towards value proposition mining - Exploration of design principles. In *Proceedings of 39th International Conference on Information Systems*, San Francisco, United States of America

Augenstein, D. (2019): The Opportunities of using Business Models in Service Management – A review and classification of Business Model Artefacts, In *Journal of Service Management Research*, Munich, Germany, Volume 4

Attachment H: Affidavit

Eidesstattliche Versicherung

gemäß § 6 Abs. 1 Ziff. 4 der Promotionsordnung des Karlsruher Instituts für Technologie für die Fakultät für Wirtschaftswissenschaften

1. Bei der eingereichten Dissertation handelt es sich um meine eigenständig erbrachte Leistung.

2. Ich habe nur die angegebenen Quellen und Hilfsmittel benutzt und mich keiner unzulässigen Hilfe Dritter bedient. Insbesondere habe ich wörtlich oder sinngemäß aus anderen Werken übernommene Inhalte als solche kenntlich gemacht.

3. Die Arbeit oder Teile davon habe ich bislang nicht an einer Hochschule des In- oder Auslands als Bestandteil einer Prüfungs- oder Qualifikationsleistung vorgelegt.

4. Die Richtigkeit der vorstehenden Erklärungen bestätige ich.

5. Die Bedeutung der eidesstattlichen Versicherung und die strafrechtlichen Folgen einer unrichtigen oder unvollständigen eidesstattlichen Versicherung sind mir bekannt. Ich versichere an Eides statt, dass ich nach bestem Wissen die reine Wahrheit erklärt und nichts verschwiegen habe.

Karlsruhe, den 12.11.2019