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Abstract

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business model transformation process from a current state towards a target state. To address this problem, we derive requirements for a business model transformation tool. We translate these requirements into design principles and present a toolset for data-driven business model transformation. This toolset enables companies to extract status quo business models from existing operational information systems. Furthermore, it allows the representation of explicit relationships between the different value dimensions of a business model and enables quantifying the impact of changes. The result of this paper is a set of requirements, design principles as well as a tool instantiation, which can actively support the business model transformation process.

Keywords (separated by '-')	Business model - Transformation - Design science

Development of a Data-Driven Business Model Transformation Tool

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Abstract. Rapidly changing environments and customer demands force companies to transform their business models in ever shorter periods of time. However, existing approaches like the business model canvas and corresponding tools mainly focus on documentation on a strategic level and do not actively support the business model transformation process from a current state towards a target state. To address this problem, we derive requirements for a business model transformation tool. We translate these requirements into design principles and present a toolset for data-driven business model transformation. This toolset enables companies to extract status quo business models from existing operational information systems. Furthermore, it allows the representation of explicit relationships between the different value dimensions of a business model and enables quantifying the impact of changes. The result of this paper is a set of requirements, design principles as well as a tool instantiation, which can actively support the business model transformation process.

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1 Introduction

Increasing global competition and new challenges driven by a growing number of services and digitalization force companies to adjust their business models (BM) steadily to the new environment. The combination of traditional products with (digital) services becomes more and more important for companies. As consumers are more than ever able to compare products and services on the markets, companies have to rethink their traditional way of doing business [1]. Thus, companies increasingly redesign their BMs and focus on digital services [2]. To support business modelling in general, several methods, techniques and tools exist [3]. The most well-known is the Business Model Canvas (BMC) by Osterwalder [4].

Although BMs have been intensively investigated in the information systems discipline as well as strategic management, entrepreneurship and marketing, there is still a gap with regards to the question how actual transformation of BMs can be better supported [5]. Having a closer look at the often cited BMC by Osterwalder, it becomes obvious that the focus of the concept is rather strategic and less focused on the operationalization of the defined BMs [4]. Thus, different advancements and frameworks have been suggested to make the concept more operational [3, 6]. Zott et al. [7]

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further mention the need of an increased flexibility in BMs to improve the support for transformation processes. As a result, the knowledge of BM transformation (BMT) can be used by practitioners. This knowledge can be used to extend the current BM concepts from the strategic level to the operational level. This is because current BM concepts like the BM canvas [8] or the BM cube [6] are inflexible in the way that these concepts focus mainly on the strategic view of a company [8]. In sum, most of these models provide guidance rather on a higher abstraction level, like the BMC as a first outline of the planned value creation in a start-up phase. IS research started to link the operational level to the rather strategic BM level and emphasizes the importance of making BMs more operational for example through considering the dependencies of lower levels [9, 10]. Implementing a higher degree of operationalization in existing BM concepts would support a better comprehension of the transformation process [5]. Having a look at strategy execution research, Richardson [11] stresses the need of supporting the execution of strategic frameworks. He further claims, that a BM is neither a strategy nor a table of actions to execute the strategy (see also [9, 12]). The key question is, how to make BMs more executable, considering operational levels in organizations to emphasize the path from strategy to execution [7, 13]. In particular, there is a need to develop a framework, which supports a transformation through clear rules. So, in this work we want to answer the question:

What are relevant meta-requirements and design principles for business model transformation tools and how can they be instantiated?

To answer this question, we follow a design science research (DSR) approach. In this paper, we first describe conceptual foundations (Sect. 2). In Sect. 3, we elaborate on the underlying DSR methodology and specifically describe the activities performed in cycle 1 of the entire DSR project. Sect. 4 presents the meta-requirements and design principles. Subsequently, we give an overview about the instantiation of the design principles in a concrete business transformation toolset (Sect. 5) and provide an outlook and a final conclusion (Sect. 6).

2 Conceptual Foundations

2.1 Business Model Tools

Business models (BM) focus on providing a transparent representation of how a company actually creates value [16]. For Timmers [17], a BM is "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". Facing disruptive changes, companies can influence such changes through extensive adjustments of their BMs [17]. Existing approaches try to support this through a representation of the value creation process of a company [16] and facilitating a mediation between strategic and operational levels [9]. However, actual support for this mediation process is lacking [3]. Contemporary business model research focuses on the challenge by adapting business models according to disruptive situations [18]. Both in practice and theory, the aim is to

demonstrate the interaction of business model components and the development of the entire business model so that changes in the environment and the associated development can be viewed better [15].

Osterwalder's ontology for BMs [4] and the related book [8] is most likely the most visible framework in research and practice. Today, more than twenty BM frameworks with various purposes of use and field of study exist [15]. Specifically, scholars added further dimensions to transform the one-dimensional BMC to a multidimensional cube. In this cube concept, the categories of the BMC are reorganized in a way, that they show relations and support BM implementations [6]. A practical tool, which is using this BM cube, is for example the "NEFFICS platform" [19]. This reflects the logic, how value is created in more detail, but also requiring higher modelling effort [6]. The basic idea of this tool is to make the entire model more operational and allow connections between the different elements of the model [20]. However, these extensions and improvements come at the expense of simplicity, which is provided through the established BM canvas [8]. An adequate tool should therefore consider the principles of operationalization as well as simplicity.

2.2 Business Model Transformation

In general, we define business model transformation (BMT) as a transformation process of the value creation caused by external or internal changes [18]. Especially, disruptive changes can affect companies in a way that they have to adapt and change their BMs significantly [15]. For this definition of BMT, we adapt the definition of Lindgardt et al. [21] for BM innovation (BMI): "A business model consists of two essential elements – the value proposition and the operating model – each of which has three sub-elements. […] Innovation becomes BMI when two or more elements of a business model are reinvented". However, if at least one element changes, one has to adapt the BM, which we define as BMT. Consequently, BMI is part of BMT when the value creation changes tremendously [22].

Three kinds of resource flows in BMs are considered: Flow of goods, representing the way of products, ownership and risk; flow of information as well as flow of funds [23, 24]. In the BMC, the categories "Key Activities" and "Key Resources" build partial models, which have interlinks between each other, because the resources are used in the activities or at least address the same questions of customer relationship and revenue streams [8]. The intention in practice as well as in theory is to show the interaction of BM parts and the development of the whole BM, so changes in the environment and the related development can be understood better [15]. This means for BMT, that the user should not only have an idea of the value creation process, but also should understands the individual partial models. This understanding is not only necessary at one single point of time, but during the entire transformation process. Scholars in BMI are aware of this requirement: They propose information about the flow of goods, information and funds as design elements and consider effects of the corresponding activities in the business model innovation process [18, 26]. As a result, the implementation of BMI using a transformation tool should follow a systematic management process [18, 22]. Thus, business model comprehension should be enabled for the corresponding users of the BMT tool during the whole transformation process.

Existing approaches try to provide a clear and transparent representation of how a company creates value [16, 27, 28]. However, they come with limitations with regards to the end-to-end perspective. An advanced BM tool should take into account the current and target state of a company and orientate itself on the processes at the operational level [3].

3 Methodology

We follow the Design Science Research framework suggested by Vaishnavi and Kuechler [29]. The overall DSR project consists of two design cycles as depicted in Fig. 1. In our research we specifically target real-world-challenges of companies in the manufacturing industries. In particular, we put a specific focus on the implementation of strategic changes of their organization triggered by changes in the BM. We tightly cooperate with industry partners in this DSR project. Each design cycle consists of a problem awareness phase to determine the needs for a comprehensive BMT tool to overcome the weaknesses of current approaches. In this paper, we specifically focus on the **first design cycle** and discover requirements and design principles for a BMT tool through the analysis of real-world cases research complemented with a literature study. The second design cycle will build on the first design cycle and deliver a complete software artefact for BMT.

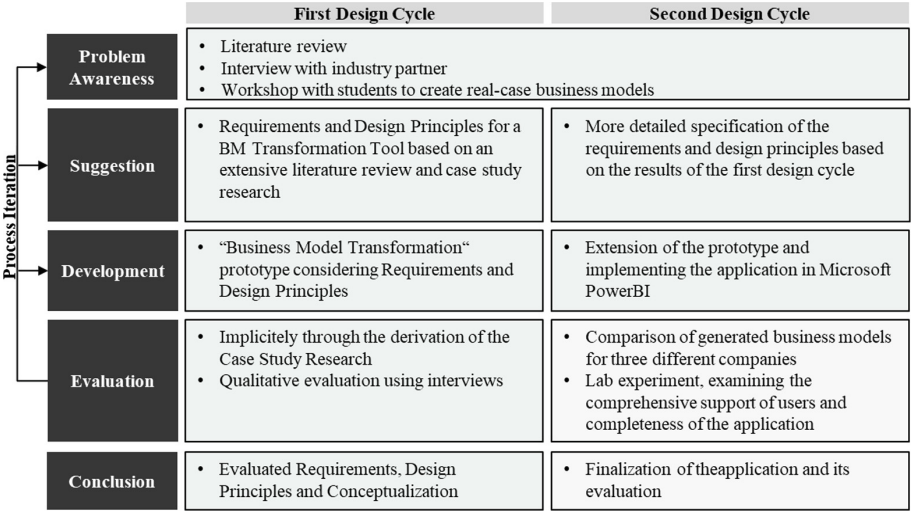

Fig. 1. DSR cycles based on Vaishnavi and Kuechler [29]

We suggest meta-requirements and design principles based on existing literature and interviews with industry partners. Furthermore, we perform a qualitative validation of the identified design principles by investigating real-world- transformation cases.

Case studies are investigations of "contemporary real-life phenomenon through detailed contextual analysis of a limited number of events or conditions, and their relationships" [30]. Studying companies, for instance by means of a customer database, and generalizing the results is a common approach. Specifically, we leverage real-world cases to validate our identified design principles. Focus of these cases is the transformation of an existing BM. We select a wide range of cases from the manufacturing sector. We focus on this sector, because for us the comparability between companies of the same sector is higher than across different sectors. The main information of the transformation in the cases is derived from public available reports [31–37]. Additionally, information is derived from public Web pages, publications of the companies and business performance reports. The companies are located all over the world, e.g. United States, India or Europe. A majority of the cases is from the automotive sector, but the rest is spread in other fields of manufacturing. Therefore, we want to guarantee a higher generalizability of the results.

4 Suggestion Phase

In this section we describe the meta-requirements and design principles for a BMT tool. As mentioned above, a BMT tool in general should demand the two mentioned main needs: Getting an objective overview of the current situation and supporting users throughout the entire transformation process.

4.1 Requirements for BM Transformation Tools

We proposed five requirements (RQ) for business model transformation tools. Three requirements focus on extracting the status quo business models from existing organizational information systems and two for supporting the actual BMT process. As mentioned earlier the use of the BMC is quite common in companies. However, BMC's are created top-down and therefore contain subjective data. This is because the BM is depending on the involved people and their actual knowledge about the value creation process. Existing literature addresses such challenges as the formation and adaption of BMs [5]. As a result, there is no evaluation step included and people involved in the transformation do not know, if they start with a complete and correct capturing of the initial situation.

A possible solution can be the use of company data from organizational information systems. In particular, information systems such as enterprise resource planning (ERP) systems can be leveraged. They provide a huge amount of data follow a more objective data-driven BM approach. Thereby, one has to take care, that relevant data is used, which provides detailed information about the current value creation process. The key challenge hereby is to identify appropriate data sources containing the relevant information of the company's BM. This, we articulate the first meta-requirement:

RQ 1.1: To enable bottom-up creation of a business model leverage existing data.
The results of this bottom-up approach have to be compared and rated towards the top-down approach. Therefore, the extracted data should be structured in some way. With that, not only a comparison between the top-down approach, but also with other BMs is important. In BMT, one typically compares the initial situation with the target state. Current BM approaches like the BMC [8] or the BM cube [6] are able to provide such a structure. Furthermore, a defined structure of the extracted data is also contributing to the comprehension for its users. Thus, we articulate

RQ 1.2: To guarantee comparability of top-down and bottom-up business model creation approaches, the extracted data should be structured in a unified way.
Not only a easy-to-understand structure of the business model is important. Too much information can negatively influence business model comprehension of a user. For example, the BMC is kept easy to fill in and to understand, so that users are more likely to use it [8]. This is in contrast to the BM cube, which is a more dimensional BM representation. Nevertheless, in this representation also the information is aggregated [6]. In general, to reduce an overload of information, the given data should be provided in a way such that the user has the necessary information in an aggregated form:

RQ 1.3: To report relevant information, the collected data should be aggregated.
Existing BM research deals with challenges such as the formation and adaptation of BMs in different business areas [5]. It is relatively easy to model the current state and a target state that represents the future to-be situation of the company [8]. However, there are specific challenges in the transformation process. For example, when mapping the actual and target situation, some elements in their context cannot be reused or are outdated. This results in a number of gaps that force decisions, e.g. by means of leveraging internal or external capacities [21]. Thus, we articulate the following requirement:

RQ 2.1: In order to increase the executability, the status quo of a companies' business model(s) should be explicitly interconnected to the target business model(s).
Mapping is difficult because the focus is mainly on the logic of value creation [4, 17]. However, the mapping of the current BM with the target BM is important because one can quickly see which elements are not mapped. We understand the "as-is state" BM to be representative of the current operational level of a company, since it represents the existing value creation logic. For us, the target state model is a representation of the company's goals. Consequently, mapping the elements means linking the different levels of an enterprise as required by a BM. Thus it is possible to mediate between these levels and to show how the different levels interact [4, 17]. For example, a company can choose between an internal or external resource with different effects on revenues and costs. After the mapping of the elements, it should be possible to carry out a gap analysis, which shows the need for action to transform towards the target state:

RQ 2.2: In order to increase mediation of different business levels, business model configuration should explicitly show the consequences of alternatives (Table 1).

An overview on the described requirements is listed in Table 1.

AQ1

Table 1. Requirements for business model transformation tools

RQ	Description
1.1	To enable bottom-up creation of a business model leverage existing data
1.2	To guarantee comparability of top-down and bottom-up business model creation approaches, the extracted data should be structured in a unified way
1.3	To report relevant information, the collected data should be aggregated
2.1	In order to increase the executability, the status quo of a companies' business model(s) should be explicitly interconnected to the target business model(s)
2.2	In order to increase mediation of different business levels, business model configuration should explicitly show the consequences of alternatives

4.2 Design Principles for BM Transformation Tools

After the derivation of the requirements we propose design principles. The requirements (RQs) 1.1–3 will be factored in the design principles (DP) 1.1–4 and analogously RQ 2.1 and 2.2 will be translated in DP 1.1–3.

For the RQs focusing on data-driven status quo capturing of business models, it is of particular importance to use suitable data that reflects the logic of a company's value creation process. It is also important that the data is correct and complete. In order to meet the requirement RQ 1.1, we suggest for DP 1.1 that data from existing organizational information system (IS) is used. This data is typically based on transactions and represents an unbiased view from the real world. In addition to the use of the corresponding data, the way in which they it is structured is important, as articulated in RQ1.2. Since the BMC is frequently used in practice and is often quoted [34], we consider the BMC categories as an adequate structure. This structure enables users to find relevant information according to the established BMC concept (DP 1.2).

Next to this, the consolidation of data is important to avoid a information overload for users. In addition, not all data can be captured by the model. Since the goal of the BMT tool is to give the user a quick and comprehensive overview of the BM [10], the extracted data should be consolidated. As a criterion for this consolidation, the various categories of BMC should be automatically populated in with aggregated information. This information can be obtained by using calculation and aggregation methods within business model extraction process. For example, important customer segments can be defined as a segment with which a company generates the majority of its sales. That is why we articulate DP 1.3. In addition, business-model-related data is distributed across different storage locations within organizational information systems. The artifact must therefore know which different tables need to be merged in order to obtain relevant information about the business model. DP 1.4 therefore requires the artifact to provide proxies on how to retrieve the dimensions of a business model, and to know from which data sources and tables in the enterprise system the information can be retrieved. These four DPs contribute to the automatic creation of a BM. Reducing effort and increasing accuracy are the two main advantages of this approach. These principles build the first part of the BMT tool. It guarantees, that the user does not have to rely on his or her feelings and knowledge, but is supported by mining algorithms.

In order to support responsible people involved in the BMT process, the target BM and the current state of the value creation should be comparable. Additionally, users should be able to work with both BMs in parallel. One possibility is the use of a semantic relationship model, as it contains the relationships between the elements and a base for comparison of different BMs. Based on a semantic relationship model for the current and the target BM, one can also support different configurations (DP 2.1). In general, the semantic models enable a more precise representation of how a company performs its business today and in the future. Subsequently, the various elements (e.g. common elements) and their categorization as well as other relevant aspects have to be considered [6]. In addition, it represents also a basis for a gap analysis if the elements of different BMs are represented. The two semantic graphs of the current and target state can then be compared with each other. This means that the same notes are recognized in both graphs. So, one can quickly see where adjustments need to be made in the target state. This should also lead to a better understanding of the transformation dependencies (DP 2.2). The mapping of the different situations allow a better comparison of existing, obsolete and missing elements in different situations. Based on a comparison between an actual and a target state, it shows the need for action. In particular, a gap analysis could show that there is a need for action in designing the implementation of the target state. If there are different alternatives to the implementation of the model, it would be helpful to see the effects of the individual alternatives on the selected KPIs [5]. This demand for DP 2.3 enables changes in the BM to be detected quickly. For a transformation and long-term observation of BMs it is very helpful, but requires that each element is linked to at least one KPI, so that the meaning of an element is visible in the model [15]. All in all, these three DPs build the second part and should consider the support of the user during the BMT process. All DPs and their related requirements are shown in Table 2.

AQ2

Table 2. Design Principles and the related Requirements

RQ	DP	Description
1.1	1.1	In order to satisfy the demand for suitable data, existing raw data should be extracted from organizational information systems
1.2	1.2	In order to meet the requirement for a uniform structure, the business model canvas structure should be used
1.3	1.3	In order to meet the need for relevant information, calculation and consolidation functions must be provided
1.4	1.4	To meet the demand for relevant business model data, the artifact requires a knowledge base of the sources of business model information and a merge logic to recombine existing the information
2.1	2.1	Status quo and target business models should be captured using semantic models to allow different configurations
2.1	2.2	A mapping between status quo and target business models should be enabled to understand transformation dependencies
2.2	2.3	Business implications of changes performed within the transformation should be reflected in KPIs referring to the corresponding business model elements

We performed a qualitative validation of the proposed design principles on the basis of real-world transformation cases. Selected results of the case analysis are depicted in Fig. 2. The basic idea is that we analyzed the cases with regards to the relevance of the proposed design principles. We rated each case from 1 (low), 2 (medium) to 3 (high) if some reference was mentioned and "X" if it is not mentioned. These proposed numbers should not be considered as formal measures, but rather reflect the tendency of the relevancy of the proposed design principles in the specific cases.

Nr.	Evaluated element	TRUMPF GmbH + Co. KG	SEW-Eurodrive GmbH & Co KG	Daimler AG	Grand Rapids Chair Company	Menlo Worldwide Logistics, LLC	Delphi Corp.	Procter & Gamble Service GmbH
1.1	Available data	2	3	3	2	2	2	3
1.2	Structured data	1	2	2	1	1	2	2
1.3	Consolidated information	2	3	3	1	1	2	3
1.4	Knowledge Base	1	2	2	X	1	1	2
2.1	Configuration	3	3	3	2	2	2	3
2.2	Mapping	2	3	3	1	1	2	3
2.3	Changes	1	2	2	X	X	2	2

Fig. 2. Aggregated results of case analysis

Getting relevant data to actually model the current state seems to be possible and relevant in all cases. However, the degree of structuration of the data is varying. For the underlying knowledge base, there are some potentials for improvement. The data quality varies across the cases. However, nearly all information is spread over different sources and is typically provided in spreadsheets or PDF-based documents.

Many limitations exist with regards to the ability to actually perform business model transformation (2.1–2.3). In many cases it remains questionable whether a structured business model transformation process has taken place at all. Looking at the changes (2.3), a partly high potential for impact monitoring with KPIs is existing. This relates also to our assumption, that some measures for transformation were not evaluated and not observed with KPIs.

Overall, the analyzed cases provide evidence for the suggested design principles. Enough data (besides KPIs for supervising the transformation) is available and provided. However, this data is often unstructured, unconsolidated and spread across different data media as Excel, PDFs etc. The BMT tool should help here, to get a complete and structured overview about the current situation. Furthermore, the BMC

seems to provide an accepted structure, which can be used as a base for a transformation. Furthermore, configuration, mapping and continuous evaluation of changes is not done and supported enough.

5 Instantiation

As mentioned earlier, a BMT tool in general should (i) support users in getting an objective and complete overview of the current business model and (ii) empower users to execute the business model transformation process. Our overall BMT tool instantiation is implemented in a toolset that currently consists of two loosely coupled tools. First, a business model mining tool implementing DP 1.1–1.3. We do not further elaborate here on this instantiation, as it has been introduced and described in Augenstein and Fleig [38]. Second, a Business Model Analyzer tool that builds up the business model mining results and supports users in actually running the transformation process. With regards to DP 2.1 and DP 2.2. the tool explicitly captures and depicts semantic relations between the different elements following a hyperlink approach in order to allow for mapping and configuration. Through the linkage between the elements, one established a semantic relationship network, which can also be mapped to other BMs. Clicking on one element shows the predecessors and successors of this element in the semantic relationship network. Furthermore, this builds also the foundation for configuration features. AQ3

Furthermore, a dedicated KPI category based on DP 2.3 is introduced. In this category, the user can include further KPIs in order to explicitly capture changes in the transformation activities. Leveraging this KPI category, changes can be captured more accurately than with the existing value capturing dimensions of the BMC. Figure 2 depicts a screenshot of the Business Model Analyzer (Fig. 3). AQ4

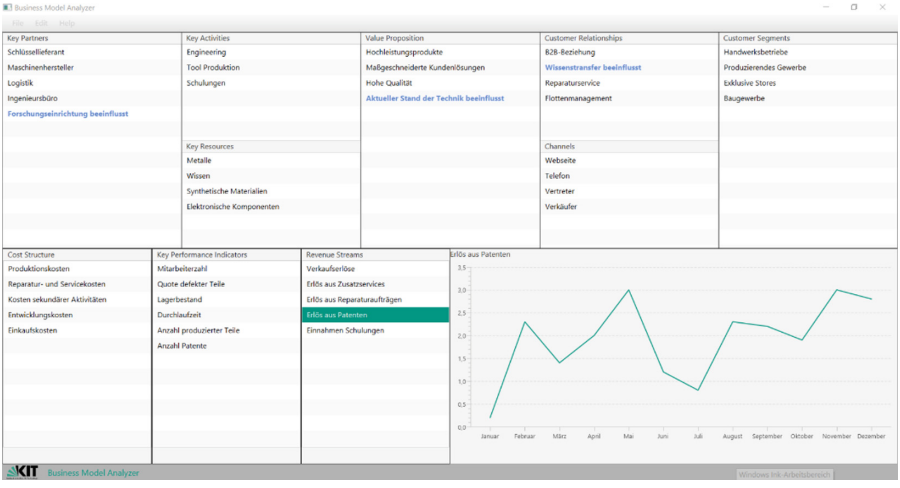

Fig. 3. Business model analyzer tool

6 Conclusion

Companies have to adapt their business models in ever shorter time intervals. Existing tools do not fully unleash the potential for a comprehensive support of such transformation processes. In this paper, the requirements and design principles for a BMT toolset have been identified and described. We present our implemented BMT toolset and specifically describe advanced mapping and evaluation features. Future work will include the evaluation of this toolset as well as advancing configuration functions as well as analytical features with regards to prognostic functions for the KPIs category and extended business model mining algorithm.

Our work in its present form comes with several limitations. First, the data required for the tool must be consistent. While downloading and consolidating data from organizational information system is a minor challenge in tool development, the real challenge is to identify business model relevant data within the various source systems. In order to "compute" business models from data, our approach must "proxy" the elements and dimensions of a business model from data. Furthermore, several business models can coexist within an organization. In addition, the current status of the prototype is not able to distinguish between the different business models in an information system and to merge business models from different source systems. A challenge will therefore be to find a way to choose and differentiate between different business models and to merge several sub-business models from several information systems.

To conclude, we believe the presented DPs for BMT tools contribute to the organizational capability to generate knowledge about the organization itself, and offer a solid base for improving transformation decisions by providing an alternative to "de jure", top-down models in "de facto" and bottom-up models. Practitioners as well as scholars can build on the presented design knowledge in order to build corresponding BMT tools addressing their challenges.

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