DESIGN PRINCIPLES FOR LEVERAGING SUSTAINABILITY IN BUSINESS MODELLING TOOLS

Research in Progress

Schoormann, Thorsten, University of Hildesheim, Hildesheim, Germany, thorsten.schoormann@uni-hildesheim.de

Behrens, Dennis, University of Hildesheim, Hildesheim, Germany, dennis.behrens@uni-hildesheim.de

Knackstedt, Ralf, University of Hildesheim, Hildesheim, Germany, ralf.knackstedt@uni-hildesheim.de

Abstract

Sustainability has become increasingly important to business research and practice. Approaches that support fundamental changes in behaviour to act economically, ecologically and socially are required. Modelling and analysing business models can contribute to this, for example by generating new ideas and enabling innovation as well as improving and evaluating current businesses. Although, the interest in business model innovation is booming, and software tools for business model development hold great promise for supporting business model innovation, there is only limited support and guidance for a tool-support that enables a satisfactory consideration of sustainability. Furthermore, there is currently a lack of comprehensive knowledge concerning which features can contribute to this consideration, and how they can be implemented. In this article, we report on the results of design science research (DSR) study that develops a set of design principles for reflecting sustainability in business models, which are refined and evaluated in several cycles. Our findings can support practitioners in (re-)designing tools, selecting and innovating business models, and—for researchers—can serve as a step towards more advances theories regarding software tools for sustainability in business modelling as well as for creating new business model ideas.

Keywords: Sustainability, Business Model, Business Modelling, Design Science, Tool-support.

1 Introduction

The rapid deterioration of the natural environment as well as concerns over wealth disparity and corporate social responsibility present fundamental issues for our entire society (e.g., Brundtland 1987; Dao et al. 2011; Seidel et al. 2013). In order to address these challenges, 'sustainability' has increasingly gained importance in business research and practice (e.g., Abdelkafi and Täuscher, 2016; Brocke et al., 2012; Elliot, 2011; Melville, 2010). Therefore, approaches that support essential changes in behaviour and practice are required. Because developing sustainable businesses is a provoking task, methods, techniques and tools from business modelling can contribute.

Business modelling—here understood as the act of representing a business model—is applied to visualize, innovate and evaluate business models (Veit et al., 2014). A business model "describes the rationale of how an organization creates, delivers, and captures value." Osterwalder and Pigneur (2010, p. 14) For representing such models, modelling languages with graphic notations are usually used (Kundisch et al., 2012), for example the Business Model Canvas (Osterwalder and Pigneur, 2010). In order to contribute to sustainability, these languages should support the design of innovative businesses which, for example consider cleaner products and processes (Lüdeke-Freund, 2010). However, we currently lack of well-accepted guidelines and principles related to modelling languages for sustainability (Abdelkafi and Täuscher, 2016; Kurucz et al., 2017). As a result, various modelling extensions

and customizations—often by adapting the Business Model Canvas—are proposed (Joyce and Paquin, 2016; Schoormann et al., 2016), which provide additional semantics to enable the consideration economic, ecological and social aspects (e.g., by modifying blocks). Furthermore, to support and facilitate the application of such modelling languages, appropriate tools are required (Recker, 2012).

Software-based tools—so-called business model development tools (BMDTs)—allow for digitally represent and edit business models. They have enormous potential to contribute to certain actions (e.g., understanding, sharing and assessing) more efficiently than the 'pen & paper' versions (Ebel et al., 2016; Kamoun, 2008; Osterwalder et al., 2005). Accordingly, different business modelling tools have been developed. Nevertheless, based on a broad BMDT study (Szopinski et al., 2017), the challenges, extensions and customizations of modelling languages for contributing to sustainability are currently not implemented by such tools. Thus, there is a lack of comprehensive knowledge related to software features and principles for innovating, analysing and evaluating business models towards sustainability. This lack is problematic because it inhibits tool designers in their efforts to (re-)design business modelling tools and inhibits tool users in supporting the application of sustainable-oriented features. Furthermore, this knowledge is necessary for further research regarding the applicability of tools and features for sustainability as well as for deriving advanced theories (e.g., Gregor, 2006).

The primary goal of our research project is to derive design knowledge for business modelling tools that particularly allows for reflecting economic, ecological and social sustainability. Therefore, a conceptualization of current knowledge and required features (e.g., from users) is necessary. Correspondingly, this research-in-progress (RIP) paper is guided by the following key question: *What are appropriate design principles for tools that allow for reflecting sustainability in business models?*

Therefore, we carried out a design science research (DSR) project that aims at deriving a set of design principles for the class of business modelling tools. As a first step, we outline the research background of business models and sustainability (Section 2). Following Kuechler and Vaishnavi (2008), we identified an initial set of design principles in prior literature and complemented these findings with empirical data by conducting several prototyping sessions (Section 3). After evaluating and refining this initial set, we present the revised principles (Section 4) which contribute to the design knowledge base for business modelling tools that especially allow for considering multidimensional sustainability. Finally, we discuss our findings and implications (Section 5), describe future steps (i.e., implement and evaluate a software tool) (Section 6) and conclude with our study (Section 7).

2 Background

In this section, we provide a brief overview of the existing discourse of business models, sustainability and the emerging stream of sustainable business models as well as supporting tools.

A good **business model** answers: "Who is the customer? And what does the customer value? […] How do we make money in the business? What is the underlying economic logic that explains how we can deliver value to customers at an appropriate cost?" (Magretta, 2002, p. 4) Key authors in this field (e.g., Amit and Zott, 2001; Chesbrough, 2002; Gordijn et al., 2005; Osterwalder and Pigneur, 2010; Teece, 2010; Zott et al., 2011) have contributed to the understanding of business models. Regarding the term 'business model', some authors refer to (1) the way a company does business and others focus on (2) the model aspect while using the term 'business model' (Osterwalder et al., 2005). Our study follows the second stream in particular and understands the term in a conceptual manner. However, although there are differences within the definition, basically the following components are described: value proposition, customer segments, channels, customer relationships, key resources, key activities, key partners, revenue streams, and cost structure (Osterwalder and Pigneur, 2010). Research on business models is broad, thus, different streams exist such as taxonomies (e.g., categorizing types of businesses), business components (e.g., providing a set of key constructs), methodologies (e.g., supporting innovation) or modelling languages (e.g., visualizing elements and their relationships) (Gordijn et al., 2005; Kamoun, 2008; Zott et al., 2011).

Contributing to **sustainability** presumes crucial changes in consumption and production from businesses and society. Sustainability is a complex term (Malhotra et al., 2013), which is usually divided

into three dimensions, for example: Triple Bottom Line/Three Pillars (social, ecological, economic) or Triple Ps (people, planet, profit) (Elkington, 1997; Isaksson and Garvare, 2003). According to the Brundtland report, it is the "development that meets the needs of the present without compromising the ability of future generations" (Brundtland, 1987, p. 43)—thus, it is "inclusive of both environmental and social sustainability" (Abraham and Mohan, 2015, p. 1). Nonetheless, a look at IS research related to sustainability—Green IS in particular—indicates that it tends to focus on economic and ecological aspects while social ones are often neglected (Dao et al., 2011). However, our study and the design principles to be determined follow the integrative definition that incorporates all dimensions.

The coherence of **business models and sustainability** has been increasingly discussed in research over the last few years (e.g., Abdelkafi and Täuscher, 2016; Bocken et al., 2013; Lüdeke-Freund and Dembek, 2017; Schaltegger et al., 2016; Stubbs and Cocklin, 2008; Upward and Jones, 2016). Generally, a sustainable business model seeks to capture "(…) economic value while maintaining or regenerating natural, social, and economic capital beyond its organizational boundaries" (Schaltegger et al., 2016, p. 6). Because a shared and well-accepted understanding of this concept is still missing (Kurucz et al., 2017), most of the prior work focused on specific fields of application such as mobility (Remane et al., 2016). As a result, various customizations of the underlying business modelling language are applied, and nearly no general design principles and features that can be implemented to support the development and design of such models are investigated.

Various software tools (BMDTs) have been proposed to support the application of modelling languages for business models (Gordijn et al., 2000; Peinel et al., 2010). These BMDTs allow for representing and editing business models as well as facilitating certain actions (e.g., annotating and versioning) in distributed teams. Business model innovation processes can be divided into four phases (Ebel et al., 2016): environmental analysis, business model development, business model implementation, and business model management. In our study, we particularly focus on the phase of business model development in which two types of tools can be distinguished: (i) tools dedicated specifically to stimulating the generation of business model ideas, for instance, in the form of business model patterns (Abdelkafi et al., 2013) and (ii) modelling languages that facilitate the development by providing features. Regarding (ii), a number of BMDTs have been proposed in research and practice. Nonetheless, based on a tool analysis, to the best of our knowledge, virtually no design-relevant knowledge exists concerning the functions (Szopinski et al., 2017) that such tools should possess to support the business model development process in an appropriate manner.

3 Research Design

The primary goal of our project is to derive knowledge for business modelling tools that respect economic, ecological and social sustainability. To do so, according to Veit et al. (2014), 'design science' is an appropriate approach. DSR is based on a problem-solving paradigm that aims to design innovative purposeful artefacts (Gregor and Hevner, 2013; Hevner, 2007). For deriving such knowledge, we follow a common DSR strategy in which we first solve a specific problem by building concrete artefacts and generalize solutions for the class of business model tools in form of design principles afterwards (Iivari, 2015). Design principles are the prevailed way to capture knowledge about instances of a class of artefacts in IS research (Chandra Kruse et al., 2016), which is helpful for both technology oriented and management oriented audiences (e.g., Seidel et al., 2017; Sein et al., 2011). They provide a general solution that can be instantiated into concrete IT applications, and thus, are an *IT meta-artefact* (Iivari, 2007). The design principles determined in this study can be categorized as *action and materiality oriented design principles* because they describe what a system should allow users to do as well as what features a system should have (Chandra et al., 2015).

Our research process for developing design principles is well-grounded by the methodology as proposed by Kuechler and Vaishnavi (2008) which is already applied to explore design principles in the context of business model tools (e.g., Augenstein and Mädche, 2017). In total, we plan our DSR project in three cycles (Figure 1). In the current state, we ran through two different cycles of suggesting, developing and evaluating our artefact until the current set of principles was developed.

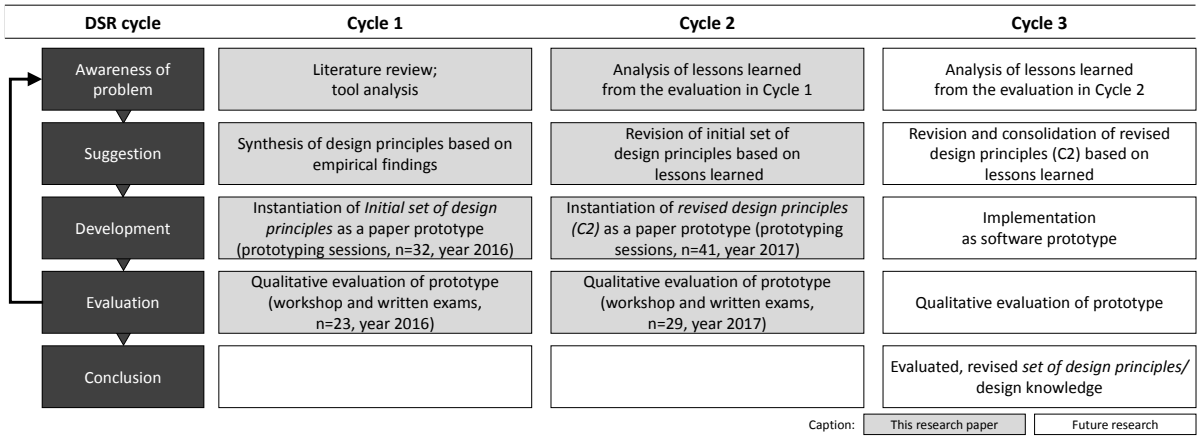

Figure 1. Research process adopted by Kuechler and Vaishnavi (2008).

3.1 Cycle 1: initial set of design principles

We started with an *awareness of two major problems*: the current lack of (1) comprehensible knowledge of features that support modelling and analysing sustainability in business models and (2) appropriate BMDTs that contribute to the application of these features. Accordingly, our purpose is to propose an artefact that supports researchers and practitioners in reflecting sustainability while modelling business models. Therefore, we aim to specify design principles that can be instantiated and implemented in a software prototype. The identification of such principles should be well-grounded in theory (i.e., use of existing theories and knowledge) and empiricism (i.e., demonstration and observation of its applicability) (Goldkuhl, 2004). In order to achieve this, we apply deduction by reviewing prior literature, and induction by conducting several prototyping sessions and workshops as well as analysing written exams (e.g., Gregory and Muntermann, 2014; Nickerson et al., 2013).

For *suggesting a solution,* we initially aim to learn from theory. To do so, we particularly draw on two prior studies. First, from a general perspective on BMDTs, Ebel (2015) suggest nine design principles for the development of BMDTs that are categorized into three parts, namely shared materials, community and business model development (e.g., implement a business model framework). Nevertheless, the applicability of these general principles for our purpose has to be verified. Secondly, from a sustainable-oriented perspective, we included Schoormann et al. (2016) who, based on an extensive literature review over 1.500 business model studies, provide a typology of possible customizations of the business model understanding. This includes, for example adding and linking building blocks or integrating views on models such as views related to economic, ecological and social issues.

Next, in the *development phase,* we carried out prototyping sessions (e.g., Wilde and Hess, 2007) in an educational context (i.e., master course 'Sustainability and Business Models'). Therefore, interdisciplinary groups of 32 students (Information Systems and Environmental Preservation) with knowledge related to sustainability and business modelling were formed randomly. These groups (each with 4-6 students) developed paper prototypes that provide features for instantiating the suggested theoretical-grounded design principles. Each group had (a) a list and explanations of the current state of the design principles, (b) a known business case from the sharing economy (e.g., Carsharing or Flatsharing), and (c) further equipment needed such as paper sheets, pens, post its etc. Before starting the prototyping session, we discussed the set of principles and business cases selected with the participants in order to reduce issues within the exercise itself and to contribute to the level of knowledge. Afterwards, the students had 90 minutes to finish the following exercise: representing negative and positive effects of sustainability in a specific case by using the current design principles.

In order to contribute to the rigorousness, *evaluating* results already at an early stage is important (Hevner et al., 2004). Following, the prototyping results of each group were discussed and consolidated with all the students and three researchers in a follow-up workshop. In this workshop, every prototype was presented by (a) indicating the concrete results of representing sustainability, (b) reflecting the

applicability of the principles as well as (c) verify or extend the current set of principles. Furthermore, in a final stage, the participants had to consolidate the findings from the workshop independently to provide more insights regarding the understandability and applicability of the current set as well as of possible extensions. Therefore, 23 students discussed relevant features—instantiation of principles—in a written exam (i.e., with an incentive scheme; 120 minutes) in which they had to reflect sustainability in a 'coffee business case' that works with rather unsustainable capsules. As a result of the evaluation, we learned that especially the assessment was hard to carry out. For example, some groups assigned a colour (e.g., 'green for sustainable') to specific elements of a business model but did not provide any information on how a colour was specified and why an element was assessed in a certain way. Thus, principles for tracking reasons and rate different aspects in particular need to be provided.

3.2 Cycle 2: current set of design principles

Based on the lessons learned (e.g., *problems* in respect of the assessment and tracking of reasons), we *suggested* a revised set of design principles. To *develop* prototypes that instantiate the revised set of principles—similar to Cycle 1—additional prototyping sessions were carried out with interdisciplinary groups of 41 master students who did not attend in the first round. Again, for finishing the exercise of representing sustainability in a certain business model, each group had a 90-minute session with (a) a list and explanations of the revised set of the principles, (b) a known business case from the sharing economy, and (c) further equipment needed.

For the *evaluation*, a follow-up workshop was conducted in which the findings were discussed and consolidated with the participants and three researchers (see also Cycle 1). Moreover, 29 students reflected the findings independently in a written exam (i.e. with an incentive scheme; 120 minutes). As a result, a trade-off analysis was designed in which different participants are able to assess specific business model elements by selecting and weighing up positive as well as negative impacts, for example, in respect of an electric vehicle: reduced noise emissions (+) and reduced range (-).

In the following section, we describe the results from the consolidation of the first two cycles of suggesting, developing and evaluating the set of design principles through different prototypes.

4 Results

Our study aims to derive design principles for the class of software-based business model tools that particularly support the representation and reflection of sustainability already during the model construction. Although some general principles such tools exist like data security (Ebel et al., 2016; Szopinski et al., 2017), we focus on those which are directly linkable to the purpose of 'sustainability'. Although we focus on a certain aspect, we might derive knowledge and features that are also applicable for further domains or even general-purpose—however, this has to be researched in future studies.

Business modelling languages support the development of business models by facilitating the analysis, communication and documentation of (new) ideas. Typically, these languages use graphic notations to represent the basic logic and the most important elements of a business model (Kundisch et al., 2012). The two most important types of modelling languages are (Kamoun, 2008; Zolnowski et al., 2014) flow-oriented approaches such as e3-value (Akkermans and Gordijn, 2003) and system-level holistic approaches such as the Business Model Canvas (Osterwalder and Pigneur, 2010). By using provided business modelling languages, the user can follow established and well-accepted practices, thereby saving time in creating a new modelling project. Also in respect of sustainability, we could observe during the workshops that mostly a common framework was selected as an initial step. Accordingly:

DP1a*—*Design principle of underlying business modelling language. *Provide features for the selection and use of an underlying business modelling language to build on established practices.*

Besides using established languages, it is common to adapt these to the specific needs of a modelling project (Schoormann et al, 2016). For example, in addition to the extensive application of the original Business Model Canvas, context-specific variants for sustainability have been suggested such as the *Triple Layered Business Model Canvas* (Joyce and Paquin, 2016), the *Flourishing Business Canvas*

(Kurucz et al., 2017; Upward and Jones, 2016) or the supporting *Value Mapping Tool* (Bocken et al., 2013). In doing so, additional semantics necessary for representing sustainability are provided. Consequently, established modelling languages provide an initial structure that needs to be adapted to best fit a certain situation. During the workshops, the participants applied different adaptations, for example: adding new blocks for 'society and environment', 'social impacts' and 'ecological benefits' or dividing 'costs' into 'social, ecological and economic costs'. However, a current study that analyses software tools indicates that these adaptations are rarely implemented in BMDTs. Accordingly:

DP1b—Design principle of adaptation. *Provide features for the adaptation and customization of a chosen business modelling language to consider required semantics for the situation at hand.*

In order to provide relevant information (e.g. strategies such as efficiency, consistency and sufficiency) which can be applied to give directions for (re-)development towards sustainability, key issues and questions should be considered. In the prototyping sessions, common strategies were applied to models to identify improvement potential. For the identification of such key issues, various characteristics are discussed in prior literature such as ecological concepts (e.g., use renewable resources or implement a closed-loop production), economic concepts (e.g., maximize financial savings or be compliant) and social concepts (e.g., be affordable for everyone or take care of employees). During our workshops, the participants applied such information to identify improvement potential as well as to get ideas for (re-)designing a business model. Accordingly:

DP2a—Design principle of key issues. *Provide features for the application of existing key concepts, strategies and questions as well as the creation of new ones to include additional information.*

In order to reduce the complexity and to take specific views on a business model, some approaches and the participants in the workshops added layers that consider sustainability relevant information. For example, Joyce and Paquin (2016) propose a Business Canvas that includes layers for ecological, economic and social content. Accordingly:

DP2b—Design principle of layer. *Provide features for the creation and application of layers in a modelling project to take different views on a business model.*

Although it is essential to assess the current state (e.g., which components of a business cause a lot of emissions?) and current efforts regarding sustainability in business models (Lüdeke-Freund et al., 2017), only limited research in business modelling languages regarding these aspects is available. However, answering the fundamental question of '*what needs to be improved first?*' requires an initial rating of the elements modelled. The participants in the workshops argued that "an easy assessment of specific business model elements is needed in order to support the identification of improvement potential very quickly". In doing so, tools need to integrate ecological, economic and social aspects. Different levels for assessment can be distinguished (Schoormann et al, 2016): (1) the entire business model, (2) single elements and (3) both the entire business model and single elements. Accordingly:

DP3a—Design principle of assessment. *Provide features for an (initial) assessment of a business model (element) to represent the current state and identify improvement potential.*

Moreover, innovating business models towards sustainability requires the involvement of people from various disciplines and is therefore a collaborative task (e.g., Ebel et al., 2016; Eppler et al., 2011). However, tracking, assessing and managing the modelling progress in a project with various members is challenging and increases the effort related to its management. Accordingly:

DP3b—Design principle of collaboration support. *Provide features for collaborating in a modelling project to plan, design, innovate and discuss a business model (element).*

Business model types or business models that belong to a certain domain often have common characteristics (i.e., specific elements and resources). The availability of these characteristics allows for systematic configuration as well as a quick analysis and comparison of existing business models and variants from the same domain or company (Osterwalder et al., 2005). Moreover, the use of such characteristics (e.g., in form of business model patterns) provides a significant reduction in the complexity (e.g., Remane et al., 2016; Schoormann et al., 2017). In addition to the literature, the workshops conducted also indicate that it is helpful to select from common characteristics during the modelling pro-

cess—particularly weighing up alternative options for a certain element (e.g., how to replace an element that has negative effects on sustainability?). Accordingly:

DP4—Design principle of common characteristics. *Provide features for the selection and creation of common business model characteristics to sum up ideas for alternative solutions.*

During the design of a business model, knowledge at various levels is developed, for example in the respect of the design choices and decisions, which have been made. Different stakeholders in a modelling project should know the rationale behind a certain model, element or decision (e.g., 'why we used the element that has more emissions?'). Therefore, the chain of reasoning should be traceable and explicated (Jin and Geslin, 2010; Karacapilidis and Papadias, 2001). Accordingly:

DP5—Design principle of reasoning. *Provide features for the tracking of reasons that led to a specific design choice related to a business model or business model element.*

5 Expected Contributions and Limitations

In general, contributing to sustainability in business models is of great relevance for research and practice, and we assume that providing design principles and tool-support allows various benefits for both.

From a research perspective, based on our findings, advanced and new original IS theories can be derived (Bichler et al., 2016; Gregor, 2006) which, for example attempt to explain and predict how specific features affect the performance of business modelling. In Green IS, 'sensemaking' is often discussed in connection with topics related to sustainability transformation and is used to interpret and make sense of complex information (Butler, 2011; Seidel et al., 2013). Applying this concept, to the features for assessing business model elements, making sense of positive and negative effects, seems promising in deriving new insights that contribute to the transformation of businesses. Additionally, we implemented a trade-off analysis to assess several alternatives. The role of collecting, developing and rating reasons within a group and individually can be analysed by applying theories for building judgments in complex situations (Haidt, 2001). Furthermore, methodologies that focus on modelling sustainability in business models can be investigated and, besides benefits for sustainable business modelling, our principles may contribute to further fields of application (e.g., service businesses).

For practice, the proposed design principles can be applied to design and develop new concrete IT-artefacts such as software tools or single features. Moreover, providing such a tool-support allows for representing and analysing business models with the aim at developing new strategies towards sustainability. Tools and systems that relate to our findings—general BMDTs in particular—have similar purposes, thus, the principles determined can be used to (re-)design further BMDTs. Besides new tools, combination with other classes of systems can be investigated, for example creativity support systems which have the potential to develop innovative ideas (Seidel et al., 2010; Shneiderman, 2007).

Although we derived helpful insights, our study is not free of limitations. First, the principles are limited to the literature selected and the workshops conducted. Second, our evaluation is carried out in an educational context (with knowledgeable master students). Although the next steps should focus on the evaluation in the 'real field', we argue that students might be a part of the start-up area and are potential users of such tools. Nevertheless, our results are useful in giving guidance on which principles of sustainable business modelling should be provided and how they can be initiated in a software tool.

6 Outlook (Research-in-Progress)

We are currently finalizing the implementation of the design principles in form of a software prototype (see specifications and mock-ups in Figure 2). We initially specified the following key features:

Following **DP1a**, we will integrate different system-holistic business modelling languages including the Business Model Canvas (Osterwalder and Pigneur, 2010) and the approach from Wirtz (2011). For adapting and customizing (**DP1b**) such languages to specific needs, we will allow for adding (e.g., through predefined components such as rectangle, circles and triangles), dividing, merging and renaming building blocks as well as for modifying the arrangement. Moreover, colours, sizes and texts can

be formatted individually. On the right side of the tool (Figure 2), we will implement an area with checklists for key issues and key questions (**DP2a**) that are related to sustainability. These provide additional information and strategies, which should be considered during the design of new business models, for example: 'circular economy', 'substitution' or 'life cycle thinking'. In order to take certain perspectives (**DP2b**), the creation of own views via tabs, like in a web-browser, will be provided (e.g., for economic, ecological and social views). The assessment of business models or single elements (**DP3a**) is a crucial but also challenging task. During the prototyping sessions, the need for an initial and quick assessment was claimed, and thus, we decided to integrate a 'trade-off analysis' in which the users can collect positive and negative aspects for specific model elements. In doing so, they discuss (in a team) and visualize elements, and might be sensitized for a certain problems (Figure 2, bottom right). For collaboration (**DP3b**), sharing of business model projects with other users as well as exporting business models will be implemented. We are planning to consider 'common characteristics' (**DP4**) through features that allow for using predefined elements (e.g., typical aspects of a business model)—thus, configuring of a business model should be able. Finally, **DP5** will be realized through a history and the possibility to comment changes of a specific element (Figure 2, top right).

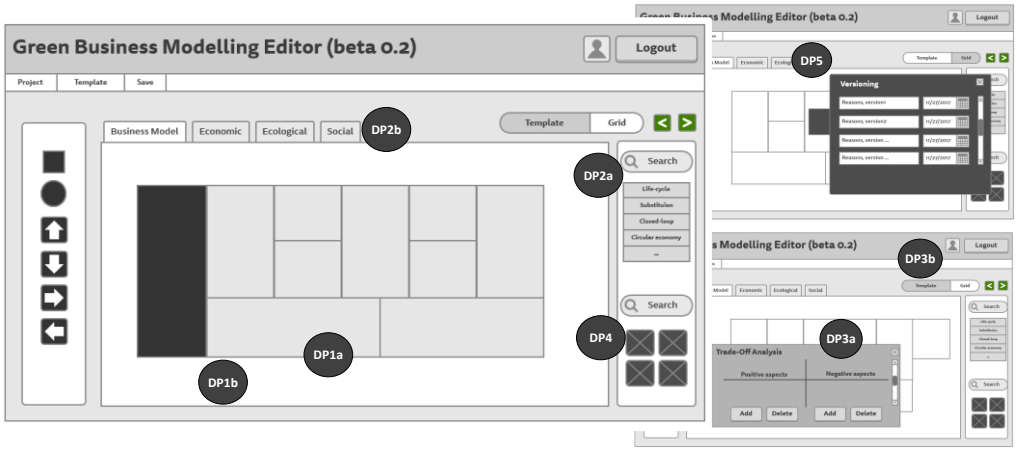

Figure 2. Implementation of design principles in a software artefact (design specifications).

Based on the software prototype, we further aim to carry out an evaluation of the principles (see Figure 1). Therefore, we plan to carry out an ex ante artificial evaluation which is appropriate for prototypes in this stage (Sonnenberg and vom Brocke, 2012). Moreover, we are working with an industry partner who addresses ecological and social aspects in their business model (including remarketing of regional IT-hardware with handicapped employees). Thus, we plan to use the prototype to model sustainability in their business case with a group of students as well as evaluate the quality of the results and correctness with the experts of our industry partner to contribute to the practical relevance.

7 Conclusion

In this article, we have proposed design principles for the class of business model tools that allow for reflecting sustainability as well as have demonstrated the feasibility of these principles in two iterations through their initiation in form of prototypes. Our study attempts to contribute to ongoing business model innovation by focusing on sustainability as a major issue for both research and practice. The various potential of a tool-support for such models is highlighted in prior literature and allowing users to represent and assess business models is crucial to support innovations towards sustainability. Overall, we hope that this work will be starting point for more discussion and research regarding the applicability and features of BMDTs in general (despite our focus) and in certain domains.

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