How software can support innovating business models: A taxonomy of functions of business model development tools

Full Paper

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Abstract

The interest in business model innovation has risen rapidly in recent years, and software tools for business model development hold great promise for supporting business model innovation. Nonetheless, virtually no design-relevant knowledge exists concerning the functions that such tools should possess. Therefore, we develop a comprehensive taxonomy that identifies characteristic functions of software-based business model development tools. For developing the taxonomy, we draw on prior research on business model innovation, process modeling, and creativity support systems, and we analyze software tools for business model development that have been proposed in practice. The resulting taxonomy can support practitioners in their tool (re-)design and investment decisions, and for researchers can serve as a preliminary step towards more advanced theories for software tools for business model development.

Keywords

Business models, business model development tools, business model innovation, taxonomy.

Introduction

A business model describes the mechanisms of how a firm creates, delivers, and captures value (Teece 2010), and as such can be likened to a detailed description of a firm's strategy (Adner et al. 2014; Casadesus-Masanell and Ricart 2010). The interest in business models and business model innovation is enormous – from researchers and practitioners alike. According to an IBM study with more than 1,000 CEOs, practically all believe that business model innovations are desirable – and more than two-thirds even strive for "extensive" business model innovations (IBM 2008, p.48). Likewise, researchers in fields as diverse as information systems, entrepreneurship, and strategy emphasize the importance of business model innovation for the competitiveness of firms (e.g., Wirtz et al. 2016).

Business model innovation is a task that is creative and collaborative (Ebel et al. 2016; Eppler et al. 2011): it is creative because it relies upon the generation of creative business model ideas, and is collaborative because it often requires that people from various disciplines (e.g., sales, marketing, and research & development) work together. Prior research in a variety of fields has found that tasks that are creative and collaborative can benefit from the support of software tools (e.g., through facilitated analysis, communication, and documentation). Process modeling research, for example, acknowledges that process modeling is creative as well as collaborative (Figl and Recker 2016), and that software tools for process modeling have a profound impact on the quality of the resulting process models (Recker 2012). Likewise, research on creativity support systems (e.g., Seidel et al. 2010) and group support systems (e.g.,

Nunamaker et al. 2015) acknowledge that software tools can substantially affect their users' performance in creative and group tasks. Consequently, given the collaborative and creative nature of the business model innovation task, software-based business model development tools (BMDTs) have great potential to support their users in innovating business models (e.g., Osterwalder and Pigneur 2013, Ebel et al. 2016, Veit et al. 2014).

A number of BMDTs have been developed in research (e.g., Ebel et al. 2016, Akkermans and Gordijn 2003) and practice (e.g., BiZZDesign and Strategyzer). These tools have functions that, among others, allow representing, sharing, annotating, and versioning business models. Some of these tools have already gained considerable popularity in practice, which is indicated, for example, by more than 100,000 downloads for the app *Business Model Canvas & SWOT*, and the more than 700,000 business model projects in the browser application *Canvanizer*[1]. Moreover, prior research has identified some functions of BMDTs that are particularly conducive to the utility of these tools (e.g., messaging functionality and profile pages, Ebel et al. 2016). Nonetheless, we lack comprehensive knowledge of the functions that BMDTs should possess to provide the best possible support for innovating business models.

From a practical perspective, this lack of knowledge is problematic because it inhibits tool designers in their efforts to (re-)design BMDTs, and inhibits tool users in making informed tool investment decisions (for an analogous argument regarding tools for process modeling, see Recker 2012). The lack of knowledge is also problematic from a theoretical perspective, because the nature of business model development processes is still ill-understood (Schneider and Spieth 2013). Therefore, knowledge concerning the usefulness of BMDTs and their functions would contribute to a better understanding of the nature of business model innovation processes in general. Accordingly, information systems researchers have called for more research to derive prescriptive, design-relevant knowledge for BMDTs (e.g., Osterwalder and Pigneur 2013, Veit et al. 2014).

The goal of this study is to respond to that call by consolidating the knowledge on BMDT functions that exists in the business model domain as well as in two adjacent domains, namely process modeling and creativity support systems. In so doing, we seek to answer the following research question: *What are characteristic functions of software tools for business model development?* Our contribution is a taxonomy of these functions, and hence a *theory for analyzing*, which according to Gregor's classification of theory types is the most basic form of theory, and as such is the necessary foundation for more advanced theories in a domain (Gregor 2006). For developing the taxonomy, following Nickerson et al. (2013), we combine deduction and induction: In the deductive part, we develop an initial taxonomy of functions for BMDTs by integrating existing research on modeling tool functions in process modeling and business model research. In the inductive part, we refine and extend that initial taxonomy by analyzing existing BMDTs that implement the Business Model Canvas (Osterwalder and Pigneur 2010), that is the de-facto standard for representing business models (e.g., Eppler et al. 2011; Günzel and Holm 2013; Iacob et al. 2012). The rationale for analyzing these BMDTs, following prior research (Riemer et al. 2011), lies in the concept of technology inscription, which assumes that technological artifacts (such as software tools) are sources of knowledge about a domain (for more details, see Cozzens et al. 1989; Riemer et al. 2011). By outlining the functions that BMDTs can possess, for practitioners our taxonomy can provide support for their tool (re-)design and investment decisions. For researchers, the taxonomy can serve as a preliminary step towards more advanced theories for software tools for business model development.

Literature review

Tools for business model development

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. Tools that have been proposed to support business model innovation particularly address the phase of business model development, and can be divided into two types: (a) tools dedicated

[1] *Business Model Canvas & SWOT:* play.google.com; *Canvanizer:* canvanizer.com (the number of projects, admittedly, only provides a very rough estimate of the popularity, as one user can start multiple projects and as it is unclear what effort was devoted to each project); figures retrieved on 25th April, 2017.

specifically to stimulating the generation of business model ideas, for instance, in the form of catalogs of business model examples (e.g., Stampfl and Sniukas 2013) or business model patterns (e.g, Abdelkafi et al. 2013; Gassmann et al. 2014), and (b) modeling languages that support business model development by facilitating the analysis, communication, and documentation of business model ideas. These business model modeling 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 modeling languages are (Zolnowski et al. 2014) flow-oriented approaches like e3-value (Akkermans and Gordijn 2003) and system-level holistic approaches like the Business Model Canvas (Osterwalder and Pigneur 2010) or the Strategic Business Model Ontology (Samavi et al. 2009). The Business Model Canvas is by far the most widely used modeling language for business models in both research (e.g., Eppler et al. 2011; Günzel and Holm 2013; Iacob et al. 2012) and practice (Strategyzer 2015): its impact on research is evidenced, for example, by more than 5,000 citations for the book that presented the Business Model Canvas (Osterwalder and Pigneur 2010), and its impact on practice is evident in that the corresponding book has sold more than one million copies (Strategyzer 2015). The Business Model Canvas defines nine components for describing a business model: value proposition, customer segments, channels, customer relationships, key resources, key activities, key partners, revenue streams, and cost structure.

In addition to the extensive application of the original Business Model Canvas as proposed by Osterwalder and Pigneur (2010), context-specific variants of the Business Model Canvas have been suggested (e.g., the Service Business Model Canvas (Zolnowski et al. 2014) and the Triple Layered Business Model Canvas (Joyce and Paquin 2016). These variants provide additional semantics necessary for representing business models in these contexts. Therefore, software tools for modeling should facilitate such context-specific customizations (Recker et al. 2010). A literature review of over 1,500 business model papers identifies customizations of the Business Model Canvas that modelers employ in order to overcome certain boundaries: (1) adding new, (2) dividing, (3) linking, (4) renaming building blocks, and (5) changing the arrangement of the building blocks (Schoormann et al. 2016). As in this way modelers customize the Business Model Canvas, we also expect such customizations to be implemented in BMDTs.

To support the application of modeling languages for business models, various software tools have been proposed (e.g., Gordijn et al. 2000; Peinel et al. 2010). These BMDTs allow to digitally represent and edit business models. They have the potential to allow their users to perform certain actions (e.g., annotating and versioning business models) more efficiently than the 'pen & paper' versions of the modeling languages. In addition, BMDTs allow their users to perform certain actions that are not even possible with 'pen & paper' tools (e.g., collaborative business model development in distributed teams, Ebel et al. 2016). Therefore, numerous authors have emphasized that BMDTs can meaningfully support business model innovation processes and that further research on such tools is necessary (e.g., Ebel et al. 2016; Osterwalder and Pigneur 2013; Veit et al. 2014). However, to the best of our knowledge, only Ebel et al. (2016) have sought to identify which functions BMDTs should have. In their action design research, they identified tangible functions that they consider conducive to innovating business models (e.g., sharing various types of documents and tagging competencies in community profiles), and these functions can be a valuable starting point for our attempt to develop a comprehensive overview of the functions of BMDTs.

Tools for creativity support

As noted earlier, innovating a business model is a creative process (e.g., Eppler et al. 2011). This suggests that findings from research on software tools for creativity support, so-called creativity support systems (CSS, Seidel et al. 2010; Shneiderman 2007), have the potential to inform the development of BMDTs. Research on CSS has mainly been advanced by researchers within information systems (see Seidel et al. (2010) for an overview), and researchers at the interface between creativity research and computer science (Shneiderman 2007). However, the understanding of which software tools constitute a CSS is very broad and there is so far no standardized definition of which functions a CSS should provide. The broad understanding of CSS can be seen in the great variety of types of software tools that Shneiderman, one of the leading researchers on CSS, sees as creativity supporting: his understanding of CSS includes tools as varied as music and video editing software, programming environments, and computer-aided design tools (Shneiderman 2007). Accordingly, he defines a wide range of generic activities that a CSS should provide through its functions (Shneiderman 2002): to collect (search and browse information and existing examples), to relate (consult peers and mentors), to create (explore possible solutions), and to donate

(disseminate results). However, neither he nor any other author has yet provided a more nuanced definition of the functions that a CSS should provide.

Tools for process modeling

The role that BMDTs have for business model modeling languages is similar to the role that process modeling tools have for process modeling languages: both kinds of tools facilitate creating and changing models whose semantics and visual notation are defined by a modeling language, and in both cases the modeling task is collaborative and creative in nature. Hence, while the domain of the modeling object is different (process vs. business model), given the outlined similarities, research on the functions of process modeling tools promises to be relevant also for the functions of BMDTs (even though, admittedly, there are other differences, e.g., process models in contrast to business models may be executable in software). However, the major part of research on process modeling addresses process modeling languages, and only a few studies address the corresponding modeling tools (Recker 2012; Riemer et al. 2011). To the best of our knowledge, only one attempt has been made to systematically assess the functions that a process modeling tool should provide. In that study, Riemer et al. (2011) develop a taxonomy that offers a comprehensive overview of process modeling tool functions. Given the outlined similarities between developing process models and developing business models, we conjecture that the functions identified in that taxonomy can provide a valuable starting point for our attempt to develop a comprehensive overview of functions of BMDTs.

Methodology

Taxonomies are artifacts that describe and classify existing or future objects of a domain and help researchers and practitioners to understand and analyze a domain. Taxonomies have already been developed in various contexts, including business models in different domains such as carsharing (Remane et al. 2016), telemedicine services (Peters et al. 2015), cloud computing (Labes et al. 2013), and crowdfunding (Haas et al. 2014). To reduce the complexity of taxonomy development and to make it transparent, Nickerson et al. (2013) propose a method for the structured development of taxonomies. In the following, we describe how we performed the seven steps of the method by Nickerson et al. (2013) to arrive at our taxonomy of functions for BMDTs (see Figure 1).

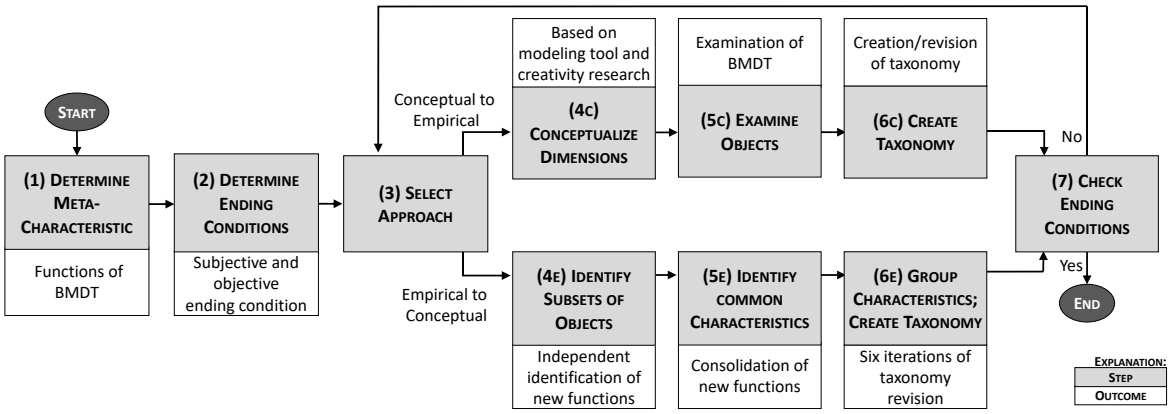

Figure 1. Research method (according to Nickerson et al. 2013)

Meta-characteristics (1). According to Nickerson et al. (2013), every taxonomy has a target group and a purpose. Furthermore, every taxonomy consists of a meta-characteristic as well as various characteristics and dimensions. The target group and the taxonomy's intended use context determine the purpose of a taxonomy, which in turn determines the meta-characteristic (the basic or overlapping property that defines which perspective(s) a taxonomy takes on the objects of a considered domain to describe these objects). The description of the objects finally takes place through characteristics (properties) that are combined into dimensions to increase the taxonomy's clarity. The target group of our taxonomy are researchers and practitioners interested in business models. The purpose of the taxonomy is to describe BMDTs in order to assist researchers and practitioners with the analysis and future development of

BMDTs, and assist practitioners with the selection of such tools. To do so, functions are particularly relevant. Therefore, we choose "functions of BMDT" as the meta-characteristic. A characteristic of BMDTs is thus relevant to the taxonomy when the characteristic addresses the functions of BMDTs (to illustrate, when choosing this meta-characteristic, the programming language used to implement a BMDT would not be relevant for the taxonomy).

Ending conditions (2). For determining when to stop the iterative buildup of the taxonomy, we adopted the ending conditions from Nickerson et al. (2013), with one exception: we did not apply the condition "at least one object is classified under every characteristic of every dimension" (Nickerson et al. 2013, p. 344) – as this would have prevented us from retaining functions in the taxonomy that are not yet available in BMDTs (but that are potentially useful as suggested, for example, by their inclusion in the taxonomy of Riemer et al. (2011) in the related domain of process modeling tools).

Nickerson et al. (2013) distinguish two approaches for the identification of the characteristics and dimensions of a taxonomy: conceptual-to-empirical (i.e., deductive) and empirical-to-conceptual (i.e., inductive). In the deductive approach, existing knowledge about the characteristics of the considered objects is used. In the inductive approach, knowledge about these characteristics is built up by analyzing objects from the domain.

Conceptual-to-empirical (4c, 5c, 6c). In iteration 1, we chose a deductive approach for integrating relevant characteristics from the existing literature (see Section 2). The three sources we drew on were (a) a taxonomy of possible adaptions for customizing the business model understanding (Schoormann et al. 2016), (b) a taxonomy for describing the functions of process modeling tools (Riemer et al. 2011), and (c) the functions of BMDTs as identified by Ebel et al. (2016). As the functions identified by Ebel et al. (2016) form a subset of the functions identified by Riemer et al. (2011), we base our initial taxonomy on the taxonomy by Riemer et al. (2011). We do so with one exception: We excluded the characteristic "process modeling notations" as this characteristic refers to process models rather than business models and hence does not fit our meta-characteristic (for space reasons we are not able to provide a detailed comparison of the functions identified by Riemer et al. (2011) and the functions identified by Ebel et al. (2016); nonetheless, in the results presentation in Table 1 we provide an indicative mapping).

Empirical-to-conceptual (4e, 5e, 6e). In iterations 2 to 6, we opted for an inductive approach for classifying BMDTs. In each iteration, we subsequently complemented the taxonomy by analyzing several BMDTs. By the end of the final iteration, all objective and subjective ending conditions of Nickerson et al. (2013) were met (e.g., each dimension was unambiguous and neither a new dimension nor a new characteristic were added).

To systematically identify the relevant objects for the inductive iterations, we adapted a rigorous procedure for literature reviews by vom Brocke et al. (2009). *Identification of keywords*: based on the widespread proliferation of the Business Model Canvas, we searched for BMDTs that use this de-facto standard. Thus, our search phrase was: *"business model canvas" AND (tool OR software)*. In app stores we searched for "business model canvas" only (i.e., without adding *tool OR software*) because there only applications are available anyway. *Selection of sources*: to increase the probability for considering as many relevant tools as possible, we searched for tools through the most widely used search engine (Google), and the most widely used portals for apps (Apple Store and Google Play Store). We considered the first 30 search engine result pages, as on the latter pages no hits were found that are relevant to the purpose of our research. *Inclusion/exclusion criteria*: we included only BMDTs that comply with the following criteria: (a) based on the Business Model Canvas; (b) available in English. *Tool search*: the search request for Google was run independently by two authors in the browser's incognito mode to avoid the search result being corrupted by previous search requests or the location. A total of 24 BMDTs was identified. 14 of them are web-browser applications, whereas the other 10 BMDTs are for use on a tablet or computer. Some BMDTs are available in multiple versions that differ in the functions they provide. For developing the taxonomy, of any tool with multiple versions, the version with the largest range of functions was used.

After the identification of BMDTs, we conducted five inductive iterations to analyze BMDTs regarding their functions. We first investigated those BMDTs, which we expect to have a wide range of functions, thus we analyzed fee-based before free BMDTs and browser-based before client-based (that require an installation on a computer or a tablet) BMDTs. The iterations were carried out in a full-day workshop.

Two authors independently identified the functions of the BMDTs in the iterations. Therefore, both authors individually investigated each BMDT. In addition, both authors were given Apple's iPod/iTunes business model (taken from Osterwalder and Pigneur 2010, p. 46) which they had to reproduce in each BMDT. The third author assumed the role of a devil's advocate by raising critical questions and then suggesting alternative explanations (Eisenhardt 1989). His primary task was to uncover deficiencies and question assessments. In addition, the devil's advocate should provide a different, possibly more objective look, thus improving the quality of the taxonomy.

After the workshop, it turned out that the developed taxonomy did indeed meet the ending conditions and was sufficient according to Nickerson et al. (2013). However, some of the functions identified in the workshop were too fine-grained. For example, some BMDTs offer predefined visual elements such as symbols, shapes, or emoticons. Instead of defining separate characteristics for each of these elements, we merged them in a follow-up of the workshop (iteration 7) into a characteristic "Graphical comments (predefined graphic)". Analogously, we merged the export file types (e.g., PDF, PNG) into a characteristic "Export". For each of the characteristics we created a short description that on the one hand allow a more robust classification of the BMDTs in the inductive iterations and on the other hand an intersubjective application of our taxonomy. For the preliminary evaluation of the taxonomy, the dimensions and characteristics as well as the corresponding descriptions[2] were presented to two student assistants who had not been involved in the research process. Both considered the understandability of the descriptions to be very high. Improvements only concerned minor changes to a few of our formulations.

Results

The resulting taxonomy (see Table 1) identifies 43 characteristics (i.e., functions) of 24 BMDTs[3] and classifies them into ten (sub-)dimensions. In the following, we briefly summarize our findings along the dimensions of our taxonomy.

Customize business model components. Only few BMDTs support the customization of the underlying business model understanding. Archi, Realtime Board, and Insight Maker allow for changing the components and their arrangement. Business Model Fiddle allows for renaming components only.

Modeling, commenting and annotating. This dimension consists of three sub-dimensions for developing, outlining, and assessing the entire business model and/or single elements. Nearly all BMDTs support creating (usually visualized through post-it notes) and connecting (through links between post-it notes) elements. Only few BMDTs do not allow for creating elements. Here, instead of using post-it notes, users write plain text directly into the business model's components. Definable templates, which suggest predefined elements of a business model (e.g., in the form of predefined business model patterns), hardly play any role in BMDTs (only Strategyzer allows users to draw on such templates). More than half of the BMDTs provide functions for adding textual comments on the level of individual elements. Fewer provide comments on the business model-level (additional information for the entire business model) or graphical comments (e.g., by adding predefined symbols). Some BMDTs address additional functions for outlining business models, such as freeform graphics (e.g., description of a model with freehand pencils), link files (e.g., link to local information like protocols), and link web-resources (e.g., link to online information like market studies). Some of the BMDTs support the evaluation of business models by gathering and documenting non-financial assessments (e.g., qualitative assessment of internal and external stakeholders). Only Business Model Toolbox and Strategyzer support a financial assessment (e.g., estimations of prices, costs, and quantities). Moreover, the Strategyzer is the only tool that allows maintaining the status of an assessment (e.g., for a hypothesis-based assessment (Osterwalder and Pigneur 2010) of single elements of a business model). The correctness checker function (e.g., with regard to the completeness of a business model) is currently not supported by any BMDT.

[2] A detailed description of the characteristics is available from the authors upon request.

[3] For space reasons, instead of complete references we included hyperlinks (last accessed on 21st February, 2017) to the BMDTs in the headline of Table 1.

(Sub-)Dimensions			BMDT: (1) Abizmo	(2) Archi	(3) Biz Canvas	(4) BiZZDesign	(5) Blank Canvas	(6) BMCanvas	(7) BM|Designer	(8) Business Model Fiddle	(9) Business Model Canvas	(10) Business Model Canvas & SWOT	(11) Business Model Toolbox	(12) Canvanizer 2.0	(13) Canvas BM	(14) Canvas for all	(15) Canvas Model Design	(16) Insight Maker	(17) Lienzo	(18) NotionCUBE	(19) Realtime Board	(20) Startup Canvas	(21) Strategyzer	(22) TheStartupToolKit.com	(23) TUZZit	(24) Waxidea
Customize business model components		Add[2]	-	●	-	-	-	-	-	-	-	-	-	-	-	-	-	●	-	-	●	-	-	-	-	-
		Divide[2]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	●	-	●	●	-	-	-	-	-
		Link[2]	-	●	-	-	-	-	-	-	-	-	-	-	-	-	-	●	-	-	●	-	-	-	-	-
		Rename[2]	-	●	-	●	-	-	-	●	-	-	-	-	-	-	-	●	-	-	●	-	-	-	-	-
		Change arrangement[2]	-	●	-	-	-	-	-	-	-	-	-	-	-	-	-	●	-	-	●	-	-	-	-	-
Modeling, commenting and annotating	To … business models: develop	Templates definable[1]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	●	-	-	-
		Elements	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	-	●	●	●	●
		Element connections	-	●	●	●	●	●	●	●	●	●	●	●	-	●	●	●	●	●	●	-	●	-	●	-
	To … business models: outline	Textual comments on element-level[1,3]	●	●	●	●	●	-	●	●	●	-	●	●	-	-	-	-	●	-	●	-	●	●	●	-
		Textual comments on business model-level[1,3]	●	●	-	●	-	-	●	●	-	-	-	-	-	-	-	-	-	-	●	-	●	-	●	-
		Graphical comments (predefined graphic)	-	●	-	●	●	-	-	-	-	-	-	-	-	-	-	●	-	●	●	-	-	-	●	-
		Graphical comments (freeform graphic)	-	-	-	-	-	-	-	●	-	-	-	-	-	-	●	-	-	-	●	-	-	-	-	-
		Link files[1,3]	-	-	-	●	-	-	-	●	-	-	-	-	-	-	-	-	●	-	●	-	-	-	●	-
		Link web-resources[1,3]	-	-	-	●	-	-	-	-	-	-	-	-	-	-	-	-	-	-	●	-	-	-	●	-
		Glossary support[1,3]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	To … business models: assess	Financial assessment	-	-	-	●	-	-	-	-	-	-	●	-	-	-	-	●	-	-	-	-	●	●	-	-
		Non-financial assessment	-	-	-	●	-	-	●	●	-	-	-	-	-	-	●	-	-	-	●	-	●	●	●	-
		Assessment status	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	●	-	-	-
		Correctness checker[1]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navigation and filtering		Model comparison[1]	-	-	-	●	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Element filter	-	-	-	●	●	●	●	-	-	-	-	●	-	-	-	-	-	●	-	-	-	-	-	-
		Phase management[1]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	●	-	-	-
		Element clipboard	-	●	-	●	●	●	●	●	●	-	-	●	-	-	-	-	-	●	●	-	-	-	●	-
		Link to business models (or parts of them) [1]	-	-	●	●	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	●	-	●	-
		Framework support[1]	-	-	-	●	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Collaboration	Communication	Chat[1,3]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	●	-	●	-	●	-	●	-
		Discussion board[1,3]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Member list[1,3]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	●	-	●	-	●	-	-	-
		Export[1]	-	●	-	●	●	-	●	-	●	-	-	●	●	-	-	●	●	●	●	-	●	●	-	-
		Import[1]	-	●	-	●	-	-	-	-	●	-	-	-	-	-	-	●	-	●	●	-	-	-	-	-
	Synchro-nization	Asynchronous modeling[1]	-	●	●	-	-	●	-	-	●	●	●	-	●	●	●	●	-	●	-	●	-	-	●	●
		Concurrent modeling[1]	-	-	-	●	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Synchronous modeling[1]	●	-	-	-	●	-	●	●	-	-	-	●	-	-	-	-	●	-	●	-	●	●	-	-
	User and role management	User management[1]	-	-	-	●	●	-	●	●	●	-	-	●	-	-	-	●	●	-	●	-	●	●	●	-
		Role management[1]	●	-	-	-	●	-	●	-	●	-	-	●	-	-	-	●	●	-	●	-	●	●	-	-
		Support of task sharing[1]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	●	-	●	-	●	-
		Workspace awareness[1]	-	-	-	-	-	-	-	●	-	-	-	-	-	-	-	-	●	-	●	-	●	-	-	-
	Repository and conflict management	Version control[1,3]	-	-	-	●	-	-	-	-	●	-	-	●	-	-	-	●	-	-	-	-	-	●	●	-
		Repository local[1]	-	●	●	●	-	-	-	-	●	●	●	-	-	●	●	-	-	●	-	●	-	-	-	-
		Repository remote[1]	-	-	-	●	●	●	●	●	-	-	-	●	●	-	-	●	●	●	●	-	●	●	●	●
Archi-tecture		Client/Server[1]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Client only[1]	-	●	●	●	-	-	-	-	●	●	●	-	-	●	●	-	-	●	-	●	-	-	-	-
		Web-based[1]	●	-	-	-	●	●	●	●	-	-	-	●	●	-	-	●	●	-	●	-	●	●	●	●

Table 1. Taxonomy of business model development tools

[1] from Riemer et al. (2011), [2] from Schoormann et al. (2016), [3] from Ebel et al. (2016)

● addressed, - not addressed

Navigation and filtering. This dimension deals with lowering the complexity of business models. Numerous BMDTs allow setting aside unfinished elements during the business model development process in a clipboard. A few BMDTs provide functions for filtering elements (e.g., to show and hide elements of the same color) and linking (parts of) business models (e.g., on a different level of abstraction). Although the development process can be divided into phases, only Strategyzer guides users by providing functions relevant for a particular phase (e.g., functions for the financial and non-financial assessment for evaluating business models). The comparison of business models for identifying differences (visually or in the form of a change document) is supported by BiZZDesign only.

Collaboration. The four sub-dimensions for communication, synchronization, user and role management as well as repository and conflict management reflect the collaborative and interdisciplinary character of business model development processes. Almost all BMDTs allow for exporting business models as a basis for any form of exchange (e.g., direct transfer into PowerPoint). Some BMDTs have chats for synchronous information exchange (e.g., text, video or screen sharing), change notifications, and member lists. None of the analyzed BMDTs provides discussion boards for exchanging and documenting information during the business model development process. Regarding the type of synchronization, our analysis indicates that asynchronous (consecutively working) and synchronous (simultaneous changing) modeling are dominant. In contrast, concurrent modeling (which requires to commit a model for immediately showing changes to all other users) is not supported by any BMDT. While a couple of BMDTs support user management (e.g., to involve different users) and role management (e.g., to specify different permissions for modeling, commenting and annotating business models), only few provide functions for task sharing (e.g., assign tasks to users), version control (e.g., document changes) and workspace awareness (e.g., notify changes).

Architecture. This dimension denotes whether a client installation is required (e.g., on a computer or a tablet). Most of the BMDTs we analyzed are web-browser applications and do not require an installation.

Discussion

The current high level of interest in business models in research and practice is undisputed. However, there is virtually no research on how business model development processes can best be supported by software. To address this problem and lay the ground for further research, our contribution is a taxonomy of functions of software tools for business model development, which consists of 43 mutually exclusive and collectively exhaustive characteristics (i.e., functions) of BMDTs.

According to Gregor's seminal work on theories in information systems, *theory for analyzing* (such as a taxonomy) is the necessary foundation for more advanced theories (Gregor 2006). With regards to BMDTs, such more advanced theories could, for example, attempt to explain and predict how specific functions of BMDTs affect the performance of business model innovation processes and what context factors affect the relationship between specific functions and resulting performance. Naturally, a comprehensive understanding of the possible functions of BMDTs is a prerequisite for such theories, and our taxonomy provides such a comprehensive understanding.

A further insight from our work is that there seems to be a gap between research on business innovation and tools for business model development. Research on business model innovation, for example, suggests that business model patterns can provide a valuable starting point for developing and innovating business models (Martins et al. 2015; Gassmann et al. 2014; Osterwalder and Pigneur 2010). This notwithstanding, such patterns have not yet been incorporated into BMDTs (Martins et al. 2015).

From the perspective of creativity research, our taxonomy could allow to be more specific about the very abstract activities that a CSS should support (Shneiderman 2002) and overcome the limited realizability of these activities. From the perspective of process modelling research, our taxonomy may help to identify additional relevant functions (for example, the filter function is included in our taxonomy, but not in the original taxonomy proposed by Riemer et al. (2011) for process modeling tools). Another advantage of our taxonomy is that it can help practitioners to get an overview of existing BMDTs and of their functions, and in this way can help to make informed tool investment decisions.

The limitations of our study mainly arise from the relatively immature nature of BMDTs and from our approach for selecting these tools. First, limitations may arise from the fact that the majority of our selected BMDTs have only been available for a few years (usually less than five), which may cause their

functions to be subject to change. However, we were able to ground parts of our taxonomy in previous research on process modeling tools, which uses tools that have been available for a long time and whose stability is already proven. Second, limitations may also arise from our selection of BMDTs, which we have based on the business model understanding of the Business Model Canvas. However, we are confident about our focus on the Business Model Canvas as its significant impact is widely recognized in research, practice, and education. Furthermore, we focused on English-language BMDTs only. However, in line with prior research that employed the Nickerson taxonomy-development method (e.g., Haas et al. 2014), we would argue that this is not a major problem, as the analyzed BMDTs exhibit considerable geographical diversity (e.g., TUZZit: Belgium, Business Model Fiddle: New Zealand, Realtimeboard: USA, Strategyzer: Switzerland).

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