Essays on Modeling Languages and Software Tools for Business Model Innovation: Theory and Empirical Evidence

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Synposis

1. Motivation

In times when digitalization is shifting competition “towards faster economic cycles, higher sociotechnical uncertainty, and the blurring of industry boundaries” (Massa & Ferriani, 2019, p. 1), business model innovation has become an increasingly decisive success factor for organizations (Massa et al., 2017). A business model helps to understand and explain the way organizations ‘do business’ and generate profits by describing “the rationale of how organizations create, deliver, and capture value” for their customers (Osterwalder & Pigneur, 2013, p. 14). Business model innovation refers to situations in which organizations, whether incumbent or newly formed, change their business models in a targeted and purposeful manner, which involves either the reconfiguration of existing business models or the design of new ones (Massa & Tucci, 2021). By helping organizations to (re-)consider how they can help customers solve their problems and satisfy their needs (Chesbrough, 2010; Teece, 2010), business model innovation can provide organizations with a lasting competitive advantage and—sometimes extraordinarily—high profits (e.g., Chesbrough & Rosenbloom, 2002).

However, constantly evolving technologies and customer needs turn business model innovation into a continuous challenge for organizations of all sizes and across all industries. Failure to innovate can upset or even disrupt not only individual organizations, but also entire industries. As exemplified by Amazon, AirBnb, Uber and Netflix, the corresponding industries (retail, hospitality, taxi, and media), have undergone pervasive, comprehensive, and disruptive changes brought about by these organizations’ innovative business models. Although technological and economic change has always existed, these changes are now occurring at an unprecedented speed and scale, shortening “average business model lifespan [...] from about 15 years to less than five” over the past 50 years (BCG, 2021, p. 1). Hence, business model innovation has become “an essential capability for organizations seeking to drive breakout growth, reinvigorate a lagging core, or defend against industry disruption or decline” (BCG, 2021, p. 1).

Given the paramount importance of business model innovation, the past two decades have seen an intense and steadily growing interest in business model innovation from researchers and practitioners alike. Practitioners consider business model innovation a non-trivial challenge for their organizations. This is evident in, for example, the majority of executives lamenting that their organizations experience “difficulties in defining an effective business model to support new ideas and make them profitable” (GE, 2018, p. 91). Moreover, “fifty percent of [executives] report that their current business model is being threatened by competitors using technology to create more compelling value propositions” (IBM Institute for Business Value, 2018, p. 9). Furthermore, executives agree that business model innovation must be addressed both urgently and extensively, with almost 80% of executives “recogniz[ing] they must change their business models significantly over the next three years” (Gartner, 2020, p. 1). Likewise, researchers in academic disciplines as diverse as strategic management (Zott, Amit, & Massa, 2011), entrepreneurship (George & Bock, 2011), innovation management (Schneider & Spieth, 2013), and information systems (IS) (Osterwalder & Pigneur, 2013; Veit et al., 2014) emphasize the significance of business model innovation. The newly established *Journal of Business Models* (Nielsen, Haslam, & Turcan, 2014), for example, suggests a continuing interest among researchers, which is also reflected in tracks at leading IS conferences (e.g., ICIS 2021; ECIS 2021) and special issues of recognized IS journals dedicated to business model innovation (e.g., Bouwman, de Reuver, Heikkilä, & Fielt, 2020; Osterwalder & Pigneur, 2013).

During the emergence of the business model concept, a considerable amount of literature has been published on defining the meaning and function of business models, mainly in strategic management (Foss & Saebi, 2017; Massa, Tucci, & Afuah, 2017; Wirtz, Pistoia, Ullrich, & Göttel, 2016), but also in IS (Al-Debei & Avison, 2010; Osterwalder, Pigneur, & Tucci, 2005). As the business model concept matures, researchers are increasingly turning their attention from the conceptualization of business models to the application of the concept (Schwarz & Legner, 2020). IS research has extensive experience in describing, understanding, and explaining phenomena using models, and is therefore predestined to contribute its knowledge base to describe, understand, and explain business model innovation (Osterwalder & Pigneur, 2013; Veit et al., 2014). In the IS discipline, knowledge about models revolves around three major questions, each with its own kind of research output (adapted from March & Smith, 1995): How to *represent* models? How to *design* models? How to *represent and design models with software tools*? Each of these three questions embodies a distinct and lively field of business model research, in which researchers have collated an array of different business model studies (Osterwalder & Pigneur, 2013; Schwarz & Legner, 2020). With the aim of representing business models, researchers and practitioners developed many *Business Model Modeling Languages* (BMML) that allow to visualize the abstract and intangible concept of business models such as the *Business Model Canvas* (Osterwalder & Pigneur, 2010) or *e3value* (Gordijn & Akkermans, 2003). With the aim of designing business models, researchers and practitioners have proposed several *Business Model Innovation Methods* to facilitate the management of uncertainty and risk during the innovation process (e.g., Di Valentin, Burkhart, Vanderhaeghen, Werth, & Loos, 2012; Haaker, Bouwman, Janssen, & de Reuver, 2017). Software tools, such as *Business Model Development Tools* (BMDT) have been designed by researchers and practitioners to enable computer-aided business model innovation (e.g., Athanasopoulou & de Reuver, 2020; Ebel, Bretschneider, & Leimeister, 2016). Although there has been a considerable amount of research on business model innovation, which has resonated with scholars and practitioners alike, the extant literature is, at the time of writing, limited in at least four ways:

First, just as the business model concept has emerged in a variety of academic disciplines, so have the corresponding visualizations of the business model concept, resulting in very different interpretations of both the concept and their visual representations. While some of the BMMLs have already received much attention, knowledge about BMMLs is scattered across disciplines with little attention to their different theoretical foundations. Thus, consolidation of knowledge on the representation of business models with BMMLs is required to advance these modeling languages and their use.

Second, unlike the many BMDTs that have been proposed by practitioners and that are already in use, there is little research on the theory-driven building and empirical evaluation of BMDTs and its features. For example, among the few available studies on BMDTs, none was found that systematically analyzes existing BMDTs and integrates the knowledge hidden in these software tools. Consequently, to advance the BMDTs themselves and their use, it is essential to consolidate current knowledge on the representation and design of business models with BMDTs.

Third, business model innovation is important not only for researchers and practitioners, but also for educators. In particular interactive and experience-driven teaching approaches are still missing from the teaching tool-box (e.g., Bouwman et al., 2020; Holm, Bidmon, Henike, Bosbach, & Baden-Fuller, 2019). Such teaching approaches should be scalable to large-classroom settings to allow as many students as possible to participate in business model innovation courses, be able to not only convey the business model concept itself, but also allow students to apply modeling languages, methods, and software tools for business model innovation.

Fourth, one of the limitations of the extant literature concerns an important methodological issue far beyond the context of business model innovation itself. Taxonomies are classification systems that help describe and understand phenomena, especially when researching novel phenomena, and are found not only in IS but also in many other academic disciplines. Recently, a growing number of taxonomies have been published, one of which forms part of this dissertation (Szopinski, Schoormann, John, Knackstedt, & Kundisch, 2020). While designing this taxonomy it became apparent that the application of existing guidance on taxonomy building lacks consistency and transparency, as well as that further guidance on taxonomy evaluation is needed. In a review of taxonomy articles, we empirically verified our anecdotal evidence. As the methodological issue has received scant attention from IS research, methodological guidance on taxonomy design needs to be advanced and extended.

My dissertation contributes to addressing each of the described limitations of extant research by presenting five research papers. The first offers a systematic, critical, and cross-disciplinary assessment of BMMLs to lay the foundation for a more integrated and theory-grounded study of modeling languages by contrasting and comparing BMMLs as well as analyzing research that has made use of them (Szopinski, Massa, John, Kundisch, & Tucci, 2022). The second paper investigates BMDTs to lay the foundation for a more theory-driven (re-)design of BMDTs by providing a taxonomy of characteristic features of such software tools (Szopinski et al., 2020). The third paper focuses on the theory-driven building and empirical evaluation of a specific creativity feature for BMDTs that is intended to support individuals in generating business model ideas (Szopinski, 2021). The fourth paper proposes an experiential and interactive approach aimed at teaching business model innovation to a large number of students, including the use of a BMML and a BMDT (Szopinski, 2019a). The fifth and final paper advances and extends methodological guidance on taxonomy design needed to rigorously build and evaluate taxonomies by presenting an extended taxonomy design process and corresponding recommendations for further operational support (Kundisch et al., 2022).

The synopsis of my dissertation is structured as follows: Section 2 illustrates the body of knowledge on business model innovation along four layers, which provide the structure for this dissertation. Section 3 identifies four research gaps in this body of knowledge, to which this dissertation contributes. Section 4 presents an overview of the five research papers of this dissertation, including a summary with detailed information on the contribution of co-authors and the scientific dissemination undertaken in the form of presentations and publications. Section 5 includes a reflection on the methodological approaches adopted in this dissertation. Finally, section 6 summarizes the implications for research and practice, discusses the limitations of the research papers, and offers directions for future research.

2. Body of knowledge

2.1 Conceptual model

With business model research being a rather vast, partially fragmented, and constantly evolving area of research, it is essential to structure the extant literature relevant to this dissertation. To provide an overview of this rich body of literature I present a conceptual model with four distinct and interrelated layers (see Figure 1) which also provides a structure for this dissertation. The layers represent the most commonly used types of research outputs in the IS discipline (March & Smith, 1995), as distinguished from the research outputs in the context of business model research (Schwarz & Legner, 2020). The inner layer contains the *Business Model Concept* itself and stands for the question of what a business model 'is'. The three outer layers apply the concept, by dealing, respectively, with the representation of business models (*Business Model Modeling Languages*), the design of business models (*Business Model Innovation Methods),* and the representation and design of business models with software tools (*Business Model Development Tools*). The conceptual model also provides the structure for the order in which the research papers of this dissertation are presented. In the following section I provide a detailed description of each of the four layers.

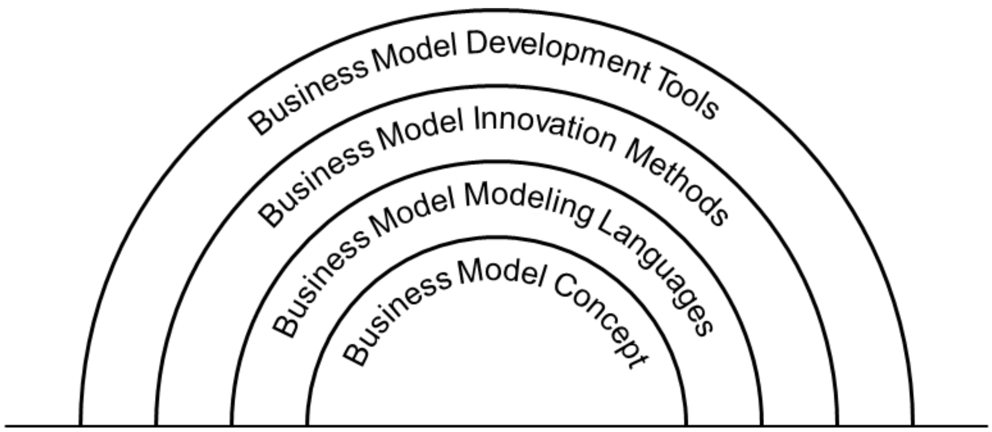


Figure 1: An information systems perspective on business model research

2.2 The business model concept

Many researchers have argued that the business model concept offers a unique perspective to describe, understand, and explain why some organizations are more competitive and profitable than others (e.g., Chesbrough, 2007a, 2007b). With the emergence of the business model concept, a plethora of interpretations for the meaning and function of business models have been proposed and discussed (e.g., Foss & Saebi, 2017; Massa et al., 2017; Wirtz et al., 2016).

In their highly regarded critical assessment of business model research, Massa et al. (2017) examine this body of knowledge and offer three interpretations of the meaning and function of business models: First, *business models as attributes of real organizations*. This interpretation suggests business models as empirical phenomena that can be observed in organizations (e.g., Casadesus-Masanell & Zhu, 2010; Chesbrough, 2010; Zott & Amit, 2010). Research using this interpretation, for example, derives patterns (Boons & Lüdeke-Freund, 2013) based on empirically observable characteristics of business models in organizations (e.g., Gassmann, Frankenberger, & Csik, 2014; Lüdeke-Freund, Carroux, Joyce, Massa, & Breuer, 2018; Remane, Hanelt, Tesch, & Kolbe, 2017) Second, *business models as cognitive/linguistic schemas*. This interpretation suggests that, for organizations and their members, individually and collectively, business models are mental representations of real systems rather than the systems themselves (e.g., Baden-Fuller & Morgan, 2010; Magretta, 2002; Martins, Rindova, & Greenbaum, 2015). Research using this interpretation focuses on, for example, how business models are interpreted by organizational members and how their mental representations shape the decision and sense making about business models (e.g., Frankenberger & Sauer, 2019; Henike, Kamprath, & Hölzle, 2020; Tikkanen, Lamberg, Parvinen, & Kallunki, 2005). Third, *business models as formal conceptual representations*. While the interpretation of cognitive/linguistic schemas is rather implicit, the interpretation of formal conceptual representation is rather explicit when it comes to what business models represent and how (e.g., McGrath, 2010; Osterwalder et al., 2005; Teece, 2010). Research using this interpretation is concerned with, for example, reducing the complexity of business models through simplification, thereby making tacit knowledge accessible for the purpose of communication on the topic of business models (e.g., Avdiji, Elikan, Missonier, & Pigneur, 2020; Casadesus-Masanell & Ricart, 2010; Osterwalder & Pigneur, 2010).

The first four research papers of this dissertation[1] relate to the context of business model innovation, and predominantly employ the interpretation of business models as formal conceptual representations (see Szopinski, 2019a, 2021; Szopinski et al., 2020, 2022). Furthermore, one of the four papers employs the interpretation of business models as cognitive/linguistic schemas, as this paper explicitly addresses the cognitive task of idea generation (see Szopinski, 2021).

Regardless of any specific interpretation of business models, organizations can leverage business models in at least two roles: Business models as *vehicle* for innovation and business models as *source* of innovation. In the first role, business model innovation enables organizations to commercialize novel ideas and emerging technologies, which in turn open up a variety of new business models (Chesbrough, 2010; Teece, 2010). In the second role, business model innovation constitutes a unique dimension of innovation. It is different from product/service, process, or organizational innovation, and complements these more traditional dimensions of innovation (Massa & Tucci, 2014). In both roles, the strength of the business model concept lies in linking the demand and supply side in creating, delivering, and capturing customer value. Business models often challenge the underlying assumptions of more traditional theories, before research is able to offer 'a business model theory' (Massa et al., 2017).

[1] The fifth research paper deals with the methodological contribution, independently of the topic of business model innovation.

However, with the sharpening of the meaning and function of business models, the groundwork for theorizing about business model innovation has been established.

Having outlined what is meant by the business model concept, I now describe how this abstract concept can be made concrete and tangible through visualization, which has been found to be crucial (Täuscher & Abdelkafi, 2017). Just as there is more than one way to define a business model, there are several ways in which it can be visualized.

2.3 Business model modeling languages

Several studies have now well established that visualizations lend themselves to enabling and supporting a range of tasks such as instruction, comprehension, and discovery of phenomena (Tversky, 2005). Equally well established is the notion that the choice for a particular visualization has a crucial impact on the cognitive processes and mental models of humans (e.g., Eppler & Bresciani, 2013; Eppler & Platts, 2009; Tversky, 2011). The same applies to the phenomenon of business model innovation (e.g., Baden-Fuller & Morgan, 2010; Eppler & Hoffmann, 2012; Osterwalder & Pigneur, 2010). Therefore, one of the most essential decisions in innovating and researching business models involves choosing an appropriate visualization, because the concept of the business model itself is abstract and intangible. Modeling languages for business models are artificial languages that humans can use to express information and knowledge about business models. Like modeling languages in general (Burton-Jones, Wand, & Weber, 2009; Moody, 2009), BMMLs are defined by a consistent set of rules that allow humans individually and collectively to interpret the meaning and function of business models. A consistent set of rules comprises semantics, syntax, and pragmatics (Burton-Jones et al., 2009). The semantics of a modeling language refers to *what* a language seeks to represent (i.e., the meaning and function of a business model), syntax refers to *how* a language represents the meaning and function (i.e., the architectural form of a representation), and the pragmatics of a modeling language refers to the conditions that a language is used in, both concerning its main purpose (e.g., to communicate business model ideas) and its boundary conditions (e.g., user experience) (Burton-Jones et al., 2009). By providing a consistent sets of rules, BMMLs also serve as boundary objects that overcome knowledge barriers between different communities of practice (Schwarz & Legner, 2020).

BMMLs have the potential to facilitate tasks throughout the entire business model innovation lifecycle. Such tasks include analysis (e.g., to examine the current business model of an organization), ideation (to envision new business models), feasibility (to inspect dependencies within and across business models and their non-/financial consequences), prototyping (to investigate different business model alternatives), decision-making (to evaluate and select business models), implementation (to develop and communicate plans for the realization of business models), and sustainability in terms of securing profits and competitive advantages (to monitor and control business models) (Wirtz & Daiser, 2018). BMMLs can support these tasks in different ways, for example, by facilitating the description, understanding, and communication of business models (e.g., Eriksson & Penker, 2000; Gordijn & Akkermans, 2003; Osterwalder & Pigneur, 2010). Furthermore, BMMLs can help to deduce requirements for the IS that underly business models (e.g., Eriksson & Penker, 2000; Gordijn & Akkermans, 2003). Moreover, BMMLs can assist in computer-aided business model innovation by integrating and applying them to software tools (e.g., Osterwalder & Pigneur, 2010; Samavi, Yu, & Topaloglou, 2009).

There are many BMMLs published, of which some have a vast impact on research, practice, and education. For illustrative purposes, I present two BMMLs, which have been chose because they illustrate well the variety as well as the strengths and opportunities of such modeling languages: The *Business Model Canvas* by Osterwalder and Pigneur (2010) and the *Causal Loop Diagram* by Casadesus-Masanell and Ricart (2010). I also chose these two BMMLs, because they are the most cited ones, have their origins in two different academic disciplines (one in IS, the other in strategic management), and they differ in terms of the complexity of their conceptualization (e.g., one has nine semantic elements, the other three), and in how they represent a business model (e.g., one is dominated by sticky notes, the other by arrows). Although Figure 2a and 2b represent the same business model, their differences can be seen on an intuitive level. The *Business Model Canvas* (see Figure 2a) conceptualizes a business model using nine building blocks (e.g., value propositions, customer relationships, and revenue streams) (=semantics) which are arranged in a two-dimensional visual template with predefined, spatially fixed boxes to outline the business model elements (=syntax). The *Causal Loop Diagram* (see Figure 2b) conceptualizes a business model using three semantic elements (i.e., choices, consequences, and links), which are generic compared to the semantic elements of the *Business Model Canvas* and can be arranged completely freely without any visual template for business model elements. The *Business Model Canvas* and the *Causal Loop Diagram* can be used both in paper-based and software-based format for a variety of tasks, to be undertaken both individually and collaboratively (=pragmatics).

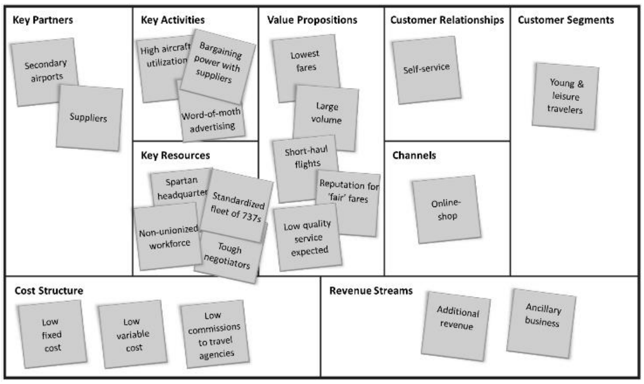


Figure 2a: The Business Model Canvas
(Osterwalder & Pigneur, 2010)

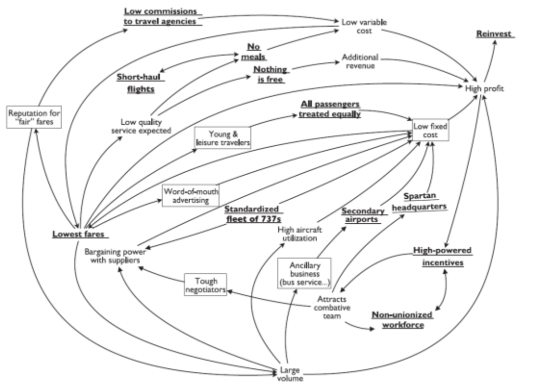


Figure 2b: The Causal Loop Diagram
(Casadesus-Masanell & Ricart, 2010, p. 199)

The impressive success of the *Business Model Canvas* has demonstrated the need for "shared languages" (Osterwalder & Pigneur, 2010, p. 12). Moreover, researchers, practitioners, and educators find such a common language useful (e.g., Strategyzer, 2015). Overall, BMMLs constitute a promising field for business model research in the IS discipline (e.g., Bouwman et al., 2020; Osterwalder & Pigneur, 2013; Pateli & Giaglis, 2004; Veit et al., 2014) and beyond (e.g., Zott et al., 2011).

This section has described what constitutes BMMLs and has argued that there is a whole range of tasks that can benefit from being worked on with BMMLs. The next section will describe methods that provide guidance for working on tasks related to business model innovation, often applying BMMLs.

2.4 Business model innovation methods

As mentioned in the introduction, business model innovation is a challenging task that has been described as complex, ill-structured, and/or wicked in nature (e.g., Bojovic, Genet, & Sabatier, 2018; Bouwman et al., 2012; Foss & Saebi, 2018). This is mainly for two reasons: First, there is an almost infinite number of possible business models and, second, at the time of innovation it is impossible to predict whether a particular business model will be successful. Therefore, the innovation of business models is subject to a high degree of uncertainty and risk, especially at the beginning (Osterwalder, Pigneur, Bernarda, & Smith, 2014; Brillinger, Els, Schäfer, & Bender, 2020). Given the prevailing uncertainties and risks organizations face when innovating their business models, organizations use iterative and hypothesis-driven procedures that, put bluntly, aim to develop profitable business models by ‘failing fast and cheap’ (Cosenz & Noto, 2018; McGrath, 2010; Sosna, Trevinyo-Rodríguez, & Velamuri, 2010). Several studies have begun to design business model innovation methods for managing uncertainty and risk, many seeking to enable rapid learning through experimentation. This applies to general innovation methods (Doll & Eisert, 2014; Euchner & Ganguly, 2014; Ries, 2011), but also to methods that are specifically tailored to business model innovation such as business model process modeling (Di Valentin et al., 2012), business model road mapping (de Reuver, Bouwman, & Haaker, 2013), business model stress testing (Haaker et al., 2017), and continuous business model improvement (Simmert, Ebel, Peters, Bittner, & Leimeister, 2019). Often, the visualization of an existing and/or desired business model using a BMML is an integral part of applying such business model innovation methods. This dissertation is mainly about modeling languages and software tools for business model innovation and less about innovation methods, however. On the one hand, this is because the aforementioned general innovation methods make it easy to apply BMMLs and BMDTs, on the other, as there are only few business model-specific innovation methods available to date, practitioners often apply general innovation methods such as the Lean Startup (Ries, 2011).

So far, the theoretical background has focused on concepts, modeling languages and methods for business model innovation that can theoretically be applied in a purely paper-based manner. The following section will introduce a new class of software tools that is dedicated to computer-aided business model innovation, including the software-based application of the business model concept and corresponding modeling languages and innovation methods.

2.5 Business model development tools

Several inquiries of research have established that tasks that are complex, ill-structured, and/or wicked in nature can benefit from being supported by software tools such as strategy development (e.g., Jarzabkowski & Kaplan, 2015; Kaplan, 2011) and product development (e.g., Kawakami, Barczak, & Durmuşoğlu, 2015; Mauerhoefer, Strese, & Brettel, 2017). This also applies to business model innovation that holds great promise in being supported by BMDTs, which in turn offers a substantial array of promising research opportunities (e.g., Bouwman et al., 2020; Ebel et al., 2016; Osterwalder & Pigneur, 2013; Veit et al., 2014).

Practitioners have recognized the capabilities of such software tools at an early stage and are ahead of academia in terms of running and using BMDTs. Note that the features researchers attribute to BMDTs may also be part of generic software tools that are not specific to business models (e.g., digital whiteboards). Digital whiteboards and BMDTs can be distinguished, based on whether they implement at least one BMML. Thus, if a software tool implements a BMML such as *e3value* or the *Business Model Canvas*, it is understood to be a BMDT. With the choice of a certain BMML, the underlying syntax, semantics and pragmatics are also adopted for the BMDT. Thereby, the modeling languages form the basis for representing and designing business models in these software tools.

Some of the BMDTs proposed by practitioners have already gained considerable popularity, as indicated by, for example, more than 500,000 downloads for the app *Business Model Canvas & SWOT*[2], and more than 2,000,000 business model projects in the browser application *Canvanizer*[3]. Furthermore, some BMDTs have a solid base of registered users (e.g., more than 22,000 active users of the app *Strategyzer*[4]). These BMDTs have features that, among others, allow to represent, share, annotate, and version business models, thus transferring the sticky-note experience of paper-based business model innovation environments to a software-based environment. They also enable in-person collaboration and allow users to work collectively, either in a distributed or fully remote manner. Features that facilitate the representation, exchange, annotation, and versioning of business models also help the application of business model innovation methods, without these BMDTs implementing any particular innovation method.

In addition to collaboration and documentation features that help users apply BMMLs in a digital environment (e.g., Fritscher & Pigneur, 2009, 2014a, 2014b), BMDTs can also offer features specifically tailored to business model innovation tasks. In principle, it is conceivable that software tools facilitate tasks throughout the entire business model innovation lifecycle, just as the underlying BMMLs. Therefore, BMDTs have the potential to facilitate tasks such as analysis (e.g., through extracting the current business model of an organization from its IS infrastructure; Augenstein & Fleig, 2017), ideation (e.g., through supporting business model exploration or automating business model idea generation; Athanasopoulou, Haaker, & de Reuver, 2018; John, 2016), feasibility (e.g., through supporting the management of dependencies within and across business models and their non-/financial consequences), prototyping (e.g., through supporting the building of prototypes on which customers can give early feedback about different business model alternatives), decision-making (e.g., through supporting the formation of a common decision-making basis; Dellermann, Lipusch, Ebel, & Leimeister, 2018; Hamrouni, Korichi, & Bourouis, 2018; Kajanus, Iire, Eskelinen, Heinonen, & Hansen, 2014), implementation (e.g., through supporting development and communication of plans for the realization of business models), and sustainability in terms of securing profits and competitive advantages (e.g.,

[2] Retrieved June 17th 2021 from https://play.google.com/store/apps/details?id=com.thirdmobile.modelcanvas&hl=de&gl=US
[3] Retrieved June 17th 2021 from https://canvanizer.com/
[4] Retrieved June 17th 2021 from https://www.strategyzer.com/app

through (semi-)automatically monitoring and controlling market conditions and consumer behavior; Augenstein, Dellermann, & Fleig, 2017; Rambow-Hoeschele et al., 2018) (Wirtz & Daiser, 2018).

In summary, BMDTs are software tools that allow to apply the concept of business models, corresponding modeling languages, and innovation methods. This section has briefly introduced each of the four layers relevant to the conceptual model for the purpose of structuring the extant literature on business model innovation. In the next section, I will identify the research gaps obtained from this literature within and across layers.

3. Identification of research gaps

Researchers seeking to contribute to the body of knowledge on business model innovation face a rather vast, partially fragmented, and evolving area of research (Foss & Saebi, 2017; Massa et al., 2017; Zott et al., 2011). Vast, because the number of articles published on business model innovation is immense. Fragmented, because multiple academic disciplines (i.e., strategic management, entrepreneurship, innovation management, and IS) study business model innovation simultaneously but with different foci (e.g., concept, modeling languages, methods, and software tools). Evolving, because despite the consensus that business models challenge the assumptions made by traditional theories (e.g., value creation, delivery, and capture assumptions; Massa et al., 2017), there is no one unifying 'business model theory' as yet, which encompasses all these aspects, or layers of study. To contribute to business model research and responding to scholarly calls (see Table 1), I first address the layers of BMMLs (leading to gap 1) and BMDTs (leading to gap 2), which are central to both practice and research.

When innovating and researching business models, one important—and yet often intuitively made—decision concerns the visual representation of the abstract and intangible concept of business models (e.g., Osterwalder & Pigneur, 2013; Täuscher & Abdelkafi, 2017; Veit et al., 2014). There are two different types of visual representations that aim to make the business model concept more concrete and tangible, and that differ in the degree to which they formalize a business model: ad-hoc visualizations that are not based on formal rules (e.g., rules about what is visualized, and how), and BMMLs that are based on formal rules. The latter aim to visually represent the business models of (m)any organization(s). The formals rules ensure that there are no deficits, redundancies, overloads, or excesses among content elements, and between content elements and visual elements. Because of such formal rules, the use of a BMML provides humans—whether involved actively as a 'sender' of a business model or passively as a 'receiver'—with a modeling language that facilitates describing, understanding, and explaining business model innovations. This applies to, for example, studies that illustrate an organization's business model or compare two or more business models through a BMML. However, BMMLs—more specifically, their formal rules for visually representing business models—are known only in a few of the many disciplines researching business models, for example, the IS discipline, with its long tradition of developing and researching modeling languages. Most of the disciplines that have proposed BMMLs, however, have not yet taken into account such formal rules and developed BMMLs in a more intuitive way without a meta-model (such as the Meta-Object Facility by Object Management Group, 2019). As a result, researchers beginning to study business model innovation may choose among several BMMLs without being aware of their similarities and differences. Moreover, it is unclear how to compare such BMMLs across academic disciplines and to determine how they are used in each discipline. This is all the more problematic as BMMLs come from such a variety of disciplines that they are difficult to access for researchers from outside of these disciplines, however potentially relevant they may be. Given that BMMLs have been proposed in academic disciplines with different research traditions, the knowledge of these BMMLs is dispersed across disciplines, and requires to be consolidated to enable a consistent and transparent visual representation of business models for the benefit of both research and practice. This allows me to formulate the following research gap:

Gap 1: Consolidation and advancement of knowledge on the representation of business models with BMMLs is required.

Software tools for business model innovation are said to have great potential (e.g., Bouwman et al., 2020; Ebel et al., 2016; Osterwalder & Pigneur, 2013; Veit et al., 2014). Despite some BMDTs having already been developed in research (e.g., Ebel et al., 2016; Gordijn & Akkermans, 2003) and practice (e.g., *Canvanizer* or *Strategyzer*), little is known about the characteristic features such BMDTs have or should have in the future. Furthermore, this lack of knowledge hinders researchers and practitioners to make informed (re-)design decisions. Little is known about when and why BMDTs are used and the effectiveness of their usage (Burton-Jones & Grange, 2013; Burton-Jones & Volkoff, 2017). To lay the foundations for this kind of research, knowledge from practitioners and researchers first has to be integrated, making it necessary to summarize and structure existing research, including revealing the knowledge that is hidden in BMDTs that are already implemented and used. For any form of theory-driven (re-)design of BMDTs, let alone their empirical evaluation, it is essential to establish such a foundation, which should include knowledge about individual features and about the class of BMDTs. One mission of IS research is to derive prescriptive knowledge. Currently available BMDTs, for example, do not yet implement any dedicated creativity features that support idea generation (Szopinski et al., 2020). In light of the potential of *creativity support systems* (Gabriel & Kirkwood, 2016; Wang & Nickerson, 2017) to support divergent and convergent thinking (Müller-Wienbergen, Müller, Seidel, & Becker, 2011; Seidel, Müller-Wienbergen, & Becker, 2010), there is a striking imbalance between the potential of BMDTs as *creativity support systems* and the features that BMDTs currently implement. The theory-driven building and empirical evaluation of creativity features would be a response to scholarly calls of IS researchers (Bouwman et al., 2020; Osterwalder & Pigneur, 2013; Schneider & Spieth, 2013; Veit et al., 2014). Given that BMDTs do not yet have any dedicated creativity features that support idea generation, despite business model ideas being at the very core of organizations' business model innovation (e.g., Martins et al., 2015; Schneider & Spieth, 2013), creativity features are predestined to advance BMDTs based on a consolidated theoretical foundation. Given these circumstances, I formulate the following research gap:

Gap 2: Consolidation and advancement of knowledge on the representation and design of business models with BMDTs is required.

Table 1 provides an overview of the research agendas, gaps and research questions identified by their respective authors that have informed my own research papers included in this dissertation. My own research papers address these first two gaps.

Table 1: Highlighted research gaps 1 and 2 in the context of business model innovation

Source	**Literature stream**	**Research gaps revealed and research questions raised in literature**	**Research gaps**
Osterwalder & Pigneur, 2013	Information systems	− Research identifying the underlying constructs and models of business model innovation as well as formalizing and visualizing them is needed. − Research transferring the principles of conceptual modeling to the process of modeling business models is needed. − Research integrating the body of knowledge dispersed across disciplines such as strategic management, business model research and information systems is needed.	Gap 1: *Consolidation and advancement of knowledge on the representation of business models with BMMLs is required.*
Veit et al., 2014	Information systems	− What are the semantic, syntactic, and pragmatic foundations of business model representations? − How are business model representations used?	
Bouwman et al., 2020	Information systems	− How to design tools[5] that are based on sound research and deep insights into issues in business model design and innovation? − How are results validated, does a tool deliver the results as expected, are tools useful?	
Schneider & Spieth, 2013	Innovation management	− How can firms be supported in conducting business model innovation in terms of tools and methods?	
Osterwalder & Pigneur, 2013	Information systems	− Research exploring the design and application of computer-aided design tools for business model innovation is needed. − How can computer-aided design tools make tasks related to business model innovation easier and quicker and support revealing as-yet-unseen opportunities for business model innovation? − How can organizations and their managers be supported in the process of coming up with entirely new and viable business models?	Gap 2: *Consolidation and advancement of knowledge on the representation and design of business models with BMDTs is required.*
Veit et al., 2014	Information systems	− How can IT tools meaningfully support business model innovation in general and the use of business model representations in particular?	

Today's students are tomorrow's managers and, therefore, just as relevant as the concept of business models is in practice, so it is in education (Bouwman et al., 2020; Holm et al., 2019; Hoveskog, Halila, & Danilovic, 2015). The everchanging economy and technology, as well as the increasing speed of this change, suggest that managers who lead organizations are expected to embrace business model innovation. For example, as a result of surveying 40 strategy academics, Markides (2015) reported that 95% of the scholars teach business model innovation, while the remaining 5% planned to do so in the future. Teaching business model innovation requires a learning environment characterized by integration and participation. To enable students from different disciplinary backgrounds to enroll in

[5] In the existing business model literature, the term 'tool' is used ambiguously, here referring to both BMMLs and BMDTs.

such courses, educators—including the author of this dissertation and its colleagues—need novel didactic approaches. However, it is not clear how the intrinsically task-oriented and interdisciplinary subject of business model innovation can be meaningfully taught through scalable didactic approaches using digital tools and peer feedback. In this regard, it is critical for successful teaching that students are able to ‘learn by doing’ (Hogan & Warrenfeltz, 2003). Therefore, educators need to close the so-called ‘knowing-doing gap’ (Pfeffer & Sutton, 2008). Applied to the concept of business model innovation, *knowing* refers to the knowledge that students acquire, and *doing* to the application of that knowledge. This also involves educators introducing students to the use of BMMLs (see gap 1) and BMDTs (see gap 2). Given that educators have not yet been provided with an interactive and experiential teaching approach to business model innovation, I formulate the following research gap:

Gap 3: Transfer of knowledge about business model innovation into teaching approaches is needed.

The number of taxonomies published in IS outlets indicates the continuously growing interest in taxonomies (see Table 2), not just in business model innovation research (e.g., Eickhoff, Muntermann, & Weinrich, 2017; Lembcke, Herrenkind, Willnat, Bührke, & Nastjuk, 2020; Remane, Hanelt, Tesch, Nickerson, & Kolbe, 2016). Taxonomies help humans to classify objects according to similarities and differences, and thus enable researchers and practitioners to describe, understand and analyze phenomena of interest (Nickerson, Varshney, & Muntermann, 2013). This is especially important in a discipline such as IS, where novel phenomena are often the subject of research (Steininger, Trenz, & Veit, 2021). To identify similarities and differences, characteristics of objects must first be identified and then structured into dimensions. To assist researchers in this process, Nickerson et al. (2013) proposed a taxonomy development method. Their method is widely used and combines a deductive approach (i.e., conceptual-to-empirical identification of characteristics and dimensions) and an inductive approach (i.e., empirical-to-conceptual identification of characteristics and dimensions). As a result of our own (see Szopinski et al., 2020) and others’ (see Kundisch et al., 2022) application of this method, we found that researchers have difficulties in applying the method for building taxonomies. Furthermore, we found that taxonomies are rarely evaluated and there is hardly any guidance on how to evaluate them. Because taxonomies often serve as *theories of analysis* (Gregor, 2006; Nickerson, Varshney, & Muntermann, 2017) at the beginning rather than at the end of a research endeavor, rigorous taxonomy design is crucial. Given that researchers have not yet been provided with continuous methodological guidance for how to implement the taxonomy design process, I formulate the following research gap:

Gap 4: Methodological guidance for building taxonomies needs to be advanced and extended to enable the evaluation of taxonomies.

Table 2: Number of taxonomies published in IS outlets[6]

Year of publication	**Number of journal and conference articles in which researchers build a taxonomy**	**Number of journal and conference articles in which researchers build a taxonomy using the method proposed by Nickerson et al. (2013)**	**Number of journal and conference articles in which researchers evaluate a taxonomy**
2013	9	4	2
2014	7	3	2
2015	11	6	3
2016	14	8	3
2017	18	13	6
2018	20	15	6
2019	19	14	4
2020	27	24	14
Total	**125**	**87**	**40**

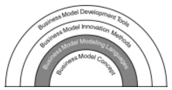
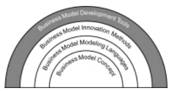
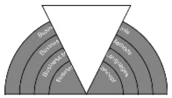
4. Overview and contribution

This dissertation comprises five research papers that expand our understanding of modeling languages and software tools for business model innovation, including their application in teaching. Furthermore, an investigation is provided into the methodological support for taxonomy designers. In these papers, I employ a wide range of research methods. Table 3 shows how the papers submitted as part of this dissertation interrelate to the gaps identified in the body of literature (cf. Table 1).

In the following, I dedicate one sub-section to each of the papers included in this dissertation, providing a summary of the paper with details on the scientific contributions made by the respective authors, and information on the dissemination of the research findings in the form of presentations and publications. Supplementary information for each paper can be found in a separate file attached to this synopsis.

[6] Table 2 refers to taxonomies published in IS outlets collated from the AIS Senior Scholar's Basket of Journals, the journal Business & Information Systems Engineering (BISE) and the proceedings of the International, European, Americas, and Pacific Asia Conferences on Information Systems as well as the International Conference on Design Science Research in Information Systems and Technology. I searched with the wildcard search term "taxonom*" in the time frame between 2013 and 2020 and excluded non-English articles and articles that do not build or evaluate a taxonomy.

Table 3: Overview of submitted research papers by research gap

Addressed research gap	**Classification according to the conceptual model (Figure 1)**	**Research paper**	**Research question(s)**	**Methodology**	**Source discipline(s)**	**Main data source**
Gap 1: Consolidation and advancement of knowledge on the representation of business models with BMMLs is required.		Szopinski et al., 2022	*What BMMLs exist? What are their semantic, syntactic, and pragmatic similarities as well as differences? How were they used in academia so far?*	Literature review	Information systems, strategy, accounting, computer science, and sustainability	1,288 articles 746 citing articles
Gap 2: Consolidation and advancement of knowledge on the representation and design of business models with BMDTs is required.		Szopinski et al., 2020	*What BMDTs exist? What are the characteristic features of BMDTs?*	Taxonomy design	Information systems	26 BMDTs
		Szopinski, 2021	*Can a creativity feature in a BMDT enhance the quality and quantity of business model ideas?*	Experiment	Information systems, cognitive psychology, and creativity research	163 Subjects
Gap 3: Transfer of knowledge about business model innovation into teaching approaches is needed.		Szopinski, 2019a	*How to design and implement a university course on business model innovation in a large classroom setting?*	Argumentative -deductive analysis	Business model research, management education and learning	1,000 Students
Gap 4: Methodological guidance for building taxonomies needs to be advanced and extended to enable evaluating taxonomies.	-	Kundisch et al., 2022	*How should taxonomies be built and evaluated?*	Argumentative -deductive analysis	Information systems	164 Taxonomy studies

4.1 Szopinski et al., 2022

In this research paper, we identify and analyze 17 BMMLs and research that has made use of them (cf. Table 4). Modeling languages for business models are an important means of representing and communicating the abstract and intangible concept of business models. Despite the widespread use of BMMLs in academia and practice, knowledge on BMMLs has hardly been systematized and is dispersed across different disciplines. Therefore, we synthesize and organize the knowledge on BMMLs as well as contrast and compare BMMLs regarding their semantics, syntax, and pragmatics. We also analyze research that has made use of these BMMLs, differentiating between research that is conducted *with* a given BMML and research *about* a given BMML. Based on the insights we gained from analyzing this vast and diverse body of knowledge, we identify research gaps, challenges, and opportunities for future research and thereby constitute the foundation for a more unified study of BMMLs within and across disciplines.

Table 4: Szopinski et al., 2022: Joint work, presentations, and scientific dissemination

Joint work	Co-authorship with L. Massa, T. John, D. Kundisch, and C. Tucci (50% D. Szopinski, 20% L. Massa, 12.5% T. John, 12.5% D. Kundisch, 5% C. Tucci) • Concretization of the research question and positioning by D. Szopinski and D. Kundisch • Literature review by T. John and D. Szopinski • Framework development for analyzing BMMLs by T. John • Set-up and management of the literature base by D. Szopinski • Keyword search, reading of abstracts as well as identification and classification of BMMLs by D. Szopinski • Coding of reviewed BMML papers by T. John, D. Kundisch, and D. Szopinski • Framework development for analyzing citations of BMMLs by D. Szopinski and L. Massa • Citation analysis, reading of abstracts as well as identification and classification of citations of BMMLs by D. Szopinski • Coding of reviewed citations of BMMLs by D. Szopinski • Write-up of the paper by D. Szopinski, L. Massa, and T. John • Feedback, comments and corrections by all authors • Team lead including alignment among authors on various content topics by D. Szopinski • An earlier version of this paper was part of the doctoral thesis of T. John.
Presentations	• 12/2017: John, T., Kundisch, D., Szopinski, D. (2017). Visual languages for modeling business models: A critical review and future research directions, in: Proceedings of the 38th **International Conference on Information Systems (ICIS)**, Seoul, South Korea. Presented by: D. Szopinski.

Table 4 (cont.): Szopinski et al., 2022: Joint work, presentations, and scientific dissemination

Scientific dissemination	• The work on this paper started in August 2016. • A preliminary version of this paper was published: John, T., Kundisch, D., Szopinski, D. (2017). Visual languages for modeling business models: A critical review and future research directions, in: Proceedings of the 38th **International Conference on Information Systems (ICIS)**, Seoul, South Korea (VHB-JOURQUAL 3 Ranking[7]: A). • An earlier version of this paper was published in the dissertation by John (2016). • The paper was initially submitted to **Communications of the Association for Information Systems (CAIS)** (VHB-JOURQUAL 3 Ranking: C) in December 2020 and was accepted for publication in August 2022.

4.2 Szopinski et al., 2020

In this research paper, we identify and analyze 26 BMDTs and their characteristic features (cf. Table 5). Software tools for business model development hold great promise for supporting numerous tasks related to business model innovation. However, virtually no design-relevant knowledge exists to date concerning the features that such tools should possess for certain tasks. Moreover, practitioners lack guidance for how to choose software tools, and researchers lack a foundation for advancing knowledge on these tools in a cumulative way. Therefore, we design a taxonomy that combines a conceptual and an empirical approach to synthesize knowledge from research and practice alike. Based on the insights gained from building and evaluating the taxonomy, we identified 43 distinct characteristic features of BMDTs. Grounded in the classification of existing BMDTs and a description of their characteristic features, we derive an agenda for future research and thereby constitute a foundation for a more cumulative stream of research on BMDTs and theory-driven design of features for such tools.

Table 5: Szopinski et al., 2020: Joint work, presentations, and scientific dissemination

Joint work	Co-authorship with T. Schoormann, T. John, R. Knackstedt, and D. Kundisch (45% D. Szopinski, 30% T. Schoormann, 15% T. John, 5% R. Knackstedt, 5% D. Kundisch) • Concretization of the research question and positioning by all authors • Literature review by T. John and D. Szopinski • Identification and classification of BMDTs for the building of the taxonomy by D. Szopinski, T. Schoormann and T. John • Frequency and cluster analysis by T. Schoormann • Development and implementation of a workshop for the evaluation of the taxonomy by D. Szopinski • Write-up of the paper by D. Szopinski, T. Schoormann, and T. John • Feedback, comments and corrections by all authors • Team lead including alignment among authors on various content topics by D. Szopinski • This paper is also part of the doctoral thesis of T. Schoormann.

[7] VHB-JOURQUAL 3 is a journal ranking published by the German Academic Association for Business Research (Verband der Hochschullehrer für Betriebswirtschaft e.V.).

Table 5 (cont.): Szopinski et al., 2020: Joint work, presentations, and scientific dissemination

Presentations	• 08/2017: D. Szopinski, T. Schoormann, T. John, R. Knackstedt, D. Kundisch (2017). How software can support innovating business models: A taxonomy of functions of business model development tools, in: Proceedings of the 23rd **Americas Conference on Information Systems (AMCIS)**, Boston, MA, USA. Presented by: T. Schoormann and D. Szopinski. • 09/2017: D. Szopinski, T. Schoormann, T. John, R. Knackstedt, D. Kundisch (2017). How software can support innovating business models: A taxonomy of functions of business model development tools, contribution at: **Bosch Business Model Innovation Summit** 2017, Renningen, Germany. Presented by: D. Szopinski.
Scientific dissemination	• The work on this paper started in June 2016. • A preliminary version of this paper was published: D. Szopinski, T. Schoormann, T. John, R. Knackstedt, D. Kundisch (2017). How software can support innovating business models: A taxonomy of functions of business model development tools, in: Proceedings of the 23rd **Americas Conference on Information Systems (AMCIS)**, Boston, MA, USA (VHB-JOURQUAL 3 Ranking: D). • The paper was initially submitted to **Electronic Markets** (VHB-JOURQUAL 3 Ranking: B) in May 2018 and was accepted for publication in December 2018.

4.3 Szopinski, 2021

In this research paper, I theoretically build and empirically evaluate a creativity feature (cf. Table 6). Successful business model innovation is dependent upon the generation of new ideas. However, during business model idea generation individuals tend to overlook the majority of potentially valuable business model ideas. Surprisingly, there are currently hardly any BMDTs that have dedicated creativity features to facilitate this idea generation process. The proposed creativity is intended to guide individual users of a BMDT through their exploration of the solution space for business model ideas and thereby enhance the creativity of business model ideas, both quantitatively and qualitatively. Designing and conducting a randomized controlled experiment with more than 160 students, I evaluate the effectiveness of the proposed feature. The findings of this study shed light on whether a creativity feature in a BMDT may support individuals generating business model ideas, but especially how such experimental research can be set up. Measuring business model idea quality was not possible because the consulted experts did not reach a consensus. The findings on business model idea quantity indicate that the creativity feature was not able to significantly enhance the creativity of business model ideas. To overcome the challenges of experimentally researching features of business model development tools in the future, I report and discuss the experiences made along the way. I hope that other researchers, too, will benefit from these experiences and that, in the long run, prescriptive knowledge can be derived that will benefit both academics and practitioners interested in the development of software-based tools for business model innovation.

Table 6: Szopinski, 2021: Joint work, presentations, and scientific dissemination

Presentations	• 06/2018: D. Szopinski (2018). Towards software-based tools for business model development: Using external stimuli for business model idea generation, contribution at: **Bosch Business Model Innovation Summit** 2018, Renningen, Germany. Presented by: D. Szopinski • 06/2019: D. Szopinski (2019). Activate software-based business model development tools: An exploratory study, contribution at: 3rd **Business Model Conference**, New York, NY, USA. Presented by: D. Szopinski • 06/2019: D. Szopinski (2019). Activate software-based business model development tools: An exploratory study, contribution at: **Bosch Business Model Innovation Summit** 2019, Renningen, Germany. Presented by: D. Szopinski • 06/2019: D. Szopinski (2019). Can stimuli improve business model idea generation? Developing software-based tools for business model innovation, in: Proceedings of the **ACM Creativity & Cognition** 2019, Poster, San Diego, CA, USA. Presented by: D. Szopinski • 06/2019: D. Szopinski (2019). Jumping, dumping, and pumping: Three mental principles for idea generation to activate software-based tools in business model innovation, in: Proceedings of the 32nd **Bled eConference**, Bled, Slovenia. Presented by: D. Szopinski • 09/2019: D. Szopinski (2019). Activate software-based tools for business model innovation, contribution at: **Research Workshop of the Faculty of Business Administration and Economics at Paderborn University** 2019, Melle, Germany. Presented by: D. Szopinski • 12/2020: D. Szopinski (2020). Active business model development tools: Design requirements, contribution at: 15th **International Conference on Design Science Research in Information Systems and Technology (DESRIST)**, Kristiansand, Norway. Presented by: D. Szopinski • 12/2020: D. Szopinski (2020). Exploring design principles for stimuli in business model development tools, in: Proceedings of the 41st **International Conference on Information Systems (ICIS)**, Hyderabad, India. Presented by: D. Szopinski
Scientific dissemination	• The work on this paper started in May 2018. • A preliminary version of this paper was published: D. Szopinski (2019). Can stimuli improve business model idea generation? Developing software-based tools for business model innovation, in: Proceedings of the **ACM Creativity & Cognition** 2019, Poster, San Diego, CA, USA. (VHB-JOURQUAL 3 Ranking: N/A). • Mental principles as theoretical foundation relevant to this paper are published: D. Szopinski (2019). Jumping, dumping, and pumping: Three mental principles for idea generation to activate software-based tools in business model innovation, in: Proceedings of the 32nd **Bled eConference**, Bled, Slovenia. (VHB-JOURQUAL 3 Ranking: N/A). • Design requirements as theoretical foundation relevant to this paper have been accepted for publication in the proceedings, but the author has made use of the opt-out policy that research-in-progress papers need not be included in the proceedings of the 15th **International Conference on Design Science Research in Information Systems and Technology (DESRIST)**, Kristiansand, Norway (VHB-JOURQUAL 3 Ranking: C). • Design principles as theoretical foundation relevant to this paper are published as short paper: D. Szopinski (2020). Exploring design principles for stimuli in business model development tools, in: Proceedings of the 41st **International Conference on Information Systems (ICIS)**, Hyderabad, India (VHB-JOURQUAL 3 Ranking: A).

4.4 Szopinski, 2019a

In this research paper, I develop and implement a teaching approach for a university course on business model innovation in a large classroom setting (cf. Table 7). As interest in business model innovation increases, so does interest in teaching approaches to business model innovation. Teaching this intrinsically task-oriented subject to a large number of students is challenging. Using a didactic approach that involves experiential learning and peer feedback, this new teaching approach allows lecturers to convey the business model concept itself by getting students to apply the concept, modeling languages, methods, and software tools for business model innovation in three consecutive assignments as well as enabling them to present their business model ideas and receive feedback. This approach includes phases in which students work individually, by themselves, and phases in which students work collaboratively in small teams. The teaching approach has been successfully tried and tested by more than 1,000 students over a period of four years.

Table 7: Szopinski, 2019a: Joint work, presentations, and scientific dissemination

Presentations	• 12/2019: D. Szopinski, T. John, D. Kundisch (2019). Digital tools for teaching business model innovation in information systems: A newly developed didactic approach comprising video-based peer feedback, contribution at: **Workshop on Information Technology and Systems (WITS)** 2019, Teaching Innovation, Munich, Germany. Presented by: D. Kundisch. • 12/2019: D. Szopinski, T. John, D. Kundisch (2019). Teaching business model innovation to large and interdisciplinary IS/IT classes: A didactic approach involving peer feedback via self-recorded video presentations, contribution at: **TREO Talks** in conjunction with the 40th **International Conference on Information Systems (ICIS)**, Munich, Germany. Presented by: D. Szopinski. • 06/2018: D. Szopinski (2018). How to teach business model innovation to 300+ students: An experience report, contribution at: 2nd **Business Model Conference**, Florence, Italy. Presented by: D. Szopinski. • 06/2018: D. Szopinski (2018). How to teach business model innovation to 300+ students: An experience report, contribution at: Teaching Forum at 2nd **Business Model Conference 2018**, Florence, Italy. Presented by: D. Szopinski.
Scientific dissemination	• The work on this paper started in January 2018. • The paper was initially submitted to **Journal of Business Models** (VHB-JOURQUAL 3 Ranking: N/A) in December 2018 and was accepted for publication in May 2019.

4.5 Kundisch et al., 2022

In this research paper, we explicate and extend existing methodological guidance for taxonomy designers in response to the growing interest in taxonomies from information systems researchers (cf. Table 8). Taxonomies help humans to classify objects according to similarities and differences, and thus enable researchers and practitioners to describe, understand, and analyze a phenomenon of interest. With the objective of providing prescriptive knowledge for taxonomy building and taxonomy evaluation, we present an extended taxonomy design process that entails 18 distinct steps, and derive 26 taxonomy design recommendations. To augment taxonomy design in this way, we analyzed 164 taxonomy articles and used the design science research knowledge base. Our proposed process for taxonomy design and the corresponding design recommendations suggest that, in addition to more rigorous and transparent taxonomy building, taxonomy evaluation plays an important role in designing taxonomies for describing, understanding, and analyzing phenomena in IS research, and beyond.

Table 8: Kundisch et al., 2022: Joint work, presentations, and scientific dissemination

Joint work	Co-authorship with D. Kundisch, J. Muntermann, A. M. Oberländer, D. Rau, M. Röglinger, and T. Schoormann (6.67% D. Kundisch, 6.67% J. Muntermann, 20.00% A. M. Oberländer, 20.00% D. Rau, 6.67% M. Röglinger, 20.00% T. Schoormann, 20.00% D. Szopinski) • Methodological guidance by D. Kundisch, J. Muntermann, and M. Röglinger • Acquisition of interview partners by D. Kundisch, J. Muntermann, and M. Röglinger • Supervision and scientific mentorship by D. Kundisch, J. Muntermann, and M. Röglinger • Concretization of the research question and contribution by D. Kundisch and M. Röglinger • Positioning of taxonomies as design science research artifacts by J. Muntermann • Coding of the literature sample by A. M. Oberländer, D. Rau, T. Schoormann, and D. Szopinski • Development of taxonomy design process and recommendations with focus on taxonomy building by A. M. Oberländer • Conducting evaluation interviews by A. M. Oberländer • Write-up of the article with being the lead for chapters “Taxonomy Design Recommendations”, “Discussion”, and “Summary” by A. M. Oberländer • Set-up and analysis of the literature sample by D. Rau • Write-up of the article with being the lead for chapters “Research method” and “Taxonomies in IS” by D. Rau • Support on taxonomy design process and recommendations, and evaluation interviews by D. Rau and T. Schoormann • Grounding taxonomies in design science research by T. Schoormann • Write-up of the article with being the lead for chapters “Research background” and Taxonomies in IS” by T. Schoormann • Team lead including alignment among authors on various content topics by D. Szopinski • Development of taxonomy design process and recommendations with focus on taxonomy evaluation by D. Szopinski • Write-up of the article with being the lead for chapters “Introduction” and “Extended Taxonomy Design Process” by D. Szopinski • Feedback, comments, and corrections by all authors • This paper is also part of the doctoral thesis of A. M. Oberländer and D. Rau.

Table 8 (cont.): Kundisch et al. (2020): Joint work, presentations, and scientific dissemination

Presentations	• 05/2019: D. Szopinski, T. Schoormann, D. Kundisch (2019). Because your taxonomy is worth it: Towards a framework for taxonomy evaluation, contribution at: **Research Seminar of the Information Systems Department at University of Lausanne**, Suisse. Presented by: D. Kundisch • 06/2019: D. Szopinski, T. Schoormann, D. Kundisch (2019). The long tail of taxonomy evaluation criteria: A structured overview, in: Digital Online Proceedings of the 14th **International Conference on Design Science Research in Information Systems and Technology (DESRIST)**, Worcester, MA, USA. Presented by: D. Szopinski • 06/2019: D. Szopinski, T. Schoormann, D. Kundisch (2019). Because your taxonomy is worth it: Towards a framework for taxonomy evaluation, in: Proceedings of the 27th **European Conference on Information Systems (ECIS)**, Stockholm-Uppsala, Sweden. Presented by: D. Szopinski • 01/2020: D. Szopinski, T. Schoormann, D. Kundisch (2020). Criteria as a prelude for guiding taxonomy evaluation, in: Proceedings of the 43rd **Hawaii International Conference on System Sciences (HICSS)**, Maui, Hawaii. Presented by: T. Schoormann
Scientific dissemination	• The work on this paper started in December 2017. • A preliminary version of this paper was published: D. Szopinski, T. Schoormann, D. Kundisch (2019). The long tail of taxonomy evaluation criteria: A structured overview, in: Digital Online Proceedings of the 14th **International Conference on Design Science Research in Information Systems and Technology (DESRIST)**, Worcester, MA, USA (VHB-JOURQUAL 3 Ranking: C). • A preliminary version of this paper was published: D. Szopinski, T. Schoormann, D. Kundisch (2019). Because your taxonomy is worth it: Towards a framework for taxonomy evaluation, in: Proceedings of the 27th **European Conference on Information Systems (ECIS)**, Stockholm-Uppsala, Sweden (VHB-JOURQUAL 3 Ranking: B). • A preliminary version of this paper was published: D. Szopinski, T. Schoormann, D. Kundisch (2020). Criteria as a prelude for guiding taxonomy evaluation, in: Proceedings of the 43rd **Hawaii International Conference on System Sciences (HICSS)**, Maui, Hawaii (VHB-JOURQUAL 3 Ranking: C). • The paper was initially submitted to **Business & Information Systems Engineering (BISE)** (VHB-JOURQUAL 3 Ranking: B) in August 2020 and was accepted for publication in August 2021.

5. Reflections on methodology

As part of conducting research for this dissertation, I reflected on the chosen research approach against the background of business model literature in general and the individual research papers of this dissertation and their methods in particular. Furthermore, I describe central drawbacks associated with the choice of these methods. I also explain how these drawbacks have affected the research conducted in the papers and informed their current state.

Among my initial concerns was whether I would be able to meaningfully contribute to the quite vast, somewhat fragmented, and constantly evolving area of business model research, given that this research is taking place simultaneously in different academic disciplines, at different layers and speeds. In addition, business model innovation is partly driven by practice, which requires integrating knowledge from research and practice. The underlying assumption of this dissertation is that the multiplicity of academic disciplines, layers, and speeds is necessary and insightful to research the notoriously complex and interdisciplinary phenomenon of business model innovation. A mix of methods is used in this dissertation to advance business model research across different layers, reflecting the respective state of research at each layer and the intended contribution of each paper.

Any research endeavor should begin with a review of the literature to provide a sound foundation for advancing knowledge (Webster & Watson, 2002). In business model research there is certainly no shortage of literature reviews. Most of these reviews can be assigned to the innermost layer, the business model concept (see Figure 1), (e.g., Foss & Saebi, 2017; Klang, Wallnöfer, & Hacklin, 2014; Massa et al., 2017; Wirtz et al., 2016; Zott et al., 2011), while some refer to the other layers such as BMMLs (Massa et al., 2017; Zott et al., 2011). However, the focus of these reviews is on the business model concept and does not go beyond briefly describing some of the representations of this concept. In this dissertation, the focus is on the layer of BMMLs and BMDTs. Reviewing both BMMLs and BMDTs is essential, because, without a sound foundation, cumulative and cross-disciplinary research is not possible. Without BMMLs, which are a representation of business models, the representation and design of business models in BMDTs is barely possible, because modeling languages form the basis of software tools. Consequently, this dissertation reviews first BMMLs and then BMDTs. The reviews offer two new and distinct IS-specific perspectives that have not been taken up in business model research previously, or if so, only tentatively and to a limited extent. However, bringing in these IS-specific perspectives can only succeed if the perspectives offer sufficient and thoroughly derived points of contact for researchers from those academic disciplines from which the business model concept originated. With this rationale for the two reviews in mind, I reflect on the goals and types of both.

Different review types can be used to achieve different review goals. Grounded in Gregor's (2006) theory types, four review goals can be distinguished: Describing, understanding, explaining, and theory-testing (Rowe, 2014). To describe and understand BMMLs, we conducted a scoping review (Paré, Trudel, Jaana, & Kitsiou, 2015), aiming "to provide an initial indication of the potential size and nature of the available literature" (Paré et al., 2015, p. 189). Likewise, we designed a taxonomy and integrated elements of a scoping review to describe and understand BMDTs. With the taxonomy, we aimed to integrate knowledge about real-world objects (i.e., BMDTs) and research about these objects (i.e., articles on BMDTs). Overall, we intended to not only summarize and organize past research on BMMLs and BMDTs, but also to suggest which and how research should be conducted in the future. Therefore, we combine backward- and forward-looking activities to advance knowledge (Schryen, Wagner, Benlian, & Paré, 2020). Specifically, this includes synthesizing extant research with a broad coverage of literature, identifying research gaps, and developing research agendas. Both consolidations of knowledge share a broad scope of questions (i.e., What BMMLs/BMDTs exist? What are the characteristics BMMLs/BMDTs?) and that their primary sources are typically conceptual in nature (i.e., existing research on BMMLs/BMDTs), and empirical (i.e., BMMLs/BMDTs itself). In the following, I reflect on the specific methodological choices and drawbacks of each review before proceeding with methodological considerations for the research papers for which these reviews are paving the ground.

With the aim of consolidating knowledge on BMMLs (Szopinski et al., 2022), we chose to conduct a scoping review. Therefore, we had to cope with drawbacks that weaken the methodological rigor concerning the search strategy, explicit study selection, and quality appraisal (Paré et al., 2015). The genesis of this research paper was preceded by finding a common language among the team of authors, who initially had a different understanding of what a language is in the first place. At the same time, this truly interdisciplinary collaboration emphasizes the need for such a review on BMMLs.

Because we intended that findings from a review on BMMLs would also inform research on BMDTs, we opted for a two-pronged search strategy to consolidate knowledge on BMMLs. As a result, we were able to synthesize knowledge about BMMLs on the one hand, and how BMMLs have been used in research so far, on the other hand. Scoping reviews usually seek to be as comprehensive as possible (Paré et al., 2015), so we identified BMMLs comprehensively to learn about them and—given the extensive size of the body of knowledge that researches with and about BMMLs—selectively in terms of identifying citations of BMMLs to learn about how they have been used in research so far.

To identify BMMLs, we conducted a keyword search on academic databases, which yielded 1,288 unique studies. To select studies explicitly and ensure their quality, we justify the compilation of our search string and report inclusion/exclusion criteria in detail. Furthermore, we derive criteria that qualify a BMML from previous literature and communicate this in detail. Applying these criteria to the resulting set of the keyword search yielded 17 BMMLs. The determination and classification of each of these BMMLs were performed independently by two authors. To identify relevant research that uses BMMLs, we conducted a citation analysis of those studies that propose one of the 17 BMMLs. This resulted in 21,933 citations. To select a relevant and manageable sample of studies that cite BMMLs in a non-trivial and non-marginal way, we apply a method suited to extremely large literature corpora (Jahangirian et al., 2011). More specially, we identified citations based on three criteria to achieve comprehensiveness within the sample as rigorously as possible, namely: citation count (so as not to miss the most frequently cited papers, which are likely to be highly relevant), publication year (to counter the bias against more recent papers that the citation count criterion introduces), and random selection (to alleviate remaining biases) (Jahangirian et al., 2011). Using these criteria, we were able to narrow down the sample to 746 studies as part of the initial cursory analysis, and to 87 studies as part of in-depth analysis, in the final step. This also included an analysis, conducted by three authors, of a randomly selected sub-sample of 100 studies. The collated literature of BMMLs and citations enabled us to synthesize knowledge across multiple academic disciplines.

With the aim of consolidating knowledge on BMDTs (Szopinski et al., 2020), we chose to design a taxonomy following the method of Nickerson et al. (2013). The design of a taxonomy perfectly fits this purpose because this method allows to identify, summarize, and integrate knowledge deductively (i.e., conceptually without examining objects) and inductively (i.e., empirically with examining objects) (Nickerson et al., 2013). In our research paper, the BMDTs are the objects. This way we were able to consolidate knowledge from previous research on BMDTs and from already implemented and running BMDTs. The rationale for investigating these BMDTs lies in the theory of technology inscription, which assumes that technological artefacts such as BMDTs are sources of knowledge about a phenomenon (Cozzens, Bijker, Hughes, & Pinch, 1989). As justified above, we pursued a similar goal for BMDTs with the taxonomy design as we did for BMMLs with the literature review. Consequently, we mitigated the drawbacks of scoping reviews again by adhering to methodological rigor in search strategy, explicit study/object selection, and quality appraisal (Paré et al., 2015). The search strategy is comprehensive in terms of identifying BMDTs that are based on the *Business Model Canvas* and that are available in English. We searched for BMDTs in scholarly (Google Scholar) and non-scholarly search engines (Google) as well as the most widely used app stores, namely *Apple App Store* and *Google Play Store*. To select studies/objects explicitly and ensure their quality we justify the compilation of our search string and report inclusion/exclusion criteria in detail. The identification and classification of the BMDTs were carried out independently by two authors. The taxonomy on BMDTs enabled us to synthesize knowledge from practice and academia. To test the rigor of our taxonomy building, we extended the search strategy in our taxonomy evaluation to BMDTs that are based on BMMLs other than the *Business Model Canvas*. The taxonomy remains stable even after classifying these BMDTs. In total, we identified and classified 26 BMDTs. Furthermore, to evaluate the understandability and applicability of our taxonomy, we conducted a workshop with eleven students that had not been involved in the taxonomy building. The students had to complete certain tasks using the taxonomy and BMDTs. The recruited students were enrolled in a business model innovation course, previously worked with BMMLs and BMDTs, but admittedly did not have the professional experience or the responsibility of employees typically in charge of business model innovation or of making an investment decision on software tools in organizations. Besides, the tasks were not worked on in an organizational setting and therefore may have been somewhat artificial. Despite the artificial nature of the workshop, we conclude that we rigorously built and evaluated the taxonomy. Our methodological approach follows the advice of Nickerson et al. (2013) to “[ask] users to evaluate the usefulness of a taxonomy” (p. 347). They also conclude that “the only way to determine if the resulting taxonomy is useful is to observe its use by others over time” (p. 347). However, much time can elapse between the evaluation of a taxonomy directly after its building (before publication) and its actual use (after publication). There is a lack of methodological guidance for taxonomy evaluation that specifically considers the target group (‘Who are the users of a taxonomy?’) and purpose (‘How is a taxonomy useful to these users?’) to anticipate future taxonomy use so that taxonomy designers do not have to wait for the actual use of a taxonomy to determine its usefulness. This also suggests that both the purpose and the target group should already be considered during taxonomy building. Overall, our reflections led to an independent methodological contribution (see Kundisch et al., 2022).

Both reviews, that on BMMLs (Szopinski et al., 2022) and that on BMDTs (Szopinski et al., 2020), demonstrate the potential of synthesizing knowledge across academic disciplines, and bridging the flow of knowledge from practice and academia. At the same time, there is a tremendous effort to synthesize knowledge at a given point in time across different disciplines, at different levels, and at different speeds—being fully aware that the knowledge will very quickly evolve again—across different disciplines, at different levels and speeds. Nevertheless, I conclude that this effort is worthwhile because today's real-world problems cannot be solved with the knowledge of a single academic discipline. I learned a lot from writing the reviews, but it was especially the close interdisciplinary collaboration with researchers from strategic management that opened up new horizons.

In Szopinski (2021) and Szopinski (2019b), I rely on the consolidated knowledge on BMMLs and BMDTs. With the aim of building and evaluating a creativity feature for BMDTs, I chose to design and implement a randomized controlled experiment to investigate whether individuals generating business model ideas can benefit from a creativity feature in a BMDT. Experimental research is “often considered to be the ‘gold standard’ in research designs [and] is one of the most rigorous of all research designs“ (Bhattacherjee, 2012, p. 83). Intending to link cause (creativity feature in a BMDT) and effect (quality and quantity of business model ideas) an ideal experiment allows to “observe a subject in a controlled setting but where the subject does not perceive any of the controls as being unnatural and there is no deception being practiced” (Harrison & List, 2004, p. 1010). This requires systematic manipulation of at least one independent variable and measurement of the effect on the dependent variables while eliminating and controlling (potential) confounding factors in control variables. The rigor of the design and implementation of such experiments is determined by reliability, validity, and generalizability (Field & Hole, 2013). The 1x2 between-subjects experimental design was conceived as a laboratory experiment that typically has high internal validity but low external validity.

To ensure reliability, I measured the two dependent variables as precisely as possible. The quality of business model ideas was determined through four independent expert evaluations for each business model idea. The experts have experience in evaluating business model ideas and used widely accepted scales from creativity research (creativity = novelty + usefulness; Amabile, 1996). Furthermore, experts were introduced to the evaluation procedure. Reliability could be improved by using business model-specific scales (e.g., Ebel et al., 2016; Simmert et al., 2019). However, these are only suitable to a limited extent due to the early stage of the business model ideas. For example, scales that are more business model-specific have constructs that partly overlap (e.g., novelty and originality) and are already geared towards feasibility, which at this early stage is not at all desirable. Despite taking into account the instructions on how to apply the consensual assignment technique, I was not able to select and instruct the experts in such a way that they could independently reach a consensus on the business model idea quality. Perhaps my chosen level of rigor was too high.

To ensure internal validity, I tried to learn as much as possible from other experiments with *Creativity Support Systems* and experiment designs in general (e.g., regarding task description, duration, and incentivization). Furthermore, numerous control variables are used in the experiment (e.g., the ability for divergent thinking, personality traits, intrinsic motivation, previous knowledge), but more and different control variables can also strengthen rigor. Probably the most influential decision to strengthen internal validity was to conduct the experiment at the individual level, rather than at the group level. An experiment on collaborative business model idea generation would require a much more complex experimental design and make it difficult to isolate the effect of the creativity feature due to group dynamics (e.g., regarding conflict resolution and collective problem solving). Experiments at the individual level are typically a prerequisite before researchers conduct experiments at the group level.

To ensure external validity, I avoided the over-use of participants in experiments by excluding those who had already taken part in a technical test of the BMDT in a previous semester (Field & Hole, 2013). Participation in the experiment was a compulsory part of a business model innovation course. Thereby, I was able to rule out the effects of voluntary participation, as volunteers are often perceived as more intelligent and better educated (Field & Hole, 2013). Nevertheless, the generalizability of the findings of this experiment is limited. This has several reasons: First, the participants in the experiment were undergraduate students and not, for example, practitioners who initiate or carry out business model innovation in organizations. Therefore, the experiment should be replicated with more typical participants. Second, the participants in the experiment worked individually, by themselves, and not collaboratively in teams, as is often the case when practitioners generate business model ideas. Therefore, the experiment should be replicated for individual and collaborative business model idea generation, independently but also alternately. Third, the participants in the experiment worked in a comparatively artificial environment. The experiment could be replicated in a more natural environment or even in the field, but experimental research on BMDTs is already a difficult challenge when conducted in the laboratory. In the field, controlling for or eliminating factors is even more challenging because there are different and a greater number of factors (e.g., organizational hierarchy and culture). Strictly speaking, this requires a different research design such as an action design research project where the creativity feature of the BMDT is the intervention and researchers study the interaction of the user and the BMDT in an organizational context (Sein, Henfridsson, Purao, Rossi, & Lindgren, 2011).

Due to the coronavirus pandemic, the experiment was not carried out in the *Business and Economic Research Laboratory* (BaerLab) of Paderborn University as originally planned, but participants took part in the experiment from home. Because this applied to participants from both the treatment and the control group, there is no systematic bias. Nevertheless, I was not able to control the participants in the same way as it would have been possible in the laboratory (e.g., ensuring a quiet working atmosphere without distractions and identical screen and workstation size).

With the aim of transferring knowledge about business model innovation into teaching approaches (Szopinski, 2019a), the research paper follows an argumentative-deductive approach. In the context of business model innovation education and learning, there have been hardly any documented teaching approaches so far. In this respect, the description of a teaching approach for business model innovation alone is a contribution, even though it is not methodologically backed up. Although the description of the teaching approach is based on and linked to concepts (e.g., peer feedback) and theories (e.g., experiential learning), this is done purely on a linguistic level and informed by anecdotal evidence from the author's implementation of this teaching approach. This research was valuable to me because I was able to combine and reflect on my roles as researcher and lecturer.

With the aim of advancing and extending methodological guidance for taxonomy design (Kundisch et al., 2022), the paper follows an argumentative-deductive approach by first analyzing 164 existing taxonomy projects and then suggesting advancements and extensions to the taxonomy development method by Nickerson et al. (2013). Although the proposed extended taxonomy design process and the corresponding recommendations are structured along with the six phases (e.g., identify a problem and motivate, define objectives of a solution, design and development, demonstration, evaluation) of the design science process (Peffers, Tuunanen, Rothenberger, & Chatterjee, 2007), the methodological drawback of this research paper lies in that this design science process itself was not applied to develop the methodological guidance. The methodological rigor stems from that (1) at least two authors analyzed each of the 164 articles independently of each other to minimize subjectivity, (2) there is a strong link to the design science research knowledge base by grounding design decisions in the extended taxonomy design process and the corresponding recommendations in previous research, and (3) expert interviews were conducted with researchers who have already designed and published a taxonomy in the *AIS Senior Scholars' Basket of Eight* to get feedback on the understandability and expected usefulness of our improvements.

The methodological considerations for this research paper were characterized by two peculiarities: First, its methodological contribution allowed me to take a completely new perspective, especially as the idea grew out of our own application of the taxonomy development method. Second, this paper was written by a comparatively large team of authors from five different universities, with a shared interest in the methodological augmentation of taxonomy design. This collaboration sparked interesting opportunities for reflection during the writing of the paper, from which it certainly benefited. Beyond, I got in contact with many researchers at conferences with whom I do not share a common research focus but, as these researchers drafted taxonomies, we engaged in exciting opportunities for exchange, and I gained valuable insights into areas of IS that were previously rather unfamiliar to me.

While most of the research papers in this dissertation are rather conceptual (i.e., Szopinski et al., 2020, 2022; Szopinski, 2019a; Kundisch et al., 2022), one is more empirical (i.e., Szopinski, 2021). In Table 9, I summarize the different methodological considerations at a general level, reflecting on three questions from Jaakkola (2020) against the background of the methodological challenges of the individual research papers: What is the logic of creating new knowledge? What role does theory play? Why are particular information sources selected, and how are they analyzed? (Jaakkola, 2020).

Overall, we were able to strengthen the rigor of the research papers by addressing the methodological drawbacks in multiple ways, namely (1) using empirical and conceptual approaches to consolidate knowledge, (2) using data from academia and practice, and (3) using theories from various academic disciplines to structure and inform research at and across various layers of business model research.

Table 9. Methodological considerations

Research paper	**What is the methodological challenge of the addressed research gap?**	**What is the logic of creating new knowledge?**	**What role does theory play?**	**Why particular information sources are selected, and how are they analyzed?**
Szopinski et al., 2022	Synthesis of knowledge about BMMLs and their use in research is required across multiple academic disciplines, including BMMLs that originated in disciplines without a modeling language tradition. The relevant body of knowledge is extensive.	To summarize and integrate the current understanding of BMMLs and their use across multiple academic disciplines by conducting a literature review and a citation analysis.	We use semantics, syntax, and pragmatics (Moody 2009; Burton-Jones et al. 2009) to organize knowledge about BMMLs.	Besides research on BMMLs, the analysis of BMMLs and research articles that make use of BMMLs is based on their semantics, syntax, and pragmatics.
Szopinski et al., 2020	Synthesis of knowledge about BMDTs in practice and academia is required, including BMDTs that have been developed solely in practice, without any connection to prior research or theory. The knowledge relevant to this is partly ‘inscripted’ in already implemented BMDTs.	To summarize and integrate the current understanding of BMDTs in practice and research by designing a taxonomy.	We use technology inscription (Cozzens et al. 1989) to extract knowledge about BMDTs.	Besides research on BMDTs, the analysis of BMDTs is based on their characteristic features.
Szopinski, 2021	Adaptation of creativity theories to the context of business model idea generation for theory-grounded building and implementation of a creativity feature for a BMDT; as well as development and implementation of a rigorous experiment design to empirically evaluate this creativity feature.	To build theory of a creativity feature and its empirical evaluation through a randomized controlled experiment.	I use *Search for Ideas in Associative Memory* (Nijstad and Stroebe 2006; Knoll and Horton 2011) and *Chance-configuration theory* (Simonton 1989) to design a creativity feature.	Analysis of creativity is based on the quality and quantity of business model ideas generated by participants in the experiment. The quality is determined through expert evaluations based on the novelty and usefulness of business model ideas.
Szopinski, 2019a	Adaptation of modeling languages, methods, and software tools for business model innovation is needed for experiential and interactive teaching approaches that enable a large number of students to enroll in such courses.	To understand teaching approaches to business model innovation by drawing on elements of experiential learning.	I use experiential learning (Kolb 1984) to anchor the elements of the business model innovation teaching approach.	Besides research on the concept, modeling languages, methods, and software tools for business model innovation, I adapt experiential learning and management education and learning.
Kundisch et al., 2022	Adaptation of existing methodological guidance is needed for rigorously building and evaluating taxonomies.	To advance and extend current understanding of methodological guidance for taxonomy design by drawing on the design science research methodology.	We use the design science research methodology process model (Peffers et al. 2007) to structure the advanced and extended taxonomy design process.	Besides research on taxonomies, we analyze taxonomies based on their properties and their design process.

6. Conclusion

The research papers that form part of this dissertation provide novel insights into business model innovation, especially concerning modeling languages and software tools, including their application in teaching. My first major contribution to the literature on business model innovation arises from synthesizing knowledge on how to visualize the abstract and intangible concept of business models using BMMLs (Szopinski et al., 2022). Because such BMMLs are typically used not only in boardrooms and lecture halls, but increasingly in their digital equivalents, this contribution also stems from synthesizing knowledge on how to visualize business models using BMDTs (Szopinski et al., 2020). The extant body of knowledge is held in 'silos', which makes it difficult to get a holistic picture of business model innovations and how they are researched: Silos have formed not only within the individual academic disciplines, across which knowledge is dispersed, but also between academia and practice, with the latter often leading the way. The present dissertation raises the possibility that, having summarized and organized this vast and diverse body of knowledge and made transparent how research contributions relate to each other, researchers might analyze, explain, and even predict the phenomenon of business model innovation differently. The research agendas for BMMLs (Szopinski et al., 2022) and BMDTs (Szopinski et al., 2020) include suggestions for how researchers can specifically take advantage of these opportunities.

My second major contribution is built on this solid foundation, showing how it can serve as a starting point for business model research. With the theory-driven design and empirical evaluation of a creativity feature in BMDTs, I propose a feature that does not yet exist in practice and which is designed to support individuals in the earliest and arguably most important phase of business model innovation, namely in business model idea generation (Szopinski, 2021). Given the immense importance of business model innovation for organizations of all sizes and industries, I also transfer the knowledge gained on BMMLs and BMDTs into an experiential and interactive teaching approach that enables students understanding how to cope with the constant state of flux of business model innovations (Szopinski, 2019a).

Finally, the demand for describing and analyzing novel phenomena in the IS and other disciplines suggests that the need for taxonomies will grow even stronger – increasing the need for better guidance on taxonomy design – as technology continues to advance rapidly. In response, my third major contribution is a methodological one that advances and extends guidance for rigorously building and evaluating taxonomies (Kundisch et al., 2022). This methodological guidance supports not only researching the phenomenon of business model innovation, but also other phenomena within or even beyond the IS discipline.

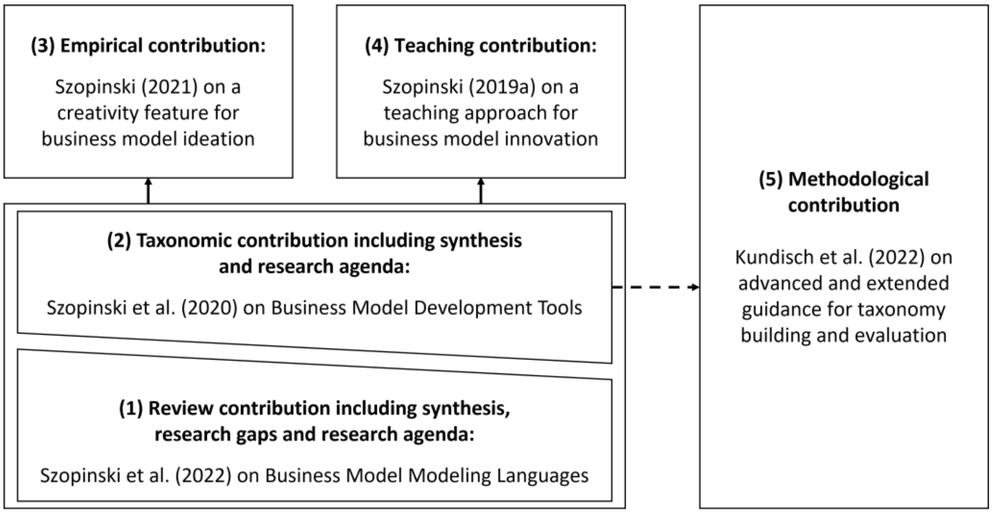


Figure 3: Contributions of this dissertation

6.1 Implications for research

The findings from this dissertation shed light on the current perspective of IS research on business model innovation and, following the triad of Ågerfalk and Karlsson (2020), carry important theoretical, empirical, and artefactual implications for both researchers and practitioners.

Theoretical implications

With our review on BMMLs (Szopinski et al., 2022), my co-authors and I are the first to provide a systematic, critical, and cross-disciplinary assessment of BMMLs to support the theoretical foundation to (further) developing and evaluating modeling languages in the context of business model innovation. On the forefront, the findings prepare the ground for a common understanding of BMMLs across academic disciplines, with the semantic, syntactic, and pragmatic underpinnings of BMMLs in turn enabling more cumulative research to be undertaken on this interdisciplinary topic. Furthermore, the findings may help to make BMMLs known and recognized as such, especially in academic disciplines outside IS. Another implication of our review is that our findings suggest that researchers can benefit from leveraging the relative strengths of each other's disciplines – conceptually and methodologically. The principal implication of our findings is that BMMLs are a central means of explicating the abstract and intangible business model concept while at the same time allowing to integrate, enable, and align research across different disciplines and different layers.

With our analysis of BMDTs (Szopinski et al., 2020), my co-authors and I are also the first to provide a systematization of BMDTs across practice and research to support the theoretical foundation of (further) developing and evaluating software tools in the context of business model innovation. The features currently available in BMDTs suggest that they are mainly conceived as digital whiteboards to be used for collaboration and documentation purposes. The principal implication of our findings is that BMDTs could incorporate new features beyond merely replicating the sticky note experience from paper-based business model innovation. In contrast to paper-based tools, software-based tools for business model innovation can be interactive, adaptive, and context sensitive. Technologies are often considered to form part of innovative business models, but rarely as part of the process of innovating the latter. While proposing new software features based on existing theories enables academia to catch up with and support the development of BMDTs in practice, it also implies that researchers should consider humans and technologies (i.e., BMDTs) when analyzing, explaining, and predicting the emergence of compelling business model innovations.

To the best of my knowledge, Szopinski (2021) is the first study to investigate the theory-driven building and experimental evaluation a particular feature of a BMDT. By viewing business models as cognitive models, and conceiving BMDTs as creativity support systems, I show the potential of the creativity features carried by such software tools for contextualizing and testing classical theories of creativity at an individual level. This also informs studies on creativity features of BMDTs at a group and at an organizational level. Although this research paper focuses on a creativity feature, it may also have a direct bearing on researching non-creativity features, as virtually none of the characteristic features of BMDTs identified in Szopinski et al. (2020) have been designed with theory in mind, let alone empirically evaluated in a randomized controlled experiment.

It has been recognized that both BMMLs and BMDTs represent a promising opportunity for researchers to test and (further) develop theories for design and action (Gregor, 2006). To do so, the rich body of knowledge available in IS research should be leveraged and, more importantly, their (effective) use by practitioners.

Empirical implications

Empirical research in the context of business model innovation is scarce and in its infancy. In the research paper on the creativity feature of a BMDT I focus on business model ideas (Szopinski, 2021). While there is already research on paper-based business model idea generation that allows to draw empirical implications (e.g., Eppler, Hoffmann, & Bresciani, 2011), my research paper allows only limited empirical conclusions to be drawn. This refers primarily to idea quantity, which could not be significantly increased by the creativity feature. In order to be able to make statements about idea creativity in the future and thus enable an empirically informed design of BMDTs, future research should address the challenges of reliably measuring the business model idea creativity (i.e., the more robust application of the consensual mapping technique to determine the quality of business model ideas).

Artefactual implications

To research and empirically evaluate a creativity feature, I designed and implemented a BMDT (Szopinski, 2021). In contrast to commercial BMDTs, this artefact is intended for research purposes, especially its use in randomized controlled experiments. Therefore, the BMDT allows experimenters to switch individual functions on or off for individual users. It also allows participants to take part in experiments anonymously without installing the software. Moreover, the BMDT randomly assigns users to one of the previously defined trial groups. The BMDT may be of assistance when creating empirical accounts for further features in BMDTs and theorizing about them.

To teach business model innovation, I presented a teaching approach for large classroom settings (Szopinski 2020). This approach appears to be one of the first attempts to thoroughly document business model innovation courses and thereby provide lecturers and researchers with an example of how business model innovation can be taught at universities to a large number of students. In this way, the scalable teaching approach applies and makes visible experiential learning, peer feedback, and digital tools in this context. This in turn has also implications for research in management education and training, as researchers can draw on this example to create empirical accounts for the efficiency of this teaching approach and theorize about it.

6.2 Implications for practice

The findings of this dissertation also have practical implications for people who initiate, carry out or support business model innovation in various roles, as well as for software vendors and educational institutions.

For executives, entrepreneurs, intrapreneurs, investors, consultants, and authorities

By synthesizing and organizing the literature on BMMLs, my dissertation informs people working on business model innovation from different angles about the similarities and differences of BMMLs (Szopinski et al., 2022). First and foremost, this reveals to practitioners that there is much more choice in BMMLs than is commonly assumed. This is primarily due to the widespread use of a few individual BMMLs (especially the *Business Model Canvas*) that dominate the notion of what a BMML is. An important implication for practitioners is also that the choice of a BMML is always a choice about what is meant by a business model. In general, our findings underscore the need for purposefully selecting, adapting, and using BMMLs. For this, we provide semantic, syntactic, and pragmatic properties of such BMMLs, which practitioners should use as criteria to distinguish between BMMLs and, on this basis, agree on a common language, for the representation of business models in projects or even entire organizations. Carefully selecting, adapting, and using BMMLs becomes even more important when business models are no longer used only within an organization, but also beyond, as a unit of analysis, for example, in the context of audits, tax and legal reports, or deal advisory services. Practitioners working on business model innovation inside and outside of corporate boundaries apply BMMLs not just in its paper-based form, but increasingly in software-based formats. My dissertation thus informs practitioners in selecting, adapting, and using BMDTs by providing properties of such BMDTs that practitioners should use as criteria to distinguish BMDTs (Szopinski et al., 2020). This synthesis and organization of knowledge about BMDTs has significant implications for practitioners seeking to understand how BMDTs implement BMMLs and what characteristic features different BMDTs may or may not have in common. This applies both to features of BMDTs that are dependent of the BMML and to those that are independent of it.

For software developers and vendors

The findings of this dissertation also inform software developers and vendors of BMDTs. In the first place, the systematic analysis of currently available BMDTs helps practitioners to get an overview of what BMDTs are available and what features they offer (Szopinski et al., 2020). As a result, practitioners are provided with a sound foundation to making more theory-informed (re-)design decisions. Such decisions concern the choice of a BMML to represent business models in BMDTs (Szopinski et al., 2022) and, based on that, the (re-)design of features. For instance, although creativity features have not yet been implemented in BMDTs, they offer various opportunities for designing new features (e.g., Szopinski, 2019b, 2020). Furthermore, software developers and vendors can take advantage of the taxonomy of characteristic features of BMDTs when making investment decisions. The findings may also guide the investment decisions of future software vendor customers considering the purchase of BMDTs for their organizations, and may also facilitate the instruction of organizational members in the use of BMDTs (Szopinski, 2019a). Moreover, some BMDT features could inspire the implementation of similar features in software tools for adjacent innovation contexts, and vice versa, such as, for example, software tools for new product development (e.g., *Productboard*, see https://productboard.com) or for new business ideas (e.g., *IdeaBuddy*, see https://ideabuddy.com).

For educators

This dissertation transfers selected parts of the findings on BMMLs (Szopinski et al., 2022) and BMDTs (Szopinski et al., 2020) into a teaching approach (Szopinski, 2019a) and thereby helps lecturers at universities, and coaches in other organizations, to train students and organizational members in business model innovation. This also involves the identification of adaptations of BMMLs for teaching purposes (Szopinski et al., 2022). Prior to the proposed approach innovation (Szopinski, 2019a), such specialized teaching approaches were mostly undocumented. Lecturers and coaches can now take advantage of this teaching approach by sharing information about it and comparing it to others. Furthermore, this may also include the implementation and/or modification of the approach. Besides, the use of peer feedback and digital tools may inform teaching approaches in management education and training on phenomena other than business model innovation.

6.3 Limitations

This dissertation is beset with limitations that at the same time offer potential avenues for future research, including how to conduct future research on business model innovation. While all five individual research papers in this dissertation present their underlying limitations and avenues for future research, Szopinski et al. (2022) and Szopinski et al. (2020) offer dedicated research agendas. To develop a more comprehensive picture, the following paragraph outlines where this dissertation is subject to certain limitations.

First, although great strides have been made in recent years, the debate about what constitutes a business model has not yet been definitively settled, and probably never will be. While there is a consensus that business model innovation challenges the assumptions of traditional theories, business model research is just on the cusp of transitioning from an ostensive understanding (i.e., meaning and function of business models) towards a performative understanding (i.e., the relationship between business models and their non-/financial consequences). Thus, the major limitation of this dissertation is that research has not yet reached a stage where a causal relationship can be drawn between a specific business model and the economic success of the implementing organization. Put differently, whether innovating a business model with the help of a BMML or BMDT will lead to better economic success than without remains an open question.

Second, business model innovation is a multi-faceted phenomenon and the limited consideration of factors that potentially influence business model innovations along their lifecycle is therefore another major shortcoming of this dissertation. This includes, for example, factors at the individual level (e.g., personality traits, gender, professional background and experience), at group level (e.g., collective problem solving, conflict resolution), organizational (e.g., size, industry, history), and even societal level (e.g., social and cultural norms). When nothing or very little is known about a phenomenon like business model innovation, it is essential to first consider what it has been so far—taking into account an increasing number of factors—before stating what it is (now), how, why, when, where, and what it will be (Gregor, 2006). Strictly speaking, the two overarching research papers (Szopinski et al., 2020, 2022) remain theories for analysis and say '*what is a BMML'* and '*what is a BMDT*', respectively, but do not say how, why, when, and where BMMLs and BMDTs should be selected, adapted, and used.

Third, one limitation concerning the methodological contribution of this dissertation is that the precise mechanism for configuring the proposed extended taxonomy design process and recommendations remains to be elucidated. Such a configuration reflects both the purpose and target group of the taxonomy as well as the specific characteristics of the phenomenon under consideration. Likewise, it remains unknown whether the configuration of such methodological guidance differs for novel or for established phenomena and novice or experienced taxonomy designers.

6.4 Future research

The tremendous interest in business model innovation among researchers, practitioners, and educators alike has thrown up many questions in need of further investigation. Beyond the research agendas in Szopinski et al. (2020) and Szopinski et al. (2022) the findings of this dissertation provide the following four avenues for future research.

First, the review on BMMLs developed in this dissertation provides ample starting points for future research. Experimental investigations on the semantics, syntax, and pragmatics of BMMLs form an essential next step in examining whether there are any relationships between certain tasks (e.g., business model analysis) and certain BMMLs that lead to superior task performance. Such future research would be of great help to inform the selection, adaptation, and use of BMMLs. Considerably more research will need to be done if it turns out that there is not just one universal BMML, but that different BMMLs are useful for different users and tasks. Further research could also be conducted to enable the interoperability of BMMLs and the transformation of business models from one BMML to another, including their integration into modeling environments with a larger scope, such as enterprise architectures.

Second, the review on BMDTs developed in this dissertation also presents numerous directions for future research. Further theory-driven building and experimental evaluation, involving a broad range of characteristic features of BMDTs, could shed more light on the affordances these features provide. Such research could also generate more definitive evidence for the effective use of BMDTs. Moreover, research could also be conducted to determine differences in the adaptation and continuous use of BMDTs, for individual users, groups of users and entire organizations. In addition to the rigorous building and evaluation of existing features, promising research also lies in designing entirely new features. Such features could include the (partly) automatic recognition of business model patterns, crowd worker involvement, or monitoring of customer needs across the business model life cycle.

Third, the topic of teaching business model innovation is an intriguing one that could be usefully explored in further research. Precisely because business model innovation introduces students to a practical challenge that is highly relevant to many organizations, business model innovation teaching itself could become the subject of future research. This research could explore manifold design decisions of business model innovation courses such as cooperation between researchers and practitioners, degree of individual and group work, as well as intra- and inter-university collaboration. Moreover, studies regarding the meaningful combination of classroom, blended, and online learning in business model innovation teaching would be worthwhile. It might also be possible to study the impact of business model teaching on students' attitudes toward entrepreneurship.

Fourth, shifting the research focus from the conceptualization of business models to their application opens abundant room for further maturation of the business model concept itself. At the theoretical level, this progress could be brought about by developing robust and valid constructs, and, at the empirical level by developing measurable variables. This in turn could enable the evolution of BMMLs and BMDTs. BMMLs could then be used to calculate non-/financial consequences of different configurations of business models or to set up scenarios of different business model alternatives that are complementary, competitive, indifferent, or antinomian to each other. Accordingly, BMDTs could then be used not only as digital whiteboards but also as software tools to process calculations and scenarios for individual business models and business model portfolios. Some first approaches for calculations using modeling languages (e.g., Kundisch & John 2012) and software tools (e.g., the *Strategyzer* app) already exist.

Given the enormous interest in taxonomies, future research on methodological guidance for taxonomy design offers three promising avenues worth pursuing. First, a natural progression of this research is to implement software that supports the building, evaluation, and/or use of taxonomies. Software tools are already being discussed for supporting design science research projects in general (e.g., Herwix & Rosenkranz, 2019; Morana et al., 2018). Similarly, software tools for taxonomy research projects could assist researchers in designing and reporting taxonomies efficiently. Features of such software tools could, for example, facilitate the application of taxonomy design methods (e.g., Nickerson et al., 2013; Kundisch et al., 2022) and the (partial) automation of individual steps within these methods such as the creation of taxonomy visualizations. In addition, artificial intelligence could be used to automatically design taxonomies utilizing machine learning classification algorithms. Second, taxonomy visualizations themselves would be a fruitful area for further research, as several questions remain to be answered (Szopinski, Schoormann, & Kundisch, 2020), including: For which purposes should taxonomies be visualized and how (e.g., morphological boxes, hierarchies, and mathematical sets)? Which taxonomy visualization is suitable for what type of taxonomy task (e.g., describing, identifying, classifying, analyzing, and clustering objects)? Which taxonomy visualization is suitable for what type of users (e.g., visual, auditory, reading/writing, and kinesthetic users)? Third, more broadly, research is also needed to examine the accumulation and evolution of knowledge captured in taxonomies. While the accumulation and evolution of knowledge are generally relevant to the IS discipline (e.g., Schuster, Wagner, & Schryen, 2018; vom Brocke, Winter, Hevner, & Mädche, 2020), this is especially true for taxonomies. This is because taxonomies capture knowledge about a phenomenon from research and practice alike, but only at a specific point in time. From then on, the accumulation and evolution of knowledge occur at different speeds in research (usually somewhat slower) and in practice (usually somewhat faster). A greater focus on observing, aligning, and updating taxonomies over time could produce interesting findings to account for the better accumulation and evolution of knowledge about phenomena. This becomes even more relevant when there are several taxonomies for the same phenomenon, each with a different perspective.

This dissertation was completed at the time of the coronavirus pandemic, which gave unexpected weight to the urgency and relevance of business model innovation. At the beginning of the pandemic in early 2020, Steve Blank put this urgency and relevance in the following words: “This is a conscious shutdown of our economy, trading jobs for saving hundreds of thousands of lives. It’s almost inconceivable that you can have the same business model today as you did 30 days ago.” (Blank, 2020). As the corona pandemic (still) continues, business model innovation remains a high priority to executives, specifically for innovating new contactless business models (IBM Institute for Business Value, 2021). In times when risk and uncertainty for successful entrepreneurial action are probably even higher than before the pandemic, practitioners and researchers perceive business models as a valuable unit of analysis. This is evidence by, for example, executives considering business model innovation to be “by far the most important strategic lever” (McKinsey, 2021, p. 1). Also, researchers began to study business models early on during this pandemic (e.g., Breier et al., 2021; Piller, 2020; Ritter & Pedersen, 2020). In this way, the coronavirus pandemic can provide practitioners, researchers, and educators both with impetus and inspiration for innovation, research, and the teaching of business models.

I hope this dissertation contributes to the body of knowledge on business model innovation in the IS discipline and beyond. Furthermore, I hope that the insights on modeling languages and software tools for business model innovation will be beneficial to practitioners, researchers, and educators, not only among themselves but, above all, with each other—with the overarching goal of leveraging the technological progress to develop compelling business models that enable customers solve their problems and satisfy their needs, and organizations to remain competitive.

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