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# Visual Languages for Modeling Business Models: A Critical Review and Future Research Directions

*Completed Research Paper*

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## Abstract

*A multiplicity of visual languages have been proposed for representing business models. These languages are claimed to facilitate tasks such as understanding, communicating, and innovating a business model; and have been developed rather independently by scholars from accounting, computer science, information systems, and strategy. Consequently, the existing approaches greatly differ and to some extent contradict each other, for example, regarding their understanding of the business model concept, their terminology, and their visual notations – which means there is little common ground for developing a cumulative stream of research. Therefore, we provide a systematic, cross-disciplinary review of this emerging field and synthesize the pragmatic, semantic, and syntactic foundations of the proposed approaches. Further, we derive an agenda for future research and discuss the challenges that lie ahead to advance the field.*

**Keywords:** Business model, modeling language, visual language, representation, review

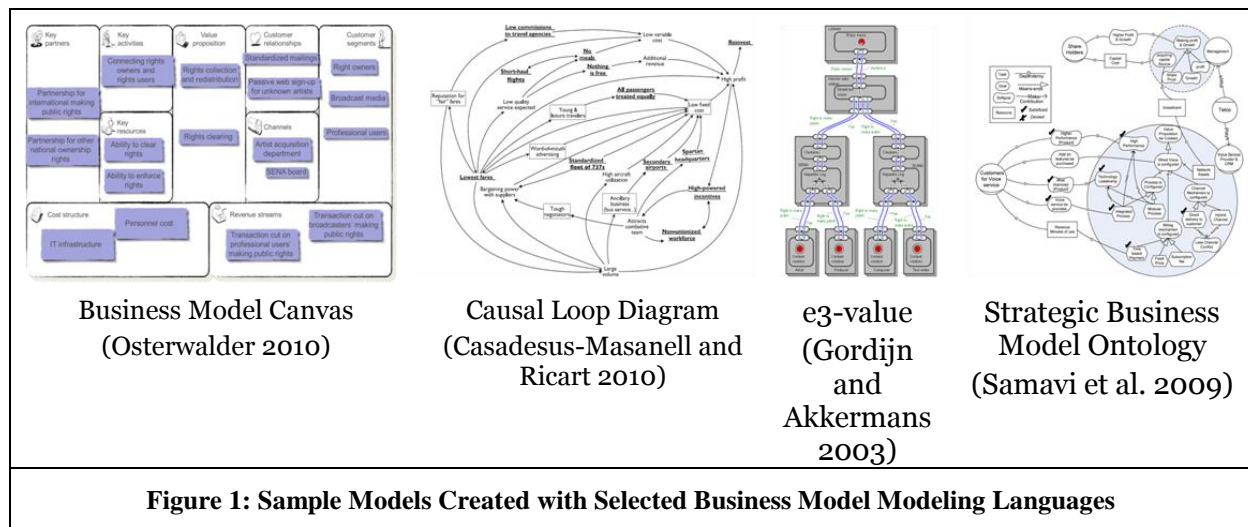
## Introduction

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

Innovating a business model is a collaborative task (Ebel et al. 2016; Eppler et al. 2011) that often requires people from various disciplines to work together (e.g., sales, marketing, research & development). The

corresponding activities include generating business model ideas and refining, analyzing, and evaluating them. Additional activities include communicating business model ideas to budget managers or investors (to acquire funding), and to technical staff (to prepare the implementation of the required IS). Given the numerous parties typically involved in business model innovation, their often interdisciplinary background, and the fuzziness inherent in the subject matter (Al-Debei and Avison 2010), it is essential to have means for making business model ideas concrete and tangible: That is, means that facilitate capturing, manipulating, and communicating the key characteristics of business model ideas (e.g., Gordijn and Akkermans 2003).

*Business model modeling languages*<sup>1</sup> (BMMLs) are one important way for making business model ideas more concrete and tangible (see Figure 1 for examples). These languages allow to visualize the core logic and elements of a business model, and are claimed to facilitate tasks such as understanding and communicating a business model (Osterwalder et al. 2005), generating business model ideas (Chesbrough 2010), and deducing requirements for the underlying IS (Gordijn and Akkermans 2003). These languages have been identified as one major theme in past IS business model research (Zott et al. 2011) and are seen as a promising future field for the IS discipline (Osterwalder and Pigneur 2013; Veit et al. 2014). Moreover, one specific language, the *Business Model Canvas*, has had tremendous impact on research and practice: The corresponding book (Osterwalder and Pigneur 2010), for example, has sold more than one million copies (Strategyzer 2015) and within only a few years has received more than 5,000 citations (according to Google Scholar).



Despite these varied indicators of the significance of BMMLs, the current state of knowledge concerning these languages is rather tentative and fragmented. In line with the interdisciplinary character of the business model concept (Chesbrough and Rosenbloom 2002), research on BMMLs has emerged in a variety of disciplines, including accounting (Sonnenberg et al. 2011), computer science (CS, e.g., Eriksson and Penker 2000), IS (e.g., Samavi et al. 2009), and strategy (e.g., Casadesus-Masanell and Ricart 2010b). Research within and across these disciplines has, however, remained rather disparate than cumulative, and the lack of cross-disciplinary integration inhibits leveraging the disciplines' comparative strengths. CS and IS researchers have, for example, made considerable achievements in thoroughly developing and evaluating modeling languages, but these achievements have only to a limited extent found their way into strategy research (Osterwalder and Pigneur 2013). Strategy researchers, in turn, have highlighted social aspects of using visual artifacts in the strategy process (Eppler and Platts 2009), but social aspects have largely been neglected in CS/IS works on modeling languages (Poels et al. 2006).

<sup>1</sup> Please note that the approaches that we subsume under the term *business model modeling language* have in prior research also been referred to by other terms, such as *business model representations* (e.g., Zott et al. 2011) and *maps of business models* (e.g., Chesbrough 2010). We will justify our choice of terminology in the background section of this article.

So, to summarize, research on BMMLs seems to have great potential, which is evident in existing calls for research and in the fascinating success of one specific BMML, the Business Model Canvas. At the same time, the knowledge we currently have is at an infancy stage, being fragmented, tentative, and partly contradictory, which means there is little common ground for advancing BMMLs in a cumulative fashion. In reply to this issue, we perform a review of research on modeling languages for business models, which – in the spirit of a *critical review* – seeks “to reveal weaknesses, contradictions, controversies, [and] inconsistencies” (Paré et al. 2015, p. 189) in the field. In so doing, we make three contributions: First, we identify the BMMLs that have been proposed rather independently from one another across a variety of disciplines. Second, by drawing on existing modeling language research, we develop a framework that provides a unified terminology for describing and comparing BMMLs. Third, we derive a research agenda that identifies key research priorities for advancing the field of BMMLs.

For practitioners, our comprehensive identification and characterization of existing languages can aid in identifying languages that best possibly fulfill the requirements of a specific business model innovation context. For researchers, with our work we hope to lay the foundation for an independent research discipline on modeling languages for business models. We envision such a discipline to be devoted to the cumulative and cross-disciplinary study of visual means for representing business models, and in the long term to be on equal footing with other subdisciplines of modeling language research, such as modeling languages for process or data modeling.

## Background

As our aim is to provide a review on modeling languages for business models, in the following, we briefly review research on business models and then introduce the concepts from modeling language research that are relevant in our context. We thereafter bring together the insights from business models and modeling languages to further motivate and refine the notion of modeling languages for business models.

## Business Models

The business model concept became prominent with the advent of the Internet era in the mid-1990s, when increasing uncertainty and dynamics surrounding digital businesses called for a new concept to address the widening gap between strategy and business processes (Al-Debei and Avison 2010). In the meantime, the concept has gained prominence in a variety of domains such as entrepreneurship (George and Bock 2011), IS (Al-Debei and Avison 2010), innovation management (Schneider and Spieth 2013), and strategic management (Zott et al. 2011) – and is widely appreciated in research as well as practice: In research, despite having been criticized for its vagueness and lack of theoretical foundation (Porter 2001), the business model concept is now seen as a valuable complement and extension of the traditional notion of a firm’s strategy. The reason is that the business model concept acknowledges the importance of creating value for customers, whereas strategy research had traditionally emphasized (only) the firm perspective as a source for explaining competitive advantage (Massa et al. 2017; Priem et al. 2013). In practice, business models are important because firm performance does not only depend on the characteristics of the products/services that a firm offers, but also on the business model(s) employed for commercializing these products/services. Put differently, “a mediocre technology [product, service] pursued within a great business model may be more valuable than a great technology [product, service] exploited via a mediocre business model” (Chesbrough 2010, p. 355). Accordingly, a recent global survey of some 3,000 executives finds that a majority of 60% consider “defin[ing] an effective business model” to be a major part of their innovation activities (GE 2014, p. 40). Also IBM’s global CEO studies (IBM 2006, 2008, 2010, 2012) consistently underline the importance of business model innovation, with each study drawing on interviews with several hundreds to nearly 2,000 CEOs.

Given the business model’s paramount importance for firm success, the number of academic and journalistic articles on business models has “virtually exploded” (Zott et al. 2011, p. 1021), and this has triggered the publication of a number of literature reviews. These reviews can broadly be categorized into the following three types: The first type reviews the business model literature across scientific disciplines, but with a focus on specific thematic perspectives, such as business model definitions (Al-Debei and Avison 2010), business model innovation (Schneider and Spieth 2013), or empirical business model research (Lambert and Davidson 2012). A second type reviews business model research with a broad perspective on the business model concept, but with a focus on a specific discipline, for example, business

model research in marketing (Coombes and Nicholson 2013) or in entrepreneurship and management (George and Bock 2011). A third type reviews business model research from a general perspective, that is, across scientific disciplines and with a broad perspective on the business model concept (e.g., Foss and Saebi 2017; Massa et al. 2017; Osterwalder et al. 2005; Pateli and Giaglis 2004; Zott et al. 2011). To the best of our knowledge, however, no review exists so far that synthesizes research on modeling languages for business models<sup>2</sup>.

## Modeling Languages

Modeling languages employ predefined constructs and mostly a visual notation to represent real-world phenomena in a certain domain (Wand and Weber 2002). Such languages are used to represent static phenomena (e.g., things and their properties) as well as dynamic phenomena (e.g., events and processes) (Wand and Weber 2002) – and popular applications of modeling languages include process modeling (e.g., Recker et al. 2011), conceptual modeling (e.g., Bera et al. 2014), and data modeling (Parsons and Wand 2008). The origin of modeling languages lies in requirements analysis in the 1970s, as at that time the understanding emerged that faulty requirements analyses are a major reason for the failure of IT projects – and that a formal approach for eliciting and articulating user requirements could help to improve the quality of requirements analyses. After a period of lower research intensity, research interest in modeling languages was renewed at the end of the 1990s, among others, because of the increased significance of process reengineering and enterprise resource planning systems (Wand and Weber 2002).

There are three main perspectives that modeling languages can be studied from, namely the *semantics*, the *syntax*, and the *pragmatics* of a modeling language (Burton-Jones et al. 2009). The semantics of a modeling language refer to the content that a language seeks to represent (i.e., the ‘vocabulary’ of a language, or *what* does a language represent?). The (visual or concrete) syntax of a modeling language refers to the form of the visual representation (i.e., *how* does a language represent content?). The pragmatics of a language refer to the context that a language is used in (Burton-Jones et al. 2009). To facilitate understanding these three perspectives, before continuing with modeling languages, we illustrate the perspectives using the example of Google Maps (admittedly, a somewhat distant example – but one that nonetheless helps developing an intuition for the terms semantics, syntax, and pragmatics).

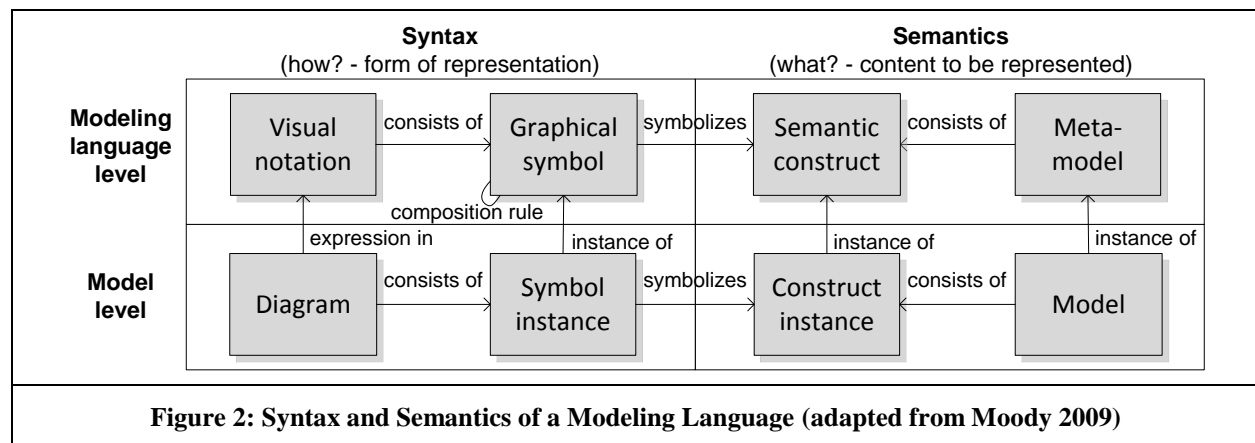
Analyzing Google Maps from a semantic perspective would imply to identify the content (i.e., information) that the maps from Google seek to represent. That content includes, for example, information on the locations of local streets as well as the locations of highways, rivers, and parks. Which content to include is a deliberate decision of Google (as is the decision to not include into its maps information on, for instance, local wind speeds and local temperatures). Analyzing Google Maps from a syntactic perspective would imply to identify which visual elements the maps use to represent the mentioned content. For example, local streets are represented through white lines, highways are represented through orange lines, rivers through blue lines, and parks through green areas. Which visual elements to use, again, is a deliberate decision of Google (e.g., Google could also decide to represent local streets through black lines instead of white ones). Analyzing Google Maps from a pragmatic perspective would imply to identify the context factors that characterize the intended or actual use context. Such context factors could, for example, include the users’ characteristics (e.g., the users’ level of knowledge concerning the represented geographic area) and the presentation medium (e.g., paper or a tablet).

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<sup>2</sup> After the submission of our paper, Täuscher and Abdelkafi (2017) published a review that is distinct yet related to our work. In their paper, the authors analyze visual approaches for representing business models, and do so mainly from a cognitive perspective. Our work complements and extends their review in at least three ways: First, we introduce well-established concepts and terminology from modeling language research into the business model domain, and thereby help to standardize and hence facilitate future discussions on visual approaches for business model innovation. Second, to advance the understanding of the state of the art, we provide an in-depth analysis of the approaches that have been published in journals and books (in contrast, Täuscher and Abdelkafi (2017) provide a higher level overview that includes contributions from scientific conferences and practitioner websites). Third, to support the future development of the field, from our analysis of the state of the art we derive a comprehensive research agenda that identifies gaps and future research directions (in contrast, Täuscher and Abdelkafi (2017) focus on providing a comprehensive high level presentation of the state of the art).

In the context of modeling languages, the terms semantics, syntax, and pragmatics, can be refined as follows (see also Figure 2):

- The semantics of a modeling language define the content or “vocabulary” of a modeling language. The *semantics* are defined by a *metamodel* that consists of the *semantic constructs* that a modeling language aims to represent (Moody 2009). To illustrate, the metamodel of a process modeling language could, for example, include the semantic constructs *start of a process*, *end of a process*, *task*, and *follows after* (to describe for instance a process that is defined through a sequence of tasks that need to be executed one after another).
- The (visual or concrete) syntax of a modeling language refers to the form of the visual representation. The syntax is defined by a *visual notation* that consists of *graphical symbols* that each represent a specific semantic construct (Moody 2009). The visual notation of a process modeling language could, for example, include a *black circle* as the graphical symbol for symbolizing the semantic construct *start of a process*, a *grey circle* as the graphical symbol for symbolizing the semantic construct *end of a process*, a *rectangle* for symbolizing *tasks*, and *black arrows* that connect tasks to symbolize that one task *follows after* another.
- The pragmatics of a language refer to the context that a language is used in (Burton-Jones et al. 2009). That context includes, for example, the characteristics of the modeler (e.g., modeling is different for modeling novices and modeling experts) and characteristics of the task that a modeling language is used for (e.g., modeling with ‘pen & paper’ is different from modeling with a software tool; the task of representing the current state of a domain is different from the task of exploring possible alternative states of a domain) (Wand and Weber 2002).



### Business Model Modeling Languages

Besides modeling languages, there are a number of other means for representing business model ideas, including text, graphics, and combinations thereof, each with varying degrees of formality. The following approaches have, for example, been identified in a review of prior case study research on business models (John and Kundisch 2012):

- *Informal text*: Textual descriptions that are structured in a somewhat ad hoc fashion and tailored to a specific case (e.g., Kshetri 2007).
- *Structured text and ontologies*: Textual descriptions that are structured along predefined business model components such as ‘revenue model’, ‘cost structure’, and ‘key resources’ (e.g., Sosna et al. 2010).
- *Morphological representations*: Generic or domain-specific frameworks that provide a number of variables and corresponding values for describing a business model (e.g., Kley et al. 2011).
- *Ad hoc graphical representations*: Ad hoc visualizations of the logic behind a business model; these may employ explicitly defined notation elements, but are tailored to a specific case rather than being intended for being repeatedly applied in a variety of contexts (e.g., Kinder 2002).
- *Dedicated graphical representations (i.e., business model modeling languages)*: Approaches with defined semantics and a dedicated visual notation, whose explicit aim is to provide a means for describing business models in a variety of contexts (e.g., Gordijn and Akkermans 2003).

As noted, in our review we focus on the last type, and in the following provide a more precise definition of the corresponding approaches. Recall that a modeling language is characterized by two properties: First, a modeling language provides predefined semantic constructs that define what content a language allows to represent. Second, a modeling language provides a visual notation for graphically representing the semantic constructs. Accordingly, we define a business model modeling language as an approach that (1) provides predefined semantic constructs and (2) a visual notation for representing these semantic constructs (3) for the purpose of representing business models. For ease of exposition, we use the terms business model modeling language, modeling language for business models and BMML interchangeably.

Note that, from a semantic perspective, our definition of BMMLs is deliberately inclusive, as we require these languages to come with only predefined semantic constructs, not with metamodels. The reason is that metamodels, at least in IS and CS (i.e., computer science) research, come with the flavor of rather formal models. Therefore, requiring BMMLs to have a (formal) metamodel would imply that we exclude all approaches from our definition that define their semantics merely through a textual description rather than a (formal) metamodel, which in turn would exclude all approaches that have been proposed in strategy and management research (as in those disciplines it is rather atypical that the semantics of a visual approach are defined in a formal way). However, excluding approaches from strategy and management research would be rather unfortunate, as this would exclude contributions from precisely those disciplines that should best know what practitioners applying a BMML need (even though researchers from strategy and management research might not possess the level of methodological sophistication in modeling language development that IS and CS researchers have achieved). Hence, acknowledging that it should not be upon IS and CS researchers alone to decide the future of BMMLs, we opted for the proposed inclusive definition.

Concerning the term that we adopt for approaches that comply with the above definition, note that these approaches have also been referred to by other terms such as *business model representations* (which arguably is the most popular term, e.g., Casadesus-Masanell and Zhu 2010; Zott et al. 2011) and *maps of business models* (Chesbrough 2010). With a somewhat broader meaning (e.g., not necessarily requiring a visual notation), these approaches have also been referred to as *formal conceptual representations/descriptions* (Massa et al. 2017) and *conceptual models/design methods & tools* (Pateli and Giaglis 2004). Nonetheless, we propose using the term business model modeling language (or BMML) for two reasons. First, the currently most popular alternative, the term *business model representation*, could be misleading because modeling languages are not the only means for representing a business model (as noted, alternatives include plain text and morphologies). Second, in contrast to the alternatives, the term business model modeling language provides terminological consistency with the terms for other types of modeling languages (e.g., process modeling languages, data modeling languages). A counter-argument could be that Osterwalder (2004) has already introduced the term *business model modeling language* to denote a markup language for formally representing business models. In subsequent work, however, Osterwalder has not referred to the term, and it seems that the corresponding language has not been widely adopted (a full text search for the term in Google Scholar yields less than 10 results). Hence, there seems to be no risk for hampering cumulative research by adopting the term *business model modeling language* as proposed above.

## Method

The goal of a literature review is to provide a firm foundation for advancing knowledge by highlighting the areas in which research exists and uncovering areas where research is needed (Webster and Watson 2002). To fulfill this goal, Webster and Watson (2002), echoed by other authors, emphasize the importance of (1) a transparent literature search, (2) a structured presentation of the results, and (3) convincingly derived future research avenues. The literature search needs to ensure that the relevant literature on a topic is covered and the search needs to be sufficiently transparent to be replicable by other researchers. For the presentation of the results, a concept-centric approach (in contrast to an author-centric approach) is essential to guide the analysis, structure the subject matter, and thereby facilitate the identification of research foci and gaps. Thereafter, transforming research gaps into research avenues is the most important, but also the most challenging part of a literature review (Webster and Watson 2002). Research avenues may not directly follow from research gaps, but rather may require more advanced speculative abilities and intuition (Rowe 2012). Nonetheless, providing guidance for future research is of

paramount importance because of the potentially wide-ranging implications for the further advancement of a field (Webster and Watson 2002). Accordingly, we structure our review around the following three questions, as proposed by Schryen (2013) and Rowe (2014): ‘What do we know?’ (i.e., research findings), ‘What do we need to know?’ (i.e., research gaps), and ‘How do we get there?’ (i.e., research agenda).

To identify relevant articles, we employed a four-staged search strategy that comprised (1) a keyword search, (2) the analysis of existing reviews of the business model literature, (3) a forward and (4) a backward search (see Table 1). We detail these stages in the following: (1) *Keyword search*. We conducted a full text search in Google Scholar and EBSCO with the keywords ‘business model modeling language’, ‘business model representation’ and ‘map of business models’ (including singular/plural forms and American as well as British spelling of the word ‘modeling language’)<sup>3</sup>. Thereby, we identified articles using the term we propose (i.e., business model modeling language) as well as the most popular alternative terms from prior research (e.g., as used by Zott et al. 2011 and Chesbrough 2010). We considered journal articles and books published until the end of 2016. The keyword search initially yielded 768 publications. By filtering for publications that were neither books nor journals, non-English publications, and duplicates, we obtained a set of 214 publications. For these publications, we determined the relevance for our review by reading the title and abstract. If the title and abstract were not sufficient for assessing the relevance, we read the entire publication to determine whether the approach proposed in a publication complied with the definition of BMMLs introduced in the previous section. Altogether, through the keyword search we identified seven BMMLs. (2) *Review analysis*. Two of the reviews identified in our background section have dedicated sections on BMMLs (Pateli and Giaglis 2004; Zott et al. 2011). Analyzing these sections yielded five additional BMMLs. (3) *Forward search*. We conducted a forward search on Google Scholar using the ‘cited by’ field for all articles identified in the first two stages. This yielded 11,448 articles. Since this amount of citations is difficult to handle, following prior advice for reviewing large corpora of literature (Jahangirian et al. 2010), we employed a filtering technique. More specifically, to increase the likelihood of obtaining reputable publications, we filtered the 11,448 articles for publications contained in the EBSCO database (which yielded 219 articles). By applying the aforementioned criteria, we identified one additional BMML. (4) *Backward search*. For all publications with BMMLs identified in the previous stages, we read the entire text and marked potentially relevant references. By applying the aforementioned criteria, we identified one more BMML.

**Table 1. Overview of the Search Strategy**

Table 1. Overview of the Search Strategy						
Stage	Source	Total number of results	Number of results after removing publications that are...			Identified BMMLs
			Neither books nor journal publications			
				Non-English		
					Duplicates	
(1) Keyword search	Google Scholar	705	218	190	183	7
	EBSCO	63	32	31	31	0
(2) Review analysis	Zott et al. (2011) and Pateli and Giaglis (2004)					5
(3) Forward search	EBSCO	219	192	171	147	1
(4) Backward search						1

<sup>3</sup> Complete search string: ("business model modeling language" OR "business model modeling languages" OR "business model modelling language" OR "business model modelling languages") OR ("business model representation" OR "business model representations" OR "business models representation" OR "business models representations") OR ("represent a business model" OR "represent business models") OR ("business model mapping" OR "business model mappings" OR "map of business model" OR "map of business models" OR "maps of business model" OR "maps of business models")



## Research Findings: What Do We Know?

Altogether, we identified 14 different modeling languages for business models, which have been developed by scholars in accounting, CS, IS, and strategy research. In the following, we characterize these languages from the main perspectives for analyzing modeling languages, namely pragmatics and syntax (Table 2) as well as semantics (Table 3).

Table 2. Identified Business Model Modeling Languages and Pragmatic/Syntactic Characteristics																
			Business Model Canvas (Osterwalder and Pigneur 2010)	Business Models for eGovernment (Peinel et al. 2010)	Causal Loop Diagram (Casadesus-Masanell and Ricart 2010a)	Causal Map (Cossette 2002; Tsai et al. 2011)	Diagrammatic Business Model Representation (Boritz et al. 2014)	e3-value (Gordijn and Akkermans 2003)	eBusiness Model Schematics (Weill and Vitale 2001)	Eriksson-Penker Business Extensions (Eriksson and Penker 2000)	Resource-Event-Agent (Sonnenberg et al. 2011)	Strategic Business Model Ontology (Samavi et al. 2009)	Value Delivery Modeling Language (OMG 2015; Roelens and Poels 2015)	Value Map (Allee 2000; Tapscott et al. 2000)	Value Net (Parolini 1999)	Value Stream Map (Pynnönen et al. 2008)
Pragmatics	Origin	Accounting					X				X					
		Computer science						X		X						
		Information systems	X	X		X			X			X	X			X
		Strategy			X									X	X	
	Scope	Domain-specific		X					X							
		General purpose	X		X	X	X	X		X		X	X	X	X	X
	Software tool available?		X	X	X		X	X		X	X	X	X			
Syntax	Visualization approach	Connection (network)		X	X	X		X	X	X	X	X	X	X	X	X
		Geometric (map)	X													
		Hybrid					X									
	Number of views	One	X	X	X	X	X	X	X					X	X	X
		Several								X	X	X	X			
	If several views: Their relationship	Non-overlapping														
		Overlapping								X	X	X	X			

### Pragmatics

Recall that the pragmatics of a language refer to the context that a language is used in (Burton-Jones et al. 2009), and that this context mainly refers to the characteristics of the modeler and the characteristics of the modeling task (Wand and Weber 2002). Concerning the characteristics of the modeler, the identified articles either implicitly or explicitly state that they intend the languages to be applicable by expert users as well as novice users, without making additional qualifications. Concerning the tasks, however, there is more variation. For example, while most of the languages are intended to be applicable across domains (see Table 2), there are also two exceptions that focus on specific domains, namely eGovernment business models (Peinel et al. 2010) and electronic business models (Weill and Vitale 2001). For some languages, software tools are available and this, not surprisingly, is mainly the case for languages that originate from CS and IS<sup>4</sup>. Moreover, the intended purposes for using the languages vary substantially, depending on the

<sup>4</sup> An analysis of the functionalities of these tools is beyond the scope of this article (for an analysis of software tools that support the currently most-widely used BMML, the Business Model Canvas, see Szopinski et al. (2017)).

discipline that a language has been proposed in: While accounting researchers see BMMLs as a means to facilitate risk assessment, CS and (to a lesser degree) IS researchers value BMMLs for their potential to support requirements engineering. Strategy and IS researchers, in contrast, see BMMLs as a means for developing more innovative business models. At a more fine-grained level, BMMLs are proposed to support the following tasks:

- *Understand a business model and communicate about it* (Eriksson and Penker 2000; Gordijn and Akkermans 2003; Osterwalder et al. 2005): A visual representation is seen to facilitate comprehension and to be less ambiguous than (informal) natural language, which reduces the risk for misunderstandings.
- *Analyze and evaluate a business model* (Gordijn and Akkermans 2003): Informally stated value propositions – due to their lack of structure – are inherently difficult to analyze (e.g., regarding their potential profitability), and BMMLs are seen to provide the foundation for a more structured analysis.
- *Deduce requirements for the underlying information systems* (Eriksson and Penker 2000; Gordijn and Akkermans 2003): It is easier to deduce requirements from a codified representation than from natural language descriptions, hence using a BMML promises to result in IS that are better aligned with the corresponding business model. In the case of a business model being used as the starting point for several IS, using a BMML can reduce the risk that different development teams interpret reality differently – and potentially develop incompatible systems (Eriksson and Penker 2000).
- *Generate business model ideas* (Chesbrough 2010; Eriksson and Penker 2000; John and Kundisch 2015): Creating explicit representations of a business model can facilitate experimenting with and generating new business model ideas, which is the first step in business model innovation.
- *Support business model design through software tools* (Osterwalder et al. 2005; Samavi et al. 2009): Some authors envision practitioners to benefit from software-based tools for business model design, for example, for comparing or simulating business models. These tools need rigorous representations to be able to capture knowledge on business model ideas.

## Semantics

Recall that the semantics of a modeling language refer to the content or ‘vocabulary’ of a modeling language (Moody 2009), which in our context means to analyze to what extent the identified BMMLs have the same or at least a similar understanding of what a business model is. There are two possible approaches for analyzing the semantics of the identified languages: First, to identify one of the identified BMMLs as a reference language and then to map the semantic constructs of all other languages to the semantic constructs of this reference language. Second, to use the semantics of a business model definition from outside the set of identified articles and then map the semantic constructs of all identified BMMLs to that business model definition. We decided to apply the second approach of using an outside business model definition, because we expected that this would allow for a more neutral mapping of the identified languages. Since ex-ante we had expected considerable variation in the semantic constructs of our languages, we chose our business model definition based on the following three criteria: it needed to be (1) well-accepted at least in IS, (2) comprehensive in its scope, and at the same time (3) fine-grained in its semantic constructs. As a result, we chose the business model definition by Al-Debei and Avison (2010, based on Al-Debei and Fitzgerald 2010), which fulfills these three criteria. For performing the semantic analysis, the first and second author independently mapped each semantic construct of each BMML to the semantic constructs defined by Al-Debei and Avison (2010); inconsistencies were resolved through subsequent discussion. In the following, we first outline the semantic constructs of Al-Debei and Avison (2010) and then sketch the main results of the semantic analysis.

Al-Debei and Avison (2010) define a business model to consist of the following four dimensions (see Table 3, left-most column): (1) value-network, (2) value-finance, (3) value-proposition, and (4) value-architecture. *Value-network* comprises the *actors* of a business model and their *roles* (an actor can assume more than one role within a value network). *Relationships* denote the level of intimacy between actors (e.g., no relationship at all, a simple sourcing relationship, or a strategic partnership). Furthermore, the value network comprises the objects that are exchanged (*flow-communication*), the *channels* used for these exchanges (physical or electronic), the *governance* (i.e., which actor has which kinds of power within the network) and *network-mode* (open or closed), which describes whether every actor or whether only selected actors can introduce new ideas into the network. *Value-finance* contains the *revenue*

Table 3. Semantic Constructs of the Identified Business Model Modeling Languages

Semantic constructs of a business model (Al-Debei and Avison 2010; Al-Debei and Fitzgerald 2010)		Business Model Canvas (Osterwalder 2004; Osterwalder et al.2010)	Business Models for eGovernment (Peinel et al. 2010)	Causal Loop Diagram (Casadesus-Masanell and Ricart 2010a)	Causal Map (Cossette 2002; Tsai et al. 2011)	Diagrammatic Business Model Representation (Boritz et al. 2014)	e3-value (Gordijn and Akkermans 2003)	eBusiness Model Schematics (Weill and Vitale 2001)	Eriksson-Penker Business Extensions (Eriksson and Penker 2000)	Resource-Event-Agent (Sonnenberg et al. 2011)	Strategic Business Model Ontology (Samavi et al. 2009)	Value Delivery Modeling Language (OMG 2015; Roelens and Poels 2015)	Value Map (Allee 2000; Tapscott et al. 2000)	Value Net (Parolini 1999)	Value Stream Map (Pynnönen et al. 2008)		
Value-proposition	Intended-value-element	Value proposition		Choice, flexible/rigid consequence	Concepts, links		Value object					ValueProposition, Component					
	Product-service									BusinessItem							
	Target-segment	Customer segments						Customer		Outside agent	Agent	Participant, Organizational Unit, Community	Member	Actor	Actor		
Value-network	Actor	Customer segments, key partners	Partner				Actor, market segment	Customer, firm of interest, supplier, ally		Inside agent, outside agent							
	Role		Role								Role	Role, Party					
	Flow-communication		Object exchange				Value object	Money, product, information				BusinessItem, DeliverableFlow	Good, service, revenue, knowledge, intangible benefits	Financial, good, information, influence	Service, free service, product, free product, information		
	Relationship	Customer relationship				Intra- or inter-category linkages			Value exchange/ port/ interface	Electronic relationship, primary relationship		Economic resource flow					BusinessNetwork, PortContainer, InputPort, OutputPort, ValueAdd
	Channel	Channels															
	Governance																
	Network-mode																
	Value-architecture	Core-competency												CapabilityOffer			
Core-resource		Key resources				Internal processes & resources			Resource				Store			Resource	
Value-configuration		Key activities	Service					Activity		Core process	Business process	Task	Capability Method, High-levelActivity		Mgmt. of external transactions, support, realization		
Value-finance	Total-cost-of-ownership	Cost structure															
	Pricing-method	Revenue streams															
	Revenue-structure																
Additional			Advantage, disadvantage, Policy					Environment/ external factors, relevant strategic goals, impact on accounts, Intra- or inter-category linkages			Domain-specific concepts, quantitative goal, qualitative goal		Goal, soft goal				

*structure*, which describes how revenues are divided among actors, the *total-cost-of-ownership* and the *pricing method*. *Value proposition* comprises the products or services offered (*product-service*), the targeted customers (*target-segment*), and the benefits which the product-service is intended to provide to the customers (*intended-value-element*). *Value architecture* consists of *core-resources*, which are combined through the *value-configuration* (i.e., key processes) to enable *core-competences*.

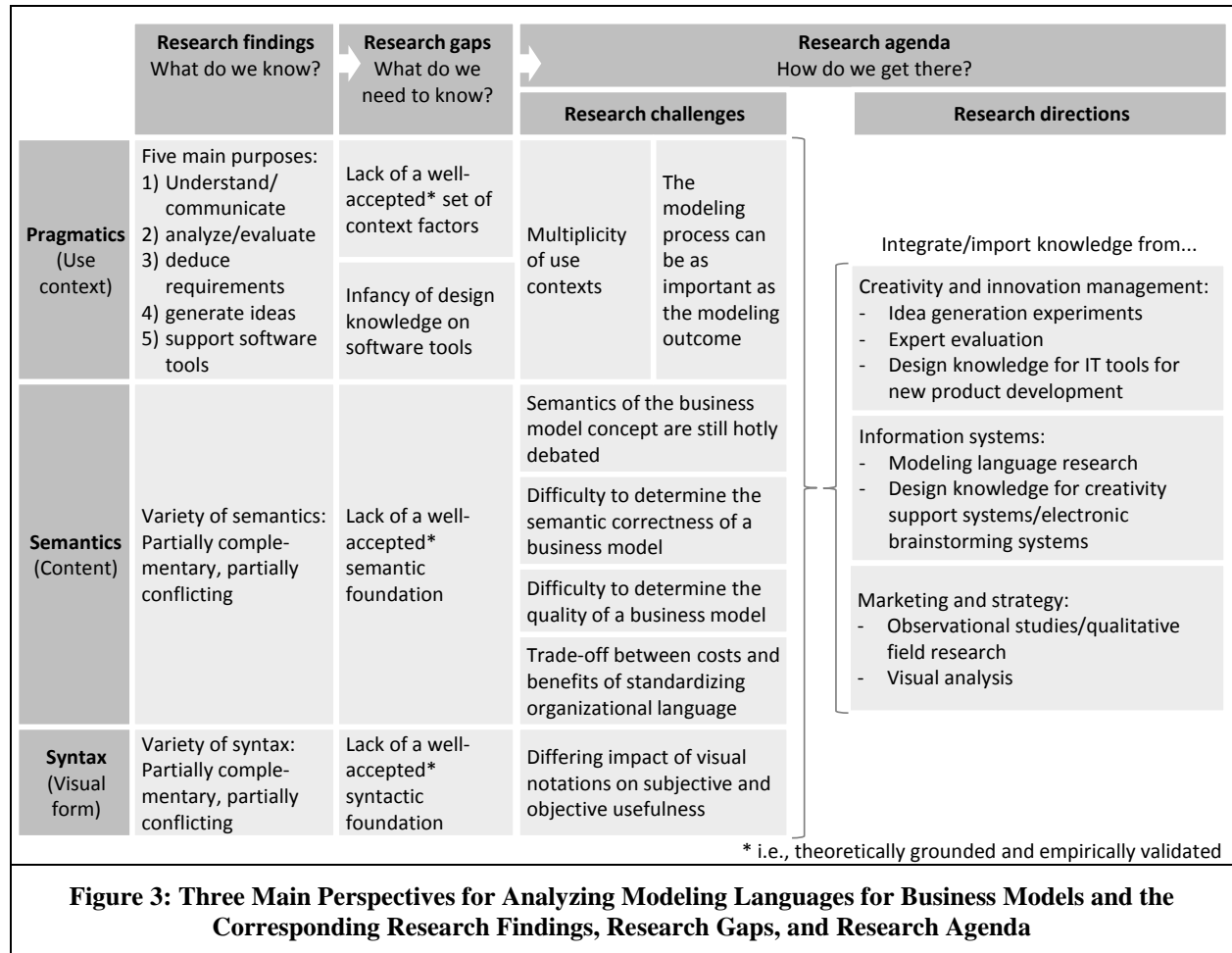
In Table 3, we provide an overview of the semantic constructs that are available in the various BMMLs. Despite some overlap, the overall picture is quite heterogeneous, and the following five observations emerge: First, the BMMLs differ greatly regarding what parts of a business model they represent. For example, while the *Business Model Canvas* and the *Value Delivery Modeling Language* cover the majority of the semantic constructs defined by Al-Debei and Avison (2010), the *Eriksson-Penker business extensions* address only two. Second, the terminology of the semantic constructs is not consistent, as in many cases different terms are used for the same constructs (e.g., actor/agent/member/participant all denote constructs with the same semantics). Third, certain areas of agreement emerge. For example, all but two approaches employ the *actor* construct. Fourth, the semantic constructs differ in terms of their level of abstraction; with some languages using aggregate constructs and others more detailed constructs (e.g., an aggregate construct *actor* vs. more detailed constructs that distinguish between actors that are *suppliers* and *allies*). Fifth, a number of approaches define semantic constructs that fall outside the semantic structure of a business model as defined by Al-Debei and Avison (2010). For example, the Strategic Business Model Ontology, the Diagrammatic Business Model Representation, and the Eriksson-Penker Business Extensions each provide constructs for representing strategic goals.

## Syntax

The (visual or concrete) syntax of a modeling language refers to the visual notation employed for representing the semantic constructs of a language (Moody 2009). Visual notations can mainly be distinguished according to their *number of views*, the *relationship between their views* (Botturi et al. 2006, by the authors referred to as *stratification* and *perspective*) and their *visualization approach* (Costagliola et al. 2002, by the authors referred to as *modality*). The number of views refers to whether a visual notation employs only one view to represent all its semantic constructs or whether it employs several views. In addition, for a multiple-view notation, *relationship of views* denotes whether each semantic construct is represented in a single view (*non-overlapping* views) or if multiple views at the same construct are available (*overlapping* views). *Visualization approach* refers to the two basic ways in which graphical symbols can be used within a given view, either by freely positioning symbols on a plane and connecting them (*connection-based*, e.g., a network of firms and their relationships, for an example see Figure 1, e3-value) or pre-defining positions on a plane for each semantic construct (*geometric-based*, e.g., having a visual template with predefined, spatially fixed boxes for outlining business model elements such as key partners, key activities, and key resources, for an example see Figure 1, Business Model Canvas) (Costagliola et al. 2002). The vast majority of approaches have only one view (see Table 2); the thematic focus of the employed views, however, greatly differs. Examples include views for the structure of the value network (Gordijn and Akkermans 2003), for the causal relationships between business model elements (Casadesus-Masanell and Ricart 2010), and for the relationship between strategic goals (Samavi et al. 2009). Only four languages have multiple views, and each of them also offers multiple views at least for some constructs. For example, Samavi et al. (2009) propose an *operational* and a *strategic* view. In the operational view, actors are represented with their tasks, relationships and (operational) goals. In the strategic view, these (operational) goals are related to strategic goals. Finally, concerning the visualization approach, the vast majority of languages use a connection-based visual notation, which means they allow describing a business model through networks that consist of actors, goals, causes, or the like. Only one language, namely the Business Model Canvas, provides a pure geometric based (in the form of a visual template, see Figure 1). In addition, one language (Boritz et al. 2014) uses a hybrid approach that combines a connection- and a geometric-based notation: This language provides a visual template that provides boxes for textually describing semantic constructs such as the resources, processes etc. that are relevant for a given business model (which makes the visual notation geometric-based). In addition, arrows allow specifying relationships between the resources, processes etc., which makes the visual notation connection-based.

## Research Gaps: What Do We Need to Know?

So far we have described the current state of knowledge concerning BMMLs, and it has become evident that a considerable amount of work has been done to advance the field: A number of languages have been proposed that exhibit considerable diversity in terms of how they understand a business model (i.e., their semantics), how they represent their business model understanding (i.e., their syntax), and what contexts they are intended for (i.e., their pragmatics). Notwithstanding what has been achieved, as we will argue in the following, quite some more work still lies ahead for developing BMMLs into a mature field. To help achieve such maturation, drawing on research on modeling languages and related disciplines, in the following we describe the research gaps that emerged in our review. Thereafter, we outline the challenges we expect in filling these gaps, and sketch directions that might help in overcoming these challenges. Figure 3 provides an overview of our overall argument.



### Pragmatics

*Lack of a well-accepted set of context factors:* From the pragmatic perspective, it is foremost needed to know which real-life contexts BMMLs are used in – to better know what factors to consider when evaluating BMMLs. The outlined purposes such as a facilitated communication or analysis of a business model provide some indication of the relevant contexts. However, at a more detailed level, effectiveness and efficiency of a language can depend on a variety of other context factors such as the modeling medium (e.g., whether modeling is performed with a software or a whiteboard, Moody 2009), a user's level of modeling knowledge, and a user's level of domain knowledge (Figl 2017). Therefore, to allow for comparable and transparent evaluation studies, an exhaustive set of context factors needs to be identified (akin to the contribution made to process modeling research by Figl 2017).

*Infancy of design knowledge on software tools:* Prior research has emphasized the importance of software tools for facilitating the application of modeling languages (e.g., Recker 2012; Burton-Jones and Parsons in Rai 2017). Also business model researchers have acknowledged that such tools have great potential to support their users in innovating business models (Ebel et al. 2016; Osterwalder and Pigneur 2013; Veit et al. 2014). Consequently, a number of such tools have already been developed, which have functions that, among others, allow representing, sharing, annotating, and versioning business models. Nonetheless, there is a lack of design knowledge (Gregor and Jones 2007) concerning the functions that such tools should possess for supporting the use of BMMLs (Szopinski et al. 2017).

## Semantics

The semantic analysis has shown that, despite some overlap, considerably diverging opinions prevail concerning the semantic constructs that should constitute the foundation of BMMLs. In contrast, what is needed is a well-accepted semantic foundation, or possibly several well-accepted, context-specific semantic foundations (as there might not be one ‘best’ semantic foundation that is equally suited for all contexts<sup>5</sup>). There are at least two reasons why research on the semantic foundations of BMMLs is needed:

(1) *The semantic constructs available in a BMML are crucial for the quality of the resulting business models.* Management research has found that the possibilities that visual tools offer for capturing information influence how managers distribute their attention and how they make sense of their expertise: “Managers may *over-construct* their contributions to make them fit a particular visualization schema, i.e. they try to make sense of their past experience in an inaccurate way” (Eppler and Platts 2009, p. 64). Hence, different BMMLs with different semantic constructs make their users devote attention to different parts of a business model, which is likely to lead to business model ideas of different qualities (as using/focusing one set of semantic constructs may lead to better business model ideas than using another set of semantic constructs). Therefore, it is important to determine which semantic constructs form a suitable foundation for BMMLs – so as to inform practitioners concerning what BMML to use to maximize their chances of arriving at innovative business model ideas.

(2) *An agreed-upon set of semantic constructs would facilitate the integration of BMMLs with adjacent modeling disciplines.* In IS research, the view prevails that business models are an interceding layer between the top-most layer of a firm, the business strategy layer, and the lower layer of the business processes (Al-Debei and Avison 2010). Hence, to mature the field of BMMLs, it is necessary to advance its integration with modeling languages at the strategy and the process layers. This integration, however, is complicated as long as the semantic foundation of BMMLs has not been clarified more thoroughly.

## Syntax

It is often put forward that *a picture is worth a thousand words*, and hence a graphical representation by its very nature is superior to a textual representation (Petre 1995). If that were the case, one could argue that further research on visual notations of BMMLs would be of little value. However, prior IS research has found that visual representations are not always superior to textual representations. Rather, it is the “fit” between the characteristics of a task and the characteristics of a visual representation that determines whether a visual representation is indeed superior to other forms of representation (Vessey 1991). Also strategy research has questioned the unambiguous superiority of visualizations. For example, it has been claimed that visualizations can lead to superficial analysis and ambiguous communication (Eppler and Platts 2009), and that visualizations can bias decisions through accentuating specific sets of options (Lurie and Mason 2007). Likewise, modeling language research states that “apparently minor changes in visual appearance can have dramatic impacts on understanding and problem solving performance” (Moody 2009, p. 758). All this suggests that the visual notation of a BMML is highly important for a

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<sup>5</sup> To illustrate, for reasoning about one focal firm’s business model, it might be reasonable to have a language that comprehensively captures information on that firm’s business model only (e.g., akin to the Business Model Canvas, see Figure 1). In contrast, for reasoning about the network of actors that a firm is embedded in, it might be reasonable to have a language that emphasizes the network of actors, but somewhat abstracts from each individual firm’s business model (e.g., akin to e3-value, see Figure 1).

BMML's effectiveness and efficiency, but that a high level of effectiveness and efficiency is not at all to be taken for granted. This notwithstanding, currently available BMMLs define their visual notations without providing theoretical arguments for their choice of the visual notation (for a notable exception, see Roelens and Poels 2015). Some languages have been developed through action research studies, which allowed improving the visual notations through feedback from users (e.g., Gordijn and Akkermans 2003; Osterwalder and Pigneur 2010). Nonetheless, research is needed that makes the corresponding knowledge explicit and that more thoroughly grounds visual notations in theory, so as to further increase the effectiveness of existing BMMLs and facilitate developing new BMMLs.

## Research Agenda: How Do We Get There?

### Research Challenges

Having outlined the existing research gaps, in the following we describe what challenges we expect in filling these gaps and thereafter make suggestions for overcoming these challenges. The challenges we identify mainly address the design of empirical studies for testing propositions concerning the design of BMMLs (concerning semantics or syntax – and given a certain set of context factors, i.e., pragmatics). For formulating the challenges, we adopted the view that controlled experiments are the best approach for evaluating propositions concerning the design of BMMLs. Making this assumption is in line with prior methodological contributions in the social sciences in general (Bhattacharjee 2012, p. 83) as well as more specifically in research on modeling language evaluation (Siau and Rossi 2007, p. 258) – which see controlled experiments as the 'gold standard' for empirical studies. Assuming the primacy of experiments is also in line with the current practice in modeling language research, which typically uses controlled experiments (e.g., Bera et al. 2014; Recker et al. 2011).

### Pragmatics

*Multiplicity of use contexts.* For all types of modeling languages there is a considerable diversity in terms of use contexts. This notwithstanding, we argue that the diversity of use contexts is more substantial for BMMLs because the range of tasks and users is greater for BMMLs than for other modeling languages: While other modeling languages are mainly used for analysis and communication tasks, BMMLs on top of these tasks are also used for highly creative tasks. Moreover, the range of use contexts is more varied because BMMLs, in contrast to other types of modeling languages, are also frequently used by very inexperienced, casual users. Private investors on equity crowdfunding platforms are one such example (e.g., the leading German equity crowdfunding platform Seedmatch requires startup firms to represent their planned business model through the Business Model Canvas, so as to inform potential investors about the startup's planned business model, [www.seedmatch.com](http://www.seedmatch.com)). Another example are the typically non-expert contributors of open innovation initiatives (e.g., Waldner and Poetz 2015 in an idea generation context asked contributors to submit their ideas through the Business Model Canvas).

*The modeling process can be as important as the modeling outcome.* A weakness of CS/IS research on modeling languages is that social factors are largely "assume[d] away" (Poels et al. 2006, p. 545). In contrast, management research acknowledges that strategy development by its very nature is a social process. This means that the shared understanding that people (in the course of strategy development) develop about their strategy and each other's' viewpoints can be as valuable as the resulting strategy itself (note that strategy development and business model development are interrelated and to some extent overlap, Zott et al. 2011). Therefore, it has been suggested to emphasize "visualizing over visualization" (Eppler and Platts 2009, p. 70), because "the actual act of *visualizing* – the collaboration involved in rendering strategy content into graphic form, rather than the mere aesthetic of the final outcome – is the vital sense-making activity" (Eppler and Platts 2009, p. 67). Experimental approaches in modeling language research, however, often focus on the modeling outcome, which complicates applying experimental approaches from other modeling disciplines to modeling languages for business models.

### Semantics

*The semantics of the business model concept are still hotly debated in research and practice.* At an abstract level, there is agreement on that a business model describes how a firm creates, captures, and

delivers value (e.g., Massa et al. 2017; Teece 2010). At a more detailed level, however, there has been a long-lasting and still not resolved debate about the defining constituents of a business model. A recent review of business model research, for example, starts with the following observation: “Over the last 5 years [at each of the large management conferences] in rooms filled to capacity with some of the most recognized scholars in the field, participants [have] debate[d] endlessly on what a business model actually ‘is’” (Massa et al. 2017, p. 73). This problem is not likely to be resolved in the short-term and hence will also in the future impede advancing the semantic foundation of BMMLs.

*It can be difficult to determine the semantic correctness of a business model created with a BMML.* Compared to other types of modeling languages, the semantic constructs of BMMLs are rather fuzzy. For example, in a process modeling language the semantics of constructs such as *start of a process*, *end of a process*, or *task* can be rather precisely defined. Hence, for a concrete process it is easy to decide whether the semantic constructs have been used correctly. For example, a process that contains a task *kitchen* is not semantically correct because a kitchen obviously cannot be a task (while *clean the kitchen* could). However, for BMMLs, determining the semantic correctness of a concrete business model can be more complicated. For example, whether a certain resource (e.g., a patent, factory, or brand image) qualifies as a *key resource* of a business model can be subject to considerable debate, which is complicated by the fact that the answer for the most part is also firm-specific. This fuzziness, at least to some degree, is inevitable and necessary to allow the users of a BMML to be creative when generating business model ideas (Fritscher and Pigneur 2010). However, this fuzziness makes it difficult to determine whether a certain business model is semantically correct (i.e., whether the semantic constructs of a BMML have been used correctly). This complicates transferring evaluation approaches from other modeling disciplines, which oftentimes rely on correctness measures (i.e., the errors made in representing a certain real-life situation through a modeling language) (Gemino and Wand 2004).

*It can be difficult to determine the quality of a business model created with a BMML.* In most modeling domains, the goal of modeling is to create models that faithfully represent the status quo of a subject matter (e.g., a process or an IS) or an agreed-upon future state of that subject matter (Wand and Weber 2002). This implies that oftentimes it is possible to determine the quality of the resulting models by checking whether the information captured in a model complies with reality (or the requirements agreed upon concerning a future state of reality). Accordingly, modeling language research oftentimes uses experiments in which participants create a model from an existing textual description, and researchers thereafter check whether the model complies with the content of that description. When using a BMML, however, especially when innovating a business model, the goal is to deliberately diverge from reality (i.e., diverge from all existing business models). Hence, for evaluating the usefulness of a BMML for supporting business model innovation, there is the challenge to determine the quality of business models that ideally no one has ever thought of before.

*There is a trade-off between the costs and benefits of standardizing organizational language with BMMLs.* Modeling languages provide a standardized means for representing information, and in CS/IS contexts, this standardization is oftentimes desirable because it facilitates communication and understanding. Also in the business model context, a standardized language can facilitate communication (Strategyzer 2015). At the same time, however, such standardization can stifle creativity, and thus lower an organization’s capability to generate innovative business model ideas. Recent management research, for instance, has proposed that a *unique organizational language* can be a source of competitive advantage, as “the limits of my language mean the limits of my world” (Wittgenstein 1921, quoted after Brandenburger and Vinokurova 2012, p. 1), which implies that a unique organizational language can allow a company to see other business opportunities than its competitors (Brandenburger and Vinokurova 2012). This organization-level statement is also supported by a plethora of cognitive-level research in creativity and innovation. Such research, for example, states that framing a problem in similar ways over extended periods of time compromises one’s ability to see that problem from different perspectives, and compromises one’s ability to access knowledge that would allow solving the problem in a non-standard, creative way (e.g., Dane 2010). Obviously, the notion of a unique organizational language is at odds with the standardized language prescribed by BMMLs. So the question arises which effect of a standardized language is stronger: the communication-enhancing effect or the creativity-stifling effect? Answering this question is rather difficult because especially the stifling effect of BMMLs is likely to become manifest only over longer time periods. At the same time, this challenge may be the most important to address, because if using BMMLs did indeed stifle firms’ long-term creativity, the impact would be tremendous.



## Syntax

*Visual notations may differently impact the subjective and the objective usefulness of a BMML.* In the context of visual programming it has been reported that individuals sometimes perceive visual languages to be superior to textual ones even when experimental evaluations do indicate no advantage (Petre 1995). Corresponding results are attributed to the *likability* of visualizations, and “sheer likeability should not be underestimated; it can be a compelling motivator” (Petre 1995, p. 41). Similarly, in a survey among 1,500 users of one specific BMML, the Business Model Canvas, more than half of the respondents (803) affirmed that “[it] is a visual tool” was one reason for adopting that BMML. As a result, it is possible that the subjective and the objective usefulness of a BMML are not always in line with one another, which might complicate the interpretation of experimental results.

## Research Directions

While the outlined challenges are substantial, in the following, we try to make some suggestions for addressing these challenges. The main suggestion we make is that researchers should see the field of BMMLs as truly interdisciplinary: While other types of modeling languages might be clearly in the domain of CS and IS researchers because these modeling languages are intended for users with a somewhat technical background, BMMLs, as noted, are intended for an interdisciplinary audience. This suggests that the challenges outlined above cannot be overcome with the expertise of CS and IS researchers alone. Rather, future research should draw upon the rich body of knowledge that has been compiled also in other disciplines. We would suggest that BMML researchers can especially benefit from the theoretical and methodological expertise of the following disciplines:

*Creativity and innovation management:* Researchers from these discipline are devoted to understanding how the creativity of individual, groups, organizations, and even societies can be fostered (Amabile and Hennessey 2010). As such, these disciplines are familiar especially with the challenge of determining the value of innovation ideas and with developing as well as evaluating methods/tools for promoting idea generation. Especially the following two methodological contributions hold value for BMML research: idea generation experiments and expert-based idea evaluation. In idea generation experiments, participants are given an idea generation task that participants in the treatment group solve with a specific idea generation method or tool, and participants in the control group without that method/tool (e.g., Dahl and Moreau 2002; Goldenberg et al. 1999). Thereafter, experts evaluate the quality (i.e., creativity/innovativeness) of the generated ideas. For this evaluation, considerable research has established to what extent and under what circumstances expert evaluations are valid measures for idea quality (e.g., Amabile 1996; Baer and McKool 2009; Magnusson et al. 2016). Through this setup of idea generation experiment and subsequent expert evaluation, it is possible to evaluate idea generation techniques/tools and underlying theoretical propositions in a controlled manner. Given the similarities between, on one hand, business model idea generation with a BMML, and on the other, idea generation in creativity and innovation management, we expect that adopting the methods of idea generation experiments and idea quality evaluation through experts holds value for BMML research. Moreover, in research on product innovation management a stream of research has recently begun to emerge that explores how software tools can support product innovation processes (e.g., Kawakami et al. 2015; Mauerhoefer et al. 2017). Given the similarities between product innovation and business model innovation (Bucherer et al. 2012), we would expect that the insights developed in product innovation have the potential to also inform the design of software tools for modeling languages for business models.

*Information systems:* Especially two subdisciplines of IS research hold value for BMML research: modeling language research (as already noted) and research on creativity support/electronic brainstorming systems (for reviews on creativity support systems, see Seidel et al. 2010; vom Brocke et al. 2011; Wang and Nickerson 2017; for a review on electronic brainstorming systems, see DeRosa et al. 2007). The relevant contributions of modeling language research include, for example, concepts and terminology for analyzing modeling languages (see our background section), theoretically grounded guidelines for the design of visual notations (Moody 2009), approaches for the semantic analysis of modeling languages (Wand and Weber 2006), and guidelines for the evaluation of modeling languages (e.g., Burton-Jones et al. 2009; Gemino and Wand 2004; Siau and Rossi 2007). Creativity support systems/electronic brainstorming systems research, in turn, can provide design knowledge for designing software tools (e.g., Müller-Wienbergen et al. 2011) for BMMLs and can facilitate identifying relevant

reference theories (e.g., Wang and Nickerson 2017) for developing design knowledge specifically for software tools for BMMLs.

*Marketing and strategy:* Some researchers within marketing and strategy research investigate how visual tools can support strategic decision making (Lurie and Mason 2007) and strategy development (Eppler and Platts 2009). As such, these disciplines are familiar with some of the challenges outlined above, especially those of the importance of the social context of using a visualization and the fuzziness of the subject matter. In reply to these challenges, marketing and strategy researchers have, among others, relied on workshop-based action research (Eppler and Platts 2009) and observational field studies (Kaplan 2011). Additionally, strategy researchers have proposed to employ *visual analysis*, which involves the analysis of “visual evidence of artifacts as they are used and as they change over time”, to understand the actual rather than the intended use of strategy tools (Jarzabkowski and Kaplan 2015, p. 553). Given the similarities between BMMLs and visual approaches in strategy and marketing, we expect that empirical studies on BMMLs would benefit from drawing on the outlined methodological expertise from strategy and marketing research.

## Conclusion

In a global survey among 3,000 executives, 60% admit that their “difficulty to define an effective business model [...] is a challenge killing the ability to innovate” (GE 2014, p. 40). Likewise, business model researchers have called for more research on “tools and methods” for supporting firms in their business model innovation efforts (Schneider and Spieth 2013, p. 23). Modeling languages for business models are such a tool, and given calls for future research (Osterwalder and Pigneur 2013; Veit et al. 2014) and the fascinating success of at least one of their exemplars, the Business Model Canvas, BMMLs seem to carry great potential for supporting business model innovation. Nonetheless, while considerable research efforts have been made in developing new modeling languages for business models, these efforts have so far largely been made in isolation, leading to a fragmented and tentative state of knowledge. In reply to this issue, and to lay the foundation for more cumulative research, we make three contributions: First, we provide a comprehensive, cross-disciplinary identification of the languages that in various disciplines have been proposed for modeling business models. Second, based on modeling language research, which defines semantics, syntax, and pragmatics as the main perspectives for analyzing modeling languages, we provide an analysis framework that can standardize and hence facilitate future analyses and discussions of BMMLs. Third, following recommendations by Schryen (2013) and Rowe (2014), we provide guidance to future researchers by identifying research gaps, research challenges, and future research directions.

We devoted considerable effort to the comprehensive identification and analysis of research on modeling languages for business models. Nonetheless, there are at least three directions that future research could pursue to create a more comprehensive synthesis. First, in line with prior research (e.g., Webster and Watson 2002), for identifying relevant contributions we relied on a combination of approaches, including keyword search, reference chasing, and the analysis of existing literature reviews. Our identification strategy could, however, be made more comprehensive by including other databases in addition to the ones we used (EBSCO and Google Scholar). Second, for our keyword search we employed the term that we suggest (i.e., *business model modeling language*) and the most popular terms from prior research (i.e., *business model representation* and *map of business models*). Given that prior research has not come up with a unified terminology, a broader set of keywords might lead to the identification of additional BMMLs. Third, for developing our analysis framework, we mainly relied on contributions from modeling language research, because that field has a natural fit to our context (given its object of research, i.e., visual languages for representing information in specific contexts). Nonetheless, additional value may lie in extending our framework with contributions from strategy visualization (Eppler and Platts 2009) and visualization research in psychology (Tversky 2011). The long-term goal of such research efforts, as well as of following our research agenda, should be that a well-accepted set of BMMLs is available, which means that the strengths and weaknesses of the approaches have been theoretically understood and empirically validated. This would allow giving meaningful guidance to practitioners as to what language to use for what purposes in what contexts, and thereby would contribute to making firms more successful in innovating their business models.

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