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# OVERCOMING SILOS: A REVIEW OF BUSINESS MODEL MODELING LANGUAGES FOR BUSINESS ECOSYSTEMS

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# OVERCOMING SILOS: A REVIEW OF BUSINESS MODEL MODELING LANGUAGES FOR BUSINESS ECOSYSTEMS

*Research in Progress*

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## Abstract

*Digital technologies have led to the emergence of new ways of creating value and, by enabling business ecosystems, to a change in the way businesses are organized. However, due to their non-hierarchical and complementary nature, business ecosystems are not easy to create or sustain. To support the systematic design and analysis of business ecosystems, business modeling has emerged as a valuable tool. Our structured review of the literature on business model modeling languages has found 45 potentially relevant publications. Although a preliminary analysis shows that existing modeling languages only provide limited support for business ecosystems, they can provide a useful conceptual basis to enable further research. This research-in-progress paper outlines first steps taken to identify recently developed business model modeling languages and to synthesize and organize the knowledge dispersed across disciplines. Thus, the future results of study are expected to contribute to research on business model collaboration and business ecosystems.*

*Keywords: Business Model Modeling Languages, Systematic Literature Review, Business Ecosystems*

## 1 Introduction

The rise of digital technologies, such as cloud computing, has enabled a notable transformation of organizational processes, boundaries and specifications (Cennamo et al., 2020). Digital transformation affects not only IT but organizations as a whole, redefining strategies and offering new means for collaborating with other companies, which is leading to greater business interdependence. This aligns with findings from recent studies that structural and operational changes are inseparable from the digital transformation of the business model (Matt et al., 2015; Tkalich et al., 2021). In a business environment of increasingly specialized and digitally connected organizations, a single organization typically does not possess all of the resources necessary to create and deliver a complete value proposition to the customer (Appleyard and Chesbrough, 2017; Kapoor and Furr, 2015).

In recent years, the concept of business ecosystems has significantly risen in prominence and, amplified by the COVID-19 pandemic, digital transformation has gained further importance. The concept of ecosystems, first introduced nearly 30 years ago, allows collaborating organizations to create value that no single company could create alone (Moore, 1993). Researchers have suggested that this phenomenon differs from traditional business constellations (Adner, 2017; Jacobides et al., 2018; Iansiti and Levien, 2004), such as platforms (see Jacobides et al., 2020) and inter-organizational networks (see Shipilov and Gawer, 2020), due to differing non-hierarchical mechanisms for joint value creation (Adner, 2017), actor roles (Valkokari, 2015) and multilateral, non-generic complementarities (Jacobides et al., 2018). The ecosystem perspective shifts the focus from the success of a single organization to that of its entire ecosystem and is therefore not just a new buzzword for 'environment'. Moreover, by linking the term "ecosystem" to the business model concept allows to fully release its potential insights, since the logic

of an ecosystem is to create a superior product or service that an individual organization cannot create on its own (Iansiti and Levien, 2004).

Recent studies suggest that the upcoming age of business ecosystems will substantially change today's business world (Lyman et al., 2021; Chung et al., 2020). By 2030, more than 30% of global revenues will potentially be generated in business ecosystems (Lewrick, 2021). Despite this huge potential, practitioners struggle to define the influences of their business models on other participants, and vice versa (Reeves et al., 2019). As Gillian Tett explains in "The Silo Effect," working in highly specialized areas makes collaborating extremely challenging (Tett, 2015). In a recent BCG Henderson Institute case study, managers across multiple companies consistently found "ecosystem strategy to be the most challenging: Only 18% succeeded versus an AI opponent, versus 71% in the classical strategy" (Fuller et al., 2019, p. 9). Despite the majority of executives (84%) recognizing the importance of ecosystems to their strategies (Lyman et al., 2021), of those companies that have established an ecosystem, only 10% have gained sufficiently in growth, i.e., generated more than 5% of company revenues from ecosystem engagements (Chung et al., 2020). Furthermore, less than 15% of the 57 ecosystems analyzed by Reeves et al. (2019) could be sustained over time.

The business model concept has allowed practitioners to depart from traditional business approaches and to utilize different ways instead to create, deliver and capture value (Osterwalder and Pigneur, 2010). Hence, business models have become a well-established means to offering an important contribution as an intermediary between strategy and processes (Veit et al., 2014). The visualization of business models is considered a promising approach for guiding their design and assessment (Täuscher and Abdelkafi, 2017). Previous works in the domains of information systems (IS), management and computer science have proposed and developed various business model modeling languages (BMML) to understand, communicate and analyze business models (John et al., 2017), the most prominent of these is the Business Model Canvas (BMC), which structures a single company's business model using a framework comprising nine components (Osterwalder and Pigneur, 2010). The BMC is well suited for developing the business model of a single company but less so for a business ecosystem (Loss and Crave, 2011). Since distinct BMMLs have emerged from different application domains and thus differ in terms of semantics, syntax and pragmatics, a general investigation and an analytical framework have already been developed (John et al., 2017). Build on the framework of John et al. (2017) we extend it with (1) new research approaches and (2) a more detailed analysis of BMMLs from the perspective of business ecosystems.

Because ecosystems do not create themselves and participants do not automatically connect and simply begin to collaborate effectively, it is necessary to understand exactly who potential ecosystem partners are, what roles they play, and what resources they can contribute. BMMLs have great potential to support these challenges, because, as boundary objects, they provide a common language in which to converse (Spee and Jarzabkowski, 2009). However, no analyses currently exist that examine the value of pre-existing BMMLs in terms of supporting business ecosystems, resulting in the following research question for this research-in-progress paper: *How can existing business model modeling languages be analyzed systematically to support the design of business ecosystems?*

To address this research question, we conducted a systematic literature review (SLR) that identified 45 relevant publications. In this research-in-progress paper, we demonstrate our SLR process and present our analysis of the 14 BMMLs identified by John et al. (2017). The expected contribution of our study is threefold: (1) to identify all relevant and recently developed BMMLs with potential contributions to business ecosystem; (2) to extend the existing BMML classification framework of John et al. (2017) and by integrating the characteristics arising from recent scholarly work on ecosystems; and (3) to discuss how the design and analysis of value creation in business ecosystems can be supported by existing BMMLs. Future research will complete this framework with the identified papers from the SLR as well as compare the merits and limitations of every existing BMML for the design and analysis of business ecosystems.

# 2 Theoretical Background

## 2.1 Business Models and the Role of Information Systems Research

With the rise of the internet and the shift from traditional to electronic business in the 1990s, the term "business model" has received increasing importance and recognition (Wirtz et al., 2016). Since then, much effort has been made to formalize the term (e.g., Al-Debei and Avison 2010), but definitions differ between research strands and studies (Massa et al., 2017). However, most current definitions agree on some central characteristics (e.g., value creation) and refer to aspects of the "design or architecture of the value creation, delivery, and capture mechanisms of a firm" (Teece, 2010, p. 172). IS researchers see their role as focusing on the interplay between strategy, business models and business processes, and on the resulting requirements for IT (Veit et al., 2014). Digital transformation has changed the view of IS from simply producing a suitable IT system to creating an integrated description and analysis of the entire business. Therefore, the business model should be the first step in the modeling process.

## 2.2 Business Model Modeling Languages

Visual representations have evolved to represent the core elements of a business model and are considered a promising approach to guiding the business model innovation process (John et al., 2017; Täuscher and Abdelkafi, 2017). The primary advantage of these artifacts is that they serve as boundary objects (Carlile, 2004) and establish a common language within an organization (Eppler et al., 2011). In addition to the BMC, several other languages have been proposed, such as the e3value ontology (Gordijn and Akkermans, 2003) and the Value Net (Parolini, 1999). The specification of modeling approaches for business models has long been largely neglected in research. Täuscher and Abdelkafi (2017) published a review identifying 45 visual representations from the academic literature, using a very broad definition, as well as including visualized business model definitions (e.g., Gassmann et al., 2014).

John et al. (2017) propose a distinction based on the degree of formality, which allows for a more targeted selection and analytical framework for the required business model representation. A modeling language is defined by formal, user-related and application-related requirements, regardless of the application area or type of modeling language used (Frank, 2013). Burton-Jones et al. (2009) suggested that modeling languages can be analyzed in terms of three main characteristics, i.e., a) content, b) visual notation and form, and c) context of use, also referred to as semantics, syntax, and pragmatics. The semantics of a modeling language refers to what a language attempts to represent (i.e., the "vocabulary" or set of predefined constructs of a language). Syntax refers to how a modeling language represents content, i.e., the type of visual notation it uses (e.g., graphical symbols, such as arrows, dashed lines, or boxes) and the type of visual form it takes (i.e., the architectural form of a representation, such as nodes and arrows). The pragmatics of a language refers to the context of use under which a modeling language is applied (Burton-Jones et al., 2009). From this, the notion of a BMML is defined as *an approach that provides a visual notation to represent semantic constructs for the purpose of representing business models to meet the requirements of modeling languages* (John et al., 2017).

Moreover, some authors have provided specific frameworks and techniques for ecosystem visualization (e.g., Basole, 2009; Faber et al., 2018), which have been used as a visual approach for understanding the relationships and interdependencies between companies in an ecosystem. Business ecosystem modeling obtained also attention in the Internet of Things (IoT) research domain, addressing ecosystem design methods (Uchihira et al., 2016) and presenting a framework to fully understand the complexity of IoT business models. Further, design frameworks (e.g., Tsujimoto et al., 2018; Garmann-Johnsen et al., 2021) or ecosystem mapping (Talmar et al., 2020) were introduced. However, to the best of our knowledge, no specific BMML currently exists suitable for business ecosystems.

## 2.3 Defining Ecosystems and Ecosystem Analysis

The notion of an "ecosystem" was introduced into the business world by Moore's (1993) belief of an "ecological" approach to describe the contexts within which businesses potentially compete and

collaborate. According to Moore's theory, an ecosystem consists of companies that collaborate toward a common goal (Moore, 1993). Since then, a wide range of literature has been produced on the topic of ecosystems, with many attempts to extend and consolidate the literature, creating a comprehensive "theory of ecosystems" (Adner, 2017; Fuller et al, 2019; Jacobides et al, 2018). Adner (2017) defines an ecosystem as "the alignment structure of the multilateral set of partners that need to interact in order for a focal value proposition to materialize" (Adner, 2017, p. 42), i.e., what enables businesses to collaborate and align in an ecosystem is creating a shared value proposition. However, Adner find faults with the ecosystem theory as being insufficiently clear regarding how to set boundaries for the ecosystem, and often conflating claims-related terms and concepts (e.g., networks, platforms). As such, specific attributes of participants and relations have recently received increased attention.

In a major contribution, Jacobides et al. (2018) describe ecosystems as a group of organizations consisting of "varying degrees of multilateral, nongeneric complementarities" (p. 2264) coupled with the absence of full hierarchical control. Complementarities can be either generic (elements are interchangeable across many applications) or non-generic (elements involve some level of specialization to achieve complementarity). Specialization, according to Jacobides et al. (2018), jointly define and set the boundaries of ecosystems. The absence of full hierarchical control means that no single company has the absolute power to determine rules and governance. Moreover, Jacobides et al. (2018) distinguish three broad streams of research: (a) business ecosystems, (b) innovation ecosystems, and (c) platform ecosystems. For our analysis, we focus primarily on (a) business ecosystems and follow Jacobides et al.'s (2018) definition while complementing it with, on the one hand, Adners observation of a shared value proposition and, on the other, Hou and Shi's (2021) observation of coevolution.

This led us to identify a total of four main characteristics of business ecosystems: (1) **Contingency Risks** accrue due to "multilateral complementarities," which arise when the value of the output of one company depends on the output of other companies. Ecosystems are built on the idea that the value proposition can only be achieved in conjunction with all companies. This entails certain risks if one of the companies decides to leave. (2) **Specificity** refers to the "non-generic" nature of complementarities between the components of a product or service, meaning that a company requires a specific, co-specialized investment to make the product or service complementary to the ecosystem, for example, Nespresso's coffee machines and coffee capsules (Jacobides, 2019). (3) **Governance** refers to the absence of hierarchical control; the participants are independent, and the ecosystem governance relies primarily on non-contractual mechanisms. This distinguishes ecosystems from supply chains. Ecosystem participants must be coordinated to specialize in specific roles with varying degrees of stratification, but every participant must have a sufficient incentive to participate. (4) **Dynamics** draws attention to an often overlooked facet of business ecosystems: coevolution. Hou and Shi (2021) call for noting not only how value is co-created in ecosystems but also the dynamics of business ecosystem formation and evolution. These characteristics aim to assess the usefulness of BMMLs in designing and analyzing business ecosystems to create a superior product or service, which an individual company cannot create on its own.

## 3    Method

This section outlines our review method and the primary phases that led to the analysis of the identified BMMLs. An SLR is intended to provide a structured basis for advancing knowledge by identifying, evaluating and synthesizing existing research, as well as revealing research gaps (Webster and Watson 2002); it thus offers the opportunity to build on existing research without repeating it (Snyder, 2019). and serves as the foundation for further research projects. We adapted the methodological guidelines and steps presented for conducting literature reviews in the field of IS (Webster and Watson, 2002; vom Brocke et al., 2015; Schryen et al., 2020) and applied a three-phase methodological review process. Figure 1 illustrates these three phases and their specific steps.
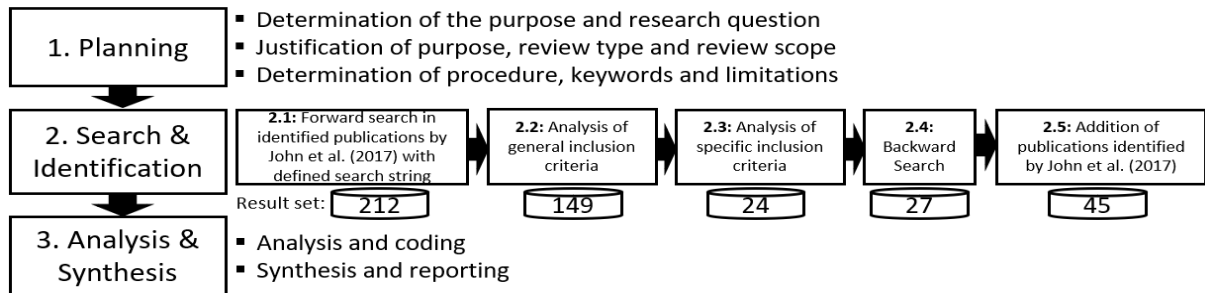
*Figure 1.        Methodological Review Process*

## 3.1      Planning Phase

The first phase determined the design of the review, as well as the clarification of the need, by identifying and reviewing existing SLRs. We have adopted vom Brocke et al.'s (2015) guidelines for planning and organizing the literature search. Executing an SLR is labor intensive, so a crucial question that must be posed in the beginning is why the review should be conducted (i.e., is there really a need for such an SLR?). To answer this question, we scanned well-known databases (e.g., EBSCO) to account for existing literature reviews in IS, thereby identifying five publications (Täuscher and Abdelkafi, 2017; John et al., 2017; Wilson et al., 2018; Wilson and Wnuk, 2018; Kundisch et al., 2012). The justification of the need for a new SLR, despite existing literature reviews, was conducted following Kitchenham and Charters's (2007) checklist (p.7). Täuscher and Abdelkafi (2017) analyze visual approaches for representing business models, primarily from a cognitive perspective. Wilson et al. (2018) examine the impact of business modeling on the effectiveness and efficiency of companies focused on software-intensive products, while Wilson and Wnuk (2018) address the impact of business modeling on business flexibility and variability. John et al. (2017) and Kundisch et al. (2012) build on the concept and terminology of modeling languages and provide an in-depth analysis of the identified BMMLs.

From this analysis, it can be seen that an SLR—as an interface between the research of Wilson et al. (2018), John et al. (2017), and Kundisch et al. (2012)—proves necessary to (1) further complement the scope of BMML and to include the research of the past years, and (2) to expand the existing frameworks with a specific focus on business ecosystems. We utilized the publications identified by John et al. (2017) as a starting point and extended and analyzed these with regard to their usability for business ecosystems. Against the backdrop of an increasing range of available BMMLs, this research employs a descriptive literature review (see Schryen et al., 2020). Furthermore, we defined the review's scope, inclusion (and exclusion) criteria and search string to align with the purpose of our study.

## 3.2      Literature Search and Identification Phase

The second step comprised the identification of a sufficient and comprehensive set of the relevant literature. To identify relevant articles, we built on the SLR by John et al. (2017) and conducted a forward search (step 2.1). The identified publications by John et al. (2017) have summed up more than 31000 citations, which makes this forward search broad but also specific for the purpose, and limited to a manageable outcome. The Google Scholar database was used because it allows a keyword search within a forward search. We considered publications published up until June 2021.The defined search string from Phase 1 comprises a combination of various terms that indicate the presence of a modeling language in combination with various terms referring to business ecosystems (Table 1).

| Model(l)ing, simulation(ing), design(ing), map(ping), visualis(z)ation, visualis(z)ing, representation, represent(ing) | **AND** | ecosystem(s), platform(s), network(s), networked, (inter)dependence(cies), interrelation(s), dependency(cies), (relation)ship(s) |
|---|---|---|

*Table 1.        Keyword Catalog of the Systematic Literature Analysis*

We consider a publication is considered relevant to our topic if it describes a BMML according to the description stated in chapter 2.2 (i.e., it is not only a visual approach). General inclusion criteria (step 2.2) include the need for papers to be complete, written in English and published in journals, conferences, conference proceedings or book chapters. Provided the research meets these criteria, an analysis of the title and abstract regarding the specific inclusion criteria was conducted to determine the paper's relevance to the topic being studied (step 2.3). If this process was insufficient to assess its relevance, the entire publication was read. Accordingly, research papers that focus on business process modeling instead of business modeling, for example, were excluded. After applying the general and specific inclusion and exclusion criteria, 24 publications remained. We then went backwards (step 2.4) by reviewing the citations for the 24 publications identified in step 2.3, and found 3 more publications (Webster and Watson, 2002). Finally (step 2.5), we added the 18 publications (14 different BMMLs) identified by John et al. (2017), obtaining a final set of 45 publications.

## 3.3 Literature Analysis and Synthesis Phase

We analyzed our literature using a concept-centric approach, enabling the creation of an overview of existing BMMLs (Webster and Watson, 2002). The analysis and synthesis procedure were conducted by one researcher and encompassed reading the full text of the sources with an emphasis on the introduction, findings and discussion sections. The final paper set from Phase 2 was analyzed regarding the following: (1) the three main perspectives of modeling languages (semantics, syntax and pragmatics), including an in-depth analysis of semantic constructs; and (2) the four characteristics stated in chapter 2.3, revealing whether the BMMLs support the modeling of ecosystems in terms of contingency risks, specificity, governance and dynamics.

# 4 Preliminary Results

In total, 45 publications were identified through our SLR. Of these, 18 had already been identified by John et al. (2017). Therefore, we identified 27 previously not considered publications after step 2.4 (see Figure 1). 17 of these publications entail a complete new BMML approach (e.g., Pombinho et al., 2015), while 10 present an extension or combination of an already existing BMML (e.g., Saxena and Wegmann, 2013). The majority of these publications are studies from the research domain of Computer Science (11) or IS (9), only four publications are dedicated to the Strategy research domain, while three belong to other diverse domains.

In this research-in-progress paper, we present our in-depth analysis of the 14 BMMLs identified by John et al. (2017) to develop and examine our framework. Further research will include the analysis of the remaining 27 publications. In a first step, we characterized the BMMLs regarding pragmatics and syntax, as well as semantics. While a detailed study of these components according to Al-Debei and Avison (2010) has already been conducted by John et al. (2017), we complement these findings with a focus on semantic properties, through which connections can be expressed. In a second step, we analyzed the BMMLs in terms of the characteristics of business ecosystems.

## 4.1 Pragmatics, Syntax and Semantics

**Pragmatics** for modeling is the study of how languages are used within a community of practice (Burton-Jones et al., 2009). For the intended *context*, a wide variation exists, derived by the various research areas. However, Wilson et al. (2018) identified three primary contexts for business modeling: (1) strategy and planning (i.e., discovering opportunities and generating new ideas); (2) governance and communication (i.e., understanding, evaluating and facilitating collective analysis); and (3) daily operations (i.e., deducing requirements for IT and executing strategies). Notably, all BMMLs from Table 1 address governance and communication, but only a few address strategy and planning.

The **syntax** describes the visual notation employed for representing the semantic constructs of a language (Moody, 2009). Under this viewpoint, a BMML can have differing *numbers of views* to reveal different angles of a business model or consider multiple business models. For example, the BMC

considers only one business model while, in contrast, Samavi et al. (2009) employ an operational view to describe the business model in which relevant actors, their activities, relationships and operational goals are represented. With respect to *visualization*, it is striking that apart from the BMC, the use of a purely map-based syntax remains the exception, whereas connection-based BMMLs dominate.

| | | | Business Model Canvas (Osterwalder 2004; Osterwalder and Pigneur, 2010) | Business Models for eGovernment (Peinel et al., 2010) | Causal Loop Diagram (Casadesus-Masanell and Ricart, 2010) | Causal Map (Cossette, 2002; Tsai et al., 2011) | Diagrammatic BM Representation (Boritz et al., 2014) | e3value (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 Network Analysis Diagram (Allee, 2000; Tapscott et al., 2000) | Value Net (Parolini, 1999) | Value Stream Map (Pynnönen et al., 2008) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pragmatics | Purpose | Strategy & planning | x | | x | | | x | | | | x | | | | |
| | | Governance & communication | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| | | Daily operations | | | | | x | x | x | x | | | x | x | | |
| Syntax | Number of views | One | x | x | x | x | x | x | x | | | | | x | x | x |
| | | Multiple | | | | | | | | x | x | x | x | | | |
| | Visualisation | Connection-based | | x | x | x | x | x | x | x | x | x | x | x | x | x |
| | | Map-based | x | | | | x | | | | | | | | | |
| Semantic | Environment | External components | | x | x | | x | x | | x | | | x | | x | |
| | | Roles | x | x | x | | | x | x | x | | x | x | x | x | x |
| | | Cross-network | | | | | | | | | | | | | | |
| | Structural Connections | Aggregation | x | x | | | | x | x | | | | x | | | x |
| | | Responsibility | | | | | | | | | | | x | | x | |
| | | Accountability | | | | | x | | | | | | | | | |
| | | Support | | | | | | | | | | | x | | x | |
| | | Information | | | | | | x | | | | | | | | |
| | Dependency Connections | Activities | x | x | x | x | | | | | x | | x | | x | |
| | | Goals | | | | | | | | | x | | x | | | |
| | | Resources | x | | | | | | | | | x | x | x | x | |
| | | Impact | | x | x | x | x | | | | | x | x | | x | |
| | Dynamic Connections | Tangible value stream | | x | | | | x | x | | | x | | x | x | x |
| | | Intangible value stream | | x | | | | x | x | | | x | | x | x | x |
| | | Development | | | x | | | | | | | | | | | |
| Ecosystem Analysis | | Contingency Risk | | | | | | | | | | | | | | |
| | | Specificity | | | | | | | | | | | | | | |
| | | Governance | | | | | | | | | | | x | | | |
| | | Dynamic (Software Tool) | x | x | x | | x | x | | | x | x | x | | | |

*Table 2.            Preliminary Overview of Business Model Modeling Languages*

The **semantics** of a modeling language describes the meaning of the symbols, or "vocabulary" (Moody, 2009). Most BMMLs aim to represent a business model located in a network of business models. While some focus only on value exchange with actors regarding external components (Allee, 2000; Samavi et al., 2009; Pynnönen et al., 2008), others not only focus on the exchange between the company under consideration and surrounding companies, but also integrate external components of other business models (e.g., Gordijn and Akkermans, 2003). External components of other business models might include internal processes, activities, business units, goals, resources, value propositions, willingness to collaborate, and internal incentives that do not directly affect the company under consideration.

The architecture of the business model can be described by the *structural connections*, so that it is possible to represent responsibilities or even existence-relevant aggregation through specific groupings. At the level of *dependency-based connections*, specific interactions between the activities and resources of individual components can be represented (influence connections), which, among other things, clarify whether the existence of the component exerts a positive or negative influence. Furthermore, this influence can also result from goals (operating connections). The exchange of values between actors can be represented with *dynamic connections*. Since Allee's (2000) grouping of different types of value flows between actors, this differentiation has been integrated in many BMMLs, thereby representing more than just product and service exchanges.

## 4.2    Ecosystem Analysis

To determine if the BMMLs can be effectively used to analyze business ecosystems, we built upon ecosystem theory and examined whether a given BMML has a semantic construct to illustrate (1) if a dependency is explicit and critical for the value proposition (contingency risk); (2) if a complementarity is generic or specific (specificity); (3) if specific roles with different degrees of stratification exist (governance); and (4) if the BMML is supported by a software tool to account for coevolution (dynamic). Table 1 shows very limited possibilities to analyze business ecosystems from the perspective of ecosystem theory. Only the Value Delivery Modeling Language (Roelens and Poels, 2015) enables hierarchical modeling. However, many languages also incorporate a software tool that could be used for dynamic modeling.

# 5    Discussion, Expected Contribution and Future Research

Researchers' and practitioners' emerging interest in business ecosystems is conspicuous and literature has already discussed the business model as a mediator (Foss and Saebi, 2018; Hacklin et al., 2018; Wirtz, 2020). Building on our review, we plan to conduct further research to show the merits and limitations of available BMMLs compared to recent developments in ecosystem theory. From our preliminary results, it appears that the multitude of BMMLs are network-based and represent interactions between actors in a business network. While most BMMLs in this segment are limited to exchanging value streams, others include intangible exchanges such as knowledge (Allee, 2000), internal impacts (Cossette, 2002) and goals, resources and processes (Samavi et al., 2009).

Moreover, the analyzed BMMLs are either company-centric or network-oriented. However, network-based BMMLs are strongly related to enterprise interaction, although they neglect the customer value proposition and are therefore less suited to analyzing the characteristics of companies collaborating in the same business ecosystem. After the completion of our study, researchers and practitioners will be able to identify an existing BMML that best suits a certain alignment or innovation purpose, conceptually revise or extend it and even use it to implement ecosystem characteristics. Today, business model collaboration depends on the skills of innovation experts who "act as the only boundary-spanners by connecting business owners […] to other business owners in order to exchange BM knowledge." (Schwarz and Legner, 2020, p. 436). Business owners ask for the possibility of not only transferring but also translating and transforming knowledge, and adapting artifacts to the specific needs of communities (Schwartz and Legner, 2020). With its extensive knowledge base on conceptual modeling, IS research holds great potential to enable collaboration, thus contributing to the next steps of business modeling.

With this research-in-progress paper, we provide a starting point for further systematic comparisons and intend to extend the conceptualization of BMMLs as useful tools not only for intra-organizational business model innovation but also for inter-organizational alignment, especially business ecosystems. On the conceptual level, we bring coherence and direction to the fast-growing body of literature on business ecosystems by bridging and synthesizing three streams of literature: business models, modeling languages and ecosystems theory. We will proceed with our research and analyze the 27 BMMLs identified in our literature review in great detail and thereby extend Table 2 as a framework to a total of 45 articles, which can then be seen as a comprehensive overview to answer our research question. We plan to pursue this work by pursuing case studies in selected domains (e.g., on-the-fly computing; Karl et al., 2020) and conducting a scenario-based comparison of the most promising BMMLs for business ecosystem design to analyze their practical suitability (Siau and Rossi, 2011) as well as their merits and limitations for business ecosystems design. We limit our study by the conceptualization of ecosystem analysis to the four stated main characteristics. Further criteria to assess the usefulness of BMML for ecosystem analysis could be identified in, for example, innovation theory.

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