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Pacific Asia Journal of the Association for Information Systems

ISSN 1943-7544

Research Paper doi: 10.17705/1pais.14402 Volume 14, Issue 4 (2022)

Business Model Evaluation: A Systematic Review of Methods

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Abstract

Background: *As a result of factors such as digitization and rapid technology change, organizations are compelled to innovate their business models at an accelerated pace. While the domain of business model innovation has focused on understanding and structuring the process of innovation, it offers limited guidance for evaluating business models during the innovation process. Business model evaluation plays a vital role in supporting decision-making about the performance or viability of new business models and motivating continued investments. Existing literature on methods for business model evaluation and their application is limited and available information is scattered. Furthermore, as the BMI process covers a broad spectrum of activities - from business model initiation to implementation - the evaluation challenges and the effectiveness of evaluation methods vary across the phases of innovation. Thus, there is a need for a better understanding on methods for business model evaluation, and their timing and application for business model innovation.*

Method: *Through a systematic literature review, we have investigated the methods available for business model evaluation and focused on understanding their characteristics and effective timing of application in the business model innovation process.*

Results: *We have identified six groups of methods used for business model evaluation. Additionally, we find that early phase business model evaluation is predominantly qualitative in nature, whereas late phases of business model innovation are generally supported through quantitatively-oriented methods. Moreover, we observe that limited evaluation support is available in the literature to support the initiation phase of business model innovation. Based on our findings, we propose a guiding structure for aligning the available methods with the respective innovation phases.*

Conclusion: *The proposed guiding structure offers guidance for business model evaluation in practice and serves as a basis for future research in developing more effective methods and tools for business model evaluation and development.*

Keywords: Business Model Evaluation, Business Model Innovation, Business Model Performance, Systematic Literature Review.

This research article was submitted on Mar-2022 and under two revisions, accepted on Jun-2022.

Citation: Gilsing, R., Turetken, O., Grefen, P., Ozkan, B., & Adali, O.E. (2022). Business Model Evaluation: A Systematic Review of Methods. *Pacific Asia Journal of the Association for Information Systems, 14*(4), 26-61. https://doi.org/10.17705/1pais.14402

Introduction

Digitization and rapid technological advances are drastically disrupting and changing traditional markets, providing novel opportunities to organizations to shape their business models (Barthel & Hess, 2020; Rueckel et al., 2020; Veit et al., 2014). For instance, the ubiquitous presence of the Internet has facilitated the introduction of platform-based business models, of which Netflix and iTunes are well-known examples (Rhuggenaath, 2020; Täuscher & Laudien, 2018; Teece, 2010). Similarly, the application of sensors and communication interfaces leveraging the Internet of Things (IoT) or the potential offered by artificial intelligence (AI) based solutions has enabled organizations to enhance the services and products offered in business models or has enabled them to extend their business model to the surrounding ecosystem (Leminen et al., 2012; Riera & Iijima, 2019; Turber et al., 2014). These technological developments enable organizations to create value through entirely new business models or rethink current business practices (Massa et al., 2016).

A significant implication of the characteristics of this digital era is that, as the technologies employed are subject to rapid change, contemporary markets become highly dynamic and evolve at an accelerated pace (Veit et al., 2014). To remain competitive in these markets, organizations have to continuously innovate their business models (Amit & Zott, 2020): to find new or improved ways of doing business that enable organizations to create and capture new value for their stakeholders (Spieth et al., 2014). The domain of business model innovation (BMI) aims to understand what factors influence, inhibit or accelerate BMI and guide organizations in structuring their BMI process - from idea generation to implementation. Additionally, it has focused on the outcomes of BMI and its effect on organizational performance (Foss & Saebi, 2017). For instance, Chesbrough (2010) explores the barriers to BMI and how these barriers can be overcome. Similarly, Doz and Kosonen (2010) discuss how BMI can be supported through cultural changes. Several frameworks have been proposed to guide the BMI process (Wirtz & Daiser, 2018).

Despite these efforts, extant research on BMI provides limited insights on how business models can be evaluated and how this evaluation is structured during the innovation process. Business model evaluation plays a vital role in understanding the viability of a business model design and supporting organizational decision-making in the lifecycle of a business model (Massa & Tucci, 2013; McGrath, 2010; Veit et al., 2014). In the context of BMI, generic approaches, such as experimentation or prototyping, have been advocated to understand how changes to business model designs influence its performance (Andries et al., 2013; Bocken & Antikainen, 2018; Brunswicker et al., 2013; McGrath, 2010). Similarly, the importance of trial-and-error learning is stressed to better understand the outcomes of new business models (Berends et al., 2016; Sosna et al., 2010). In terms of concrete evaluation support for BMI, whereas previous literature reviews by Tesch and Brillinger (2017), Schoormann and co-authors (2018), and Süβ et al. (2021) on business model evaluation inform on a (focused) set of methods, they provide no interpretation of why, how, and when certain methods should be used for evaluating business model designs during the innovation process.

As business model designs change whilst decisions are made, and conditions unveil during the innovation process, decision-makers are faced with vastly different evaluation challenges. As a result, certain methods can be more effective in specific phases of the innovation process than in other phases (Tesch & Brillinger, 2017). For instance, in the initial phases of the innovation process, it may not be effective to leverage simulation analysis to analyze the performance of new business model designs (McGrath, 2010). In this early phase of BMI, the abstract nature of the business model design, as well as potential limitations in the quality and quantity of business data related to the design, may only allow the design and use of high-level simulation models which offer limited value with respect to decision making. Contrastingly, later phases of BMI require clear and precise operational decisions, which

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DOI: 10.17705/1pais.14402

may not be sufficiently addressed by qualitative results from methods such as expert judgment. An ineffective application of methods may prolong the innovation process, result in inadequately evaluated business model designs, or be unnecessarily costly.

Understanding the methods available for business model evaluation and the timing for BMI would contribute to extant research on supporting decision-making for business model development and innovation. It may contribute to unveiling mechanisms, tools, and techniques that can be used to reduce uncertainty in decision-making on new business model configurations (Schneckenberg et al., 2017). Additionally, such results can extend design-based knowledge (i.e., prescriptions of how artifacts are designed) on how (software) tools to support business model development and innovation should be configured (Amit & Zott, 2020; Ebel et al., 2016; Szopinski et al., 2020). Such results can help motivate and clarify why certain evaluation methods may better suit specific phases of the innovation process. This can serve as the starting point for the (selection of methods for the) development of tools to support evaluation at a specific phase or phases of the innovation process. Furthermore, these insights may also contribute to supporting the link between BMI and its effects on organizational performance (Foss & Saebi, 2017), providing clarity on how and why methods are used to support evaluation goals in the context of BMI. This can enhance our understanding of how phases of BMI contribute to its outcomes generated and how this can be supported through business model evaluation.

In addition to research, an investigation of the methods available and their respective timing for BMI would support practitioners in effectively applying evaluation methods to better understand the viability of their business model designs and make projections on the innovation process. In turn, this can help practitioners reduce uncertainty in developing new business models and support their decision-making.

Therefore, the objective of this study is to identify the methods used for business model evaluation as reported in the academic literature, to understand the characteristics and timing of their application for BMI, and to present the outcomes in a structured guideline.

To address our research objective, we conducted a systematic literature review (SLR) on *business model evaluation*, following the guidelines of Kitchenham and Charters (2007). We applied a keyword-based search strategy over a comprehensive set of academic digital libraries. We elicited works that discuss the evaluation of the viability of a business model design. In other words, we focused on the *methods that enable business modelers to analyse or assess the (expected) viability of a business model design*. We searched and reviewed articles performed between and including the years 2000 and 2021 (December). From a large number of articles initially retrieved, 69 were finally selected in accordance with our selection criteria. We identified six groups of methods from these articles, each with several variations. We analyzed the characteristics of these methods, including their timing of application within the BMI process. Finally, we synthesized our findings into a structure that provides a mapping between the identified evaluation methods and the phases of the BMI process. The objective of this structure is threefold: it offers a structure in terms of aligning business model evaluation for BMI; it contributes to existing design-based knowledge on the tools to support business model development and innovation; it aims to guide practitioners in comparing, selecting, and applying suitable evaluation methods to support business model innovation.

The remainder of this paper is structured as follows. First, we describe the research background and work related to our study. Next, we present the research questions and protocol employed for conducting the systematic literature review. Consequently, we present the results of our review, after which we introduce a guiding structure for business model evaluation that resulted from the synthesis of our findings. Lastly, in the section *conclusion*, we list the implications, contributions and limitations of this study as well as highlight avenues for future research.

Background and Related Work

This section presents the background on the business model concept and business model innovation, discusses the existing contributions concerning business model evaluation, and highlights the research gaps.

Business Model Concept

The concept of business models has attracted significant attention in various research fields, including information systems, technology management, e-business, and strategic management (DaSilva & Trkman, 2014; Massa et al., 2016; Zott et al., 2011). However, this wide-ranging interest has also led to various definitions, conceptualizations, and representations (Zott et al., 2011). From a broader perspective, a business model describes how an organization functions and how its goals are achieved (Massa et al., 2016). It represents the *logic of how a (networked of) organization(s) creates and captures value* (Osterwalder, 2004; Turetken & Grefen, 2017; Zott & Amit, 2010), describes the *resources, capabilities, and competencies* needed to enable these value mechanisms (Roelens & Poels, 2015; Zott & Amit, 2010), addresses the *revenue model* (Magretta, 2002; Osterwalder et al., 2005; Timmers, 1998), relates to or reflects the *business strategy* that the organization pursues (Casadesus-Masanell & Ricart, 2010; Shafer et al., 2005), and shows how it can be supported by *IT* (Al-Debei & Avison, 2010; Veit et al., 2014).

Business Model Innovation

Business model innovation has tentatively been defined as the process of discovering fundamentally new business models in an existing business (Markides, 2006), thereby modifying or renewing the existing business logic on how value is created and captured (Foss & Saebi, 2017). Business model innovation may be the result of business model renewal (in which the current business model is incrementally improved) or the result of business model generation and design (in case no business model previously was in place) (Berends et al., 2016). Although each path is vastly different in challenges, both pathways require business modelers to understand and decide how the current activity system of organizations should be altered and how this contributes to value creation and capture (Amit & Zott, 2020).

Although BMI, in principle, is messy in nature (Bucherer et al., 2012), driven by the need to innovate business models increasingly more rapidly, research has focused on understanding how BMI can be structured (Massa & Tucci, 2013; Spieth et al., 2014). As a result, several process conceptualizations for BMI have been proposed (Wirtz & Daiser, 2018). For instance, Sosna et al. (2010) identify two generic phases organizations go through to innovate their business models: *exploration* and *exploitation*.

In the exploration phase, the organization aims to understand what business model design would address the strategic challenges (such as changing customer demands, increased competition, or emergent technologies) through a trial-and-error process. Consequently, the model is fine-tuned until an agreement has been established on the correct business model design. In the exploitation phase, the business model is implemented, its performance is measured, and if proven to be valuable, it is scaled. Frankenberger et al. (2013) propose a finer-grained iterative BMI process with four phases. The first phase, *initiation*, involves analyzing and understanding the ecosystem's needs and identifying important stakeholders. This phase aims to understand and select the challenges or problems to be addressed by the novel business model. The subsequent *ideation* phase concerns generating potential new (draft) business model designs. The goal here is to ensure that the viability of business models is tested at a high level and that the structure of the business model designs adheres to the selected strategic goals. The third phase, *integration*, aims to establish a viable and

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DOI: 10.17705/1pais.14402

complete business model design, concretizing its structure, business logic, and resources needed. As stakeholders should agree or be motivated to participate here, a business case analysis is generally conducted. The last phase, *implementation*, ensures that the selected business model design can be put into practice and is supported through organizational processes. A viability and feasibility analysis at the process level should support setting the operational parameters and should help to clarify how organizations can scale their business model long-term.

Business Model Evaluation

Business model evaluation is considered as the *act of analyzing and understanding the performance of a business model design* (De Vos & Haaker, 2008). In the context of BMI, the output of business model evaluation should enable business model stakeholders to make an informed decision about a business model design aligned with their business strategy. It should offer an increased understanding of the conditions for which the business model will perform or insights on how to improve the projected performance of the model through its parameter settings (McGrath, 2010). Although business model performance can be both of a technical and business nature and has an implicit time dimension (e.g., feasibility and viability and robustness, respectively), we consider *viability* (business performance) as our study's primary focus of interest. Therefore, we focus on what outcomes a business model design is expected to generate and how these outcomes are captured (Schrauder et al., 2018), and leave the feasibility (i.e., if or how the model can be executed or operationalized and to what extent organizations have access to resources to do so) and robustness aspects (the degree to which the business model design can respond to internal and external changes) out of our scope (Gilsing, Turetken, et al., 2021).

Relevant research has highlighted the need for investigating and supporting the business model evaluation (Burkhart et al., 2011; Veit et al., 2014). On the one hand, research has focused on developing and using metrics or key performance indicators to support the business model evaluation (Gilsing, Wilbik, et al., 2021; Heikkila et al., 2016; van de Ven et al., 2022). Such business model metrics help in explicating or expressing business model performance (e.g., profit generated, product quality) and providing structure to decision making, but require evaluation methods to support the analysis of the business model. We also see that research has focused on developing software-based design and evaluation tools to support business model innovation (Athanasopoulou et al., 2018; Ebel et al., 2016; Szopinski et al., 2020). Generally, these tools embed reference options for designing and developing new business models and, as such, offer guidance to practitioners on relevant design choices. These choices could benefit from evaluation support to quantify the effect of such choices on business model performance.

In terms of research on methods that can be used as a basis for developing (comprehensive) evaluation approaches, Tesch and Brillinger (2017) present a literature review on the evaluation tools for (digital) business model designs. Similarly, Schoormann et al. (2018) and Süß et al. (2021) propose an overview of (groups of) business model evaluation methods, reasoning from a sustainability perspective of business models. While these analyses provide a (focused) overview of methods used to support the evaluation of digital and sustainable business models, they do not elaborate on how these methods can be linked to and support the evaluation in different phases of the BMI process. Hence, extant research lacks a comprehensive overview of the methods available for business model evaluation, their purpose for business model evaluation, and their effective timing concerning the BMI process. Such insights would help extend design-based knowledge on the development of tools to support business model innovation (Szopinski et al., 2020) and contribute to structuring business model evaluation in the context of BMI.

Research Design

In this section, we discuss the research design for this study. First, we introduce and motivate our research questions. Consequently, we describe the search strategy followed for conducting the SLR and the inclusion and exclusion criteria for selecting relevant articles.

Research Questions

The main objective of this structured literature review is to identify the methods used for evaluating the viability of business models by analyzing the articles in the academic literature. In doing so, we aim to report on their application, understand the relevant characteristics of these methods (focusing on whether they are quantitative or qualitative in nature and their purpose for decision making), cluster them, and investigate their application in the BMI process. Accordingly, our first research question relates to identifying and grouping the evaluation methods for a comprehensive overview based on the academic literature. Therefore, our first research question is:

RQ1. What groups of methods for business model evaluation can be identified in literature?

Our second research question relates to the timing of application for the BMI process for the identified methods. As highlighted by Tesch and Brillinger (2017), there is a need to understand the timing in the BMI process at which the identified methods are used. Despite the difficulty in generating an all-encompassing precise representation, such a mapping can provide initial insights into the effectiveness and usefulness of evaluation methods at certain BMI phases. Accordingly, the second research question is formulated as follows:

RQ2. In which phase of the business model innovation process can the identified methods be applied?

Based on the results of our research questions, we propose a guiding structure that presents an overview of the methods that can be used at different phases and their application.

Search Strategy

To answer our research questions, we conducted an SLR on business model evaluation to gather evidence from the literature, following the research protocol stipulated by Kitchenham and Charters (2007), frequently used in IS literature. Accordingly, we defined a *search strategy* to identify relevant articles, including the *search string, search procedure,* and *selection criteria*. We started with an initial search string related to business model evaluation. After a set of trial runs, we finalized our search string based on the number of articles identified and their relevance. The final search string for the search procedure was defined as follows:

"Business model" AND ("evaluation" OR "assessment" OR "feasibility" OR "viability")

We included the term *assessment* as a synonym for *evaluation* to be complete and inclusive. Similarly, for broader coverage, we included the terms *feasibility* and *viability*, which are often used interchangeably in practice. This way, we aimed to cover studies that focus explicitly on (evaluating) business model outcomes or business model performance. Although we focus on identifying methods for business model evaluation, we did not explicitly include the terms 'method' or 'approach' as these appeared to be too restrictive. Similarly, we did not include *performance* as a keyword. Although we highlight the relevance of business model performance for evaluation, including it as a keyword significantly inflated the number of search results with studies on organizational or strategic performance. Our further analysis of the search results indicated that the terms *feasibility* and *viability* were sufficient to cover relevant works that present performance-related discussions on business model evaluation.

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DOI: 10.17705/1pais.14402

We have searched relevant works in the following online library databases: *ACM Digital Library, AIS Electronic Library, Emerald Insight, ScienceDirect, SciVerse Scopus, SpringerLink, and Web of Science*. We selected this group of library databases as it covers a broad range of scientific domains (such as strategic management, innovation and technology management, and information systems) in which the business model concept has become a key research topic. As a result, we expect that our study includes the most relevant works related to our research.

We defined the selection criteria (Table 1) to determine the articles that were directly relevant for our review. The selection criteria were applied in two stages: context and content. The steps and criteria applied in the *context* stage set the scene for the thorough analysis conducted in the *content* stage. The steps in the *context* stage were performed jointly by three researchers (authors of this paper), whereas the *content* stage has been covered by a single researcher, after which the results were verified by the remaining researchers. Any differences regarding included or excluded articles were discussed until a consensus was achieved.

Table 1 - Selection Criteria for the Search Procedure

Stage	Type of Criteria	Name of Criteria	Description
Context	Inclusion (I1)	Language	The article is written in English.
	Inclusion (I2)	Publication date	The article is published between 1-1-2000 and 31-12-2021.
	Inclusion (I3)	Scientific relevance	The article is either a (peer-reviewed) journal article, (scientific) book section/chapter, or conference paper.
	Inclusion (I4)	Search string	The article complies with the search string for either title, abstract or keywords.
Content	Inclusion (I5)	Business model evaluation approach	The article applies, validates, or proposes a method that facilitates the evaluation of the viability or feasibility of a business model design.
	Exclusion (E1)	Evaluation of business model design method	The article is excluded if it focuses on evaluating a business model *design* method.
	Exclusion (E2)	Focus on evaluation of technology or product innovation	The article is excluded if it focuses only on evaluating a technology or product innovation within a business model.

Figure 1 presents the search procedure that we followed, including the number of articles that resulted after each step. The first step was related to the *context*, where we applied the above-specified search string and context criteria as listed in Table 1. As a result, we obtained 7820 articles. As some digital libraries provide different search functionalities (i.e., searching articles on keywords and title only, or lack of filtering functionality for the language of the article), some inclusion criteria were adapted or checked manually to fit as best as possible to a specific digital library's convention.

Figure 1 - Search Procedure and Results

The second step concerned a multi-step *content* analysis of the remaining articles. First, the lists of relevant articles in each digital library were sorted by relevance. Then, we read the

titles, abstracts, and keywords of the articles to eliminate those deemed irrelevant. We applied the fifth inclusion criteria (I5) to guide us in this selection process. Accordingly, the article should mention an application, validation, or proposal of methods for business model evaluation or the assessment of business model performance to be included for further analysis.

For the list of each digital library, we continued this examination of articles until no relevant work was identified after 100 consecutive articles. (For instance, if we considered article 150 as relevant, we stopped reviewing the list of articles in that digital library if the further examination of articles between 151 and 250 did not locate any additional relevant work). Next, we eliminated the duplicate articles found in multiple digital libraries (Step-3) and generated a single list of 371 articles for further review.

The fourth step involved reading and going through these 371 articles in more detail and examining if and how the business model evaluation was conducted. This step involved multiple iterations of content analysis of articles until all the articles were reviewed. For this analysis, we applied two exclusion criteria to omit works that were not relevant to our research objective. The first criterion (E1) was applied to exclude works that discuss the evaluation of a business model *design method* or the use of a business model design method to analyze the business model. We also excluded articles that focus exclusively on evaluating the performance of a product or technology innovation, as they do not have the business model concept as their unit of analysis (exclusion criterion E2). While the economic or environmental performance of a product is relevant to the performance or viability of a business model, we considered studies that focus on the technical or environmental feasibility of a new product or service as out of the scope of our research.

For steps 2-4, three authors in total were involved. Here, we applied a two-stage procedure: one author focused on the actual filtering of the set of papers using the inclusion and exclusion criteria defined, capturing why a paper was included or excluded at what step for the search procedure. For the second stage, two different researchers individually screened the exclusion and inclusion process. Any differences of opinion on why papers were included/excluded were discussed until consensus on the final set of papers to be considered was achieved.

The application of all criteria resulted in a set of 69 relevant *primary* articles from which the results were extracted. The full list of these articles, the breakdown of search results, and the application of the classification scheme is available in Appendix-A, Appendix-B, and Appendix-C of this work, respectively.

Results

In this section, we discuss the findings of our review and provide answers to our research questions. We start by presenting descriptive statistics of the primary list of articles (publication year and type) to indicate the maturity of the topic in academia. Next, we describe the evaluation methods we have synthesized from our analysis of the primary articles. We briefly elaborate on each group of methods and their variations as used in the primary articles. Consequently, we present the mapping between the evaluation methods and the respective BMI phases in which they have been applied.

Distribution of Primary Articles by Year and Type

Figure 2 shows the type and distribution of the selected articles by year. The figure shows that the number of publications about the applications of business model evaluation has increased significantly in the last decade, with an unexpected lack of relevant articles in

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DOI: 10.17705/1pais.14402

2012. Still, we can infer that continual attention exists to business model evaluation. For our primary articles, the majority (71%) have been published in journals, followed by conference papers (19%) and book chapters (10%), which indicate that the research related to business model evaluation has matured over the years.

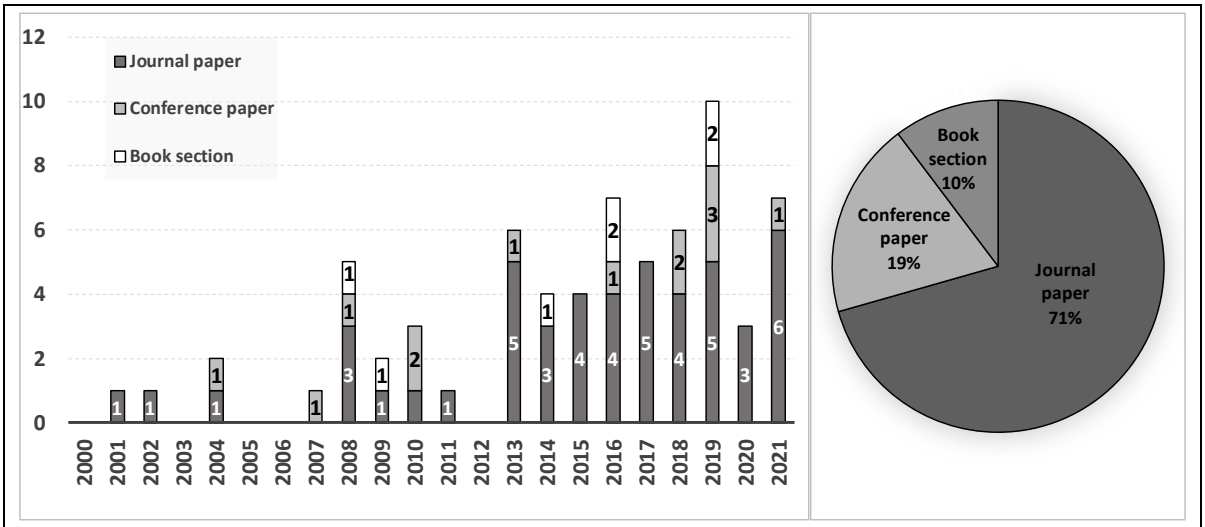

Figure 2 - Distribution of Primary Articles per Year (Left) and per Type (Right)

Identified Business Model Evaluation Methods

Detailed analysis of the primary articles resulted in several methods that have been applied to evaluate the performance of business model designs and their relative frequency of use. Through a thematic analysis (Braun & Clarke, 2012), we clustered these methods into *groups,* as presented in Figure 3. It should be noted that the groups are not mutually exclusive - integrated methods to support business model evaluation can be built on multiple groups to be applied for business model evaluation (e.g. a scenario analysis-based method supported through expert judgment).

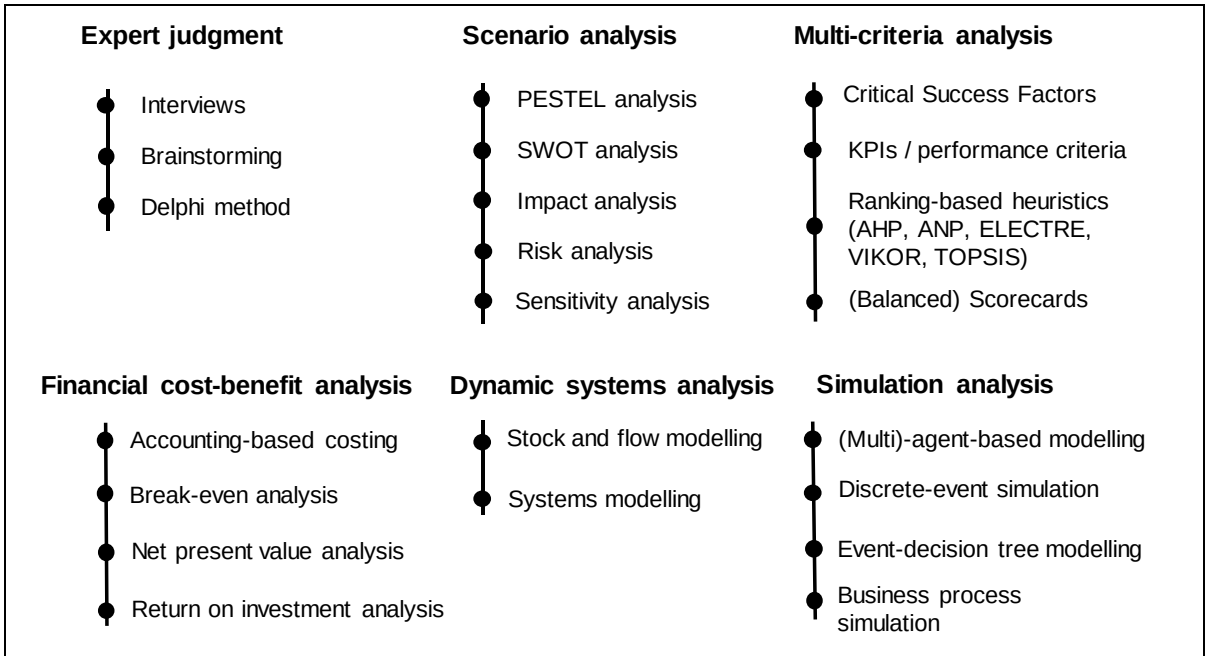

Figure 3 - Method Groups and Variations of Methods Identified through the Analysis of Primary Studies

Table 2 presents an overview of the frequency of methods used for our primary studies. The results show that *expert judgment* and *scenario analysis* are the most frequently used methods to support the evaluation of business model designs. Out of 69 articles, 31 discuss an application of expert judgment to assess the performance of business model designs, whereas 24 articles use (a variation of) scenario analysis to support business model evaluation. As a more inherent quantitative method, *financial cost-benefit analysis* is applied in 14 articles to analyze the performance of a business model. We discuss these methods in more detail in the remainder of this section.

Expert Judgment

Expert judgment is used to elicit the opinion of stakeholders involved or experts within the business domain to understand whether the business model design is likely to perform (Clayton, 1997; O'Hagan et al., 2006). Based on their knowledge and experience, or by leveraging strategic or performance metrics (Heikkila et al., 2016; Mateu & March-Chorda, 2016), experts or relevant stakeholders can intuitively make qualitative assessments concerning business model aspects, such as the business model structure, likeliness of consumer adoption of the service or product offered by the business model, and the projected costs and benefits. Although the results may often be high-level and qualitative, the expert judgment provides decision-makers with a quick way of obtaining valuable insights for evaluating the business model designs (D'Souza et al., 2015). Moreover, applications in group settings (such as the *Delphi method* or *brainstorming*) can bring together the knowledge of multiple experts, where differences in expert opinions can directly be discussed and resolved. Although care should be taken to avoid biases, expert judgment allows generalized and robust insights into the business model evaluation (Laukkanen & Patala, 2014).

Table 2 - Business Model Evaluation Methods Identified in the Primary Articles

Identified Evaluation	Frequency of Occurrence	Occurrence in the Primary Articles
Expert judgement	31	[S1] [S5] [S7] [S9] [S10] [S11] [S13] [S15] [S16] [S17] [S19] [S20] [S22] [S24] [S28] [S36] [S37] [S38] [S39] [S41] [S42] [S46] [S48] [S51] [S52] [S59] [S63] [S65] [S66] [S68] [S69]
Scenario analysis	24	[S3] [S5] [S6] [S7] [S8] [S10] [S12] [S15] [S18] [S19] [S20] [S22] [S24] [S25] [S29] [S30] [S33] [S37] [S39] [S41] [S43] [S45] [S55] [S48]
Multi-criteria analysis	15	[S4] [S9] [S10] [S13] [S16] [S21] [S22] [S26] [S28] [S38] [S49] [S50] [S54] [S58] [S69]
Financial cost-benefit analysis	14	[S10] [S19] [S22] [S24] [S29] [S31] [S32] [S45] [S47] [S53] [S55] [S57] [S67] [S69]
Dynamic systems analysis	8	[S3] [S6] [S27] [S34] [S35] [S40] [S61] [S62]
Simulation analysis	16	[S2] [S8] [S9] [S12] [S14] [S18] [S23] [S24] [S25] [S29] [S30] [S43] [S44] [S56] [S60] [S64]

Scenario Analysis

Scenario analysis is used to explore what-if situations and understand how changes both in the business model design and in the market in which the business model is positioned may impact the performance of the business model design (Tesch, 2016). These scenarios range from high-level change factors or threats (such as changing market demands, shifting

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DOI: 10.17705/1pais.14402

competition, or generic business model structure) to highly granular risks and uncertainties concerning business model parameters. By exploring these what-if scenarios, decision-makers can better understand how and under what conditions the expected performance of the business model design can be influenced.

Several variations of scenario analysis are used in our set of primary articles. *Risk analysis* (Vose, 2008) is used to understand and quantify the risks associated with the costs and benefits and to have a better view of the robustness of the design. This is often used in conjunction with *sensitivity analysis*, which involves adding probabilistic values to financial costs and benefits or defining multiple scenarios (e.g., optimistic, normal, or pessimistic) against which the viability of the business model design is evaluated. *Impact analysis* (Allee, 2003) takes a more qualitative perspective. It explores how changes to the business model design may impact its performance by identifying what stakeholders or business model elements can be affected. Finally, *SWOT/PESTEL analysis* (Yüksel, 2012) aims at capturing how external effects (such as market influences) may impact business model performance.

Multi-Criteria Analysis

Multi-criteria analysis is used for business model evaluation to compare key performance indicators (KPIs) or performance criteria associated with a business model design (Ishizaka & Nemery, 2013). It facilitates decision-makers to incorporate subjective stakeholder preferences, as the method requires stakeholders to indicate how preferred or important a performance criterion or indicator is as opposed to other criteria that can be associated with the business model design. Accordingly, the method offers ample flexibility to decision-makers to evaluate and compare multiple outcomes of a business model design, which do not have to be expressed in the same dimension of units (for instance, increased financial profit can be compared to increased environmental pollution). Using a pairwise comparison between costs and benefits emerging from a business model and normalizing the results, the method facilitates decision-makers to derive relative weights per performance criterion for a business model design (Zografos et al., 2008). Based on how well a business model alternative performs on these criteria, it allows decision-makers to objectively interpret business model performance or select between business model alternatives (Daas et al., 2013). Several algorithms for conducting multi-criteria analysis have been used in our primary articles, such as Analytic Hierarchy Process (AHP) or Analytic Network Process (ANP) (Saaty, 1988), ELECTRE (Roy, 1999), and TOPSIS (Yoon & Hwang, 1995).

Financial Cost-Benefit Analysis

Financial cost-benefit analysis permits decision-makers to assess and investigate whether the expected monetary benefits of a business model design will outweigh the monetary costs of implementing and sustaining this business model (Mishan & Quah, 2007). For business model evaluation, financial cost-benefit analysis strongly pertains to the revenue model, which is often the dominant component in the business model structure and the main driver of business model endeavors (Morris et al., 2005). Through financial cost-benefit analysis, decision-makers can investigate the future (financial) performance of a business model design, understand the cost structure of the resources deployed and map how cash flows can be exchanged between network parties (Gilsing et al., 2020). A variety of financial performance metrics is used to accommodate this type of analysis in our primary articles, such as the Net Present Value (NPV), Internal Rate of Return (IRR), Break-even Analysis (BEA), and Return on Investment (ROI) (Mishan & Quah, 2007).

Simulation Analysis

Simulation analysis is generally used to understand the fine-grained performance or robustness of the business model and to capture risks and uncertainties associated with a

particular business model design (Täuscher & Abdelkafi, 2018). Each model parameter can be captured through mathematical (sub)models and can follow a probabilistic distribution that represents the risk or uncertainty related to the parameter (which is difficult to realize through system dynamics modeling). Accordingly, decision-makers can deal with or reduce uncertainty concerning the outcomes or performance of a business model (Power & Sharda, 2007). Several variations of simulation analysis to support business model evaluation have been used in the primary articles we analyzed. Examples include agent-based simulation (Tian et al., 2008), event-decision tree simulation (Copani & Rosa, 2015), and discrete-event or business process simulation (Brandt et al., 2017; Fishman, 2013).

Dynamic Systems Analysis

Dynamic systems analysis is used to explore the 'behavior' of business models over time. It helps in understanding how business model parameters or outcomes change over time and what short or long-term impact changes for these business model parameters may have on other business outcomes of the model, as well as taking into account environmental factors that may influence business model performance. In contrast to simulation analysis, which aims to replicate the structure of the system and allows its performance to be analyzed through different scenarios, dynamic systems analysis maps a problem onto a generic structure not only to help treat the symptoms but also understand the underlying causes underneath the behaviour of the system (Greasley, 2009). To support dynamic systems analysis, we see that *System Dynamics models* are frequently used, which offers a modeling language that enables decision-makers to represent or translate a business model design as an interrelated set of systems or concepts, focusing explicitly on the dynamics, exchanges, and influence of interactions between these (sub-)systems (Karnopp et al., 1990; Sterman, 2000). By modeling these dynamics and relationships as feedback loops, and stock and flow structures, decision-makers can analyze the impact of changes in specific parameters or policies, both internal and external, on the outcomes of the business model, testing its performance but also its robustness over time (Moellers et al., 2019; Täuscher & Abdelkafi, 2018).

Timing of Business Model Evaluation Methods

To address our second research question, we investigated the phases of the BMI process at which our primary articles applied the identified evaluation methods. For the phases of the BMI process, we have adopted the process proposed by Frankenberger et al. (2013). We choose this representation of the innovation process as it thoroughly elaborates on the subsequent phases and has received significant recognition in the academic literature. We conducted the mapping of the selected articles to the relevant phases of the BMI process by leveraging the goals of the respective phases and translating these into *evaluation goals* as follows:

- Initiation: As the goal of the initiation phase is to identify strategic opportunities for which a business model should be designed, the evaluation method should concern with assessing these strategic opportunities in light of the to-be-designed business model.

- Ideation: The goal of the ideation phase is to generate business model designs that fill the void or satisfy the need identified in the initiation phase. Therefore, the evaluation method at this phase should focus on assessing the strategic fit of the business model design concerning the stakeholders' preferences for the business model.

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DOI: 10.17705/1pais.14402

- Integration: The goal of the integration phase is to concretize the business model and find a working business case to motivate the participation of stakeholders. Therefore, evaluation methods in this phase should focus on assessing the business case of the business models (how value is concretely created and captured by the stakeholders).

- Implementation: This phase focuses on operationalizing the business model and changing the organization to accommodate this. Evaluation methods for this phase should provide decision-makers insights on the future or existing operational performance, including resources to be deployed and to facilitate scalability, support in setting relevant parameters, and understanding and mitigating risks and uncertainty.

Leveraging these concrete evaluation goals, we assessed each primary article for the goal that the evaluation aims to pursue and accordingly mapped the methods used in these articles to the respective business model innovation phase. Figure 4 presents this mapping.

Our analysis of the mapping has yielded two main findings. First, the identified methods were applied to support the evaluation at the *initiation* phase only to a limited extent. At this phase, the dominant concern in evaluation is to analyze the environment/ecosystem through a strategic lens to identify strategic needs or opportunities that match the organization's or ecosystem's interest. Hence, we attribute the limited use of the evaluation methods at this phase to the fact that the evaluation at the initiation phase does not necessarily take the business model design as the focal point of evaluation but aims instead at the strategic opportunities that provide the basis for a new business model design. As our research design explicitly takes the evaluation of a business model as the unit of analysis, it makes sense that the articles that focus on evaluating strategic opportunities are not explicitly considered.

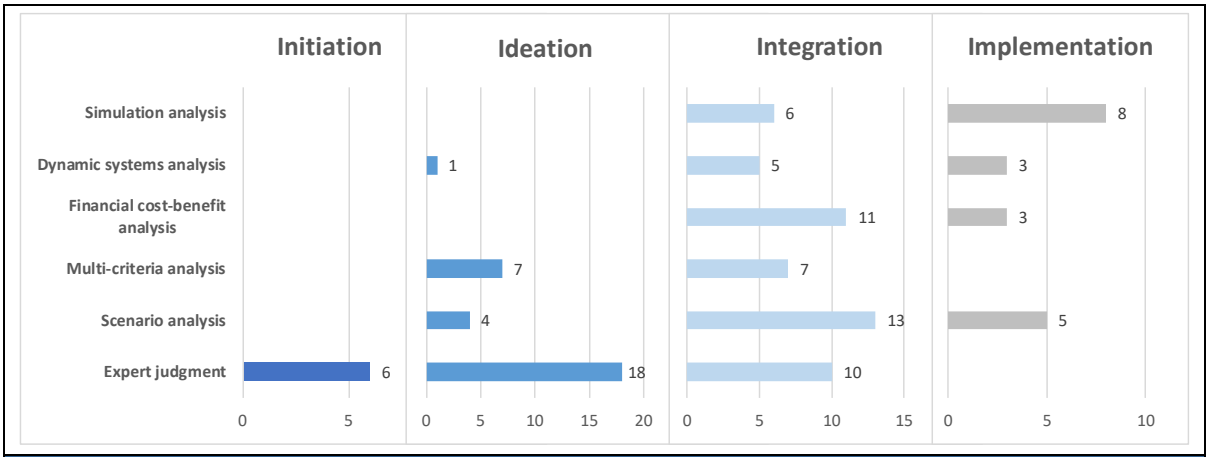

Figure 4 - Application of the Evaluation Methods at the Relevant Phases of the Business Model Innovation Process

Nonetheless, given the role of business models, it is important that this link between the strategy and business models is established (Casadesus-Masanell & Ricart, 2010; Magretta, 2002). Among our primary articles, those that do focus on evaluation in the initiation phase almost always include this activity as part of a broader BMI cycle, either to understand and evaluate the ecosystem in which the business model is to be positioned or to derive goals and requirements for the subsequent design of the business model. Contrastingly, the *integration* phase features applications of all identified evaluation methods and is often the main focus of evaluation in the primary articles we analyzed.

As a second key finding, none of the methods (or their variations) is applied across all phases. *Scenario analysis* and *expert judgment* have a wider range of variations making their application potentially effective across multiple BMI phases. We also see the dominance of these qualitative methods in the *ideation* phase. In this phase, we particularly see the *impact analysis* (as a variation of the scenario analysis method) and (to a lesser extent) the *multi-criteria analysis* being used. Conversely, the *implementation* phase shows a strong presence of quantitatively-oriented methods, such as *simulation*, *system dynamics,* financial cost-benefit analysis, and the quantitatively-oriented variations of the *scenario analysis* (specifically the risk and sensitivity analysis). From these findings, we can infer that the early phases of the BMI process can be characterized by qualitative evaluations of business model designs, while the quantitative support for business model evaluation becomes pre-dominant as the BMI process progresses to implementation. This aligns with how decision-making processes are generally perceived and supported (Eyisi, 2016).

A Guiding Structure for Business Model Evaluation

The evidence we gathered and analyzed through our systematic review of the academic literature suggests that the effectiveness of the evaluation methods in supporting the BMI also depends on the timing of their application in the BMI process. This is because the BMI process encompasses the entire spectrum of decision-making and transitions from *strategic* to *tactical* and *operational* decision-making (Casadesus-Masanell & Ricart, 2010). Hence, business modelers face different evaluation challenges while going through this process.

Early phase business model design and innovation is often characterized by uncertainty, lack of data, and lack of a clear structure with respect to the business model design. As a result, it is challenging -if possible- to quantify all outcomes of the business model to evaluate its (expected) performance (Dellermann et al., 2019; McGrath, 2010; Simmert et al., 2019). However, at these early phases, the decision-makers are still required to evaluate their model to ensure its alignment with the organization's strategic goals. Similarly, later phases of the BMI require concrete, quantified evidence to support operationalization and implementation and work towards future scaling. Therefore, we advocate the need for a process-led structure for business model evaluation, elaborating how evaluation methods should be used. Such a structure can provide guidance on which methods are suited for the evaluation of a certain innovation phase and how these methods should be applied. In this section, we present such a structure for guiding business model evaluation.

Our synthesis of the review of the primary articles and a thorough analysis of the applied evaluation methods led to the structure presented in Figure 5. Based on the characteristics and challenges of each phase, we derived explicit *evaluation goals* for each phase, which are described as the input for conducting evaluation at the respective innovation phase. For each goal, we highlight what purpose each method serves or how it contributes to achieving this goal.

The proposed structure explicitly aims at providing *guidance* for the selection of methods and the timing of their application in the BMI process for their effective use. In that respect, it is not designed as a *prescriptive* structure for applying business model evaluation methods. Stakeholders can use their concrete evaluation goals (as a concretization of the generic goals listed per phase) and the purpose of the methods to guide the selection of methods. This is especially relevant for the integration phase of business model innovation, for which the use of the majority of the evaluation methods is applicable. For instance, scenario analysis is best suited if part of the business model evaluation requires organizations to reduce uncertainty. Similarly, a multi-criteria analysis can be effective if evaluation requires a

comparison between business model outcomes expressed in different units of analysis (for example, the comparison between financial and non-financial benefits).

Organizations can use the generic evaluation goals per phase as entry points to the innovation and evaluation process. As a result, the structure can be used both for organizations that aim to improve existing business models and for those that focus on developing entirely new business models (Foss & Saebi, 2017; Schneider & Spieth, 2013). For the former, it is likely that a business model design is already present, allowing organizations to enter the process at the ideation or integration phase (meaning that the evaluation of the initiation phase may be lightweight in nature). In such a scenario, there is likely no need to evaluate the strategic goals that drive the design of a business model. However, it may still be valid to consider (through SWOT/PESTEL analyses) what potential opportunities or threats can be identified regarding the current business model or how it can be strengthened (Haaker et al., 2017). The methods highlighted for the integration and implementation phase can consequently be used to guide business model renewal or improvement.

For the latter, which is often the case for radical innovations, the strategic concerns related to new business models may have to be evaluated. In such cases, the structure of a new business model is likely to be absent or uncertain. Hence, the entry point is the initiation phase, for which the entire evaluation process is followed.

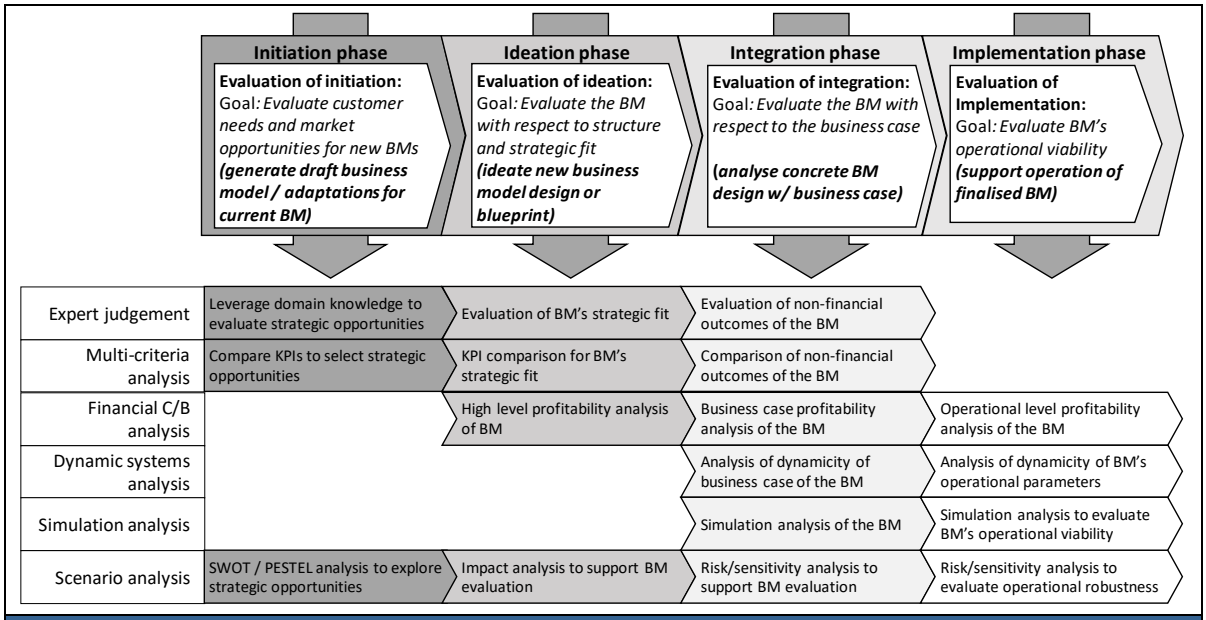

Figure 5 - Guiding Structure for the Application of Evaluation Methods at Different BMI Process Phases

In the subsections below, we elaborate on the evaluation perspective of each phase of the BMI process

Evaluation in the Initiation Phase

The goal of the evaluation in the initiation phase is to assess the strategic goals and opportunities that serve as the basis for business model (re)design and evaluate the environment, including market and stakeholders, in which the business model design is to be positioned. In this phase, a business model is often still to be designed. Given the high level of uncertainty involved in this setting, the need for using qualitative methods is evident. Based on our review of methods and their application, we propose using *expert judgment,*

multi-criteria analysis, and *scenario analysis* in this phase. Expert judgment can be used to decide on ad-hoc strategic opportunities, to help devise strategic criteria that can be used to evaluate such opportunities, or to judge or understand what potential draft business models may be considered relevant, taking into consideration the needs of the market and ecosystem (O'Hagan et al., 2006). Although the business model design can potentially be unclear or unstable at this phase (e.g., draft business models or ideas for new business models), the evaluation in this phase can be based on the (tacit) domain knowledge of experts. To further structure the evaluation process, decisions can be supported by *multi-criteria analysis* to indicate the relative importance of performance criteria concerning the strategic goals an organization desires to pursue. Similarly, scenario analysis (e.g., SWOT or PESTEL analyses (Yüksel, 2012)) can be used by decision-makers to evaluate the impact or risks associated with the identified strategic opportunities and how these may affect potential new business models.

Evaluation in the Ideation Phase

The evaluation in this phase should facilitate decision-makers to assess whether business models fit the strategic goals set and provide a preliminary indication of the performance of these models to motivate stakeholders to continue with the innovation process. It should also become apparent what customer segment(s) will be addressed by means of the business model design. Additionally, it should be understood how the business models ideated can take the needs of the intended customers into account. Our review results pointed out the use of *expert judgment, multi-criteria analysis, scenario analysis,* and to a lesser extent, *financial cost-benefit analysis* as suitable methods to achieve this phase's evaluation goal. As the output of the ideation phase represents concrete business model designs, often explicitly represented using modeling approaches, the available evaluation methods are catered to the business model design along with its components to help evaluate whether a business model design makes sense. Similar to the initiation phase (but this time explicitly taking the business model itself as the point of interest), *expert judgment* and *multi-criteria analysis* are used to set up the business model performance or selection criteria that allow decision-makers to evaluate the strategic fit, structure, and potential viability of the business model design. For example, it can help in a high-level assessment of whether strategic goals set for the business model design are likely to be achieved. It can also be catered to understanding what value is created for the customer or other stakeholders involved and whether this is appropriate. Eliciting the view of the stakeholders and experts, the decision-makers can determine whether the business model design is acceptable to be taken along the next phase of the innovation process, whether the design should be changed, or if the strategic goals should be reconsidered.

In this phase, scenario analysis (particularly impact analysis) can be used to help understand how the business model can work in practice under a set of conditions or future scenarios to support the evaluation further (e.g., by using storytelling (Tesch, 2016)). If the business model design and the context already provide sufficient data concerning its revenue model, the *financial cost-benefit analysis* can present insights into the initial performance of the business model design. However, the analysis at this phase is preliminary as the likelihood of significant changes and uncertainty is still high (particularly in the case of radical changes to the business model design) (Simmert et al., 2019).

Evaluation in the Integration Phase

The evaluation goal in the integration phase is to determine if and under which conditions the business model design can produce a desirable outcome for all stakeholders (Meertens et al., 2013). In other words, the evaluation results should motivate stakeholders to continue or redesign the business model. Here, the business case behind the business model design is generally considered the *object of evaluation* (Morris et al., 2005). In this phase,

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DOI: 10.17705/1pais.14402

quantitatively-oriented methods, such as the *financial cost-benefit analysis, system dynamics analysis,* and *simulation analysis* can be effective in providing further support to the evaluation of business model designs, mixed with the use of qualitative methods to support decision-making. Quantitative methods, such as those listed above, are used to understand the financial performance of a business model design, and how this can change over a time dimension for the stakeholders involved. A lack of financial performance may require the business model to be redesigned.

However, depending on the strategic concerns of the respective stakeholders, whether the performance is deemed viable or desirable may also depend on non-quantifiable or non-financial concerns, such as social or environmental outcomes (Bocken et al., 2015; Freudenreich et al., 2019), which may drive the (competitive) positioning of organizations (de Oliveira da Costa et al., 2018). *Expert judgment* and *multi-criteria analysis* can support this comparison between business model outcomes expressed in different units of analysis, and as such, extend the analysis of the business case of the business model design.

Similar to the previous phases, *scenario analysis* (specifically risk analysis) can be used by decision-makers to conduct what-if analysis by taking concrete business model elements as the point of analysis. More specifically, risk analysis can facilitate decision-makers to deal with uncertainty regarding outcomes of the business model design (for instance, risks involving future cash flows), allowing them to assess the robustness of the model. This is frequently supported through *system dynamics analysis* to offer a detailed understanding of how changes in parameters (such as customer demand, pricing, or competitor behavior) can impact the business model performance (Moellers et al., 2019).

Evaluation in the Implementation Phase

Evaluation of the implementation phase should give decision-makers detailed, quantified insights on the performance of business models in relation to the operational processes to be deployed, the resources needed to support these processes and to understand how the business model over time can be scaled. The results of our review reflect the abovementioned need for quantitative, fine-grained decision support, which features methods like *simulation analysis*, *financial cost-benefit analysis, system dynamics analysis,* and *scenario analysis* (particularly risk and sensitivity analysis). These methods help decision-makers understand business model performance at the operational level based on the deployed or available resources (Moellers et al., 2019). For instance, simulation analysis can be applied to analyze the performance of the business model design concerning resource deployment. Similarly, system dynamics analysis can support in understanding how changes in the capacity, workforce availability, customer demand, or service or product quality impact the viability of the business model or analyzing to what extent the business model can viably be scaled under the current capacity and resources available (Moellers et al., 2017; Täuscher & Abdelkafi, 2018). Lastly, *risk* and *sensitivity analysis,* as variations of the scenario analysis, can account for testing the robustness of the business model design and understanding the criticalities concerning the operational viability of the business model.

Conclusion

The age of digitization requires organizations to innovate their business at an accelerated pace (Teece, 2010; Veit et al., 2014). In the literature, increased emphasis is placed on providing guidance and support towards BMI, delineating how the innovation of business models can be fostered and how steps can be taken to guide the innovation process. However, so far, support in evaluating the (projected) performance of business model designs within this process has been largely neglected (Veit et al., 2014). The literature does not provide clear guidance on the methods that are suitable in each phase of the innovation

process and the goals and challenges that should be satisfied. Without adequate evaluation support, it is difficult for organizations to predict or assess the performance of new business model designs and motivate investment or scaling decisions (McGrath, 2010).

In this study, we conducted a systematic literature review to identify the methods that have been applied in the academic literature to evaluate business model designs. We identified six groups of evaluation methods that are most commonly referred to in academic research. We briefly explain these methods and map them to the BMI phases they have been applied in, based on the implicit evaluation goals that each phase possesses.

Our review identified *scenario analysis* and *expert judgment* as the most commonly used methods for the evaluation of business model designs. In addition, as the context and goals change at each BMI phase, none of the methods cater to the entire BMI process, confirming that a single, comprehensive method for the business model evaluation would not be effective. Therefore, we advocate for a goal-oriented process-led structure for guiding the selection of business model evaluation methods. Based on the findings of our review and the detailed examination of the methods, we propose such a structure, providing clarity on what methods are used, how they are used, and at what timing for the innovation process.

Implications for Research

Our work has several implications for research. First and foremost, it provides a synthesis of the current state-of-the-art in business model evaluation, contributing to the knowledge domain of the business model evaluation (Veit et al., 2014). It offers an increased understanding of the available methods (with their variations) concerning the BMI process phases. Additionally, the guiding structure synthesized through our results clarifies how these methods can fulfill the evaluation challenges that arise during the innovation process. In turn, this strengthens our knowledge of how business model evaluation contributes to understanding the outcomes of BMI. Secondly, our work establishes an explicit link between the BMI process and business model evaluation, which has been under-investigated in the academic research (Foss & Saebi, 2017). We highlight that the nature of methods used increasingly becomes quantitatively-oriented as BMI progresses to later phases of the process and to what purpose methods are used. This can help better understand how evaluation in different phases of the BMI process contributes to decision-making on new business models. Lastly, our results also contribute to research on business model development tools, providing design-based knowledge on what evaluation methods are available, how they are used, and at what phase of the innovation process they are used. This can serve as a starting point for method selection to guide the development of business model (software-based) tools geared toward the specific needs of the BMI phases (Dellermann et al., 2019; Szopinski et al., 2020). Looking at the set of methods identified through our literature study, we believe that methods such as expert judgment or (multi-) criteria analysis can significantly benefit from software-based tool support. In contrast to the methods (such as system dynamics or simulation), these methods tend to be more unstructured and rely heavily on eliciting the perceptions or preferences of users and stakeholders to support evaluation purposes (for example, through checklists or interviews). Arguably, this data collection process can be structured and supported through software-based means, although care should be taken regarding how users will interact with or use the tools developed.

Implications for Practice

For practitioners, the proposed structure would serve as a comprehensive synthesis of available methods to support business model evaluation. It points out how these methods are applied for business model evaluation and how they contribute to business model innovation. As a result, it can serve as the basis for selecting methods to support the

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evaluation of business models throughout the BMI process, in turn supporting and structuring decision making.

Limitations

Our research work is not without limitations, specifically regarding the applied research method and inclusion and exclusion criteria. For instance, we excluded white papers, grey publications, and non-academic books. However, given the practical nature and goal of business model evaluation, these sources may provide useful insight into the methods or techniques currently not covered or reported in the scientific literature.

Limitations also exist due to the inclusion/exclusion criteria and search string used in selecting relevant articles. For instance, our search string does not include keywords related to methods (e.g., method, tool, technique), as this proved to be too limiting. Similarly, although used frequently in describing our work, we did not include keywords such as 'performance', as this inflated the results significantly. However, this may have caused some articles to be excluded from our initial selection of articles, affecting the potential completeness of our list of primary articles. In addition, it should also be noted here that methods *outside* the business model field could be useful to support business model evaluation and decision making. For example, as a business model can be considered an IS artifact, methods supporting decision-making on the IS artifacts could be applicable also for business model evaluation. However, given our search string (explicitly including the search term 'business model'), these methods likely have not been included as part of our search.

Lastly, our results and the guiding structure are based on evaluations of business model designs as reported in the existing research. The majority of these articles feature exploratory rather than real-world business cases. This poses threats to the validity of the proposed guiding structure. Although a method can be effective for a hypothetical case, its practical applicability remains to be seen in real-life cases.

Avenues for Future Research

In light of the limitations of our study, future work can consider conducting a multi-vocal review of the academic and grey literature to reflect the current standing in practice. This may unveil methods not identified through our literature study and, as a result, may further extend the method base. Additionally, future research can also consider the applicability of evaluation methods outside of the business model field and examine how they can be used to support evaluation in the BMI process. Here, it would also be valuable to examine what methods are used for specific business model types (e.g., sustainability-oriented, collaborative, digital) and what differences between method groups can be observed and what can be learned from this.

Through our analysis of the primary articles, we have also identified a number of research gaps that future research in this field should consider. Firstly, with the increased interest in establishing sustainable business models (Bocken & Antikainen, 2018; Freudenreich et al., 2019), analysis of our primary articles reveals only limited support for business model evaluation that integrally considers both financial and non-financial cost-benefits in assessing the performance of business models. This also confirms the study by Bocken et al. (2015). Evaluation approaches that focus solely on financial outcomes are too limited to cater to the evaluation needs of future business models, which are public-oriented, social, and sustainability-driven (Yunus et al., 2010). Such models are explicitly aimed at maximizing social or enviromental rather than economic value outcomes. In these cases, methods or integrated approaches that support the effective comparison of not only economic but also social and environmental outcomes should be pursued. These approaches should also consider how this relates to the robustness of the business model

and whether the model can be scaled over time (Palomares-Aguirre et al., 2018). Through our investigation of primary studies, we observed that methods such as multi-criteria analysis and simulation analysis could aid the comparison between financial and non-financial outcomes. We believe that these method groups can thus serve as a valuable starting point for concrete method or tool development to support the evaluation of sustainability-oriented business models, which corresponds to the findings of Schoormann et al. (2018) and Süß et al. (2021). Here, it would also be valuable to consider how AI can be used in the context of sustainability to support these methods (Bracarense et al., 2022).

Complementary to this, many modern business models are directed at collaborative initiatives aimed at tackling sustainability or transition challenges, in which multiple stakeholders collaborate closely for the co-creation of value (Freudenreich et al., 2019; Turetken et al., 2019). In such settings, each stakeholder plays an essential role in making a business model viable and fostering sustainable impact. To facilitate this, mutual value capture should be pursued (Adali et al., 2021; Derks et al., 2022; Gilsing et al., 2018). Therefore, more research work is necessary to validate the applicability of existing methods in multi-party settings, emphasizing mutual value capture. Given the specific requirements posed in these settings, future research should consider adapting existing methods or designing new ones that can be effective in fulfilling these requirements.

Acknowledgments

We would like to thank Bambang Suratno and Anna Wilbik for their participation and support in this research. We would also like to thank the anonymous reviewers for their constructive feedback on previous versions of the manuscript.

https://aisel.aisnet.org/pajais/vol14/iss4/2
DOI: 10.17705/1pais.14402

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Appendix A. Set of Primary Articles

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[S2] Jia F., Wang X., Mustafee N., Hao L. (2016). Investigating the feasibility of supply chain-centric business models in 3D chocolate printing: A simulation study. *Technological Forecasting and Social Change, 102*, 202-213.

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Appendix B: Breakdown of Search Results

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Digital library	Initially retrieved	Finally selected
ACM Digital Library	73	5
AIS Electronic Library	64	5
Emerald Insight	33	10
ScienceDirect	1160	15
SciVerse Scopus	4226	9**
SpringerLink	2264*	25
Total	7820	69

* SpringerLink does not accommodate library search based on 'title, keyword, abstract'. As a result, primary studies were sorted on relevance and the search stopped if more than 100 studies were deemed irrelevant.
** Primary studies were also found and selected for different libraries.

https://aisel.aisnet.org/pajais/vol14/iss4/2
DOI: 10.17705/1pais.14402

Appendix C: Classification Scheme

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#	Pub. year	Article Type			Techniques identified for business model evaluation						Mapping to BMI Phases				Domain BM
		Journal paper	Conf. paper	Book Chapter	Expert Judgment	Scenario Analysis	MCA	FCBA	DSA	SA*	Initiation	Ideation	Integration	Implem-entation	Agnostic, Service, Digital, Sustainable
S1	2019	1	0	0	1	0	0	0	0	0	0	1	0	0	Agnostic
S2	2016	1	0	0	0	0	0	0	0	1	0	0	0	1	Agnostic
S3	2016	1	0	0	0	1	0	0	1	0	0	0	0	1	Agnostic
S4	2016	0	0	1	0	0	1	0	0	0	0	0	1	0	Service
S5	2008	1	0	0	1	1	0	0	0	0	0	1	0	0	Agnostic
S6	2013	1	0	0	0	1	0	0	1	0	0	0	0	1	Agnostic
S7	2013	1	0	0	1	1	0	0	0	0	1	1	1	0	Digital
S8	2008	1	0	0	0	1	0	0	0	1	0	0	1	0	Agnostic
S9	2009	1	0	0	1	0	1	0	0	1	0	1	1	0	Digital
S10	2013	1	0	0	1	1	1	1	0	0	0	1	1	0	Agnostic
S11	2007	0	1	0	1	0	0	0	0	0	0	1	1	0	Digital
S12	2008	0	0	1	0	1	0	0	0	1	0	0	0	1	Service
S13	2013	1	0	0	1	0	1	0	0	0	0	1	1	0	Agnostic
S14	2016	1	0	0	0	0	0	0	0	1	0	0	1	0	Digital
S15	2008	0	1	0	1	1	0	0	0	0	0	1	0	0	Digital
S16	2008	1	0	0	1	0	1	0	0	0	0	1	1	0	Agnostic
S17	2009	0	0	1	1	0	0	0	0	0	0	1	0	0	Agnostic
S18	2013	0	1	0	0	1	0	0	0	1	0	0	1	0	Agnostic
S19	2010	0	1	0	1	1	0	1	0	0	0	0	1	0	Agnostic
S20	2016	0	1	0	1	1	0	0	0	0	0	0	1	0	Digital
S21	2010	0	1	0	0	0	1	0	0	0	0	0	1	0	Digital
S22	2014	0	0	1	1	1	1	1	0	0	0	0	1	0	Agnostic
S23	2014	1	0	0	0	0	0	0	0	1	0	0	0	1	Agnostic
S24	2017	1	0	0	1	1	0	1	0	1	1	1	1	1	Sustainable
S25	2014	1	0	0	0	1	0	0	0	1	0	0	0	1	Agnostic
S26	2015	1	0	0	0	0	1	0	0	0	0	0	1	0	Agnostic
S27	2019	1	0	0	0	0	0	0	1	0	0	0	1	0	Agnostic
S28	2014	1	0	0	1	0	1	0	0	0	1	1	0	0	Agnostic

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#	Pub. year	Article Type			Techniques identified for business model evaluation						Mapping to BMI Phases				Domain BM
		Journal paper	Conf. paper	Book Chapter	Expert Judgment	Scenario Analysis	MCA	FCBA	DSA	SA*	Initiation	Ideation	Integration	Implem-entation	Agnostic, Service, Digital, Sustainable
S29	2015	1	0	0	0	1	0	1	0	1	0	0	1	0	Sustainable
S30	2002	1	0	0	0	1	0	0	0	1	0	0	1	0	Digital
S31	2004	1	0	0	0	0	0	1	0	0	0	0	0	1	Agnostic
S32	2004	0	1	0	0	0	0	1	0	0	0	0	1	0	Agnostic
S33	2017	1	0	0	0	1	0	0	0	0	0	1	0	0	Agnostic
S34	2018	1	0	0	0	0	0	0	1	0	0	0	1	0	Sustainable
S35	2017	1	0	0	0	0	0	0	1	0	0	0	0	1	Sustainable
S36	2017	1	0	0	1	0	0	0	0	0	0	0	1	0	Digital
S37	2018	0	1	0	1	1	0	0	0	0	0	1	1	0	Agnostic
S38	2019	1	0	0	1	0	1	0	0	0	0	1	1	0	Agnostic
S39	2019	1	0	0	1	1	0	0	0	0	0	1	0	0	Agnostic
S40	2019	0	1	0	0	0	0	0	1	0	0	0	1	0	Agnostic
S41	2018	1	0	0	1	1	0	0	0	0	0	0	1	0	Agnostic
S42	2018	1	0	0	1	0	0	0	0	0	0	0	1	0	Agnostic
S43	2019	1	0	0	0	1	0	0	0	1	0	0	1	0	Sustainable
S44	2011	1	0	0	0	0	0	0	0	1	0	0	0	1	Service
S45	2017	1	0	0	0	1	0	1	0	0	0	0	1	0	Agnostic
S46	2021	1	0	0	1	0	0	0	0	0	0	1	0	0	Service
S47	2020	1	0	0	0	0	0	1	0	0	0	0	0	1	Agnostic
S48	2019	0	0	1	1	0	0	0	0	0	0	0	1	0	Digital
S49	2010	1	0	0	0	0	1	0	0	0	0	1	0	0	Digital
S50	2020	1	0	0	0	0	1	0	0	0	0	0	1	0	Agnostic
S51	2015	1	0	0	1	0	0	0	0	0	0	1	0	0	Agnostic
S52	2015	1	0	0	1	0	0	0	0	0	0	1	0	0	Sustainable
S53	2001	1	0	0	0	0	0	1	0	0	0	0	1	0	Digital
S54	2013	1	0	0	0	0	1	0	0	0	0	1	0	0	Agnostic
S55	2016	0	0	1	0	1	0	1	0	0	0	0	1	0	Service
S56	2016	1	0	0	0	0	0	0	0	1	0	0	1	0	Service
S57	2019	0	1	0	0	0	0	1	0	0	0	0	1	0	Agnostic
S58	2019	0	1	0	0	1	1	0	0	0	0	0	1	0	Agnostic
S59	2021	1	0	0	1	0	0	0	0	0	0	0	1	0	Service

Appendix C - Classification Scheme															
#	Pub. year	Article Type			Techniques identified for business model evaluation						Mapping to BMI Phases				Domain BM
		Journal paper	Conf. paper	Book Chapter	Expert Judgment	Scenario Analysis	MCA	FCBA	DSA	SA*	Initiation	Ideation	Integration	Implem-entation	Agnostic, Service, Digital, Sustainable
S60	2021	1	0	0	0	0	0	0	0	1	0	0	0	1	Agnostic
S61	2021	1	0	0	0	0	0	0	1	0	0	1	1	0	Digital
S62	2021	0	1	0	0	0	0	0	1	0	0	0	1	0	Service
S63	2021	1	0	0	1	0	0	0	0	0	0	1	1	0	Digital
S64	2021	1	0	0	0	0	0	0	0	1	0	0	1	1	Agnostic
S65	2019	0	0	1	1	0	0	0	0	0	1	1	0	0	Agnostic
S66	2021	1	0	0	1	0	0	0	0	0	1	1	0	0	Sustainable
S67	2018	1	0	0	0	0	0	1	0	0	0	0	1	0	Agnostic
S68	2018	0	1	0	1	0	0	0	0	0	0	1	0	0	Digital
S69	2020	1	0	0	1	0	1	1	0	0	1	1	0	0	Sustainable

**MCA: Multi-criteria analysis; FCBA: Financial cost-benefit analysis; DSA: Dynamic systems analysis, SA: Scenario analysis.*

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https://aisel.aisnet.org/pajais/vol14/iss4/2
DOI: 10.17705/1pais.14402