Key Performance Indicators for Business Models: A Review of Literature

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Research Paper

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Abstract

To support decision-making during the business model innovation process, researchers have investigated approaches for evaluating business models. Key Performance Indicators (KPIs) related to business models can play an important role in evaluating the performance of business models, as they reflect the decisions and activities that drive the critical aspects of the organization. To date, there has been considerable research on business model KPIs. However, current research lacks an overall understanding of how business model KPIs are managed. Therefore, this paper aims to contribute with a classification of existing studies on business model KPIs in five categories relevant to KPI management, as well as future research avenues. In particular, we identify the development of methods and software tools to support selection, concretization, and reporting of business model KPIs, and the design of an integrated approach for business model KPI management as important areas for further research.

Keywords: Business models, Performance Indicators, Performance Measurement, Literature review.

1 Introduction

Today's dynamic business environment is characterized by ongoing digital innovation and increased stakeholder pressure (Al-Debei and Avison, 2010). To stay competitive, organizations focus on adapting or innovating their business models to change the way they do business (Foss and Saebi, 2017; Wirtz and Daiser, 2018). A business model describes the design or architecture of how an organization creates, delivers, and captures value (Teece, 2010). It functions as a useful concept to represent, analyze, and manage the business logic of an organization (Osterwalder et al., 2005). Therefore, the business model has become increasingly established both in research and practice (Baden-Fuller and Morgan, 2010).

While it is of vital importance for organizations to continuously reconsider and change the way they do business, innovating a business model is not an easy task (Chesbrough, 2010). Generally, the process of business model innovation comprises four phases: analyzing an organization's existing business model,

designing a new model, implementing the newly designed model, and controlling the success of the implemented model (Bucherer et al., 2012). Throughout this process, organizations face challenges of managing idea creation, internal resistance to change, and conducting pilots to test the new business model (Frankenberger et al., 2013). To reduce uncertainty and ease implementation, researchers have investigated approaches for evaluating business models during the innovation process (Budler et al., 2021). As a result, several methods and tools have been developed to support business model evaluation (Schoormann et al., 2018; Tesch and Brillinger, 2017).

Key Performance Indicators (KPIs) related to business models can play an important role in evaluating the performance of business models, as they reflect the decisions and activities "*that influence the critical dimensions of performance for a firm*" (McGrath, 2010, p. 252). KPIs are a set of performance indicators (also called measures or metrics) that capture the most important performance aspects for the current and future success of an organization (Parmenter, 2020). Organizations can use KPIs to specify measurable objectives for their business models and assess the extent to which these objectives have been reached (Gilsing et al., 2021b; Heikkilä et al., 2016).

Recent studies on business model evaluation confirm the key role that KPIs can play in evaluating business models (Schoormann et al., 2018; Tesch and Brillinger, 2017). To support practitioners in defining and selecting KPIs, several studies present repositories of business model KPIs (Dubosson-Torbay et al., 2002; Heikkilä et al., 2016; di Valentin et al., 2012c). However, existing studies focus predominantly on the definition of specific business model KPIs and provide limited support for their further concretization and measurement.

Organizations are still facing challenges in identifying relevant KPIs for their business models and refining and measuring them throughout their lifecycle (Terrenghi et al., 2017). Particularly the early phases of business model innovation are characterized by high uncertainty and limited data availability (McGrath, 2010). Despite several research contributions, we lack an understanding of how existing research supports organizations in systematically managing their business model KPIs - from the definition, selection, operationalization, to measurement and reporting.

To address this gap, we conducted a systematic literature review *with the objective to identify and analyse related works and portray the current state of the research on business model KPIs*. We developed a concept matrix to characterize relevant studies. Based on our review and synthesis of these studies, we formulated avenues for further research on the management of business model KPIs.

Our work contributes to the information systems research, in particular, to the field of business models, by providing a basis for further exploration of business model KPI management. Through the concept matrix developed in this study, we analyze the type of approaches (e.g., those providing a repository of KPIs or a method to manage KPIs), decision-making support enabled by the approaches by using KPIs, the use of qualitative or quantitative KPIs in the approaches, and the context for which the approach is designed. Thereby our research responds to the multiple calls in the literature for investigating the use of KPIs for evaluating business models (Burkhart et al., 2011; Nielsen et al., 2018; Wirtz et al., 2016). We contribute to practice by providing a structured overview of the available approaches for managing business model KPIs that can be used during the different phases of the business model innovation process.

The remainder of this paper is structured as follows. In Section 2, we provide the theoretical background on the key concepts of business model, KPI management, and business model evaluation using KPIs. In Section 3, we describe our research approach and the development of the concept matrix. The results of the review are presented in Section 4. In Section 5, we discuss the results and outline opportunities for future research. In Section 6, we conclude our review and discuss its limitations.

2 Theoretical Background

2.1 The business model concept

Over the last 20 years, business model research has gained importance in several research domains, including information systems (Al-Debei and Avison, 2010; Veit et al., 2014), technology and innovation management (Chesbrough and Rosenbloom, 2002; Teece, 2010), strategic management (Casadesus-Masanell and Ricart, 2010; Richardson, 2008), and more recently, entrepreneurship (George and Bock, 2011; Trimi and Berbegal-Mirabent, 2012) and environmental sustainability (Geissdoerfer et al., 2018; Lüdeke-Freund et al., 2018). From this vast amount of research, there have been many definitions of the business model (Al-Debei and Avison, 2010; Massa et al., 2017; Zott et al., 2011). While initially the term "business model" was often used interchangeably with other terms, such as "business process", "revenue model", and "strategy" (DaSilva and Trkman, 2014), there is a growing consensus about how a business model is defined (Foss and Saebi, 2017). In this paper, we adopt the definition of Teece (2010), who defines a business model as *the design or architecture of the value creation, delivery, and capture mechanisms"* of an organization (p.172). In other words, a business model describes what value proposition the company offers and who the target customer is, what capabilities are needed to support this, and what costs and benefits are associated with this. Most organizations adopt more than one business model targeted at different customer segments (Schwarz et al., 2017). For example, Daimler decided to complement its traditional car manufacturing business model with a new car-sharing business model under the brand Car2go (Globocnik et al., 2020).

From an information systems perspective, a business model functions as an intermediary between an organization's strategy and business processes, including its IT systems (Veit et al., 2014). The nature of information that each concept offers represents the main difference between these organizational layers (Al-Debei and Avison, 2010). While a strategy provides a set of high-level choices of how an organization will compete in a certain industry, the business model depicts the tactical choices about how value is created for target customers and how the organization captures value from this (Casadesus-Masanell and Ricart, 2010). In contrast, business processes provide a more detailed description of how an organization's operations are executed (Gordijn et al., 2000; Turetken et al., 2019). Consequently, the business model has emerged as a distinct unit of analysis and innovation that exceeds the scope of other concepts, such as products and services (Bucherer et al., 2012; Frankenberger et al., 2013).

To support the design and management of business models, several frameworks, methods, and tools have been put forward in the literature (Bouwman et al., 2020). In both research and practice, the most influential business model framework is the Business Model Canvas (BMC) by Osterwalder and Pigneur (2010). Originally based on the Business Model Ontology (BMO) (Osterwalder, 2004), the BMC consists of nine building blocks of business models, namely value proposition, customer segments, customer relationships, channels, key partners, key activities, key resources, cost structure, and revenue streams (Osterwalder and Pigneur, 2010). It poses as the quasi-standard for analyzing and communicating about business models (Foss and Saebi, 2018; Massa et al., 2017). Other frequently used business model frameworks and conceptualizations include the unified business model framework (Al-Debei and Avison, 2010) and STOF ontology (Bouwman et al., 2008).

2.2 Managing key performance indicators

Organizations need to evaluate their activities and systems to determine the extent to which their objectives are being fulfilled. Therefore, they carry out performance measurement activities, for which they make use of metrics known as Key Performance Indicators (KPIs) (Domínguez et al., 2019). KPIs are defined as *"those indicators that focus on the aspects of organizational performance that are the most critical for the current and future success of the organization"* (Parmenter, 2020, p. 6). KPIs are used to measure the impact of change, and, thus, are distinct from other performance concepts such as "evaluation criteria" (used to assess whether or not performance has changed) and "success factors" (used to explain the drivers behind performance) (Parmenter, 2020). According to a global survey among

over 3000 organizations by the Advanced Performance Institute, 77% of companies use KPIs as a performance measurement instrument (Marr, 2012). Thereby the use of KPIs is the most popular approach to measure performance in practice, surpassing other methods and tools such as performance appraisals, mission and vision statements, and Lean/Six Sigma management (Marr, 2012).

KPIs are used to measure performance at different organizational levels. While KPIs at the strategic level are often driven by external stakeholder perspectives, managers at the tactical level (i.e., the level of the business model) use KPIs to allocate resources and evaluate business performance against strategic objectives (Chennell et al., 2000; Gunasekaran et al., 2004). At the operational level, performance measures and metrics require accurate data to assess the decisions of operational managers in charge of the processes that support the delivery of products and services to the customer (Chennell et al., 2000; Gunasekaran et al., 2004).

Performance measurement models are a useful tool to support the definition and analysis of KPIs (Nudurupati et al., 2011). They are used for performance measurement in many different fields, including strategic management (Kaplan and Norton, 1996), business process management (van Looy and Shafagatova, 2016), enterprise architecture (Schelp and Stutz, 2007), and supply chain management (Gunasekaran et al., 2004). One of the most well-known performance measurement models is the Balanced Scorecard (BSC) developed by Kaplan and Norton (1992, 1996). The BSC is a framework used for translating an organization's strategic objectives into measurable outcomes, based on four dimensions of organizational performance: financial, customer, internal business processes, and "learning and growth". It is the most frequently used performance measurement framework in both research and practice (Bain & Company, 2018; Neely et al., 2005). Other frequently discussed frameworks in the literature include the Performance Pyramid (Cross and Lynch, 1988), Performance Measurement Matrix (Keegan et al., 1989), and Performance Prism (Neely et al., 2001).

Notably, the design of the BMC was also partly based on the four dimensions of the BSC (Osterwalder, 2004). However, the BMC aims to provide a more granular and detailed description of business logic of an organization, which goes beyond the four high-level strategic perspectives of the BSC (Nielsen et al., 2017). Thus, in the context of performance measurement, the business model concept can guide the identification of dedicated business model KPIs that can be observed and compared (Montemari et al., 2019; Osterwalder et al., 2005). As in the example of Daimler, customer satisfaction can be measured as an organizational KPI to evaluate the strategy and overall performance of the firm (Williams and Naumann, 2011). However, since Daimler is running multiple business models in parallel (i.e., a manufacturing and a car-sharing business model), the organization would also want to measure customer satisfaction separately for its distinct business models that are targeted at different customer segments, to manage how they perform (Globocnik et al., 2020).

2.3 Business model evaluation using key performance indicators

In recent years, there has been a rise in the number of publications related to business model evaluation (Budler et al., 2021). Business model evaluation activities are performed during the early phases of the business model innovation process (i.e., analysis and design) to assess different business model alternatives and support design decisions (Gilsing et al., 2020; Mateu and Escribá-Esteve, 2019). During posterior phases of business model innovation (i.e., implementation and operation), business model evaluation aids in assessing business cases, monitoring operational performance, and mitigating risks and uncertainty regarding the newly implemented business model (Terrenghi et al., 2017; Wirtz et al., 2016).

Several evaluation approaches are presented in the literature for different phases of the business model innovation process (Schoormann et al., 2018; Tesch and Brillinger, 2017). Evaluation approaches performed prior to the implementation of the business model leverage domain knowledge and compare KPIs in different scenarios to qualitatively evaluate strategic opportunities and evaluate the fit of potential business model alternatives (Gilsing et al., 2021b). Meanwhile, evaluation approaches used after a business model has been implemented often make use of quantitative approaches, such as system

dynamics and simulation analysis, to evaluate profitability, operational robustness, and financial and non-financial outcomes of the business model (Moellers et al., 2019).

One possible way to evaluate business models is by using KPIs (Gilsing et al., 2021b; Heikkilä et al., 2016). Business model KPIs can be used and managed in various ways, both before and after business model implementation. Prior to business model implementation, organizations can use KPIs to formulate measurable objectives for business model performance (Heikkilä et al., 2014). For example, organizations may be interested in measuring the satisfaction of customer needs, which is an important indicator of business model performance (Wirtz, 2020). After business model implementation, KPIs can be used for monitoring the performance of a business model in operation, to timely adapt and improve the model when performance deflects (di Valentin et al., 2013). Both before and after implementation, KPIs can provide a way to compare alternative business models and benchmark an organization's business model against those of competitors (Afuah and Tucci, 2003). Therefore, KPIs are instrumental for business model evaluation as they can be used to measure, monitor and compare business model performance during the different phases of the business model innovation process.

3 Research Approach

The objective of this study is to identify and analyze existing approaches for managing business model KPIs. To this end, we conducted a systematic literature review following the guidelines by Okoli (2015) and Webster and Watson (2002). Accordingly, our research process comprises the following four main phases: *planning*, *selection*, *extraction*, and *execution* (Okoli, 2015). The following subsections describe the literature search, selection process, and the development of a concept matrix based on the analysis of the selected studies.

3.1 Systematic literature review process

During the *planning phase*, we defined the objective of our review (presented in Section 1) as to depict the current state of the research on business model KPIs. Subsequently, we described the protocol that we followed to discover and examine relevant studies as described below.

Next, in the *selection phase*, we first conducted pilot searches in selected academic libraries using different combinations of keywords. Based on this initial search, we specified the following search string: *"business model*" AND ("performance indicator*" OR "performance measure*" OR "performance metric*" OR "KPI*")*. We included the terms (key) performance indicator, performance measure, and performance metric in our search string since these are often used interchangeably in the literature (Lebas and Euske, 2007). In this paper, we adopt the term "KPI", as this is often used by managers in practice to refer to a carefully selected set of performance indicators with a specific purpose in mind (Hope, 2007). After having determined the search string, we defined several criteria for including or excluding studies during our review. In line with our research objective, we included studies that introduce KPIs dedicated to business models or approaches for managing business model KPIs. Moreover, the studies needed to explicitly adopt a non-trivial definition of the business model concept, aligned with the definition given in Section 2. In addition, we focused only on established works and included studies that are published as journal articles, conference papers, or book chapters (and excluded those that are published as workshop proceedings, book editorials, and case study descriptions). Subsequently, we selected *Scopus*, *Web of Science*, and *AISeL* digital libraries to identify relevant studies, as their combination cover the venues that are most relevant to the objective of our study (Bandara et al., 2011). Within these libraries, we conducted a title, abstract, and keywords search using the specified search string, which resulted in an initial set of 812 studies (as of 20-Sep-2021).

Figure 1 provides an overview of the process we followed in the *extraction* phase, where we systematically extracted relevant information from our initial set. As some studies were present in more than one of the selected libraries, we first eliminated 223 duplicate studies. Next, we screened the titles, abstracts, and keywords of the remaining 589 studies based on our inclusion and exclusion criteria. To increase the reliability of our research, the two leading authors of this paper evaluated the relevance of

each study. The screening of title, abstract, and keywords resulted in an exclusion of 376 studies. Two researchers reviewed the full text of the remaining 213 studies. During this step, we found that some authors published multiple studies regarding the development of a single approach (e.g., Gilsing et al., 2021b; Wilbik et al., 2020). In these cases, we selected the most comprehensive study.
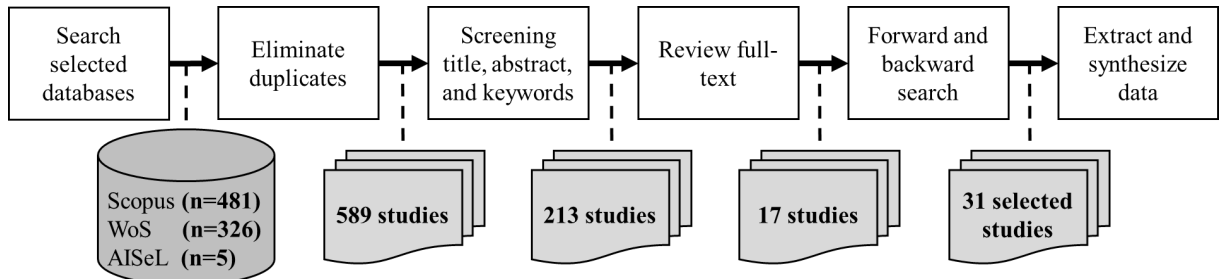

Figure 1.   Overview of research process in the extraction phase.

Based on the full text-review, we selected 17 papers that we deemed relevant for the scope of our review and that met the inclusion/exclusion criteria. Next, we performed a snowballing search by inspecting the reference lists of the papers (backward), and by using the 'cited by' option in Google Scholar (forward). We kept snowballing until no further relevant papers were found, as suggested by Webster and Watson (2002). This resulted in the discovery of an additional set of 14 relevant papers, leading to a final set of 31 selected studies.

Finally, in the *execution phase*, we analyzed and synthesized the findings from the selected papers. We analyzed the final set of 31 studies following a concept-centric approach through a *concept matrix* (Webster and Watson, 2002), which was developed iteratively during the analysis phase. The goal of developing a concept matrix is to provide an overview of the existing literature and identify knowledge gaps that can pose as opportunities for further research (vom Brocke et al., 2009). The identified studies are positioned in the left column of the matrix, and the relevant concepts and their corresponding subcategories are positioned in the remaining columns. We describe the development process of the concept matrix in the next subsection.

3.2   Development of the concept matrix

The concepts and categories in the concept matrix, as well as their respective dimensions were derived based on the theoretical works on business models and KPIs and refined through an iterative process of analyzing the selected studies. We derived the following concepts from the literature: the *type of approach*, the *decision-making support* offered in different KPI lifecycle phases, the *stage* at which the KPIs are used, KPI *type*, and *context* for which the approach is designed.

We consider *types of approaches* of papers in the form of design artefacts (Hevner *et al.*, 2004). Accordingly, artefacts can be *constructs* (vocabulary, symbols), *models* (abstractions, representations), *methods* (practices), and *instantiations* (implementations, prototype systems). In the context of our research, we do not seek for *constructs* as approaches, and consider *KPIs*, *repositories of KPIs*, and *frameworks* as types of *models*. We interpret *KPIs* as a central aspect of performance to the current and future success of an organization (Parmenter, 2020). While some studies give examples of KPIs, others systematically propose *repositories of KPIs*. Moreover, several studies develop a *framework* from which business model KPIs can be derived.

The existing methods and tools provide *decision-making support* for different phases of the lifecycle of a KPI. Based on lifecycles mentioned in the existing literature (Glas et al., 2018; Mourtzis et al., 2018), and inspired by the business process KPI lifecycle by Del-Río-Ortega and Resinas (2009) and the KPI management taxonomy by Domínguez et al. (2019), we uncovered five generic phases in the lifecycle of business model KPIs: *definition, selection, operationalization, measurement*, and *reporting*. During the *definition* phase, KPIs are identified and defined to measure the performance of a certain business model. The *selection phase* involves picking a set of relevant KPIs based on the organization's strategic

objectives. Subsequently, the selected KPIs are gradually concretized during the *operationalization* phase. In the *measurement* phase, the values of the concretized KPIs are calculated. To do this, performance data and information about the business model need to be gathered. Lastly, in the *reporting* phase, the measured KPI values are summarized into a comprehensive report or dashboard, which can then be monitored by the responsible decision-makers.

KPIs are used in two *stages*: *ex-ante realization* and *ex-post realization*. The use of KPIs in *ex-ante realization* implies that the KPIs are defined and evaluated during the design phase of a new business model, before the new model is implemented (Gilsing et al., 2021a; Heikkilä et al., 2014). In the early phases of business model design, KPIs and their associated values often take the form of qualitative statements, based on the intentions and expectations of the focal organization's management (Gilsing et al., 2021b). These qualitative KPIs are then concretized when the newly designed business model is implemented (Heikkilä et al., 2016). Subsequently, KPIs are used in *ex-post realization* to monitor and control the performance of the new model, based on the concrete KPIs and their expected values (Terrenghi et al., 2017; Wirtz et al., 2016).

We identify two *types of KPIs*: *quantitative* and *qualitative* (Domínguez et al., 2019). Qualitative KPIs are metrics that are not directly measurable (Popova and Sharpanskykh, 2010). Examples of such KPIs in the business model context include customer satisfaction, brand image, and service quality (Heikkilä et al., 2016). Qualitative KPIs can be measured by aggregating other metrics, or by, for example, conducting survey data analysis (Domínguez et al., 2019). On the other hand, quantitative KPIs are hard performance indicators that are directly measurable (Popova and Sharpanskykh, 2010). With respect to business models, examples of quantitative KPIs include the number of unique visitors, number of customer complaints, time to market (in days), and average order size (Heikkilä et al., 2016).

The *context* of the approach describes the business model level for which the approach is designed. Following Osterwalder et al. (2005), we make a distinction between two conceptual levels of the business model: approaches that are focused on managing KPIs for a *specific type* of business model, such as start-ups and governmental organizations, and approaches that are focused on KPI management for *business models in general*.

4   Results

Table 1 provides an overview of the selected 31 studies that we included in our literature review, and how they differ based on the type of approach, the decision-making support offered in the KPI lifecycle, the stage at which the KPIs are used for evaluation, KPI type, and context of the approach. In the following subsections, we synthesize and discuss the extant research based on the categories in the concept matrix.

4.1   Type of approach

We found a large variety of *Key Performance Indicators (KPIs)* for business models presented in the literature. Examples of business model KPIs include customer satisfaction, number of partners, average delivery time, service availability, R&D expenses, and profit margin (Heikkilä et al., 2016; Montemari et al., 2019). Existing studies mainly focus on defining KPIs in a specific context, such as e-business (Afuah and Tucci, 2003; Dubosson-Torbay et al., 2002; Yu, 2006) or networked business models (Heikkilä et al., 2014, 2016; Rodríguez-Rodríguez et al., 2015), rather than developing generic KPIs for any type of business model. Furthermore, most researchers consider KPIs related to financial aspects, such as operational costs, revenue growth, and profitability as important indicators of business model performance (Afuah and Tucci, 2003; Kijl and Boersma, 2010; Wirtz, 2020). Additionally, we observe an increasing interest in defining and measuring non-financial costs and benefits of business models, such as environmental impact, and societal benefits (Lüdeke-Freund et al., 2017; Turetken et al., 2019).

Selected studies	Type of Approach					Decision-making Support					Stage of use		Type of KPIs		Context	
	Model			Method	Instantiation	Definition	Selection	Operationalization	Measurement	Reporting	Ex-ante realization	Ex-post realization	Qualitative	Quantitative	Specific type	General
	KPI	Repository of KPIs	Framework													
Afuah & Tucci (2003)	x	x	x	x		x		x	x		x	x	x	x	x	
Augenstein et al. (2018)				x	x	x		x	x	x	x	x		x		x
Batocchio et al. (2017)	x		x	x		x	x	x	x	x		x		x	x	
Bouwman (2003)	x	x	x			x		x	x		x		x	x	x	
Bouwman & van den Ham (2004)	x	x				x		x	x		x		x	x	x	
di Valentin et al. (2012a)	x	x	x			x			x			x	x	x		x
di Valentin et al. (2012c)	x	x				x			x			x	x	x	x	
di Valentin et al. (2013)					x	x	x	x		x	x	x			x	
Díaz-Díaz et al. (2017)	x	x	x	x		x		x	x	x	x		x		x	
Dubosson-Torbay et al. (2002)	x	x	x			x			x		x	x	x	x	x	
Gilsing et al. (2021b)	x			x		x	x					x		x		x
Glas et al. (2018)	x	x	x			x	x		x	x	x	x	x	x	x	
Heikkilä et al. (2010)	x		x	x		x	x	x	x		x			x		x
Heikkilä et al. (2014)	x		x	x		x	x	x	x		x		x	x	x	
Heikkilä et al. (2016)	x	x	x			x	x	x	x		x	x	x	x	x	
Kastalli et al. (2013)	x		x			x		x	x	x	x	x	x	x	x	
Khoshalhan & Kaldi (2007)	x	x				x		x				x	x	x	x	
Kijl & Boersma (2010)	x	x		x	x	x			x	x	x			x		x
Kriegel et al. (2016)	x	x				x					x		x	x	x	
Lüdeke-Freund et al. (2017)	x		x	x		x						x	x	x	x	
Minatogawa et al. (2020)	x		x	x		x	x	x	x	x	x	x		x		x
Montemari et al. (2019)	x		x			x	x	x				x	x	x		x
Morioka et al. (2016)			x			x		x				x	x	x	x	
Mourtzis et al. (2018)	x		x	x	x	x	x	x	x	x	x	x	x	x	x	
Nielsen et al. (2017)	x	x			x	x	x					x	x	x		x
Osterwalder et al. (2005)			x			x				x		x				x
Rodríguez-Rodríguez et al. (2015)	x	x		x		x			x		x	x	x	x	x	
Schaffer et al. (2020)				x	x	x		x	x	x	x	x		x		x
Wirtz (2020)	x	x	x			x		x	x			x	x	x		x
Yu (2006)	x	x	x	x		x					x		x	x	x	
Yu (2014)	x	x	x	x		x					x	x	x	x	x	
Total (n=31)	**26**	**17**	**19**	**16**	**6**	**31**	**11**	**18**	**20**	**11**	**21**	**22**	**23**	**27**	**21**	**10**

Table 1.   Concept matrix of studies on business model KPI management.

To introduce business model KPIs in a structured way, researchers also present them in the form of a *repository* (Glas et al., 2018; Heikkilä et al., 2016; Kriegel et al., 2016). The KPI repositories presented in the literature are often structured based on a set of specific elements, such as business model dimensions (Heikkilä et al., 2016), industry types (Glas et al., 2018), or value chain activities (di Valentin et al., 2012c). To come up with the set of KPIs in a repository, researchers often carry out literature reviews (Glas et al., 2018), expert interviews (di Valentin et al., 2012c), or a combination of both (Kriegel et al., 2016). Two studies also propose to digitize their KPI repository in a software-based database (Mourtzis et al., 2018; Nielsen et al., 2017). One study that stands out is the work by Heikkilä et al. (2016), which features an extensive repository of KPIs for networked business models, based on business model and performance measurement literature. The repository is structured using the business model elements of the CSOFT ontology (Heikkilä et al., 2010): Customer, Service, Technical, Organizational, Financial, and extended with three additional perspectives specific for networked organizations: Value Exchange, Information exchange, and Process alignment (Solaimani and Bouwman, 2012).

Regarding studies that develop *frameworks*, we found that current research often builds on existing frameworks for the development of new ones. We identified six studies that design a new framework based on Kaplan and Norton's (1992, 1996) Balanced Scorecard (BSC) (e.g., Lüdeke-Freund et al., 2017; Yu, 2006, 2014). In total, 19 of the 31 studies mentioned the BSC, which confirms that it is still a prominent framework for managing KPIs, as we already indicated in Section 2.2. Moreover, four studies used the Business Model Canvas (BMC) (Osterwalder and Pigneur, 2010) or Business Model Ontology (BMO) (Osterwalder, 2004) as a basis for developing a business model KPI framework (Batocchio et al., 2017; Díaz-Díaz et al., 2017; Minatogawa et al., 2019; Osterwalder et al., 2005). Other frequently used or cited frameworks include the CSOFT ontology (Customer-Service-Organisation-Finances-Technology) (Heikkilä et al., 2010), and Performance Prism (Neely et al., 2001).

Compared to the number of models presented in the literature, extant research has paid less attention to developing *methods* for business model KPI management. Our literature review revealed methods for defining qualitative KPIs during early-phases of decision-making (e.g., Gilsing et al., 2021b), as well methods that support KPI selection (e.g., Mourtzis et al., 2018). Several authors divide their method into steps, with explicit guidelines for the activities to carry out in each step (Batocchio et al., 2017; Heikkilä et al., 2014; Montemari et al., 2019), and some studies demonstrate their method through an application in one or multiple case studies (e.g., Afuah and Tucci, 2003; Minatogawa et al., 2019; Rodríguez-Rodríguez et al., 2015). Furthermore, methods presented in the literature are often catered towards a certain business model context, such as start-ups (Batocchio et al., 2017), smart cities (Díaz-Díaz et al., 2017), and sustainable business models (Lüdeke-Freund et al., 2017; Minatogawa et al., 2019). Moreover, some methods support the design of performance measurement systems based on business models (Heikkilä et al., 2010, 2014; Montemari et al., 2019). Lastly, we identified studies that present design principles for software tools that support KPI management, which serve as guidelines for software development and implementation (Kijl and Boersma, 2010; Schaffer et al., 2020).

In total we found six studies that develop *instantiations* that support business model KPI management. An interesting software instantiation is developed by Mourtzis et al. (2018), who present an integrated software tool for selecting and assessing KPIs of product-service system (PSS) business models (Goedkoop et al., 1999). The tool also supports decision-makers in collecting, storing, processing, and visualizing PSS KPIs. Moreover, we identified three studies that present software instantiations to support the monitoring of business model dynamics and transformation (Augenstein et al., 2018; Schaffer et al., 2020; di Valentin et al., 2013). In these instantiations, data is extracted from an organization's ERP systems and databases, and changes in business model KPIs are measured and visualized in a dashboard.

4.2   Decision-making support during KPI lifecycle phases

Figure 2 provides an overview of the approaches that support decision-making in each phase of the business model KPI lifecycle (see Section 3.2) that we identified in the existing literature. In this subsection, we discuss the approaches per KPI lifecycle phase.
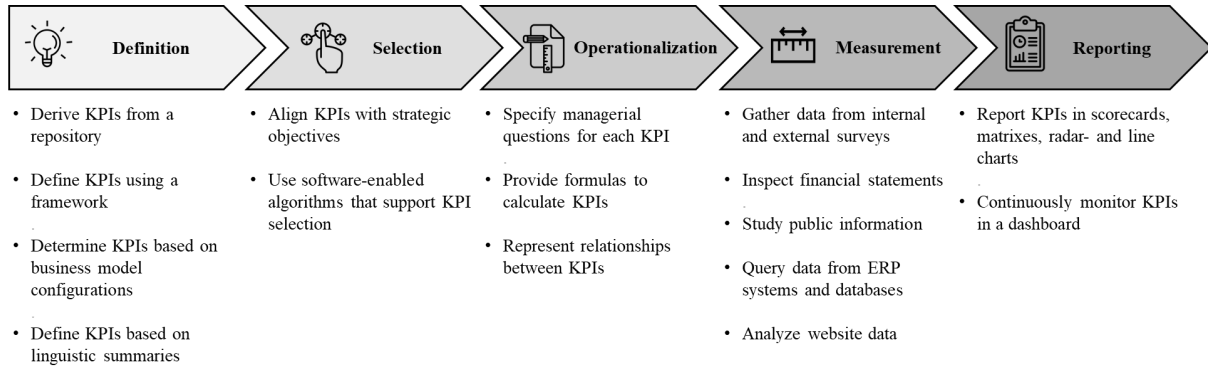

Definition	Selection	Operationalization	Measurement	Reporting
• Derive KPIs from a repository	• Align KPIs with strategic objectives	• Specify managerial questions for each KPI	• Gather data from internal and external surveys	• Report KPIs in scorecards, matrixes, radar- and line charts
• Define KPIs using a framework	• Use software-enabled algorithms that support KPI selection	• Provide formulas to calculate KPIs	• Inspect financial statements	• Continuously monitor KPIs in a dashboard
• Determine KPIs based on business model configurations		• Represent relationships between KPIs	• Study public information	
• Define KPIs based on linguistic summaries			• Query data from ERP systems and databases	
			• Analyze website data	

Figure 2.   Business model KPI lifecycle and identified approaches for each phase.

All selected studies provide support for the *definition* of business model KPIs. We identified four types of approaches in the literature that support KPI definition. The most common approach is to provide a repository, list, or catalogue of KPIs relevant to business models (Heikkilä et al., 2016; Kriegel et al., 2016; di Valentin et al., 2012c). The second approach consists of studies that develop performance measurement frameworks. Instead of offering a list of pre-defined KPIs, these studies allow decision-makers to derive more specific KPIs based on the measurement areas and high-level indicators in the framework (Bouwman and van den Ham, 2004; Lüdeke-Freund et al., 2017; Yu, 2006). Moreover, several studies propose to specify KPIs based on the performance drivers of the organization, that are linked to specific configurations of business model elements (Montemari et al., 2019; Nielsen et al., 2017). Lastly, one study (Gilsing et al., 2021b) propose a set of protoforms (i.e., descriptive suggestions) to support the definition of KPIs for the different actor roles present in service-dominant business models: customer, orchestrator, or global perspective.

While a wide variety of studies provide models and methods that support in KPI definition, we identified only a few approaches for *selecting* KPIs. Most studies that do discuss KPI selection point out that the indicators should be aligned with the organization's strategic objectives (Batocchio et al., 2017; Heikkilä et al., 2014) and their corresponding performance drivers (Montemari et al., 2019), similar to how Balanced Scorecard measures are determined based on the organization's strategy (Kaplan and Norton, 1992, 1996). In the majority of the studies, researchers propose to make a selection of KPIs based on discussions with managers of the focal organization who are responsible for managing the business model (Batocchio et al., 2017; Heikkilä et al., 2016). We identified three studies that propose software-enabled algorithms that suggest relevant KPIs based on weighted criteria (Mourtzis et al., 2018) or the organization's business model configuration (Nielsen et al., 2017; di Valentin et al., 2013).

Existing research provides different ways to support the *operationalization* of business model KPIs. A few studies specify managerial questions for each KPI, to reduce complexity and guide decision-makers in quantifying their selected metrics (Afuah and Tucci, 2003; Bouwman and van den Ham, 2004; Díaz-Díaz *et al.*, 2017; Wirtz, 2020). Moreover, six studies provide specific formulas to express how a particular KPI is calculated (e.g., Kijl and Boersma, 2010; Minatogawa et al., 2019; Wirtz, 2020). Lastly, four studies propose to represent the relationships between KPIs in a conceptual model (Bouwman, 2003; Minatogawa et al., 2019; Morioka et al., 2016; Rodríguez-Rodríguez et al., 2015). Relationships between KPIs are modelled to show cause-and-effect relationships (e.g., Minatogawa et al., 2019), or to represent the links between KPIs and activities of an organization (e.g., Morioka et al., 2016).

With respect to the *measurement* of business model KPIs, several ways to collect relevant data are presented in the literature. The most frequently reported way to collect data is by organizing workshops

and interviews with responsible managers of the focal organization (e.g., Heikkilä et al., 2016; Kijl and Boersma, 2010; Montemari et al., 2019). Moreover, some studies propose to carry out surveys among employees, external partners, or customers (e.g., Glas et al., 2018; Heikkilä et al., 2014; Wirtz, 2020). Other methods for data collection include inspecting financial statements (e.g., Bouwman and van den Ham, 2004; Morioka et al., 2016), and studying public information (e.g., Díaz-Díaz et al., 2017; Dubosson-Torbay et al., 2002; Heikkilä et al., 2010). Furthermore, several authors suggest to retrieve data from an organization's IT systems, for instance by querying ERP systems and databases (Augenstein et al., 2018; Glas et al., 2018; di Valentin et al., 2012a) or analyzing a company's website data (Bouwman and van den Ham, 2004; Minatogawa et al., 2019).

To *report* the measured values of KPIs in a single report, we observe the use of scorecards (Batocchio et al., 2017; Osterwalder et al., 2005), matrix overviews (Kastalli et al., 2013), radar charts (Díaz-Díaz et al., 2017), and line charts (Minatogawa et al., 2019). For the continuous monitoring and reporting of KPIs, a few studies provide prototypes and design principles for dashboards to visualize performance data (Augenstein et al., 2018; Mourtzis et al., 2018; Schaffer et al., 2020; di Valentin et al., 2013).

4.3 Stage of use of the approach

In approaches used in the *ex-ante realization* stage of the business model, KPIs are defined and evaluated to make predictive analyses and reduce business model risks (Augenstein et al., 2018; Kijl and Boersma, 2010). Several authors propose to use KPIs to make estimations about business model performance in future scenarios (e.g., Heikkilä et al., 2010; Rodríguez-Rodríguez et al., 2015). Moreover, a few studies propose methods and frameworks that support the benchmarking of business model alternatives or the comparison of an organization's business model with those of competitors, which can be carried out in both the ex-ante and ex-post realization stage (e.g., Afuah and Tucci, 2003; Morioka et al., 2016).

In *ex-post realization* of the business model, KPIs are used to gather insights about the current or past performance of an organization's business model (Batocchio et al., 2017). For this stage, we found several studies that present software instantiations that support the continuous monitoring of business model KPIs to track the performance and dynamics of a business model in operation (Schaffer et al., 2020; di Valentin et al., 2013). By keeping track of business model KPIs, managers can compare the actual performance of a business model with its expected performance (Globocnik et al., 2020). If the performance of a business model deflects, this may trigger managers to create detailed action plans for re-designing the business model, for example by adapting the business model's underlying business processes (Suratno et al., 2018; di Valentin et al., 2012b).

4.4 Type of key performance indicators

In the literature, two studies introduce approaches that are exclusively focused on *qualitative KPIs*. Gilsing, et al., (2021b) present a method for defining qualitative KPIs for business models using linguistic summaries. An example of such a linguistic summary that includes a KPI and an expected value is: *Most of the customers use the service easily*. These soft-quantified KPIs can gradually be concretized and quantified during later phases, when the business model is implemented (Gilsing et al., 2021b). Moreover, Díaz-Díaz et al., (2017) introduce a questionnaire-based evaluation approach, which includes 29 qualitative questions to assess the business model based on six KPIs. The answers to the questions are translated into quantifiable levels to assess business model performance.

Six studies provide approaches that focus exclusively on *quantitative KPIs*. Most of these studies have a focus on financial KPIs such as product price, operational costs, and return on investment (Afuah and Tucci, 2003). For example, based on expert interviews, Kijl and Boersma (2010) derive the following finance-related KPIs: total turnover, gross margin, profit after tax, margin per e-mail, re-investable profit, and investment portfolio value.

Many studies make use of a *mix* of both qualitative and quantitative KPIs. Oftentimes in these studies, quantitative KPIs are measured first to calculate an aggregated qualitative KPI. For instance, Kastalli et al., (2013) propose a "*complementarity index*" as a critical KPI for manufacturing firms that adopt

product-service system (PSS) business models. The value of this index is calculated based on sales numbers (quantitative), and can indicate a negative, substitutive, positive, or complementary relationship (qualitative) between a company's product and service business (Kastalli et al., 2013).

4.5   Context for which the approach is designed

While some studies provide approaches for managing KPIs in the context of business models in *general*, most methods and tools in the literature are developed with a focus on a *specific type* of business models. In total, 21 of the 31 studies are developed for a specific context. Most of these studies were dedicated to business models of networked organizations (Bouwman, 2003; Gilsing et al., 2021b; Rodríguez-Rodríguez et al., 2015). In this type of business model, multiple organizations are collaborating in a networked setting to co-create and deliver value to the customer. Next, with four studies, e-business was the context for which most KPI management approaches were developed (Afuah and Tucci, 2003; Bouwman and van den Ham, 2004; Dubosson-Torbay et al., 2002; Yu, 2006). We classified studies related to internet business models and e-commerce in this context. Another context that comprises multiple studies is the domain of product-service system (PSS) business models (Glas et al., 2018; Kastalli et al., 2013; Mourtzis et al., 2018). PSS is a specific business model in which tangible products are combined with intangible services in a single system (Goedkoop et al., 1999). Moreover, two studies by di Valentin et al. (2013, 2012c) focused on business models in the software industry, and Lüdeke-Freund et al. (2017) and Morioka et al. (2016) provide approaches dedicated to sustainable business models. Other contexts for which specific approaches were developed include start-ups (Batocchio et al., 2017), skills brokerage platforms (Khoshalhan and Kaldi, 2007), ambient assistant living (Kriegel et al., 2016), and mobile government (Yu, 2014).

5   Discussion and Future Research Agenda

Our review of the academic literature located a variety of methods and tools for managing business model KPIs. We revealed that existing approaches are mainly catered towards the definition of KPIs. The methods and tools presented in the literature are often used for defining new business model KPIs or monitoring the performance of an existing business model in a specific context. Below, we discuss the knowledge gaps that we uncovered in our review and present four main avenues for further research on business model KPI management.

First, our research revealed that limited attention has been paid to the development of methods for managing business model KPIs. While many studies present repositories and frameworks for business model KPI management, less research has focused on developing structured methods. Future research can build on the existing business model KPIs and performance measurement models to develop step-by-step methods for business model KPI management. For instance, researchers can structure the identified KPIs in this study along relevant business model dimensions into repositories and focus on developing a structured method to select and tailor KPIs from the repository to the specific needs of an organization. Developing new methods for defining, specifying, and measuring business model KPIs can support decision-makers in assessing alternative business models and evaluating the performance of business models that are already in operation (Batocchio et al., 2017; Minatogawa et al., 2019).

Second, only a few studies were uncovered that present software instantiations to support business model KPI management. Most software tools presented in the literature have either been only partially instantiated (e.g., Augenstein et al., 2018; Schaffer et al., 2020) or are only suitable for measuring business model performance in established organizations (di Valentin et al., 2013). As developing software tools for business model management has been a major topic of interest in the domain of information systems (Osterwalder and Pigneur, 2013; Veit et al., 2014), we call for further research on the development of software instantiations to support the management of business model KPIs. The design principles and requirements in existing studies can provide initial guidelines for further development and implementation of these systems (e.g., Augenstein et al., 2018; Gilsing et al., 2021b).

Third, when compared to KPI definition, existing research provides limited support for selecting, operationalizing, and reporting business model KPIs. To move beyond the definition of performance indicators and to increase the effectiveness of KPI management for researchers and practitioners, future research can focus on developing methods and tools to support the selection, concretization and reporting of business model KPIs. The formalization of selection techniques and calculation rules in existing methods for KPI management can provide support for further development of software tools for managing business model KPIs (e.g., Del-Río-Ortega et al., 2013; Mourtzis et al., 2018). Moreover, we argue that existing knowledge from the field of enterprise modeling can inform the development of conceptual models for representing relationships between different business model KPIs, activities, and organizational objectives (e.g., Popova and Sharpanskykh, 2010; Strecker et al., 2012).

Lastly, our study shows that several studies offer an integrated approach for supporting business model KPI management through all phases of the KPI lifecycle, i.e., defining, selecting, operationalizing, measuring, and reporting. In total, we found three studies that provide methods or tools that address to a certain extent all five phases of the KPI lifecycle. One of the approaches proposed by Mourtzis et al. (2018) present an integrated method and toolkit specific for product-service system (PSS) business models. We argue that future research can focus on the design of integrated approaches for other business model contexts, that support all phases of the KPI lifecycle. Specifically, we see an opportunity to build on the existing knowledge in the PSS domain to develop an integrated method and tool for the general context and domain of business models.

6   Conclusion and Limitations

In this paper, we identify and analyze the existing literature on business model KPI management. For this purpose, we conducted a systematic literature review in which we identified 31 relevant sources from the literature and identified their characteristics in 5 dimensions. Based on these characteristics, we achieved a classification of the streams of knowledge on the approaches for the management of business model KPIs in the literature. The result of our analysis shows that the studies contribute mainly with KPIs or models that aid the definition of business model KPIs. They often focus on KPIs for specific types of business models. Despite a wide range of contributions, our analysis also points out gaps in existing research. Future research avenues on business model KPIs include the development of methods for defining, selecting, and operationalizing business model KPIs, developing software instantiations to support the management of business model KPIs, developing methods and tools to support the selection, concretization, and reporting of business model KPIs, and designing integrated approaches for different contexts that support all phases of the KPI lifecycle. The concept matrix developed in this study can guide managers in adopting relevant models, methods, and instantiations for specifying measurable objectives and monitoring the performance of their organization's business models. Nevertheless, the specific context and needs of the organization still need to be considered when selecting the business model KPI management approaches identified in this study.

Despite following a rigorous research approach (Okoli, 2015; Webster and Watson, 2002), our study is subject to some limitations. First, we initially focused on business model studies that included any type of KPI and then broadened our results to also encompass approaches related to the management of business model KPIs. Second, the terminology around business model KPIs, performance indicators, measures, and metrics is used in diverse ways and these terms have multiple definitions in the literature. Therefore, a certain level of subjectivity was involved in the process of selecting relevant studies. To minimize the effect of this, we involved multiple authors of this paper in all steps and followed a rigorous process in selecting and analyzing relevant works.

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