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ORIGINAL PAPER

Does the combination of sustainable business model patterns lead to truly sustainable business models? Critical analysis of existing frameworks and extensions

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Abstract

Business models can be created by combining business model patterns. The use of patterns can stimulate creativity of entrepreneurs and support the design of innovative business models for sustainability. In this article, we analyze the frameworks on sustainable business model (SBM) patterns, which can be mainly classified along the three dimensions of the triple bottom line (TBL): economic, environmental, and social. Furthermore, we introduce the concept of "truly sustainable business models" by drawing on contingency and system theory. We observe that the simple application of the frameworks of business model patterns by combining economic, environmental, and social business model patterns for sustainability into one single business model does not necessarily lead to a truly sustainable business model. Therefore, the combination of patterns along the TBL seems a necessary, but not sufficient condition for achieving true sustainability, and hence, the mere reliance on SBM patterns in business model design can be misleading to entrepreneurs. Our conceptual work advances research related to frameworks on SBM patterns by identifying three critical levels for the analysis of whether a business model is truly sustainable or not. The first level is inherent to the business model as a system; the second is related to the larger system, in which the business model is embedded; and the third is about the contingency factors that can impact the sustainability effectiveness of the business model over time.

Keywords Business model · Sustainability · Sustainable business model · Business model pattern

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1 Introduction

The creation of frameworks constitutes an essential activity in the scientific endeavor. In the field of management, frameworks such as the Business Model Canvas (Osterwalder and Pigneur 2010) or SWOT represent a combination of interlinked items that support a particular approach to a specific objective (Budler and Trkmman 2019). Sustainability is among the research fields that, in previous years, have witnessed the development of many relevant frameworks such as the triple bottom line (TBL) (Elkington 1997) and the circular economy (The Ellen MacArthur Foundation 2015) as well as the study of relationships between different frameworks such as stakeholder theory and corporate social responsibility (Dmytriyev et al. 2021).

This work focuses on an emerging type of sustainability frameworks that is related to the field of business models for sustainability (e.g., Schaltegger et al. 2016). Research in this area emphasizes, among others, the role of the entrepreneur in developing sustainable business models (SBMs), in other words business models that are not only ecologically, but also economically and socially sustainable (e.g., Abdelkafi and Hansen 2018; Abdelkafi and Täuscher 2016). At the same time, researchers sought to classify the different sustainability-related elements into SBM archetypes or SBM patterns (Bocken et al. 2014; Lüdeke-Freund et al. 2018b).

Notably, business model archetypes or patterns—used interchangeably in this work—have been debated in the general academic literature on business models, not necessarily related to sustainability (e.g., Abdelkafi et al. 2013), owing to their support for business model design and development. Indeed, patterns discovery should be an essential endeavor in business model innovation research (Abdelkafi and Hansen 2018). A business model pattern is "the relationship between a certain context or environment, a recurring problem and the core of its solution" (Abdelkafi et al. 2013, p 14 based on Alexander 1977), while SBM pattern refers to "an ecological, social, and/or economic problem that arises when an organization aims to create value, and it describes the core of a solution to this problem that can be repeatedly applied in a multitude of ways, situations, contexts, and domains" (Lüdeke-Freund et al. 2018b, p 148). The discussion on SBM patterns was initiated mainly by Bocken et al. (2014) with a framework consisting of eight essential archetypes of business models. Since then, researchers have built upon this framework to further propose fine-grained frameworks on SBM patterns (e.g., Lüdeke-Freund et al. 2018a; Lüdeke-Freund et al. 2018b; Dijkstra et al. 2020).

Business model patterns can provide direction and support to entrepreneurs, while nurturing creativity during the design of innovative business models for sustainability. The underlying idea is to leverage analogical and combinatorial thinking (e.g., Abdelkafi et al. 2013; Gassmann et al. 2014)—two creativity techniques—for the generation of new business models based on patterns. Analogical thinking transfers patterns that prove successful in one industry to another. Combinatorial thinking is used to combine these SBM patterns to develop new viable business models. The new combinations may not be new to the world, but new to the target industry where they are transferred. For example, Better Place proposed

a business model for electric vehicles by analogy to the telecommunication industry. Although this model could not take off, it was new to the automotive industry. In this model, users pay for the battery usage level depending on the driven distance, by analogy to telecommunication where mobile phone users pay for calls per unit of time (Johnson 2018).

Our work acknowledges the usefulness of frameworks for SBM patterns to develop innovative business models (e.g., Lüdeke-Freund et al. 2018b) as "…patterns and taxonomy are meant to help corporate leaders, entrepreneurs, organisation designers, and business model developers in modifying or creating new business models with a stronger orientation towards sustainability issues." (Lüdeke-Freund et al. 2018b, p. 159). These frameworks can support entrepreneurs and firms in improving the sustainability of their business models. However, whereas business model patterns can be applied in a stand-alone fashion, combinations are expected to be more frequent for several reasons. First, patterns are generally related to a single element of the business model such as value proposition, value creation, or value capture (Abdelkafi et al. 2013). As such, combinations of patterns are more likely in real cases (Amshoff et al. 2015). Second, business models can be clustered in different groups (Lüdeke-Freund et al. 2018b): mainly economic, social-economic, social, mainly ecological, and integrative. Hence, most SBM patterns do not cover all dimensions of the TBL, making a combination of patterns required. These combinations can involve patterns from the same group, for example, combining "repair" and "reuse" patterns, or over different groups, such as "cooperative ownership" and "green supply chain management". Third, given the value capture challenges that SBMs can encounter, e.g., due to limited market segments, companies may be tempted to combine different patterns to generate additional sources of revenue (e.g., Fairphone case) (Beltagui et al. 2020). Fourth, business model frameworks such as the triple layered business model canvas include explicitly the social and environmental dimensions in business model design by leveraging specifically developed canvases: environmental life cycle business model canvas and social stakeholder business model canvas (Joyce and Paquin 2016).

Despite their usefulness, these frameworks exhibit some limitations that we aim to address in this paper. These frameworks can help entrepreneurs and firms to foster sustainability orientation, but this does not mean that the integration of economic, environmental, and social patterns into one single business model would make the resulting business model unconditionally sustainable. As discussed later, the simple combination of SBM patterns from all sustainability dimensions is at best a necessary, but not a sufficient condition.

The critical view on business model frameworks for sustainability in state-of-the-art literature is not new. Several authors have proposed extensions and improvements of business model frameworks (e.g., Bradley et al. 2020; Joyce and Paquin 2016). In addition, we do not question the relevance of SBM pattern frameworks as such, but rather aim to increase awareness concerning the limitations of these frameworks, while identifying relevant aspects that should be considered when these frameworks are used. Hence, our research question (RQ): How can entrepreneurs and managers improve the sustainability of developed business models based on frameworks of SBM patterns?

It is tempting to call any business model that undergoes some sustainability transformation sustainable. For example, is a business model that integrates a more resource efficient production process sustainable? In fact, the new model is more sustainable than the one at the start, but it is not possible to say that the business model is sustainable. As such sustainability seems to be a matter of degree or level. Because of this, in the following sections, we introduce the concept of truly sustainable business models, and we elaborate on the conditions to be fulfilled, in order for a business model incorporating sustainable patterns to be truly sustainable at the start and over time. In line with Searcy (2018), in truly sustainable business models, economic, environmental, and social aspects reinforce each other. Thus, the mere combination of economic, environmentally, and socially focused patterns into one single business model can actually result in an unsustainable, "a seemingly sustainable" business model, or a business model that does not achieve full sustainability potential.

This work addresses the limitations of the frameworks developed for SBM patterns and suggests further levels of analysis to support entrepreneurs in verifying and eventually rectifying their business models to increase the likelihood that these business models are truly sustainable. To achieve the research objectives and provide an answer to the research question, we adopt a conceptual research method, which aims at creating new knowledge not by building on empirical evidence, but rather by assimilating and combining previously developed concepts (Jaakkola 2020). The conceptual research methodology allows us to bridge different frameworks and theories, looking at them with a broad, multi-level perspective without constraints of empirical generalization (Gilson and Goldberg 2015).

In the next section, we review the proposed frameworks on business model archetypes for sustainability. The third section theoretically derives three levels of analysis along which an initial business model design composed of different patterns should be assessed. Our reasoning leads to the definition of so-called truly sustainable business models. The fourth section further elaborates the theoretical argument, identifying case examples along all three levels of analysis to demonstrate that the combination of sustainable patterns is not necessarily truly sustainable. Thus, entrepreneurs can use these levels to stress-test the real sustainability of their business models. Based on this, Sect. 5 addresses the answer to the research question, also by providing a process for the validation of business model designs for sustainability. Finally, the last section concludes and proposes directions for future research.

2 Frameworks for sustainable business model patterns

2.1 Sustainable business model patterns

The identification of business model patterns represents an important cornerstone in business model research (Abdelkafi and Hansen 2018) and the quest for patterns should be an important objective in any scientific endeavor. From a general perspective, patterns are proven problem–solution combinations and serve as instruments for the codification of knowledge (Leitner 2015). Like similar concepts that aim at

organizing knowledge (e.g., types and categories), business model classifications and patterns can be derived based on essentialism (conceptual) or empiricism (identified through observation, e.g., by using clustering techniques) (Lambert 2015). Business model patterns have a strong communicative power because they describe essential dynamics of value creation, value delivery, and/or value capture (Lüdeke-Freund et al. 2018b) and can also inspire business model innovation (Bocken et al. 2014).

The business model can enable the firm's sustainability orientation (Nosratabadi et al. 2019). Many scholars consider SBMs as vital 'meta' factors in the transition towards sustainable consumption and production (e.g., Tukker et al. 2008). SBMs are business model innovations that can support a systematic creation of business cases for sustainability (Schaltegger et al. 2012). A business case for sustainability results from the firm's intelligent design of voluntary activities regarding environmental and social aspects that create a direct or indirect positive economic effect (Schaltegger et al. 2012). SBM literature therefore tackles the question of how firms can capture economic value, while maintaining and regenerating social and environmental capital (Lüdeke-Freund et al. 2018b). In this regard, several contributions have proposed richer and more specific frameworks for SBM archetypes (e.g., Lüdeke-Freund et al. 2018b; Reinhardt et al. 2020). Moreover, existing tools such as the business model canvas (Osterwalder and Pigneur 2010) have been extended, e.g., triple layered business model canvas (Joyce and Paquin 2016), to integrate all TBL dimensions.

2.2 Overview of relevant frameworks

Our analysis of relevant frameworks reveals five clusters: (i) frameworks of industry-specific patterns; (ii) frameworks integrating existing frameworks; (iii) frameworks of specific overarching business model concept, such as servitization, sharing economy, or reverse logistics business models; (iv) frameworks for green technologies deployment; and (v) general frameworks of SBM patterns (For the methodology of framework selection and overview table with the analyzed frameworks, see Appendix 1).

In the first group of industry-specific patterns, Yip and Bocken (2018) propose eight SBM archetypes for banks by introducing four new technological, social, and organizational archetypes to the original framework of Bocken et al. (2014). Zufall et al. (2020) look at the smartphone industry and propose seven SBM patterns, whereas Heesbeen and Prieto (2020) analyze five circular business model alternatives in the construction industry. In the second group where existing frameworks are combined, Dijkstra et al. (2020), for example, propose eight SBM archetypes for plastic management resulting from the combination of Bocken et al. (2014)'s framework and the Waste Hierarchy framework for circular economy (European Council 2008). In the third group, we find, for example, Yang and Evans (2019) and Kwon et al. (2019), who present frameworks with respectively four and five archetypes that are focused on product-service-system business models. Curtis (2021) focuses on sharing economy and proposes, based on an extensive literature review, eight

patterns for environmental sustainability, whereas Alshammari and Ball (2016) concentrate on economic and environmental archetypes for reverse logistics. In the fourth group, Abdelkafi and Hansen (2018) propose four user business models to support the deployment of green technologies such as electric mobility. Trapp and Kanbach (2021) take Ritala et al. (2018) framework as a starting point to propose ten environmental archetypes for the support of the transition towards green technologies. Holzmann et al. (2020) deal with 3D-printing technology and propose five service-related SBMs for the deployment of this technology. Finally, the fifth group contains three widely accepted frameworks: Bocken et al. (2014), Ritala et al. (2018)—a further development of Bocken et al. (2014)—and Lüdeke-Freund et al. (2018b). As general frameworks, they may be applied in different industries. In the following, we provide a detailed overview of these frameworks for two reasons. First, they seem to be very influential, especially the one by Bocken et al. (2014) with most citations in the field. Second, in the subsequent sections, we use some patterns from these frameworks for argumentation purposes.

Bocken et al. (2014) propose eight SBM archetypes grouped into technological, social, and organizational categories. The prevailing focus is the environmental dimension, an inherent element in all eight SBM archetypes, although the term "environmental" does not appear in any of the SBM archetypes. Technological archetypes ("Maximize materials and energy efficiency", "create value from waste" and "substitute with renewable and natural processes") refer to possible solutions to climate change and environmental over-exploitation of natural resources. The social archetypes mostly deal with consumer behaviors and socio-cultural issues. "Deliver functionality rather than ownership" refers to models, in which the transfer of ownership is replaced by a service-oriented approach (Ritala et al. 2018). Though social, this archetype is aimed at achieving environmentally sustainable production and consumption (Ritala et al. 2018). "Adopt a stewardship role" emphasizes the firm's key responsibility for its stakeholders, e.g., society and the environment. Additionally, "encourage sufficiency" is based on consuming less and producing just as needed (Bocken et al. 2014), thus driving environmentally sustainable production and consumption. The organizational archetypes by Bocken et al. (2014) are "Repurpose for society and environment", and "develop scale-up solutions". "Repurpose for society and environment" implies that companies re-orient their missions by prioritizing society and the environment as compared to economic profit. Businesses based on "develop scale-up solutions" can provide solutions at large scale to maximize sustainability benefits, e.g., by leveraging collaborative approaches such as crowd sourcing and open innovation.

The framework of Ritala et al. (2018) is different from Bocken et al. (2014) in two ways. First, they rename the organizational category as economical, and in this way, adjust the pattern classification to TBL specific terms. Second, Ritala et al. (2018) add to the economical dimension the "inclusive value creation" archetype, which addresses resource and knowledge sharing that can be based on peer-to-peer sharing platforms or Bottom of the Pyramid innovations.

Lüdeke-Freund et al. (2018b) propose a framework with 45 SBM patterns classified in 11 groups. Most patterns are associated with a specific type of value creation such as "mainly economic", "mainly social", and "mainly environmental", while

some hybrid value creation patterns consider multiple sustainability dimensions. For instance, the "freemium" SBM pattern is expected to create social-economic value by avoiding the exclusion of poor people from consumption (Lüdeke-Freund et al. 2018b). This set of patterns reveals that existing SBM patterns rarely cover all three TBL dimensions together. Within all 11 pattern groups—with each group containing one or more patterns—only two patterns can be integrative: shorter supply chains (Renting et al. 2003) and sharing business.

Business model pattern frameworks have been proposed in practitioner-oriented publications such as consulting reports. For instance, the Circular Economy Initiative (2021) proposes 22 patterns to inspire the circular economy transition, whereas Business Hub4Sustainability (https://bh4s.no/sustainable-business-model-archetypes) introduces four groups of SBM archetypes to. In our work, however, we only focus on patterns that have been proposed in the scientific literature, though Bocken et al. (2014)'s framework derives from a review of the scientific and practitioner-oriented literature (e.g., UNEP 2012; WWF 2012), and Lüdeke-Freund et al. (2018b)'s framework has involved practitioners in the identification and categorization of the SBM patterns.

2.3 SBM contribution to sustainability in practice

Despite the advances in SBM research and the potential of SBM patterns to inspire next generation SBMs, the current progress towards SDGs is rather disappointing (Bocken and Short 2021). The achievement of SDGs depends, among others, on the widespread diffusion and success of SBMs. The drivers for success can be sought in the following aspects: the alignment of the business model value with the customers' individual values, business model design, and business model execution (Pisciccelli et al. 2018).

Regarding execution, although a fair body of research on business model ideation and design exists, the integration of sustainability into business models is still unclear in practice, hence the design-implementation gap (Baldassarre et al. 2020). For example, literature indicates how a generic SBM type can be adopted in different industrial domains (e.g., Yip and Bocken 2018; Ulvenblad et al. 2019; Reinhardt et al. 2020), or describes a specific pattern, as the circular business models (CBM), in richer details (e.g., Lüdeke-Freund et al. 2018a) with the objective of facilitating eventual implementation. Nevertheless, in the case of CBM, Salvador et al. (2020, p. 12) argue that "… the aspects of CBM implementation are still in their early stages of investigation, as little research has been devoted to them."

The success of a SBM depends on its conceptualization (Abdelkafi and Täuscher 2016), among others the combination of SBM patterns. However, we argue that the set of SBM archetypes proposed in literature should be taken with criticism because of two reasons. First, some SBM patterns such as "Maximize material and energy efficiency" in Bocken et al. (2014) do not really reflect ways of doing business, but rather point to operational efficiencies that many firms, if not all—sustainable or unsustainable—aim for. This can result in rather "seemingly sustainable" business models. Second, recent empirical research that aims to evaluate the sustainability

value of different SBM patterns found that SBM patterns do not have equal contributions to sustainability. For example, in the context of Product Service Systems (PSS), Yang and Evans (2019) show that result-oriented PSS exhibits a higher sustainability value than use-oriented or product-oriented PSS, whereas PSS alone does not significantly improve social sustainability. In another study, Laukkanen and Tura (2020) identify different sustainability potentials along the TBL dimensions of 13 patterns in the sharing economy, concluding that sharing economy-based business models can entail positive and negative impacts on sustainability performance and that achieving a positive balance depends on managerial actions to control negative outcomes (Laukkanen and Tura 2020). These studies demonstrate that the mere integration of a sustainable pattern in a business model does not guarantee high sustainability performance.

3 Theoretical derivation of the levels of analysis for the assessment of truly sustainable business models

As revealed by recent research, the contribution of patterns to sustainability is not absolute, but depends on the inherent characteristics of the pattern itself or the actions undertaken by management. This section capitalizes on this and derives theoretically the levels along which the combination of business model patterns (or even single sustainability patterns) should be evaluated at the business model design stage. This way, we take a different perspective from the sustainability assessment literature (e.g., Süß et al. 2021), which is focused on the evaluation of business model sustainability after implementation. Our discussion of the levels of analysis leads to the definition of truly sustainable business models.

3.1 Identification of relevant theories: contingency and system theory

As explained above, sustainability depends on the specific context. Hence, the assertion that context factors can impact the sustainability performance of the business model is in line with the contingency theory, which assumes that the impact of a decision on performance depends on the context or contingency factors (Donaldson 2001).

According to Dubin (1976), all theories are contingency theories, because the validity of a proposition depends on assumptions about starting premises, boundaries, and system states (Drazin and Van 1985). Boundary conditions specify the ranges, over which a relationship holds, and system states specify the period of time as well as other conditions under which the relationships are expected to occur (Drazin and Van 1985). Transferred to our research, this means that we have to define the system's boundaries. Abstractly, the relationship between pattern combination and sustainability performance depends on the system chosen. Therefore, we argue that system theory (Bertalanffy 1968) is relevant to our research. The application of system theory in sustainability research is, however, not new (Williams et al. 2017).

Literature suggests that sustainability is a system property rather than a property of the single parts constituting the system itself (e.g., Clayton and Radcliffe 1996).

3.2 Levels of analysis

From the perspective of system and contingency theories, three levels of analysis can be derived to define the boundary conditions that have an impact on the sustainability level of the combination of SBM patterns: (i) the business model system level, (ii) the wider system, in which the business model system is embedded, and (iii) the internal and external contingencies, which are respectively related to the business model as a system and the wider system. In the following, we develop theoretical arguments that support the relevance of these levels, whereas an example-based explication is provided in Sect. 4.

3.2.1 Business model system level

A business model denotes a system of activities (Zott and Amit 2010). To design a new business model, incumbents and entrepreneurs should make choices (Casadesus-Masanell and Ricart 2010). During business model design, patterns are a source of inspiration. When firms integrate a combination of most appealing and promising patterns into their business, they implicitly make relevant choices about policies (e.g., pricing policy), assets (e.g., manufacturing facilities), and governance structures (e.g., contractual arrangements regarding whether to own or lease a fleet of trucks). A business model pattern cannot be leveraged without specific activities that enable it (Zott and Amit 2010). As each pattern can lead to different types and interrelationships among activities, the question is whether the required activities are consistent in a way they are pulling in the same direction. Obviously, business model patterns like integrator and orchestrator (Gassmann et al. 2014) induce two different logics that do not match. Whereas an integrator aims at integrating as much activities as possible, orchestrators coordinate the activities of independent actors to deliver the intended value proposition to customers. Hence, the combination of integrator and orchestrator patterns into one business model leads to inconsistencies. Similarly, patterns such as "razor and blades" and "reverse razor and blades" (Johnson 2018) are opposite by design. The implications of other business model patterns for the activity system are more subtle and need a much more careful scrutinization. For example, a pattern may lead to the introduction of an activity with a positive environmental impact, whereas another one may require an activity that engenders the opposite effect. Combining both patterns can have implications like those of the rebound effect, e.g., when the positive output of higher efficiency is outweighed by a pattern triggering more customer consumption.

3.2.2 The larger system level

The business model system itself is embedded within a larger system (a system within a system). A firm naturally exchanges several flows with its external

environment, including materials, energy, people, money, and information. Consider the orchestrator business model pattern. By design, an orchestrator interacts with several actors and coordinates many external activities that are essential for value creation. The coordination activity may rather have negligeable to low effect on environmental sustainability, while other activities such as manufacturing and logistics, carried out by suppliers and service providers, can induce—most probably in the absence of full orchestrator's visibility—highest detrimental effects on environmental and social sustainability. By only considering orchestrator's activity system (coordination), sustainability performance is high. Sustainability, however, should consider the "whole picture" (Searcy 2018), hence the elements of the larger system, with which the business model interacts. Thus, the sustainability of a business model pattern or a combination of patterns will depend on where the boundaries of the larger system are placed. Demarcating the boundaries of the larger system very narrowly, in a way they are close to the business model system, can lead to the exclusion of relevant stakeholders and important relationships between the wider system and business model activities. However, extending the system boundaries excessively away from the business model activity system can induce unnecessary complexities because of the consideration of stakeholders and relationships with little or no interaction with the business model design. Literature identifies two approaches to stakeholder identification (Rodriguez Serna et al. 2022): (i) reactive identification during strategy or business model implementation (e.g., Bundy et al. 2013), and (ii) proactive approach during the phase of strategy formulation or business model design (e.g., Mitchell et al. 2021).

Hence, the boundary of the system-of-interest matters for the sustainability assessment of business model designs, since the quantity and quality of the flows exchanged with the business model may vary, depending on the elements included in the larger system. At the highest level, the world itself can be considered, in which many (sub-) systems are located, including economic and business-related activities—open systems, that exchange resources and energy with the environment, or entire countries—open systems that exchange materials and people with other countries (Clayton and Radcliffe 1996).

3.2.3 System contingencies

System contingencies denote the context factors that affect the business model and can be either internal or external (Pati et al. 2018). The internal contingencies relate to the business model—the firm's activity system (Zott and Amit 2010)—whereas the external contingencies to the larger system, in which this business model is embedded. Contingency theory (Donaldson 2001) predicts different sustainability performances of a business model pattern or a combination of patterns, depending on the internal and external contextual factors. In addition, when the firm's contingency factors change over time, its business model may shift from a sustainable to an unsustainable state or lower level of sustainability, thus necessitating adaptations to preserve the high sustainability performance. Sustainability, therefore, should call for a dynamic and evolving perspective on business models that continuously adapt in dependence on internal and external contingencies.

Consider a situation, in which owners of an investment good or equipment do not fully utilize the capacity of their goods, hence the availability of free unused capacities. We also assume that the technology used in later generations of the equipment does not change; that is, it not replaced by a greener more sustainable technology. Let us suppose that owners would accept to make their free capacities accessible to potential users that would have otherwise made the investment in the absence of the accessibility option. To get the service of the equipment, potential users either buy the equipment or get access to available free capacities. An entrepreneurial firm can exploit the opportunity and enter this market to connect owners to potential users (Multisided platform pattern), while orchestrating their corresponding activities (Orchestrator pattern). This enables a better exploitation of unutilized capacities, potentially avoiding investments in new equipment. Viewed from this perspective, the additional environmental harm caused by the mere coordination of activities through a combination of multisided platform and orchestrator models is much lower than the harm triggered in the wider system if new equipment is produced and operated. The sustainability level of the larger system composed of owners, users, and the natural environment is higher than the level of sustainability in the "excessive" ownership case, in which the production and operation of new equipment have to be considered.

Now, imagine that the platform itself makes investment in its own equipment and provides it, in addition to other owners, as a service to potential users. This means the integration of a new activity into the business model. While the business model slightly changes, the effects on sustainability performance can be high, as the new activity can increase the total level of unused capacities within the wider system. The decision of adding this activity or not and the amount of the capacity added only depend on the sustainability orientation of the platform's managerial board, obviously an internal contingency factor to the business model. What can also happen over time is that new actors enter the wider system. Being non-users of the equipment, but essentially driven by a financial opportunity, these actors can introduce new capacities in the hope of getting market shares for themselves. This can result again in excessive capacities that are not fully utilized. While the initial business model of the platform did not change, its sustainability performance decreases because of the change in the external system and its contingencies. Consequently, the activity system would potentially migrate from a sustainable to an unsustainable state.

3.3 Truly sustainable business, strong sustainability, and the triple bottom line

Truly sustainable business stands for the shifted perspective on business from seeking to minimize the negative impacts of firm's activities to the generation of "significant positive impact in critical and relevant areas for society and the planet" (Dyllick and Muff 2016, p. 165). With the excavation of business sense of potential solutions to sustainable issues, truly sustainable business promotes that financial rewards, social benefits, and environmental regeneration are not in conflict but rather reinforcing each other (Searcy 2018), thereby enhancing the internal consistency of

business operations. Based on the three levels identified above, a business model is truly sustainable if the following characteristics are satisfied: (i) activities that result from the combination of SBM patterns are consistent in a way that fosters all dimensions of the TBL (i.e. inherent consistency); (ii) the business model is sustainable within the wider system-of-interest (i.e. sustainability at system level); and (iii) the business model adapts over time to accommodate changes in contingencies that may lead to a degradation of its sustainability performance (i.e. contingencies of SBMs).

The definition of truly sustainable business closely relates to the strong sustainability perspective (Victor et al. 1998; Ayres et al. 2001) and the concept of TBL (Elkington 1997). Proponents of strong sustainability believe that produced capital (e.g., infrastructure, manufactured goods, labor, and knowledge) and natural capital are not interchangeable (Victor et al. 1998; Pelenc et al. 2015). Thus, as opposed to weak sustainability, the strong sustainability perspective values the ecological aspect over economic gains and states that a growth in the aggregate stock of natural and man-made capital over time is not necessarily sustainable (Wilson and Wu 2017). Note that existing frameworks of SBM patterns do not always comply with strong sustainability. For instance, Lüdeke-Freund et al. (2018b) classification of SBM patterns complies to the weak sustainability perspective, which views the three dimensions of the TBL in trade-off (e.g., a SBM can be strongly economic while weakly ecologic and social). Instead, the principle of strong sustainability is demonstrated through the "integrative sustainability model" (Wu 2013) where the economic dimension completely resides in the social dimension, and the social dimension is fully captured by the environmental dimension (Wilson and Wu 2017). Thus, strong sustainability suggests that the three bottom lines are never in contradiction. Following this thread of research, the concept of strongly sustainable business models is then introduced to describe the business model of a successful strongly sustainable business (Kurucz et al. 2017) as one that achieves simultaneous "tri-profit" creation, generating "positive environmental, social, and economic value throughout its value network, thereby sustaining the possibility that human and other life can flourish on this planet forever" (Upward and Jones 2016, p. 103).

Yet, the inadmissibility of any reduction in natural capital may lead to the misperception of strong sustainability and its interpretation from a rather absurdly strong sustainability perspective (Wilson and Wu 2017), thus jeopardizing practical applicability. Given the specific context and constraints of businesses, the theoretical state of strong sustainability may be idealistic and hardly achievable. Existing literature has proposed a pragmatic interpretation of strong sustainability, as a certain level of substitution between the natural and produced capital must be allowed and a reasonable threshold of the expense of natural capital should be suggested (Wilson and Wu 2017). Considering that weak and strong sustainability are the two extremes on the continuum, it seems that a more pragmatic interpretation of strongly sustainable business, in terms of truly sustainable business models, as introduced at the beginning of this section, is needed.

We argue that a truly sustainable business model values the differentiation between natural and produced capital in accordance with strong sustainability (Victor et al. 1998; Wilson and Wu 2017). It offers a pragmatic instrument that enables companies to evolve towards the strong sustainability polar, but also acknowledges

that potential trade-off between natural and produced capital is not always avoidable. Practically, this tradeoff can be dealt with by decoupling the various dimensions of sustainability as much as possible, e.g., through ensuring the internal consistency of business model patterns, or through adopting advanced technologies that can make previously inconsistent pattern combinations consistent (e.g., sharing economy and pay-per-use patterns could be combined, only because of the advances of technological platforms, which match service providers and service seekers economically). Moreover, the truly sustainable business model finds its theoretical underpinning of sustainable development in line with the TBL (Elkington 1997) and further supports the need asserted by Elkington (2018) to repurpose the concept by extending the perception of TBL beyond the narrow and inappropriate interpretation as merely a tool for sustainability accounting (Elkington 2018).

4 Critical analysis of the sustainability performance of sustainable business model patterns based on the three levels of analysis

This section capitalizes on the definition of truly sustainable business models and illustrates that the combination of SBM patterns does not always lead to truly sustainable business models. Our argumentation extends the rather theoretical discussion elaborated in the previous section by drawing on selected examples and results from sustainability literature. Thus, this section places SBM patterns and their combination in the center of truly sustainable business model development, and operationalizes the truly sustainable business model concept, by elaborating on three levels introduced theoretically: (i) inherent consistency, (ii) sustainability at system level, and (iii) contingencies of SBMs.

4.1 Inherent consistency

Inherent consistency examines whether the business model patterns are not contradictory and can be productively combined within one single business model. Potential inconsistencies are rooted in two reasons: (i) lack of internal fit of the business model elements (e.g., by combining incompatible patterns such as razor and blade, and its reverse) and/or (ii) inconsistency due to the tensions that can arise among TBL dimensions.

The discussion on the inherent consistency of business models in general (also outside sustainability) is not new. According to Giesen et al. (2010), business model consistency means that all elements of the business model are in agreement with each other. Casadesus-Masanell and Ricart (2010) point to the extreme relevance of designing inherently consistent business models because of the reinforcing loops created inside the model. Coherence of the model elements is equivalent to the achievement of internal fit and alignment, avoiding that the model is pulled in different directions, which lower its economic performance and/or environmental orientation. However, research in this area is still scarce. In particular, there is a lack of measures and tools for the evaluation of the degree of business model consistency.

Kranich and Wald (2018) develop a measure for the evaluation of the consistency level of business models. Consistency is "…represented by the distance between values of variables suspected to score similarly, [and] high consistency is thus expressed by small distances between pairs of item values, where each measures different BM elements" (Kranich and Wald 2018, p. 212). Based on a sample of 74 German firms from the power transmission engineering industry, the authors found that those undertaking business model innovation (BMI) have generated consistent models and that there is a positive effect between consistency and BMI performance. In another research, Echterhoff et al. (2017) propose a matrix tool to evaluate the pairwise consistency of business model patterns. The method involves expert contributions and an evaluation scheme that ranges from 1 (complete inconsistency) to 5 (strong mutual assistance) to assess the consistency between patterns.

From a TBL perspective, business models are sustainable when they satisfy all three dimensions. As put by Lüdeke-Freund et al. (2018b), "a sustainable business model is about creating significantly increased positive effects and/or significantly reduced negative effects for the natural environment and society through changes in the way a company and its network create, deliver, and capture value". Literature tends to approach SBM patterns in an ideal manner, as it assumes the enhancement of one sustainability dimension leads to a higher sustainability overall. This is only true, if all three dimensions are orthogonal.

As it is more realistic to assume that the TBL dimensions are interconnected, the environmental and social sustainability may come at an economic cost, while optimization of economic performance could jeopardize the other dimensions. The SBM pattern "create value from waste" puts predominant focus on recycling and transforming wastes into valuable input back to the loop (Bocken et al. 2014). While the improvement of sustainability is evident from the technological/environmental perspective, such practice could increase cost in the subsequent production phases, challenging the economic sustainability. Similarly, an overemphasis of the economic perspective can worsen environmental and social aspects. Thus, if one sustainability dimension is emphasized, the implication on the other sustainability dimensions should also be addressed (Lüdeke-Freund et al. 2018b).

Car sharing, for example, reduces the number of cars in a city, leading to lower level of car production as well as less energy and natural resource consumption due to car manufacturing (e.g., Jochem et al. 2020). The underlying BM can be considered sustainable falling into a combination of the SBM patterns of "deliver functionality rather than ownership/result-oriented pay per use", "product longevity" and "consumer education" (Bocken et al. 2014). Ideally, car owners that switch to this service sell their cars or decide to not repurchase a new car when their old car reaches its end of life, whereas non car owners may decide to use the service on demand without the necessity of a car purchase. Yet, based on a game-theoretic model, Ke et al. (2019) found that car sharing does not always reduce vehicle quantity; it does so, only under specific conditions. Furthermore, there is a lack of proof that the reduction of car ownership will lead to the reduction of car-use (Chapman et al. 2020). Bocken et al. (2019, p. 80) mention that "the Zipcar model does not incentivize driving less or more eco-efficiently, that is, to minimize the fuel use per kilometer driven." Because of increased accessibility, car sharing could lead to

non-environmentally friendly driving behaviors such as turning to car-use for walk-distance rides, or for travels that would originally be carried out with public transportations. The SBM could be inherently inconsistent from two perspectives: (i) the resource savings from less car production is shifted towards the consumption stage, and (ii) the offering of a wide access to the service (i.e., social sustainability) comes at the cost of environmental sustainability. Because of this, car sharing cannot be considered truly sustainable.

The tensions that may exist among the TBL dimensions need not necessarily translate to inconsistent business models. For example, Bettervest, a crowdfunding platform, on which small amounts of money can be invested in energy efficiency projects initiated by companies or local authorities, enables investors to earn money by getting a percentage of the energy cost savings that result from project implementation. Thus, the more frequently Bettervest sells its value proposition, the more money it makes for itself, and the more it is beneficial for the environment (Abdelkafi and Täuscher 2016). The same is true for social businesses; the more the company sells, the more it delivers its social value proposition to people. Another case in point is Newlight technologies, an innovative plastics manufacturer from California. The firm captures carbon dioxide (CO2) from other firms' chimneys to use it as raw material for the production of biodegradable plastic (Jørgensen and Pederson 2018). Thus, Newlight technologies derives value from a gas with harmful effects on the environment (CO2). It uses it as raw material for its process and gets paid for it (instead of paying for it!). The firm also generates revenues from the value proposition of selling plastic. Consequently, the more carbon dioxide is captured, the higher the positive impact on the environment, but also the more biodegradable plastic can be produced, and the higher the economic performance of Newlight technologies. This demonstrates the internal fit and consistency of the business model in spite of the tensions that may exist between economic and environmental objectives.

The example of Newlight technologies fits into industrial symbiosis, in particular so-called long-distance industrial symbiosis exchanges (e.g., Jensen et al. 2011; Prosman et al. 2017), which do not necessarily call for geographical proximity. Industry symbiosis is based on the SBM pattern "create value from waste" and value from by-products in general (Chertow 2000; Bocken et al. 2014). It offers environmental advantage by reducing the level of landfill, an economic advantage, e.g., through premium price that can be targeted due to environmental reputation (e.g., Fraccascia et al. 2019), and social advantage (Susur et al. 2019), also by increasing the awareness of consumers for products based on circular processes (e.g., Mostaghel and Chirumalla 2021).

4.2 Sustainability of BM at system level

System thinking (Bertalanffy 1968) implies the analysis of how the performance of a business model as a system (Massa et al. 2018) is affected by the larger system. Gaziulusoy (2015, p. 369) mentions that "…products, services, technologies or organisations individually cannot be defined as sustainable or unsustainable and they should be considered within the systems they are embedded." Where to draw

the boundaries of the larger system proves particularly relevant in determining the sustainability effectiveness of a given business model. In business model design or implementation, system level implications related to economic performance such as taxes, costs, or intellectual property rights should be considered. This does not hold always true for the environmental and social dimensions.

In the design phase of a SBM, the elements of the system within which the SBM is embedded should be considered, given that business models are executed within systems: e.g., countries, cultures, geographical areas. A given SBM that is applied inside a country or geographical region (system) with its laws, regulations, and culture can generate economic, social, and environmental value within that system. However, when applied—or simply some of its outputs are managed—in another country or region, given different laws and regulations, the same business model may not generate the same sustainability performance. For example, Laukkanen and Patala (2014) highlight the importance of regulatory frameworks for the creation of new SBMs as well as the relevance of cultural and structural changes to facilitate the societal transitions towards SBMs. In the case of servitization business model patterns and their impact on the environment, however, a systemic perspective is still required. Whereas Lüdeke-Freund et al. (2018b) claim that SBM patterns related to "service and performance" (also called servitization) drive economic value and eco-efficiency, as asserted in most of the literature (e.g., Tukker 2004), Blüher et al. (2020) indicate that the current debate on the implications of "service and performance" (or servitization) business models lacks a systemic approach, thus questioning the environmental efficiency of this type of business models.

Take as example the professional printer industry. European producers are considered sustainable when their action is evaluated with reference to European Union as a holistic geographical system (WEEE Directive (2002/96/EC; recast 2012/19/EC)). Within Italy, for instance, professional printer producing companies, which are essentially servitizers, recycle the components and modules of used printers, recondition the first-hand printers for a second life, etc. This business model fits into Bocken et al. (2014) classification in the archetype "create value from waste". However, such action brings environmental advantages only within the geographical boundary, since the used printers, after being recycled and reconditioned, enter the market overseas (typically outside Italy and Europe), leading to an extension of the system boundaries and a loss of control on the products by the servitizers. Italian companies cannot guarantee, for example, whether the components of the printers used abroad will be collected, recovered, or recycled, and overall, properly disposed. Although the selling of used printers to developing countries can serve a social mission, e.g., providing accessibility of professional printers to institutions in low-income countries at affordable prices, these business models are no more ecologically sustainable when the boundary of the system is extended from local to global (Abdelkafi et al. 2022; Pero et al. 2021). In this context, Valentinov (2013, p 682) mentions that "…human decisions […] must be based on the theory of whole systems, with the definition of the relevant whole system ultimately being an ethical decision."

The BMs of professional printer firms cannot be considered truly sustainable, since these firms neglect the system boundary in assessing sustainability

performance. A careful consideration of the system boundaries and the elements inside (i.e., society or environment-related) that interact with the business model are required. The lack of assessment of the system boundaries might result in SBMs that are "seemingly sustainable", proving to be environmentally and socially sustainable only within the confines of a certain system. When the system considered is enlarged, environmental and social sustainability can be overall lower or even negative.

From a general perspective, the larger system consists of stakeholders and their interactions with the business model. Stakeholders can be located in different geographical regions: local, national, regional, or international. The professional printer industry in Europe creates value from waste because the natural environment is considered relevant stakeholder whereas it is not the case in other regions where exported printers are likely to not be properly disposed. In addition, markets and customers are relevant stakeholders to any business model, be it sustainable or not. When enlarging the system, e.g., by launching products globally, preferences of customers and their sustainability awareness levels, which are key to economic success, can change. Outside the realm of sustainability, for example, Coca Cola had difficulties selling its value proposition in Spain because it marketed its beverage in big (two liter) bottles, as it used to do in the US, whereas Spanish households used to have small refrigerators (de Kluyver 2010).

Eventually, businesses that apply patterns that are more likely to be applied in a geographically distributed context exhibit higher risk of not considering relevant stakeholders. For example, closing-the-loop and supply chain patterns (Lüdeke-Freund et al. 2018b) can involve activities over many locations, making the choice of the larger system a relevant, but difficult decision to achieve sustainability targets. Note, also, that some patterns may seem rather sustainable and independent of the larger system. Take the example of the social pattern "buy one, give one". A shoe manufacturer gives away a pair of shoes to people with limited income in developing countries, whenever a customer in Europe buys a pair of shoes. At first glance, there is nothing wrong with this business model. However, since giving shoes away can be harmful to local shoe manufacturers, the larger system should necessarily include them to not solve a social problem (giving shoes to poor people) and create another more substantial one (by destroying jobs). Truly sustainable business models should include all important stakeholders to avoid negative impacts on stakeholders that may be (intentionally) excluded from the system.

4.3 Contingencies of SBMs

Contingencies exert internal and external forces that can shift SBM to lower level of sustainability or even unsustainability over time. As the conditions under which a business model operates change, they should be considered in the design of SBMs.

Although the contingent variables affecting the outcome of a business model design process have been investigated (Brenk et al. 2019), contingency analysis in the areas of business models and sustainability are still rare (Maletič et al. 2018; Pati et al. 2018). Pati et al. (2018) put forward that existing literature on business models,

despite recent progress, did not dedicate sufficient attention to the way external and internal contingencies impact the organizational performance of a given business model design. In addition, empirical studies that investigate the role of contingency factors in moderating the effects of sustainability practices on organizational performance are claimed to be scarce (Maletič et al. 2018). Nevertheless, extant literature points to the possibility of sustainability practices being context dependent (Campbell 2007; Maletič et al. 2014).

Being contingent on internal and external factors, a given business model design that involves economic, environmental, and social patterns may not be truly sustainable because of various reasons. First, from the start, the business model design does not fit well the company's context. Second, execution problems can constrain the achievement of sustainability targets. Third, a business model may start truly sustainable, but changes in the environment may push it to lower sustainability levels, or even unsustainability. A SBM can also miss an opportunity for higher sustainability performance, e.g., due to technological progress that happened after business model launch, but that the firm could not accommodate because of the lack of awareness or incapability to integrate the new technology. The leverage of such a technology could have improved one or more TBL dimensions, eventually without compromising any other dimension. Such a business model cannot be called truly sustainable anymore.

In each of the major contingency categories (internal/external) (e.g., Pati et al. 2018), two subcategories can be defined. Internal contingency consists of (i) strategy and long term entrepreneurial/managerial orientation, and (ii) organizational (tangible and intangible) resources, whereas the subcategories inside external contingencies are (i) competitive environment and (ii) firm's stakeholders and value adding network. The methodology, according to which contingency literature was analyzed and an overview table with all identified contingencies are provided in Appendix 2.

4.3.1 Internal contingencies

4.3.1.1 Strategy and long term entrepreneurial/managerial orientation Business models are "… reflections of the realized strategy". In addition, "…strategy entails designing business models (and redesigning them as contingencies occur)" (Casadesus-Masanell and Ricart 2010, p. 204). Thus, business models depend on the strategic, long-term orientation of the firm, which is related to the entrepreneur's mindset. Some companies have a sustainable orientation ingrained in their DNA. For instance, certified B Corporations not only need to demonstrate high social and environmental performance, but also must make legal commitments of accountability to all stakeholders and must exhibit high transparency (https://www.bcorporation.net/en-us). Often, these companies have business models where the more they create value for customers, the more they reduce environmental damage or increase social performance. A B-Corp example is Mr Green Aftrica (https://www.mrgreenafrica.com/), which collects plastic waste through a network of fairly-paid local collectors, then reconverts it, and sells it (Gall et al. 2020).

To be sustainable in the long run, business models should adapt over time in line with the company's strategy. In the case of Patagonia, for example, some

sustainability-oriented actions were about putting the company's business at risk (Szekely and Dossa 2015). Still, decision makers enforced them because of their strong belief that these measures will support the company in achieving its sustainability targets and overall goals. According to VBN Theory (Value-Belief-Norm), sustainable entrepreneurs adapt their beliefs, e.g., about the natural environment, continuously (Henry and Dietz 2012). This translates to specific behavior that results in business model updates, even with some delay (Abdelkafi and Täuscher 2016). For other business models, however, sustainability may only be a short living endeavor to cope with urgent pressures from society and/or other NGOs in the short term. The implementation of an innovative business model that combines economic, environmental, and social business model patterns in an organization that has been so far driven by financial performance is likely to result in an unsustainable business model, especially if the business model is not separated from current organization so that it can grow independently from the rest of the organization (Pati et al. 2018). In this case, sustainability is not ingrained in the DNA of the business. For example, McDonald's applies franchising as dominant model. As such the business model is economically driven. The combination of franchising with environmental patterns such as maximizing efficiency and creating value from waste, or socially oriented patterns aiming at the adoption of a stewardship role by engaging in projects for the support of certain disadvantaged communities have rather a lower priority.

4.3.1.2 Organizational (intangible and tangible) resources Prior knowledge and experience (e.g., due to a firm's age), which materialize in existing organizational structures, routines and processes, management experience, and even business model innovation capabilities can be considered valuable resources that support a company to maintain its true sustainability level. Companies can leverage these (intangible) resources to adjust their sustainability position over time. Whereas these resources can be important to realize fit between the environment and SBM, they can also act as inertia forces opposing this organizational fit. For example, incumbents confined in established organizational structures and routines will be less engaged in the exploration of innovative pathways leading to true sustainability than new entrants and relatively young companies with low level of inertia.

Financial resources can support companies in achieving true sustainability. The more resources a company can mobilize for its SBM, the more capabilities it can build up for sustainable exploration and exploitation, and the higher the likelihood to maintain a truly sustainable business model. Additionally, companies with high level of resources can accept, at the beginning, a low financial performance, if they project an improvement in the future. However, if companies do not find the required resources, true sustainability will be difficult. Davids and Goliaths in the field of sustainability have triggered an important debate in the scientific literature (Hockerts and Wüstenhagen 2010). Small-sized and relatively young companies have fewer financial resources, but do not suffer from forces of inertia that act against SBM changes. Large-sized incumbents may have more financial resources, but their existing structures and routines, though helpful to a certain degree, can oppose the shift toward truly sustainable business models.

4.3.2 External contingencies

4.3.2.1 Competitive environment The change in competitive dynamics can make a business model design that is inherently sustainable unsustainable. An example that illustrates the role of competition in reducing the sustainability performance of a given business model is bike-sharing in China (Huang 2018). The service boomed in 2014 when a private company started its operations to alleviate the shortcomings of state-owned bike-sharing, which suffered from limited access. With the support of mobile technologies such as GPS and mobile payment, the business expanded rapidly. Users could ride across cities at low cost, reducing fossil energy consumption and improving social benefit by increasing the overall well-being of citizens.

The turning point came when the number of bike-sharing companies grew rapidly. Haphazardly parked bikes have led to clogging the sidewalks, triggering anger and frustration in people. Bike repair and relocation with trucks were much burdensome than expected. This ended up in vicious competition with extremely low margins. New entrants believed that there would be long-term payoff with the value of user data (e.g., targeted marketing). In the end, competition was called to an end with the acquisition of the startups by two technology providers (Alibaba and Tencent), who tend to operate the business at a loss in exchange of valuable geolocation user data. There are no flaws in the business model design of the startups but fierce competition and increased congestion of bikes on sidewalks have brought it to an early end. Consequently, though being sustainable at the beginning, the model cannot be considered truly sustainable business since its fails to sustain itself in the changing environment.

In competitive environments, where technology advancements are fast and users are constrained to change products more often because of planned obsolescence and because products are outdated rapidly, the rules of competition are centered around the frequent launch of innovative products on the market. For example, in the mobile phone industry, companies like Apple and Samsung, are leveraging unrelentless technological progress to innovate and increase their market shares. At the same time, consumption is increased by making repair and reuse increasingly difficult. The business model conflicts with true sustainability logic, and companies that start new SBMs in these fields would find it hard to survive, thus either giving up their business or adjusting their business models to converge to pre-defined unsustainable industry practices.

In such competitive environments, to be truly sustainable, firms need to be innovative with the objective of changing the system from within in the hope that other players adjust their businesses, accordingly, leading to durable sustainable impact in the whole industry. Fairphone is a case in point. The company has designed a SBM for the mobile phone industry (Norris et al. 2021) with the mission of making a social contribution for the mines of the Democratic Republic of Congo, a conflict region, where essential minerals for making chips of phones are extracted (social responsibility). Fairphone leverages modular designs to enable repair, reuse, and recycling, increasing the lifetime of used phones (environmental orientation through maximizing efficiency and creating value from waste business model patterns). Fairphone understood that the only reliance on the sustainability drive of potential

customers would not enable the company's business to thrive. Would Fairphone have only relied on Fairness customers—those with sustainability drive—the business model would never take off. Fairphone, however, extended the customer base by targeting openness customers. It opened its design and enabled users that own 3D printers to print own accessories for the phone, integrating the open innovation pattern into the business model. This way, the company could achieve a respectable base of customers that was necessary to achieve a high level of diffusion and hence required economic targets (Beltagui et al. 2020).

4.3.2.2 Firm's stakeholders and value adding network The composition of stakeholders depends on a company's industry and business model. Most typical stakeholders are customers, employees, financiers such as shareholders and banks, suppliers, and communities (Dmytriyev et al. 2021). According to Stakeholder theory, businesses can be understood as a set of relationships among stakeholders (Freeman 2010). Sengupta et al. (2021) investigate the acceptance case of a social business model innovation at the Bottom of the Pyramid in India from a stakeholder perspective. They investigated eKutir, a digital platform that provides services around agriculture for small farmers. The acceptance of this business model by farmers, and hence the level of adoption of the platform, are found to depend on (i) stakeholder network stability, which is fostered by older microentrepreneurs that are respected in their community and have power and authority to drive the community toward platform adoption, and (ii) stakeholder incentives such as advisory services to improve crop yield or insurance services to protect agricultural products.

The value adding network reflects the firm's configuration of actors involved in value creation. This network is composed of suppliers and customers as well as their interactions. The larger the network, the higher its complexity, and so the level of uncertainty. Decisions on what activities to be executed by suppliers and those to be conducted by the firm itself are supported by transaction cost economics (Coase 1937; Williamson 1981). As suppliers can act opportunistically, they are sources of external uncertainty. According to transaction cost economics, those value adding activities associated with high opportunistic behavior should be internalized; those with low opportunistic behavior should be externalized. Opportunistic behavior such eco-opportunism leads to increased transaction costs (Nygaard 2022). Thus, the consideration of the value adding network and suppliers' opportunistic behavior are an essential requirement toward true sustainability, as suppliers have direct impact on company's sustainability. Consider the environmental impact of a high-tech company that leverages contract manufacturing from providers located overseas (e.g., Apple). Its own environmental impact is low, if considered as stand-alone entity in isolation of its network (doing mainly design and marketing activities). This impact is, however, high once the network of suppliers, which execute production and logistical activities, is included. Suppliers that do not fulfill agreed-upon sustainability objectives can move the company to an unsustainable state that can even end up with high financial losses and reputation damages (e.g., Nike's suppliers relying on children labor).

The sources of uncertainty in the value adding network can also be related to the difficulties in predicting customers' demand, which is related to customer's

consumption behavior, e.g., in online fashion retail (Stöcker et al. 2021), customers' characteristics such as consumer's age (Falke et al. 2021), or patience, e.g., in the adoption of electric vehicles (Chu et al. 2021), or it can be defined with reference to technological change and short technological lifecycles. At least from an operational perspective, stable customer demand leads to cost-efficient and optimized processes, favorizing lean management procedures. Changing customer demands, however, can trigger fluctuations that require production systems to be responsive (Fischer 1997), leading to the leverage of unsustainable solutions such as polluting air transportation for moving goods.

Unilever's business model exemplifies the importance of a firm's stakeholders and value network for its sustainability. During the last decade, Unilever set up several strategic actions involving its suppliers and customers to improve the firm's TBL (Adams et al. 2016). For example, the company started sourcing from smallhold local farmers in Vietnam and Indonesia, creating new jobs and introducing sustainable agricultural techniques to allow them to thrive in the long-term (Bell 2013a). Moreover, it distributed free water purifiers in India, which increased the people's quality of life and created a new market for Unilever's cleaning products (Bell 2013b). Unilever also suspended a multi-million contract with a producer of palm oil involved in the destruction of rainforests and later resorted to sustainable palm oil only, which also turned out to be of higher quality (Bell 2013b).

5 Discussion and management implications

This section discusses our approach to answering our initial research question: How can entrepreneurs and managers improve the sustainability of developed business models based on frameworks of SBM patterns?

Because the mere combination of patterns is not sufficient for the achievement of true sustainability, we propose a framework for checking the previously introduced levels in a specific sequence. Companies and entrepreneurs can apply this framework to improve the likelihood of implementing truly sustainable business models.

The inclusion of economic, environmental, and social business model patterns in one single business model is at best a necessary, but not a sufficient condition for true sustainability. Indeed, inherent coherency of the SBM, the boundaries of the wider system as well as internal and external contingencies, are relevant aspects that can have an impact on the sustainability performance of a given business model.

The consistency requirement ensures that the selected patterns do not pull the business model in opposite directions. For example, a freemium model can encourage consumption (due to free product or service), whereas an environmental pattern can aim at reducing resource usage and increasing product longevity. Thus, the combination of these two patterns can be misleading. The analysis of pattern consistency is complicated by the fact that measuring environmental and social impact of a business model is much less straightforward than the measurement of economic sustainability. In this regard, Valentinov (2021, p 1502) mentions that "there seems to be little doubt that the economic function system, and corporations affiliated therewith, generate a broad variety of adverse social and ecological consequences

that fail to be reflected in 'the language of prices'". In car sharing, for example, the negative impact on the environment because of careless car-user behavior cannot be "subtracted" from the benefit that results from limiting car production. In addition, a single indicator that includes all the impacts is not available. Because of this, a multitude of sustainability indicators may be used. Note, however, that many of the impacts, and therefore also the corresponding indicators, may not be known to the business model designer before business model launch. For example, at the design phase of a car sharing business, a careless driving behavior of users may not be predictable until the model is launched or tested.

A business model can be truly sustainable if it is applied within the confines of a given system, e.g., a location in the world. As in the recycling of used printers, the system is sustainable within a given geographical boundary. In car sharing, by only focusing on the portion of the market that cannot afford to buy a car, a car sharing model can be regarded socially advantageous because it increases accessibility. This same pattern may have a lower sustainability performance, if we include—by enlarging the system—the portion of users that is tempted to switch from public transportation to car sharing.

The barriers to reaching true sustainability might reside in the contingency factors that act on the business model. Many contingencies can affect business model sustainability. Strategy and long term entrepreneurial/managerial orientation, organizational (intangible and tangible) resources, competitive environment, and firm's stakeholders and value adding network are the contingencies that we derived from state-of-the-art literature. However, we reckon that these might not be the only contingencies that matter. First, research on business models and sustainability should make more progress in this regard. Second, managers, when designing new business models, may be better aware of the factors that can affect the sustainability of their own business models. Sure enough, however, the identification of relevant contingency factors remains the most challenging aspect as compared to consistency checking and system boundaries demarcation.

Based on the previous results, we propose a process for validating business model designs for true sustainability (Fig. 1). The SBM design can be supported by combining SBM patterns, which lead to a process of validation to verify that the business model is truly sustainable by checking all three levels. The validation process consists of three steps: (i) eliminate the possible inconsistencies inside the business model activity system by checking the compatibility of the selected business model patterns; (ii) demarcate the system boundaries, in which the business model is embedded, and verify that sustainability targets are achieved within these boundaries (without excluding relevant system elements); and (iii) develop awareness for the contingencies (internal and external contextual factors) that exert forces on the business model activity system to pull it away from its current sustainable position, in a way that the business model can be adapted continuously, while achieving high sustainability performance over time. By answering some key questions at every step, managers can decide to either reject the SBM and redesign it by trying new combinations or designing actions to mitigate/prevent the negative impacts.

The validation process starts with the inherent consistency check, which is aimed at identifying possible tensions inside the business model. Lüdeke-Freund et al.

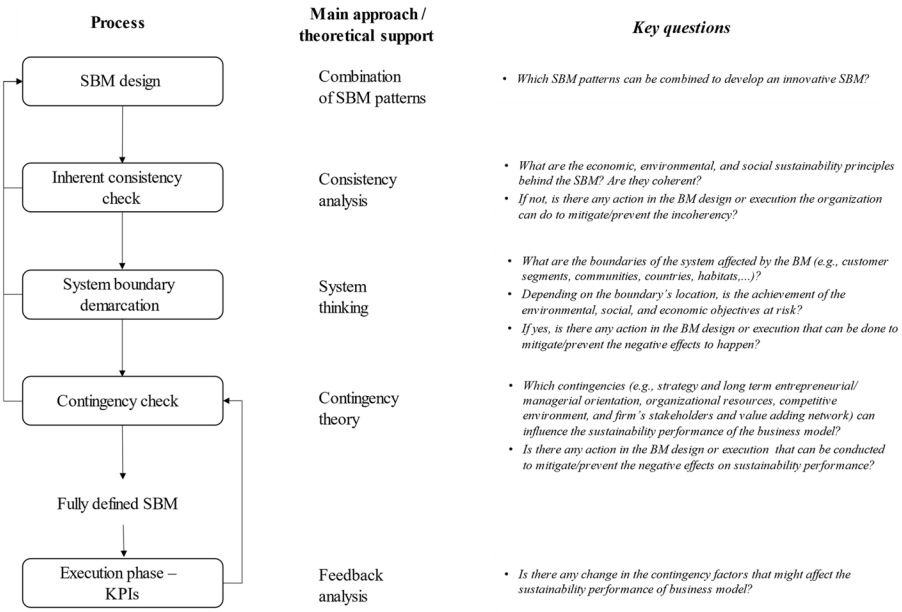

Fig. 1 Process for the validation of business model designs for true sustainability

(2018b) proposed 45 SBM patterns, and these patterns can be combined with others focused on economic objectives (e.g., Remane et al. 2017). Hence, the combination possibilities can reach astronomic numbers. Although this exercise can be rewarding from research and practical viewpoints, the evaluation of each possible combination possibility would be eventually difficult to achieve. Nevertheless, given a concrete business model design composed of a few patterns, consistency checking can be done more easily. In this regard, a consistency matrix for the pairwise consistency check of business model patterns (Echterhoff et al. 2017) can be helpful.

The next step is about positioning the business model in the system, in which it should operate. The characteristics used to define the system boundaries may not be clear-cut and can differ from one situation to another. At least two system characteristics are of paramount importance: the system of users or clients that the business model aims to serve (according to the car sharing example), and the geographical coverage of the business model (according to the printer industry).

Finally, the last level to deal with consists of the relevant set of contingency factors. These contingencies depend on the system's boundaries (internal and external). Some contingencies can be case-specific and change over time, leading to a situation where the business model becomes less sustainable or even unsustainable, hence the need to adapt the current business model to the new emerging context (Brenk et al. 2019).

As every entrepreneurial endeavor, be it sustainability-oriented or not, SBM design should be preceded with opportunity identification through context analysis with the objective of examining aspects such as available products on the market, existing competitors, unserved customer needs, and market size. This phase is not illustrated in Fig. 1.

This process will help entrepreneurs get an increased awareness of the implications of their SBM design choices along the TBL. The approach also suggests a continuous review of the SBM to adapt to changes. Therefore, a business model that is truly sustainable at its inception is not sustainable forever, and adaptations are required. As denoted in Bocken et al. (2014), technology represents one of the dimensions that can potentially enhance sustainability. With the rapid development of technologies for production and control, it is likely that an unsustainable business model today becomes sustainable in the future. For instance, environmental sustainability can be improved through the advancement of recycling techniques, and economic sustainability can be achieved by lowering production and service offering costs. However, social sustainability may be less affected by technological development.

Though business model design—our focus in this work—is of paramount importance, business model execution remains a key success factor. Research does not provide sufficient guidance in this regard. In the execution phase, the business model takes its final shape, whereas contingencies such as resource availability and technological capabilities can exert many forces on the sustainability effectiveness of the business model. During execution, a SBM design may not achieve the targeted sustainability level; in other situations, some design problems can even be rectified. For instance, car sharing companies can leverage internet of things technologies to send a warning to users with careless driving behavior, otherwise they risk paying extra fees (Bocken et al. 2019).

6 Conclusions and directions for future research

The integration of sustainability pattern types along the TBL dimensions seems a necessary, but not sufficient condition for achieving true sustainability. Therefore, researchers and practitioners alike should be aware that the mere application of business model patterns can be misleading. Our work advances research on frameworks related to SBM patterns by identifying three critical levels of analysis along which business models can be evaluated. These levels of analysis have been derived theoretically by drawing on contingency and system theories and then used to provide a definition for truly sustainable business models.

The identification and discussion of these levels open the way to managerial implications, in the form of a proposed approach to SBM analysis and design. The approach is organized in steps. The various steps should guide the design of a truly

sustainable business model by leveraging SBM patterns along the three dimensions of the TBL, and by challenging the design at three levels.

This research opens the way to multiple research directions. First, developing a conceptual framework based on theory alone and supported by case examples from the literature is a limitation. The proposed framework can benefit from follow-up work that connects it to empirical research. Such empirical research can assess the business models of companies with respect to all three levels of analysis and relate this to their sustainability performance.

Second, empirical research based on real cases can help one explore the characteristics and interfaces among SBM patterns that are more likely to be combined in a truly sustainable business model. To identify such cases, researchers may use convenience sampling or look for cases among firms with B-corp certification. The set of B-corps may be the best sample to start with when looking for truly sustainable business models. First, stringent requirements are posed on B-corps to receive the certification. In addition, the certification is renewed over time, depending on the firm's sustainability performance.

Third, with respect to the stages of the validation process, one research direction can focus on inherent consistency checking of business model patterns. In this work, we argue that this can be a difficult task, if all combinations of patterns are checked one by one. Nevertheless, one idea that can be interesting to follow, is to group patterns into clusters with similar principles/mechanisms underneath. For example, it can be possible to categorize business model patterns along the economic principles such as network effects, lock-in-effects, economies of scale and sustainability principles such as the creation of value from waste or extension of product longevity, and then check the compatibility of pattern clusters instead of single patterns.

Fourth, for what concerns the phase related to the demarcation of system boundary, our work points to two important system characteristics: geographical location and user system. Other system characteristics not mentioned in this work can be also relevant. Moreover, demarcating the system boundaries requires adequate methods and approaches to avoid being too narrow or too broad. Thus, future research can be devoted to the development of methods for the support of entrepreneurs in drawing the system boundaries of SBM.

Appendix 1: Analyzed pattern frameworks

Appendix 1.1: Methodology for the identification of relevant frameworks

Literature on frameworks for SBM patterns is rich and has evolved rapidly over the last years. To identify such frameworks, we perform a search query on Scopus database by combining the keywords "business model" and "sustainab*" with "pattern"

or "archetype". This search, conducted by July 28th, 2022, has led to a total of 274 articles, 85% of which have been published after 2014, the year of publication of the article by Bocken et al. (2014).

An analysis of the titles of all 274 articles reveals that the social dimension is less covered than the environmental aspect. In addition, among all 274 articles, "green", "ecological", and "environmental" business models are found more frequently in the titles (13 articles, e.g., Palmiè et al. 2021) than the "social business models" (7 articles, e.g., Abhi et al. 2015). Interestingly, some contributions focus on a single SBM pattern (e.g., Ferrer et al. 2022), without proposing an integrative framework that consists of many patterns.

For the purpose of our research, we analyze a subset of the identified articles. We select the first 20 articles according to the "relevance" criterion by the Scopus database. These articles have collected around 80% of the overall citations in all 274 articles. Our sample includes some recent papers, which are less cited than older ones, but are considered highly impactful for current and future debates in the areas of sustainability, business models, and patterns. The analysis of the final sample (Table 1) shows that selected articles either propose novel frameworks or extend existing ones with new or more specific patterns.

Appendix 2: SBM contingencies

Appendix 2.1: Methodology for the identification of relevant literature

To identify potential contingencies systematically, we inserted a search query in the Scopus database that combines all relevant search terms "business model" and "sustainab" and "contingenc". This resulted in a very small number of articles. Therefore, we decided to eliminate the term "sustainab" from our query with the objective of identifying all research articles related to business model contingencies in general. In this way, those articles that are related to sustainability will be among the articles in our sample. This query resulted in 160 papers. The selection of relevant articles has been conducted by two of the authors. Each one has scrutinized the articles independently by using the following algorithm. If the title seems relevant, then the article was included in the sample. If not, then the abstract was read, and then it was decided, whether to include the article to the sample or not. If doubts persisted, the full article was scanned. Since these tasks were conducted by two researchers independently, their results could be compared to each other in the case of disagreement. Discussions aimed at reaching agreement and deciding as to whether an article is included in the final sample or not. This process led to 25 articles that have been analyzed for the identification of business model contingencies. The detailed results are provided in Table 2.

Table 1 Overview table of selected pattern frameworks for analysis

Groups	Author(s) (year)	Frameworks for SBMs: types/groups	Sustainable value creation dimension(s)
Industry specific patterns	Yip and Bocken (2018)	Eight business model archetypes for banks. Refined version of Bocken et al. (2014) with four modified archetypes	Environmental, economic and social (inclusive value creation)
	Heesbeen and Prieto (2020)	Five circular business model archetypes in the construction industry (i.e., industrially manufactured building products)	Environmental and economic
	Zufall et al. (2020)	Seven SBM patterns for the smartphone industry	Environmental (e.g., energy consumption), economic (e.g., fast replacement business model), social (e.g., illicit operations with conflict minerals)
Frameworks that combine existing frameworks	Hora et al. (2016)	Seven SBM patterns for sustainable mass customization resulting from a combination of mass customization patterns (e.g., postponement, modularity, etc.) and sustainability patterns (e.g., longevity, eco-design)	Environmental, social, and economic orientation of the different patterns
	Dijkstra et al. (2020)	Eight SBM archetypes resulting from a combination of the archetypes proposed by Bocken et al. (2014) and the Waste Hierarchy framework	Environmental, economic and social

Table 1 (continued)

Groups	Author(s) (year)	Frameworks for SBMs: types/groups	Sustainable value creation dimension(s)
Frameworks that characterize a specific overarching business model concept	Alshammari and Ball (2016)	Three main SBM archetypes for reverse logistics	Economic and environmental
	Kortmann and Piller (2016)	Nine SBMs in the extended product life cycle to create closed loop value chains	(Mostly) Environmental and economic, social
	Kwon et al. (2019)	Five SBM patterns for product-service-system	Economic. Environmental impact is described just for the general PSS, but not for each archetype separately
	Yang and Evans (2019)	Four archetypes of product-service-system business models	Prevailing orientation towards economic and environmental-economic. Social value is covered but less relevant
	Rosa et al. (2019)	Five "macro-categories" of business models for the circular economy (i.e., share, optimize, loop, virtualize, exchange)	Environmental, economic and social
	Henry et al. (2020)	Five circular business model archetypes of startups	(Mostly) Environmental and economic, social impact is mentioned in relation to industrial symbiosis pattern that contributes to local development
	Curtis (2021)	Eight prototypical patterns for sharing economy	Environmental, economic (e.g., improvement of resource efficiency) and social (e.g., trust between peers and social cohesion)

Table 1 (continued)

Groups	Author(s) (year)	Frameworks for SBMs: types/groups	Sustainable value creation dimension(s)
Frameworks that consist of business model patterns that aim to support the deployment of green technologies	Bohnsack et al. (2014)	Four SBM archetypes for electric vehicle	(Mostly) Environmental and economic (e.g., energy efficiency and reduction of environmental degradation thanks to electric vehicles)
	Abdelkafi and Hansen (2018)	Four SBM archetypes in the context of e-mobility	(Mostly) environmental, due to the focus on green technologies (e-mobility)
	Holzmann et al. (2020)	Five SBM patterns for 3D-printing service	(Mostly) Economic. Environmental friendliness is presented as a part of the value proposition of such business models
	Palmié et al. (2021)	25 business model archetypes for the "green transition" in the electrical power sector	Environmental and economic
	Trapp and Kanbach (2021)	Ten business model archetypes for green technologies starting from Ritala et al. (2018)	Environmental and economic
General frameworks	Bocken et al. (2014)	Three types of categories of SBMs for eight archetypes: technological, social, organizational	Environmental, economic, environmental-economic
	Lüdeke-Freund et al. (2018b)	Eleven groups of 45 SBM patterns	Economic, ecological, social, social-economic, ecologic-economic and two patterns regarding integrative value creation, which covers all TBL dimensions together
	Ritala et al. (2018)	Three types of categories of SBMs for 9 archetypes: environmental, social, economic. It is a refined version of Bocken et al. (2014)	Environmental, economic, environmental-economic, social-environmental

Table 2 Overview table of SBM contingencies

Contingencies	References
Internal contingencies	
Strategy and long term entrepreneurial/managerial orientation	
Product market strategy	Zott and Amit (2008)
Strategic objectives and vision	Gaiardelli and Songini (2020); Niemand et al. (2021); Pateli and Giaglis (2005)
Long term orientation	Gaiardelli and Songini (2020); Ibarra et al. (2020); Niemand et al. (2021); Niemand et al. (2017)
Logic conflicts between established and new business model	Brenk et al. (2019)
Organizational resources: (intangible) capabilities and skills and tangible assets	
Organizational structures and processes	Gaiardelli and Songini (2020)
Managerial skills and capabilities	Gaiardelli and Songini (2020); Pateli and Giaglis (2005); Guo et al. (2013)
Business model innovation capabilities	Ibarra et al. (2020)
Entrepreneurial skills	Guo et al. (2013)
Knowledge base (Breadth and depth)	An et al. (2022)
Firm's age (as an antecedent of experience and inertia forces acting on the organization)	Pati et al. (2018)
Top management team experience	Patzelt et al. (2008)
Firm's size (as an indicator of the availability of resources)	Gaiardelli and Songini (2020); Pateli and Giaglis (2005)
Firm's assets	Gaiardelli and Songini (2020); Pateli and Giaglis (2005)
Financial resources	Gaiardelli and Songini (2020); Lüdeke-Freund (2020); Pateli and Giaglis (2005)
External contingencies	
Competitive environment	
Environmental dynamism/stability	Pati et al. (2018); Hacklin et al. (2018); Liao et al. (2018)
Environmental munificence	Pati et al. (2018); Lüdeke-Freund (2020)
Venture capital investments and private financing	Guo et al. (2017)
Industry structure (monopolistic, oligopolistic, highly competitive)	Pateli and Giaglis (2005)
Technology-driven contingencies (e.g., sharing economy, cloud computing, big data)	Niemimaa et al. (2019)
(General) Environmental requirements	Lahti et al. (2018)
Regulation and public policy	Lüdeke-Freund (2020); Demir and Angwin (2021); Reinhold et al. (2017)
Industrial standards	Demir and Angwin (2021)
Firm's stakeholders and value adding network	
Stakeholder network stability	Sengupta et al. (2021)
Stakeholder incentives	Sengupta et al. (2021)
Stakeholder relationships	Gaiardelli and Songini (2020); Lüdeke-Freund (2020)

Table 2 (continued)

Contingencies	References
Firm's position in the value chain	Hacklin et al. (2018)
Supply characteristics (quality, timing, quantities and value)	Prosman and Cagliano (2022)
Value configuration	Fjeldstad and Snow (2018)
User's experience with technology	Lin and Chan (2019)
Balance between transaction costs and costs of internal development	Pateli and Giaglis (2005)

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Data availability We do not analyze or generate any datasets, because our work proceeds within a theoretical and conceptual approach.

Declarations

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Human and animal participants This research is conceptual and therefore 'Research involving Human Participants and/or Animals' is not applicable.

Informed consent Informed consent is also not applicable because of the nature of this research, which is theoretical/conceptual.

References

Abdelkafi N, Hansen EG (2018) Ecopreneurs' creation of user business models for green tech: an exploratory study in e-mobility. Int J Entrep Ventur 10(1):32–55

Abdelkafi N, Täuscher K (2016) Business models and sustainability—studying the missing links and managerial implications. Organ Environ 29(1):74–96

Abdelkafi N, Makhotin S, Posselt Th (2013) Business model innovations for electric mobility: what can be learned from existing business model patterns? Int J Innov Manag 17(1):1–41

Abdelkafi N, Pero M, Masi A, Capurso I (2022) Revisiting the servitization-sustainability link: a case study in the professional printing supply chain. Clean Logist Supply Chain 4:100061

Abhi S, Venugopal V, Shastri S (2015) Social entrepreneurship—building sustainability through business models and measurement of social impact. In: Manimala MJ, Wasdani KP (eds) Entrepreneurial ecosystem. Springer, New Delhi, pp 295–323

Adams CA, Potter B, Singh PJ, York J (2016) Exploring the implications of integrated reporting for social investment (disclosures). Br Account Rev 48(3):283–296

Alexander C (1977) A pattern language: towns, buildings, construction. Oxford University Press, Oxford
Alshammari S, Ball P (2016) Towards reverse logistics archetypes to stimulate manufacturers' usage of end of life and end of use products. In: Setchi R, Howlett RJ, Liu Y, Theobald P (eds) Sustainable design and manufacturing. Springer, Cham, pp 179–187
Amshoff B, Dülme C, Echterfeld D, Gausemeier J (2015) Business model patterns for disruptive technologies. Int J Innov Manag 19(3):1540002
An W, Huang Q, Liu H, Wu J (2022) The match between business model design and knowledge base in firm growth: from a knowledge-based view. Technol Anal Strateg Manag 34(1):99–11
Ayres R, Van den Berrgh J, Gowdy J (2001) Strong versus weak sustainability: economics, natural sciences, and consilience. Environ Ethics 23(2):155–168
Baldassarre B, Konietzko J, Brown P, Calabretta G, Bocken N, Karpen IO, Hultink EJ (2020) Addressing the design-implementation gap of sustainable business models by prototyping: a tool for planning and executing small-scale pilots. J Clean Prod 255:120295
Bell G (2013a) Doing well by doing good: an interview with Paul Polman, CEO of Unilever, part 1. Strateg Dir 29(4):38–40
Bell G (2013b) Want to change the world? Think differently: an interview with Paul Polman, CEO of Unilever, part 2. Strateg Dir 29(5):36–39
Beltagui A, Kunz N, Gold S (2020) The role of 3D printing and open design on adoption of socially sustainable supply chain innovation. Int J Prod Econ 221:1–16
Bertalanffy LV (1968) General system theory: foundations development applications. Revised Edition Thirteenth paperback printing 2001 George Brazill, New York
Blüher T, Riedelsheimer T, Gogineni S, Klemichen A, Stark R (2020) Systematic literature review-effects of PSS on sustainability based on use case assessments. Sustainability 12(17):1–25
Bocken NM, Short SW (2021) Unsustainable business models-Recognising and resolving institutionalised social and environmental harm. J Clean Prod 312:127828
Bocken NM, Short SW, Rana P, Evans S (2014) A literature and practice review to develop sustainable business model archetypes. J Clean Prod 65:42–56
Bocken NM, Ingemarsdotter E, Gonzalez D (2019) Designing sustainable business models: exploring iot-enabled strategies to drive sustainable consumption. In: Aagaard A (ed) Sustainable business models: innovation, implementation and success. Palgrave Macmillan, Cham, pp 61–88
Bohnsack R, Pinkse J, Kolk A (2014) Business models for sustainable technologies: exploring business model evolution in the case of electric vehicles. Res Policy 43:284–300
Bradley P, Parry G, O'Regan N (2020) A framework to explore the functioning and sustainability of business models. Sustain Prod Consum 21:57–77
Brenk S, Lüttgens D, Diener K, Piller F (2019) Learning from failures in business model innovation: solving decision-making logic conflicts through intrapreneurial effectuation. J Bus Econ 89(8):1097–1147
Budler M, Trkman P (2019) The nature of management frameworks. Journal of management & organization. DOI https://doi.org/10.1017/jmo.2019.83. https://repozitorij.uni-lj.si/IzpisGradiva.php?lang=eng&id=115352. Accessed 26 Oct 2021
Bundy J, Shropshire C, Buchholtz A (2013) Strategic cognition and issue salience: toward an explanation of firm responsiveness to stakeholder concerns. Acad Manag Rev 38(3):352–376
Campbell JL (2007) Why would corporations behave in socially responsible ways? An institutional theory of corporate social responsibility. Acad Manag Rev 32(3):946–967
Casadesus-Masanell R, Ricart JE (2010) From strategy to business models and onto tactics. Long Range Plan 43:195–215
Chapman DA, Eyckmans J, Van Acker K (2020) Does car-sharing reduce car-use? An impact evaluation of car-sharing in flanders, Belgium. Sustainability 12(19):1–27
Chertow M (2000) Industrial symbiosis: literature and taxonomy. Annu Rev Energy Environ 25:313–337
Chu W, Kim H, Im M (2021) Patience and the adoption of electric vehicles: an application of the dual-self model. J Bus Econ 91(6):851–866
Circular Economy Initiative Deutschland (2021) Circular business models: overcoming barriers, unleashing potentials-executive summary and recommendations. https://static1.squarespace.com/static/5b52037e4611a0606973bc79/t/60a633d025c8aa6d5b5e2f69/1621504987694/GM+EN_Executive+Summary.pdf. Accessed 04 Sep 2022
Clayton T, Radcliffe N (1996) Sustainability: a systems approach. Routledge, New York
Coase RH (1937) The nature of the firm. Economica 4(16):386–405

European Council (2008) Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives (text with EEA relevance). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008L0098. Accessed 2 Sep 2022
Curtis SK (2021) Business model patterns in the sharing economy. Sustain Prod Consum 27:1650–1671
De Kluyver CA (2010) Fundamentals of global strategy: a business model approach. Business Expert Press, New York
Demir R, Angwin D (2021) Multidexterity: combining competing business models in transforming economies. Manag Organ Rev 17(2):282–313
Dijkstra H, van Beukering P, Brouwer R (2020) Business models and sustainable plastic management: a systematic review of the literature. J Clean Prod 258:120967
Dmytriyev SD, Freeman RE, Hörisch J (2021) The relationship between stakeholder theory and corporate social responsibility: differences, similarities, and implications for social issues in management. J Manag Stud 85(6):1441–1470
Donaldson L (2001) The contingency theory of organizations. Sage, Thousand Oaks
Drazin R, Van de Ven AH (1985) Alternative forms of fit in contingency theory. Adm Sci Q 30(4):514–539
Dubin R (1976) Theory building in applied areas. In: Dunnette MD (ed) Handbook of industrial and organizational psychology. Rand McNally, Chicago, pp 17–39
Dyllick T, Muff K (2016) Clarifying the meaning of sustainable business: introducing a typology from business-as-usual to true business sustainability. Organ Environ 29(2):156–174
Echterhoff B, Koldwey Ch, Gausemeier J (2017) Pattern based business model development—identification, structuring and application of business model patterns. Proceedings of the ISPIM Innovation Forum, Toronto Canada 19–22 March 2017
Elkington J (1997) Cannibals with forks. The triple bottom line of 21st century business. Capstone Publishing, Oxford, UK
Elkington J (2018) 25 years ago I coined the phrase 'triple bottom line.' Here's why it's time to rethink it. Harvard Business Review. https://hbr.org/2018/06/25-years-ago-i-coined-the-phrase-triple-bottom-line-heres-why-im-giving-up-on-it. Accessed 18 Jan 2022
Falke A, Schröder N, Hofmann C (2021) The influence of values in sustainable consumption among millennials. J Bus Econ 92(2–3):899–928
Ferrer JR, García-Cortijo MC, Pinilla V, Castillo-Valero JS (2022) The business model and sustainability in the Spanish wine sector. J Clean Prod 330:129810
Fischer ML (1997) What is the right supply chain for your product. Harv Bus Rev March-April 1997:105–116
Fjeldstad ØD, Snow CC (2018) Business models and organization design. Long Range Plan 51(1):32–39
Fraccascia L, Giannoccaro I, Albino V (2019) Business model for industrial symbiosis: a taxonomy focused on the form of governance. Resour Conserv Recycl 146:114–126
Freeman RE (2010) Strategic management: a stakeholder approach. Cambridge University Press, Cambridge
Gaiardelli P, Songini L (2020) Successful business models for service centres: an empirical analysis. Int J Product Perform Manag 70(5):1187–1212
Gall M, Wiener M, de Oliveira CC, Lang RW, Hansen EG (2020) Building a circular plastics economy with informal waste pickers: recyclate quality, business model, and societal impacts. Resour Conserv Recycl 156:104685
Gassmann O, Frankenberger K, Csik M (2014) The business model navigator: 55 models that will revolutionize your business. Pearson Education Limited, Harlow
Gaziulusoy IA (2015) A critical review of approaches available for design and innovation teams through the perspective of sustainability science and system innovation theories. J Clean Prod 107:366–377
Giesen E, Riddelberger E, Christner R, Bell R (2010) When and how to innovate your business model. Strategy Leadersh 38:17–26
Gilson LL, Goldberg CB (2015) Editors' comment: so, what is a conceptual paper? Group Org Manag 40(2):127–130
Guo H, Zhao J, Tang J (2013) The role of top managers' human and social capital in business model innovation. Chin Manag Stud 7(3):447–469
Guo L, Wei SY, Sharma R, Rong K (2017) Investigating e-business models' value retention for start-ups: the moderating role of venture capital investment intensity. Int J Prod Econ 186(February):33–45

Hacklin F, Björkdahl J, Wallin MW (2018) Strategies for business model innovation: how firms reel in migrating value. Long Range Plan 51(1):82–110
Heesbeen C, Prieto A (2020) Archetypical CBMs in construction and a translation to industrialized manufacture. Sustainability 12:1572
Henry AD, Dietz T (2012) Understanding environmental cognition. Organ Environ 25:238–258
Henry M, Bauwens T, Hekkert M, Kirchherr J (2020) A typology of circular start-ups: an analysis of 128 circular business models. J Clean Prod 245:118528
Hockerts K, Wüstenhagen R (2010) Greening Goliaths versus emerging Davids—theorizing about the role of incumbents and new entrants in sustainable entrepreneurship. J Bus Ventur 25(5):481–492
Holzmann P, Breitenecker RJ, Schwarz EJ, Gregori P (2020) Business model design for novel technologies in nascent industries: an investigation of 3D printing service providers. Technol Forecast Soc Chang 159:120193
Hora M et al (2016) Designing business models for sustainable mass customization: a framework proposal. Int J Ind Eng Manag 7:143–152
Huang F (2018) The rise and fall of China's Cycling Empires. Foreign Policy. https://foreignpolicy.com/2018/12/31/a-billion-bicyclists-can-be-wrong-china-business-bikeshare/. Accessed 21 Oct 2021
Ibarra D, Bigdeli AZ, Igartua JI, Ganzarain J (2020) Business model innovation in established SMEs: a configurational approach. J Open Innov 6(3):76
Jaakkola E (2020) Designing conceptual articles: four approaches. AMS Rev 10(1):18–26
Jensen PD, Basson L, Hellawell EE, Bailey MR, Leach M (2011) Quantifying "geographic proximity: experiences from the United Kingdom's National Industrial Symbiosis Programme. Resour Conserv Recycl 55(7):703–712
Jochem P, Frankenhasuer D, Ewald L, Ensseln A, Fromm H (2020) Does free-floating carsharing reduce private vehicle ownership? The case of SHARE NOW in European cities. Transp Res Part A 141:373–395
Johnson MW (2018) Reinvent your business model: how to seize the white space for transformative growth. Harvard Business Review Press, Boston, Massachusetts
Jørgensen S, Pederson LJT (2018) Restart sustainable business model innovation. Palgrave Macmillan, Cham
Joyce A, Paquin RL (2016) The triple layered business model canvas: a tool to design more sustainable business models. J Clean Prod 135:1474–1486
Ke H, Chai S, Cheng R (2019) Does car sharing help reduce the total number of vehicles? Soft Comput 23:12461–12474
Kortmann S, Piller F (2016) Open business models and closed-loop value chains: redefining the firm-consumer relationship. Calif Manag Rev 58:88–108
Kranich P, Wald A (2018) Does model consistency in business model innovation matter? A contingency-based approach. Creat Innov Manag 27:209–220
Kurucz EC, Colbert BA, Lüdeke-Freund F, Upward A, Willard B (2017) Relational leadership for strategic sustainability: practices and capabilities to advance the design and assessment of sustainable business models. J Clean Prod 140:189–204
Kwon M, Lee J, Hong YS (2019) Product-service system business modelling methodology using morphological analysis. Sustainability 11(5):1376
Lahti T, Wincent J, Parida V (2018) A definition and theoretical review of the circular economy, value creation, and sustainable business models: where are we now and where should research move in the future ? Sustainability 10(8):2799
Lambert S (2015) The importance of classification to business model research. J Bus Models 3(1):29–61
Laukkanen M, Patala S (2014) Analysing barriers to sustainable business model innovations: innovation systems approach. Int J Innov Manag 18(6):1440010
Laukkanen M, Tura N (2020) The potential of sharing economy business models for sustainable value creation. J Clean Prod 253:120004
Leitner H (2015) Pattern theory—introduction and perspectives on the tracks of Christopher Alexander. HLS, Graz
Liao S, Liu Z, Fu L, Ye P (2018) Investigate the role of distributed leadership and strategic flexibility in fostering business model innovation. Chin Manag Stud 13(1):93–112
Lin SP, Chan YH (2019) An investigation on sharing economy mobile service adoption: How perceived risk, value, and price interact? In: Antona M, Stephanidis C (eds) Universal access in human-computer interaction. Theory. methods and tools. Springer, Cham, pp 312–325

Lüdeke-Freund F (2020) Sustainable entrepreneurship, innovation, and business models: integrative framework and propositions for future research. Bus Strateg Environ 29(2):665–681
Lüdeke-Freund F, Gold S, Bocken NM (2018a) A review and typology of circular economy business model patterns. J Ind Ecol 23(1):36–61
Lüdeke-Freund F, Carroux S, Joyce A, Massa L, Breuer H (2018b) The sustainable business model pattern taxonomy—45 patterns to support sustainability-oriented business model innovation. Sustain Prod Consum 15:145–162
Maletič M, Maletič D, Dahlgaard JJ, Dahlgaard-Park SM, Gomišček B (2014) Sustainability exploration and sustainability exploitation: from a literature review towards a conceptual framework. J Clean Prod 79:182–194
Maletič M, Maletič D, Gomišček B (2018) The role of contingency factors on the relationship between sustainability practices and organizational performance. J Clean Prod 10:423–433
Massa L, Viscusi G, Tucci C (2018) Business models and complexity. J Bus Models 6(1):59–71
Mitchell JR, Israelsen TL, Mitchell RK, Lim DSK (2021) Stakeholder identification as entrepreneurial action: the social process of stakeholder enrollment in new venture emergence. J Bus Ventur 36(6):106146
Mostaghel R, Chirumalla K (2021) Role of customers in circular business models. J Bus Res 127:35–44
Niemand T, Rigtering C, Kallmünzer A, Kraus S, Matijas S (2017) Entrepreneurial orientation and digitalization in the financial service industry : a contingency approach. Proceedings of the 25th European Conference on Information Systems (ECIS), Guimarães, Portugal, June 5–10, 2017:1081–1096
Niemand T, Rigtering C, Kallmünzer A, Kraus S, Maalaoui A (2021) Digitalization in the financial industry: a contingency approach of entrepreneurial orientation and strategic vision on digitalization. Eur Manag J 39(3):317–326
Niemimaa M, Järveläinen J, Heikkilä M, Heikkilä J (2019) Business continuity of business models: evaluating the resilience of business models for contingencies. Int J Inf Manag 49:208–216
Norris S, Hagenbeck J, Schaltegger S (2021) Linking sustainable business models and supply chains—toward an integrated value creation framework. Bus Strateg Environ 30:3960–3974
Nosratabadi S, Mosavi A, Shamshirband S, Zavadskas EK, Rakotonirainy A, Chau KW (2019) Sustainable business models: a review. Sustainability 11:1663
Nygaard A (2022) From linear to circular economy: a transaction cost approach to the ecological transformation of the firm. Circ Econ Sustain. https://doi.org/10.1007/s43615-022-00158-w
Osterwalder A, Pigneur Y (2010) Business model generation: a handbook for visionaries, game changers, and challengers. John Wiley & Sons, Hoboken, New Jersey
Palmié M et al (2021) Startups versus incumbents in "green" industry transformations: a comparative study of business model archetypes in the electrical power sector. Ind Mark Manag 96:35–49
Pateli AG, Giaglis GM (2005) Technology innovation-induced business model change: a contingency approach. J Organ Chang Manag 18(2):167–183
Pati RK, Nandakumar MK, Ghobadian A, Ireland D, O'Regan N (2018) Business model design-performance relationship under external and internal contingencies: evidence from SMEs in an emerging economy. Long Range Plan 51:750–769
Patzelt H, Zu Knyphausen-Aufseß D, Nikol P (2008) Top management teams, business models, and performance of biotechnology ventures: an upper echelon perspective. Br J Manag 19(3):205–221
Pelenc J, Ballet J, Dedeurwaerdere T (2015) Weak sustainability versus strong sustainability. Brief for GSDR United Nations 2015:1–4. https://sustainabledevelopment.un.org/content/documents/6569122-Pelenc-Weak%20Sustainability%20versus%20Strong%20Sustainability.pdf. Accessed 04 Sep 2022
Pero M, Fabbri M, Masi A, Capurso I, Abdelkafi N (2021) Improving sustainability performance of the Italian professional printers supply chain. Proceedings of the Summer School Francesco Turco. http://www.summerschool-aidi.it/section.php?id=19. Accessed 30 Oct 2021
Piscicelli L, Ludden GD, Cooper T (2018) What makes a sustainable business model successful? An empirical comparison of two peer-to-peer goods-sharing platforms. J Clean Prod 172:4580–4591
Prosman EJ, Cagliano R (2022) A contingency perspective on manufacturing configurations for the circular economy: insights from successful start-ups. Int J Prod Econ 249:108519
Prosman EJ, Waehrens BV, Liotta G (2017) Closing global material loops. J Ind Ecol 21(3):641–650
Reinhardt R, Christodoulou I, García BA, Gasso-Domingo S (2020) Sustainable business model archetypes for the electric vehicle battery second use industry: towards a conceptual framework. J Clean Prod 254:119994

Reinhold S, Zach FJ, Krizaj D, Reinhold S (2017) Business models in tourism: a review and research agenda. Tour Rev 72(4):462–482
Remane G, Hanelt A, Tesch JF, Kolbe LM (2017) The business model pattern database-A tool for systematic business model innovation. Int J Innov Manag 21(1):1750004
Renting H, Marsden TK, Banks J (2003) Understanding alternative food networks: exploring the role of short food supply chains in rural development. Environ Plan A 35(3):393–411
Ritala P, Huotari P, Bocken N, Albareda L, Puumalainen K (2018) Sustainable business model adoption among S&P 500 firms: a longitudinal content analysis study. J Clean Prod 170:216–226
Rodriguez Serna L, Nakandala D, Bowyer D (2022) Stakeholder identification and prioritization: the attribute of dependency. J Bus Res 148:444–455
Rosa P, Sassanelli C, Terzi S (2019) Towards circular business models: a systematic literature review on classification frameworks and archetypes. J Clean Prod 236:11796
Salvador R, Barros MV, Mendes da Luz L, Piekarski CM, de Francisco AC (2020) Circular business models: Current aspects that influence implementation and unaddressed subjects. J Clean Prod 250:119555
Schaltegger S, Lüdeke-Freund F, Hansen EG (2012) Business cases for sustainability: the role of business model innovation for corporate sustainability. Int J Innov Sustain Dev 6(2):95–119
Schaltegger S, Hansen EG, Lüdeke-Freund F (2016) Business models for sustainability: origins, present research, and future avenues. Organ Environ 29(1):3–10
Searcy C (2018) Defining true sustainability. MIT Sloan management review. https://sloanreview.mit.edu/article/defining-true-sustainability/. Accessed 18 Jan 2022
Sengupta T, Narayanamurthy G, Hota PK, Sarker T, Dey S (2021) Conditional acceptance of digitized business model innovation at the BoP: a stakeholder analysis of eKutir in India. Technol Forecast Soc Chang 170:120857
Stöcker B, Baier D, Bran BM (2021) New insights in online fashion retail returns from a customers' perspective and their dynamics. J Bus Econ 91:1149–1187
Süß A, Höse K, Götze U (2021) Sustainability-oriented business model evaluation—a literature review. Sustainability 13:10908
Susur E, Chiaroni DHA (2019) A strategic niche management perspective on transitions to eco-industrial park development: a systematic review of case studies. Resour Conserv Recycl 40:338–359
Szekely F, Dossa Z (2015) Patagonia's sustainability strategy: don't buy our products. Harvard Business Publishing Education. https://hbsp.harvard.edu/product/IMD790-PDF-ENG?Ntt=Patagonia. Accessed 21 Oct 2021
The Ellen MacArthur Foundation (2015) Delivering the circular economy: a toolkit for policymakers. Ellen MacArthur Foundation. https://ellenmacarthurfoundation.org/a-toolkit-for-policymakers. Accessed 21 Oct 2021
Trapp CTC, Kanbach DK (2021) Green entrepreneurship and business models: deriving green technology business model archetypes. J Clean Prod 297:126694
Tukker A (2004) Eight types of product-service system: Eight ways to sustainability? Experiences from suspronet. Bus Strateg Environ 260:246–260
Tukker A, Emmert S, Charter M, Vezzoli C, Sto E, Andersen MM, Geerken T, Tischner U, Lahlou S (2008) Fostering change to sustainable consumption and production: an evidence-based view. J Clean Prod 16(11):1218–1225
Ulvenblad PO, Ulvenblad P, Tell J (2019) An overview of sustainable business models for innovation in Swedish agri-food production. J Integr Environ Sci 16(1):1–22
UNEP (2012) Towards a green economy—pathways to sustainable development and poverty eradication. https://www.unep.org/resources/annual-report/unep-2012-annual-report. Accessed 2 Sep 2022
Upward A, Jones P (2016) An ontology for strongly sustainable business models: defining an enterprise framework compatible with natural and social science. Organ Environ 29(1):97–123
Valentinov V (2013) Veblen and instrumental value: a systems theory perspective. J Econ Issues XLVI I(3):673–688
Valentinov V (2021) Sustainability in classical institutional economics: a systems theory view. Sustain Prod Consum 28:1500–1507
Victor P, Hanna S, Kubursi A (1998) How strong is weak sustainability? In: Faucheux S, O'Connor M, Straaten J (eds) Sustainable development: concepts, rationalities and strategies. Springer, Dordrecht, pp 195–210

Williams A, Kennedy S, Philipp F, Whiteman G (2017) Systems thinking: a review of sustainability management research. J Clean Prod 148:866–881
Williamson OE (1981) The economics of organization: the transaction cost approach. Am J Sociol 87(3):548–577
Wilson MC, Wu J (2017) The problems of weak sustainability and associated indicators. Int J Sust Dev World 24(1):44–51
Wu J (2013) Landscape sustainability science: ecosystem services and human well-being in changing landscapes. Landscape Ecol 28(6):999–1023
WWF (2012) Living planet report 2012. http://awsassets.panda.org/downloads/1_lpr_2012_online_full_size_single_pages_final_120516.pdf. Accessed 2 Sep 2022
Yang M, Evans S (2019) Product-service system business model archetypes and sustainability. J Clean Prod 220:1156–1166
Yip AW, Bocken NM (2018) Sustainable business model archetypes for the banking industry. J Clean Prod 174:150–169
Zott C, Amit R (2008) The fit between product market strategy and business model: implications for firm performance. Strateg Manag J 29:1–26
Zott C, Amit R (2010) Business model design: an activity system perspective. Long Range Plan 43:216–226
Zufall J, Norris S, Schaltegger S, Revellio F, Hansen EG (2020) Business model patterns of sustainability pioneers—analyzing cases across the smartphone life cycle. J Clean Prod 244:118651