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Fostering Cross-Disciplinarity in Business Model Research

Florian Lüdeke-Freund[1], Romana Rauter [2], Christian Nielsen[3], Marco Montemari[4], Nikolay Dentchev[5], Niels Faber[6]

Abstract

Purpose: We illustrate how cross-disciplinarity in business model research (multi-, inter- and transdisciplinarity) can help scholars overcome silo-building and span disciplinary boundaries. The seven articles contained in the special issue 'Fostering Cross-Disciplinarity in Business Model Research' are summarised, and the authors' perspectives on the phenomena studied as well as the theories and methods adopted are portrayed.

Methodology: We provide literature-based definitions of cross-disciplinary research modes and discuss their potential for business model research informed by insights from the seven special issue articles.

Findings: There is much variety regarding the theories applied in business model research. These include design, imprinting, information asymmetry, paradox theories and many more. This variety illustrates that traditional domains, such as organisation, management and entrepreneurship studies, can be extended in creative ways, and hence can be equipped to deal with emerging and complex issues such as sustainability, circular economy, data management and base-of-the-pyramid entrepreneurship. Interdisciplinarity seems to be well developed regarding the use of theories, but more must follow in terms of research methods and collaboration formats.

Research Implications and Limitations: The common understanding of the potential and importance of cross-disciplinarity can be considered the major implication of this special issue. Beyond this, further critical reflection is required. Important questions remain open, primarily regarding research methods and collaboration formats. This editorial article reflects the perspectives of both the guest editors and the authors in this special issue. The presented understandings of cross-disciplinary business model research and implications for its future are of a preliminary nature.

Originality and Value: Business model research is growing rapidly and scholars from various fields contribute to expanding our knowledge. An explicit focus on the potential of multi-, inter- and transdisciplinary research approaches is missing so far.

Keywords: Cross-disciplinarity, multidisciplinarity, interdisciplinarity, transdisciplinarity, business model research

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1 ESCP Business School Berlin, fluedeke-freund@escp.eu, 2 University of Graz, romana.rauter@uni-graz.at
3 Aalborg University Business School, chn@business.aau.dk, 4 Università Politecnica delle Marche, m.montemari@univpm.it
5 Vrije Universiteit Brussel, nikolay.dentchev@vub.be, 6 University of Groningen / Hanze UAS, n.r.faber@rug.nl

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Introduction

The field of business model research is garnering more diverse attention, and publication activity is growing rapidly (Nielsen et al., 2018). It is remarkable that this research field attracts researchers from many diverse disciplines, including management and organisation studies, entrepreneurship and innovation, industrial design, information technologies, engineering, sociology, sustainability studies and many more (e.g. Dentchev et al., 2018; Foss and Saebi, 2017; Massa et al., 2017; Maucuer and Renaud, 2019; Wirtz and Daiser, 2018). This involvement of multiple disciplines speaks not only to the inherent complexities of business models (cf. Massa et al., 2018) but also to the richness and potential of this research field.

Referring to the latter, we can state that business model research holds potential for cross-disciplinary modes of knowledge generation, bringing together researchers from more than one discipline to investigate a specific phenomenon (Mennes, 2020). For example, several disciplines deal with shared or recurring business model phenomena from their individual perspectives, which allows juxtaposing their specific insights (e.g. what management scholars discover about business model innovation compared to what designers can tell us). However, despite, or maybe because of, this situation there seems to be a tendency towards 'silo-building' in business model research, hampering progress towards other, more integrative, *cross-disciplinary* modes, including multi-, inter- and transdisciplinary research.

Let us look at two recent developments. First, silo-building takes place *between* different business model (sub-)communities. We see at least one community dealing with 'traditional' or 'mainstream' business models, and another one interested in 'new' or 'sustainable' business models. The existence of two conference series—*International Conference on New Business Models* and *Business Model Conference*—is an indication of these different communities.[1] Similar patterns can be found in the topics typically discussed in leading journals such as *Long Range Planning* and *Journal of Management* on the one hand and *Organization & Environment* and *Journal of Cleaner Production* on the other hand.

Second, silo-building takes place *within* these communities as well, as researchers tend to limit themselves to discipline-specific phenomena, theories and methods and fall back to their camps in the multidisciplinary spectrum. Such a tendency is natural since specialisation in once-acquired knowledge and skills together with subordination to given cultures of research, hierarchies and knowledge structures are key features of disciplines (cf. Turner, 2017) and serve the very pursuit of an academic career (Aagaard-Hansen, 2007). As a consequence, we observe some hesitation with regard to the development and application of more diverse cross-disciplinary research modes (cf. Mennes, 2020).

As guest editors of this special issue, we wondered: What if we could make use of the richness and potential of various streams of business model research early on, before specialisation turns into unsurmountable barriers, and help researchers from different disciplines to connect and learn from each other? This may have been a naïve stance, but we insisted on giving it a chance and hence called for contributions showcasing cross-disciplinary research in business models applied to diverse topics and phenomena (e.g. paradoxes of business model development and performance, disruptive business models and industry dynamics, ecological and social entrepreneurship, business models for sustainability transitions and so on)—referred to as 'multi- and interdisciplinary' in the original call for papers.[2] Our aim was to explore the variety of current business model research and to motivate cross-disciplinary exchange to make sure that progress in specialised streams of business model research translates into progress of the field as a whole. We deliberately invited participants from both 2019 business model conferences to submit their papers to this special issue.

Let us take stock of what we did and did not find. But before, we briefly explain our understanding of cross-disciplinarity in business model research and why striving to overcome silos and disciplinary boundaries is a worthwhile endeavour.

[1] See http://businessmodelconference.com/ and https://www.newbusinessmodels.org/

[2] See http://www.journalofbusinessmodels.com/media/1253/cfp-fostering-multi-and-interdisciplinary-business-model-research.pdf

Why Strive to Overcome Silos and Disciplinary Boundaries?

In 2011, Zott, Amit and Massa found that the business model literature was 'developing largely in silos, according to the phenomena of interest to the respective researchers. The main interest areas identified were (1) e-business and the use of information technology in organizations, (2) strategic issues, such as value creation, competitive advantage, and firm performance and (3) innovation and technology management' (Zott et al., 2011, p. 1019). From more recent reviews we can conclude that this tendency is becoming more pronounced and that other special interest groups, such as entrepreneurship and sustainability researchers, are adding new camps to the business model research landscape (e.g. Dentchev et al., 2018; Foss and Saebi, 2017; Lüdeke-Freund and Dembek, 2017; Massa et al., 2017; Maucuer and Renaud, 2019).

Increasing specialisation within a maturing research field is undoubtedly necessary to gain more detailed insights into its phenomena, improve its research methods and theories, discover new ones, and, in general, make use of efficient division of labour and variety in perspectives. In a similar vein, Lecocq et al. (2010) argued for the advantages of developing a 'research programme' for business models, which was followed by Nielsen et al.'s (2018) four distinct phases of business model research. In particular, the first phase focuses on definitions and conceptualisations of business models as well as the links between business models and strategies. The second phase is dominated by the research stream of business model innovation. The design of frameworks and the foundations for theory-building are at the core of the third phase. The fourth phase is centred on the performative approach. Studies in this phase explore what actually happens in companies when business model tools are designed, implemented and used (e.g. what works and what does not work, levers and barriers of designing, implementing and using business model tools; see Montemari, 2018). Research adopting a performative approach builds on the assumption that business models are context-dependent and are given meaning by subjects in the specific situations in which they are developed and applied (Roslender and Nielsen, 2019).

Taking these developments in business model research into consideration, this special issue builds on the conviction that the increasing specialisation and search for a research programme should be complemented by a search for cross-disciplinary approaches (cf. Mennes, 2020) or, at least, the openness to look beyond disciplinary boundaries. Our assumption is that cross-disciplinarity improves our understanding of phenomena, methods and theories, particularly regarding complex questions that scholars aim to address, for example, how entrepreneurial values motivate the shape and performance of ecologically and socially beneficial business models. Finding answers to questions such as this one requires expertise from diverse fields (e.g. entrepreneurship, psychology and sustainability). Cross-disciplinary approaches (in contrast to mono-disciplinary approaches) should be better suited to grasp these issues and to study business models as they actually are: *complex and multi-dimensional systems* (Massa et al., 2018). As such, business models integrate human interactions, organisational structures, markets and diverse stakeholders, and thus, they typically cross the boundaries of various social, economic and technological systems, for example, by connecting supply and demand, technologies and markets, stakeholders and value creation and so on (for exemplary overviews of the variety in business model research see Lüdeke-Freund and Dembek, 2017; Dentchev et al., 2018; Maucuer and Renaud, 2019).

Accordingly, Maucuer and Renaud suggest that 'disciplines should cross-fertilize in order to enrich their own conceptualization [of business models] and reinforce the co-development of their respective fields … [and to] combine their efforts in developing transversal issues …' (Maucuer and Renaud, 2019, p. 38). The benefits of such an approach can be illustrated with another example: Some researchers work on the cognitive micro-foundations of business model development and propose that these involve configurations of simple design and decision-making rules, so-called heuristics (Loock and Hacklin, 2015), or schemas representing firms' value-creating activities (Martins et al., 2015; Massa et al., 2017). Such cognitive perspectives are also important to understand how actors deal with ambiguous and even paradoxical issues, such as integrating sustainability considerations into business activities (Hahn et al., 2014). In turn, how such challenges can be

addressed effectively by developing new business models is a question that may be answered by building on two decades of research on business model innovation (Foss and Saebi, 2017; Wirtz, Göttel et al., 2016, Wirtz, Pistoia et al., 2016). Business model researchers have a natural tendency to deal with complex and multi-dimensional issues (cf. Massa et al., 2018) involving multiple stakeholders' needs and interests (Lüdeke-Freund et al., 2020) and hence require correspondingly integrative and diverse research modes.

What is Cross-Disciplinarity?

We follow Mennes (2020) and use the term *cross-disciplinarity* 'to refer to the general category of research that involves more than one discipline' (p. 3). Dominating taxonomies of cross-disciplinarity typically distinguish three modes. The following definitions proposed by Mennes particularly highlight the role of collaboration:

- ''multidisciplinarity' refers to the collaboration of researchers with different backgrounds where their respective disciplines are juxtaposed instead of integrated …;
- 'interdisciplinarity' stands for the collaboration of researchers with different disciplinary backgrounds where (elements of) the respective disciplines are integrated …; and
- 'transdisciplinarity' either refers to a collaboration where the integration of (elements from) different disciplines is so extensive that the origin of the elements gets lost, or refers to a collaboration of researchers and non-academics such as stakeholders and/or practitioners who integrate their knowledge and know-how.' (p. 4–5)

Multidisciplinarity is typically described as juxtaposing different disciplines (Klein, 2017; Vermeulen and Witjes, 2021). The involved disciplines, for example, innovation management and psychology, remain separate and their characteristics, such as theories and methods, retain their original identity. This research mode involves different approaches to studying shared phenomena, for example, how entrepreneurs come up with new business models. While innovation management scholars and psychologists may both study this phenomenon, the theories and methods they use and the knowledge they generate remain within their respective disciplinary boundaries. The obtained results will be complementary and may even be combined in a joint framework, but they will only be loosely related and presented in a sequential or encyclopaedic manner. The multidisciplinary research mode leads to multiple perspectives on jointly studied business model phenomena, but it does not foster theoretical or methodical integration.

By contrast, *interdisciplinarity* is characterised by proactive integration and interaction between disciplines (Klein, 2017; Vermeulen and Witjes, 2021). Methods and concepts are borrowed from other disciplines to test hypotheses, develop new theories and find answers to research questions that require the knowledge and skills from more than one discipline. Such approaches are driven by, for example, the complexities of natural and social phenomena, the search for solutions to societal problems and technological change. For example, innovation management scholars can borrow psychological concepts, such as values and motivation, to study the antecedents and moderators of entrepreneurs' sustainability-oriented business model innovation processes. Beyond 'borrowing', researchers may cross disciplinary boundaries—in fact, create new disciplines—by proactively integrating their approaches and developing new theoretical constructs and empirical methods. Psychologically enhanced innovation theories and empirical investigations of 'values-based business model innovation' (e.g. Breuer and Lüdeke-Freund, 2017) or the development of new reference frames for 'sustainability-oriented business models' (e.g. Dentchev et al., 2018) serve as examples.

Attributes associated to *transdisciplinarity* include 'hyper-integrative' (Mennes, 2020), 'transcending' and even 'transgressive' (Klein, 2017). While interdisciplinarity crosses boundaries by being integrative and interactive, transdisciplinarity goes further in that the original characteristics of involved disciplines may even disappear. The use of transdisciplinary inquiry aims to reach such integration at multiple levels of abstraction (Max-Neef, 2005). Such overarching synthesis can lead to new sciences, such as anthropology as the science of humans, universal 'interlanguages' that transcend not only disciplines but also science, education and practical application (e.g. mathematics or system theory), and the redefinition of hierarchies, structures and actor roles in

the creation and application of knowledge. Transdisciplinarity is driven by the quest for systematically integrated and universal knowledge, critical evaluation of theories, concepts and methods as well as the underlying sociopolitical antecedents. Transdisciplinary research driven by environmental and sustainability issues (Schaltegger et al., 2013; Vermeulen and Witjes, 2021), for example, acknowledges the 'life-worlds' of humans, and not disciplinary interests, as frames for the definition of research problems and knowledge production. New forms of collaboration between academics, business and other social actors, in which scientifically reliable knowledge is merged with socially robust problem definitions and knowledge, are another result of the search for more integrative and universal modes of research.

Mono-disciplinarity represents an 'opposite' research mode in which scholars apply a rather limited or focused perspective to investigate a phenomenon. However, one must bear in mind that a clear differentiation between these different research modes is difficult to achieve and is context dependent.

It is not difficult to see that cross-disciplinary research holds some potential for contemporary business model studies as these often require, at least theoretically, cross-disciplinary collaboration, diverse theories and methods and new ways of dealing with complex phenomena such as innovation, entrepreneurship and sustainability. In the following, we briefly summarise the articles and key findings of the special issue articles and how researchers deal with various phenomena and use diverse theories and methods. These articles' contributions to, and implications for, cross-disciplinarity in business model research are discussed in the final section.

Articles in the Special Issue

This special issue contains seven articles, all of which provide inspiration for, and contribution to, future cross-disciplinary conversations and projects in the field of business model research. Table 1 provides an overview of these articles, the diversity of phenomena studied and the variety of applied theories and methods.

The short paper by Dror Etzion (2020), 'Radical Resource Productivity as an Inspiration for Business Model Innovation: The Case of Foodchain', addresses business model innovations in the service sector. Foodchain is a fast-casual restaurant recently founded in Montreal, Canada, with the primary aim of serving uncooked, vegetable-based meals. The research objective is to understand the effects of waste-minimisation efforts, following a radical resource productivity (RRP) approach on business model design. A major RRP design choice was to use so-called Robot-Coupes for food production, which increases efficiency gains in earlier manufacturing-like stages of the value chain. Furthermore, an activity map was found to be a useful tool to visualise essential business model design choices and consequences.

The article by Michael Fruhwirth, Christiana Ropposch, and Viktoria Pammer-Schindler (2020), 'Supporting Data-Driven Business Model Innovations: A Structured Literature Review on Tools and Methods', reviews research on tools and methods for data-driven business model innovation. The analysed literature is structured according to the types of contribution (taxonomies, patterns, visual tools, methods, IT tools and processes), types of thinking supported (divergent and convergent) and the business model elements that are addressed (value creation, value capturing and value proposition). By drawing on these findings, the authors identify three avenues for future research: first, tools and methods that enable convergent thinking require additional studies; second, more research is needed to provide a holistic view that integrates single tools and methods; and third, designing software tools to support data-driven business model innovation is an area that should be further investigated.

The article by Martin Glinik, Michael Rachinger, Christiana Ropposch, Florian Ratz, and Romana Rauter (2021), 'Exploring Sustainability in Business Models of Early-Phase Start-up Projects: A Multiple Case Study Approach', explores the drivers for integrating sustainability aspects in the business models of early-stage start-ups. The authors studied the sustainability in the business models of six early-stage entrepreneurial projects. They found that most cases indicate that early-stage start-ups do not holistically integrate sustainability, but rather consider it as an additional benefit to their products and services. The authors assert that the main drivers of sustainable business models in early-stage ventures are entrepreneurial motivation, careful resource use and waste reduction. Both

Author(s) and title	Phenomena studied	Theories and methods used
Etizon, D. (2020), Radical resource productivity as an inspiration for business model innovation: The case of foodchain, Journal of Business Models, Vol. 8, No. 1, pp. 1–6.	Foodchain's business model Business model design driven by radical resource productivity and efficiency	Radical resource productivity; business model innovation Teaching case data; activity mapping
Fruhwirth, M., Ropposch, C. and Pammer-Schindler, V. (2020), Supporting data-driven business model innovations: A structured literature review on tools and methods, Journal of Business Models, Vol. 8, No. 1, pp. 7–25.	Data-driven business model innovation Types of thinking related to business model innovation Tools and methods for business model innovation	Data- and analytics-enabled business model development Structured literature review; conceptual framework development
Glinik, M., Rachinger, M., Ropposch, C., Ratz, F. and Rauter, R. (2021), Exploring sustainability in business models of early-phase start-up projects: A multiple case study approach, Journal of Business Models, Vol. 9, No. 2, pp. 22-43.	Sustainability in business models of early-phase start-ups Imprinting processes giving shape to new business models	Imprinting theory; sustainable business model development Multiple case study approach; qualitative content analysis
Luoma, P., Toppinen, A. and Penttinen, E. (2021), The role and value of data in realising circular business models: A systematic literature review, Journal of Business Models, Vol. 9, No. 2, pp. 44-71.	Role of data in circular business models Data as a source of value in data-driven business models	Data- and analytics-enabled business model development; circular business models Systematic literature review; conceptual framework development
Endregat, N. and Pennink, B. (2021), Exploring the coevolution of traditional and sustainable business models: A paradox perspective, Journal of Business Models, Vol. 9, No. 2, pp. 44-71.	Tensions and paradoxes of sustainability-driven business model development Strategies to deal with co-evolutionary tensions and paradoxes	Business model co-evolution; paradox perspective Multiple case study approach; conceptual framework development
Alba Ortuño, C. and Dentchev, N. (2021), We need transdisciplinary research on sustainable business models, Journal of Business Models, Vol. 9, No. 2, pp. 72-86.	Transdisciplinary research in vulnerable entrepreneurship Data-related challenges in sustainable business model research	Information asymmetry; sustainable business models; international management; base-of-the-pyramid Case study; interviews and focus groups; data triangulation
Urmetzer, S. (2021), Dedicated business models – connecting firms' values with the systemic requirements of sustainability, Journal of Business Models, Vol. 9, No. 2, pp. 87-108.	Role of business models in changing innovation systems Integration and diffusion of sustainability values	Dedicated innovation systems; sustainability transitions Systematic literature review; conceptual framework development

Table 1: Articles contained in the special issue

altruistic and strategic, respectively financial motivations were found to be important for the inclusion of sustainability considerations.

The article by Päivi Luoma, Anne Toppinen, and Esko Penttinen (2021), 'The Role and Value of Data in Realising Circular Business Models: A Systematic Literature Review', is positioned at the crossroads between circular business models and data. It studies the role that data, such as supply-chain and life-cycle data, plays in circular business models. The review shows that this role is still poorly understood. The recognition of data as both driver and enabler for circular economic activities is common. Additionally, two approaches

regarding the value of data are distinguished: the outward-oriented approach emphasises the value of data to shape the user experience relating to the design of circular products and services, and the inward-focused approach focuses on the way in which data operationally contributes to improving economic and environmental performance.

The article by Niklas Endregat and Bartjan Pennink (2021), 'Exploring the Coevolution of Traditional and Sustainable Business Models: A Paradox Perspective', uses seven case studies to investigate the tensions and paradoxes that occur when traditional and sustainability-oriented business models co-evolve under one corporate roof. The identified tensions and paradoxes include competing demands in terms of performance and value creation, fit with organisational culture and mindset, challenges in training and staffing, the allocation of resources between traditional and sustainable business models and balancing the roles and expectations of multiple stakeholders. The authors present a framework to structure these challenges and to analyse their sample of cases. Four coping strategies are identified: 'splitter', 'operational perfectionist', 'strategic mandator' and 'transformer'.

The article by Claudia Alba Ortuño and Nikolay Dentchev (2021), 'We Need Transdisciplinary Research on Sustainable Business Models', argues in favour of transdisciplinarity in sustainable business model research. The authors developed their arguments based on a transdisciplinary programme in Bolivia and 57 interviews and 10 focus group discussions with vulnerable entrepreneurs and relevant stakeholders, alongside numerous on-site observations. The authors used the theoretical lens of information asymmetry and argue that transdisciplinary research can resolve the problems of moral hazard, information analysis and information access, which occur while investigating complex phenomena, such as sustainable business models. Based on the findings of this study, the authors make five suggestions for how scholars can adopt transdisciplinarity in their sustainable business model studies: (i) understand the context, (ii) adapt to the context, (iii) develop relationships of trust, (iv) be flexible with the research focus and (v) systematically present to other disciplines and non-academic actors.

The article by Sophie Urmetzer (2021), 'Dedicated Business Models – Connecting Firms' Values with the Systemic Requirements of Sustainability', brings together insights from innovation system theory, sustainability transitions and innovation trajectories. The main finding is that dedicated business models affect an innovation system at the level of its leading paradigms. These business models commit to sustainability values, increase their influence through expansion of their networks and actively impose these sustainability values on consumers and suppliers. The theorical link this paper explores between innovation system and transition theories culminates in the role business models play as a linking pin to shape and instigate change at a fundamental level. More in-depth insights into diffusion mechanisms and patterns of values, and how these reconfigure leading paradigms at regime and systems levels, call for the inclusion of additional disciplines (e.g. social psychology, innovation management).

Implications and Potential for Cross-Disciplinarity in Business Model Research

The goal of this special issue is to illustrate the variety of phenomena studied by business model scholars and to shed light on the diversity of theories and methods they apply. While this special issue can of course only offer a very limited snapshot, it covers diverse topics including business model design, entrepreneurship, sustainability and data and analytics, in addition to diverse combinations of these topics. Several indications of cross-disciplinarity in studying these topics can be found in the articles, mostly in terms of interdisciplinary approaches to defining phenomena under investigation and to using theory. We discuss the implications of these observations in more detail below.

In addition to our reading of the articles, we asked the authors to appraise their research modes, using a simple continuum ranging from mono- to multi-, inter- and transdisciplinarity. The authors were provided with the definitions of research modes proposed by Mennes (2020) (see the 'What is Cross-Disciplinarity?' section). Figure 1 demonstrates how the authors appraised their own work by responding to the following question:

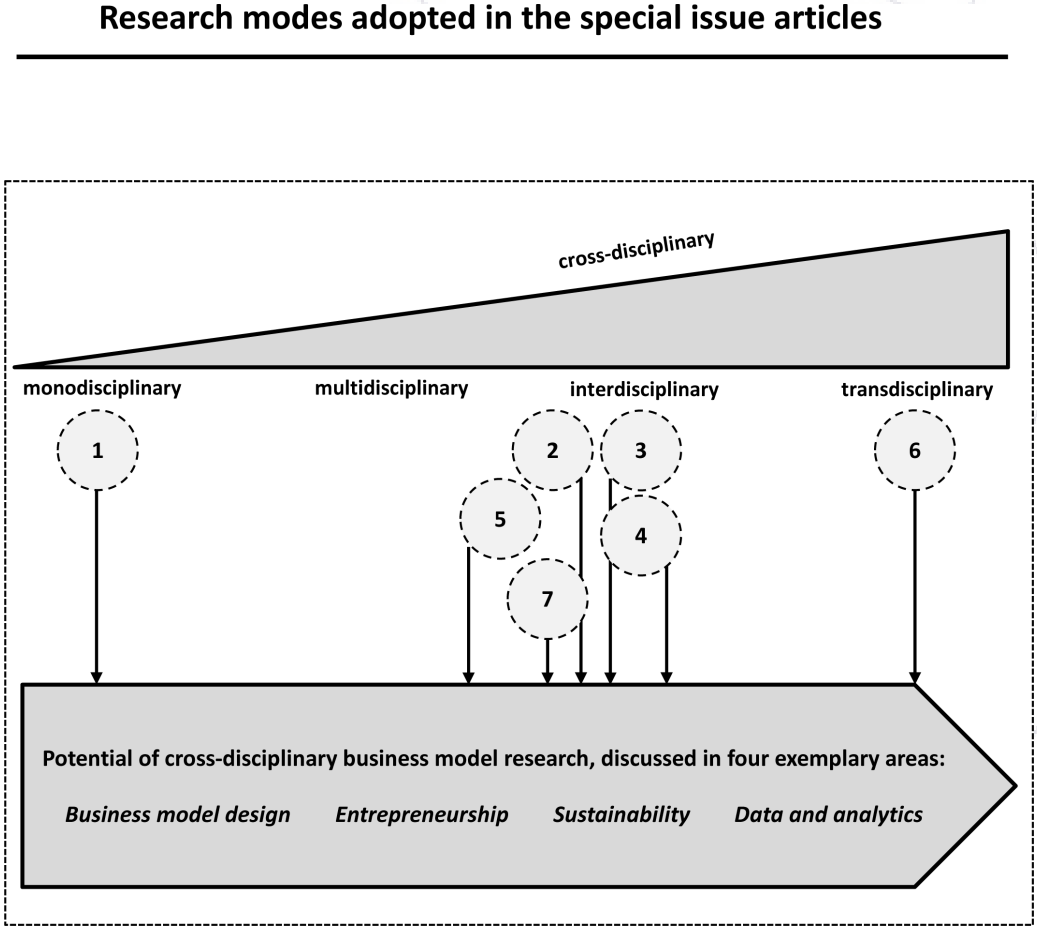

Figure 1: Research modes adopted and thematic areas covered in the special issue articles (according to the authors)

Note: (1) Etzion; (2) Fruhwirth, Ropposch and Pammer-Schindler; (3) Luoma, Toppinen and Penttinen; (4) Glinik, Rachinger, Ropposch, Ratz and Rauter; (5) Endregat and Pennink; (6) Alba Ortuño and Dentchev; (7) Urmetzer

'Please position your paper along the continuum from mono- to transdisciplinary. The cross-disciplinary aspects of your research approach adopted could refer to, for example, theories, methods, collaboration processes, or disciplinary backgrounds of the authors.' According to the authors, most of the studies presented in the special issue involve interdisciplinary research modes.

Acknowledging that interdisciplinarity seems to be a common research mode applied by the special issue authors and that future research should be more transdisciplinary, we reflect on some implications for cross-disciplinarity in business model research. We focus on the four most prominent topics covered in our special issue, namely *business model design, entrepreneurship, sustainability* and *data and analytics*. In doing so, we also present the authors' points of view. Asked for their key learnings, they offered some interesting insights and explanations for why cross-disciplinarity makes sense in the context of business model research.

Business model design

Many special issue articles deal with topics related to business model design, including business model innovation, design principles and methods and tools for business model development. Business model design is a 'hot topic' in business model research, exemplified by a constantly growing number of journal articles focusing on it (e.g. Wirtz and Daiser, 2018). In this special issue, it is addressed from various theoretical perspectives, including engineering- and sustainability-inspired approaches to resource use (Etzion, 2020), imprinting theory to explain organisational behaviour (Glinik et al., 2021), data- and analytics-enabled

business model development (Fruhwirth et al., 2020; Luoma et al., 2021) and tensions and paradoxes occurring in the co-evolution of different types of business model (Endregat and Pennink, 2021).

This variety shows that, regarding *theories*, interdisciplinary approaches are common and maybe even the norm, given the many various issues studied in relation to business model design. This is an interesting, but perhaps not surprising, observation, given that business models and related phenomena are, per se, complex and related to a huge variety of systemic and multi-level issues (cf. Dentchev et al., 2018; Massa et al., 2018). Entrepreneurship, management and business scholars seem to be accustomed to applying theoretical perspectives coming from 'alien' domains such as design, engineering and information technology, as well as domains such as psychology and biology. This openness to interdisciplinary approaches in the form of using theory seems to be a useful research strategy—first, to deal with new and complex socio-technical and socio-economic phenomena, and second, for cross-fertilisation (see 'Why Strive to Overcome Silos and Disciplinary Boundaries?' section). Novel and promising perspectives can be expected the more business model scholars delve into other domains' theories, for example, those derived from psychology (e.g. micro-foundations of business model development), biology (e.g. business model evolution and ecosystems) and data sciences (e.g. new business models driven by, and driving, big data). This expectation seems to be shared by the special issue authors:

'Not only in academia, but also in business and policy, there is a significant need for more people that have insight on the interfaces of different disciplines, opportunities and challenges etc. Multi- and interdisciplinary business model research can make a great contribution to this. Frameworks used in some disciplines could add great value when used in others.' (Luoma, Toppinen and Penttinen; personal statement)

'Most of the investigated start-up projects did not holistically integrate sustainability-related values. Instead, sustainability was considered as an ancillary benefit to providing products or services. Besides intrinsic motivation, there are also strategic reasons ...' (Glinik, Rachinger, Ropposch, Ratz and Rauter; personal statement)

The value of interdisciplinary approaches to using theory is obviously appreciated. The Glinik et al. (2021) paper, as an example, shows that better understanding of how sustainability is integrated into new business models requires both strategic management and psychological, respectively ethnographical perspectives that can be embedded in an imprinting theory framework borrowed from animal studies.

Although the potential for interdisciplinarity is obvious, questions and challenges remain beyond the special issue articles, such as whether appropriate empirical methods are available and how collaborative research settings can be instituted in a fruitful manner.

Entrepreneurship

Continuing with the Glinik et al. (2021) paper, we see how a focus on various interrelated aspects of a phenomenon, such as sustainability-oriented business model design, can give shape to interesting, yet hardly understood, research topics in the realm of entrepreneurship. These topics include the development and acceleration of new ventures with a sustainability orientation; the characteristics, motivations and intentions of entrepreneurs driving these ventures; their values and normative orientations; how they arrange value creation for multiple stakeholders; or their ventures' strategic positioning. Going deeper into any of these facets of entrepreneurial behaviour and its outcomes not only requires cross-disciplinary collaboration, theories and methods, but can also serve as a steppingstone to transdisciplinarity.

An example of moving towards a transdisciplinary research mode is presented by Alba Ortuño and Dentchev (2021). Regarding theory, they build on information asymmetry, international management and base-of-the-pyramid approaches to study the business models of vulnerable entrepreneurs in Bolivia. The authors actively participated in a programme aiming 'to contribute to the development of the Bolivian society by enhancing institutional capacity building' for local communities and entrepreneurs (Alba Ortuño and Dentchev, 2021, p. 75). Creating meaningful insights and new knowledge required intense collaboration with various stakeholders, including continuous formal and informal discussions with local communities, different participatory methods, primary data collection through interviews and focus groups and analyses of secondary data.

The authors summarise their experience as follows:

'Transdisciplinary research allows to understand the opportunities and challenges of sustainable business models (SBM) more precisely due the interaction of all involved actors. Transdisciplinary research is highly beneficial to overcome problems in information asymmetry when researching SBM.' (Alba Ortuño and Dentchev; personal statement)

This example tells us that complex entrepreneurship topics, such as vulnerable entrepreneurship and its potential for social value creation, can be addressed by combining different theoretical lenses, which are not limited to 'pure' entrepreneurship theories. Furthermore, the immersion of researchers into a local context and object of study is not only promising but maybe even required. In support of this, longitudinal research designs, action research and data triangulation are useful elements in a transdisciplinary toolbox for the study of entrepreneurship business models.

Sustainability

Sustainability, for example, in terms of integrating principles of ecological or social value creation into business model design or seeing it as an entrepreneurial motivation, has already been mentioned (Alba Ortuño and Dentchev, 2021; Etzion, 2020; Glinik et al., 2021). This shows that sustainability topics seem to be likely and promising subjects for cross-disciplinary business model research. An interesting and innovative interdisciplinary perspective is offered by Urmetzer (2021). Her conceptual work deals with how values of sustainability (e.g. customer expectations for better ecological performance) can become part of a business model and diffuse in innovation systems. Her theory is that the design of value proposition, delivery and capture is an important mechanism to diffuse certain values and hence to link business model and system-level sustainability. Values of sustainability are touched on by Glinik et al. (2021) as well, as the motivation of entrepreneurs to give their business models a certain direction, and Etzion (2020) makes a very explicit link between ecological design principles and business model design.

While Etzion (2020) and Glinik et al. (2021), in simple terms, study how sustainability becomes a part of business models, Urmetzer (2021) attempts to understand how business models can help diffuse sustainability values throughout the wider innovation systems in which business models are embedded. Both perspectives are highly complementary and indicate a new field of study, namely values-based business models (Breuer and Lüdeke-Freund, 2017). With a view to the future, Urmetzer (2021) concludes that more in-depth insights about diffusion mechanisms and patterns of values are needed, and how these reconfigure leading paradigms at the regime and systems levels. This is a much needed, but no less ambitious call for cross-disciplinary business model research and a call for various micro-, meso- and macro-level disciplines to join in (e.g. social psychology, culture studies, policy research, innovation and sustainability transition studies).

A novel firm-level perspective is offered by Endregat and Pennink (2021). They identify tensions and paradoxes that occur when companies operate traditional business models and aim to add sustainability-oriented business models to their portfolios. Competing demands regarding performance and value creation, lack of fit with the dominant organisational culture and mindset, as well as challenges related to training, staffing and resource allocation are observed. While these challenges and the theoretical lens through which they are studied remain largely in the field of organisation and management studies, deeper analysis of the origins of the corresponding tensions and paradox will require a broad multi- or interdisciplinary approach. As with the examples above, various disciplines are required to understand how business performance is impacted (e.g. accounting), how organisational and business cultures are formed and (de-)stabilised (e.g. cultural studies, institutional theory), how human resources can be managed with regard to sustainability demands (e.g. psychology, human resource research and how decision-makers find solutions to paradoxical decisions about resources (e.g. paradox theory, psychology, leadership studies).

The authors' statements below show that such issues offer promising contexts for cross-disciplinary business model research:

'Integrating theories from different disciplines is a challenge but worth doing: It results in interesting new questions and 'black-boxes' to discuss from multiple

angles. Introducing more philosophical arguments in your research broadens the theoretical perspective, for example it can overcome previously established divides (as in the concepts of TBM [traditional business model] and SBM [sustainable business model]).' (*Endregat and Pennink; personal statement*)

'I learned that business models tell us so much more about the true values and objectives of a firm than mission statements, sustainability reports, or interviews with CEOs.' (*Urmetzer; personal statement*)

Again, the availability of corresponding research methods and collaboration formats is crucial. Given the attention that universities and funding bodies are currently paying to issues of sustainability and circular economy, the future looks quite promising for business model research in these fields.

Data and Analytics

An interesting direction at the junction of sustainability and data sciences has been taken by Luoma et al. (2021). They studied the role and value of data for the development of circular economy business models and found an outward-oriented and inward-focused approach to business model development, the former emphasising how data (such as product life cycle data) can be used to shape the user experience with circular products and services, and the latter focusing on how using data can improve the economic and environmental performance of circular economy business models. For the outward approach, further studies may encourage behavioural sciences to obtain more insights into consumer behaviour and the data requirements this creates. In addition to data on products and services, this approach calls for the inclusion of data on user behaviours and attitudes. The inward approach calls for a more intimate relation with the discipline of information management, obtaining a clearer picture of the requirements for data process optimisation, information systems, storing and search, or artificial intelligence for the optimisation of circular economy business models. While it seems reasonable to continue with a multi-disciplinary approach in which, for example, data sciences and psychology prepare the ground, later stages will most likely require inter- and transdisciplinary approaches in which theories and methods from these fields are merged.

In a similar vein, Fruhwirth et al. (2020) call for a more intense integration of different disciplines for future studies on data-driven business model design. These include, for example, innovation management, information systems and data sciences. Further integration issues, such as the need to better understand the role of collaboration and to integrate insights from data-specialists, are mentioned by Luoma et al. (2021), all pointing to the need for further theoretical and methodical advances. In addition, Fruhwirth and colleagues emphasise in their statement that more knowledge at cross-disciplinary intersections is needed, particularly when there is the need to combine different business model conceptualisations and tools:

'Tool support for (data-driven) business model innovation needs more conceptualisation and integration in the scientific community. Tools typically are very specific to a single element of a business model or phase of business model innovation – and very little knowledge has been created about how these different conceptualisations map to each other, and how tools can be used in combination, and in a coherent process.' (*Fruhwirth, Ropposch, and Pammer-Schindler; personal statement*)

Researchers, managers and entrepreneurs obviously have different understandings of business models. The same holds true for engineering, organisation theory, circular economy and data experts. This is a challenge and an opportunity, as for example, Alba Ortuño and Dentchev (2021) tell us very explicitly.

In short, we have just begun exploring the business model concept, but we can see that cross-disciplinary business model research can deliberately create situations in which theoretical and methodical diversity, fruitful deviance and sometimes tensions and conflicts are created to make the most of the otherwise unconnected expert perspectives.

For the moment, this is maybe our conclusion, we are moving rapidly towards interdisciplinary applications of theory, but in terms of research methods, more must come. This might result also in different perceptions of (empirical) findings, or different findings, per se, and allow for diverse implications. This relates to the overall idea of interdisciplinarity that describes a collaboration

of researchers leading to an integration of elements of the disciplines involved (Mennes, 2020), but it does not need to happen all at once.

The same for the 'ultimate' move towards transdisciplinarity, of course, without falling into the fallacy that more cross-disciplinarity is always the best solution. As with many things in life, it depends. Our colleague Dror Etzion nicely reminded us of that:

'My paper suggests avenues for future research that remain mono-disciplinary, within the management discipline, but I do not want to suggest that cross-disciplinary business model research is a bad idea. Quite the opposite.' (*Etzion; personal statement*)

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Exploring the Coevolution of Traditional and Sustainable Business Models: A Paradox Perspective

Niklas Endregat, MSc[1]*, Dr. Bartjan Pennink[2]

Abstract

Purpose: This paper rectifies a dearth in current research and investigates the coevolution of traditional and sustainable business models under one corporate roof. By taking on a paradox perspective, firms' solutions, and mechanisms to cope with the paradoxical tensions that arise throughout the coevolution are determined and analyzed.

Design/Methodology/Implications: This is executed by conducting seven case studies of Western-European firms, consulting firms, and governmentally-owned consulting institutions.

Findings: Findings display the array of responses firms deploy to address paradoxical areas of competing demands of economic, social, and environmental foci, organizational culture and mindset, training and staffing, resource allocation, and the stakeholder environment during the coevolution of traditional and sustainable business models. Furthermore, four coping strategies firms utilize are derived from the data, namely splitters, operational perfectionists, strategic mandators, and transformers.

Research limitations: All cases under investigation resemble Western-European firms, which limits the generalizability of the findings at hand. Furthermore, the sample size and the mixed industries cases have been selected from stipulate a limitation.

Practical implications: This paper outlines four pathways firms deploy to address paradoxical tensions arising during the coevolution of traditional and sustainable business models under one corporate roof.

Originality/Value: This study contributes to the discussion related to the integration of traditional and sustainable business model research, as it sheds light onto a previously largely unresearched phenomenon: a situation where both business models coevolve under one corporate roof. Utilizing the paradox view as a theoretical lens, underlying dynamics and arrays of solutions are uncovered.

Keywords: Traditional business models, sustainable business models, coevolution, paradox lens, sustainability

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1-2 University of Groningen, The Netherlands
*Corresponding author, email: nik.endregat@gmail.com

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Introduction

In light of a rapidly and radically changing planet, which has exposed long-term challenges such as climate change and pollution (Montalvo et al., 2006), the development of new logics regarding the conduct of social and environmental affairs in the field of business models is more crucial than ever before. Whilst the predominant logic of a firm rests upon neo-classical theory (Stormer, 2003), current developments have raised awareness that firms indeed may have an obligation to move beyond mere economic value creation, and the literature on Sustainable Business Models (SBMs) has experienced a surge of interest (Dentchev et al., 2018). SBMs assimilate three pillars, namely (i) a sustainable value proposition not only to a firm's customers, but spanning all stakeholders, (ii) value creation that includes all stakeholders, and distributes benefits accordingly, and (iii) an economic value capture that, at the least, maintains social, environmental, and economic value throughout the spheres of organizations' operations (Lüdeke-Freund & Dembek, 2017; Schaltegger et al., 2016).

SBMs, hence, inherit the potential to facilitate the development of solutions to face the long-term challenges identified by our society. Nonetheless, Dentchev et al. (2018) outline a dearth of literature concerning the coevolution of Traditional Business Models (TBMs) and SBMs. Ergo, the coevolutionary process and interrelations between TBMs and SBMs remain unexplored (Dentchev et al., 2018). In order to bridge this gap, this paper investigates the following research question:

How do traditional and sustainable business models coevolve within firms?

In order to answer this research question, a paradox lens is adopted. The paradox view stipulates that organizations must, throughout the course of their existence, overcome situations where apparently opposing goals and demands seem to be incongruent. Representing "persistent contradiction[s] between interdependent elements" (Schad, 2016: 6), and therefore the definition of a paradox, TBMs and SBMs, stemming from their opposing foci, resemble opposing poles on a continuum (Biloslavo et al., 2018). Throughout the coevolution of TBMs and SBMs, the interrelated nature gives rise to several paradoxical tensions (Vladimirova et al., 2017). These paradoxical tensions need to be bridged with coping strategies that firms develop to navigate their way around paradoxical waters.

By addressing the dearth in the literature and using case studies, the contribution of this paper is threefold. Firstly, insights into the coevolution of TBMs and SBMs within a firm are generated. We hope these aid further developments in the integration of the fragmented research fields on TBMs and SBMs by analyzing the coevolution through a fresh perspective: a paradox lens (Biloslavo et al., 2018; Dentchev et al., 2018). Secondly, this paper uncovers four coping strategies to overcome paradoxes during the coevolution. And lastly, it informs practitioners of best practices on the management of both TBMs and SBMs under one corporate roof.

Theoretical Background

The Concept of a Traditional Business Model

The concept of the traditional business model started to emerge in the late 1990s (Alt & Zimmerman, 2014), with a logic of the firm resting upon neoclassical theory (Stormer, 2003). Neoclassical theory mandates the firm to maximize economic profits, and hence, success is defined by profit maximization only. Reforms would only be engaged in if it serves the organization's own agenda (Purser, Park, & Montouri, 1995). Consequently, this dictates that externalities like waste or pollution are disregarded, encouraging firms to engage in make-to-throw-away approaches instead of sustainable resource utilization (Shrivastava, 1995). Indeed, in the neoclassical view, corporate ambitions to pursue sustainable goals are seen to be inferior to the principal aim of economic profit maximization (Freeman & Gilbert Jr., 1992).

Due to the different usage of the concept of a TBM, and hence the different contexts it has been applied to, three major stances have been identified by Wirtz (2011, Wirtz et al., 2016). These are the technology driven approach (e.g. Gambardella & McGahan, 2010; Ghaziani & Ventresca, 2005), organizational theory (e.g. Tikkanen et al., 2005), and the strategy-oriented approach (e.g. Chesbrough, 2010; Mitchell & Coles, 2003). Overarching of these streams, Boons et al. (2013) have identified three distinct elements a TBM encompasses. Firstly, a value proposition, referring to the interconnection of exchange between an organization and its customers. Secondly, it must clarify the process of value creation, spanning the organization's spheres of operations. Lastly, a business model identifies the value capture component. In a

similar fashion, Boons and Lüdeke-Freund (2013) identify four areas a business model portrays. By extending the work of Osterwalder (2004) and Doganova & Eyquem-Renault (2009), they have identified (i) a value proposition, (ii) a specification on the arrangement of the supply chain, (iii) a clarification on customer relationships, and (iv) a financial model stipulating the distribution of costs and revenues.

More recently, Wirtz et al. (2016) highlighted a convergence of all three major stances regarding the business model concept. They identified a more homogenous comprehension of the business model concept materializing with contemporary authors increasingly defining it as an abstraction of the organization in its entirety. Thus, after a revaluation of the dominant literature concerning the business model, Wirtz et al. (2016) defined a business model as follows, and this definition shall serve as a conceptualization for this paper:

"A business model is a simplified and aggregated representation of the relevant activities of a company. It describes how marketable information, products, and/or services are generated by means of a company's value-added component. In addition to the architecture of value creation, strategic as well as customer and market components are taken into consideration, in order to achieve the superordinate goal of generating, or rather, securing the competitive advantage (Wirtz et al., 2016: 41)."

The Concept of a Sustainable Business Model

The shift away from economic-focused business models by including social and environmental values has paved the way for sustainable business models (Schaltegger et al., 2012). Lit by Elkington's (1997) early approach of a triple bottom line entailing people, planet and profit combined, and Lovins' et al. (1999) fourfold set of actions incorporating environmental needs in firms' operations, the spark of sustainable infusion of TBMs started to glow. Elkington's (1997) triple bottom line has earned its places in the majority of corporate CSR reports, and is commonly acknowledged as a guiding principle in SBMs (cf. Breuer et al., 2018). The concept of an SBM has begun to emerge (Schaltegger et al., 2012). Similarly to TBMs, SBMs display a fragmented nature and the literature has progressed in several ways. Lüdeke-Freund & Dembek (2017: 1674) present evidence that "SBM research and practice show blankial traits of an emerging field, or at least sufficient momentum to become a field in the very near future." Following their findings of a review on the contemporary state of the field, five core beliefs and concepts have been presented to hold true among all streams of literature, based on Ehrenfeld's (2004) criteria on the evaluation of a research field. They identified (i) an explicit orientation towards sustainability, comprising ecological, social, and economic elements, (ii) a redefinition of the traditional notion of value creation, (iii) an extended comprehension of value capture in terms of actors considered, (iv) a replacement of customer focus with stakeholder focus, and (v) an embeddedness of the organization's surrounding within its sustainable business and beyond. In light of these five core principles, the definition of Schaltegger et al. (2016) embodies the best reflection of these constituents, and shall thus serve as this paper's definition:

"A business model for sustainability helps describing, analyzing, managing, and communicating (i) a company's sustainable value proposition to its customers, and all other stakeholders, (ii) how it creates and delivers value, (iii) and how it captures economic value while maintaining or regenerating natural, social, and economic capital beyond its organizational boundaries (Schaltegger et al., 2016: 6)."

The Co-Evolution of Traditional and Sustainable Business Models

The evolution from TBMs to SBMs, hence, involves a threefold set of economic, social, and environmental components, leading to multi-value creation and multiple actors across the firm's operational chain (Pennink, 2014). When introducing a new SBM, it will co-exist and co-evolve with the firm's incumbent TBM (Graf, 2005; Moingeon & Lehmann-Ortega, 2010). Similarly, Sabatier, Mangematin, & Rousselle (2010) find that new firms may entertain a BM portfolio, defined as "a portfolio of business models as the range of different ways a firm delivers value to its customers" (Sabatier, Mangematin, & Rouselle, 2010: 432). The relationship between TBMs and SBMs, thus, ought to be seen as two opposing yet mutually influencing poles along a continuum rather than a linear relationship (Boons & Lüdeke-Freund, 2013; Moingeon & Lehmann-Ortega, 2010). Hence, the situation considering the BMs in this paper is the following. The cases investigated for this paper have had TBMs established first, and (co-established) their SBMs

afterwards. The moment of investigation is from that time onwards, so after both have been established and are operating alongside one another.

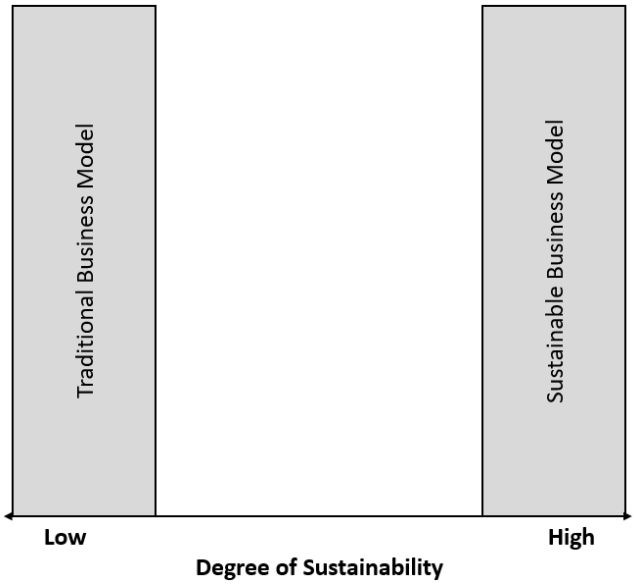

Figure 1: TBMs and SBMs.

Combining Opposites: A Paradox Perspective

Following the paradox view, corporations have to face and resolve apparently opposing goals and demands along the course of their existence (Smith & Lewis, 2011). TBMs and SBMs are to be seen as opposing poles on a continuum, thereby reflecting the definition of a paradox, or a "persistent contradiction between interdependent elements" (Schad, 2016: 6). Paradoxes originate in the unique history of organizations, cultural context, and the strategic settings utilized along their existence. Paradoxes may be occurring across several time and space levels (Biloslavo et al., 2018). Paradoxes, such as the coevolution of TBMs and SBMs, inherit paradoxical tensions. Tensions are defined as "elements that seem logical individually but inconsistent and even absurd when juxtaposed" (Smith & Lewis, 2011: 382). Paradoxical tensions that occur during the co-evolution of TBMs and SBMs will be discussed below.

Paradoxical Tensions and Coping-Strategies in the Co-Evolution of Traditional and Sustainable Business Models

Paradoxical tensions arise throughout the process of organizing, when two opposing poles manifest within a given context (Smith & Lewis, 2011). An orientation in the direction of sustainability implies constant friction and challenges that materializes between internal and external stakeholders and their respective set of interests (Biloslavo et al., 2018). Indeed, the co-evolution of TBMs and SBMs sets free potential for paradoxical tensions (Vladimirova et al., 2017), which we have summarized below after consulting relevant literature.

Concerning a first area of paradoxical tension, namely the ***competing demands*** of TBMs and SBMs, Hart & Millstein (2003) corroborate how sustainability, although often described as being incompatible with economic value creation, may be integrated and balanced. Similarly, Stubbs & Cocklin (2008) pinpoint the challenges of balancing the neoclassical and the ecological modernization perspective within organizations, whilst Schaltegger et al. (2012) underscore the battle to balance economic fitness and social and environmental sustainability. To remedy this, Rangan, Karim, and Chase (2015) present three theaters that embellish our understanding of the degree sustainability is embedded in companies' BMs and how reporting is undertaken. The first theater takes a philanthropic approach, the second theater opts for operational improvements to enhance sustainability, and the third theater is concerned with a complete business model transformation. Regarding a possible cannibalization of profit margins between TBMs and SBMs, Schaltegger et al. (2012) highlight three possible reaction-types to address this. Firstly, the defensive type, involving adaption of products and product communication to reduce risks of profit margin loss. Second, the accommodative type, recognizing customer segments targeted at sustainability, and serving them with specific products, next to pre-existing TBMs. And thirdly, the proactive type, strategically establishing a competitive advantage with an SBM becoming the dominant element in the business portfolio.

The second area of paradoxical tension concerns the ***organizational culture and mindset*** of an organization. Barquet et al. (2013) illustrate the time- and resource intensity required to (re-)craft and harmonize culture and mindset during BM innovation. Similarly, the tension between incumbent and sustainable mindsets is highlighted by Schaltegger et al. (2012). As avenues for harmonization, the following paths to rectify these paradoxical tensions are found in the literature. Barquet et al. (2013) and Stubbs & Cocklin (2008)

identify strong (top-)leadership as a key factor, while value-aligned and inclusive corporate strategies are also highlighted by Stubbs & Cocklin (2008).

Regarding ***training and staffing,*** Barquet et al. (2013) pinpoint the necessity to maintain capabilities at the highest standards through adequate training, and the possible urgency to recruit new talent in the event of change. In a similar fashion, Kianto, Sáenz, & Aramburu (2017) corroborate the concepts of knowledge-based training and knowledge-based recruitment, to ease the achievement of an adequate human resource stock necessary to sail through the waters of co-evolution. Thus, knowledge-based training and hiring display two alternatives to rectify the paradox concerning staffing and training.

Resource allocation, the fourth area of paradoxical tension, requires a critical consideration of a firm's resource allocation among its BMs (Barquet et al., 2013). Björkdahl & Holmén (2013) further accentuate this circumstance, stressing the frictions regarding resource allocation between new and old BMs, as the incumbent BM is generating the majority of the firm's profits. More extremely, Chesbrough (2010) pinpoints the hazard of starvation of new BMs for that reason. Avenues for rectification are (i) an allocation of resources that enables both BMs to run independently and self-sufficient, and (ii) a gradual shift in resources from TBMs to SBMs to boost growth (Björkdahl & Holmén, 2013).

The ***stakeholder environment*** stipulates a fifth area of paradoxical tension. Boons & Lüdeke-Freund (2013) pinpoint the increased involvement of stakeholders and communities in organizations' socioeconomic environment when SBMs have advanced. Schaltegger, Lüdeke-Freund, & Hansen (2016) corroborate the different roles that stakeholders inherit within TBM and SBM settings, where the stakeholders are more involved and rewards are more equally distributed than in TBMs, where economic value maximization for the focal firm is the main goal. This notion is underscored by Stubbs & Cocklin (2008), who found the same challenging role differences of stakeholders between the two models. Thus, an increase in collaboration and involvement with stakeholders, and a balance of perks are avenues to rectify the paradox in the stakeholder environment (Schaltegger, Lüdeke-Freund, & Hansen, 2012; Stubbs & Cocklin, 2008).

We have summarized the areas of paradoxical tensions found in the literature in Table 1.

No. of Paradox	Paradox Name	Short Explanation	Authors
1	Competing demands	Competing demands of economic, social, and ecological foci within one organization	Hart & Milstein (2003) Rangan, Chase, & Karim (2015) Stubbs & Cocklin (2008) Schaltegger et al. (2012)
2	Organizational culture and mindset	Competing organizational mindsets per business model and tensions for organizational culture	Barquet et al. (2013) Boons & Lüdeke-Freund (2013) Yu & Hang (2010)
3	Training and staffing	Different requirements related to the workforce engaged with the different business models	Barquet et al. (2013) Kianto, Sáenz, & Aramburu (2017)
4	Resource allocation	The allocation of different resources between traditional and sustainable business models	Barquet et al. (2013) Björkdahl & Holmén (2013) Chesbrough (2010)
5	Stakeholder environment	The impact of the coevolution on and of both the internal and external stakeholder environment surrounding the corporation	Boons & Lüdeke-Freund (2013) Schaltegger, Lüdeke-Freud, & Hansen (2016) Stubbs & Cocklin (2008)

Table 1: Different paradoxes occurring during coevolution.

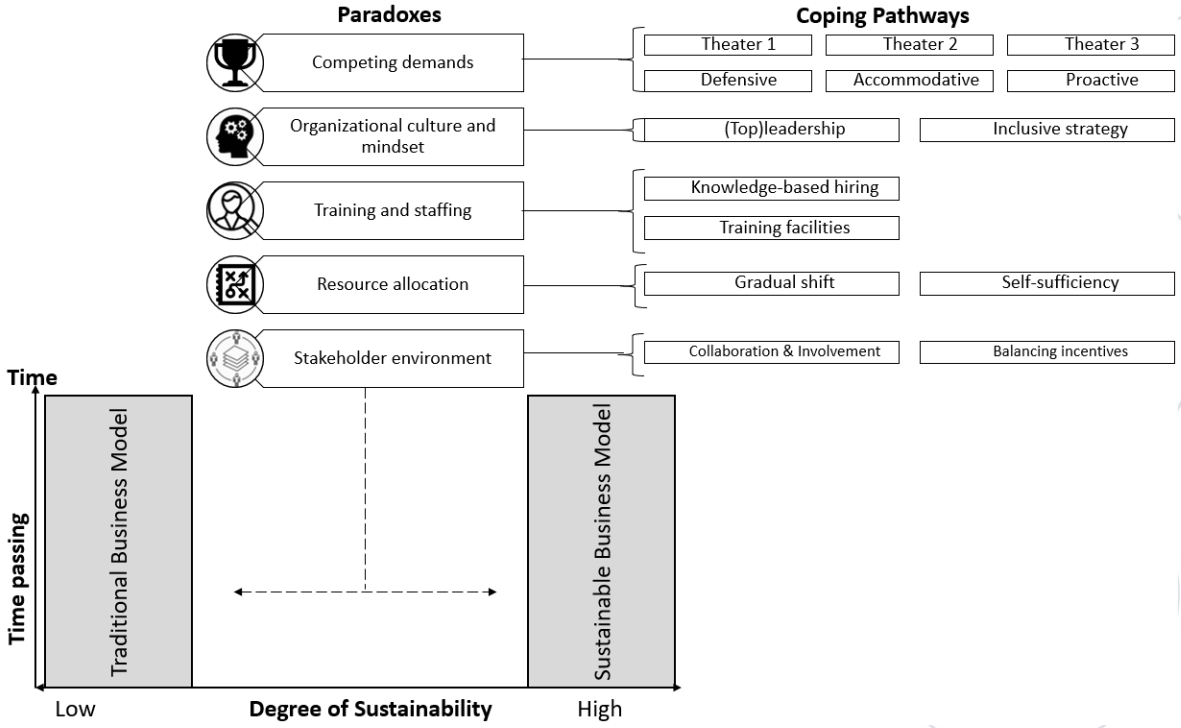

Figure 2: The Five Paradoxical Tensions and Coping Pathways.

The Conceptual Model

The above-discussed areas of paradoxical tension may occur in different moments in time and reappear throughout the process of coevolution. Figure 2 visualizes the five areas of paradoxical tension along with the solutions identified above. The process here refers to the time passing whilst the TBM and SBM are simultaneously managed under a single corporate roof.

Methodology

Given the aim of this research, namely, to provide coping strategies associated with the paradoxes unearthed by the coevolution of TBMs and SBMs, an inductive, qualitative design is chosen. Derived from the interest of this research and given the fact that the research question resembles a 'how' or 'why' question, a multiple case study design is chosen (Yin, 2003). Moreover, this paper investigates a contemporary event, which resembles another criterion in favor of a case study design (Yin, 2014: 9).

Case Selection

Case selection was undertaken based on theoretical sampling (Eisenhardt, 1989). The purpose of this study is the extension of an emerging field. Thus, cases have been selected based on the notion that organizations are undertaking a coevolution of TBMs and SBMs. Hence, potential cases had been approached via LinkedIn or email, and been asked whether a coevolution of TBMs and SBMs was currently taking place under their roof. If this condition was met, or if they were directly involved in advising a firm undertaking such a coevolution, they were considered feasible for the analysis. The selection resembles a literal replication aimed at gaining and validating crucial insights that can answer the research question (Yin, 2014). To determine the optimal number of cases, saturation is chosen as a cut-off criterion (Jonker & Pennink, 2010). A list of the seven selected cases can be found in Appendix 1. Moreover, cases have been chosen from the following three groups of companies. The differences in groups are related to the theoretical sampling: in the three groups we expect to find differences in the process of coevolution of TBMs and SBMs.

1. Businesses directly experiencing a coevolution of traditional and sustainable business models under their corporate roof. This group provides us with direct in-house experience, thereby validating our answers to refine our conceptual model.

2. Private consulting firms, which are involved in advising firms who are experiencing a coevolution of traditional and sustainable business models. This group will infuse a birds-eye perspective, thereby enhancing reliability of our answers.
3. Public research and innovation entities, who are involved in advising firms, but may not be as concerned with economic viability of their consulting style as group 2. The third group is chosen to check whether the answers will differ due to economic success pressures.

This has resulted in a sample of seven cases. Two cases are from the Netherlands, the five others from countries in Europe (UK, France, Belgium, Norway and Sweden). Two cases were energy producers, one case a consumer good producer and four consulting firms.

Data Collection

Phone interviews serve as a data collection method to obtain information from participants of the cases selected. To extract the full potential of information from participants, interviews have been conducted in a rather closed fashion in conjunction with a semi-structured interview approach with the utilization of probing to clarify ambiguous answers. The interview guide can be found in Appendix 2. All interviews were conducted by the same researcher, which may limit the search for answers on our research question.

Data Analysis

This research is guided by Dey's (1993) analytical spiral. In accordance with this spiral, textual analysis is utilized to gain information from gathered data, also referred to as coding (Strauss & Corbin, 1990). Data is organized into codes, which are explained and defined in their initial context, and then compared and categorized to develop theory (Hennink, Hutter, & Bailey, 2011). This process is also referred to as open, axial, and selective coding. Open coding encompasses the initial organization into chunks of data and being labeled with codes. These codes are then grouped into overarching categories, which is called axial coding. Selective coding, then, involves the organization of axial codes into core variables. Selective coding is provided in Appendix 3, whilst open and axial coding as well as the thick description of codes are available upon request. The coding procedure was done by the same researcher to ensure consistency, which was the same researcher conducting the interviews. An overview of the analyzed transcripts is found in Table 2 below.

Research Criteria

Data triangulation, ergo the utilization of a multitude of data sources in order to ensure a strong weight of evidence, has been chosen to strengthen this paper, combined with a closed chain of evidence (Guion, 2002; Jonker & Pennink, 2010; Yin, 2014). These are resembled by the three distinct groups outlined earlier. Moreover, the selection of different European cases improves the external validity, as findings stem from an inter-European level. Additionally, a case study data base was established, comprising transcripts, recordings, and other related documents, which improves reliability (Yin, 2014). To account for controllability and transparency, transcripts, interview guide, and coding procedure are available upon request for the assessing entities (Jonker & Pennink, 2010). In this article we

Case	Label	Time Interviewed	Pages of Interview Transcript Analyzed	Month Interview Conducted
Case 1	Business 1 (B1)	35:33	20	November 2019
Case 2	Business 2 (B2)	43:25	19	November 2019
Case 3	Business 3 (B3)	32:21	12	November 2019
Case 4	Consulting Firm 1 (CF1)	38:01	19	November 2019
Case 5	Consulting Firm 2 (CF2)	40:01	15	November 2019
Case 6	Consulting Firm 3 (CF3)	32:24	12	November 2019
Case 7	Government Consulting Firm 1 (GCF1)	39:38	16	November 2019

Table 2: Overview of Interview and Transcript Length.

have used the cases in an illustrative way to build up our arguments for the answer. Whilst this may evoke the feeling we are testing this is not the case.

Results & Discussion

How Do Firms Address the Paradoxical Tensions of Competing Demands?

Competing demands of economic, social, and economic foci

The tension of the competing demands of economic, social, and environmental foci between TBMs and SBMs have been addressed in several ways. B1, B2 and B3 have balanced these foci through integration of sustainability into their overall strategy. Both TBMs and SBMs have to fulfill sustainability standards, with B2 even making sustainability a mandatory part of doing business. CF1 similarly aligns these foci through the added value that sustainability is offering, such as cost reduction and satisfaction of customer demands for more sustainability. CF2, on the contrary, reported a distinct separation of the foci per BM, where the TBM funds sustainable operations through donation of its earnings. CF3 and GCF1 both acknowledge the competitive treatment of sustainability, and the integration via a long-term strategic perspective.

Hence, results show that firms rectify this paradoxical tension through integration. Rangan, Chase, and Karim's (2015) three "theaters" are found in solving these foci. Consulting Firm 2 embodies Theater 1, where TBM's profits are being used to fund the SBM. Theater 2 manifests in operational improvements to integrate social and environmental issues, and is embodied in B1 and B3, CF1, CF3, and GCF1, who also report business cases for sustainability introduced by Schaltegger et al. (2012) and Hart & Milstein (2003) identified to align the competing foci during the co-evolution. Theater 3, hence, a transformation of BMs through engraining sustainability as a mandatory aspect of every BM, manifests in B2.

Comparability of performance metrics

To establish comparability of endeavors throughout the corporation, the following possibilities have been reported. B2, CF1, CF2, CF3, and GCF1 have integrated sustainable and traditional reporting structures into all operations. GCF1 further adopted a triple bottom line canvas to ensure comparability of operations. B3 implemented a strategic mandate to manage future expectations for the SBM, and to prevent a bias for decisions based on return on investment only. B1 and CF1, however, adopted a translation approach to metrics, where all metrics are being translated into a higher-order performance indicator, such as translating emissions into Euro, or other objective key results. CF2 indicated a clear separation of metrics per business model, meaning that the TBM is measured against traditional performance metrics, whilst the SBM utilizes indicators that are in congruence with its purpose. Therefore, a comparison between the two is willingly not made.

Stubbs & Cocklin (2008) underscored the necessity of having a reporting structure that meaningfully reflects economic, social, and ecological impacts a firm has. As GCF1 exemplifies, Elkington's (1999) triple-bottom-line approach is mirrored in a triple-bottom-line-canvas (TBLC), which maps out economic, social, and environmental aspects of an organization's operations (Joyce & Paquin, 2016). Most cases opted for a combined reporting structure of traditional and sustainable metrics, although different options than the TBLC were chosen. B3 opted for a strategic mandate to counterbalance a bias towards economic metrics (Stubbs & Cocklin, 2008). CF2, on the contrary, highlighted a clear separation of metrics per BM, which reflects Rangan, Chase, and Karim's (2015) reporting structures in Theater 1.

Cannibalization of profit margins

With respect to addressing profit margin cannibalization, two different options have been reported. Cannibalization of profit margins of the TBM by the SBM has been reported to be accepted in the long-term if not strategically mandated by most cases. B2, however as a second option, handles the cannibalization issue based on a global-local strategic consideration. Whilst sustainability is a mandatory pillar in these decisions, profit cannibalization dilemmas are dependent on economic and strategic factors only.

Schaltegger et al. (2012) highlighted three different types, of which two types have been found in the data analyzed. The accommodative type, where customer segments concerned with sustainability are recognized and served with specific products, besides existing

TBMs, is embodied by most cases, who have been entertaining an SBM next to a TBM. B2, as the second recognized type, mirrors the proactive type, as BMs have been transformed to accommodate sustainable components as a mandatory part across the corporation. Noteworthy is the acceptance of profit margin cannibalization by all interviewed cases.

How Do Firms Address the Paradoxical Tensions of Organizational Culture and Mindset?

Organizational culture and mindset

To address the tension of cultural and mindset difficulties between TBMs and SBMs, B2, B3, CF1, CF2, CF3, and GCF1 have outlined strong leadership as a key component to harmonize culture and mindset. B1 deploys a participation-based corporate strategy coupled within an inclusive corporate purpose, which is continuously communicated internally. B2, CF1, and CF2 established a strong and values-based corporate vision and philosophy which resonates with the staff's own value set. B2 further deploys champions for sustainability that are constantly advocating for sustainable change within the organization, a practice that is also acknowledged by CF1 and CF2. B3, however, highlights the cruciality of external market developments confirming a necessary switch onto SBMs alongside the TBM to aid cultural harmonization.

Yu & Hang (2010) and Boons & Lüdeke-Freund (2013) highlight the pivotal role culture and mindset play during the co-evolution of BMs. Successful adaptation of culture requires leadership (Barquet et al., 2013; Stubbs & Cocklin, 2008). Moreover, B2, CF1, and CF2, advocate for strong, values-based corporate visions and philosophies that resonate with staff's own values, and B1 reports a participative, inclusive strategy to motivate cultural harmonization. These values-related and inclusive corporate vision and strategy is also highlighted by Stubbs & Cocklin (2008) and Lleo, Viles, Jurburg, & Lomas (2017). B3, instead, underscored the notion of Hockerts & Wüstenhagen's (2010) market development fostering adjustment of corporate mindset. B3, thus, opted for an organic approach to cultural adjustment and harmonization. Moreover, increased communication of values and purpose has been introduced, as well as different programs to standardize processes and boost growth based on common value sets. Zerfass & Viertmann (2016) describe a similar approach in their values-based communication paradigm, where corporate value communication to internal stakeholders is key.

Behavioral rules, norms, and regulations

B1 established a stage-gate model that ensures the involvement of all relevant stakeholders at each step of the design process of a product or service, which enables joint agreement and inhibits cultural conflicts internally. Moreover, an in-house program is in place, establishing a common mindset for the workforce by stressing the importance of operational optimization. The organization set two different strategic objectives per BM, which aids expectation management of relevant stakeholders. B2 reported a code of principles that has to be signed by every employee semi-annually, clearly underscoring the importance of values such as sustainability, respect, authenticity. A further powerful mechanism is the firm's innovation and corporate development process, giving each brand its own purpose and commitment to shape strategy in accordance. CF1, similarly, highlights the importance of continuous communication of values and purpose. CF3 and GCF1 reported HR involvement and leadership as crucial mechanisms, whilst B3 opted for organic cultural growth instead.

How Do Firms Address the Paradoxical Tensions of Training and Staffing?

Regarding the training of staff, B1, B2, CF2, and GCF1 established training centers and programs to enable continuous learning. Employees receive training on different matters reaching from basic skill development onto more complex, sustainability-related topics. B2 additionally introduced a purpose-led self-development program. B1 has introduced training programs for everyday improvements and understanding the weighted impact of IT development per business model, which enhances transparency on how IT resources are being devoted. CF2 deploys training courses to improve collaborative management. GCF1 reported the utilization of an in-house academy to facilitate skill development. In addition to these physical training opportunities, B2, B3, and GCF1 also utilized online training facilities and platforms to train employees, and other relevant stakeholders.

In terms of accommodating the workforce into the process of the coevolution, values-based hiring has been introduced by Business 2, Business 3, Consulting Firm 1, Consulting Firm 2, and Government Consulting

Firm 1. This matches with the slightly confusing term in this context, 'knowledge-based recruiting', which "involves a strong and explicit focus on choosing candidates with relevant knowledge, learning and networking capabilities" (Kianto et al., 2017: 12). In the context of the coevolution of business models, the ability to properly learn and network hinges on the understanding of the common corporate values. Furthermore, Kianto et al. (2017: 13) highlight the necessity to "regularly developing the depth and breadth of employees' knowledge and expertise, personalizing training to fit particular needs and, finally, ensuring continuous employee development". Virtually all cases entertain either physical or online training facilities, or both.

Concerning staffing, most cases reported a values-based hiring process to find the best match. B2 and B3 state that recruitment efforts move toward specialized talent to satisfy the needs for the sustainable business model. Similarly, CF1, CF2, and GCF1 report this development.

How Do Firms Address the Paradoxical Tensions of Resource Allocation?

B1, B3, CF1, CF2, CF3, and GCF1 confirmed that resources are increasingly reallocated towards the SBM. CF2, on the other hand, reported that there are dedicated resources for each BM, and no resources flow from one to another. B2 highlighted that resources are allocated based on strategic growth decisions and performance, based on quarterly agile-performance-reviews, so that resources may flow quickly to where they are needed the most.

In line with Björkdahl & Holmén (2013) and Chesbrough (2010), almost all cases indicated a gradual shift of resources from the TBM to the SBM. B2 highlighted that the allocation of resources was dependent on an agile-performance-review in order to allocate resource most efficiently, a trend gauged by Cappelli & Travis (2016). Lastly, CF2 reported no resource shift between TBM and SBM, but a fixed allocation of resources per model, a notion indicated by Björkdahl & Holmén (2013).

How Do Firms Address the Paradoxical Tensions Arising in the Stakeholder Environment?

External stakeholders

All cases have reported an increase in collaboration, communication, and interaction with stakeholders. CF1 highlights stakeholders' increased emphasis on transparency and involvement, whilst GCF1 underscores the cruciality in increased communication to maintain close ties and credible relationships with stakeholders. B3, CF2 and CF3 report an increase in interaction, but also in the number of stakeholders involved. B1 highlights further the increase in collaboration with local governments and other industries, whilst B2 highlights more inter-industry partnerships and collaborations, as well as partnerships with NGOs and governments.

In line with Schaltegger, Lüdeke-Freund, & Hansen (2016) and Stubbs & Cocklin (2008), all cases reported an increase in collaboration, communication, and interaction with stakeholders. CF1 and CF3 further note an increase in the number of stakeholders involved, a notion indicated by Pennink (2014). Furthermore, B1 and B2 highlight an increase in inter- and intra-industry collaborations, as well as partnerships with governments and NGOs. Schaltegger, Lüdeke-Freund, & Hansen (2016) highlight similarly an increased collaboration with NGOs, retailers, and other relevant stakeholder groups, whilst Boons and Lüdeke-Freund (2013) stress the need for inter-organizational clusters even beyond firm actors and an embracement of stakeholder's expectations.

Resistance throughout the value chain

Whilst B1 outlined no frictions during the coevolution, most cases highlighted issues along their value chains. B2 reported cynics and critics along the value chain but overcame the resistance by demonstrating the potential of sustainable business conduct and strong leadership. By now, supplier who wish to work with B2 must sign a code of principles, subscribing to the adherence to sustainable practices. B3 also reported frictions in the value chain, especially with the financial industry, which were tackled via collaboration with partners that were willing to change. CF1 and CF2 concur this notion, and advocate for supplier screening and co-creation of value with suitable partners. CF3 and GCF1 highlight the necessity for strong leadership and effective change management to combat resistance, as well as advocating for risk reduction through more sustainable business conduct.

Regarding possible difficulties throughout the value chain, B1 did not encounter any frictions. The remainder of cases have addressed supplier reluctance through

supplier screening and alignment of interests via demonstration, which according to Stubbs & Cocklin (2008) is crucial to overcoming these difficulties. CF1 further outlines the co-creation of value with suppliers as a crucial mechanism to manage supplier friction, which is in line with Sheth (2019).

Internal stakeholders

To overcome issues in the internal stakeholder environment, CF1, CF2, and CF3, and GCF1 address this with strong leadership and increased collaboration and communication. This is achieved by establishing a clear corporate vision and strategy. B1 and B2 confirm this notion, and also highlight the need for a unified processes and transparency. B3 overcame competing interests of internal stakeholders with patience and strategic consequence. While exercising the coevolution continuously, stakeholders that resisted gradually diminished by natural turnover, and opted for an organic approach.

With respect to the internal stakeholder environment, competing interests have been addressed in several ways. Strong leadership and collaboration have been reported as a key strategy to remedy competing interests (Boons & Lüdeke-Freund, 2013; Stubbs & Cocklin, 2008). Along the argumentation of Lleo, Viles, Jurburg, & Lomas (2017) and Stubbs & Cocklin (2008), B1, B2, CF2, CF3, and GCF1 report the cruciality of a strong corporate vision and strategy in conjunction with internal stakeholder involvement. B3, on the contrary, has opted for an organic approach to rectify competing interests, whereby organic turnover diminished incompatible stakeholders, an approach enabled through strong leadership and strategy (Stubbs & Cocklin, 2008).

Conclusive Findings: Four Coping Strategies

This paper's objective is to explore and identify the coping pathways and mechanisms of businesses that encounter paradoxical tensions during the coevolution of traditional and sustainable business models. Therefore, the following research question has been formulated based on literature and current developments:
How do traditional and sustainable business models coevolve within firms?

Through the adoption of a paradox lens, we have been able to view TBMs and SBMs as opposing poles, that are yet interrelated and interdependent (Smith & Lewis, 2011). Thus, we could identify several areas of paradoxical tensions that must be addressed as they occur during the coevolution. After reviewing a map of uncovered responses, the empirical data revealed four fruitful coping strategies to address the five areas of paradoxical tension during the coevolution, which are presented below. Coping strategies, in the spirit of Lazarus and Folkman (1984), refer to the behavior and endeavors undertaken to address different internal and external demands, in this research context, the five areas of paradoxical tension occurring during the coevolution of TBMs and SBMs. The four coping strategies range from separation of TBMs and SBMs, to narrowing of TBMs and SBMs via operational improvements or strategic mandates, to a complete transformation from TBMs to SBMs. The results suggest, however, a predominant shift from TBMs onto SBMs in the long run.

1. ***Type 1 "Splitter",*** splits TBMs and SBMs, and displays a philanthropic approach, where reporting structures remain separate per business model, profit margin cannibalization is accommodated in the operations with respect to competing demands. Strong leadership and an inclusive, participatory strategy are chosen to harmonize organizational mindset and culture. Values-based hiring and the utilization of training facilities are used to address the paradox in staffing and training. Regarding resource allocation, a self-sufficiency of business models is opted for, with no gradual shift in resource allocation over time. The external stakeholder environment is included through increased stakeholder involvement, whilst competing interests in the internal stakeholder environment were addressed with strong leadership, and a participatory internal management approach.

2. ***Type 2 "Operational Perfectionist"***, focuses on operational excellence, ergo exhibits operational improvements in the traditional business model, while entertaining an SBM to combine competing demands. Traditional and sustainable metrics are jointly reported throughout the corporation, and profit margin cannibalization is accommodated. For organizational mindsets and cultures, strong

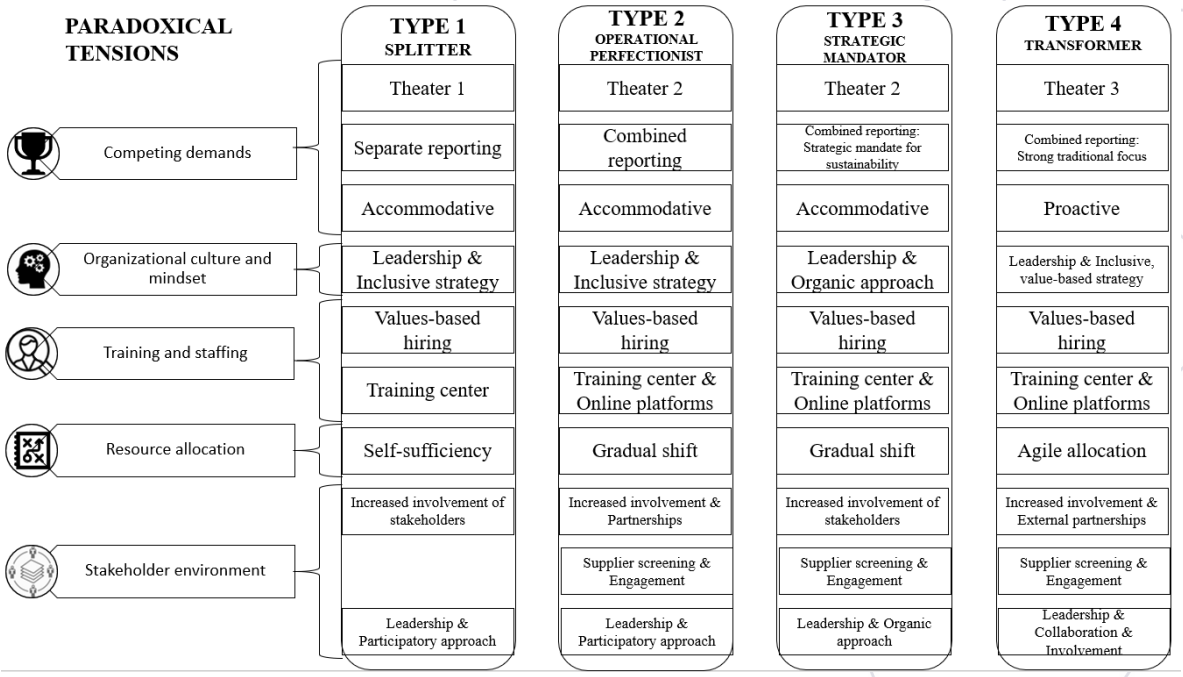

Figure 3: Four Coping Strategies: From Splitters to Transformers.

leadership and an inclusive strategy are used. Regarding staffing and training, values-based recruitment as well as physical training facilities and online platforms are established. Resources shift gradually from the TBM to the SBM. Furthermore, more interaction in the external stakeholder environment and partnerships with other industries and governmental actors is observed. Along the value chain, suppliers are screened for fit, closer collaboration initiated, and value jointly created. Competing interests in the stakeholder environment are addressed through strong leadership, increased collaboration, and involvement of all relevant internal actors.

3. ***Type 3 "Strategic Mandator"***, strategically mandates the SBM's development. A strategic mandator undertakes operational improvements in the TBM whilst entertaining an SBM to combine competing demands. TBMs and SBMs are jointly reported, although a strategic mandate has been established to counterbalance a bias towards traditional metrics. Profit margin cannibalization has been accommodated. Regarding organizational mindset and culture, strong leadership paired with an organic approach was chosen, with market trends providing the stimulus for harmonization. Training and staffing have been approached via values-based recruitment, and the utilization of training facilities and online platforms. Resources are gradually shifted from the TBM toward the SBM. Furthermore, increased involvement of external stakeholders as well as supplier screening and collaboration is observed. Competing interests in the internal stakeholder environment are addressed through strong leadership, and an organic approach where the number of incompatible internal stakeholders diminishes over time.

4. ***Type 4: "Transformer"*** resembles a transformation of BMs to satisfy competing demands of economic, social, and environmental foci. Sustainable and traditional metrics are jointly reported, although the focus on traditional metrics such as return on investment remains the crucial set of metrics. Profit margin cannibalization was addressed in a proactive manner, as BMs were transformed to be sustainable and become one of the main drivers of the organization. For organizational mindset and culture, strong leadership paired with an inclusive, values-based strategy were deployed. As for training and staffing, values-based recruitment, as well as physical training centers and online platforms are utilized. Resource allocation is based on an agile,

performance-based allocation mechanism to channel resources fast and efficiently. The external stakeholder environment is addressed through increased involvement and external partnerships with actors from different industries and governmental entities. Suppliers are screened for fit based on capabilities and values. Competing interests in the internal stakeholder environment are approached through strong leadership paired with involvement and collaborative value-alignment programs.

The coevolution of TBMs and SBMs creates paradoxical tensions. These five areas of paradoxical tension, specifically competing demands, organizational culture and mindset, training and staffing, resource allocation, and the stakeholder environment, necessitated firms to develop strategies. By identifying an array of firms' responses and four coping strategies, this research contributes to existing literature in the following ways. Firstly, it infuses the field of TBM and SBM research with a paradox lens and highlights four coping reactions firms have developed that might help them to address the paradoxical tensions. Secondly, it points out current best practices on the synchronistic management of TBMs and SBMs under one roof.

Limitations

Nevertheless, this research has inherent limitations. As is clearly indicated this is an inductive oriented case illustration with the main purpose to develop new theoretical insights. Our four coping strategies and the five areas of paradox are as we hope new theoretical insights. Furthermore, our case selection was based on theoretical sampling, ergo the selection hinged on relevant criteria to the issue under investigation, which might have limited our inductive search process as also our choice of only western European cases could have done that. Additionally, the relatively small number of cases and their mixed industries may contribute accordingly. Lastly, the scope of this paper limits the detail of the outcome. This research concentrates on five areas of paradoxical tension, however, there may be smaller, nonetheless still significant, paradoxical areas that may remain unaccounted for.

Avenues for Future Research

Future research may explore the phenomenon of the coevolution of TBM and SBM in a context beyond West-Europe. Secondly, as sub-groups of cases do not exhibit equal numbers, this offers the opportunity to investigate whether findings would diverge in case of equal distribution of sub-groups. Lastly, due to the limited scope of this paper, a rather complex phenomenon was explored with a single interview per case. A longitudinal case study with multiple interviews over time would may enable a more nuanced capture of the coevolution, with more data points over time (Yin, 2014).

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Appendix

Appendix 1: List of Interviewed Cases

Case	Industry	Location	Label	Firm Size (No. Employees)
Case 1	Energy/Power Producer	Netherlands	Business 1 (B1)	> 40,000
Case 2	Consumer Goods	United Kingdom	Business 2 (B2)	> 150,000
Case 3	Energy/Power Producer	France	Business 3 (B3)	> 150,000
Case 4	Consulting	Netherlands	Consulting Firm 1 (CF1)	> 150,000
Case 5	Consulting	Belgium	Consulting Firm 2 (CF2)	< 100
Case 6	Consulting	Sweden	Consulting Firm 3 (CF3)	< 100
Case 7	Governmentally-owned Consulting	Norway	Government Consulting Firm 1 (GCF1)	> 500

Appendix 2: Interview Guide

Section	Question	Literature	Expectation
Introduction	(...)	N.A.	N.A.
General information	What is your current position and how does your experience with both traditional and sustainable business models look like?	N.A.	N.A.
Competing demands	1. How do you deal with competing demands of economic, social, and environmental foci?	Hart & Milstein (2003) Stubbs & Cocklin (2008) Rangan, Chase, & Karim (2015)	To explore pathways for rectifying competing foci.
	2. How do you ensure comparability of projects with respect to performance metrics?	Schaltegger et al. (2012) Stubbs & Cocklin (2008) Rangan, Chase, & Karim (2015)	To explore pathways for rectifying comparability of endeavors.
	3. How do you address the potential issue of cannibalization of profit margins between the two models?	Hart & Milstein (2003) Schaltegger et al. (2012)	To explore pathways for rectifying cannibalization of profit margins.
Organizational mindset and culture	4. Have you experienced any difficulties with respect to organizational culture? How did you overcome this?	Barquet et al. (2013) Stubbs & Cocklin (2008)	To explore pathways for rectifying competing mindsets/ cultures.
	5. Have you introduced new internal behavioral norms or rules to harmonize the co-evolution within the firm?	Barquet et al. (2013) Stubbs & Cocklin (2008)	To explore pathways for rectifying competing mindsets/ cultures.

Appendix 2: Interview Guide *(Continued)*

Section	Question	Literature	Expectation
Training and staffing	6. How is staffing and the workforce affected by the coevolution?	Barquet et al. (2013) Kianto, Sáenz, & & Aramburu (2017)	To explore pathways for rectifying competing interests in and demands from the workforce.
	7. Have you introduced a learning platform, such as a training center?	Barquet et al. (2013) Kianto, Sáenz, & & Aramburu (2017)	To explore pathways for rectifying competing skill requirements.
Resource allocation	8. In terms of resource allocation, how is this managed between the two models?	Barquet et al. (2013) Björkdahl & Holmén (2013) Chesbrough (2010)	To explore pathways for rectifying competing resource demands.
Stakeholder environment	9. How has the co-evolution affected the external stakeholder environment?	Boons & Lüdeke-Freund (2013) Schaltegger, Lüdeke-Freund, & Hansen (2013) Stubbs & Cocklin (2008)	To explore pathways for addressing competing interests in the external stakeholder environment.
	10. Have you faced any resistance throughout your value chain throughout the process? How have you addressed potentially competing interests?	Boons & Lüdeke-Freund (2013) Schaltegger, Lüdeke-Freund, & Hansen (2013) Stubbs & Cocklin (2008)	To explore pathways for addressing competing interests in the external stakeholder environment, specifically along the value chain.
	11. How has the coevolution affected the internal stakeholder environment? How have you addressed potentially competing interests?	Boons & Lüdeke-Freund (2013) Schaltegger, Lüdeke-Freund, & Hansen (2013) Stubbs & Cocklin (2008)	To explore pathways for addressing competing interests in the internal stakeholder environment.

Appendix 3: Selective Coding

Paradox	Codes
Competing demands	All businesses integrate economic, social and environmental foci (B1, B2, B3) as well as most consulting firms (CF1, CF2, CF3, GC1) by engraining sustainable and economic requirements in both traditional and sustainable business models (B1, B2, B3, CF1, CF3, GC1), through cost reduction (CF1) Another option to balance the competing demands is by generating profits with the traditional business model and donate them to a social business model (CF2) Translation of different KPIs onto a common level (B1, CF1) Integration of both sustainable and traditional metrics across all operations (B2, CF1, CF2, CF3, GC1) and expectation management for lower returns of sustainable business models (B3) Separate set of metrics per business model's emphasis (CF2) Acceptance of cannibalization of profit margins from traditional model by sustainable model (B1, B3, CF1, CF2, CF3, GC1) Direction of strategic narrative guides cannibalization acceptance, unrelated to sustainability (B2) Future legislation favors focus on sustainability (CF1, GC1)
Organizational mindset and culture	Participation-based corporate strategy (B1) with inclusive organizational purpose that is continuously communicated to overcome cultural difficulties Top leadership (B2, B3, CF1, CF2, CF3, GC1) Strong, values-based corporate vision and philosophy (B2, CF2, CF3) with champions for sustainability in the ranks (B2, CF1, CF2) Market development proving the right direction (B3) Mechanisms used are HR involvement and leadership (B1, GC1, CF3), increased communication of values (CF1, B2), and organic cultural growth (B3)
Training and staffing	Values-based hiring to find the best match (B2, B3, CF1, CF2, GC1) Online platforms to enable continuous learning (B2, B3, GC1) Training centers and programs to facilitate learning (B1, B2, CF2, GC1) Collaborative management, communication, and leadership (B2, CF1, CF2, CF3, GC1)
Resource allocation	Resources are increasingly being re-allocated from traditional to sustainable business models (B1, B3, CF1, CF2, CF3, GC1) Resources are being allocated based on strategy and performance, without taking sustainability into consideration (B2) Resources are distinctly allocated per business model, and all business models are functioning self-sufficiently (CF2)
Stakeholder environment	Increased collaboration, communication, and interaction with stakeholders (B1, B2, B3, CF1, CF2, CF3, GC1) Increased partnerships with governmental entities (B1, B2) Increased inter- and intra-industry partnerships (B1, B2) To address and overcome resistance from the value chain, suppliers are being screened and engaged if they share the same values (B2, B3, CF1, CF2, CF3) To address and overcome resistance from the value chain, effective risk management is being advocated (GC1) To overcome internal stakeholder issues, leadership (CF1, CF3, GC1), as well as collaboration and participation of these internal stakeholders in the process is key (B2, CF1, CF2, CF3) To overcome competing interests of internal stakeholders, unified processes and transparency are vital (B1, B2) Organic outgrowing of incumbent resistance (B3)

About the Authors

Niklas Endregat is a master graduate from the University of Groningen, The Netherlands. After his bachelor's in International Business, he obtained his master's degree in International Business and Management in 2020. He was runner-up for the Cloverleaf Award at the 5th International Conference on New Business Models 2020. His research interests lie in sustainability topics within the realm of international business and management.

Dr Bartjan W. Pennink is Assistant Professor at the department of Global Economics and Management. After his study of Sociology at the same University he started there to work at 1984 at the University of Groningen. In 2004 he finished his PhD. The last ten years the focus in his research is on modeling the process of Local Economic Development and for his research he travels to Indonesia and Tanzania in order to collect data in regional remote areas. From this focus the connection with sustainable business models has been made: Which factors do support the cooperation of involved actors and on sharing which values to stimulate local economic and social development. For much more details see: https://www.sustainable-local-economic-development.nl/

In his teaching he is involved in courses on Corporate Social Responsibility (MSc) on Organizational Theory (BSc) and on Project Management for Humanitarian Actions (MSc). From 2015 on he is also Visiting Lecturer in the field of Research Methodology at the Institute of Finance Management in Tanzania (Dar es Salaam). Besides the regular programs he also participates in the Honours Master programs of the RUG by a Masterclass on Ubuntu and a Masterclass on New (Sustainable) Business Models.

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Exploring Sustainability in Business Models of Early-Phase Start-up Projects: A Multiple Case Study Approach

Martin Glinik[1], Michael Rachinger[2], Christiana Ropposch[3], Florian Ratz[4], and Romana Rauter[5]

Abstract

Purpose: The purpose of this paper is two-fold: First, we provide an analysis of sustainability topics that occurred in business models deployed in early-phase start-up projects. Second, we investigated potential drivers that led to the inclusion of sustainability aspects in different business model elements.

Design/Methodology/Approach: We investigated our sample of six early-phase start-up projects using a multiple case study approach, whereby the business model of each start-up project represents one case. The nascent entrepreneurs took part in a four-month academic start-up accelerator, called the *Gruendungsgarage*, and we collected qualitative data at three sequential points in time. These data were then analysed using a qualitative content approach and interpreted from a business model and imprinting theory perspective.

Findings: The business models deployed in these six early-phase start-up projects are centred around sustainable value propositions. However, the type and degree of sustainability differs. In fact, an intention to comply with sustainability principles was initially expressed in only two of the six start-up projects. Most of the investigated start-up projects did not holistically integrate sustainability-related values. Instead, sustainability was considered as an ancillary benefit to providing products or services.

Practical and social implications: The findings offer practical knowledge that entrepreneurs can use to develop business models centred around a sustainable value proposition and benefit from the interactions among the three sustainability dimensions to address the unmet demand of a larger stakeholder group (i.e. solving social and ecological problems).

Originality/Value: These study findings expand our knowledge about sustainable business model development in early-phase start-up projects. We use multiple data from six start-up projects to provide examples of different sustainability aspects that are being imprinted in business models. In addition, we provide empirical evidence of drivers that are considered to be supportive in the context of sustainable business model development, such as entrepreneurial motivation, careful resource use and waste reduction. Viewed through an imprinting theory lens, several of the identified drivers can be associated with the individual entrepreneur (imprinter), highlighting the importance of the entrepreneurs' characteristics for the further development of sustainable business models. In addition, just as many drivers could be assigned to strategic considerations (imprinting processes) to imprint sustainability in the business model. These considerations can be used to develop specific strategies to improve the competitive advantage of start-up projects that place a focus on sustainability.

Keywords: sustainable business model development, entrepreneurial business models, start-up accelerator; sustainability

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1-4 Institute of General Management and Organisation, Graz University of Technology, martin.glinik@tugraz.at
5 Institute of Systems Sciences, Innovation & Sustainability Research, University of Graz

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Introduction

For more than a decade, authors have explored the alternative orientations and motivations of entrepreneurs that go beyond mere profit maximisation, describing their findings in the literature on entrepreneurship (Muñoz et al., 2018). Although scholars have dealt extensively with the relevance of values and goals to founding new businesses (Leung et al., 2013), they have paid relatively little attention to understanding how early-phase start-up projects elaborate and imprint sustainability aspects in their business models (Taeuscher and Abdelkafi, 2018; Voinea et al., 2019; Fischer et al., 2020).

So far, most scholars have treated the purpose of an organisation as a binary and static construct (Estrin et al., 2016; Stevens et al., 2015). This suggests that nascent entrepreneurs involved in early-phase start-up projects are likely to choose either a commercial or a sustainable purpose when starting a business. This choice remains stable throughout the process of business development (Dacin et al., 2011; Mair and Marti, 2006) and shapes important characteristics of the business model (BM) when a business is started (Chesbrough and Rosenbloom, 2002; Siggelkow, 2002).

Once the BM has been introduced or founded, it is less likely to change due to path dependencies, dominant logics, the cognitive limitations of managers and a general aversion to change (Gilbert, 2005; Tripsas and Gavetti, 2000). The initial characteristics of the BM may be retained over long periods of time, even if environmental impacts change at a later date (Marquis and Tilcsik, 2013). This phenomenon was first described by Stinchcombe (1965) as *imprinting*. In this article, he argued that some characteristics of an organisation which are shaped during a sensitive period (i.e. founding or formation) may persist over a long period of time and can influence (or imprint) organisational design later on, even if subsequent environmental changes occur (Stinchcombe, 1965; Marquis, 2003; Johnson, 2007). The imprinting theory implies that the decisions entrepreneurs made in the start-up phase shape the internal organisational design or its boundary-spanning design in the form of its BM (Beckman and Burton, 2008; Snihur and Zott, 2020). Scholars agree that entrepreneurial decisions which influence the BM itself are crucial and of particular importance, since these BMs are often preserved over a longer period of time (Siggelkow, 2002; Tripsas and Gavetti, 2000). Against this background, we argue that imprinting sustainability into the BM is a decision that also needs to be made early (enough) in the development phase to ensure that it remains a central cornerstone and becomes imprinted in strategies and structures as the organisation grows.

However, little is known about these early development phases of the BM or the drivers (or reasons) that stimulate (or lead to) the imprinting of sustainability in BMs used in early-phase start-up projects (Stubbs and Cocklin, 2008; Rauter et al., 2017; Davies and Chambers, 2018; Laasch, 2018; Voinea et al., 2019). To the best of the authors' knowledge, only one study has been carried out to investigate how start-ups integrate corporate social responsibility (CSR) into their BMs and identify what motivates them to engage in CSR activities (Voinea et al., 2019). In contrast to our study, their work builds on the stakeholder and social capital theory and does not examine the imprinting of sustainability in BM elements (Remane et al., 2017) or the use of the Business Model Canvas as a practical BM tool (Osterwalder and Pigneur, 2010; Teece, 2010; Remane et al., 2017; Voinea et al., 2019). In addition, the five investigated start-ups in Voinea et al.'s study (2019) were already established a couple of years ago, and interview data were only collected once 2019. Their findings provide the first general insights regarding how start-ups strive to include sustainability in their BMs and serve as a valuable basis for investigating the sustainability aspects of BMs in start-up projects and, specifically, the inclusion of sustainability aspects within the BM elements. Rauter et al. (2017) also investigated driving factors leading to the inclusion of sustainability in BMs and came to the conclusion that these drivers included personal beliefs; their sample, however, was not limited to start-up companies. A more general study by Sher et al. (2020) was carried out to investigate the drivers of start-up intentions for sustainable entrepreneurship, especially in the context of university students. Overall, the lack of (empirical) evidence on early-phase start-up BMs as well as the lack of information about which drivers cause certain start-up projects to develop BMs that include sustainability aspects is obvious. To obtain a more thorough understanding of how early-phase start-up projects imprint sustainability aspects in their early BMs, we addressed this research gap by posing the following research questions:

(a) What elements of early-phase start-ups BMs include aspects of sustainability?
(b) What drives the inclusion of sustainability aspects in early-phase start-up BMs?

To answer these research questions, we investigated the BMs deployed in six out of nineteen early-phase start-up projects and examined how they included sustainability aspects. We chose early-phase start-up projects that were not yet present on the market to study how they imprinted sustainability aspects in their BMs in order to 'arrive at a balanced sustainability system' (DiVito and Bohnsack, 2017; Fischer et al., 2020, p. 88). All nineteen early-phase start-up projects were part of the start-up accelerator programme *Gruendungsgarage* during our investigation (Mueller et al., 2019). Six out of the nineteen interdisciplinary early-phase start-up projects integrated sustainability aspects in their BMs. We analysed the BMs used in these six early-phase start-up projects in detail by applying multiple qualitative methods (Glaeser and Laudel, 2010; Mayring, 2010) and by using the imprinting theory (Simsek et al., 2015) as a theoretical basis. The findings of this qualitative empirical study allowed us to examine the drivers that led to the inclusion of sustainability aspects in these BMs and improved our understanding of how and why early-phase start-up projects imprinted these sustainability aspects.

Theoretical Background

Sustainable Business Model Development in Early-Phase Start-Up Projects

The concept of the BM was originally developed for and used in purely profit-oriented organisations. For this reason, the focus of attention has typically rested on the commercial logic behind how an organisation creates, delivers and captures value (Teece, 2010). The underlying conceptual structure of organisational values, however, also extends beyond the pure commercial market (Laasch, 2018). The boundaries and limitations of purely profit-oriented BMs have been identified recently (e.g., Kiron et al., 2013; Schaltegger et al., 2016; Seelos, 2014), and scholars as well as practitioners have become increasingly interested in exploring the potential of eco-friendly and socially-oriented BMs (Luedeke-Freund and Dembek, 2017), the so-called sustainable BMs. Sustainable BMs have been developed to achieve financial and sustainability objectives simultaneously (Stubbs and Cocklin, 2008; Schaltegger et al., 2016) and, thus, create extended value for the individual, natural environment and society (Govindaraj, 2003; Boons et al., 2013; Bocken et al., 2014; Wells, 2016; Taeuscher and Abdelkafi, 2018). This extended value creation, however, is challenging and might require the use of new BM approaches (Di Domenico et al., 2010; Kuckertz and Wagner, 2010; Wilson and Post, 2013) that enable scholars and practitioners to achieve both non-financial and financial goals (Murphy and Coombes, 2009; Hahn et al., 2010).

So far, researchers have concentrated mainly on the BMs of (established) sustainability-oriented organisations, providing a broad overview but failing to offer specific insights into entrepreneurial activities (e.g. Schaltegger et al., 2012; Boons and Luedeke-Freund, 2013; Bocken et al., 2014). Furthermore, the current methods used to imprint sustainability in BMs have been designed for established organisations and SMEs. For this reason, they suffer from certain limitations when they are applied to start-ups due to the considerably different characteristics (Retolaza et al., 2009). Start-ups are characterised by their novelty and are supposed to mature and scale-up; therefore, it is of major importance to investigate how these organisations develop BMs that go beyond the mere creation of economic value (Boons et al., 2013) while facing high amounts of uncertainty regarding the market adoption of their products or the availability of critical resources (Hall et al., 2010; Bocken, 2015).

However, little is known about how to develop appropriate BMs to support early-phase start-up projects to imprint sustainability in their BMs (Stubbs and Cocklin, 2008; Rauter et al., 2017; Davies and Chambers, 2018; Laasch, 2018; Voinea et al., 2019).

Using the Imprinting Theory Lens to Examine Sustainability Aspects in BM Elements of Early-Phase Start-up Projects

Originally developed to study animal behaviour (Stinchcombe, 1965), the imprinting theory has proven to be a valuable approach for the investigation of new ventures (Simsek et al., 2015). Like the development of imprints during the early life stage of an individual, the imprinting theory can also be applied to explore imprints in emerging start-up projects (Marquis and Tilcsik, 2013).

Every organisation goes through various sensitive periods during its entrepreneurial journey (Nelson, 2003; Judge et al., 2015). Thereby, the foundation period is certainly the most sensitive period in the life of an organisation, since it represents the transition from non-existence to existence (Marquis and Tilcsik, 2013; Simsek et al., 2015). In this phase, the organisation takes shape. This shape lays the foundation for further orientation and business development. During this sensitive period, various sources of imprints may influence the organisational development and shape the key characteristics of the organisation (Johnson, 2007; Marquis and Tilcsik, 2013).

We based our work on the imprinting framework described by Simsek et al. (2015) and focused on the genesis phase, in which an imprinting source becomes reflected in an imprinted entity. The framework suggests that the genesis of imprints can be organised around three core concepts: the *imprinters* (sources of imprinting), the *imprinted* (the focal entity that is subject to imprinting) and the *imprinting processes* (activities that refer to the occurrence of imprint formation during the founding period) (Simsek et al., 2015).

The initial work on imprinting focused on the environment as a crucial source of imprinting (Stinchcombe, 1965). One of the early insights from this work was that the organisational structure reflects its founding environment. The initial focus on the environment as an influential source was subsequently extended to the personal level, explaining why founders were considered as an additional source of imprinting (Van Driel and Dolfsma, 2009). It became evident that individual imprinters are often portrayed as founders or founding teams (Beckman and Burton, 2008; Leung et al., 2013). Especially in the (pre-) seed phase, the founders' characteristics and motives represent particularly strong sources of imprinting (Helfat and Lieberman, 2002), as they have normally not yet been exposed to the imprinting effects of investors (Alakent et al., 2020) and rarely have hired employees who participate in the imprinting process (Snihur and Zott, 2020).
To date, the management scholars have primarily selected the organisation as the subject of imprinting (Fauchart and Gruber, 2011; Leung et al., 2013; Gioia et al., 2010; Milanov and Shepherd, 2013). In our study, we narrowed this perspective to focus on the BM and investigated early-phase start-up projects, the organisational structures of which had not yet been formalised. By referring to the imprinting framework of Simsek et al. (2015), we address the BM as the *imprinted* (subject of imprinting) and the drivers that lead to the inclusion of sustainability aspects in the BMs as *imprinters* (sources of imprinting) and forces that set in motion an *imprinting process*.

Methods

Data selection

Our analysis uses data on the BMs of early-phase start-up projects that were collected as part of the start-up accelerator programme *Gruendungsgarage* hosted at the Graz University of Technology and University of Graz (Mueller et al., 2019). In our study, we investigated two cohorts of early-phase start-up projects; their founders participated in the accelerator from October 2018 to January 2019 and March 2019 to June 2019, respectively. In total, these two cohorts comprised nineteen early-phase start-up projects with each start-up project consisting of up to four people. Using a purposive sampling method (Patton, 2002; Denzin and Lincoln, 2005), two of the authors independently screened the application documents (compare with Figure 1) of the early-phase start-up projects for indications of sustainability. If the application documents contained aspects of either social or ecological sustainability in the BM elements of the early-phase start-up projects, they were included in the sample. In total, six of the nineteen early-phase start-up projects included aspects of sustainability in their BM elements. These BMs were subsequently investigated in detail to examine whether they included sustainability aspects and to identify the respective drivers for this inclusion during the start-up accelerator.

Data collection

We investigated our sample of six early-phase start-up projects using a multiple case study approach, whereby the BM of each early-phase start-up project represents one case (Eisenhardt, 1989; Yin, 2009). Qualitative data were collected from multiple sources at distinct time points during the accelerator programme to triangulate our data and add richness to our cases (compare with Figure 1 and Table 1 on next page).

First, we collected documents required by the *Gruendungsgarage*. These documents included written applications to take part in the accelerator programme,

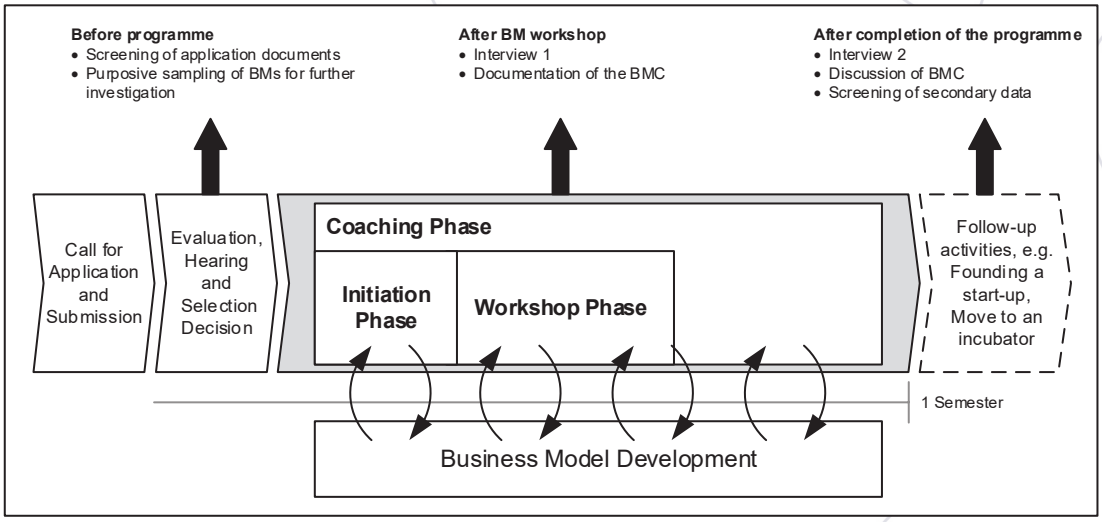

Figure 1: Procedural overview of the start-up accelerator programme (Based on Mueller et al. (2019) and Vorbach (2017)). Data collection points are shown.

which outlined the initial ideas about each start-up project's BM. Second, the BMC used by each early-phase start-up project was evaluated at discrete points in time during the four-month period of the investigation (Osterwalder and Pigneur, 2010). The BMC was used in this research as it is the '*most widely used tool for developing and analysing business models*' (Bertels et al., 2015, p. 21) as well as the '*de facto reference standard [...] taught in management and entrepreneurship education worldwide*' (Upward and Jones, 2016, p. 100). Specifically, we evaluated the BMs of each early-phase start-up project after they had participated in a BM workshop (compare with Figure 1). Furthermore, the BMC was discussed in detail with each start-up project team at the end of the *Gruendungsgarage*. Third, over the four-month investigation period, we conducted two semi-structured interviews with each start-up project team. The interview included detailed questions

	Start-up project	Time in accelerator programme *Gruendungsgarage*	Datapoint 0 (application documents)	Datapoint 1 (after BM Workshop) Interview 1 BMC 1	Datapoint 2 (after accelerator programme) Interview 2 BMC 2	Current status of start-up project
A	*Alphawood*	Oct 2018 - Jan 2019	A0	A1	A2	Founding in progress
B	*DigniSens*	Oct 2018 - Jan 2019	B0	B1	B2	Founded (website available)
C	*Mady Pure*	Oct 2018 - Jan 2019	C0	C1	C2	Founding in progress
D	*FreyZein*	Mar 2019 - Jun 2019	D0	D1	D2	Founded (website available)
E	*smarter studieren*	Mar 2019 - Jun 2019	E0	E1	E2	Founding in progress (website available)
F	*Whoopedu*	Mar 2019 - Jun 2019	F0	F1	F2	Founded (website available)

Table 1: Overview of investigated cases and empirical data collected.

regarding the overall BM used in the start-up project, the inclusion of sustainability aspects in BM elements as well as drivers towards the inclusion of sustainability aspects. We transcribed all interviews in full. Finally, secondary data, such as information extracted from the websites of the successfully founded start-ups, were gathered and compared with information from the documents and interviews. Due to the early phases of investigated start-ups, the availability of secondary data was limited. The information about the early-phase start-up projects' BMCs, interview data as well as publicly available data extracted from websites were archived in a case study database for each start-up project. Table 1 provides an overview of the investigated early-phase start-up projects and the collected data.

Data analysis

All written material was coded and evaluated using the qualitative content analysis method described by Glaeser and Laudel (2010) and Mayring (2010). The analysis was conducted using the web-based software QCAmap. We applied inductive codes to paraphrased items. In addition, as proposed by Mayring (2010), the 'intra-coder reliability' as well as 'inter-coder reliability' was ensured by meticulous coding of available material and discussing deviations in the interpretations among four individual researchers. The codes identified were subsequently assigned to main themes, applying the clustering logic proposed by Gioia et al. (2013). Furthermore, using the data gathered on the early-phase start-up project BMCs during the workshops as well as interview data, we analysed each start-up project's BM to examine its inclusion of sustainability aspects on an element basis. Again, differences in opinion were discussed among the authors until an agreement was reached. Key examples shown in Appendix 1 illustrate how the allocation of sustainability was applied to individual BM elements to ensure their intersubjective traceability.

Findings

Evidence for Sustainability Aspects in BM Elements of Early-Phase Start-up Projects

The analysis of sustainability aspects in BM elements was performed for the main BM dimensions of value proposition, value delivery, value creation and value capture (Teece, 2010; Remane et al., 2017). The results indicate that the value propositions included in five out of the six early-phase start-up projects show strong evidence of either ecological and/or social sustainability. For instance, FreyZein formulated their intentions towards sustainability as follows:

> 'One of our advantages is that starting now, we can ensure that every product we put on the market is fully integrated into this biological cycle.' (FreyZein, Datapoint 1, translated)

> 'Our product for the customer should still offer him a good experience, that he can have fun outside and still act sustainably with it. And that was the plan all along.' (FreyZein, Datapoint 2, translated)

One interesting finding was that not all of the investigated early-phase start-up projects integrated sustainability aspects in their BMs to address customers. The start-up projects Alphawood, Mady Pure, FreyZein and Whoopedu predominantly showed strong indications that they used sustainability in the value-delivery dimension of their BMs (compare with Table 2, Appendix 1). However, while Alphawood, Mady Pure and FreyZein displayed indicators of ecological sustainability, DigniSens, smarterstudieren and Whoopedu leaned more towards social sustainability.

All start-up projects emphasised sustainability aspects in the value-creation dimension of their BMs. Because the start-up project teams had an interest in emphasising sustainability in value creation, they were driven to use local and/or sustainable resources, create local job opportunities and select partners that met sustainability standards. However, the exact focus of the sustainability in value creation in each start-up project varied. For instance, Alphawood saw environmental sustainability as an ancillary benefit:

> 'So it is a pleasant and very good environmental purpose. But it is not a main topic on which I want to focus.' (Alphawood, Datapoint 1, translated)

> 'I still have the same mindset, that my product embodies sustainability [...]' (Alphawood, Datapoint 2, translated)

While all start-up project teams mentioned aspects of sustainability regarding their resources, sustainability

aspects were not always emphasised in the value creation elements of each start-up project's initial BM. For example, the start-up projects Alphawood and Mady Pure did not include sustainability aspects in their activities, and smarterstudieren did not express any intentions regarding the selection of sustainable partners. While the start-up project teams predominantly reported that the inclusion of sustainability aspects in the BM led to higher overall costs, no evidence could be found that this had any significant impact on the principal cost structure of the investigated early-phase start-up projects.

> 'It is designed to make a profit, quite clearly. Otherwise we would probably not do it. It is also about making money with it, of course. Secondly, sustainable in terms of ecological aspects or environmental protection etc. in any case.' (Mady Pure, Datapoint 2, translated)

However, the early-phase start-up projects used sustainability aspects to increase revenue streams by justifying their higher sales prices. FreyZein and Whoopedu actively took advantage of their products' sustainable properties to establish additional revenue streams, while Alphawood acknowledged a reduction in revenues due to higher costs resulting from sustainable value creation processes, although they already used upcyclable materials (compare with Appendix 2). Furthermore, Whoopedu was engaged in voluntary work while being committed to making donations; thus, they generated social value while increasing the start-up project's overall costs.

To summarize, Table 2 provides an overview of the occurrence of sustainability issues in the BMs of the investigated start-up projects. The allocation of sustainability aspects to BM elements only refers to aspects identified in the data.

Evidence for Drivers Leading to Imprinting of Sustainability Aspects in BM Elements of Early-Phase Start-up Projects

Based on the sustainability aspects observed in the BMs of the investigated start-up projects, we identified specific drivers, determined whether they were internal or external and pinpointed the aspects of sustainability they addressed. Furthermore, we assigned each driver an imprinting concept to identify which source (*imprinter*) or activity of imprinting (*imprinting process*) leads to a sustainability imprint in the investigated start-up project BMs.

The entrepreneur's motivation to create social value (Driver 1) was identified as a driver in all investigated start-up projects. Moreover, the nascent entrepreneurs were motivated by different factors to contribute towards ecological sustainability, such as the desire to imprint ecological sustainability to increase revenues

	Value Proposition and Value Delivery				Value Creation			Value Capture	
	VP	CS	CH	CR	KR	KA	KP	C$	R$
Alphawood	✔	✔	✔	✗	✔	✗	✔	✗	✗
DigniSens	✔	✗	✗	✗	✔	✔	✔	✗	✔
Mady Pure	✔	✔	✔	✗	✔	✗	✔	✗	✗
FreyZein	✔	✔	✔	✔	✔	✔	✔	✗	✔
smarter studieren	✔	✗	✗	✔	✔	✔	✗	✗	✗
Whoopedu	✔	✗	✔	✔	✔	✔	✔	✗	✔

VP = Value Propositions; CS = Customer Segments; CH = Channels; CR = Customer Relationships;
KR = Key Resources; KA = Key Activities; KP = Key Partners; C$ = Cost Structure; R$ = Revenue Streams
Note: ✔ = aspect identified; ✗ = no aspect identified;

Table 2: Overview of sustainability aspects in BM elements of investigated early-phase start-up projects.

(Driver 2) and reduce waste (Driver 3), which were identified as common drivers that supported the imprinting of sustainability aspects in the BMs of the start-up projects.

Table 3 lists all identified drivers that led to the imprinting of sustainability aspects in the BMs of the start-up projects. Furthermore, the drivers were sorted by the number of start-up projects in which they occurred and not on the basis of their absolute occurrence. This was done to avoid the influence of repeating answers of individual start-up projects on the obtained order (compare with Table 4).

Driver No.	Identified driver	Main sustainability dimension in the BM (Elkington, 1994) (imprinted entity)	Internal or external driver	Imprinting Framework (Simsek et al., 2015)	
				Level of analysis	Concept
D1	Entrepreneurial motivation to create social value	Social	Internal	Individual - Initial position holder and founder	Imprinter
D2	Ecological sustainability to increase revenues	Ecological/ Economic	Internal	Adoption and Structuring - Strategy selection	Imprinting Process
D3	Entrepreneurial motivation to reduce waste for ecological sustainability	Ecological	Internal	Individual - Initial position holder and founder	Imprinter
D4	Entrepreneurial motivation towards ecological sustainability	Ecological	Internal	Individual - Initial position holder and founder	Imprinter
D5	Customers demand drives sustainability in BM	Ecological/Social/ Economic	External	Environment - Economic and ecological conditions	Imprinter
D6	Demonstrating added value through sustainable partners	Ecological/Social/ Economic	Internal	Network - Alliance Characteristics	Imprinter
D7	Inclusion of sustainability aspects to achieve differentiation from competitors	Ecological/Social/ Economic	External	Adoption and Structuring - Strategy selection	Imprinting Process
D8	Ecological sustainability to differentiate from competitors	Ecological/ Economic	External	Adoption and Structuring - Strategy selection	Imprinting Process
D9	Enabling sustainable consumption through durable products	Ecological/ Economic	Internal	Adoption and Structuring - Strategy selection	Imprinting Process
D10	Careful use of resources as entrepreneurial motivation	Ecological	Internal	Individual - Initial position holder and founder	Imprinter
D11	Local value creation activities to create ecological sustainability	Ecological	Internal	Individual - Initial position holder and founder	Imprinter
D12	Sustainability to communicate additional value	Ecological/Social/ Economic	Internal	Adoption and Structuring - Strategy selection	Imprinting Process
D13	Reputation drives ecological sustainability	Ecological	Internal	Selection and Synthesis Identity formation	Imprinting Process

Table 3: Identified drivers leading to imprinting of social, ecological or economic sustainability aspects in BMs of investigated start-up projects. *(Continued)*

Driver	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13
Alphawood	1	2	2	1	x	1	1	1	2	3	2	1	1
DigniSens	10	1	3	2	x	x	x	x	2	x	x	x	x
Mady Pure	1	3	x	x	3	x	x	x	x	x	x	x	1
FreyZein	1	2	6	2	1	1	4	3	x	1	1	x	x
smarter studieren	5	x	x	x	x	x	x	x	x	x	x	x	x
Whoopedu	1	x	x	x	1	1	x	x	x	x	x	2	x
Occurrence in start-up projects	6	4	3	3	3	3	2	2	2	2	2	2	2
Absolute Occurrence	19	8	11	5	5	3	5	4	4	4	3	3	2

Note: *Identified drivers are sorted by the number of start-up projects in which they occurred.*

Table 4: Distribution of identified drivers for imprinting sustainability aspects in the BMs of the start-up projects.

In general, the identified drivers in Table 3 illustrate that the personal beliefs of initial position holders form the main factor for imprinting ecological and social sustainability in the BMs of investigated start-up projects. Table 4 shows that particularly the entrepreneurial motivation to create social value was the most frequently mentioned driver for imprinting sustainability in the BMs. This driver was predominantly present in the start-up projects created by DigniSens and smarter-studieren, indicating that these start-up projects were strongly motivated to promote social sustainability.

> 'The basic idea was to be sustainable. So the first idea was to help immigrants in a certain way. Then we sort of switched to a not-so-sustainable BM, where we said: "Hey let's start with all kids and try to make as much profit as we can. And then later on we switched back to sustainability, where we said: "Let's target both: mainstream kids and let's target refugee kids as well and put this fund that we are generating with this not so sustainable BM to this sustainable BM."' (Whoopedu, Datapoint 1, adjusted for readability)

Our findings also reveal that several respondents noted that environmental sustainability aspects were not included in the BM out of altruism but for strategic reasons, such as to generate additional revenues or to differentiate themselves from competitors.

> 'So if I have two products and they are actually quite identical, meet the same needs and one of them is sustainable and costs a similar amount, then that is always a selling point.' (Mady Pure, Datapoint 2, translated)

The development of durable products was also introduced by DigniSens for strategic reasons because they changed their revenue mechanics from a one-time-sale to a leasing model, because it was more profitable for them to provide durable products. This is an example of an *imprinting process* in which the inclusion of sustainability was seen as a strategy selection. Table 4 shows how often the identified drivers occurred in the respective start-up projects, sorted according to their frequency.

Discussion

This research was conducted to explore the inclusion of sustainability aspects in the different BM elements of early-phase start-up projects (Stubbs and Cocklin, 2008; Rauter et al., 2017; Davies and Chambers, 2018; Laasch, 2018; Voinea et al., 2019). We applied the imprinting theory (Simsek et al., 2015) as well as the BM concept (Teece, 2010) to identify internal and external drivers that led to the inclusion of sustainability aspects in the BMs of the investigated start-up projects.

Sustainability Aspects in BM Elements of Start-up Projects

First, the BMs of the investigated start-up projects were clearly centred around sustainable value propositions, as illustrated in Table 2. While Alphawood, Mady Pure and FreyZein pursued more ecologically sustainable value propositions, DigniSens, smarterstudieren and Whoopedu placed a focus on creating social sustainability. The start-up projects Alphawood, DigniSens and Mady Pure viewed aspects of sustainability in their BMs more as ancillary benefits than as main objectives. This is underlined by Mady Pure's initial intention to address customers who were aware of sustainability; this idea was dropped later on without changing the remaining elements in the BM (compare with Appendix 2). Alphawood, Mady Pure and DigniSens prioritised the economic dimension as higher than the social and ecological dimensions, which is consistent with the results of the empirical study by DiVito and Bohnsack (2017), who uncovered prioritisation logics with regard to the entrepreneurial and sustainability orientation. The prioritisation regarding the economic dimension also corresponds to the results of Voinea et al. (2019) who argued that short-term economic survival is more urgent for start-ups than for established organisations, indicating why the direct economic benefit is crucial for their organisational survival.

Second, in terms of sustainability in value creation, aspects of social sustainability appeared in the activities of all start-up projects (e.g. through the deliberate creation of local jobs, as in the cases of Alphawood and DigniSens). In addition to the creation of local jobs, the start-up projects also indicated their intentions to keep employee fluctuation rates low (Voinea et al., 2019). The ways in which the start-up projects selected partners provided evidence for ecological sustainability in value creation (as in the cases of DigniSens, Mady Pure and FreyZein), as did their use of more sustainable resources (e.g. Alphawood, Mady Pure).

Third, aspects of sustainability in capturing value were least pronounced in the investigated start-up projects (compare with Table 2). However, aspects of sustainability were used to justify the higher sales prices established by Whoopedu and FreyZein, while reduced revenues as a trade-off for a more sustainable value proposition were acknowledged by Alphawood. Furthermore, Whoopedu contributed towards social sustainability by donating a share of their revenues.

Fourth, like the results presented by Govindaraj (2003), our results show that several BM elements were interlinked and oriented towards delivering value to customers in the investigated start-up projects. Nevertheless, the type and degree of sustainability differed in each project; this meant that not every BM managed to present a balance of all three values (economic, environmental and social) (Stubbs and Cocklin, 2008; DiVito and Bohnsack, 2017; Fischer et al., 2020). Fragmented aspects of sustainability in the BMs were observed, especially regarding the dimensions of value delivery as well as the activities and partners for value creation (compare with Table 2, Appendix 1 and Appendix 2). However, aspects of ecological sustainability seemed more pronounced in the start-up projects that offered physical products, while social sustainability seemed more pronounced in start-up projects that offered non-physical products.

Drivers for Imprinting Sustainability-Aspects in BMs of Early-Phase Start-up Projects

Our findings reveal that the drivers for imprinting of sustainability aspects in the BMs are heterogeneous, even in our limited sample of six start-up projects. Based on our data, we matched the drivers according to identified aspects of sustainability as well as respective concepts of imprinting (*imprinter* or *imprinting process* – compare with Simsek et al. (2015)).

As indicated in Table 3 and 4, entrepreneurial motivation, which corresponds to the *imprinting process*, was identified as the most prominent driver for imprinting aspects of sustainability and, in particular, social sustainability. This finding supports the insights provided by Rauter et al. (2017) and Voinea et al. (2019), who also noted that the personal beliefs and factors motivating entrepreneurs drove them to include sustainability aspects in their BMs (Rauter et al., 2017; Voinea et al., 2019).

Interestingly, while entrepreneurial motivation as a driver was mentioned by every one of the six start-up project teams, the specific form of imprinted social value largely differed. While some start-up projects like Whoopedu took a multi-faceted approach to generate

social value, Alphawood or DigniSens contributed to social value more as an ancillary benefit.

We identified various forms of drivers in our data that resulted in ecological sustainability being imprinted in the investigated BMs. Again, entrepreneurial motivation was identified as the main respective driver. It was interesting to note that, in addition to purely altruistic drivers, rather strategic drivers were also identified. This refers to the *imprinting process*, in which the inclusion of sustainability is seen as a strategy selection. The entrepreneurs' specific reasons ranged from an interest in increasing revenues to distinguishing themselves from competitors. Thereby, sustainability value was used as an add-on to the general product features and sometimes even as a unique selling proposition for a specific customer segment. Thus, sustainability value was directly connected to the commercial orientation in the BMs of the respective start-up projects in our study; this finding is also reflected in the findings of Hahn et al. (2019). Financial advantages serve as continuously motivating factors for imprinting sustainability in the BMs from the earliest stage in the BM development, as a need exists to achieve competitive strength and reputation. This result is similar to one presented by Voinea et al. (2019).

Furthermore, the data revealed that most of the nascent entrepreneurs favoured imprinting of ecological sustainability aspects, although the literature to date has placed a strong emphasis on balancing all three dimensions of sustainability (economic, environmental and social) rather than treating them as self-contained components (DiVito and Bohnsack, 2017; Fischer et al., 2020). One reason for these findings could be that sustainability-oriented start-up projects can only carry out a finite number of activities due to their distinct scarcity of resources and available capabilities (Austin et al., 2006; Moizer and Tracey, 2010). The nascent entrepreneurs of the investigated start-up projects strove to imprint sustainability and consequentially accepted the lower profits and growth that resulted in greater sustainability (Hahn et al., 2010) or reduced their support of sustainability as they acquired more business knowledge (Kuckertz and Wagner, 2010). Surprisingly, the nascent entrepreneurs of the investigated start-up projects did not consider the start-up accelerator programme *Gruendungsgarage* as an environmental imprinting-source that influenced the inclusion of sustainability in their BMs.

By highlighting the connections between drivers and specific aspects of sustainability in the BMs of these start-up projects, we were able to add to the existing literature on entrepreneurial motivation towards sustainability (Rauter et al., 2017; Voinea et al., 2019). The focus on the early phase of sustainable BM development in start-up projects is of substantial importance, since the *imprinters'* characteristics as well as the *imprinting process* potentially highly influence the BM elements (Simsek et al., 2015). Once imprinted, the characteristics of BMs might become resistant to change (Gilbert, 2005; Tripsas and Gavetti, 2000). Consequently, it is of particular interest to acquire in-depth knowledge regarding sustainability aspects imprinted in BMs. Using the data from an academic start-up accelerator programme, we were able to add to the knowledge collected by Voinea et al. (2019) about how entrepreneurs in early-phase start-up projects imprint aspects of sustainability into their BMs.

Conclusions

Our exploratory study provided valuable insights into the BMs of early-phase start-up projects that took part in the accelerator programme *Gruendungsgarage*. In this context, we shed light on early development phases of BMs by illustrating (1) how sustainability was allocated to individual BM elements and (2) what drives the inclusion of sustainability in the BM. Although all cases of our sample exhibit a sustainable value proposition, the types and degrees of sustainability in their BMs differed, explaining why most of the start-up projects did not holistically integrate the sustainability-related values.

This study, moreover, reveals the drivers that encouraged nascent entrepreneurs within early-phase start-up projects to include sustainability aspects in their BMs from an imprinting theory perspective. The characteristics of initial position holders within the investigated start-up projects strongly affected the inclusion of ecological and social sustainability in their BMs during the imprint genesis. It was interesting to note that, in addition to purely altruistic drivers, rather strategic drivers could also be identified that led to the inclusion

of sustainability aspects in the start-up projects BMs. This suggests that the inclusion of sustainability aspects in the BMs of the investigated start-up projects was influenced by a combination of personal and financial intentions.

Naturally, our study has several limitations which, in turn, offers opportunities for future research:

First, data were included from six cases of start-up projects that were involved in an academic start-up accelerator programme for a limited period of time. Researchers could address these limitations by (1) performing similar research in other academic start-up accelerator programmes as well as (2) conducting a long-term, longitudinal study of sustainable start-ups.

Second, this study did not take into consideration contextualised data that refer to future industries, target markets, regulations, or potential investors, all of which can influence the imprinting of sustainability aspects in the start-ups' longer-term BMs. Another recommendation for further research is to extend the scope of the study by analyzing key stakeholders and customers and to collect secondary data about the market in which the respective start-ups are represented.

Third, the qualitative nature of our research and the limited sample size do not allow us to generalize the results. In subsequent studies, this issue could be addressed by triangulating the qualitative data using questionnaires or secondary company data, if already available.

Fourth, the initial position holder and founder was predominantly identified as a source of imprinting, whereas other imprinters were clearly underrepresented. Further research could address this phenomenon and investigate whether this is a finding that can be confirmed in other studies as well.

In this way, our understanding of the development of sustainable start-ups and the subsequent inclusion of sustainability aspects in their BMs could be improved.

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Appendix

Criteria		Key examples for the allocation of sustainability aspects in BM elements of investigated start-up projects
VP + Value Delivery	**VP**	FreyZein: 'We want to make outdoor sportswear, but also want our clothing to be sustainable. Our jacket can be reintegrated into the biological cycle, i.e. if you lose a piece of our jacket in nature during a tour, it will rot at some point of time. That is what differentiates our product from all others.'
	CS	Mady Pure: 'Our target customers are interested in sustainability and consist of vegans, vegetarians, environmentally conscious people and owners of dogs with allergies who are looking for alternatives on the market.'
	CR	smarterstudieren: 'We want to build a long-term community of smart students who help each other. Students who learn and implement our methods should support classmates who do not have the financial resources to buy our products. It is important to us that students motivate and support each other so they can succeed together. In the end, everyone should benefit from it.'
	CH	Alphawood: 'We don't use print media and don't make personal customer visits, where we have to travel across the whole country, because we also want to conserve resources. I use existing sales channels to attract B2B customers.'
VCr	**KR**	DigniSens: 'Sustainability means that a product is manufactured in a resource-saving manner.'
	KA	FreyZein: 'We decided to do research on the material to stand out from the competitors. The special thing about it is the cradle-to-cradle approach and the biodegradability of the product. At FreyZein, we try to add functionality but still preserve the naturalness of the product.'
	KP	Whoopedu: 'We started our application because of social sustainability and in the end the whole start-up has a social impact. Basically, our whole BM is around partners because without our partners we cannot do anything. Partners are a pillar or the centre of our entire BM.'
VCa	**C$**	No sustainability aspects identified in this BM element of the investigated start-up projects.
	R$	FreyZein: 'A jacket is a durable product, which I do not want to send back after one year and get a new one. In the circular economy, we talk about leasing, second-hand market, etc. Here, the business approach and the revenue mechanism are different.'

Appendix 1: Key examples for the allocation of sustainability aspects in BM elements of investigated start-up projects.

	Value Proposition and Value Delivery	Value Creation	Value Capture
Alphawood	Alphawood uses 'waste materials' as a basic resource but does not explicitly emphasise sustainability aspects in its entire BM (A0). Alphawood includes ecological sustainability in its value proposition by communicating an added value through the use of waste materials (A1).	Alphawood has a strong commitment towards local value creation and local sourcing (A1, A2). In addition, Alphawood contributes to social responsibility by placing a focus on local production to create and secure local jobs (A1). Further, procuring local resources was also identified as an influence on sustainability in the BM.	A precondition for all initiatives towards sustainability is the economic sustainability of the venture (A1, A2). Respondents mentioned the effects of sustainability on Alphawood's pricing (A1, A2). Sustainability led to higher costs for resources and, subsequently, to lower profit margins when initially launching the product on the market (A1, A2).
DigniSens	By using a clothing sensor, the number of nightly routine checks by nursing staff who care for bedridden people can be reduced. This potentially leads to an increase in the labour productivity of the nursing staff, as well as an improvement in life quality of the affected person (B1). DigniSens offers a sustainable product but sees sustainability more as an add-on to its (main) value proposition (B2).	DigniSens refers to social responsibility in terms of human resources in order to offer secure jobs (B1, B2). DigniSens emphasises local production and local sourcing. In that regard, the reasons are the availability of local supply chain partners and the perceived threat of patent theft when outsourcing to manufacturers abroad (B1, B2).	DigniSens expects that their customers (hospitals and nursing homes) will not necessarily pay extra for a sustainable product. Therefore, sustainability is more of an ancillary benefit of the (main) value proposition (B1, B2). DigniSens follows a durable product design using recyclable materials. This decision provides benefits in conjunction with the introduction of a leasing model (B0, B1, B2).
Mady Pure	Mady Pure initially addressed ecologically aware dog owners who were looking for a long-term dietary solution for dogs with allergies (C0). When Mady Pure entered the start-up accelerator programme, they considered the ecological sustainability of the developed product to be an additional value that could be offered to ecologically aware customers (C1). Mady Pure strived for transparency to communicate sustainability as added value to customers. (C1). At a later stage of BM development, the focus on targeting owners of dogs with allergies was emphasised while the main focus on ecologically aware customers was dropped (C2). By the end of the start-up accelerator programme, sustainability aspects were seen as an ancillary benefit of providing dog food for dogs with allergies (C2).	Manufacturing partners enable the creation of a sustainable value proposition mainly by supplying insect protein (C1). The production of insect-protein is generally more efficient than animal-protein and allows for upcycling of organic waste (C1, C2). Although attempts are made to use local suppliers, the main criterion for supplier-selection is economic sustainability. Mady Pure highlighted the need to increase the transparency of the operations along the start-up's supply chain (C1) as well as lean operating principles (C2). The decision to add sustainability aspects, such as sustainable packaging, is heavily influenced by the respective economic feasibility (C2).	Mady Pure mentioned that the communication of sustainability is to justify the higher sale prices of their products (C1, C2). Mady Pure emphasises that its BM needs to be economically sustainable above all (C2).

Appendix 2: Sustainability aspects in BM elements in the investigated start-up projects.

	Value Proposition and Value Delivery	Value Creation	Value Capture
FreyZein	FreyZein produces textile products for the outdoor and sports sector (D0, D1), targeting sustainability aware customers. According to the cradle-to-cradle principle, their textiles can be repeatedly processed into new products and are biodegradable (D0). Furthermore, the textiles produced can be mended using a proprietary repair-concept that increases longevity, addresses individual customer wishes and increases overall customer value (D1). Sustainable product properties are actively communicated to customers (D2).	R&D, contract manufacturing and branding are major parts of FreyZein's value creation (D1). FreyZein emphasises control and transparency (D1) of partners. They seek to work with partners with similar mindsets regarding ecological issues, such as waste water management and the use of renewable energy (D2). FreyZein relies on renewable resources and waste products for their products. In addition, FreyZein works on the development of a biodegradable proprietary material (D2).	In addition to research grants and conventional product sales, FreyZein generates continuous revenue by offering leasing and subscription models. Furthermore, FreyZein offers a repair model and re-sells refurbished products (D1, D2). FreyZein identifies R&D, prototyping and design as the most important cost drivers (D1, D2).
smarter studieren	smarterstudieren aims to help as many students as possible to achieve the best results in their studies. Their approach does not involve expensive tutoring, but instead mediation of the correct mindset and the improvement of the emotional intelligence, time management and approved learning methods (E0, E1). For this purpose, smarterstudieren offers digital information products as well as personal coaching (E0-E2) to provide students with tools and methods that enable them to 'study smarter instead harder'. Due to their pedagogic concept, the level of frustration of students drops and the graduation rate increases (E0-E2).	The development of pedagogic concepts for personality development (E0, E1) and the establishment of a community (E1, E2) are the main activities regarding the value creation. The community contributes to increase the social added value of the coaching and, thus, enables a large number of students to study more successfully (E2).	smarterstudieren generates revenues by selling e-books, video lessons and podcasts via their online platform. Their digital information products are usable for every German-speaking student (E0, E1), which enables the scalability of their product at a reasonable price. Furthermore, they offer paid individual and group coaching, whereby smarterstudieren specifically addresses problems expressed by the respective participants (E1, E2).
Whoopedu	Whoopedu offers a mobile one-stop shop application for gamified education, providing value for children as well as parents. Whoopedu improves its educational value through analytics (F1). Customer groups are people from the Balkan as well as refugees in transit who are not able to access conventional education (F0, F1). The international market is addressed using a premium-version of the application (F0, F1). Customers are reached over Whoopedu's marketing channels (e.g. social media) as well as their sales channels (F1, F2).	Whoopedu emphasises partnerships in value creation to keep costs for creating value at a minimum (F1). The key partners are willing to invest in a company with a social impact and need to be sustainable themselves or at least promote sustainability (F1, F2). Whoopedu's resources are mainly invested in personnel, such as developers, designers, animators and marketers (F1).	Whoopedu uses a freemium subscription model (F0). In addition, revenue streams are generated through advertisements, product placements, merchandise as well as funding from NGOs or companies with a CSR focus. However, premium subscribers account for the main part of their revenues (F1). Whoopedu redirects a percentage of all sales made on the international market into financial aid for education in underdeveloped countries and refugees (F1). Whoopedu's cost structure includes costs for legalisation of business, marketing, app store fees, merchandise, content translation as well as donations (F1).

Appendix 2: Sustainability aspects in BM elements of investigated start-up projects. ***(Continued)***

About the Authors

Martin Glinik is a Research Assistant at the Institute of General Management and Organisation at the Graz University of Technology. He is a Ph.D. candidate with a master's degree in Business Administration. His research interests focus on the fields of Entrepreneurship, Business Models and Sustainability. In his dissertation, he investigates sustainability-oriented business models of start-ups. Martin Glinik works in the Entrepreneurial University project, with the aim of inspiring and embedding the entrepreneurial spirit in the minds and hearts of students and scientific employees of Graz University of Technology. In addition, he is part of the Gruendungsgarage, the Academic Start-up Accelerator in Styria, Austria and has been able to support more than 50 start-ups in the (pre-) seed phase in the course of his consulting activities.

Michael Rachinger is a Ph.D. candidate in Industrial Management. His research interests are business models, business ecosystems, and innovation. Currently, he is a Research and Teaching Assistant at the Institute of General Management and Organization at the University of Technology in Graz. Also, he teaches management classes at the University of Applied Sciences Campus02 in Graz and is a trainer for innovation. Before, he worked in the automotive industry and completed two Master's degrees in engineering.

About the Authors

Christiana Ropposch is Assistant Professor and head of the Business Model Management working group at the Institute of General Management and Organisation at the Graz University of Technology. She is currently working on her habitation with the topic of technology-oriented business model management. Her focus is on business model development and business model innovation, mainly in the context of digitalization. Christiana and her colleagues run a Business Model Lab in which they advise and train companies on business model development and business model innovation.

Florian Ratz is a Research and Teaching Assistant at the Institute of General Management and Organisation at the Graz University of Technology. He graduated from the Master's Degree Programme Mechanical Engineering and Business Economics at the Graz University of Technology and is currently attending the Doctoral School Techno-Economics. In his dissertation, he investigates technology-based business models in the strongly evolving topic of sustainable mobility of persons and goods.

Romana Rauter is Assistant Professor at University of Graz, Austria. Her research and teaching interests include sustainability innovation, new and sustainable business models as well as strategic sustainability management. Romana has (co)-authored numerous scientific publications in these fields, and recently became co-chair of the New Business Models Conferences Board.

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The Role and Value of Data in Realising Circular Business Models – a Systematic Literature Review

Päivi Luoma[1], Anne Toppinen[2], and Esko Penttinen[3]

Abstract

Purpose: A systematic review of the literature on circular business models was performed, for synthesis of what it reveals about the role and value of data in those models. The increasing quantity of supply-chain and life-cycle data available has potential to be a significant driver of circular business models. The paper describes the current state of knowledge and identifies avenues for further research related to use of various forms of data in the models.

Design: A systematic review of literature on the use of data in circular business models was carried out, to inform understanding of the state of knowledge and provide a firm foundation for further research.

Findings: The literature reviewed points to fragmented understanding of the role and value of data in circular business models. Nonetheless, scholars and practitioners commonly see data as a driver and enabler of circular economy. The article identifies two distinct approaches to value for data as presented in the corpus and discusses what types of data seem to be valuable in a circular business-model context. Among the further research opportunities are work on data as a source of business-model innovation and on collaboration in capturing the value of data in circular business models.

Value: The study provides new insight on the nexus of circular business models and data, and it represents one of the first comprehensive reviews addressing data's value in a networked circular-economy context.

Keywords: business models, circular economy, value of data, data-driven, sustainability

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1 Faculty of Agriculture and Forestry, Dept. of Forest Sciences, University of Helsinki, Finland, paivi.luoma@helsinki.fi
2 Faculty of Agriculture and Forestry, Dept. of Forest Sciences, Helsinki Institute of Sustainability Science, University of Helsinki, Finland
3 School of Business, Department of Information and Service Economy, Aalto University, Finland

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Introduction

Scarcity of natural resources is among the most significant factors defining the landscape where today's companies do business and create value. Population growth and climate change create rising pressure related to the use of natural resources (IPCC, 2019) and call for intelligent decisions for efficient allocation, use, and conservation of valuable resources. For companies, resource scarcity is not only a source of risk and concern (e.g., Gaustad *et al.*, 2018) but, through circular business models, also an opportunity to pursue new revenue streams and market segments, along with enhanced customer experience (e.g., Lüdeke-Freund *et al.*, 2019; Stahel, 2016; Tukker, 2015).

In the context of circular economy, new innovative business models are needed for closing resource loops, slowing the cycle, and narrowing the loops, by such means as extended customer experience, long-life goods, product-life extension, recycling, reuse of materials, and resource-efficiency (e.g., Bocken *et al.*, 2016). Circular business models are aimed at resolving environmental sustainability challenges by turning linear resource flows into loops (Stahel, 1997). The goal is to get more value from the resources and simultaneously improve the sustainability of production and consumption.

At the same time, the burgeoning availability of data is transforming how businesses operate, and data's utility in generating knowledge and insight to improve decision-making is seen as a potentially powerful source of creation of both economic and social value (Grover *et al.*, 2018). More efficient use of data can serve as a significant driver and enabler of circular economy (Frishammar and Parida, 2019; Gupta *et al.*, 2018; Stahel, 2016), and interesting examples of data-driven circular business models, such as performance contracts, sharing models, and digital marketplaces for resources and waste streams, are already emerging (Ellen MacArthur Foundation, 2019; World Economic Forum, 2016). Circular economy requires better understanding of (often complex) flows and loops of resources, their value, and environmental impacts in contexts of complex value chains and networks. At the same time, these phenomena extend across borders between technologies, actors, and industries and over the full lifetime of products and services. Particularly in light of this complexity, data might be of help in considering how to realise circular economy.

Recent years have witnessed growing interest in sustainable business models and related innovations (e.g., Dentchev *et al.*, 2018; Wirtz *et al.*, 2016), with circular business models being no exception (e.g., Brown, 2019; Lüdeke-Freund *et al.*, 2019; Manninen *et al.*, 2018; Pieroni *et al.*, 2019). However, previous studies have not specifically considered the role and value that the wealth of data can have at the core of circular business models and related decision-making. Research on the intersection of data and circular business models has remained scarce (for exceptions, see Bressanelli *et al.*, 2018; Tseng *et al.*, 2018), and more insight into this nexus is needed, for understanding of how data can support creation of sustainable business.

Accordingly, we identified two research questions, formulated thus: 1) In what ways does literature on circular business models inform about the role and value of data in this set of models? 2) Through a review, can one identify possible paths for further research related to the use of various forms of data in circular business models?

The presentation of the systematic review begins in Section 2, laying out the conceptual background with regard to circular business models and the value of data therein. Then, Section 3 describes the research design and Section 4 presents the findings from the literature review. We conclude the paper by offering final thoughts and identifying further research opportunities.

Conceptual Background

Circular Business Models

The aim in employing circular business models is to address environmental sustainability challenges by transforming linear resource flows into loops, giving them circular form (Bocken *et al.*, 2016; Stahel, 2016; Tukker, 2015). The goal is to obtain greater value from the resource use and increase the sustainability of production and consumption. In circular business models, value is created in three ways: closing resource loops through reuse and recycling of materials, slowing the

loops by designing long-life goods and extending products' service life, and narrowing the resource flows via resource-efficiency (Bocken *et al.*, 2016). To move from linear business models to circular ones, companies must redesign their value-creation logic, covering value propositions, the value-creation infrastructure, and the value-capture models (Hofmann, 2019).

For this paper, a business model is defined as describing the logic or design of how a business creates value and delivers it to the customers while also outlining the architecture of the revenues, costs, and profits associated with the company delivering that value (Teece, 2010). It is seen to include the following components: the value offered to customers (the value proposition), how the value is created and delivered to customers (value's creation and delivery), and how profit is generated (value capture) (Bocken *et al.*, 2014; Richardson, 2008; Teece, 2010). However, the concept of the business model is versatile, and it is defined and conceptualised in numerous ways (e.g., Al-Debei and Avison, 2010; Lüdeke-Freund *et al.,* 2019; Zott *et al.,* 2011). At base, such a model provides an abstract understanding of the relevant organisation's business logic in a somewhat descriptive manner (Al-Debei and Avison, 2010). In practice, business models are systems that exhibit complex interdependencies among these elements (Massa *et al.*, 2018). They are often industry-specific and depend also on the company context and business maturity in how they are designed to yield competitive advantage for the organisation in question.

In this paper, a circular business model is defined as a business model that helps companies to create value by means of using resources in multiple cycles, thus reducing both waste and consumption (Lüdeke-Freund *et al.*, 2019). In the context of circular business models, several approaches have been taken to apprehend the core of the model, with reasoning based on various taxonomies of the value-creation rationale (Ellen MacArthur Foundation, 2015), strategies (Bocken *et al.*, 2016), and patterns (Lüdeke-Freund *et al.*, 2019) represented by the business models. For this paper, the classification of circular business patterns developed by Lüdeke-Freund *et al.* (2019) was used for categorisation of the literature in the circular business model context. In this classification, the following six patterns are considered: repair and maintenance, reuse and redistribution, refurbishment and remanufacturing, recycling, cascading and repurposing, and organic feedstock.

The value expected to arise via circular business models encompasses not just economic value and direct value created for the customer (through means such as savings on production costs and materials and greater 'value-in-use') but also societal value (Lüdeke-Freund *et al.*, 2019; Stahel, 2016). As a concept, circular economy has strong connections with sustainability, and this concept is evolving, manifesting various definitions, boundaries, principles, and associated practices as it does so (Merli *et al.*, 2018). That said, from a sustainability point of view, the concept has, in general, been claimed to be more environmentally driven, with only a tenuous link to social sustainability (e.g., D'Amato *et al.*, 2017). Likewise, the value is characterised as created primarily on foundations of an environmental value proposition (Manninen *et al.*, 2018), and some have argued that circular business models might not always be able to capture the full scale of sustainability (Geissdoerfer *et al.*, 2018). In these models, the value is often co-created over the entire supply chain: customers, suppliers, manufacturers, retailers, etc. (Manninen *et al.*, 2018; Urbinati *et al.*, 2017).

Although not unambiguously defined or conceptualised, circular business models facilitate reflection on how companies can reach sustainability objectives in a way that makes good business sense. Hence, the insights from the review presented here are clearly relevant not only for academia but also for companies striving for circular-economy objectives.

Business models and innovation in them have been subject to increasing research efforts in recent years (e.g., Foss and Saebi, 2017; Massa *et al.*, 2018; Nielsen *et al.*, 2018), and, their conceptual fuzziness notwithstanding, they have turned out to be a helpful tool for understanding how companies do business and create value. Paying attention to business models can aid in rethinking and redesigning how companies reach their goals, understanding new types of innovation, and drawing attention to creation of social and environmental value alongside the economic (Massa *et al.*, 2018). There is a growing body of research on sustainable business models and related innovations (e.g., Dentchev *et al.*, 2018; Wirtz *et al.*, 2016) – of which examination of

circular business models forms a key part (e.g., Brown, 2019; Lüdeke-Freund *et al.*, 2019; Manninen *et al.*, 2018; Pieroni *et al.*, 2019) – and on what kinds of inherent uncertainties these entail (Linder and Williander, 2017). While a few authors have cited data as a potential driver and enabler of circular economy and related business models (e.g., Frishammar and Parida, 2019; Gupta *et al.*, 2018), the role and value of data in circular business models remains largely uncharted territory.

Understanding the Value of Data

Growth in the volume of data is changing how businesses operate, and the power of data in generating insight to support better decision-making is seen as a potentially vast source of customer, economic, and social value (Grover *et al.*, 2018), where one can define data as objective facts about events and observations about the state of the world (Davenport and Prusak, 1998) or as symbols that represent properties of objects, events, and their environments (Ackoff, 1989). Said data may be either structured or unstructured, although the application of analytics to extract value from data usually assumes availability of sufficiently structured data – normalised records in a database with a rigid and regular structure (Abiteboul, 1997; McCallum, 2005). However, vast volumes of data are being generated in unstructured form, such as human-generated e-mail messages and their attachment files, photos, videos, voice recordings, and social-media content. This limits the direct applicability of traditional analytics.

Through data's integration, discovery, and exploitation (e.g., Miller and Mork, 2013), one can turn data into valuable information and knowledge. That insight holds promise for improving decisions and yielding such results as better utilisation of assets, greater operation efficiency, cost savings, and extended customer experience (e.g., Chen *et al.*, 2015; Günther *et al.*, 2017). Through data's potential contribution to uncovering hidden patterns and heretofore unknown correlations (Chen *et al.*, 2015), this resource could aid in increasing understanding of circular phenomena and in realising circular economy.

In this paper, we focus on which circular business models and strategies are seen as specifically benefiting from data and how the data may be conceptualised as a source of value under circular business models. More efficient use of data may help to turn the visions behind these models into reality by refining the value-creation logic, including decisions on how value is created, offered, and delivered to customers and how profit is generated. Those classes of business models that rely on data may be termed data-driven business models (Hartmann, 2016).

However, data might not always represent the world accurately, as it is easier to capture data from readily quantifiable phenomena (Jones, 2018). Structured and quantifiable data might be more readily available, as well as more attractive to use, than unstructured and non-quantifiable data. Data that could yield understanding of often complex circular phenomena might not be available, at least in relevant form, and a less accurate view of the phenomena might be produced. Such a picture may have much less value in decision-making. In addition, value may be lost through delays in extracting data, transforming the data into usable information, and deciding how to act on the information (Pigni, 2016). For example, either the absence of data indicating a need for maintenance or non-response to such data can lead to equipment breakdowns, production downtime, and other waste. Also, some use of data can have adverse impacts, which may run counter to circular-economy objectives. Even if handled responsibly and well, exploitation of data often requires extensive investments in management, technology, and other capabilities (Akter *et al.*, 2016).

General rationales related to data-driven value creation may be applicable in circular business models. More efficient use of data can add value by affording transparency of information and greater access to it, discovery and experimentation, prediction and optimisation, rapid adaptation and learning, customisation of products and services, and deeper understanding of customers (Chen *et al.*, 2015). Value can be extracted from data streams through initiation of action on the basis of real-time data or via merging of multiple data streams (Pigni, 2016). For example, real-time data on products' use and performance can prompt initiation of predictive maintenance measures, and demand for

ride-sharing services can be forecast from considering weather data in combination with details of mobility demands. Data can be accumulated for information services, refined into insights and decision support, aggregated to inform existing services and enable new ones, and utilised for tracking and optimising operations and performance (Pigni, 2016). Better use of data can lead to innovation in product, service, and business models and thereby transform businesses' operations (Grover *et al.*, 2018; Hartmann, 2016). Reaping the full benefits of data often demands a change in business model, however (Buhl *et al.*, 2013).

Prior research offers insight pertaining to data-driven business models and the benefits and value of data in general (e.g., Chen *et al.*, 2015; Grover *et al.*, 2018; Hartmann, 2016). Yet, while some authors have identified data as a potential driver and enabler of circular economy (de Mattos and de Albuquerque, 2018; Frishammar and Parida, 2019; Gupta *et al.*, 2018; Tura *et al.*, 2019), little work has addressed the role and value of data specifically in relation to circular business models (for exceptions, see Bressanelli *et al.*, 2018; Tseng *et al.*, 2018). Nonetheless, further research addressing it is seen as important (Alcayaga *et al.*, 2019; Rajala *et al.*, 2018). This area represents a significant gap in scholarly understanding of data's potential to support development of circular economy.

The Research Design

To understand what the existing body of research indicates about the role and value of data in realisation of circular business models, we identified, reviewed, and formed a synthesis of the relevant literature. The literature review represents a method suited to systematic understanding of an existing body of knowledge and to providing a firm foundation for further research (Levy and Ellis, 2006). The search was limited to peer-reviewed scholarly articles found in academic databases (Scopus and EBSCO Business Source Complete) and published in this millennium.

For emphasis on the business context, the search used the term 'circular' in combination with either 'business model' or 'value creation', in the title, abstract, key words, or subject (stemming and Boolean operators were used thus: 'circular' AND 'business model*' OR 'value creat*'), where 'data' was used in any of the text. These search terms had been identified as having appropriate breadth and depth for answering our first research question (Levy and Ellis, 2006; Okoli, 2015). Additional criteria were used to screen the literature: publication language (English) and publication date (1.1.2000–30.8.2019).

After removal of duplicates, the total number of articles was 147, and 39 papers from this set were identified as relevant for understanding the role and value of data in circular business models. To be deemed relevant, the content had to speak to the research questions. There were no criteria related to research design or the context of the research. This search was complemented with forward and backward searches because the key words taken as search terms might have a limited 'lifetime' and alternative terms may have been used (Levy and Ellis, 2006). The forward and backward search yielded five further articles. Therefore, the final sample consisted of 44 articles.

The full text of each article selected was systematically reviewed with regard to the theoretical, conceptual, and empirical contribution to answering research question 1. Relevant material was collected manually and documented systematically in Excel sheets. The perspective of the articles on data and data's value was assessed and the link to circular business models identified. The type and sources of data dealt with, the nature of the data-driven activities considered, and the benefits and impacts of data identified as expected and/or realised were identified as the main themes in the course of the analysis. This enabled classifying and comparing the content of the articles and systematically synthesising the findings within a conceptual framework.

The development of our conceptual framework was based on the results of the literature review and reflects the conceptual background for our work also. Finally, further research opportunities were identified on the basis of the outcomes from the literature review. Figure 1 summarises the research design.

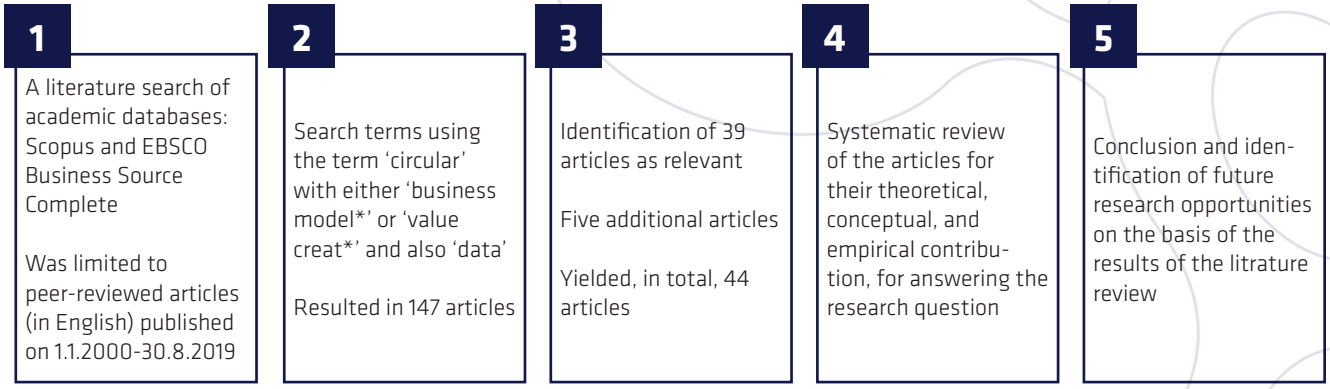

Figure 1: The research design for the literature review

Results of the Literature Review

In the corpus, data and related information technologies, services, and platforms are commonly presented as drivers and enablers of circular economy (e.g., de Mattos and de Albuquerque, 2018; Tura *et al.*, 2019), and lack of data is often cited as a barrier to circular business models (e.g., Saidani *et al.*, 2018; Vermunt *et al.*, 2019). A summary table covering all 44 articles is presented in Annex 1, and Annex 2 lists the context of each piece, its perspective on the relevant data, and the business models and strategies discussed.

All the articles matching the criteria used for our review are quite recent, published between 2016 and 2019. This attests to a strong upswing of attention to the subject, with growing interest in understanding the nexus of circular business models and digital technologies. In total, the sources feature 340 articles published on circular business models and value creation during the time span considered, so about 10% of the model-related papers deal with the role of data in one way or another.

As a whole, the body of literature reviewed indicates that the state of understanding of the intersection of circular business models and data is highly fragmented. The articles show wide variety in the circular business models addressed. In addition, diverse contexts and industries, among them manufacturing, waste management, and digitalisation, are covered. In some articles, the data or related factors are at the core of the discussion, while they are presented as a minor issue in others. Perspectives on the data were found to vary too, from perceiving the data as input to modelling, through applying life-cycle assessment of information flows in the supply chain, to expressing more general views on unlocking the potential of circular economy.

Below, we discuss the ways in which the literature on circular business models informs us about circular business models' relationship with data (including the associated strategies for exploitation of data) and what specific use data may have in circular business models. In addition, we identify two approaches to value of data that were articulated in the corpus and discuss which sorts of data seem the most valuable in this context.

Connecting circular business models to the role and value of data

The articles reviewed cover a broad spectrum of circular business models. Table 1 presents examples of this breadth with regard to the potential role and value of data, reflecting the various circular business model patterns introduced by Lüdeke-Freund *et al.* (2019). Many of the articles show connections with several business-model patterns, not least because roughly half of the papers express a general perspective on circular business models, without considering any specific ones. Many of the models discussed in the literature represent a high-level strategy or approach rather than a ready-to-apply model that could easily be classified as a specific business-model pattern.

Several articles cite opportunities in servitization and product–service systems, providing customers with service and performance rather than products (Alcayaga *et al.*, 2019; Bressanelli *et al.*, 2018; Frishammar and Parida, 2019; Khan *et al.*, 2018; Pialot *et al.*, 2017; Spring and Araujo, 2017). While this prominence might

Circular business model pattern (Lüdeke-Freund *et al.*, 2019)	Potential role and value of data	Examples from the literature
Repair and maintenance Through repair and maintenance services, companies can extend product life. This necessitates customer-centred services, expertise in the products, ability to solve problems 'on the fly', and corresponding forward and reverse logistics.	• End-to-end product and service data, real-time and historical, are needed for design support and for provision of long-life products and their repair and maintenance. Both understanding of customers' behaviour and preferences and the real-time visibility of the usage of a product seem crucial for increasing value for the customer. • There is potential value in data on the use, status, condition, location, and operation of products and services. Both real-time and historical data for the products or services' full service life and on customers' behaviour and preferences could be relevant. The data may be either user- or product-generated. • Several articles point to opportunities for product–service systems to provide customers with service and performance instead of products. These can extend companies' ownership of products over the full service life. This potential encourages companies to optimise the design, maintenance, and service-life management. Product–service systems' creation requires good understanding and evidence of customer behaviour and preferences.	Alcayaga *et al.* (2019) Bressanelli *et al.* (2018) Pialot *et al.* (2017) Spring and Araujo (2017) Zhang *et al.* (2017)
Reuse and redistribution Through reuse and redistribution, customers can be given access to used products, possibly with minor enhancement or modifications. This might require evaluating the products' market value and creating suitable marketplaces.	• Product lifetime data is a prerequisite for supporting the design and provision of long-life products that can be reused and redistributed. Digital platforms could serve as marketplaces. Both understanding of customers' behaviour and preferences and clarity as to the usage of a product seem crucial. • Data on the use, status, condition, location, and operation of products and services may be of value. Both real-time and historical data for their full lifetime and details on customers' behaviour and preferences may be relevant. The data may be either user- or product-generated.	Alcayaga *et al.* (2019) Nascimento *et al.* (2019) Saidani *et al.* (2018)
Refurbishment and remanufacturing Refurbishing and remanufacturing products – e.g., repairing or replacing components – can extend product life. This requires combining repair and maintenance capacity with reuse and redistribution capabilities in various ways, including reverse and forward logistics and applying technical expertise about products and their refurbishment and remanufacturing.	• Data for the products' full lifetime performance can be used to adjust design, operation, and disposal strategies for refurbishment and remanufacturing. Tools for product design can assist with assessing refurbishment and remanufacturing potential but might demand prohibitive quantities of product data. For a summary of potentially valuable data, see 'Repair and maintenance' and 'Reuse and redistribution', above.	Favi *et al.* (2019) Jensen *et al.* (2019) Khan *et al.* (2018) Matsumoto *et al.* (2016)

Table1: The potential role and value of data in circular business models

Circular business model pattern (Lüdeke-Freund *et al.*, 2019)	Potential role and value of data	Examples from the literature
Recycling Used materials can be converted into materials of lower value or into higher-quality materials for improved functionality. This requires knowledge of product design, material sciences, and the materials' physical and chemical properties, along with solid ability to arrange reverse logistics.	• Data on material flows and on waste streams are of potential value. In addition, product-design data and data covering the entire service life (from the materials used to end-of-life contamination) are of importance for understanding recyclability and the recovery options.	Alcayaga *et al.* (2019) de Mattos and de Albuquerque (2018) Favi *et al.* (2019) Mishra *et al.* (2018) Niero and Olsen (2016)
Cascading and repurposing Organisations can apply iterative use of the energy and materials within physical objects, including biological nutrients. Exploiting this pattern demands facilitating material flows and supporting industrial symbiosis networks.	• Real-time and historical data on the whole life cycle and details of material flows, environmental impact, performance, etc. are seen as relevant. Valuable data may pertain to condition, operation, status, location, use, and the surrounding system. Information flows in the supply chain appear crucial. • Articles referring to closed-loop systems and industrial symbiosis are classified as articulating a cascading and repurposing business model, as they often focus on facilitating material flows and supporting industrial symbiosis networks. However, they may be crucial for any of the models in enabling forward and reverse logistics.	Aid *et al.* (2017) Fisher *et al.* (2018) Rajala *et al.* (2018) Tseng *et al.* (2018)
Organic feedstock This pattern involves processing organic residuals, via biomass conversion or anaerobic digestion, for use as production inputs or safe disposal in the biosphere. Corresponding reverse flows, alongside conversion, must be arranged and managed. Material compositions might be complex and the residues contaminated.	• The articles reviewed do not specifically address a business model based on organic feedstock. However, some do focus on cloud manufacturing, the sharing of manufacturing capabilities and resources on a cloud platform, which might be valuable in this context. Among the potential benefits are greater process resilience and improved waste reduction, reuse, and recovery.	Fisher *et al.* (2018) Lindström *et al.* (2018)

Table1: The potential role and value of data in circular business models *(Continued)*

be connected with the popularity of these models in writings on circular business models, it also ties in with the role that data could take specifically in such systems. Product–service systems of this nature show links to several business models (repair and maintenance, reuse and redistribution, refurbishment and remanufacturing, and recycling). Exploiting data for product–service systems should encourage companies to optimise their products' design, maintenance, and lifetime management to support a long service life, easy reuse, and recyclability, alongside other circular-economy-related objectives.

Several articles refer to closed-loop supply chains and product systems (Aid *et al.*, 2017; de Mattos and de Albuquerque, 2018; Mishra *et al.*, 2018; Niero and Olsen, 2016; Rajala *et al.*, 2018; Tseng *et al.*, 2018), bringing in discussion of cross-industry networks needed for reverse logistics, with links to many of the business models. Said articles are classified as representing a cascading and repurposing business model (just as the articles dealing with industrial symbiosis are), although networks of this sort may offer value under any of the models presented. These papers indicate that data could be of particular value with regard to orchestrating

resources and activities in circular business ecosystems. Since flows and loops of resources often cross boundaries among a host of actors in complex value chains, there is good reason to deem associated data valuable for this component of circular business models.

Most of the papers reviewed place emphasis on manufacturing, the goods domain, and related issues such as product design and managing the supply chain or waste, while the corpus concentrates less on some other sets of businesses (such as companies in the service industry). The material points also to an uneven spread of attention across the various families of circular business models and strategies. For instance, there is relatively little focus on extending product value via such mechanisms as sharing-oriented platforms and collaborative consumption (for further details, see, for instance, Moreno *et al.*, 2016), even though use of data holds potential for significant contributions in these contexts too.

It appears that the role/value of data varies less from one business-model pattern to another than it does with the activity those data can support. This makes sense in that several models may incorporate a given general activity, whether that is orchestrating the necessary resources and activities, extending product lifetime through the product design, enabling effective forward and reverse logistics, or providing a service instead of products.

Collaboration in collecting and sharing data is portrayed as crucial for capturing the value of data in a networked circular-economy context, as is efficient flow of information along the supply chain (e.g., Brown, 2019; Gupta *et al.*, 2018; Rajala *et al.*, 2018). While existing circular business models vary in their degree of openness (Frishammar and Parida, 2019), a shift over time seems evident: toward a more collaborative approach to data-sharing (Rajala *et al.*, 2018). Nonetheless, data discrepancies, gaps, and confidentiality issues still hamper collaboration somewhat (Tseng *et al.*, 2018), and sharing of data requires ample trust (Gupta *et al.*, 2018; Rajala *et al.*, 2018). The possibility of lock-in to unproductive partnership relationships is to be considered also, since it may be difficult for a company to shift to employing circular business models if its partners are 'unwilling to make the required investments and adjustments' (Lahti *et al.*, 2018). In circular-economy-driven collaboration, collection and sharing of data could be the first joint step (Brown *et al.*, 2019) and a way to align the value chains' actors at the outset (Lopes de Sousa Jabbour *et al.*, 2018). Also highlighted in the corpus is that service providers specialising in software or data analytics might be needed, to boost the total value of the offer, provide access to knowledge resources, and render the solutions more innovative (Frishammar and Parida, 2019). At the same time, companies may find their data to exceed their own needs and be more valuable to others (Spring and Araujo, 2017), thereby opening collaboration opportunities and possibly representing sources of additional revenue.

The specific use of data in circular business models

Numerous types of data, such as product, service, and system data of various sorts (from design to disposal), can be valuable in the context of circular business models. More precisely, the data may represent the volume, characteristics, use, transactions, location, state and operation, condition, history, and surroundings related to products, services, systems, and associated material flows (Lopes de Sousa Jabbour *et al.*, 2018; Rajala *et al.*, 2018). Whether real-time or historical, user-generated or product-generated, structured or unstructured in form, said data holds potential to offer insight into, for example, how customers are actually using the products (Bressanelli *et al.*, 2018) or how supply-chain logistics could be optimised (Hopkinson *et al.*, 2018). There are limitations, though. Details for the entire service life are not always accessible (Alcayaga *et al.*, 2019), so more general material-flow data (e.g., on waste streams) may be used in their stead for mapping the current state and baseline (Gupta *et al.*, 2018) or identifying circular-economy opportunities (Aid *et al.*, 2017). Also, the data type and collection frequency demanded by any given use vary; for example, continuous flow of data may be needed for maintenance purposes while irregular input might suffice for other purposes (Alcayaga *et al.*, 2019).

In circular business models, as characterised by the literature reviewed, data can be used for product design, extension of products' life span, product and service innovation, and enhancement of customer experience. In product design, both user- and product-generated

data may hold value (Zheng *et al.*, 2018) in affording insights into customers' usage patterns (Spring and Araujo, 2017). One can use data to extend product life (Bressanelli *et al.*, 2018); evaluate the life-cycle performance of products (Matsumoto *et al.*, 2016); improve recyclability (Favi *et al.*, 2019); and adjust the design, operation, and disposal strategies over the life cycle in line with said data (Khan *et al.*, 2018). The importance of data for better product design is emphasised by several articles specifically in the case of product–service systems and long-life products. Product-design tools can be used to assess product-specific disassembly and recycling potential and to provide redesign suggestions (Favi *et al.*, 2019). Data-mining tools can be employed to uncover hidden patterns and knowledge via real-time and historical life-cycle data for improving the product design, optimising the production process, and honing the recovery strategy (Zhang *et al.*, 2017). However, many design tools require significant quantities of technical data on the products (Matsumoto *et al.*, 2016) such as material and mass for each component and the contamination potential of all the materials, down to the coatings and adhesives (Favi *et al.*, 2019). Through the notion of digital identity introduced by Rajala *et al.* (2018), information could be made available on each product's composition, the process parameters used by all actors involved, and the instructions for processing and sorting – preferably without a need for add-on sensors or monitoring devices. In any case, this could lead to product and service innovation, in such forms as product–service systems and performance services wherein companies retain ownership of the products while the relevant data are used to optimise performance and expand service offerings (e.g., Alcayaga *et al.*, 2019; Frishammar and Parida, 2019). Integration of data into the systems and implementation of data-driven services might enable richer and longer customer relationships (Spring and Araujo, 2017), personalisation of the customer experience, and greater user involvement (e.g., Bressanelli *et al.*, 2018; Khan *et al.*, 2018).

In addition, data can be used for improving operational performance and optimising assets' utilisation, maintenance, and the end-of-life activities. Smart systems and embedded intelligence produce data on condition, operation, status, location, use, history, and surrounding systems, which enable any necessary real-time monitoring and control of systems and material flows (Lopes de Sousa Jabbour *et al.*, 2018; Rajala *et al.*, 2018). These data can be used for optimising processes and supply chains (Zhang *et al.*, 2017), reducing waste in production systems between supply chains (Lopes de Sousa Jabbour *et al.*, 2018), finding hidden patterns and correlations that could inform systems' optimisation (Gupta *et al.*, 2018), and conducting fault diagnostics (Zhang *et al.*, 2017). Data use can assist in identifying failures; monitoring, controlling, and intervening in the operations; planning the maintenance; and optimising delivery routes (Jabbour *et al.*, 2019). It can also enable sophisticated maintenance activities, including preventive, predictive, and prescriptive maintenance and the automation of these activities (Alcayaga *et al.*, 2019; Bressanelli *et al.*, 2018), alongside optimisation of end-of-life activities – reuse, remanufacturing, recycling, etc. (Bressanelli *et al.*, 2018). Data can be of use in judging the environment-related performance of circular business models too (e.g., Jensen *et al.*, 2019; Manninen *et al.*, 2018), though assessing the impact of large integrated systems may be difficult (Aid *et al.*, 2017). In addition, some significant differences exist between branches of industry in data's use and interpretation (Tseng *et al.*, 2018).

Approaches to Obtaining Value from Data in Circular Business Models

Proceeding from the literature review, we identified two approaches to gaining value from data under circular business models: an outward-oriented one and an inwardly focused one. Examining the outward-focused approach, we found reference to utilisation of data as enhancing the customer experience in respect of circular-economy objectives through good product and service design, extension of product life, stronger user involvement, and building of product–service systems. Taking this approach necessitates possessing data-based information and knowledge pertaining to not only products' and services' performance over their entire life cycle but also customers' behaviour and preferences. When used in support of circular design principles such as reliability and durability, trust in products and attachment to them, extended product life, and non-material products (these circular design principles are based on the work of Moreno *et al.*, 2016), data can play a significant part in encouraging longer use lives for products and slowering resource flows.

Among the relevant business activities in the context of enhancement to customer experience are improving product and service design, attracting the target customers, monitoring and tracking product-related activity, providing technical support (including preventive and predictive maintenance), optimising use, upgrading the products, and enhancing renovation and end-of-service-life activities (e.g., Bressanelli *et al.*, 2018; Rajala *et al.*, 2018; Zheng *et al.*, 2018). For example, giving customers access to data from products' real-world use can enable them to tune their usage patterns better, dissuade from careless use behaviour, and guide them toward suitable preventive and predictive maintenance; such data also can be utilised for provision of personalised advice and of mutually beneficial sharing-based business models (Bressanelli *et al.*, 2018).

In work representing the second approach, the inward-focused approach, one finds data serving as input to optimising the economic and environmental performance of circular systems and supply chains at a more technical and operations-oriented level. In this approach, the value is seen as lying in real-time and historical data on system or process performance and on related flows (of materials, energy, etc.). For this approach, use of data possesses vast potential to aid in narrowing the streams of resource flows by 'tightening up' various production steps or links in the value chain, 'lightweighting' the products, optimising yield and eliminating losses, and reducing material use (again, principles rooted in work by Moreno *et al.*, 2016).

Relevant business activities in the context of managing circular systems, supply chains, and value networks encompass managing the supply chains, optimising operation performance, improving assets' utilisation, managing waste, monitoring and tracking activity, and gauging environment-related performance (Gupta *et al.*, 2018; Hopkinson *et al.*, 2018; Lopes de Sousa Jabbour *et al.*, 2018; Rajala *et al.*, 2018; Zhang *et al.*, 2017).

These two approaches to value from data are not entirely separate. Rather, they overlap. They can be mutually supportive in slowing cycles, closing loops, and narrowing resource flows. For both approaches, the literature identifies potential for circular business models' application in which significant customer, business, and societal value is created and captured by means of data.

The idea of these two approaches is close to what Urbinati *et al.* (2017) pinpoints as so significant in creating new circular business models: a customer value proposition that involves extensive co-operation with the customers and a value network that encompasses reverse supply-chain activities and collaboration with the supply chain's other actors. This is in line with what Zolnowski *et al.* (2016) describe as the source of data-driven business innovations – customer-centred or co-operative value innovation and company-centred or co-operative productivity improvements.

Types of Data with Specific Value for Circular Business Models

With regard to circular business models, the literature review points to awareness of potential value in the following data categories especially: customer behaviour, use throughout the life cycle, system performance, and material flows. These are detailed in Table 2, below. The first category, consisting of data on the customers' behaviour, habits, and preferences, offers insight into, for example, how customers use products. Secondly, data covering the full life cycle of goods or services help us understand such factors as how usage has affected the reuse value of the materials. The performance category refers to data on the operation of larger technical or organisational systems, and its use can aid in, for example, optimising supply chains. Finally, data on flows of materials through various production, consumption, and end-of-life-management systems can stimulate insight into, for instance, waste streams that could be avoided. These four classes of potentially valuable data are highly interlinked, and these too can support closing the resource loops, slowing their cycle, and narrowing their flows.

To be valuable for circular business models, the above-mentioned data on customer behaviour, products' and services' full life, performance of systems, and material flows must be exploited in efforts to direct customer experience, supply chains, and value networks toward circular economy (e.g., Alcayaga *et al.*, 2019; Khan *et al.*, 2018; Zheng *et al.*, 2018). Thus, data must be transformed into information and knowledge that guides decision-making toward closing resource loops through

Data category	Definition	Description of a specific use of data in circular business models	References
Customer behaviour	Data on the customers' behaviour, habits, and preferences	The data can yield insight into how customers use various products and services and into how their needs can be met resource-efficiently. This insight enables companies to provide a service rather than a mere product and may help them extend their ownership of the products to the full service life. That, in turn, can encourage optimisation of products' design, maintenance, and lifetime management to support a long service life, ease of reuse, recyclability, and meeting of other circular-economy objectives.	Bressanelli *et al.*, (2018); Khan *et al.*, (2018)
Product and service lifetime	Data on the full service life of a product – raw materials to post-use life	This data type can inform insight into how product life could be extended or how use has affected the reuse value of the component materials. With such insight, companies can extend their products' service life through such means as long-life products, maintenance, and product upgrades. In addition, the most suitable design, operation, and disposal strategies can be chosen in light of the full life cycle, and these choices contribute to reducing consumption of resources.	Khan *et al.*, (2018); Spring and Araujo, (2017); Zheng *et al.*, (2018)
System performance	Data on the operation and performance of systems and value networks – devices, processes, activities, and value chains	This type of data can afford insight into how to improve operations' performance and optimise asset-utilisation, maintenance, and end-of-life activities throughout the systems and the supply chains. Such insight enables optimising systems' resource use by such means as finding and exploiting hidden patterns and correlations or applying data-driven initiation of predictive maintenance actions, thereby averting the risk of subsequent failure and large waste volumes.	Gupta *et al.*, (2018); Lopes de Sousa Jabbour *et al.*, (2018); Tseng *et al.*, (2018); Zhang *et al.*, (2017)
Material flows	Data on flows of materials through various production, consumption, and end-of-life systems	The data can yield insight into the volume, characteristics, and geographical location of various material flows, waste streams among them. This insight can inform efforts to reduce the use of resources and to avoid unnecessary waste streams or build business activities that exploit the relevant streams.	Aid *et al.*, (2017); Mishra *et al.*, (2018); Nascimento *et al.*, (2019); Rajput and Singh, (2019)

Table 2: Examples of the specific use of particular data types in circular business models

reuse and recycling of materials, slowing the looping by such means as designing long-life goods and extending the service life, and narrowing resource streams via resource-efficiency. Circular-economy objectives might be well in line with the general potential identified in data – for better utilisation of assets, higher-efficiency operations, a fuller and longer customer experience, and transparency of information (Chen *et al.*, 2015; Günther *et al.*, 2017).

However, data might not always reveal an accurate picture of circular phenomena, irrespective of the potential for novel data-analysis tools and models (artificial-intelligence applications among them) to unveil patterns and correlations that may advance understanding of circular phenomena further (e.g., Jabbour *et al.*, 2019). The detectability, measurability, and interpretability of the event determine whether the associated data supplied can be of value for decision-making (Pigni, 2016). Lack of access to relevant data that could inform understanding of often complex circular phenomena could lead to underutilised value for decision-making. In summary, companies moving from linear business models to circular ones must simultaneously develop their capabilities, processes, and activities throughout the value's creation, delivery, and capture (Frishammar and Parida, 2019). Companies have to possess the ability to identify data streams

that can generate value, the capacity to use appropriate tools and technologies to tap these streams, ability to orchestrate the skills and resources required, and the necessary mindset (Pigni, 2016). For reaping the full sustainability potential of circular strategies, systems thinking is needed (Bocken *et al.*, 2016; Brown, 2019; Lewandowski, 2016). To this end, data could be of great help in solving unstructured, exploratory, and wicked problems (Surbakti *et al.*, 2019) connected with circular economy or with sustainability-related challenges more broadly.

Discussion and Conclusions

Our review, aimed at creating new insight into the nexus of circular business models and data, is one of the first comprehensive surveys addressing the value of data in a networked circular-economy context. We sought greater understanding of the use and perceived utility of data in realisation of circular business models, and we identified which circular business models and strategies typically appear to benefit from data. In addition, the two distinct approaches to value from data were clarified, as were the types of data found to be valuable in the context of circular business models. Awareness of these directions can aid in further improving both practical and scientific expertise in the field. Our primary goal with regard to informing practice was to provide business-relevant decision-supporting insight into how data may be conceptualised as a source of value under circular business models.

The corpus reviewed indicates that current understanding of the role and value of data in circular business models is fragmented but also that improved access to data is commonly seen as a driver and enabler of circular economy. Diverse business models and strategies identified in the literature can take advantage of data at the core of the value creation.

In the outward-focused approach to value from data that we pinpointed, data sources are utilised for directing the customer experience toward circular-economy objectives via more suitable product design, longer service life, greater user involvement, and product–service systems. At the same time, there was attention to an inward-focused approach, wherein real-time and historical performance and material-flow data etc. are used to optimise the economic and environmental performance of circular systems and supply chains. While the literature points to benefits from both approaches, understanding of the route from data to circular business models and onward to circular impacts (or the other way around) remains weak.

Another question considered is whether the role and value of data as conceptualised in relation to circular business models differs from data's role and value under other business models. In general, joint use of circular business models and data gets justified in terms of potential environmental benefits. However, environment-linked benefits may be gained also when, for example, one seeks supply-chain cost savings without having specific circular-economy objectives. While such data-driven optimisation of business activities might dovetail with environmental sustainability objectives, more comprehensive circular-economy value-creation rationales are likely to demand comprehensive understanding of circular-economy phenomena and objectives.

Business models and also data's potential role and value can be highly context-specific and dependent on the business and its ecosystem's conditions for exploiting data in pursuit of circular benefits. The material reviewed discusses neither the possibly quite substantial investments in capabilities and technology that exploiting data may demand nor other obstacles and constraints to realising data-focused circular business models. Also, the vast increase in the volume of potentially valuable but unstructured and non-quantifiable data should be kept in mind, as should the possible non-existence of relevant data. In addition, discussion of whether data-driven circular business models capture the full scale of sustainability was beyond the scope of our study. Nonetheless, it is clear that many of the conceptual mechanisms identified can be expected to display delayed, non-linear, and feedback-related effects, bound up with risks of adverse consequences connected with sustainability.

Our approach has its limitations, most prominently that this stage of evaluation was confined to examining the understanding displayed in the articles reviewed and the research designs reported. Clearly, not all research that could assist in understanding the role and value of data

could be identified through our review method, and the literature examined might be unevenly distributed. Another factor is that both the concept of circular business models and that of data-driven approaches are showing strong development over time. The concepts and definitions are still evolving as studies accumulate from a host of disciplines (e.g., the fields of strategy, business models, management studies, information systems, operations management, engineering, and sustainability research). Hence, this review should be taken in its temporal context and as offering a starting point for scholarship of this nature. It represents a perspective gained via a systematic approach to describing the current state of understanding of data's role and value in circular business models.

Opportunities for Further Research

We will now discuss the key opportunities for further research that were revealed through examination of the literature. These fall into three areas: data as a driver of innovation in development of circular business models, the role of collaboration in capturing value from data, and ways of creating value jointly with customers. As we discuss each of these in turn, we refer to both the state of the art, as evidenced by our review, and the research gaps indicated.

Proposition 1: Data Can Inform Circular Business Models' Development

Our review of the 44 articles showed that data and related information technologies, services, and platforms are commonly seen as drivers and enablers of circular economy and as possessing potential to act as key inputs to a variety of circular business models (the state of the art). While the literature highlights potential opportunities for using data in circular business models, there is less systematic assessment or empirical evidence of data's role and value in these models, showing a gap. Data may clearly exhibit potential to enable and accelerate the development of innovative, even transformative, circular business models, but systemic understanding of circular phenomena and the context in which innovative business models are to be introduced remains necessary (another gap). The path from data to circular business models and, in turn, to circular impacts or, *vice versa*, from circular impacts and business models to valuable data is still little understood (a gap). In a final gap, fuller insight into strategies for designing data-driven circular business-model innovation and how to facilitate the emergence of such business-model innovations in a networked circular-economy context is needed.

Contributions from specialists in data-driven value creation and business models would, therefore, be beneficial for filling gaps by taking research on the impacts and benefits of data in circular-economy context further. Further empirical and conceptual research is needed if we are to understand the role and value of data in circular business models and specify the understanding more fully. Our finding of a need for further research is in line with conclusions from previous studies (e.g., Alcayaga *et al.*, 2019; Rajala *et al.*, 2018), which have identified, for example, a need to increase understanding of closed-loop business models based on platforms with multiple actors (Rajala *et al.*, 2018) and of technologies' impact on product design and circular strategies (Alcayaga *et al.*, 2019).

Proposition 2: Collaboration Is Needed for Capturing Data's Value in Circular Business Models

In the articles reviewed, collaboration in collecting and sharing data and simultaneous efficient flow of information in the value networks are portrayed as crucial for capturing data's value in a networked circular-economy context. However, there remains a need to better understand how inter-organisation collaboration can contribute to data-driven circular business-model innovation and how such collaboration could be enhanced. Interesting matters include companies' strategic decisions on openness levels in creating and sharing data and the business models used to capture value from collaborative value propositions.

Circular economy is seen as inherently collaborative, and inter-organisation innovation is needed for sustainability impacts (e.g., Lewandowski, 2016; Lüdeke-Freund *et al.*, 2019). Circular value creation takes place throughout the supply chain and the network formed of suppliers, manufacturers, retailers, customers, and other potential partners (Lewandowski, 2016; Manninen *et al.*, 2018). There is growing interest in how companies can collaboratively create circular value propositions and system-level business models (Brown, 2019). The need for collaboration in exploiting the value of data is

consistent with what is visible for more general data-driven business models and the related notion that value of data is produced in activities involving other stakeholders in the data ecosystem (Bharadwaj *et al.*, 2013; Thomas and Leiponen, 2016).

In circular business models, the impetus for collaboration can arise from such angles as a need to understand complex crosscutting systems, such as global supply chains, along with shared risks, critical leverage points, and technical barriers (Brown, 2019). Company reluctance to share data for reason of privacy, security, or competitiveness concerns is not specific to circular business. Digital trust is necessary between any collaboration partners (Rajala *et al.*, 2018), and data access may be controlled via formal contracts or selling of data alongside explicit specification of data ownership and rights (Günther *et al.*, 2017).

Proposition 3: Data Can Yield Insight on How to Co-create Value with Customers

The literature shows that several types of circular business model are aimed at changing the role of the customer in the value creation. This may occur, for example, when one provides the customer with service, access, or performance instead of product ownership. As evidenced by the literature, the middle stretch of a product's life (i.e., the use of products and services) is receiving growing interest. There is awareness also that data on customers' behaviour and preferences and lifelong data on products and services can be of great value for understanding how to design circular products, services, and business models that all extend service life or how to provide a personalised offering that reduces users' consumption of resources. However, a gap is visible with regard to research into the customer's changing role in circular business models and how data can be used in response.

Circular business models, when extending a company's responsibility for the ownership of products over their entire life, increase interaction with customers (Lewandowski, 2016). The interactions are a possible source for additional valuable data, of use for enhancing customers' experience and customer relations. Getting more involved in the product-use phase can lead companies to rethink their relationship with customers and consumers (Hofmann, 2019) and to make customers a significant part of the value co-creation. Such developments represent new opportunities for circular business models.

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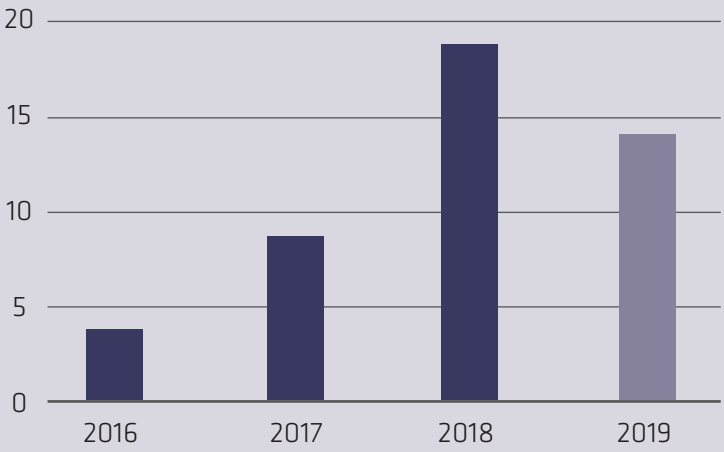
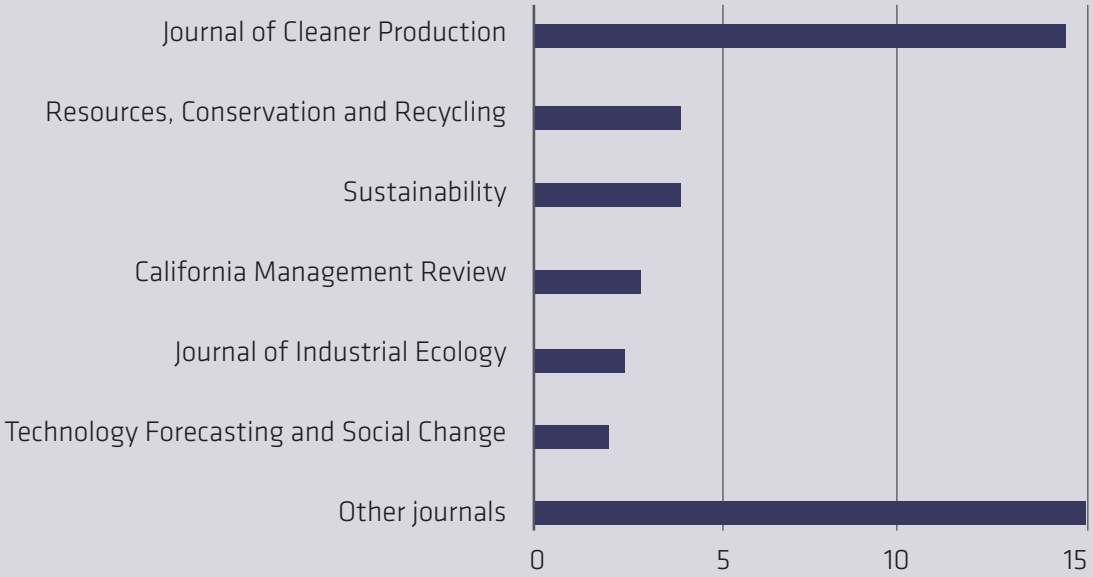
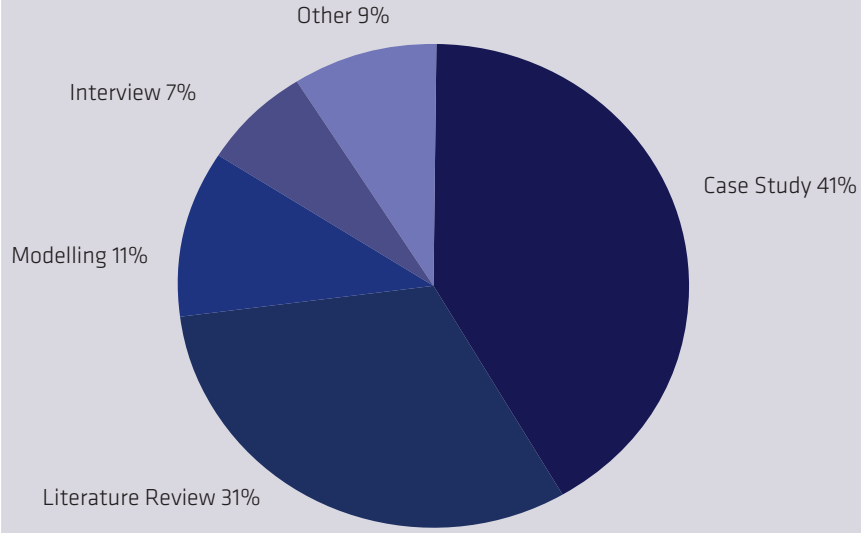
Summary of the articles reviewed	
Years of publication	Number of articles  No relevant articles were published before 2016. The bar for 2019 covers the months from January to August.
Journals	Number of articles  The 'other journals' category covers *Advanced Engineering Informatics*, *Annals of Operations Research*, *Annual Review of Materials Research*, *Applied Sciences*, *Autonomous Agents and Multi-Agent Systems*, *Industrial Marketing Management*, *International Journal of Information Management*, *International Journal of Management Cases*, *International Journal of Precision Engineering and Manufacturing – Green Technology*, *Journal of Manufacturing Systems*, *Journal of Manufacturing Technology Management*, *Management Decision*, *Marine Policy*, *Production Planning & Control*, and *Social Sciences*, with one article each.

Annex 1: Summary of the literature reviewed

Summary of the articles reviewed	
Research methods	 The other research methods were action research, questionnaire-based surveys, preparation of perspective papers, and multi-method approaches.

Annex 1: Summary of the literature reviewed *(Continued)*

Authors	Title	Journal	Year	Method	Context	Perspective on the data	Business models and strategies discussed
Aid, G., Eklund, M., Anderberg, S., & Baas, L.	'Expanding roles for the Swedish waste management sector in inter-organizational resource management'	Resources, Conservation and Recycling	2017	Interviews	Waste management	Material flow and environmental impact data	Industrial symbiosis
Alcayaga, A., Wiener, M., & Hansen, E.	'Towards a framework of smart-circular systems: An integrative literature review'	Journal of Cleaner Production	2019	Literature review	Smart circular systems	Products' lifetime data	Product–service systems; maintenance; reuse; remanufacturing; recycling
Asif, F., Lieder, M., & Rashid, A.	'Multi-method simulation based tool to evaluate economic and environmental performance of circular product systems'	Journal of Cleaner Production	2016	Modelling	Circular product systems	Data as input to a software tool	Circular product systems
Bressanelli, G., Adrodegari, F., Perona, M., & Saccani, N.	'Exploring how usage-focused business models enable circular economy through digital technologies'	Sustainability	2018	Case study	Circular economy; digital technologies	Digital technologies	Servitized business models
Camacho-Otero, J., Boks, C., & Pettersen, I.	'Consumption in the circular economy: A literature review'	Sustainability	2018	Literature review	Circular economy; consumption	Customer data	No specific model or strategy

Annex 2: Articles included in the literature review

Authors	Title	Journal	Year	Method	Context	Perspective on the data	Business models and strategies discussed
Cezarino, L., Liboni, L., Oliveira Stefanelli, N., Oliveira, B., & Stocco, L.	'Diving into emerging economies bottleneck: Industry 4.0 and implications for circular economy'	Management Decision	2019	Literature review	Circular economy; industry 4.0	Opportunities and limitations connected with industry 4.0	No specific model or strategy
de Mattos, C., & de Albuquerque, T.	'Enabling factors and strategies for the transition toward a circular economy (CE)'	Sustainability	2018	Case study	Circular economy	Data as a key aspect of circular business models	Industrial symbiosis; extending resource value; reverse supply chain
Favi, C., Marconi, M., Germani, M., & Mandolini, M.	'A design for [a] disassembly tool oriented to mechatronic product de-manufacturing and recycling'	Advanced Engineering Informatics	2019	Modelling	Disassemblability and recyclability	Data as input to a software tool	Disassemblability; recyclability
Fisher, O., Watson, N., Porcu, L., Bacon, D., Rigley, M., & Gomes, R. L.	'Cloud manufacturing as a sustainable process manufacturing route'	Journal of Manufacturing Systems	2018	Literature review	Cloud manufacturing	Cloud manufacturing as a mechanism to share and exploit data	Automation, process resilience, waste reduction, reuse, and recovery
Frishammar, J., & Parida, V.	'Circular business model transformation: A roadmap for incumbent firms'	California Management Review	2019	Case study	Circular business transformation	The potential role of software and data-analytics specialists	Product–service systems
Garcia-Muiña, F., González-Sánchez, R., Ferrari, A., & Settembre-Blundo, D.	'The paradigms of Industry 4.0 and circular economy as enabling drivers for the competitiveness of businesses and territories: The case of an Italian ceramic tiles manufacturing company'	Social Sciences	2018	Case study	Circular economy; industry 4.0	Industry 4.0 in support of collecting, storing, and processing of data	No specific model or strategy
Gilbert, P., Wilson, P., Walsh, C., & Hodgson, P.	'The role of material efficiency to reduce CO_2 emissions during ship manufacture: A life cycle approach'	Marine Policy	2017	Modelling	Life-cycle analysis	Data as input to life-cycle analysis	Material-efficiency
Gupta, S., Chen, H., Hazen, B., Kaur, S., & Santibañez Gonzalez, E.	'Circular economy and big data analytics: A stakeholder perspective'	Technology Forecasting and Social Change	2018	Interviews	Circular economy; Big Data analytics	Big Data as a facilitator of circular economy	No specific model or strategy
Heyes, G., Sharmina, M., Mendoza, J., Gallego-Schmid, A., & Azapagic, A.	'Developing and implementing circular economy business models in service-oriented technology companies'	Journal of Cleaner Production	2019	Case study	Circular business models	Data's monitoring and analysis as an attractive business model for IT companies	Data's monitoring and analysis
Hofmann, F.	'Circular business models: Business approach as driver or obstructer of sustainability transitions?'	Journal of Cleaner Production	2019	Literature review	Circular business models	Digital technologies supporting circular business models	No specific model or strategy
Hopkinson, P., Zils, M., Hawkins, P., & Roper, S.	'Managing a complex global circular economy business model: Opportunities and challenges'	California Management Review	2018	Case study	Circular business models	Asset-tracking tools; real-time visibility	No specific model or strategy

Annex 2: Articles included in the literature review *(Continued)*

Authors	Title	Journal	Year	Method	Context	Perspective on the data	Business models and strategies discussed
Jabbour, C., Lopes De Sousa Jabbour, A., Sarkis, J., & Filho, M.	'Unlocking the circular economy through new business models based on large-scale data: An integrative framework and research agenda'	Technology Forecasting and Social Change	2019	Literature review	Circular economy; Big Data	Big Data in unlocking the potential of circular economy	'Regenerate, share, optimize, loop, virtualize, exchange'
Jensen, J., Prendeville, S., Bocken, N., & Peck, D.	'Creating sustainable value through remanufacturing: Three industry cases'	Journal of Cleaner Production	2019	Case study	Sustainable remanufacturing	Data in assessment of environmental and economic performance	Remanufacturing
Khan, M., Mittal, S., West, S., & Wuest, T.	'Review on upgradability – a product lifetime extension strategy in the context of product service systems'	Journal of Cleaner Production	2018	Literature review	Upgrading; extending products' service life	Data to support designing of upgradable services	Product–service systems
Leising, E., Quist, J., & Bocken, N.	'Circular Economy in the building sector: Three cases and a collaboration tool'	Journal of Cleaner Production	2018	Case study	Circular economy	Information flow in the supply chain	No specific model or strategy
Lieder, M., Asif, F., & Rashid, A.	'Towards Circular Economy implementation: An agent-based simulation approach for business model changes'	Autonomous Agents and Multi-Agent Systems	2017	Modelling	Circular business models	Data as input to understanding customers' behaviour and preferences	No specific model or strategy
Lindström, J., Hermanson, A., Blomstedt, F., & Kyösti, P.	'A multi-usable cloud service platform: A case study on improved development pace and efficiency'	Applied Sciences	2018	Case study	Cloud service platforms	Data collection and analytics in Big Data operations	No specific model or strategy
Lopes De Sousa Jabbour, A., Jabbour, C., Godinho, F., & Roubaud, D.	'Industry 4.0 and the circular economy: A proposed research agenda and original roadmap for sustainable operations'	Annals of Operations Research	2018	Literature review	Circular economy; industry 4.0	Industry 4.0's technologies to collect, analyse, and act on data	'Regenerate, share, optimize, loop, virtualize, exchange'
Lüdeke-Freund, F., Gold, S., & Bocken, N.	'A review and typology of circular economy business model patterns'	Journal of Industrial Ecology	2019	Literature review	Circular business models' design	Identifying equipment databases as an example of auxiliary services	No specific model or strategy
Manninen, K., Koskela, S., Antikainen, R., Bocken, N., Dahlbo, H., & Aminoff, A.	'Do circular economy business models capture intended environmental value propositions?'	Journal of Cleaner Production	2018	Case study	Circular business models	Lack of data for verifying the environmental benefits of circular business models	No specific model or strategy
Matsumoto, M., Yang, S., Martinsen, K., & Kainuma, Y.	'Trends and research challenges in remanufacturing'	International Journal of Precision Engineering and Manufacturing – Green Technology	2016	Literature review	Remanufacturing	Design tools as requiring significant quantities of product data	Remanufacturing
Merli, R., Preziosi, M., & Acampora, A.	'How do scholars approach the circular economy? A systematic literature review'	Journal of Cleaner Production	2018	Literature review	Circular economy	Linking of Big Data and the Internet of Things to circular economy	No specific model or strategy

Annex 2: Articles included in the literature review *(Continued)*

Authors	Title	Journal	Year	Method	Context	Perspective on the data	Business models and strategies discussed
Mishra, J., Hopkinson, P., & Tidridge, G.	'Value creation from circular economy-led closed loop supply chains: A case study of fast-moving consumer goods'	Production Planning & Control	2018	Case study	Closed-loop supply chains	Integration of material data with supply-chain databases and systems	Closed-loop supply chains, reverse material flows, and reverse logistics
Nascimento, D., Alencastro, V., Quelhas, O., Caiado, R., Garza-Reyes, J., Lona, L., & Tortorella, G.	'Exploring Industry 4.0 technologies to enable circular economy practices in a manufacturing context'	Journal of Manufacturing Technology Management	2019	Interviews	Circular economy; industry 4.0	The value of data in collection and sorting of waste	Selective waste collection; sorting of waste
Niero, M., & Olsen, S.	'Circular economy: To be or not to be in a closed product loop? A Life Cycle Assessment of aluminium cans with inclusion of alloying elements'	Resources, Conservation and Recycling	2016	Modelling	Life-cycle assessment	Life-cycle data	A closed product loop
Niero, M., Hauschild, M., Hoffmeyer, S., & Olsen, S.	'Combining eco-efficiency and eco-effectiveness for continuous loop beverage packaging systems: Lessons from the Carlsberg circular community'	Journal of Industrial Ecology	2017	Case study	Life-cycle assessment	Life-cycle data	Circular industrial systems
Oghazi, P., & Mostaghel, R.	'Circular business model challenges and lessons learned – an industrial perspective'	Sustainability	2018	Case study	Circular business models	Lack of tools to handle products' lifetime data	No specific model or strategy
Pialot, O., Millet, D., & Bisiaux, J.	'"Upgradable PSS": Clarifying a new concept of sustainable consumption/production based on upgradablility'	Journal of Cleaner Production	2017	Action research	Product–service systems; upgradability	Using data to achieve upgradability	Product–service systems
Planing, P.	'Will digital boost circular? Evaluating the impact of the digital transformation on the shift towards a circular economy'	International Journal of Management Cases	2017	Literature review	Digital transformation	Focus on digital transformation	No specific model or strategy
Rajala, R., Hakanen, E., Mattila, J., Seppälä, T., & Westerlund, M.	'How do intelligent goods shape closed-loop systems?'	California Management Review	2018	Case study	Intelligence of goods in closed-loop ecosystems	Intelligent goods; traceability; digital identity	Closed-loop business models; digital platforms
Rajput, S., & Singh, S.	'Connecting circular economy and industry 4.0'	International Journal of Information Management	2019	Survey	Circular economy; industry 4.0	Enabling and challenging factors within industry 4.0	No specific model or strategy
Reuter, M., van Schaik, A., Gutzmer, J., Bartie, N., & Abadías-Llamas, A.	'Challenges of the circular economy: A material, metallurgical, and product design perspective'	Annual Review of Materials Research	2019	Literature review	Circular economy	Data needed for assessing the circular benefits	No specific model or strategy
Saidani, M., Yannou, B., Leroy, Y., & Cluzel, F.	'Heavy vehicles on the road towards the circular economy: Analysis and comparison with the automotive industry'	Resources, Conservation and Recycling	2018	Multi-method approach	End of life	Insufficiency of data for understanding the end-of-life options	End-of-life perspective

Annex 2: Articles included in the literature review *(Continued)*

Authors	Title	Journal	Year	Method	Context	Perspective on the data	Business models and strategies discussed
Spring, M., & Araujo, L.	'Product biographies in servitization and the circular economy'	Industrial Marketing Management	2017	Literature review	Circular economy; servitization	Potential of Internet of Things solutions and smart connected products, along with product biographies	Servitization
Tseng, M., Tan, R., Chiu, A., Chien, C., & Kuo, T.	'Circular economy meets industry 4.0: Can big data drive industrial symbiosis?'	Resources, Conservation and Recycling	2018	Perspective paper	Industry 4.0; Big Data; industrial symbiosis	The nexus of industry 4.0 and circular economy	No specific model or strategy
Tura, N., Hanski, J., Ahola, T., Ståhle, M., Piiparinen, S., & Valkokari, P.	'Unlocking circular business: A framework of barriers and drivers'	Journal of Cleaner Production	2019	Case study	Circular economy	Enhanced information management technologies, services, and platforms as drivers for circular economy	No specific model or strategy
Veleva, V., & Bodkin, G.	'Corporate–entrepreneur collaborations to advance a circular economy'	Journal of Cleaner Production	2018	Case study	Circular economy; collaboration	Lack of data for assessing circular economy's performance	No specific model or strategy
Vermunt, D., Negro, S., Verweij, P., Kuppens, D., & Hekkert, M.	'Exploring barriers to implementing different circular business models'	Journal of Cleaner Production	2019	Case study	Circular business models	Lack of information and data, as a barrier to circular business models	No specific model or strategy
Zhang, Y., Ren, S., Liu, Y., Sakao, T., & Huisingh, D.	'A framework for Big Data driven product lifecycle management'	Journal of Cleaner Production	2017	Case study	Big Data; product life-cycle management	Big-Data-driven product life-cycle management	Product life-cycle management

Annex 2: Articles included in the literature review *(Continued)*

About the Authors

Päivi Luoma is an experienced professional in strategy and business development, new business concepts, and innovation strategies. She has 20 years of experience on working with impact-driven companies and their innovations globally. She has a background in environmental economics and corporate responsibility. Lately she has focused on sustainable business models, co-creation and clean technologies, as well as commercialising circular innovations. Currently she is working on her PhD on the role and value of data in circular economy business and ecosystems.

Anne Toppinen is Professor of forest economics and marketing at University of Helsinki and the leader of Helsinki Institute of Sustainability Science (HELSUS). Toppinen's expertise is on sustainability transformations and business economics and markets in the context of circular bioeconomy. She has also studied policy coherence and diffusion of sustainability practices in the natural resource context, as well as related sustainable business models. She has published over 130 scientific peer review journal articles and supervised 14 doctoral theses. For more information of her projects and publications, see https://www.helsinki.fi/en/researchgroups/forest-bioeconomy-business-and-sustainability

About the Authors

Esko Penttinen is Professor of Practice in Information Systems at Aalto University School of Business in Helsinki. He holds a Ph.D. in Information Systems Science and a M.Sc. in Economics from Helsinki School of Economics. Esko leads the Real-Time Economy Competence Center and is the co-founder and chairman of XBRL Finland. He studies the interplay between humans and machines, organizational implementation of artificial intelligence, and governance issues related to outsourcing and virtual organizing. His main practical expertise lies in the assimilation and economic implications of inter-organizational information systems, focusing on application areas such as electronic financial systems, government reporting, and electronic invoicing. Esko's research has appeared in leading IS outlets such as MIS Quarterly, Information Systems Journal, Journal of Information Technology, International Journal of Electronic Commerce, and Electronic Markets.

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We Need Transdisciplinary Research on Sustainable Business Models

Claudia Alba[1] and Nikolay A. Dentchev[2]

Abstract

Purpose: This paper explores the challenges sustainable business model (SBM) studies may face related to the information gathered during the data collection process, and elaborates on how transdisciplinary research can help to overcome these challenges. Our contribution is based on the theoretical lens of information asymmetry.

Design/Methodology/Approach: This paper uses a qualitative methodology based on a transdisciplinary program that aims to support disadvantaged communities in Bolivia. The program started 3 years ago, with as objective to help vulnerable communities through transdisciplinary intervention in 6 projects, viz. 1. Social vulnerability, 2. Integrated water management, 3. Food security, 4. Indigenous rights, 5. Productive development and 6. Transversal. In addition to our experience in the program, we have conducted 57 interviews and 10 focus group discussions with vulnerable entrepreneurs and relevant stakeholders, alongside numerous on-site observations.

Findings: The findings of our study illustrate that SBM research can face information asymmetry issues such as lack of access to, lack of understanding of and lack of trust in the information provided. We also show how transdisciplinary research helps to bridge such issues of trust, understanding and information availability. Based on our research, we propose 5 suggestions to scholars who wish to adopt transdisciplinary research in their study of SBMs: (i) understand the context, (ii) adapt to the context, (iii) develop relationships of trust, (iv) be flexible with your research focus and (v) systematically present to other disciplines and non-academic actors.

Originality/Value: Our contribution is based on the theoretical lens of information asymmetry and argues that a transdisciplinary approach is necessary to accumulate fundamental knowledge on SBMs. Such an approach constitutes a rather sophisticated research methodology that can help us embrace the complexity of sustainable business models and find practical solutions for their scalability.

Keywords: Transdisciplinary research, vulnerable entrepreneurs, sustainable business models, methodology

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1-2 Vrije Universiteit Brussel

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Introduction

Scholars in the field of sustainable business models (SBMs) have generated a solid body of knowledge during the past years, as demonstrated by numerous special issues, academic conferences as well as the vast interest shown by business and policymakers (Lüdeke-Freund and Dembek, 2017). Such a broad interest in SBM scholarship is a logical consequence of the serious social and environmental challenges that our planet faces (Brundtland *et al.*, 1987), and of the expectation that managers can find solutions to them (Bansal, 2003). Lüdeke-Freund (2010) argues that SBMs create competitive advantage while contributing to the sustainable development of our planet. In fact, SBM scholars are often preoccupied with the practical side of sustainable business models, studying how organizations can improve their positive impact. The attention to practical relevance in this field is indicated by the various SBM ontologies (Breuer, 2013; Joyce and Paquin, 2016; Upward and Jones, 2016) and archetypes developed (Stubbs and Cocklin, 2008; Bocken *et al.*, 2014; Yip and Bocken, 2018). Despite the growing body of research with a practical orientation in SBMs, much work still needs to be done to develop stronger and cumulative theoretical knowledge in this scholarly field (Dentchev *et al.*, 2018).

This need for cumulative development of theoretical knowledge is a result of the complexity of SBMs (Høgevold *et al.*, 2014), which is associated with the overall activity and strategic management of organizations (Kolk and Mauser, 2002). Integrating sustainability in the business models arguably requires specific knowledge of social and environmental issues, additional processes and procedures, and an ambition to realize continuous improvement. The complexity of SBMs themselves is based on their triple bottom line approach, embracing economic, environmental and social dimensions (Bocken *et al.*, 2014). The economic dimension refers to value generation from a profit perspective (Osterwalder and Pigneur, 2011), the environmental one to the preservation of environmental resources, while the social dimension appertains to the consideration of various stakeholders in business activities (Joyce and Paquin, 2016). These three dimensions need alignment (Bocken *et al.*, 2014) and should result in tangible outcomes of sustainable development (Stubbs and Cocklin, 2008). To understand this complexity of SBMs, scholars need to be familiar with the practice of SBMs, studying their slightest details and their context. In this line of reasoning, we follow the assertion of Lüdeke-Freund & Dembek (2017, p. 1677) that our field "requires multi-, inter- and transdisciplinary efforts [... with the] importance to establish and maintain a strong link and communication not only within but also between academia, industry, and government."

Transdisciplinary research involves academics from different disciplines studying a specific phenomenon in collaboration with non-academic participants (Stock and Burton, 2011). Non-academic participation provides information about the real-world dynamics that complement academic knowledge and improves the understanding of a specific phenomenon (Horlick-Jones and Sime, 2004). Such transdisciplinary research is adequate to study complex phenomena (Wickson, Carew and Russell, 2006; Pohl and Hadorn, 2008; Stock and Burton, 2011), such as SBMs and is considered a valuable research strategy to increase academic rigor in the SBM field (Lang *et al.*, 2012). Hence, our paper will elaborate on transdisciplinary research as a means to resolve challenges related to data collection and interpretation in SBM studies, our paper's purpose.

We use information asymmetry as a theoretical lens to focus on the challenges of data collection and interpretation (Akerlof, 1970; Malkiel and Fama, 1970; Stiglitz, 2000). This theoretical viewpoint is useful to help us understand the challenges of studying complex phenomena, such as SBMs since it points out issues such as information availability, understanding and trust (cf. infra) that appear in the process of studying complex phenomena.

This paper offers insights gathered in a transdisciplinary research program in support of disadvantaged communities from the Universidad Catolica Boliviana (UCB) in Bolivia. This program is funded by VLIR, the Flemish Interuniversity Council in Belgium. Drawing on the author's experience in the program, we have further developed our methodological recommendations based on 57 interviews and 10 focus group discussions with vulnerable entrepreneurs and relevant stakeholders. Here vulnerability refers to an inability to earn sufficient income to live a decent life, with exposure to a variety

of social and environmental disadvantages such as malnutrition, insufficient health-care, lack of education, pollution and violence (Pearlman, 2012). The business models of vulnerable entrepreneurs can resolve a variety of social issues, and in this sense, they can be seen as a subtype of SBMs (Dembek, York, & Singh, 2018).

The remainder of the paper is organized in five sections. First, we explain the importance of transdisciplinary research for the field of sustainable business models. Secondly, we propose the use of the theoretical lens of information asymmetry in transdisciplinary research. Thirdly, we clarify the methodological considerations used in this paper. Fourthly, we present the findings of this paper. The fifth and final section summarizes our concluding remarks and recommendations.

TRANSDISCIPLINARITY IN SBMs

Transdisciplinary research is recommended for the study of life-world problems (Pohl & Hadorn, 2008) with a complex nature (Stock & Burton, 2011). Transdisciplinary research approaches complex problems (e.g. poverty) through the insights of various scientific disciplines and through the involvement of any relevant group of actors in a study (Bracken, Bulkeley and Whitman, 2015). Sustainability problems are not limited to the boundaries of a single discipline, therefore it is useful to approach them from multiple scientific angles, as transdisciplinary research prescribes (Wickson, Carew and Russell, 2006). Such an approach is also effective in creating linkages between theory and practice, yet above all it is a very useful tool in solving societal problems (Horlick-Jones and Sime, 2004).

The strength of transdisciplinary research is related to its ability to understand (1) the complexity of the phenomena studied, (2) the possible logical explanations and predictions, and (3) the different interpretations of reality (Max-Neef, 2005). This is achieved in the first place by the interactions of disparate disciplines, which provide distinct lenses through which to study complex problems. Moreover, the involvement of stakeholders affected by the problem (e.g. poverty) provides an additional perspective on the phenomenon. Poor people, for example, are then no longer the object of study, but have become part of the transdisciplinary research team. These non-academic participants are useful for researchers to make sense of the complex phenomena (Horlick-Jones and Sime, 2004). As such, the research team receives a more solid understanding about the context of the phenomenon studied, based on knowledge exchange with non-academic participants. As a result, the theoretical knowledge is more accurate, and its implications are more useful for the solution of complex societal problems. Additionally, the mix of scientific and non-scientific perceptions of problems offers opportunities for practical solutions (Wickson, Carew and Russell, 2006; Pohl and Hadorn, 2008; Stock and Burton, 2011). Transdisciplinary research emphasizes three interrelated components, i.e. the context of the problem, the knowledge necessary for its solution and the learning about possible solutions (Mitchell, Cordell and Fam, 2015). It thus provides a comprehensive approach to complex problems and enables the co-creation of solutions by the various members of the transdisciplinary team (Polk, 2015).

It therefore should not come as a surprise that transdisciplinary research is recommended for studying sustainability (cf. Brandt et al., 2013). Resolving the sustainability challenges of our planet requires coordinated research across multiple disciplines, and input by practitioners, policy makers, and civic organizations involved in a specific challenge needs to be taken into account (Hadorn *et al.*, 2006). Actors outside academia provide knowledge and expertise that are indispensable to solving sustainability problems (Polk, 2015). Such a transdisciplinary research team is expected to result in collaborative problem solving of sustainability challenges (Gibbons and Nowotny, 2001; Cundill, Roux and Parker, 2015; Mitchell, Cordell and Fam, 2015) . In this context, SBMs being rather complex and involving a wide range of stakeholders (Bocken *et al.*, 2014; Schaltegger, Hansen and Lüdeke-freund, 2016) seem prime candidates for such collaborative problem solving, i.e. the reduction of harm to society and the natural environment, and the increase of social and environmental benefits (Dembek, York and Singh, 2018).

In other words, the engagement of actors with various backgrounds is deemed necessary to develop successful SBMs. We follow the assertion of Max-Neef (2005, p. 15) that "the epistemology of transdisciplinarity may be relatively clear, its applicability as a methodology in the social sciences still suffers from deficiencies" Yet, we will argue that transdisciplinary research

is essential to bridge the various information problems related to SBMs, and we base our arguments on the theory of information asymmetry.

INFORMATION ASYMMETRY

The theory of information refers to the various problems related to information imperfections (Schwartz and Wilde, 1978). Stiglitz (2000) identifies three major problems of information, i.e. incentives, scarcity, and selection. The *problem of incentives* is better known in literature as a moral hazard (Holmstrom, 1979). Mirrlees (1997) draws our attention to the problem of trust as a consequence of moral hazard, i.e. the question whether the information collected in SBM studies is always trustworthy.

Scarcity of information is related to its availability: do we have sufficient information? Fama (1970) argues that markets work more efficiently when more information is available. He points at various types of information that could be available, such as secondary information, publicly available and insider information. The availability of information (Sandmo, 1999) refers to our access to information in the data collection process of sustainable business models studies.

The *problem of information selection* is related to the complexity of information (Akerlof, 1970), which goes beyond the access to information and focuses on its being understood and interpreted. Based on our background knowledge and interests, as Simon (1991) would argue, scholars select and interpret information differently. Without prior knowledge of relevant aspects of sustainable business models, it would be difficult to find a meaningful solution for improving their efficiency and effectiveness in doing this.

Successful SBM solutions can be developed with access to information, the comprehension of it, and the trust in the honest motives of all actors involved. Information problems generate market imperfections (Schwartz and Wilde, 1978), and thus suboptimal solutions to the sustainability challenges of our planet, as it reduces the ability of practitioners and academics to develop new knowledge (Bergh, Ketchen, Orlandi, & Heugens, Boyd, 2019). We will use the three dimensions of information asymmetry – incentives, scarcity, and selection – to discuss the challenges and potential solutions in adopting transdisciplinary research methods on SBMs, based on the insights from a transdisciplinary research program in Bolivia.

RESEARCH CONTEXT AND METHODS

The goal of this paper is to argue why and how transdisciplinary research should be adopted in SBM scholarship. The insights presented in this paper are based on a transdisciplinary research program with UCB Bolivia, aimed at "contribut[ing] to the development of the Bolivian society by enhancing institutional capacity building" (VLIRUOS, 2019). Bolivia is one of the poorest countries in South America (World Bank Group, 2019b), which is among the least industrialized regions (Nyssens, Wanderley and Gaiger, 2019). According to the Inter-American Development Bank, 41% of the total Bolivian population can be considered vulnerable, with a low level of education, limited access to healthcare, minimal social protection and inferior quality of jobs (Beverinotti, 2018; Castellani & Zenteno, 2015).

The transdisciplinary research program with UCB started in January 2017, with the objective to help disadvantaged communities in a transdisciplinary intervention in 6 projects: 1. Social vulnerability, 2. Integrated water management, 3. Food security, 4. Indigenous rights, 5. Productive development and 6. Transversal. Each of these projects contributes to the program from a specific scientific discipline, viz. psychology, water engineering, agriculture, law, entrepreneurship, and research methods respectively. The involvement of four different vulnerable communities in Bolivia is deemed crucial. The focal points of this program are the so-called transdisciplinary learning communities (TLCs), composed of team members of each of the 6 projects mentioned above and stakeholders from the selected communities (such as local NGOs, political organizations, and the local population) as well as the involvement of scholars from different disciplines.

As a team of authors, we are involved in project 5, Productive development, with as main objective to build supportive ecosystems that can help vulnerable entrepreneurs to improve their business models. Vulnerable

entrepreneurs are defined as poor individuals who are self-employed by necessity and unable to earn sufficient income to ensure minimal life standards (Yurdakul, Arik, & Dholakia, 2017). Disadvantaged communities suffer typically from extreme poverty, and as a consequence are exposed to a variety of social and environmental problems. According to Dembek, York, & Singh (2018), the business models of vulnerable entrepreneurs can be seen as a subtype of SBMs. Casado-Caneque & Hart (2015) further explain that vulnerable entrepreneurs develop activities that are in harmony with the social community and the natural environment, while generating sufficient income to survive. Therefore, we recognize the business models of vulnerable entrepreneurs in Bolivia as a good proxy of SBMs. Despite the high percentage of self-employed, many entrepreneurs operate in informality (Beverinotti, 2018). Although Bolivia has the seventh-highest rating of "Total entrepreneurial activity" (Querejazu, Zavaleta and Mendizabal, 2014), more than 60% of the enterprises in this country are motivated by pure necessity and not because they have identified a business opportunity (Fernandez *et al.*, 2010). The legal process to start a company in Bolivia is quite demanding (Pardo Rada, 2019), ranking the country at one of the bottom places (175 out of 190) in the world (World Bank Group, 2019a). Regarding the financial system, access to loans is limited and expensive, since business angel investors and venture capitalists are not legally approved (Pardo Rada, 2019).

The transdisciplinary research program has been developed across the four campuses of UCB, viz. in Cochabamba, La Paz, Santa Cruz, and Tarija. Data collection for this study is based on the triangulation of (i) participatory techniques and observations, (ii) secondary information, and (iii) primary information based on interviews and focus group discussions in the period between December 2017 and April 2019. Triangulation comes naturally in transdisciplinary research as it contributes to the internal validity by providing stronger justifications of constructs (Eisenhardt, 1989). As to the external validity, it is typically considered rather limited in qualitative research (Sharir and Lerner, 2006), as generalization would only be relevant in contexts with similar characteristics (Creswell, 2014). It is important to mention, however, that the overall research process – study design, data collection, data analysis, and research conclusions – has coincided with continuous discussions with actors from the vulnerable communities and with researchers from other disciplines. In this sense we can speak of a co-creation of research.

As members of the transdisciplinary program, we have participated in 3 steering committees per year. Each UCB campus has selected a specific disadvantaged community, viz. UCB La Paz chose Batallas, UCB Cochabamba picked Tiraque, UCB Santa Cruz preferred San Jose de Chiquitos, and UCB Tarija selected Subcentral de Cirminuelas. In each of these communities, there is constant interaction between the different scientific disciplines and the different stakeholders from the local population in order to guarantee mutual learning, which is essential for the transdisciplinarity of the program (Lang *et al.*, 2012). We have received minutes and briefings of the TLC discussions (659 pages). We have personally visited each community at least twice and have organized events in three communities to observe the needs related to the business models of vulnerable entrepreneurs. In addition, we have studied secondary data from governmental plans, the publicly available data of the National Institute of Statistics of Bolivia, publicity material by the different supporting organizations, marketing material of the ventures including their webpages and social media communications, newspaper articles, and books regarding the researched communities.

Our primary data collection is based on 57 interviews and 10 focus group discussions. Interviewees were chosen following discussions with local researchers and community members, and we followed a combination of purposeful and snow-ball sampling. The interview protocols guided a discussion with the participants towards the challenges and opportunities related to the business models of vulnerable entrepreneurs and to the exploration of their supportive ecosystems. Two interview protocols were used (cf. Appendix 1), one for entrepreneurs and one for supportive organizations such as NGOs, financial institutions, government or others (e.g. Church institutions that support entrepreneurship). Interviews lasted on average of 51 minutes, ranging between 19 and 156 minutes. The 10 focus group discussions included between 4 and 18 participants and took on average of 106 minutes, with a range between 60 and 240 minutes. Interviews and focus group discussions were recorded and transcribed

to heighten reliability. Please note that one interviewee refused to be recorded and during one focus group we had technical problems with the recording. On these two occasions, only notes were taken. The interviews were conducted in Spanish, which is the mother tongue of the first author and the language of preference of the interviewees. All quotes from respondents are a translation into English. We have adopted a thematic analysis (Clarke, Braun and Hayfield, 2015) using the three problems of information asymmetry, i.e. incentives, scarcity and selection, while the analysis was conducted in NVivo 12. After interviews and focus groups, there have been follow-up discussions with the communities and also with colleagues from other disciplines. For an overview of the participants in the interviews and focus group discussions, cf. Table 1.

Sector	No. of Interviews	No. of Focus Groups	TOTAL
Entrepreneurs	36	4	40
NGO	7	2	9
Financial Institution	4	0	4
Government	6	2	8
Other	4	2	6
TOTAL	57	10	67

Table 1: Interviews and focus groups

Out of 36 interviews with entrepreneurs, 14 involved vulnerable ones, while they made up all of the 4 focus group discussions. We have deliberately approached both vulnerable and conventional entrepreneurs to be able to determine what are the general and what are the specific challenges of their business models. The data provided by conventional entrepreneurs allowed us to better understand the distinctive challenges related to the business models of vulnerable entrepreneurs.

RESULTS

Based on this research in Bolivia, we will now present the results predicated on the three dimensions identified in information asymmetry. We discuss first how the transdisciplinary research method can help to resolve the information problem of incentives. Only then do we examine the information problems of scarcity and selection. This order in our discussion is guided by the insights gained from our study.

The information problem of incentives

The problem of incentives refers to the trustworthiness of information. In this context, one needs to build a solid relationship with the respondents, which is a basic principle in transdisciplinary research (Polk, 2015). This is expressed clearly by one of the researchers who is part of the VLIR Project in Cochabamba. He visited Tiraque at least two times per week in the last year.

> I55: "We need to build good relationships, which basically means that we come here to become friends of the people. You do not come to interview, because you are going to hear what you want to hear or because they will not tell you anything. (...) Entrepreneurs think that we are coming to get information and return nothing. Not even the results of the research. We are trying to change things by also giving back something valuable for them. Hence, we do workshops on topics that they are interested in."

This quote indicates that one needs to create a dynamic around the research that peaks the interest of people in the communities and stimulates them to join based on the added value to themselves. It is not about going and getting the information that the researcher needs, but about creating value for all the participants. This is essential to generate trust, which is the most important element to avoid problems related to information asymmetry. As Mitchell, Cordell and Fam (2015) explain, all the aspects of the research need to be shared with the participants and be as transparent as possible to maintain trust. However, respondents will question the researchers' motives, as they occasionally suspect opportunistic behavior. This was mentioned by a vulnerable entrepreneur who is producing leggings:

> I41: "Researchers come regularly to us, but we do not think they are here to really help us. We attend their theoretical courses, but when we ask their support in practice, their support remains absent. Their behavior is selfish. If we have taken their training, why can they not support us?"

In transdisciplinary research, engaging with respondents is specifically helpful to overcome selfish and short-sighted research behavior. A good tactic to overcome the perception of opportunism is to work through intermediaries that are closer to the entrepreneurs and already have their trust. Nevertheless, and even with the intermediaries helping in the process, researchers doing transdisciplinary research need to be ready to devote substantial amounts of time to overcome this suspicion of self-centered intentions (Stokols, 2006). This method allowed the VLIR researcher I54 to approach the people in Tiraque faster.

> I54: "There is a lot of mistrust (in the entrepreneurs). Also, they are very reluctant to receive and even more, to give information. That is why I go often with the NGO, so they can start trusting me (...) but takes time."

It is therefore important to select carefully the intermediaries through whom a researcher can approach vulnerable entrepreneurs, keeping in mind the goal of the transdisciplinary research and the profile of the entrepreneurs. With or without intermediaries, good transdisciplinary practice presupposes that the collaboration between researcher and entrepreneurs becomes obvious (Wickson, Carew and Russell, 2006) due to mutual trust.

The scarcity of information

Once entrepreneurs and researchers trust each other, access to information becomes fairly easy. Throughout the activities of the project, we have noted that vulnerable entrepreneurs are then eager to share information about their business models. This mainly entailed a detailed explanation of the business, an invitation to visit their premises and homes, and in only a few cases a business plan (prepared thanks to supportive organizations). It is essential to have access to this detailed information about the business models and the context in which vulnerable entrepreneurs are working. Without it is impossible to understand their business ideas, opportunities, and challenges, nor their needs and requirements. In other words, detailed information is a precondition to help vulnerable entrepreneurs improve their business model.

Moreover, a transdisciplinary approach improves not only access to information for the researcher but also for the vulnerable entrepreneurs (Bracken, Bulkeley and Whitman, 2015). It is important to realize that a transdisciplinary intervention involves various stakeholders with different backgrounds and potentially useful networks to help vulnerable entrepreneurs to improve their business models. These stakeholders can thus provide access to valuable information for the entrepreneurs. This point is well illustrated by interviewee 39 from Tarija, a vulnerable entrepreneur producing llama sausages:

> I39: "This business plan was developed by me, but it was impossible to have all the details and ideas without the information and feedback provided by the people of the municipality, the business incubator, and the university."

In addition, transdisciplinary interventions can provide access to more specific and technical information for vulnerable entrepreneurs. In the words of interviewee 4, a member of a handcraft association from San Jose de Chiquitos:

> I4: "Recently we had a training by UCB regarding the development of a strong brand. One week before we had a training by an NGO about clothing and traditional painting. Until now we have received a lot of trainings that are useful to further develop and improve our business."

There is no doubt that the business models of vulnerable entrepreneurs are strengthened by additional information, training, and feedback. Nevertheless, transdisciplinary interventions should keep flexibility in their priorities and timing (Lang *et al.*, 2012). Without such flexibility, the value of the intervention risks becoming suboptimal. This argument is made clear by an NGO member that works with the VLIR project in Tiraque (I56) and a researcher of the VLIR project (I54):

> I56: "Even if they are interested in the training that you are offering to them, be careful with the timing. If you plan activities in the period of planting or harvesting, they will not participate."

> I54: "There was a meeting during which the entrepreneurs were talking about politics. At that meeting, the researcher was giving a training on marketing strategies, willing to help them to improve their sales. The entrepreneurs did not say anything to the researcher, but just wanted the

> researcher to be out of the room, so they could continue with their discussion about politics."

Referring to this last quote, making time to discuss overarching issues contributes to further the dynamic of the transdisciplinary research. It might feel like time wasted for the researcher, but in fact, such a discussion could be helpful to better understand the context, the needs, and the thinking of the vulnerable entrepreneurs. After all, transdisciplinary research is meant to help vulnerable entrepreneurs, and the flexibility of the researcher can contribute to realize this objective.

The problem of information selection

The problem of information selection is related to our understanding of the information available. At the beginning of project 5, we were thinking that our intervention is simply related to scaling up the business models of vulnerable entrepreneurs. However, the transdisciplinary methodology proved in various ways beneficial to understanding the context and the needs of vulnerable entrepreneurs. During one project meeting, for example, we were talking about the scaling of business models with the project leader of P1 (social vulnerability). On that occasion, our colleague explained that growing the business might increase domestic violence, especially in cases of female entrepreneurship. In paternalist communities, she explained, the husband feels humiliated when his wife earns more money and this carries the risk of an increase of violence as well as the husband wasting the financial resources of the enterprise. After this discussion, we understood that our task is not only simply focusing on the business model, but we should take into account the overall social context of the entrepreneur. Understanding the context of vulnerable entrepreneurs constitutes a long process of constant interaction, in which the researcher needs to understand the available information, and interpret it correctly (Hadorn *et al.*, 2006). Jumping quickly to conclusions based on early-stage preconceptions should therefore be avoided. In this sense, according to VLIR researcher in Tiraque, a transdisciplinary approach needs to adopt a careful and open attitude:

> I55: "The context of vulnerable communities contains a completely different life philosophy and different logic regarding the role of woman and man in the family. It is not a good idea to go in those communities only with your own perspective, without a willingness to understand their reality."

The above quote was confirmed in a discussion with a vulnerable entrepreneur. During our visit to his textile production activity, we asked what he would wish for in case his business became successful. The answer "I just wish to have a peaceful life" was rather surprising to us. No reference to an ambition of owning a business empire, becoming rich, living in a better house or having a new car. For vulnerable entrepreneurs, wealth is apparently not about having money but about satisfying their daily needs while acting responsibly toward nature (Casado-Caneque & Hart, 2015). Our Western view on life and business might hence diverge from the philosophy of vulnerable communities (Chmielewski, Dembek and Beckett, 2020). Therefore, an open mindset is required, in which it is important to reflect on the views of the vulnerable entrepreneurs and of all other stakeholders and scientists from various disciplines (Wickson, Carew and Russell, 2006). The case of an entrepreneur from Tarija who makes leggings makes it very clear how contextual factors may impact the business model of precarious ventures.

> I41: "I am a single mother and I reached a point in which I wanted to quit my venture. But due to the support of my daughter and my desire to help other women in need through employment made me continue with the business. (...) Why did I want to quit? At a certain moment, I needed a credit to finance the growth of my business. But I am separated from my husband without a divorce. Since my ex has a credit, and we are not separated, I have no access to funding."

The above quote illustrates the differences in the financial and legal system of a country, and hence the importance to keep an open mind and understand the local context. The necessity for such an open attitude is further asserted in the 2017 Annual Report of the project: to integrate the different researchers and work together, for example by jointly designing surveys. This is in line with conventional views on transdisciplinary research, stressing the importance of dissolving disciplinary boundaries (Wickson, Carew and Russell, 2006; Bracken, Bulkeley and Whitman,

2015). However, such discipline transgressing is easier said than done, even in a program with transdisciplinarity at its core. Three years into the program, engaging colleagues from other projects and disciplines remains a continuous concern and needs constant attention, due to the differences in their research routines and the divergence in their respective theoretical approaches. Therefore, we have decided at program level to organize regular presentations between projects. This methodological tactic ensures the possibility of feedback from different disciplines. Moreover, through this dynamic, colleagues find opportunities for joint research initiatives. It is important to stress that transdisciplinary research is a learning process that requires regular adaptation (Lang *et al.*, 2012; Mitchell, Cordell and Fam, 2015).

The problem of understanding the information available is also relevant to vulnerable entrepreneurs. Please note that those vulnerable entrepreneurs are not educated, let alone familiar with theories on entrepreneurship, marketing, management, accounting, or finance, to mention only a few of the most relevant disciplines to develop a solid business. When supporting entrepreneurs, therefore, some colleagues adopted game-based methodologies, where the learning experience takes place during the play of the game. On other occasions, we organized fairs, where vulnerable entrepreneurs had the opportunity to sell their products, and the coaching took place in a real-life environment. Moreover, an NGO which had been working with vulnerable communities for 34 years explains the need to use examples from the entrepreneur's reality, to improve their understanding of the information provided:

> I56: "Simply explaining a certain topic is not sufficient. With the years, I start explaining by using the examples of a community, where to context is very close to theirs (…) In this way, vulnerable entrepreneurs see themselves in similar situations and understand our advice."

The overall goal of our research is to improve the business models of vulnerable entrepreneurs, which requires a thorough understanding of their context and background, and a transdisciplinary intervention is thereby an indispensable approach.

DISCUSSION AND CONCLUDING REMARKS

In this paper, we explain that SBM studies face challenges related to the information gathered during the data collection process and argue that transdisciplinary research can help us overcome these challenges. We view our arguments through the theoretical lens of information asymmetry. Such a lens helps us to see the contribution of transdisciplinary research to the trustworthiness of information, the availability of information, and the access to information. Based on our research and on insights from various disciplines (international management, BoP, and transdisciplinary research methods), we would like to advance 5 suggestions for adopting transdisciplinary research methods in SBM studies:

1. Understand the context.

   This is in line with insights from international business research (Verbeke, 2013) warning that copy-pasting strategies from other contexts may prove futile.

2. Adapt to the context.

   The timing and content of transdisciplinary research should be adapted towards the needs of the relevant actors (Casado-Caneque & Hart, 2015). Understanding their living conditions, their background, and their time availability will help you make more accurate suggestions on to how to improve SBMs.

3. Develop relationships of trust.

   Improving trust (Rivera-Santos and Rufín, 2010) can be done by: (a) creating trustful relationships, (b) working together with all kind of intermediaries, – or by (c) simply being transparent about what your needs are and what you can contribute to the community.

4. Be flexible.

   Researchers may want to be flexible in adapting their research focus to what the field finds relevant. SBM quarrels may change substantially over time (Chmielewski, Dembek and Beckett, 2020), so relevant transdisciplinary research should take such changes into account.

5. Present your ideas to stakeholders.

   Researchers typically work in a monodisciplinary fashion. However, they should adopt an open attitude towards other disciplines (Bracken et al., 2015). We simply recommend systematically presenting individual research ideas at different stages of the process to scholars from other disciplines and to non-academic actors. This methodological tactic not only provides continuous feedback but also gives researchers from various disciplines the opportunity to throw light from different angles on your ideas and ensures that the solutions become co-created by all stakeholders.

While the 5 above-mentioned suggestions of transdisciplinary research in SBMs are advocated, it is important to note the limitations of our study. In the first place, our study is restricted by the exclusive focus on vulnerable entrepreneurs. Although we openly admit that vulnerable entrepreneurs are a very specific context of SBMs, we are convinced that the challenges of information asymmetry apply to a broad variety of sustainable business models. Therefore, a future avenue for transdisciplinary research could be to extend it to a variety of SBM contexts, apart from the context of vulnerable entrepreneurs. Secondly, our study is constrained by its geographical context, i.e. 4 cities in Bolivia. Future transdisciplinary research should take place in other geographical contexts as well (Lang *et al.*, 2012). A third limitation of our study is our use of qualitative research. Please note that transdisciplinary research may be perfectly well conducted in the form of surveys, experiments and any other forms of quantitative research. A fourth and a final limitation of our study is the focus only on the theoretical lens of information asymmetry, whereas a variety of theoretical lenses may further enhance the argumentation for transdisciplinary research of SBMs.

The creation of cumulative knowledge in SBMs based on transdisciplinary research implies a serious reflection on the above-mentioned limitations and opportunities for future research. In addition, we note that it is not self-evident to conduct transdisciplinary research as it presumes intense contact within academic and nonacademic fields. Yet, the development of tools and the gathering of resources that can help social entrepreneurs constitute powerful avenues for future research. Despite all challenges of information asymmetry in SBM research, this field of research remains an important contributor to sustainable development. Overall, we may conclude that transdisciplinary research can help us embrace the complexity of sustainable business models, find practical solutions for their scalability and as such is a much-needed additional methodological tool in the field.

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Appendix 1: Interview protocols

Questionnaire for Entrepreneurs

1. Tell me about yourself (studies, family situation (kids, married, brothers, profession…)
2. Can you describe your day-to-day routine?
3. What product/service is being provided?
4. To whom?
5. How many customers have been served?
6. Where are you providing your products/services?
7. What are the major costs of your activity (materials, labor,…)?
8. How is your activity funded?
9. Do you consider yourself as an entrepreneur?
10. Is there an entrepreneurial culture in San Jose?
11. What are the main problems of your business activity?
12. What type of support do you need as an entrepreneur (financials, networking, legal, coaching,…)?
13. What are the organizations or people in Bolivia (San Jose, Santa Cruz, etc.) who can support of entrepreneurs like yourself?
14. Are you part of a network or a group? Can you describe how's that working?

Questionnaire for organizations

1. Can you describe the mission of your organization? (Association, NGO, Government, Training, Financing, Education, Other)?
2. Describe your organization: legal status, years of operation, founders, capital, top management, board of directors (if applicable) and other relevant information about the management of the organization.
3. Is there a culture for Entrepreneurship in San Jose de Chiquitos? What is the most relevant activity for entrepreneurs in San Jose de Chiquitos?
4. What is your relationship with Entrepreneurship/ Entrepreneurs in the city of San Jose de Chiquitos?
5. Policy environment for Social (vulnerable) entrepreneurs: a. What is the role of the government in supporting entrepreneurship: programs, needs or constraints? b. What is your perception of the policy environment: ease to create new businesses, taxes, incentives, regulations, grants, other programs) c. Are there any other institutions or organizations having an influence in the organization's environment?
6. What are the principal obstacles in the local market for your organization?
7. Do you consider there is sufficient and qualified human capital to stimulate entrepreneurship/support entrepreneurs? If not, what types of profiles are missing.
8. Infrastructure: what is your perception (Electricity, Telecommunications – internet, water, gas and transport)
9. Can you please describe the Business Environment for your organization? Competitors, supply chain, informal competition, and other relevant aspects.)
10. Support: a. What type of support is available to Entrepreneurs in the city: (networking, training, mentorship, coaching, legal, funding) b. Who provides this support?
11. What do you consider is further needed to stimulate entrepreneurship in the city of San Jose de Chiquitos?
12. What are the relevant entrepreneurs/entrepreneurial organisations in San Jose de Chiquitos?

About the Authors

Claudia Alba Ortuño is PhD Student at the Department of Business at the Vrije Universiteit Brussels, Belgium. After obtaining her Master on International Business, she is preparing her doctoral dissertation on international support for enterprises at the bottom of the pyramid. Her research is on vulnerable entrepreneurs from an ecosystem point of view. She is part of the VUB Chair of Social Entrepreneurship that focus on encouraging social and student entrepreneurship. She has participated in international conferences as IABS, NBM and the Social Entrepreneurship Summit. Claudia has been mentor of Tu Beca Bolivia since 2019, a social enterprise that supports Bolivians to access international scholarships.

Nikolay A. Dentchev is Associate Professor of Entrepreneurship and Corporate Social Responsibility at Vrije Universiteit Brussel, Belgium. He holds the Solvay Business School Chair of Social Entrepreneurship at VUB, with founding partners Close the Gap and Euroclear. Nikolay is an executive board member of the International Association for Business and Society and the International New Business Model Conference Series, and co-organizer of the Social Entrepreneurship Summit. He serves as a member of the Investment Committee of Trividend, member of the Ethical Committee of Solifin, and board of directors member at VUB related incubator ICAB nv. Nikolay has (co-)authored more than 45 scientific publications, realized in various indexed journals such as *Business & Society, Journal of Business Ethics* and *Business Ethics: A European Review*. He serves as associate editor of *Business and Society Review*, and occasionally leads special issues in journals such as *Business & Society* and *Journal of Cleaner Production*.

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Dedicated Business Models: Connecting Firms' Values with the Systemic Requirements of Sustainability

Sophie Urmetzer[1]

Abstract

Purpose: The concept of *dedicated business models* is drafted to bridge the gap between the micro-level value frameworks of individual firms and the macro-level systemic requirements of sustainability transformations.

Design: Three theoretical concepts are drawn on to describe the potential relations between firms' strategies and the normative orientation of economic systems: *Dedicated innovation systems* to represent the macro-level and their *innovation paradigms* as the connection to the micro-level which is represented by *business models* employed by the individual firms. Then, the scientific literature is reviewed systematically and three propositions are developed that conceptualize dedicated business models.

Findings: Business models that contribute to an increased dedication to sustainability in innovation systems take effect on the paradigmatic level and can be expected to feature: (i) an explicit commitment to sustainability-related values; (ii) the active creation and exploitation of new networks to gain access to untapped material, technological, intellectual, and institutional resources that promise higher levels of sustainability; and (iii) mechanisms to nurture and reinforce changed demands of consumers and suppliers in terms of sustainability principles.

Limitations: The paucity of relevant literature limits the substantiation of the theoretical argument. It also lacks an empirical verification, which is beyond the scope of this conceptual paper.

Originality: The study contributes to the growing scholarship on business models by highlighting their potential effect on innovation paradigms.

Keywords: Sustainable business model, dedicated business model, innovation system, dedicated innovation system, innovation paradigm, sustainability transformation

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1 Department of Innovation Economics, University of Hohenheim, Germany. sophie.urmetzer@uni-hohenheim.de

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Introduction

Scholars increasingly acknowledge that the global sustainability challenges such as climate change, ecological degradation, the accumulation of waste in the environment, or poverty are interconnected issues that must be explored and addressed from a systems perspective (Murphy, 2012; Steffen *et al.*, 2015; Swart *et al.*, 2004). The rising awareness of the complexity of societal, environmental, and economic problems and the acknowledgement of their systemic interrelations have revived systems thinking and respective notions of governance (Abson *et al.*, 2017; Meadows, 1999; Voß *et al.*, 2006). In contrast, private firms' efforts to take account of sustainability issues in business are often based upon a rather narrow and disconnected understanding of sustainability (Whiteman *et al.*, 2013). Reporting on economic, social, and environmental performance has become the credentials for corporate sustainability (Milne and Gray, 2013) rendering these three domains competitors rather than acknowledging them as inseparable and synergistic contributors to the creation of value (Fiksel, 2003). With its exclusive focus on quantitative, direct indicators, this approach to sustainability – also referred to as the *triple bottom line* (Elkington, 2013) – ignores more qualitative and structural as well as indirect and systemic impacts of businesses. Does a car manufacturer using bioplastic for interior paneling contribute sufficiently to the solution of problems originating from the drastic increase in private transport, greenhouse gas emissions, and air pollution? Notwithstanding improvements in integrating sustainability in corporate performance reporting (e.g., via integrated reporting supported by the Global Reporting Initiative), sustainability reporting in general premises a firm-centered (inside-out) perspective grounded on economic efficiency and encourages management to make incremental improvements along business-as-usual trajectories (Alexander and Blum, 2016; Dyllick and Muff, 2016). Yet, to achieve fundamental and systemic change firms must develop an understanding of the surrounding socioeconomic system and – by adopting an outside-in perspective – contribute to its continuous innovation and improvement (Dyllick and Muff, 2016; Fiksel, 2003).

One well-established framework to analyze systems in the context of progress and innovation is the notion of systems of innovation or *innovation systems* (IS) (Dosi *et al.*, 1988; Freeman, 1987; Lundvall, 1992). It considers innovation as a collective output of the systemic interplay among scientific, political, and business actors who continuously exchange knowledge according to given rules and structures. It has been widely acknowledged that the configuration and functioning of IS generally affects the dynamic characteristics and the development of its elements (i.e., firms, research and political institutions, etc.) (Dantas and Bell, 2011; Lundvall, 2007; Motohashi, 2005). However, the specific effect – vice versa – of individual management decisions within firms on the setup and outcome of the IS has not been explored very well. This results in a very vague conceptualization of the role of the firm in IS generally, which also holds for the characterization of the established firms' contributions to sustainability transitions. While literature about motivations and incentives for firms to engage in sustainability abounds (see, e.g., Ariely *et al.*, 2009; Bossle *et al.*, 2016; Dangelico and Pujari, 2010; Hahn and Scheermesser, 2006; Mahoney *et al.*, 2013), it is generally agreed that the dominant economic systems in their present form do not naturally promote such behavior (Hawken *et al.*, 2013; Jackson, 2009; Porter and Kramer, 2011; Schweickart, 2009). Therefore, transitions researchers have commonly framed currently successful firms as part of the problem that must be overcome in order to destabilize present unsustainable regimes (Geels, 2014). Accordingly, relatively recent conceptual advancements of IS for sustainability (Lindner *et al.*, 2016; Pyka, 2017; Urmetzer and Pyka, 2021) also neglect the potential contribution of currently powerful private actors in realizing normative improvements of the system. This underestimation is worrying considering the influence, power, and sheer number of incumbents that can hardly be entirely substituted before long (Wells and Nieuwenhuis, 2012). Luckily, the first studies of the transformative role of firms in sustainability transitions (Andersen and Markard, 2017; Augenstein and Palzkill, 2016; Hansen and Coenen, 2017; Loorbach and Wijsman, 2013) have started to bridge the observed disconnection between regime-conforming firms and transition endeavors.

From the micro-level perspective, a useful conceptual approach to address the effect of corporate strategies on the systemic surroundings is the *sustainable business model* framework, which connects the firm level with the systems level (Bocken *et al.*, 2014; Stubbs and

Cocklin, 2008). Accordingly, it has been shown in several studies that the systems context of a firm, in terms of natural, social, institutional, industry, and technology-specific systems, influences the design and content of sustainable business models (Morioka *et al.*, 2017). The same holds for impacts of IS on business models (BM) (Ahlstrom *et al.*, 2018; Hannon *et al.*, 2015). However, little research has been done to address influences in the opposite direction, i.e., the question in which way BM innovation impacts IS configuration. Consequently, the evolutionary impact of BM on IS has remained rather unspecific. Against the backdrop of the urgent systemic sustainability challenges, however, it may be crucial to understand in which way the design of BM can support the fundamental changes required in the structure, the dynamics, and the outcomes of the surrounding IS.

This gap is addressed in the article at hand by posing the following research question:

> What are the characteristics of business models that have the potential to contribute to an entire innovation system's dedication to sustainability?

The business model perspective is adopted to link the micro-level orientation within firms to the mechanisms and configurations that determine outcomes on the systems level. This perspective promises insights into an individual actor's potential to contribute to systemic change. Therefore, the article does not focus on sustainable innovation (as output of an IS) as such, but explores opportunities of firms to contribute to a reconfiguration of present IS in a way that their overall capacity to produce more sustainable outcomes increases. In other words, the research at hand focuses on ways how firms can prompt a system-wide change towards a stronger systemic dedication to sustainability instead of exploring their (obviously quite limited) transformative possibilities within current IS. It provides pathways towards the better linking of concepts of management sciences with theories of innovation economics, thus contributing to the fostering of interdisciplinary BM research, which is the expressed aim of this special issue.

The following section serves as a short introduction to dedicated innovation systems and systems thinking in general, carves out the central role of paradigmatic search heuristics in innovation-driven transformation processes, and introduces sustainable business models. Section 3 presents the procedure and results of a systematic literature review on the coevolution of business models and IS. Together with the theoretical frameworks introduced in section 2, these are used to reflect on possible BM characteristics that increase firms' systemic effect on dedicated innovation systems in section 4. Three propositions summarize the discussion and facilitate further research on 'dedicated business models'. Section 5 concludes.

Conceptual Background

Dedicated innovation systems

An innovation system (IS) consists of "interacting private and public firms (either large or small), universities, and government agencies aiming at the production of science and technology …" (Niosi *et al.*, 1993: 212). This is achieved by the continuous creation and flow of new knowledge which is eventually introduced "into the economy in the form of innovations, [and diffused and transformed] into something valuable, for example, international competitiveness and economic growth" (Gregersen and Johnson, 1997: 482). Due to their history and application, IS have a strong (often implicit) focus on technological innovation, competitiveness, and economic development (Schlaile *et al.*, 2017).

Lately, however, IS research has started to also consider innovation as a source of the required radical changes in response to global sustainability challenges. This calls for an expanded framing of IS beyond the incubator of technological remedies by incorporating a system-wide dedication to the continuity and resilience of social and ecological systems, inter- and intra-generational justice, and quality of life (Daimer *et al.*, 2012; Lindner *et al.*, 2016; Schlaile *et al.*, 2017; Tödtling and Trippl, 2018; Urmetzer and Pyka, 2021; Warnke *et al.*, 2016; Weber and Truffer, 2017). Such reframing has been accomplished on a theoretical level by the conceptualization of *dedicated innovation systems* (DIS). DIS are understood as IS that "explicitly go beyond technological innovation and economic growth and allow for paradigmatic change towards sustainability: They are 'dedicated' to foster the joint search for transformative innovations" (Pyka, 2017: 3). A dedication towards sustainability can be understood as a very specific innovation paradigm

that determines the rate and direction of innovative activity towards sustainable outcomes. Based on and expanding Dosi's evolutionary notion of *technological paradigms* (Dosi, 1982), such dedication will become manifest in changed search heuristics shared by the actors of an IS. This will influence the definition of the 'relevant' problems, the knowledge claimed necessary to solve them, as well as the common understanding of what progress or 'success' means. Simply put, the conception of 'business-as-usual' changes in DIS and innovation that promotes more sustainable production and consumption patterns is no longer regarded the exception, but the rule.

While Dosi himself recognizes "the selective and focussing effect [on the selection and emergence of new paradigms] induced by various forms of *stricto sensu* non-economic interests" (Dosi, 1982: 160), it has not been explored so far *how* such noneconomic interests like the preservation of ecosystems or the well-being of current and future generations actually influence paradigms and *who* will be in the position to intentionally do so. Since the DIS approach "targets radical transformations of existing institutions …" (Pyka, 2017: 3), the powerful incumbent industries have so far not been expected to be the ones taking the lead. Due to their embeddedness in the system, firms have for a long time been regarded as incapable of influencing market structure, consumer demand, institutions, and infrastructures towards more sustainable configurations (Smith *et al.*, 2005). Firms that are currently successful naturally focus on the exploitation of existing procedures and infrastructure (Schaltegger *et al.*, 2016), thus rather supporting the continuation of current paradigms. Consequently, throughout a major part of the literature, incumbents play quite a passive role in that they only change their innovation logics under severe pressure from civil society, governments, and consumers (Penna and Geels, 2015), incentivized by imminent creative destruction from external forces (Kivimaa and Kern, 2016) or by rewarding public policy programs (Jacobsson and Bergek, 2011). Sustainability challenges are generally considered as negative externalities of production processes which are traditionally taken care of by the public sector. Likewise, social and environmental development beyond business interests is regarded to be the responsibility of the government (Kieft *et al.*, 2017; Málovics *et al.*, 2008; Steward, 2012). Consequently, corporate sustainability endeavors have usually not departed from dominant innovation paradigms in their continuing reliance on linear growth, increasing consumption, and maximized shareholder wealth (Sharma and Lee, 2012). In the conventional concept of IS such behavior is in full accordance with what is expected from incumbent private firms. In DIS, by contrast, that role might (have to) change. But how can we conceive a way of corporate behavior that is mindful to Dosi's noneconomic interests and contributes to an overall systemic dedication to sustainability?

Connecting collective and individual levels

From a systems perspective it is not easy to make out individual patterns of action that will collectively lead to a desired outcome of the whole. Instead, quite often the diverging aims of subunits together effectuate systemic outcomes that have not been intended by any of them. As Donella Meadows points out, "one of the most frustrating aspects of systems is that the purposes of subunits may add up to an overall behaviour that no one wants" (2008: 15). Consequently, if private and public organizations, universities, and government agencies each pursue their isolated, particular sustainability goals, this will hardly contribute to an overall system with the purpose of producing transformative innovations dedicated to sustainability. We know little of the systemic role of the various micro-processes within IS subsystems in innovation processes, a fact that makes the planning of deliberate intervention in systems towards desired outcomes extremely difficult if not impossible. Strong and instrumental links have been built between the IS literature and sustainability before (see Urmetzer and Pyka, 2021 for an overview), but these concepts hardly illuminated those individual orientations and mindsets necessary to afford the required transformation (Urmetzer *et al.*, 2018).

Figure 1 illustrates the relation of IS subsystems, innovation paradigms, and IS outcomes as conceptualized for this research. It pictures innovation paradigms as one central lever for the different IS actors to influence the way the IS functions and thus the kind of innovation it produces. The figure highlights the reciprocal interference between the elements shown: while the various subsystems in an IS collectively influence the innovation paradigm (thereby determining the rate and direction of the innovative output), the paradigm itself

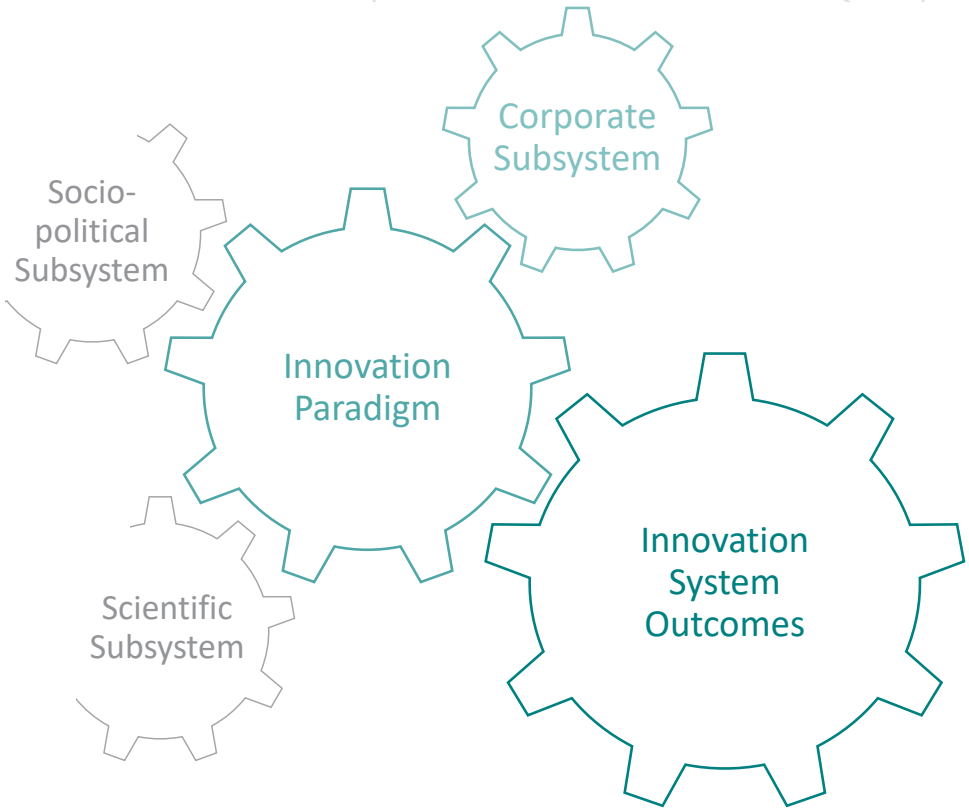


Figure 1: Interrelation of the corporate subsystems (firms) with innovation paradigms and IS outcomes as conceptualized in the context of the study. (Please note that this article explores corporate subsystems only, which is why examples of other important IS subsystems are only insinuated.)

in turn affects the innovative activity of the subsystems as well as IS outcomes.

For the individual subsystems in IS to instigate paradigmatic change and become motors of innovation dedicated to sustainability they must (i) frame the innovation challenge as systemic and sustainability related (in Dosi's terms: define the relevant problem), (ii) explore alternative heuristics and sources of knowledge production and use (in Dosi's terms: define the knowledge required to solve the problem), and (iii) change the general perception of success from (pure) profit maximization towards societal desirability (in Dosi's terms: define the meaning of progress).

An example: The automobile industry's (representing the IS) paradigmatic turn towards sustainability would require from an individual dedicated automobile company (representing a corporate subsystem) to (i) understand and reconsider its individual role in the societal challenges connected to congestion, air pollution, and climate change (what Dyllick and Muff (2016) term *the outside-in perspective*). Consequently, the company would have to (ii) open up and use their expertise to find solutions that provide mobility instead of combustion engines. The respective new search heuristics would probably require, for instance, experimentation with alternative mobility concepts and extraneous technologies, collaboration with public transport enterprises, competitors, consumer associations and citizens' initiatives, as well as adapted procurement policies. Accordingly, (iii) progress or 'success' would need to be redefined from 'faster, safer, more comfortable' to, for instance, 'cleaner, smarter, more convenient.'

Beyond corporate sustainability: The business model perspective

This systemic perspective on businesses' contribution to sustainability transformations has been argued to be in stark contrast to specific, incremental change initiatives such as traditional notions of corporate social responsibility or the triple bottom line (Miller Gaither

et al., 2018; Milne and Gray, 2013; Schaltegger and Burritt, 2018). For "reporting progress on sustainability influences stakeholders' perceptions and is therefore an important tactic, but on its own it does not appear to be a significant driver of sustainability" (Stubbs and Cocklin, 2008: 115). But even without insinuating greenwashing, against the backdrop of the overall aim to transform the IS, these endeavors must be regarded as being too narrow in focus. In its current form, corporate social responsibility actually runs the risk of contributing to the manifestation of unsustainable system configurations instead of putting the firm in "the broader context of necessary structural and systemic change that stands beyond the reach of mainstream corporate responsibility initiatives" (Waddock and White, 2007: 42; see also Bocken *et al.*, 2014; Dyllick and Muff, 2016; Hart, 1997; Sharma and Lee, 2012).

To open up towards this broader context, a suitable unit for the analysis of a firm's capacity to become a system (co-)builder of a DIS is the business model (BM). According to Teece, a BM "describes the design or architecture of the value creation, delivery and capture mechanisms employed" by a firm (2010: 179). The concept also offers great insights into businesses' roles in sustainability transformations because it ultimately reflects the way a company 'does business' (Amit and Zott, 2008). It does so by combining the firm level with the systems perspective (Bocken *et al.*, 2014; Bocken, 2019; Boons and Lüdeke-Freund, 2013; Schaltegger *et al.*, 2016; Stubbs and Cocklin, 2008) and encapsulating the belief system of a company – a fundamental driver of corporate decision-making and, subsequently, action (Martins *et al.*, 2015; Massa *et al.*, 2017; Tikkanen *et al.*, 2005).

These characteristics prompted a new line of research investigating how the underlying principles guiding the technological and social innovation of a firm can be aligned with system-level sustainability via sustainable BM (also referred to as BM for sustainability, or sustainability BM) (Bocken *et al.*, 2015; Boons and Lüdeke-Freund, 2013; Schaltegger *et al.*, 2016; Stubbs and Cocklin, 2008). Sustainable business models (SBM) "draw on economic, environmental, and social aspects of sustainability in defining an organization's purpose, use a triple bottom-line (people, profit, planet) approach in measuring performance, consider the needs of all stakeholders rather than giving priority to shareholder expectations, treat 'nature' as a stakeholder and promote environmental stewardship, and encompass a system, as well as a firm-level perspective" (Bocken, 2019: 1). The contribution of SBM to system-wide sustainability is mainly seen in a direct effect on the systemic outcomes, such as a reduced resource impact through circular production or through the provision of a service instead of a product. While such concrete outcomes are indeed necessary and as innovative ideas most welcome, we must suspect that a diffusion of such BM will be slow to reach scale and momentum will not necessarily be created (Bocken *et al.*, 2014). Coming back to what has been argued before, one of the reasons may be that SBM can be expected to occur within established paradigms. BM for DIS, by contrast, aim for a *paradigmatic change* by introducing a dedication to sustainability as normative direction in innovation processes across the entire (innovation) system. In other words, SBM change individual configurations and isolated outcomes in socio-technical systems, whereas BM for DIS are expected to change the innovation paradigms thus influencing the inner logic of innovation across the system.

Coming back to the example of the automobile industry of the previous section, an SBM would be restricted to the given problem definition (e.g., combustion engines fuel climate change), the known solution space (e.g., technological alternatives to combustion engines or increased efficiency in resource use), and the agreed definition of success (mostly measured in economic terms).

To sum up, I have chosen the BM perspective as a suitable unit for exploring the potential power of firms to change the paradigmatic underpinnings of innovation in IS towards a dedication to sustainability. Dosi's notion of technological paradigms is expanded to provide a framework that connects individual actors' orientations (as expressed by a specific BM) with the systemic outcomes produced by the IS via modifications in the innovation paradigm (as expressed by an understanding of what problems need to be solved, what solutions need to be picked, and how success needs to be defined, shared across the IS) (see figure 2).

Although notions and usage of BM vary widely across literature and practice, the following three fundamental elements are generally seen to make up a BM (Bocken *et al.*, 2014) and shall serve as the baseline for

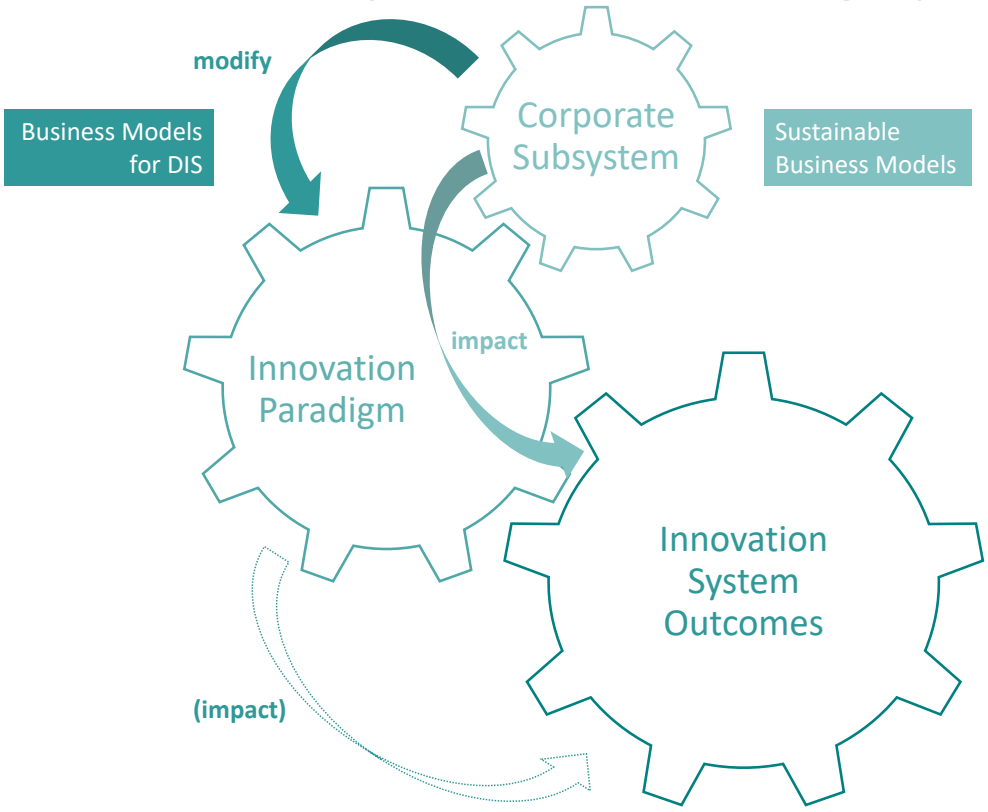


Figure 2 The different modes of action of SBM (right) and BM for DIS (left): While the former impacts IS outcomes on the basis of a given paradigm, the latter is expected to operate through actively modifying paradigms (via redefining problems, solutions, and success), thus potentially affecting IS outcomes indirectly.

exploring the systemic relationship between BM and DIS: (1) value proposition (the way to describe the product or service offered), (2) value creation and delivery (the way new business opportunities are created and realized), and (3) value capture (the way revenues are earned from the provision of goods or services).

The following section presents a systematic review of the literature to map the coevolutionary relationships between BM and IS discovered and described by earlier research. The findings will serve as a basis for developing three propositions for outlining the contours of dedicated BM.

Business Models in Innovation systems

An increasing number of studies have explored the role of BM in socio-technical systems transitioning to sustainability (Bocken *et al.*, 2014; Bocken and Short, 2016; Boons and Lüdeke-Freund, 2013; Schaltegger *et al.*, 2012, 2016; Stubbs and Cocklin, 2008). In the following, I will zoom in on the intricate relationship between (changes in) the corporate innovation rationale (as embodied in BM) and the introduction of a dedication towards sustainability across the IS.

Methodology and data

To explore the literature on BM in the context of IS, a systematic literature review was carried out (Kivimaa *et al.*, 2019; Petticrew and Roberts, 2008). A scientific literature repository search based on keywords was conducted using Scopus – a database which has been proven to excel in covering literature in social sciences and outcompeting other repositories, such as Web of Science (Bartol *et al.*, 2014; Gavel and Iselid, 2008; Mongeon and Paul-Hus, 2016). It was explicitly searched for research contributions at the interface of BM and IS to gain insights into conceptual work on

the coevolutionary relation of the two. The selection of articles was completed in four steps. First, the database was browsed combining the search terms "business model" AND ("innovation system" OR "system of innovation") in the title/abstract/keywords fields, which yielded 74 items. The publication had to be (1) a peer-reviewed piece of academic work in the field of social science and business studies and (2) indexed in Scopus as of April 4, 2019. Second, the respective article abstracts were carefully analyzed using the following exclusion criteria: (3) Articles that used one of the search terms in a fundamentally different sense were excluded (i.e., the term "business model" needed to be used in the sense of design or architecture of the value creation, delivery, and capture employed by a firm (Teece, 2010), whereas "innovation system" needed to refer back to the evolutionary framework as described by the fathers of the concept (e.g., Freeman, 1987; Lundvall, 1998)); (4) articles that treated the two focal key concepts only superficially or separately without addressing their interplay were excluded from the analysis. Abstract reading resulted in a selection of 37 articles, of which 22 were omitted based on reading the full papers (exclusion criteria 3 and 4), resulting in 15 articles feeding into the next step. This involved searching the reference lists of the selected 15 articles for earlier relevant contributions, also considering terms with similar meaning. This "backward citation snowballing" added two articles to the analysis. The "cited by" option in Google Scholar helped to carry out a "forward citation snowballing" for each of the 17 articles. The resulting list of citing articles was then scanned according to the above exclusion criteria. This offered an additional set of three new articles. The final list of articles considered in the systematic review numbered 20. All the articles were read and coded according to the following criteria: The type of IS covered (IS in general, technological, national, regional, or sectoral IS), the business/industrial sector studied, the consideration of sustainability (yes or no), the BM element in focus, the BM definition, the question addressed by BM (what, how, for whom), the empirical field explored, the relation of BM and IS (which influencing which), proposed points of intervention, the research question, the formulation and addressee of recommendations, the focus (economics, business administration, or politics), the related theories covered, and central statements (citations).

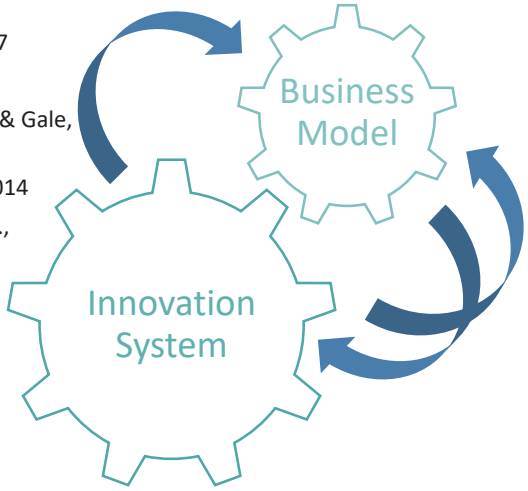
Results

The way business models operate in IS and how specific IS configurations and functions affect business models has rarely been studied. The number of studies has increased over time though, with four of the articles published between 2000 and 2009 and 16 between 2010 and 2019. This approximately concurs with the period during which the two concepts evolved (Klein and Sauer, 2016; Massa *et al.*, 2017). Most of the articles either refer to national IS (six articles) or to technological IS (six articles), while three studies explore regional IS, one a sectoral IS, and the remainder just use IS as a general approach without specifying a particular level of analysis. The types of industry studied vary greatly, from low-tech fields (agriculture, gardening) to high-tech sectors (nanotechnology, biotechnology) and typical "transitions industries" such as the energy or the mobility sector. Nine publications – and since 2014 almost all of them – explicitly consider the contribution of BM to sustainability in IS. This observation and the fact that also the sustainability transition community is increasingly discovering BM research (Bidmon and Knab, 2018) confirms the general suitability of this concept to explore long-term systemic transitions from a micro perspective (Arevalo *et al.*, 2011).

The notion of the term BM varies across the publications, ranging from encompassing certain innovation and marketing strategies of the focal firm (Casper, 2000), an "interplay between innovation strategies and resources" (Markard and Truffer, 2008: 460), the organizational method of how the firm does business (Kalvet, 2010), to how it creates, proposes, and/or captures value (Adams *et al.*, 2016; Breznitz, 2007; Grin *et al.*, 2018; Hannon *et al.*, 2015; Provance *et al.*, 2011; Sarasini and Linder, 2018). Not surprisingly, those authors who stress the *value creation* element of BM also appear to be the ones that ascribe to BM an active role in shaping the IS (Grin *et al.*, 2018; Kishna *et al.*, 2017; Yun *et al.*, 2017). From this perspective, firms no longer only respond to the demands and interests of customers, policy, or competitors, but partake in defining what is of value.

About half of the selected studies describe the relation between BM and IS as being purely unidirectional, in that the authors do acknowledge the influence of different IS configurations and specifications on the

1. Ahlstrom D., Yang X., Wang L., Wu C., 2018
2. Atteridge A., Weitz N., 2017
3. Segers J.-P., 2016
4. Hannon, M. J., Foxon, T. J., & Gale, W. F., 2015
5. Laukkanen M., Patala S., 2014
6. Provance M., Donnelly R.G., Carayannis E.G., 2011
7. Kalvet T., 2010
8. Breznitz D., 2007
9. Casper S., 2000



1. Bidmon, C.M., Knab, S.F., 2018
2. Grin J., Hassink J., Karadzic V., Moors E.H.M., 2018
3. Sarasini S., Linder M., 2018
4. Kishna, M., Negro, S., Alkemade, F., Hekkert, M., 2017
5. Planko J., Cramer J., Hekkert M.P., Chappin M.M.H., 2017
6. Yun J.J., Won D., Park K., Yang J., Zhao X., 2017
7. Adams, R., Jeanrenaud, S., Bessant, J., Denyer, D., Overy, P., 2016
8. McCall T., 2013
9. Musiolik, J.; Markard, J.; Hekkert, M., 2012
10. Chiaroni D., Chiesa V., De Massis A., Frattini F., 2008
11. Markard, J., Truffer, B., 2008

Figure 3 The relation between BM and IS: While nine publications describe an effect of IS on BM (single arrow, to the left), eleven studies explicitly refer to an effect of BM on IS or a mutual relationship (double arrow, to the right).

emergence of certain BM but not vice versa. Some of those scholars, for instance, show how national institutional frameworks influence organizational structures and innovation strategies of individual firms (Ahlstrom *et al.*, 2018; Casper, 2000) or whole industries (Breznitz, 2007) (figure 3, left).

The remaining eleven papers of the set of publications either describe the mutual relationship of BM and IS (Adams *et al.*, 2016; Bidmon and Knab, 2018; Grin *et al.*, 2018; Kishna *et al.*, 2017; Planko *et al.*, 2017; Sarasini and Linder, 2018) or explicitly scrutinize different ways of how business models have been found to change the configuration or behavior of IS (Chiaroni *et al.*, 2008; Laukkanen and Patala, 2014; Markard and Truffer, 2008; McCall, 2013; Yun *et al.*, 2017) (figure 3, right). Of this latter half, three studies (Laukkanen and Patala, 2014; Markard and Truffer, 2008; Planko *et al.*, 2017) analyze the effect of BM according to their ability to drive IS processes, conceptualized by various scholars as *functions* of technological innovation systems (Bergek *et al.*, 2008; Hekkert *et al.*, 2007; Jacobsson and Bergek, 2004). The functions offer a validated concept to break down overall IS performance and thus provide the theoretical foundation for empirical studies on the interface between the system and the actors. Markard and Truffer (2008), for example, consider the IS as composed of a variety of actor groups each contributing a specific set of resources and innovation activities necessary to fulfil the basic functions of the IS (knowledge creation, guidance of the search, supply of resources, the creation of positive externalities, and market formation). Although in their analysis the authors do not explicitly consider BM, they do come close to the concept by distinguishing three different corporate innovation strategy types: leading, learning, and image shaping. They conclude that firms adopting a leading innovation strategy can actively shape IS trajectories by (strongly) influencing all system functions, especially the direction of innovation (function: guidance of search). The two other studies that draw on systems functions (Laukkanen and Patala, 2014; Planko *et al.*, 2017) use the concept rather to describe different setups of IS while not further elaborating on the potential impact of BM on the fulfilment of the IS functions.

One recurrently identified role of firms in shaping IS via BM is that of system builders (Adams *et al.*, 2016; Grin *et al.*, 2018; Musiolik *et al.*, 2012) or network and cluster creators/changers (Adams *et al.*, 2016; Bidmon and Knab, 2018; Kishna *et al.*, 2017; Musiolik *et al.*, 2012; Yun *et al.*, 2017). Musiolik and colleagues (2012) analyze the potential of individual organizations and formal networks to pool their abilities, influence, and endowments (referred to as resources) to strategically change

Potential BM effects that impact IS	References
1. Open communication of new visions and paradigms	Laukkanen and Patala, 2014; Grin et al., 2018
2. Networking with peers and other allies	Yun et al., 2017; Adams et al., 2016; Kishna et al., 2017; Bidmon and Knab, 2018; Musiolik et al., 2012; McCall, 2013; Planko et al., 2017; Sarasini and Linder, 2018
3. Collaboratively aligning existing institutions	Grin et al., 2018; Yun et al., 2017
4. Reconfiguring supply chains	Kishna et al., 2017; Laukkanen and Patala, 2014; Bidmon and Knab, 2018; Sarasini and Linder, 2018; Musiolik et al., 2012
5. Stakeholder involvement	Adams et al., 2016; Laukkanen and Patala, 2014
6. Educating consumers and suppliers	Chiaroni et al., 2008; McCall, 2013; Planko et al., 2017; Grin et al., 2018
7. Creating legitimacy and new markets	Grin et al., 2018; Planko et al., 2017

Table 1 BM effects observed to actively influence the IS they are part of as found in the literature reviewed.

the IS they are part of. In a literature review, Adams and colleagues (2016) find evidence that establishing more sustainable systems requires firms to proactively and radically change their philosophy and behavior, be creative, acquire new knowledge, redefine their purpose in society, and collaborate with peers, government, and NGOs. The latter requirement, i.e. to collaborate with others in order to increase the business's impact on systemic outcomes, is brought up by six studies examined (Adams *et al.*, 2016; Grin *et al.*, 2018; McCall, 2013; Musiolik *et al.*, 2012; Planko *et al.*, 2017; Sarasini and Linder, 2018).

A few interesting additional points are made by McCall (2013), who emphasizes the important role of collaboration to increase a firms' success. Working together with others helps to strengthen regional competitiveness, facilitate long-term planning among traditionally rather short-term considerations of single firms, and share and improve knowledge and competences. Further possibilities for businesses to shape IS include the creation of legitimacy and new markets (Grin *et al.*, 2018; Planko *et al.*, 2017), the creation and diffusion of knowledge relevant for systems change (including, e.g., consumer awareness campaigns or technical know-how) (Chiaroni *et al.*, 2008; Grin *et al.*, 2018; McCall, 2013; Planko *et al.*, 2017), an open communication of alternative visions and paradigms (Grin *et al.*, 2018; Laukkanen and Patala, 2014), and the active destruction of current institutions (e.g., practices or regulations) (Grin *et al.*, 2018; Yun *et al.*, 2017). An overview of the possibilities of firms to influence IS via their BM is given in table 1.

Discussion: Business Models for Dedicated Innovation Systems

The literature on the potential impact of BM on the functioning of IS is scarce and lacks concrete implications for research as well as for practice. Against the conceptual background of DIS and the expected nature of BM in DIS as unraveled in section 2, a concrete indication of an IS-wide paradigm-changing effect of BM is missing. The findings, however, do provide insights that help us to better understand the potential of incumbents to introduce a dedication to sustainability into the entire IS by changing their BM in a certain way. This section will discuss some of the findings and use them to conceptualize the elements of BM effective in DIS.

With reference to what has been deducted in section 2, the introduction of a dedication in IS must be conceptualized as paradigmatic change through the alteration of the search heuristics. The literature analyzed suggests that IS influence the development and behavior of firms and are at the same time influenced by firms and other important subsystems, such as policy, science, and civil society. Furthermore, it has been acknowledged that BM can be understood as an internal agreement of a firm on how business is done. As such,

BM of firms in an IS collectively cocreate (together with other important IS subsystems that are not considered here) the baseline of its innovation paradigms, which means that the collective of BM in an IS determine its problem definition (in the following referred to as *Dosi I*), its search heuristics (including *what* to search and *where* to search, in the following referred to as *Dosi II*), as well as its definition of what successful innovations are (in the following referred to as *Dosi III*). Businesses are thus capable of changing innovation paradigms, for instance towards more sustainable modes of production, by innovating their BM. The research question posed at the outset of this article regarding the characteristics of BM that contribute to an IS's dedication to sustainability shall be answered by the following discussion of the results and the successive formulation of propositions to guide further research. The propositions are summarized in the subsequent figure 4.

Value proposition

The fundamental philosophy behind a firm's business is reflected in the way how and in relation to whom it proposes the value it intends to create. A proactive shift in an incumbent firm's value proposition, e.g., away from pure profit maximization towards attending societal goals, must thus be regarded crucial for a firm intending to shape IS towards a dedication to sustainability. One possible expression of the commitment of a firm to such change is the exposition of innovation behavior that takes on a leading position within an industry. Albeit not in a sustainability context, Markard and Truffer (2008), for instance, substantiate the power of firms that adopt a leading innovation strategy to actively shape an IS's paradigm by (strongly) influencing all system functions, especially the direction of innovation (function: guidance of search). The empirical evidence points to the power of a changed value proposition to co-determine innovation paradigms – a potential with strong implications for the dissemination of a dedication to sustainability (see also Schaltegger *et al.*, 2012). Some authors bring to mind that such changes in value proposition relating to the core business logic are systemically most effective when undergone in collaboration with peers (Adams *et al.*, 2016; Grin *et al.*, 2018; Vargo *et al.*, 2015), since "the ultimate objectives of sustainability lie beyond the individual capacity of firms to achieve" (Adams *et al.*, 2016: 193).

Such BM innovation concerning the value proposition can be regarded the decisive link between firm-level dedication and its proliferation throughout DIS: it extends the decision-making basis for innovation strategies traditionally comprising cost, risk, margin, reputation, and innovative capability (Schaltegger *et al.*, 2012) towards sustainability-related value propositions ranging from the reduction of social and environmental harm to an increase of positive impact or solving societal challenges (Bocken *et al.*, 2014). Following this and based on reflections of other scholars (Abdelkafi and Täuscher, 2016; Miller Gaither *et al.*, 2018; Schaltegger *et al.*, 2012; Schaltegger and Burritt, 2018), it seems that the degree of dedication of corporate sustainability endeavors, as reflected in bold value propositions, correlates with their potential effect on the IS-wide innovation paradigm. That way, firm-specific value propositions hold the power to contribute to the IS's dedication towards alternative values that, for instance, promote more sustainable systemic outcomes. The literature review has shown that open communication of such extended visions and paradigms is essential if IS are to be affected (Grin *et al.*, 2018; Laukkanen and Patala, 2014) (see table 1, no. 1).

> **Proposition 1:** The value proposition of a BM that contributes to IS' dedication towards sustainability reflects a firm's commitment to sustainability-related values and open communication of the same. This way a firm can act upon the IS-wide problem definition (Dosi I: problem definition).

Value creation and delivery

It has been suggested that firms which make a conscious decision regarding the business opportunity they aim to seize by emphasizing the value creation and delivery element in their BM tend to have a strong influence on the evolution of the surrounding IS (Grin *et al.*, 2018; Kishna *et al.*, 2017; Yun *et al.*, 2017). In fact, value creation is seen as being "at the heart of any business model" (Bocken *et al.*, 2014: 43). In the context of shaping alternative paradigms, changes in the operational aspects of business, such as the determination of key activities, resources, stakeholders, and technologies bear a special meaning. This is the part of the BM where decisions regarding the search heuristics for innovative activity become manifest. For subordinating one's innovation activity to an alternative paradigm, it

can, for instance, be fundamental to determine new sources of knowledge (outside the traditional expertise and suppliers) by seeking new collaboration partners. This could improve the success of the adoption of whole new value creation concepts as provided, for instance, by a circular business model disrupting the traditional take-make-waste industrial logic (The Ellen MacArthur Foundation, 2013). For a reduction of uncertainty in innovative endeavors for the value creation and delivery, various authors recommend the involvement of the surrounding IS by networking with peers and other allies (Adams *et al.*, 2016; Bidmon and Knab, 2018; Kishna *et al.*, 2017; McCall, 2013; Musiolik *et al.*, 2012; Planko *et al.*, 2017; Sarasini and Linder, 2018; Yun *et al.*, 2017) to collaboratively align existing institutions (Grin *et al.*, 2018; Yun *et al.*, 2017) and to eventually reconfigure traditional supply chains (Bidmon and Knab, 2018; Kishna *et al.*, 2017; Laukkanen and Patala, 2014; Musiolik *et al.*, 2012; Sarasini and Linder, 2018) (see table 1, no. 2, 3, and 4).

> **Proposition 2:** The value creation and delivery of a BM that contributes to IS' dedication towards sustainability draws on unprecedented linkages within the IS that provide access to new material, technological, and intellectual resources to reach higher levels of sustainability. This way a firm can act upon the diffusion of alternative directions of search across the IS to reach a critical mass (Dosi II: search heuristics).

Value capture

The impact that modified value capture strategies of a firm have on the degree of dedication within an IS has not been studied much. As long as value is interpreted in purely monetary terms, strategies for its capture can be expected to be a barrier rather than a driver of BM innovation towards DIS. Bocken and Short (2016) present a few cases where firms accommodate their sustainability engagement by charging a premium price for a more durable product and/or a better after-purchase service. Such BM innovation, albeit not paradigm-breaking in itself, indeed has the potential to instigate paradigmatic change in IS, for instance by introducing the sufficiency principle to the logic of innovation. This could also motivate other firms to shift towards the provision of robust and long-lasting products, taking advantage of and reinforcing consumers' preference for high-quality products or of the benefits of consuming a service instead of owning a product. At the same time, it would change the definition of innovation success, and of progress for that matter. An innovative product would feature, for instance, characteristics such as a prolonged lifetime, easier accessibility, and smart resource usage. Along these lines, the product service systems (PSS) hold some potential for dedicated BM innovation. A PSS has been defined as "a system of products, services, supporting networks and infrastructure designed to be competitive, satisfy customer needs and have lower environmental impact than traditional business models" (Mont, 2002: 239). The sustainable PSS concept offers an approach to value capture which takes account of the ability of producers to influence supply and/or consumption and thus altering innovation paradigms. By offering services in connection to products, firms have the chance to persistently alter producer and consumer practices in a way that reduces material input and increases utility (Mylan, 2015). Accordingly, value capture innovations effective on the IS level have generally been found to require the capacity to involve a broad array of stakeholders (Adams *et al.*, 2016; Laukkanen and Patala, 2014), to educate consumers and suppliers (Grin *et al.*, 2018), and thus create legitimacy and new markets (Grin *et al.*, 2018; Planko *et al.*, 2017) (see table 1, no. 5, 6, and 7).

> **Proposition 3:** The value capture of a BM that contributes to IS' dedication towards sustainability nurtures changed demands of consumers and suppliers who acknowledge sustainability principles, such as the superiority of quality over quantity or utility over ownership. This way a firm can act upon the general perception of innovation success among IS subsystems (Dosi III: definition of success).

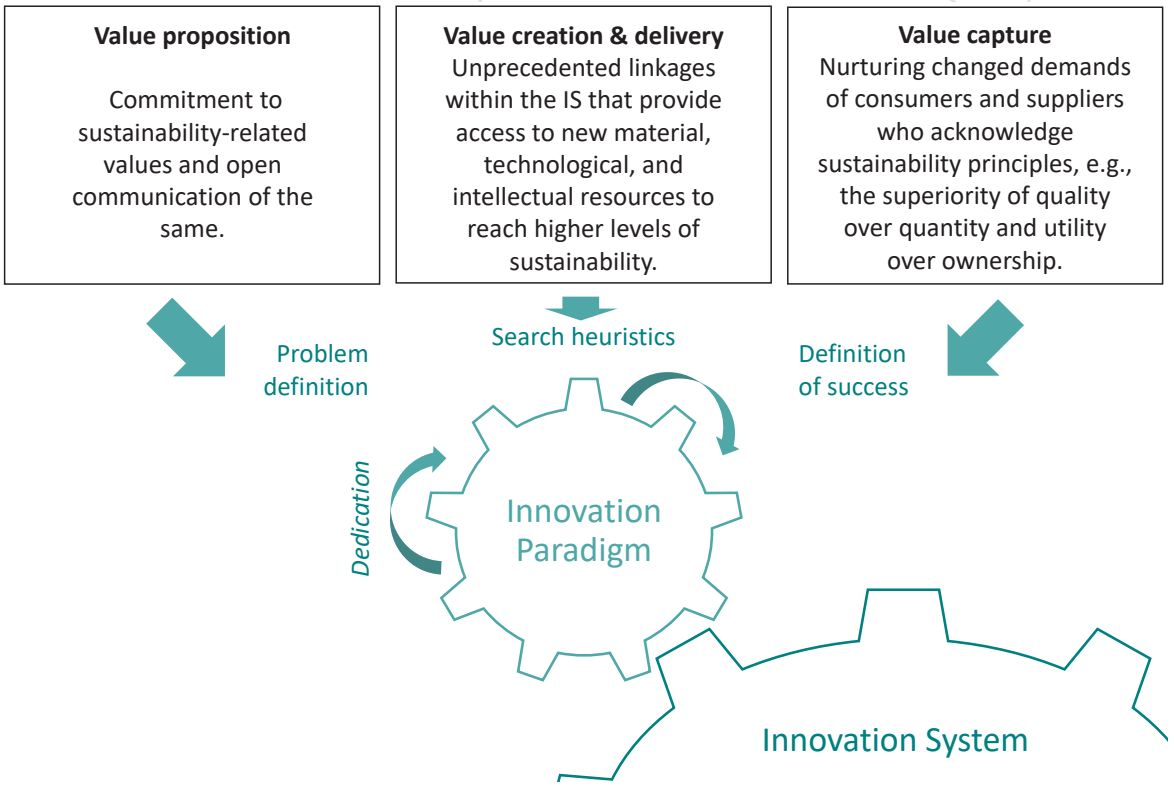


Figure 4 Overview of the elements of BM that potentially contribute to IS' dedication towards sustainability by changing the innovation paradigm.

Conclusion

It has been argued that enterprises can only be considered sustainable when the system of which they are part is sustainable (Jennings and Zandbergen, 1995). Following the arguments made in this article, however, this fact does not release incumbent firms from their responsibility to contribute to sustainability transformations. A systematic review of related literature together with a conflation of several strands of theory has revealed linkages between individual strategic decision-making (as expressed by BM) and the paradigmatic underpinnings of innovation across the entire IS. It has been shown that firms have the potential to contribute to the dedication of IS by (1) redefining the 'relevant' problems and acknowledging their role in them; (2) opening up their search heuristics to gain the knowledge claimed necessary to solve these problems; and (3) propagating a common understanding of what 'success' means in this context. Firms will however only be successful in collaboration with other IS actors (government, consumers, civil society, entrepreneurs, competitors, academia). This is how they will be able to distribute the burden of risk, create legitimacy, and contribute to changing market paradigms. Combining the findings of this study with how Bocken and colleagues frame sustainable BM (Bocken *et al.*, 2014: 44), the following definition of a BM that contributes to the dedication of IS towards sustainability or *dedicated business model* is proposed: "A business model that significantly changes the innovation paradigm of the entire innovation system towards the principles of sustainability, through describing and disseminating the way the organization and its value-network define, create, deliver, and capture value."

The concept of dedicated BM originates from the idea that for deliberately transforming a system, a change in individual parameters (e.g., via the substitution of a certain production input) or isolated linkages (e.g., via direct marketing) offers a lower degree of leverage than changes in the logic or the paradigm according to which the system functions (e.g., via a redefinition of problems, solutions, and success factors across an entire system or sector). Much alike (and inspired by)

Donella Meadows' concept of *leverage points* (1999), such intentional paradigmatic changes are rare and far harder to implement than changes at lower levels of intervention. This is presumably why concrete empirical examples of dedicated BM are yet to be discovered.

The limitations of the study are twofold. Firstly, the line of argument is complemented by a relatively small sample of literature reviewed, which is owed to the fact that the mutual relation between BM and IS has not been researched much so far. The second limitation arises from a lack of explanatory power by a 'theory of the dedicated firm,' which neglects the incentives and barriers for firms to change their BM. Discussions of these issues with sustainability leaders of large incumbent enterprises reveal various ontological issues, such as the heterogeneity within corporate management, uncertainties regarding future sociopolitical developments, and the volatility of societal values (see also Garst *et al.*, 2019). These are some of the reasons why the paper comes up with rather generic implications that are not yet mature enough to guide dedicated management endeavors. Increasing the practical relevance and refining the conceptual base of BM innovation towards DIS will require further research, e.g., by testing the propositions posed above in empirical cases. Future conceptual research could inquire into the impact of BM on individual IS functions (building on Markard and Truffer, 2008) or explore the suitability of dedicated BM to complement Bocken and colleagues' SBM archetypes (2014). Moreover, empirical substantiation is required to test the concept against what is presently available and potentially feasible under real-world circumstances.

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About the Authors

Sophie Urmetzer graduated from the University of Applied Sciences Eberswalde and the University of Aberdeen in International Forest Ecosystem Management (BSc). She received her second degree in Sustainable Resource Management (MSc) at the Technical University of Munich (TUM) specializing in Renewable Resources and Environmental Economics. Between 2005 and 2011 she was employed as scientific coordinator in study management at TUM. In 2013, she commenced her position as research assistant at the Chair of Innovation Economics at the University of Hohenheim, where she obtained her PhD degree in 2020. She is engaged in research on national innovation systems and explores the particularities of transformation paths towards a knowledge-based, sustainable bioeconomy.

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