Business experimentation for sustainability: emerging perspectives

Editorial: Special Issue Business Experimentation for Sustainability

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1. Introduction

Natural resource and climate change pressures are becoming increasingly urgent and businesses need to adapt their way of generating social, environmental and economic value, i.e. generating sustainable value (Epstein, 2018). This necessitates a clear focus on developing new technologies, products, services and business models that contribute to sustainable value for both established businesses and new ventures. Experimentation can produce learning about pressing sustainability challenges to generate evidence-based actionable knowledge (Caniglia et al., 2018). While experimentation has been the topic of transitions research and policymaking involving different actors, such as citizens, business, science, NGOs and governments (e.g. Hildén et al., 2017; Sengers et al., 2016), this Special Issue focuses on the role of business in conducting experimentation for sustainability, referred to as Business Experimentation for Sustainability (BES). The purpose of BES is to learn about aspects of novel products, services and ways of sustainable value generation with limited risks and resources (Antikainen et al., 2017; Weissbrod & Bocken, 2017).

In the natural sciences, experimentation is a method (Caniglia et al., 2017) and aims to produce evidence that is universally applicable, value-free and disconnected from context (Mitchell 2009). In business literature, experimentation has been linked to innovating for future competitiveness through generating novel solutions (Chesbrough, 2010), but it has also been described as a research method (Bryman & Bell, 2015). Within the sustainability and business context, experimentation differs, however, significantly from the more value-free experimentation approach of the natural sciences. Experimentation with the goal of enabling and developing business activities towards sustainable value creation with products and services is always closely connected to values and the business operation context (Weissbrod, 2019). In fact, values were even identified as a key enabler and context of business experimentation for sustainability (Weissbrod & Bocken, 2017). The importance of context for

business experimentation for sustainability is evident also in research on sustainability-oriented transitions, where experimentation has been described as an approach for accelerating innovations in societal transitions (e.g. Kemp et al., 1998; Luederitz et al., 2017; Sengers et al., 2016). Business experimentation for sustainability is a recent field of research, with early publications looking into sectors like solar PV (e.g., Jolly et al., 2012; Huijben & Verbong, 2013) and later contributions on the circular economy (e.g., Antikainen et al., 2017; Bocken et al., 2018). The ever-changing business operating context and quickly advancing and changing sustainability challenges increase the importance of this emerging research field. This special issue (SI) explores business experimentation for sustainability as a concept to advance business transitions towards sustainability.

The remainder of this editorial is structured as follows: first, the concept of business experimentation for sustainability and recent advances are discussed. This is followed by an overview of the six contributions to this SI and potential future research questions, followed by concluding thoughts on the development of the field.

2. Advances towards Business Experimentation for Sustainability

We reason that generating evidence-based actionable knowledge is a key requirement for businesses to produce products and services with sustainable value. This SI has the objective to further the understanding of what this might mean, both for large established businesses and new ventures and with different innovation types (i.e., technology, product, business model, value chain, ecosystem). First, we discuss experimentation in business literature as one of the ongoing research fields (Section 2.1), followed by the field of experimentation for sustainable development (Section 2.2), and the research gap of business experimentation for sustainability (Section 2.3).

2.1. What is Business Experimentation?

Business experimentation is a concept in mainstream business literature (Andries et al., 2013; Bojovic et al., 2018; 2019) and has been increasingly adopted in business practice (Felin et al., 2019; Osterwalder et al., 2014; Ries, 2017; Thomke, 2001).

The role of business experimentation in customer development and experience, as well as business model innovation, is a recent development (Thomke, 2020). First, experimentation is viewed as a method within management studies (e.g. Bryman & Bell, 2015; Chatterji et al., 2016). Chatterji et al. (2016) for example refer to the method of field experiments where researchers randomly assign research subjects to a treatment and a control group to answer otherwise difficult to investigate questions and identify causal relationships. Second, experimentation is approach to (optimizing) business innovation (e.g. Andries et al., 2013; Bojovic et al., 2018; 2019; Zollo et al., 2013; Thomke, 2020). Thomke's (2001) concept of 'enlightened experimentation' is about organizing for rapid experimentation; failing early an often but avoiding mistakes; anticipating and exploiting early information and combining new and traditional technologies. Zollo et al. (2013) describe the need for an evolutionary process of discovery and refinement to explore what constitutes a sustainable enterprise.

Practitioners such as Ries (2011; 2017), Blank (2013), Osterwalder et al. (2014) and Bland and Osterwalder (2020) also discuss experimentation as an innovation approach by companies. Business experimentation may be referred to as "[a] procedure to validate or invalidate a value proposition or business model hypothesis that produces evidence" (Osterwalder et al., 2014, p.

216). Experimentation can generate immediate learning and lead to practical insights, without excessive resource and time expenses (Osterwalder et al., 2014; 2020). Business experimentation from this innovation perspective on the one hand has been described as a more structured process of building, measuring and learning based on a hypothesis about the customer reaction to amended or new products and services (Camuffo et al., 2017; Ries, 2011; Thomke, 2020). In contrast, it has also been described as an effectual process: paying less attention to predictive information; making do with resources at hand and stitching together networks of partnerships (Dew et al., 2009; Sarasvathy, 2001).

Experimentation in a business context typically lacks some of the aspects from the experimental method in natural sciences and also has different purposes. In established businesses, immediate financial pressures and the need to attend to the current customer base hinder the potential to control experiments (Weissbrod & Bocken, 2017). Challenges to control experiments in the sustainability context lead to uncertainty of outcomes (Caniglia et al., 2017). At the same time, the governance of experiments becomes more important as controllability of experiments decreases (Hildén et al., 2017). Applied during the corporate innovation process, BES is an essential corporate capability to quickly test new sustainable value offerings (Weissbrod & Bocken, 2017). Coupled with continuous and collective learning with stakeholders, BES has been positioned as a potential way for established business to accelerate business model innovation for sustainability (Antikainen et al., 2018; Bocken et al., 2018). In contrast to established businesses, start-ups have been described as 'one big experiment' (Blank, 2013), with new ventures considered to be an important driver for advancing sustainable development in existing markets (Hockerts & Wüstenhagen, 2010). Compared to large scale pilots, experiments are smaller in scale and resource use (Osterwalder et al., 2014) and experimental learning is iterative (Ries, 2011; Tuulenmäki & Välikangas, 2011).

At the organizational level perspective, theories such as the ones on ambidexterity and dynamic capabilities are of relevance and there are clear linkages to product and process innovation, in particular disruptive and radical innovation and open innovation.

Ambidexterity in established organizations (O'Reilley & Tushman, 2013), refers to whether organizations are able to exploit (i.e. refinement, efficiency, selection, implementation and execution) and explore (i.e. search, variation, risk taking, experimentation, discovery and innovation) within the same organizational context (March, 1991). It is about the ability to compete in mature technologies and markets where efficiency, control, and incremental improvement are needed but also compete in new technologies and markets where flexibility and experimentation are required (O'Reilley & Tushman, 2013). Exploration, focused on identifying and trialing new markets and technologies, is most closely related to experimentation. The theory on dynamic capabilities proposes that competitive advantage of firms depends on distinctive ways of coordinating and combining, shaped by the firm's specific asset positions, such as the firm's portfolio of knowledge assets and other assets, and the evolutions of these (Teece et al., 1997). Dynamic capabilities are about identifying new opportunities and organizing effectively and efficiently to embrace them, summarized as sensing, seizing and reconfiguring (Teece, 2018). Dynamic capabilities have been linked to sustainable business literature and experimentation (Bocken & Geradts, 2019; Pieroni et al., 2019; Weissbrod & Bocken, 2017). For example, corporate budget for experimentation may be a good prelude for dynamic capabilities needed for sustainable business model innovation (Bocken & Geradts, 2019).

The field of radical and disruptive innovation (Bower & Christensen, 1995) focuses on new to the market or world technologies or propositions, are adjacent to this as this is the desired outcome of such processes. How to organize such innovation is the focus of the open innovation approach (Chesbrough, 2003; Chesbrough & Appleyard, 2007), paying particular attention on the extent of collaboration with others to innovate products and processes (Weissbrod, 2019).

With business experimentation as a theme in management literature, there is, still, ample of opportunity for learning about the intersections of sustainability studies with mainstream management literature.

2.2 Experimentation for sustainability transitions

Experimentation has been described as an approach for accelerating innovations in societal transitions in sustainability-oriented transitions literature (e.g. Kemp et al., 1998; Luederitz et al., 2017; Sengers et al., 2016). For example, strategic niche management suggests that "sustainable innovation journeys can be facilitated by creating technological niches, i.e. protected spaces that allow the experimentation with the co-evolution of technology, user practices, and regulatory structures" (Schot & Geels, 2008, p. 537). Whereas niches are often pushed by outsiders and fringe actors (Geels & Schot, 2007), it has been suggested that established firms also need to start pushing innovations to transform their dominant business models (Sarasini & Linder, 2018) through processes such as experimentation (Bocken et al., 2018) to accelerate much needed sustainability transitions. Experiments can produce learning and actionable knowledge on responses to pressing sustainability challenges (Caniglia et al., 2017). Critically, Hildén et al. (2017, p. 1) also note that "experimentation and experiments can contribute to transitions in very different ways and that experimentation also runs the risks of merely becoming a distraction that maintains status quo instead of contributing to transformative change". Moreover, apart from highlighting the importance of learning, repeating and upscaling, there is a lack of empirical work on how the experiments actually make a transition happen (Hildén et al., 2017).

Others have been echoing the work of Chatterji et al. (2016) in the field of conventional business literature on field experiments and argue that field experiments are a useful means to understand, for example, the drivers of energy consumption behavior (Delmas & Aragon-Correa, 2016). In particular, experimentation in cities, with a focus on urban living labs, has gained recent research attention. Living labs act as an innovation environment and approach to innovation (Ståhlbröst, 2012) and are characterized by their geographical embedding, emphasis on experimentation, and user involvement (Voytenko et al. 2016). As a popular approach on innovation in cities, living labs still require methodological and empirical advancement to contribute to sustainability transitions (von Wirth et al., 2018). Moreover, strategic living labs with a focal role for business are not so widespread (Bulkeley et al. 2019).

While experiments in, for example, the city context, have been quite well researched (e.g., Croci et al., 2017), research on business experiments for sustainability in the transitions context is only emerging (e.g. Bocken et al., 2018; Weissbrod, 2017) and the contribution to wider sustainability transitions need to be more widely understood.

2.3 Research gap: Business Experimentation for Sustainability

On the one hand business experiments have been discussed in literature and practice. On the other hand, experimentation has been discussed as a general approach to reach sustainable development (Caniglia et al., 2017). Yet the role of business as a lever for change through experimentation in sustainability transitions remains underexplored.

Experimentation in business may focus on the process and technology, product, value chain, business model and more systemic, ecosystem level (Konietzko et al., 2020a; Lieder & Rashid, 2016). The process and technology level have been extensively research in fields like radical innovation, also in relation to the activity of experimentation (O'Connor & Ayers, 2005). More recently, the business model lens has received significant attention. Experimentation plays an important role during the exploration of the new value propositions, because experiments help companies understand the implications of adopting a different business model, for example, to test the marketplace acceptance for a new products and services (Chesbrough, 2010). Experimentation has been identified as key theme in sustainable and business model research (e.g. Bocken et al., 2018; Weissbrod & Bocken, 2017) and practice (Kraaijenhagen et al., 2016). Finally, the need for experimentation at the business eco-system level for greater levels of sustainability has been recognized and tools have been developed for ecosystems innovation (Konietzko et al., 2020b; Talmar et al., 2018).

The area of BES is diverse: capturing different levels of innovation (e.g. process, technology, product, business model, value chain and ecosystem) and different actors (e.g. start-up, established business). It clearly has the potential to leverage the existing theories within disciplines of business and management studies, as well as adjacent disciplines such as transitions management and urban governance. This special issue focused on the concept of BES as well as the practical gap on how businesses might experiment for sustainability. The special issue papers are discussed next.

3. Towards Business Experimentation for Sustainability: papers in this SI

To explore the concept of BES and the practical application of this concept, we envisaged a mix of qualitative and quantitative methods. Most studies submitted to the SI, however, were qualitative contributions, except the study by Bashir et al. (2020) who conducted a randomized online survey experiment with a control group. The young nature of this field, perhaps, means that relevant research is mainly explorative in nature, therefore qualitative methods are a highly appropriate at this stage.

We did find a variety of focus points at the level of innovations for BES (Table 1). This included an explicit product innovation lens (Keskin et al. 2020), a value chain lens (Van Keulen & Kirchherr 2020) and a business model innovation lens (Konietzko et al. 2020, Bashir et al. 2020). The works by Aminoff and Pihlajamaa (2020) seeks to cover experimentation at the value chain and ecosystem level and Aagaard et al (2021) cover the more technological types of innovation experiments. Hence, within the broader spectrum of possible innovations, the papers represent the different types, ranging from technology to product, business model, value chain and ecosystem innovation (Konietzko et al., 2020b).

Furthermore, we explicitly did set out with this SI to explore, what role government and industry policy might play in incorporating and using BES. The rising popularity of the Circular Economy concept, and the uptake of the Sustainable Development Goals call for advancing sustainability governance and industry policies. For example, the Circular Economy concept led to a renewed interest in product obsolescence policy, but this has not yet led to

coordinated policy approaches that could stimulate profound industry changes to dominant practices and business models (Maitre-Ekern & Dalhammer, 2016). The same is true for sustainability management areas such as stimulating sustainable consumption as a business approach (Mont & Dalhammer, 2005; Bocken, 2017) and through stakeholder engagement (Freudenreich et al., 2019). The included papers all look at the level of the business, hence further research to link the level of the business to the wider economic landscape is called for, echoing Hildén et al. (2017) who argue for business sector climate governance experiments to be embedded in a broader regulatory setting.

Instead of the governmental industry policies, we found a clear indication that the six papers could be divided along the micro, meso and macro levels of product, technology (micro) business model, value chain (meso) and socio-technical system and wider ecosystem (macro). Of course, the boundaries between the levels are porous, however, experimentation is the link that enables to learn to transition from the micro level to the macro level. For example, experimentation at the technology level with new recycling technologies might illuminate the need for further experimentation at the value chain and ecosystem level with different actors.

Whereas BES potentially covers the three pillars of sustainability, the societal, environmental and economic aspects, only two studies in the SI took into account all pillars (Table 1). The main focus was on the environmental and economic aspects, where the economic aspects refer to the value proposition to the customer and the business case for the company, and environmental aspects to, for example cleantech (Aagaard et al., 2021), or on waste (Aminoff & Pihlajamaa, 2020).

In addition to the innovation and sustainability orientation, the papers can further be classified according to three themes: experimentation approaches and processes; experimentation in new ventures; and experimentation in established business, discussed next.

Table 1 Papers of the Special Issue on Business Experimentation for Sustainability (BES)

Themes	Authors	Title	Innovation orientation	Dominant sustainability orientation
Experimentation approaches for the Circular Economy	Aminoff and Pihlajamaa	Business experimentation for a circular economy - Learning in the front end of innovation	Value chain innovation; Ecosystem innovation	Environment & economic
	Konietzko, Baldassaire, Bocken, Brown, Hultink	Circular business model experimentation: Demystifying assumptions	Business model innovation	Environmental & economic
Experimentation in new ventures	Aagaard, Saari, Mäkinen	Mapping the types and process of sustainable business experimentation in start-ups — A study of green entrepreneurs	Technology innovation	Environmental & economic

	Keskin, Wever, Brezet	Product innovation processes in sustainability-oriented ventures: A study of effectuation and causation	Product innovation	Environmental, social & economic
Experimentation in established businesses	Bashir, Jorgensen, Pedersen, Skard	Experimenting with sustainable business models in fast moving consumer goods	Business model innovation	Environmental & economic
	Van Keulen and Kirchherr	The Implementation of the Circular Economy: Barriers and Enablers in the Coffee Value Chain	Value chain innovation, Business model innovation	Environmental, social & economic

3.1 Experimentation approaches for the Circular Economy

The topic of circular economy has come to the forefront as a driver for sustainability (Geissdoerfer et al., 2017) and authors have focused on developing tools and approaches (e.g. Bocken et al., 2019; Pieroni et al., 2019). However, this transition still requires significant experimentation with a potential role for business as a lever for change and tools are needed to support this experimentation (Pieroni et al., 2019). This is evident from the two articles in the BES special issue on the circular economy. The papers give insight into the learning processes associated with experimentation (Aminoff & Pihlajamaa, 2020), as well as the assumptions in the experimentation process (Konietzko et al., 2020). Yet, the papers also reveal that there are various open questions that need further research.

Aminoff & Pihlajamaa (2020) use four experiments within one case company as the basis for their investigation. They associate experiments to single, double and triple loop learning. Single loop learning refers to learning from the previous experiment when setting up the next one, double loop learning also scrutinizes the underlying assumptions and root causes of problems at hand, while triple loop learning is the most reflective and uses the outcomes of an experiment to develop new methodologies and approaches for the future (Aminoff & Pihlajamaa, 2020; Lozano, 2014). It is suggested that experiments should foster learning beyond the single loop in order to accelerate the transition to a circular economy.

Konietzko et al. (2020) conducted workshops (mix of incumbent and start-ups) to develop an understanding about how innovators develop and test assumptions to create more 'circular' outcomes (e.g. significantly reduced resource use). Focusing on what innovations find important (part of the identity), what they know (skills and knowledge), and whom they know (skills and knowledge) forms the basis for understanding the assumption making process and what aspects to experiment on first. The focus on assumptions to test in the experiments as discussed in the workshops heavily focused desirability and less on circularity. This shows the need to involve those with circular economy knowledge early on in the experimentation team to guide the process and keep circular economy in as an important theme (Konietzko et al., 2020).

3.2 Experimentation in new ventures

Novelty and experimentation are often associated with new business ventures. Yet, while lean startup (Ries, 2011) has its origin in startups, it is increasingly used as an approach by large business (Felin et al., 2019). Authors have also investigated the interplay between new ventures and established business (Hockerts & Wüstenhagen, 2010) and the way that incumbents have replicated new ventures in the field of sustainability (Schaltegger et al., 2016). In this special issue, the focus of BES special issue authors is on the experimentation processes of new ventures for sustainability. Keskin et al. (2020) and Aagaard et al. (2021) both identify relevant processes and types of experimentation in a new venture context.

Keskin et al. (2020) focus on the processes of sustainability-oriented ventures and how they experiment in the product innovation process. The study builds upon the theory of effectuation (Sarasvathy, 2009) as a useful approach to decision-making under uncertainty. A longitudinal case study on four sustainability-oriented revealed adaptive and exaptive approaches. An adaptive approach is characterized by long-term value propositions and high-fidelity design experiments used to get stakeholder commitment to a predefined value proposition. In contrast, the exaptive approach is characterized by short-term value propositions, and low-fidelity affordable design experiments to test market potential of multiple value propositions through various stakeholder interactions Keskin et al. (2020).

Aagaard et al. (2021) map the different types of experimentation in seven cleantech ventures based on an exploratory case approach. Their study revealed six different business experimentation types which are classified according to internal and external types. Their study also reveals how business experimentation types are applied as a continuum as part of the cleantech start-ups' sustainable value creation process. Finally, their study confirms the work by Bojovic et al. (2018) who identified learning, signaling, and convincing as key roles of experimentation in the startup business context.

3.3 Experimentation in established businesses

To date, business experimentation has largely been described as a process for startups, and less so with a focus on conventional businesses and sustainability, or radical innovation. Exceptions include the cases described in Frishammar and Parida (2019) and Weissbrod and Bocken (2017). Open for exploration are, still, best practices, challenges and opportunities of using BES, as well as detailed case studies of the process and practice of BES. This should enable a deeper understanding on the organizational manifestations and sustainability management dimensions (ecological, financial, environmental) of BES.

In this SI, Bashir et al. (2020) focus on experimentation with new business models in the Fast-Moving Consumer Goods (FMCG) sector. The case of Norway's largest FMCG company Orkla is presented. Three interrelated studies related to a refill business model for cleaner products to reduce plastic reveal relevant barriers and strategic interventions to overcome them. These relate to systematic barriers to be overcome to stimulate the adoption of more sustainable solutions by consumers, and behavioral interventions to facilitate consumer behavior change.

Van Keulen and Kirchherr (2020) investigate the circular economy implementation in the coffee value chain by observations of an Amsterdam based coffee importer for a period of seven months. The business experimentation method focused on both the consumption and

production of the coffee value chain with the aim to increase sustainability, focusing on waste minimization and balancing the three sustainability dimensions. The main barriers related to circular economy implementation identified related to the coherence in governmental policies, "silo thinking" of industries and standardization of circular design, while awareness and vision and designing solid business models were found to be key enablers.

4. Conclusions and open questions

Business Experimentation for Sustainability (BES) is a concept that focuses on the experimentation practices and approaches of business for sustainability. This BES special issue contributes with conceptual and empirical work on experimentation in new ventures and in established business. Empirical case research on both established business and new ventures is presented, although the connections between new and old ventures has not been explored by the papers in this special issue and it is a fruitful area for future research (Hockerts & Wüstenhagen, 2010). BES captures different levels of innovation at the micro (e.g. process, technology, product), meso (business model, value chain) and macro (ecosystem) level, and is initiated by different business actors (e.g. start-up, established business, hybrid business). Additionally, BES is investigated in urban and transition studies. BES has the potential to foster multiple aspects of sustainability, although in the present SI, the covered aspects were largely environmental and economic. This special issue covered business as the main actor, while a previous special issue in the Journal of Cleaner Production explored the role of policy and public actors (e.g. Hildén et al., 2017).

BES is grounded in several research domains, such as management studies (e.g. Camuffo et al., 2017; March, 1991), transitions research (e.g. Kemp et al., 1998) and interdisciplinary sustainability studies (e.g. the field of urban living labs; Bulkeley et al., 2019). Exploring research at the intersections of these disciplines can help move this field forward. Furthermore, research on experimentation for sustainability and the interactions and collaborations between different business, governmental and non-governmental actors will be a fruitful area for future research. Remaining research questions include:

- What barriers and opportunities to BES exist in a multinational or established business environment?
- What tools, practices and methods do entrepreneurs use for BES?
- What evidence exists on consumer behavior transformations resulting from conducting trials with new business models?
- What is the role of different actors in BES, in isolation and collaboratively?
- To what extent do entrepreneurs push for 'strong' as opposed to weak sustainability, and novel and impactful solutions?
- How to design and implement BES at the process, technology, product, business model, value chain and ecosystem level?
- How can the factor of time be embedded in methods and theory of BES (i.e., urgency of sustainability challenges coupled with fast learning loops)?
- How can, or even should, businesses collaborate with stakeholders during the BES process?
- How to move from BES to scalable pilot and full business implementation?
- How to ensure that positive environmental and societal impacts are embedded in BES and subsequent scaled-up pilots and full business roll-out?

The shift from experimentation to larger pilots and scaling up within businesses, as well as in the wider industry context needs to be more fully understood. This echoes recent work on understanding the role of the business model in transitions literature (Bidmon & Knab, 2018; Sarasini & Lidner, 2018). The bodies of knowledge on transitions, sustainability impact assessment, management studies, and design and engineering will need to be built on and combined to develop desirable, feasible and significantly more sustainable value propositions that pave the way to a viable future.

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