



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

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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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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 *Gründungsgarage* 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,

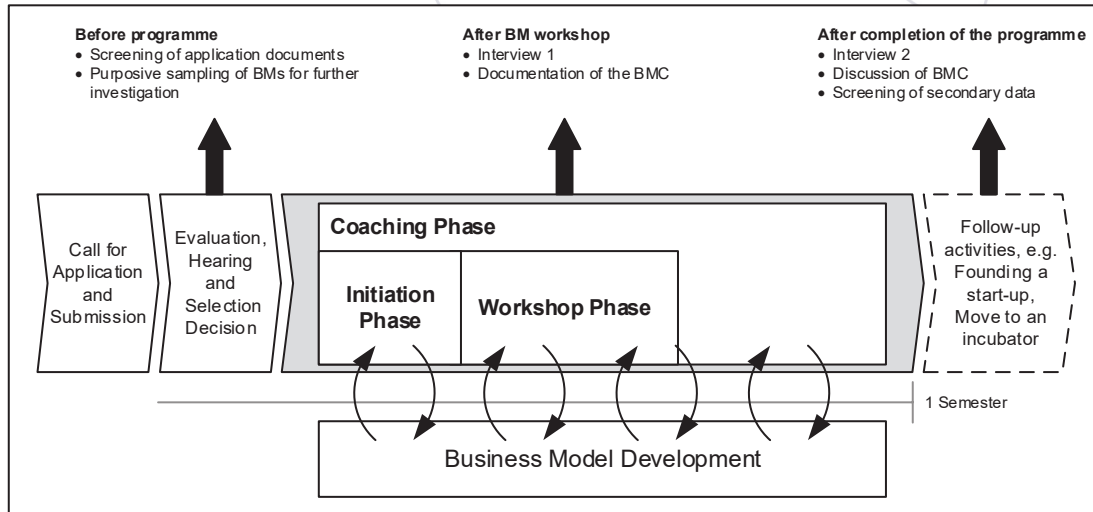


Figure 1: Procedural overview of the start-up accelerator programme (Based on Mueller et al. (2019) and Vorbach (2017)). Data collection points are shown.

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 BMCs 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 *Gründungsgarage*. 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 <i>Gründungsgarage</i>	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	<i>Alphawood</i>	Oct 2018 - Jan 2019	A0	A1	A2	Founding in progress
B	<i>DigniSens</i>	Oct 2018 - Jan 2019	B0	B1	B2	Founded (website available)
C	<i>Mady Pure</i>	Oct 2018 - Jan 2019	C0	C1	C2	Founding in progress
D	<i>FreyZein</i>	Mar 2019 - Jun 2019	D0	D1	D2	Founded (website available)
E	<i>smarter studieren</i>	Mar 2019 - Jun 2019	E0	E1	E2	Founding in progress (website available)
F	<i>Whoopedu</i>	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	✓	✓	✓	X	✓	X	✓	X	X
DigniSens	✓	X	X	X	✓	✓	✓	X	✓
Mady Pure	✓	✓	✓	X	✓	X	✓	X	X
FreyZein	✓	✓	✓	✓	✓	✓	✓	X	✓
smarter studieren	✓	X	X	✓	✓	✓	X	X	X
Whoopedu	✓	X	✓	✓	✓	✓	✓	X	✓

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; X = 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	<u>Individual</u> - Initial position holder and founder	Imprinter
D2	Ecological sustainability to increase revenues	Ecological/ Economic	Internal	<u>Adoption and Structuring</u> - Strategy selection	Imprinting Process
D3	Entrepreneurial motivation to reduce waste for ecological sustainability	Ecological	Internal	<u>Individual</u> - Initial position holder and founder	Imprinter
D4	Entrepreneurial motivation towards ecological sustainability	Ecological	Internal	<u>Individual</u> - Initial position holder and founder	Imprinter
D5	Customers demand drives sustainability in BM	Ecological/Social/ Economic	External	<u>Environment</u> - Economic and ecological conditions	Imprinter
D6	Demonstrating added value through sustainable partners	Ecological/Social/ Economic	Internal	<u>Network</u> - Alliance Characteristics	Imprinter
D7	Inclusion of sustainability aspects to achieve differentiation from competitors	Ecological/Social/ Economic	External	<u>Adoption and Structuring</u> - Strategy selection	Imprinting Process
D8	Ecological sustainability to differentiate from competitors	Ecological/ Economic	External	<u>Adoption and Structuring</u> - Strategy selection	Imprinting Process
D9	Enabling sustainable consumption through durable products	Ecological/ Economic	Internal	<u>Adoption and Structuring</u> - Strategy selection	Imprinting Process
D10	Careful use of resources as entrepreneurial motivation	Ecological	Internal	<u>Individual</u> - Initial position holder and founder	Imprinter
D11	Local value creation activities to create ecological sustainability	Ecological	Internal	<u>Individual</u> - Initial position holder and founder	Imprinter
D12	Sustainability to communicate additional value	Ecological/Social/ Economic	Internal	<u>Adoption and Structuring</u> - Strategy selection	Imprinting Process
D13	Reputation drives ecological sustainability	Ecological	Internal	<u>Selection and Synthesis</u> 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 smarterstudieren, 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 inter-linked 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)

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