

The sustainability impact of new ventures
Measuring and managing entrepreneurial contributions
to sustainable development

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Jannic Horne

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ARTICLE 1: Lean Impact Measurement – Predicting the sustainability impact of business model innovation in effectual ventures

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ARTICLE 2: Testing the practicality of ‘Lean Impact Measurement’ to evaluate the sustainability impact of business models

Jannic Horne, Malte Recker, Ingo Michelfelder

- In preparation for submission

ARTICLE 3: Exploring entrepreneurship related to the Sustainable Development Goals – Mapping new venture activities with semi-automated content analysis

Jannic Horne, Malte Recker, Ingo Michelfelder, Jason Jay, Jan Kratzer

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ARTICLE 4: Modeling entrepreneurial opportunities for the rapid diffusion of sustainable venture ideas

Jannic Horne

- In preparation for submission

Author's Preface / Forward

This dissertation has been inspired by the belief that progress in sustainable development is possible and entrepreneurs can play an important role in it. This belief is not blind to the fact that humanity is very close to creating irreversible damages to our ecosystem (Rockström et al., 2009) and human societies face a wide range of severe challenges (General Assembly, 2015). On the contrary, this belief acknowledges the challenges ahead but argues that entrepreneurial actions (ranging from sustainable entrepreneurs to sustainable intrapreneurs and institutional entrepreneurs) are among the best opportunities to create meaningful change. It is my hope that this dissertation contributes to a better understanding of how entrepreneurs can create this change and that it enables stakeholders in the entrepreneurial ecosystem to make decisions that create the largest benefits for sustainable development.

In this spirit I would like to quote Eric Ries (2011) the author of the famous Lean Startup approach: *"My hope all along was to find ways to eliminate the tremendous waste I saw all around me: startups that built products nobody wanted, new products pulled from the shelves, countless dreams unrealized"* (Ries, 2011: 6). Reformulating this statement in a more positive way, I hope the insights from this dissertation can help to direct attention, time and resources where they do most good for sustainable development.

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List of abbreviations

BMC	Business Model Canvas
EE	External Enabler
e.g.	exempli gratia (for example)
et al.	et alii (and other)
etc.	et cetera (and so forth)
GECES	European Commission Expert Group on Social Entrepreneurship
GRI	Global Reporting Initiative
GRQ	Guiding Research Question
ibid.	ibidem (in the same place)
ICT	Information and Communication Technology
IE	Internal Enabler
i.e.	id est (that is)
IOOI	Input-Output-Outcome-Impact
M&A	Merger and Acquisition
MLP	Multi-level perspective
NVI	New Venture Idea
LIM	Lean Impact Measurement
KPI	Key Performance Indicator
OC	Opportunity Confidence
RQ	Research Question
SDG	Sustainable Development Goal
SNB	Sustainability Net Benefits
SROI	Social Return on Investment
TLBMC	Triple layered business model canvas
UN	United Nations.
WBCSD	World Business Council for Sustainable Development

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1. Executive Summary

Purpose

The four articles of this dissertation assess how much entrepreneurs contribute to sustainable development and how this contribution can be increased. By doing so, this dissertation wants to help academics and practitioners to better measure and manage the sustainability contribution of entrepreneurship.

Previous research and research needs

Unsustainable development is a major societal problem (Brundtland Commission, 1987; General Assembly, 2015) and business is a major cause (Bansal & DesJardine, 2014; Cohen & Winn, 2007; Loorbach & Wijsman, 2013). In the past, entrepreneurship has often been portrayed as an important lever to overcome unsustainable business practices (Dean & McMullen, 2007; Hall, Daneke, & Lenox, 2010; Schaltegger, Lüdeke-Freund, & Hansen, 2016; Shepherd & Patzelt, 2011). However, various open questions remain. For example, academics and practitioners lack suitable approaches to measure the contribution of new ventures to sustainable development (Bengo, Arena, Azzone, & Calderini, 2015; Dichter, Adams, & Ebrahim, 2016; Evans, Rana, & Short, 2014; Hansen, Grosse-Dunker, & Reichwald, 2009; Mudaliar, Bass, & Dithrich, 2018; Schaltegger, Hansen, & Lüdeke-Freund, 2016; Simon, 2018; Stubbs & Cocklin, 2008) and we need more clarity about the underlying mechanisms through which entrepreneurs contribute (Bocken, Fil, & Prabhu, 2016; Boons, Montalvo, Quist, & Wagner, 2013; Hall, Daneke, & Lenox, 2010; Hockerts & Wüstenhagen, 2010; Schaltegger, Lüdeke-Freund, & Hansen, 2016). The four articles in this dissertation add to the existing body of literature on how to measure entrepreneurial contributions to sustainable development and they analyze how entrepreneurial contributions can be increased.

Research approach

Article 1 and 2 focus on measurement in individual firms with a practical approach to capturing the actual impact of a venture. First, article 1 conceptually develops a suitable measurement approach by adapting an existing approach to impact measurement to the special requirements of new ventures. Then, article 2 explores the practical applicability of the new approach. Therefore, the approach is taught to 87 individuals from 58 entrepreneurship organizations to empirically test its practicality. Following the measurement of individual firms at the impact level in article 1 and 2, article 3 explores more scalable ways to measure the sustainability contribution of multiple ventures. The resulting approach collects data with semi-automated content analysis of venture text material. Thus, business activities of 588 ventures are mapped to the Sustainable Development Goals (SDGs) to reveal patterns of

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entrepreneurial activities. Finally, article 4 explores the mechanisms through which entrepreneurial contributions to sustainable development occur and create the largest impact. Therefore the article combines research on the sustainability transition, the individual-entrepreneurship nexus, sustainable entrepreneurship, and international entrepreneurship.

Results

Article 1 introduces Lean Impact Measurement (LIM) as a new approach for impact measurement in effectual new ventures. Building on stakeholder theory Social Return on Investment is taken as a starting point, but it is simplified for the effectual circumstances of new ventures. The empirical test of the LIM approach (article 2) shows that entrepreneurs value the approach in practice due to its clear structure and user-friendliness. However, the empirical findings also show that a wide application of LIM requires intensive guidance and/or high-quality support software as well as stronger demand for impact metrics from investors. Article 3 on the measurement of multiple ventures shows empirically that entrepreneurs concentrate on certain Sustainable Development Goals and that there are significant correlations between some goals that are frequently addressed together. Finally, article 4 proposes a conceptual model on sustainable venture creation and venture idea diffusion. The three central constructs of this model – i.e., the new venture idea, internal enablers and external enablers – explain under which circumstances entrepreneurs decide to create a venture and how the underlying business model idea is diffused successfully. The model shows that sustainability considerations have only an indirect effect in the process through one of the three principal constructs.

Theoretical contributions

This dissertation offers three main contributions. These are the LIM approach to (article 1 and 2), the approach to map entrepreneurial activities to the SDGs (article 3) and the model on entrepreneurial opportunities for the diffusion of sustainable innovation (article 4). The LIM approach sheds new lights on stakeholder theory and constitutes a resource-friendly approach to measure and forecast the sustainability contributions of individual new ventures at the impact level. The SDG mapping offers a more scalable approach to identify patterns of entrepreneurial activities across numerous ventures. Both measurement approaches were specifically developed to assess sustainability contributions of new ventures and they open up various opportunities for future empirical research. For the scope of this dissertation, the empirical testing concentrated on the practical applicability of LIM in article 2 and the mapping of entrepreneurial activities in article 3. Equally, the newly developed model on sustainable venture creation and the diffusion of the underlying venture idea in article 4 opens up numerous

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opportunities for future research. In particular, empirical research would be of great value to complement the four case studies in article 4.

Practical contributions

A better understanding of how much entrepreneurs contribute to sustainable development and how this contribution can be increased is of great relevance for practitioners – i.e., entrepreneurs, but also investors, incubators or policymakers. The LIM approach (article 1 and 2) is particularly relevant for entrepreneurs and investors to improve their decision-making. The mapping of entrepreneurial activities along the SDGs (article 3) is particularly relevant for policymakers to understand where entrepreneurs can contribute to sustainable development. Finally, a better understanding of the mechanisms in sustainable venture creation and the successful diffusion of sustainable venture ideas (article 4) can guide strategic decision-making in ventures, and it can help policymakers in the design of suitable framework conditions.

2. Introduction

2.1 Research need and purpose of this research project

“Business activities are the root cause of many environmental and social problems and thus a major source of sustainability concerns.” (Schaltegger, Lüdeke-Freund, & Hansen, 2016: 266)

“Entrepreneurship is increasingly being recognized as a significant conduit for bringing about a transformation to sustainable products and processes, with numerous high-profile thinkers advocating entrepreneurship as a panacea for many social and environmental concerns.” (Hall, Daneke, & Lenox, 2010: 439)

The two quotes above point to the important link between sustainable development and entrepreneurship. On the one hand, unsustainable development is a major societal problem and business is a major cause (Bansal & DesJardine, 2014; Brundtland Commission, 1987; Cohen & Winn, 2007; General Assembly, 2015; Loorbach & Wijsman, 2013). On the other hand, entrepreneurial businesses constitute a potential lever to make our societies more sustainable (Cohen & Winn, 2007; Dean & McMullen, 2007; Hall, Daneke, & Lenox, 2010; Schaltegger, Lüdeke-Freund, & Hansen, 2016; Shepherd & Patzelt, 2011). This research analyzes the link between entrepreneurship and sustainable development with a focus on measuring entrepreneurial contributions to sustainable development and understanding the mechanisms that can increase their contributions.

There is tremendous scientific evidence that humanity is on an unsustainable development path that exceeds ecological boundaries of this planet and prevents sustainable social systems (Meadows, 1972; Pachauri & Mayer, 2015; Rockström et al., 2009). Policymakers, businesses, and civil society have recognized the need to act and started various initiatives to promote sustainable development (Brundtland Commission, 1987; General Assembly, 2015; Global Reporting Initiative, United Nations, & WBCSD, 2015; The Global Compact Network Germany, econsense, & Fountain Park, 2016). Equally, academics from various disciplines continue to be engaged in sustainable development with activities that range from better understanding to actively solving the sustainability challenges ahead (Bocken, Short, Rana, & Evans, 2014; Geissdoerfer, Bocken, & Hultink, 2016; Nilsson, Griggs, & Visbeck, 2016; Griggs et al., 2013). In this context, the field of sustainable entrepreneurship emerged with topics like the analyses of sustainable business models (Lüdeke-Freund & Dembek, 2017; Schaltegger, Hansen, & Lüdeke-Freund, 2016), support tools for sustainable venture development (Bocken, Rana, & Short, 2015; Geissdoerfer, Bocken, & Hultink, 2016), studies on sustainable entrepreneurs

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(Parrish, 2010; York, O'Neil, & Sarasvathy, 2016) and theoretical contributions about this phenomenon (Dean & McMullen, 2007; Hockerts & Wüstenhagen, 2010).

Unfortunately, evidence for the sustainability contribution of entrepreneurs remains vague. It usually rests on theoretical models (e.g., Bidmon & Knab, 2018; Hockerts & Wüstenhagen, 2010) or individual case studies (e.g., Dentchev et al., 2018; Schaltegger, Lüdeke-Freund, & Hansen, 2016). Underlying reasons for this are the complexity through which entrepreneurs contribute to sustainable development (see Bidmon & Knab, 2018; Hockerts & Wüstenhagen, 2010; Schaltegger, Lüdeke-Freund, & Hansen, 2016) and a lack of suitable approaches to measure the effects of new ventures on sustainability (Bengo, Arena, Azzone, & Calderini, 2015; Dichter, Adams, & Ebrahim, 2016; Evans, Rana, & Short, 2014; Hansen, Grosse-Dunker, & Reichwald, 2009; Mudaliar, Bass, & Dithrich, 2018; Schaltegger, Hansen, & Lüdeke-Freund, 2016; Simon, 2018; Stubbs & Cocklin, 2008). For example, research on co-evolutionary sustainable business model development (Schaltegger, Lüdeke-Freund, & Hansen, 2016) provides a great overview of mechanisms through which sustainable innovation can be diffused based on case studies. However, the authors themselves highlight that they lack broader empirical insights on the effectiveness of this diffusion. Usually, it remains unclear whether and how much different actors contribute to sustainable development.

To some extent, the challenge of measurement is inherent to sustainable development. The complex interdependencies in sustainable development make measurement extremely challenging (Costanza et al., 2016; Nilsson, Griggs, & Visbeck, 2016). Nevertheless, on the national level indicators to measure sustainable development have been defined (Sachs, Schmidt-Traub, Knoll, Durand-Delacre, & Teksoz, 2017; United Nations, 2017) and also for mature organizations some approaches emerged (e.g., Global Reporting Initiative, 2016; Nicholls & Cupitt, 2012), but to the author's knowledge there are no widely applied approaches to measure and manage the sustainability contributions in new ventures. In mature businesses, the dominant approaches so far either guide businesses towards very comprehensive sets of KPIs like those of the Global Reporting Initiative (Global Reporting Initiative, 2016; Global Reporting Initiative, United Nations, & WBCSD, 2015) or they embed KPIs in rather complex measurement approaches like Life-Cycle Assessments (Rossi, Germani, & Zamagni, 2016) or Social Return on Investment (Nicholls & Cupitt, 2012). Unfortunately, such approaches are relatively complex and resource intensive and therefore not practicable for new ventures.

Most new and small ventures do not even have sufficient financial data to measure and manage their operations properly (Garengo, Biazzo, & Bititci, 2005; Neely, Gregory, & Platts, 1995). Thus, the collection of social and ecological data for a full triple bottom line accounting – which is a base for sound sustainability measurement – is an unrealistic expectation in most cases (see Dichter, Adams, & Ebrahim, 2016).

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In sum, measurement in new ventures must work despite data scarcity, limited resources, frequent changes and uncertainty in new ventures (Alvarez & Barney, 2005; Dichter, Adams, & Ebrahim, 2016; Garengo, Biazzo, & Bititci, 2005; Sarasvathy, 2001). Prominent approaches like Life-Cycle Assessments or Social Return on Investment are not applicable under these circumstances (see article 1). Accordingly, the special circumstances of new ventures point to the need for more research on how to evaluate the sustainability contributions of entrepreneurs and guide them towards more impact.

2.2 Background for this research and research approach

The before described research gap on entrepreneurial contributions to sustainable development has originally been identified in a larger research project on sustainability impact measurement at the Department of Entrepreneurship and Innovation Management at the Technical University Berlin in cooperation with the Sustainability Initiative of the MIT Sloan School of Management. The project aims for the development of an impact benchmark for startups that can be applied at different maturity levels of new ventures. Research for this dissertation contributes to this overall project.

At the same time, the four articles of this dissertation constitute an independent research project that creates important insights independent of the overall project. The specific focus of this dissertation is the development of efficient and effective measurement approaches to capture and manage entrepreneurial contributions to sustainable development. The need for efficiency can be explained with the effectual circumstances of new ventures (Sarasvathy, 2001). Effectuation theory explains that the choices of entrepreneurs are usually limited by their available means. In most cases, new ventures lack important resources like know-how, capital or time. Thus, they have to choose carefully what activities they pursue and which not. The low application of existing measurement approaches by entrepreneurs suggests that many entrepreneurs do not consider the effort worthwhile (Dichter, Adams, & Ebrahim, 2016; Manetti, 2014; Yates & Marra, 2016b). To be relevant for entrepreneurs with their limited resources, the measurement process must create valuable insights in an efficient manner – the rise of the lean startup methodology for business model development illustrates the demand for such resource light approaches (Blank, 2013a; Ries, 2011). Equally, the development of lean data collection methodology for social and environmental data points into this direction (Dichter, Adams, & Ebrahim, 2016). Accordingly, measuring should minimize efforts for new ventures to be applicable in their effectual circumstances. It can be expected that inflexible, resource heavy approaches fail to obtain sufficient data to measure a venture's contribution to sustainable development.

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It is important to note that these calls for efficiency must be balanced with the need to measure sustainability contributions as effective as possible. With effective, I mean that the results must provide valid information about the sustainability contribution of new ventures. Generally, this means to measure the actual impact – following the widely used input-output-outcome-impact logic (Clark & Brennan, 2016; Clifford, 2014; European Union & OECD, 2015; Grabenwarter & Liechtenstein, 2011; Hornsby, 2012). However, the data requirements for measurement at the impact level bring us back to the before stated concern about too resource intensive measurement approaches. This highlights a certain trade-off between efficient and effective measurement that is at the heart of this dissertation.

This trade-off points to an important fact about measurement: whether and what should be measured is relative. At least since the 1990s, classical performance measurement research realized that frequently too many and the wrong things have been measured (Atkinson, Waterhouse, & Wells, 1997). This realization triggered research that aligned measurement with corporate strategy and the specific information needs of stakeholders (Atkinson, Waterhouse, & Wells, 1997; Garengo, Biazzo, & Bititci, 2005; Neely, Gregory, & Platts, 1995). Such developments suggest that measurement of the sustainable development contribution of new ventures should focus on those aspects that are strategically relevant for key stakeholders. In this dissertation, two perspectives are in focus. First, the perspective of stakeholders that assess individual ventures like founders or investors and second the perspective of stakeholders that want to assess the developments across multiple ventures like policymakers or researchers. To satisfy these stakeholder needs the balance between efficiency and effectiveness differs. For the assessment of an individual venture (e.g., to inform the founder or investors) a more detailed impact measurement is required than for the assessment of numerous ventures (e.g., to inform policymakers). These two levels of analysis can be rephrased as measurement at the micro and the meso level. The distinction between measurement at the micro and meso level stems from Davidsson's (Davidsson, 2016) explanation of entrepreneurship research as the study of micro-level behavior that has macro-level implications. Translated to sustainable entrepreneurship this means that researchers study how the behavior of individual ventures on the micro level affects sustainable development on the macro level. Analog to this, I define the meso level as the study of numerous ventures and their effects on sustainable development on the macro level. This distinction into the micro and meso level is central for the first two guiding research questions (GRQs) of this dissertation:

- **GRQ 1:** How to measure the sustainability contribution of new ventures at the micro level? (addressed in article 1 and 2¹)

¹ Article 1 concentrates on the theoretical development of a suitable measurement approach and article 2 operationalizes and applies this approach in practice.

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- **GRQ 2:** How to measure the sustainability contribution of new ventures at the meso level? (addressed in article 3)

On the micro level (article 1 and 2), the measurement focus lies on effective measurement at the impact level. On the meso level (article 3), the focus lies on efficiently measuring the sustainability contribution in order to assess numerous ventures with limited effort.

However, measurement alone is not enough to make entrepreneurship the initially quoted panacea for sustainable development (Hall, Daneke, & Lenox, 2010: 439). Accordingly, this dissertation also explores why, how and when entrepreneurs contribute most to sustainable development:

- **GRQ3:** How can entrepreneurial contributions to sustainable development be increased? (addressed in article 4)

Understanding the mechanisms through which entrepreneurs create the largest contribution to sustainable development can generate valuable insights for entrepreneurs and their stakeholders in order to maximize entrepreneurial contributions to sustainable development. These insights can be further refined and verified with suitable measurement approaches (GRQ 1 and GRQ 2). Thus, there can be a reinforcing relationship between measurement and management of entrepreneurial contributions to sustainable development. The focus of this dissertation lies on measurement (GRQ 1 and GRQ 2), but it leads over to management (GRQ 3). Figure 2.1 below illustrates this reinforcing relationship and it points to stakeholders that are typically interested in measuring and managing entrepreneurial contributions at the three levels of analysis.

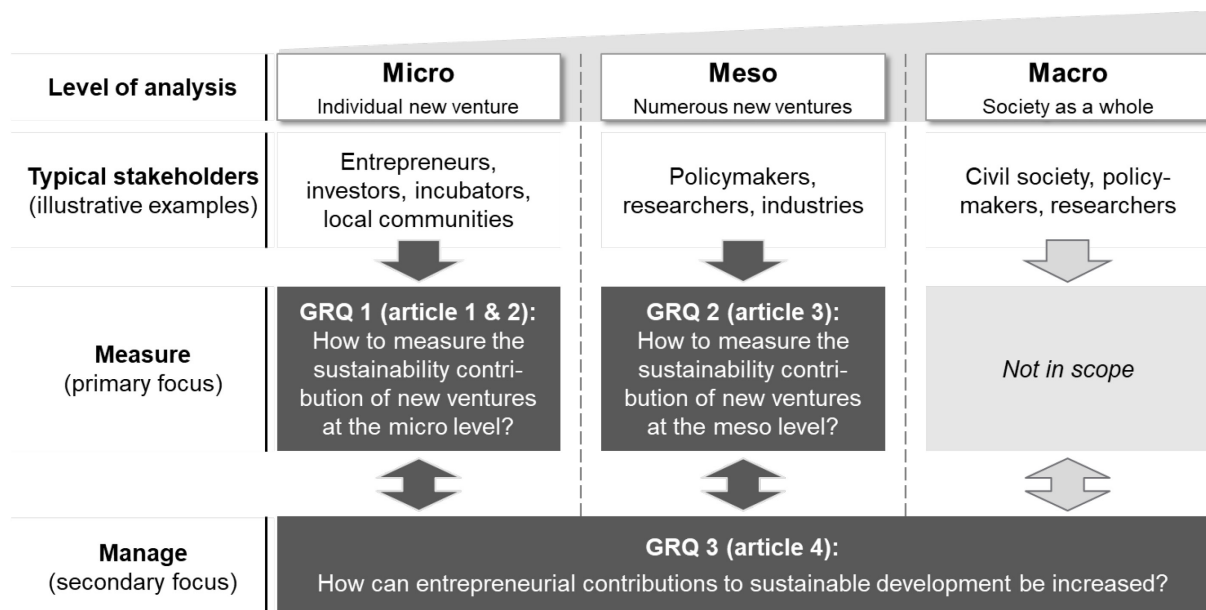


Figure 2.1 Overview of the guiding research questions (GRQ) and the corresponding level of analysis for this dissertation

2.3 Situating the research project in the scientific landscape

“[...] we define the field of entrepreneurship as the scholarly examination of how, by whom, and with what effects opportunities to create future goods and services are discovered, evaluated, and exploited (Venkataraman, 1997).” (Shane & Venkataraman, 2000).

This widely cited quote highlights three entrepreneurial processes that entrepreneurship scholars investigate: the discovery, evaluation, and exploitation of opportunities². Out of the three processes, this dissertation concentrates on the evaluation of opportunities. In response to the GRQ 1 and GRQ 2, it investigates how the independent variable (different types of new ventures) affects the dependent variable (sustainability), and it assesses the underlying factors that influence this interaction in response to the GRQ 3. Answers to these questions can be found at the intersection of research on entrepreneurship, sustainability and performance measurement (see figure 2.2). First, the field of entrepreneurship research helps to understand the independent variable under investigation. In particular, the challenges around measurement in effectual new venture (Sarasvathy, 2001) and the inherent uncertainty of entrepreneurship (Alvarez & Barney, 2005). Second, the field of sustainability research offers an understanding of the dependent variable and the technical and behavioral changes necessary for sustainable development. It also clarifies the uncertainty, the interdependencies and the value judgments that shape research in the field. Finally, performance measurement provides insights on how to create strategically relevant insights into entrepreneurial contributions to sustainable development in order to strike a proper balance between efficiency and effectiveness. The following section goes into more depth for each of these three research fields. First, relevant insights from sustainability research, then linkages to entrepreneurship and finally experiences from performance measurement are discussed. Thus, this chapter outlines how this dissertation is situated in the scientific landscape.

² See article 4 for a discussion of what is meant by opportunity based on Davidson (2015)

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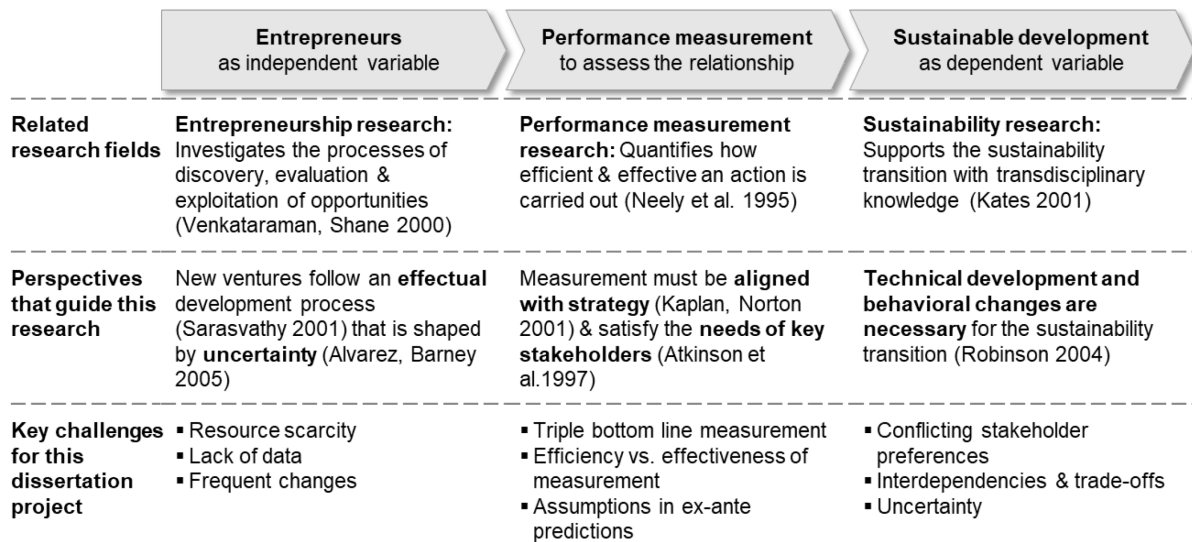


Figure 2.2 Overview of the linkages between entrepreneurship research, performance measurement and sustainability research in this dissertation project

2.3.1 Sustainability

Sustainability research understands itself as a transdisciplinary provider of knowledge that tries to support the sustainability transition (Lang et al., 2012; Swart, Raskin, & Robinson, 2004). This ambition has been specified with three main goals: (1) understanding the complex interactions between society and the environment, (2) guiding interactions towards more sustainability and (3) educating relevant actors to make sustainable development possible (Kates, 2001; Miller et al., 2014). Unfortunately, there are different understandings of what sustainability means and thus how this sustainability transition should look like. In his assessment of various perspectives on sustainability and sustainable development Robinson (Robinson, 2004) consolidated the various perspectives into two views: a technology-focused view that wants to conserve natural resources with the development of new policies and technologies to allow for ‘sustainable development’ and a behavioral focused view that wants to embed ‘sustainability’ in individual lifestyles that are no longer dependent on growth based ‘development’. Robinson concluded that both perspectives must be integrated, as technical solutions and changed lifestyles are necessary to overcome the unsustainable status quo. In this dissertation, I follow his conclusion, which means that technical and behavioral contributions to sustainable development are investigated and the terms sustainability and sustainable development are used interchangeably³.

Independent of the different views on how to achieve sustainable development, all perspectives on sustainability acknowledge the complex challenges around sustainability – i.e., to create viable social systems that do not exceed the carrying capacities of our natural

³ Robinson himself decided to only use the term sustainability, but he emphasized that it includes the technological perspectives of sustainable development.

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systems. As stated before, sustainability research wants to help to solve these challenges. Kates et al. (Kates, 2001) outlined the research approaches that are necessary to do so. They argued that research must capture multiple spatial scales (e.g., interactions between the micro and the macro level), balance the urgency with the longevity of sustainability problems (e.g., in the case of the ozone hole), take into account the complex multi-causal and interdependent relationships in sustainability (e.g., in climate change) and create knowledge that is usable for a wide range of actors from science and society. Following this guidance, the evaluation of entrepreneurial sustainability in this dissertation project tries to measure entrepreneurial sustainability contributions at different scales and it wants to create insights that are accessible to science and society. For this to happen, it is necessary to take into account the characteristic challenges of sustainability research. This research identified three main challenges: (1) the very different stakeholder preferences and values around sustainability, (2) the various interdependencies and trade-offs between different aspects of sustainable development and (3) the uncertainty about future developments.

(1) Sustainability is a profoundly ethical concept that requires value judgments about social and ecological justice within and between generations (Miller et al., 2014; Norton, 2005). Naturally, on a global scale, the differences in cultures, lifestyles and wealth translate into a huge diversity of views and preferences. To harmonize the very different value judgments globally the Sustainable Development Goals (SDGs) (General Assembly, 2015) have been developed. They provide political guidance on what should be prioritized in different nations depending on their state of development (Sachs, Schmidt-Traub, Knoll, Durand-Delacre, & Teksoz, 2017).

(2) But – despite making the concept of sustainable development more concrete with the definition of national goals – sustainability researchers identified countless interdependencies and trade-offs between the goals (Costanza et al., 2016; Nilsson, Griggs, & Visbeck, 2016; Sachs, Schmidt-Traub, Knoll, Durand-Delacre, & Teksoz, 2017). This research shows that solving one sustainability challenge at one location might still negatively affect other stakeholder needs and/or lead to the exploitation of environmental resources today or in the future. Accordingly, even if we consider the ethical debate solved by accepting the prioritization of the SDGs, the practical interdependencies and trade-offs still challenge the measurement of sustainable development.

(3) In addition to this, the uncertainty about future developments poses an important challenge for the evaluation of entrepreneurial contributions to sustainable development. The future has always played a central role in sustainability research. It shapes this field of research with famous publications on the limits of growth (Meadows, 1972), planetary boundaries (Rockström et al., 2009) or climate change (Pachauri & Mayer, 2015). In these publications, scholars outline future scenarios and reduce uncertainty about future developments in order

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to guide decision-makers in their actions (Swart, Raskin, & Robinson, 2004). However, similar to the uncertainty in entrepreneurship (Alvarez & Barney, 2005), uncertainty in sustainability research remains an unresolvable element. As this dissertation brings together sustainability and entrepreneurship research its findings naturally entail uncertainty.

The before stated constraints make sustainability a complex, but also fascinating field of research that attracts a large interdisciplinary set of researchers (Lang et al., 2012). Unfortunately, in practice, the complexity and uncertainty tend to make sustainability a topic of secondary relevance, particularly in business. Many businesses prefer to ignore the three dimensions of sustainability and concentrate their attention on short-term financial outcomes (Bansal & DesJardine, 2014). They disregard the various stakeholders that their businesses affect and their needs unless external pressure (e.g., from regulators or customers) incentivizes them to pay attention (Geels, 2002; see article 4). This explains why businesses are often considered major contributors to unsustainable development (Cohen & Winn, 2007; Meadows, 1972). However, being a major source of unsustainable development, businesses are also considered a major lever for more sustainable development (Cohen & Winn, 2007; Loorbach & Wijsman, 2013). Therefore sustainability-oriented business scholars developed and promote concepts like corporate social responsibility (McWilliams & Siegel, 2001), shared value (Porter & Kramer, 2011) or circular economy (Bocken, Pauw, Bakker, & van der Grinten, 2016; Ellen MacArthur Foundation, 2015) to direct the economic sector towards more sustainable practices. Such concepts constitute important scientific contributions at the intersection of sustainability and business research that can help to transform the economic system towards sustainability.

2.3.2 Entrepreneurship

Entrepreneurship is often considered an important lever to support the sustainability transition of our economic systems (Bidmon & Knab, 2018; Cohen & Winn, 2007; Hall, Daneke, & Lenox, 2010; Hockerts & Wüstenhagen, 2010). This hope shapes sustainable entrepreneurship research in general, and it shapes this dissertation. Sustainable entrepreneurship scholars are interested in the interactions between entrepreneurs and the different dimensions of sustainability (Belz & Binder, 2017; Dean & McMullen, 2007; Hall, Daneke, & Lenox, 2010; Shepherd & Patzelt, 2011). Accordingly, the scope of sustainable entrepreneurship research extends far beyond the economic focus of traditional entrepreneurship research (e.g., Murphy, Trailer, & Hill, 1996; Shane & Venkataraman, 2000; Venkataraman, 1997). But it is important to mention that despite this generally shared interest, scholars have very different understandings of sustainable entrepreneurship. Some scholars concentrate on ecological issues (Gast, Gundolf, & Cesinger, 2017; York & Venkataraman, 2010), some focus on

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entrepreneurs that simultaneously create progress along a triple bottom line (Belz & Binder, 2017) and others concentrate on entrepreneurs that contribute to at least one of the three pillars of sustainability (see Dean & McMullen, 2007; Schaltegger & Wagner, 2011; Shepherd & Patzelt, 2011). This dissertation project contributes to sustainable entrepreneurship along the last, broader perspective. Thus, all entrepreneurs that contribute to a more sustainable future compared to the status quo are considered sustainable entrepreneurs.

Whether and how entrepreneurs contribute to a more sustainable future is at the heart of this dissertation. Chronologically, there are two dimensions for this evaluation. Entrepreneurial activities can be evaluated ex-ante in form of forecasts about expected outcomes, or ex-post⁴ as an evaluation of past entrepreneurial activities. While the latter type of evaluation can analyze empirical data on a venture to draw conclusions, the former type of evaluation lacks such empirical sources, which makes them particularly challenging. Unfortunately, the evaluation of new ventures naturally concentrates on ex-ante assessments due to the lack of historical data, which creates an unresolvable element of uncertainty (Alvarez & Barney, 2005; Knight, 1921).

Besides uncertainty about future outcomes, the venture development process is shaped by frequent changes and a lack of resources like know-how, capital or time (see earlier discussion in section 2.2). Entrepreneurs generally rely on their available means to experiment, learn and shape their own future in an iterative process instead of making one sophisticated long-term plan that is successively executed (Sarasvathy, 2001). This effectual process leads to a dynamic venture development process for individual ventures. In this dynamic process, the activities of discovery, evaluation, and exploitation are reoccurring efforts. For instance, while an entrepreneur exploits an opportunity, he or she might discover new opportunities that need to be evaluated to decide whether they should be exploited or not. Throughout these dynamic processes, a venture's business model is likely to change. Along with the changing business model a venture's effect on the economy, society and ecology changes (see article 1 and 4). These frequent changes limit the validity of ex-ante evaluations of new ventures together with the before stated uncertainty. Despite these challenges, ex-ante evaluations are of great relevance for decision-making in new ventures.

2.3.3 Performance measurement

To address some of the above-stated challenges, this research project draws from research on performance measurement. Performance measurement can be defined "*as the process of quantifying the efficiency and effectiveness of action.*" (Neely, Gregory, & Platts, 1995). In the context of this dissertation, this translates into the process of quantifying the efficiency and

⁴ The monitoring/accounting of ongoing activities is considered a part of ex-post evaluations.

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effectiveness of sustainable entrepreneurial contributions (or expected future contributions) to sustainable development. Unfortunately, research shows that already the measurement of economic performance in new ventures is very challenging (Garengo, Biazzo, & Bititci, 2005; Hudson, Smart, & Bourne, 2001; Neely, Gregory, & Platts, 1995). Given the before stated complexity of sustainable development (Costanza et al., 2016; Geels, 2002; Nilsson, Griggs, & Visbeck, 2016), the challenges multiply with ex-ante evaluations of the triple bottom line.

In management research, performance measurement has been studied increasingly since the 1980s and approaches evolved from isolated financial metrics to comprehensive measurement approaches that are aligned with a company's strategy and address the needs of all relevant stakeholder (Atkinson, Waterhouse, & Wells, 1997; Garengo, Biazzo, & Bititci, 2005); (Kaplan & Norton, 2001). The most prominent approach from this research is probably the balanced scorecard. It extended the one-sided focus on financial metrics to also include measurements of internal operations, customer views as well as innovation and learning (Kaplan & Norton, 1992). Along with this evolution of performance measurement in the for-profits sector, there was growing interest in performance measurement for the non-profit and the public sector (Forbes, 1998; Poister, 2003). Thus, approaches like the balanced scorecard were adapted to the non-profit sector (Kaplan, 2001) and alternative measurement approaches like Social Return on Investment were developed to measure tangible and intangible social and ecological outcomes (Emerson, Wachowicz, & Chun, 2000; Millar & Hall, 2013).

Throughout this development, priority has been given to historic performance measurement, instead of predictive measurements (Neely, Gregory, & Platts, 1995). Thus, the more relevant measurement approaches for entrepreneurs (who generally lack historical data) have not been in focus. The experiences from this research revealed similar challenges to the once I discussed in the context of uncertainty and effectuation (see 2.2 & 2.3). There is a lack of financial and human resources, insufficient historical data, unclear benefits of measurement, volatile venture structures and short-termism (Brush & Vanderwerf, 1992; Garengo, Biazzo, & Bititci, 2005; Hudson, Smart, & Bourne, 2001; Neely, Gregory, & Platts, 1995). As a result of these challenges measurement efforts in new ventures usually concentrate on a limited set of economic indicators around efficiency, growth, profit or size ((Brush & Vanderwerf, 1992); (Davila, Foster, & Oyon, 2009; Murphy, Trailer, & Hill, 1996).

Despite these challenges, the importance of economic performance measurement for entrepreneurs is expected to grow as a means to strive in the dynamic entrepreneurial environment (Davila, Foster, & Oyon, 2009). The growing field of impact investment suggests that measurement along the triple bottom line will equally grow in importance (Mudaliar, Schiff, Bass, & Dithrich, 2017; Simon, 2018; The Economist, 2017). Hence, it makes sense to develop suitable approaches to measure the sustainability contribution of new ventures. Learning from economic performance measurement these approaches must strike a proper balance between

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structure and adaptability, they must be resource-light and they must create tangible benefits for the entrepreneurs to encourage long-term implementation (Garengo, Biazzo, & Bititci, 2005; Hudson, Smart, & Bourne, 2001).

2.4 Structure of the dissertation and applied methods

The dissertation at hand explores the sustainability contribution of entrepreneurs. It studies how this contribution can be measured at the micro level (GRQ 1) and the meso level (GRQ 2), and it explores how this contribution can be increased (GRQ 3). Answers to these guiding research questions are developed over four articles. Responding to GRQ 1, the first two articles concentrate on the micro level and assess whether and how an individual venture contributes to sustainable development. The third article responds to GRQ 2 on the meso level and develops an empirical approach to assess the sustainability contribution of numerous ventures. Finally, article four assess the interactions that allow sustainable entrepreneurship to create societal change. Below, the main structure and the specific research questions of the four articles are discussed in more detail. The research questions, research approaches and aspired outcomes for each of the four articles are summarized in table 2.1.

Table 2.1 Overview of the four articles that respond to the guiding questions of this dissertation

	GRQ 1		GRQ 2		GRQ 3
	<i>Develop micro approach</i>	<i>Test micro approach</i>	<i>Develop and test meso approach</i>		<i>Model the sustainability contribution of new ventures</i>
	Article 1	Article 2	Article 3		Article 4
Article Research questions	RQ1: How can we measure and forecast sustainability impact in a way that is practicable for new ventures & meaningful for internal & external stakeholders in terms of benchmarking?	RQ1: How does LIM contribute to the sustainable business model development process? RQ2: How should LIM be taught to entrepreneurs? RQ3: Is LIM a practical approach to measure and forecast the sustainability impact of new ventures?	RQ1: How can we map the SDG related activity of entrepreneurs in Germany? RQ2: Which SDGs show high entrepreneurial activity in Germany and which SDGs remain unaddressed?		RQ1: Under which circumstances do entrepreneurs create ventures that contribute to sustainable development? RQ2: Under which circumstances is the underlying venture idea diffused rapidly? RQ3: What role play sustainability considerations in the process?
Research approach	<ul style="list-style-type: none"> - Review requirements for impact measurement in new ventures - Use stakeholder theory to navigate through the complexity of sustainability - Conceptual development of a measurement approach based on effectuation theory 	<ul style="list-style-type: none"> - Translation of LIM into a workshop and Excel-tool for entrepreneurs - Empirical data collection with entrepreneurs that learn to apply LIM (surveys, discussions) - Explorative un- & semi-structured expert interviews 	<ul style="list-style-type: none"> - Empirical data collection of publicly available venture data - Semi-automated content analysis of venture text material 		<ul style="list-style-type: none"> - Conceptual model development - Interdisciplinary review of literature to derive constructs for the model - Focus on the multi-level perspective, the opportunity construct, co-evolutionary business model development & rapid internationalization
Aspired outcome	<ul style="list-style-type: none"> - A practical approach to measure & forecast sustainability impact in new ventures - Conceptual foundation for future empirical studies - New insights on stakeholder theory in entrepreneurship 	<ul style="list-style-type: none"> - Understanding how to implement measurement at the micro level - Refined teaching methodology for LIM that complements existing approaches - Empirical evidence for the practicality & relevance of the LIM approach 	<ul style="list-style-type: none"> - Understanding how to measure at the meso level - A scalable methodology to map entrepreneurial activities to the SDGs - Transparency on SDG related entrepreneurship in Germany 		<ul style="list-style-type: none"> - A conceptual model that explains the role and mechanisms through which entrepreneurs contribute to sustainable development - Transparency on the role sustainability considerations play in the process

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GRQ 1 is addressed over two articles. Article 1 concentrates on the theoretical development of a measurement approach at the micro level. Then, article 2 concentrates on the operationalization and empirical testing of the approach.

Article 1: In article 1, GRQ 1 is translated into one more specific research question (RQ):

- **RQ 1:** How can we measure and forecast sustainability impact in a way that is practicable for new ventures and meaningful for internal and external stakeholders in terms of benchmarking?

Initially, the article explores existing challenges to impact measurement in new ventures and defines key requirements for proper measurement in effectual ventures. Building on stakeholder theory, the article identifies Social Return on Investment (SROI) (Emerson, Wachowicz, & Chun, 2000; Nicholls & Cupitt, 2012) as a promising approach to impact measurement in effectual ventures; however, it requires too much effort (Manetti, 2014; Yates & Marra, 2016a). To reduce measurement effort of SROI, principles from effectuation theory (Sarasvathy, 2001), the related practitioner approach Lean Startup (Frederiksen & Brem, 2017; Ries, 2011) and sustainable value added (Figge & Hahn, 2004) are integrated into SROI. This creates an iterative approach to measure and forecast the additional sustainability value a venture creates compared to the status quo that is called Lean Impact Measurement (LIM). The central contribution of this article is the development of LIM as an efficient approach to measure and predict a venture's contribution to sustainability at the impact level. In addition to this, the article offers new perspectives on stakeholder theory in the context of business model innovation.

Article 2: Building to the theoretical work of article 1, article 2 operationalizes LIM and gathers empirical insights on the practicability of LIM at the micro level. The work on article 2 is structured along three research questions:

- **RQ1:** How does LIM contribute to the sustainable business model development process?
- **RQ2:** How should LIM be taught to entrepreneurs?
- **RQ3:** Is LIM a practical approach to measure and forecast the sustainability impact of new ventures?

Initially, the article examines the existing landscape of scientific tools to support sustainable entrepreneurs in the discovery, evaluation, and exploitation. This assessment shows that there is a lack of practical quantitative tools for the evaluation of sustainable business models. A gap that LIM can fill. To translate the conceptually developed LIM approach into practices the articles follows Geissdoerfer et al. (Geissdoerfer, Bocken, & Hultink, 2016) and Bocken et al. (Bocken, Allwood, Willey, & King, 2011) with their four phases: exploration, conceptualization, improvement, and evaluation. The practicality of the resulting approach – a workshop and a

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complementary Excel-tool – are tested and refined empirically over 12 workshops with 58 entrepreneurship organizations. Overall, the results confirm the practicality of the taught LIM approach, but they highlight the need for more automation and the need to institutionalize impact measurement in the entrepreneurial ecosystem, especially among investors. The central contribution of this research is the practical application of LIM filling the gap of quantitative tools for the evaluation of sustainable business models.

Article 3: The third article responds to GRQ 2 and assesses entrepreneurial contributions to sustainability at the meso level. To realize the earlier stated ambition of efficient measurement at the meso level, the research in article 3 concentrates on measuring entrepreneurial contributions to the Sustainable Development Goals (SDGs) (General Assembly, 2015). This translates into two main research questions:

- **RQ1:** How can we map the SDG related activity of entrepreneurs in Germany?
- **RQ2:** Which SDGs show high entrepreneurial activity in Germany and which SDGs remain unaddressed?

In response to these questions, article 3 examines existing measurement approaches at the meso level and discusses potential solutions. Building on this analysis the article develops a scalable and repeatable approach that maps venture activities related to the SDGs and identifies those areas that have not been addressed. The approach is based on semi-automated content analysis of venture text material and it is applied to 588 ventures that were awarded in one of 193 venture competitions in Germany 2017. The resulting data are analyzed statistically and contrasted with the national performance across the 17 SDGs (based on Sachs, Schmidt-Traub, Knoll, Durand-Delacre, & Teksoz, 2017). This reveals significant correlations between SDGs, and it shows how frequently entrepreneurs are active in certain SDGs. The research equips researchers with a new approach to measure entrepreneurial activities for sustainable development at the meso level and offers guidance to policymakers.

Article 4: The last article responds to GRQ 3 and examines how entrepreneurs contribute to sustainable development and how this contribution can be increased. It thus studies the interactions between the micro, meso and macro level that lead to societal change. To address this complex issue the work in article 4 is structured along three research questions:

- **RQ1:** Under which circumstances do entrepreneurs create ventures that contribute to sustainable development?
- **RQ2:** Under which circumstances is the underlying venture idea diffused rapidly?
- **RQ3:** What role play sustainability considerations in the process?

These questions are answered based on research on the sustainability transition, entrepreneurial opportunity, and evolutionary economics. Through a combination of these

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research streams, a conceptual model is developed that first explains under which circumstances entrepreneurs decide to start a sustainable venture, second, it explains how the underlying new venture idea can be diffused and third it explains the role of sustainability considerations in the process. The model is based on three principal constructs – the new venture idea, internal enablers and external enablers – that define successful venture creation and venture idea diffusion. Sustainability considerations have only an indirect influence through the other three constructs. The model is illustrated with case studies from the mobility sector, and it is adapted to explain the best conditions for rapid international growth of sustainable venture ideas.

The following chapters 3 to 6 present the four individual articles of this dissertation. Then, chapter 7 summarizes the overall findings, limitations and future research opportunities for each of the four articles. Chapter 8 brings the findings of the four articles together with the three GRQs and discusses the findings of this dissertation on a more general level. Finally, chapter 9 summarizes the main contributions of this dissertation project and gives an outlook on areas for future research.

3. **Article 1: Lean Impact Measurement** – Predicting the sustainability impact of business model innovation in effectual ventures

Article 1

Lean Impact Measurement

Predicting the sustainability impact of business model innovation in effectual ventures

Jannic Horne, Ingo Michelfelder, Malte Recker,
Jason Jay and Jan Kratzer

Keywords: Sustainable Entrepreneurship, Impact Measurement, Social Return on Investment, Effectuation, Stakeholder Theory

JEL Classification: L26, L31, M13, O3, Q01, Q56

3.1 Abstract

Measuring the impact of new ventures is essential in understanding and advancing their role in creating a sustainable world. In this article, we propose Lean Impact Measurement as a pragmatic approach to measuring, comparing and forecasting the impact of new ventures despite entrepreneurial dynamics, financial constraints, limited human capital, and poor data management systems. Building on stakeholder theory the approach uses Social Return on Investment in combination with effectuation theory, Lean Startup and sustainable value added. The approach reveals the additional sustainability value (or destruction) a new venture might create and provides new perspectives on innovation in stakeholder theory.

3.2 Introduction

Analyzing the impact of entrepreneurial ventures is central to entrepreneurship research (Davidsson, 2016; Shane & Venkataraman, 2000). For example, Shane and Venkataraman (2000: 241) argued that entrepreneurship research should examine “*how, by whom, and with what effects opportunities to create future goods and services are discovered, evaluated, and exploited*”. With growing consensus that sustainability is a major societal challenge that entrepreneurs should contribute to (Bidmon & Knab, 2018; Hall, Daneke, & Lenox, 2010; Hockerts & Wüstenhagen, 2010; Shepherd & Patzelt, 2011) the notions of “*effect*” and “*evaluation*” translate into the need for sustainability impact measurement.

The purpose of this article is to provide a feasible and meaningful way to measure, compare and forecast the sustainability impact of new ventures at an early stage. The problem is that measuring sustainability impact is inherently difficult for mature organizations (Bengo et al, 2015; Clifford et al, 2013; Jay & Gerard, 2015; Kroeger & Weber 2014). Measuring it for new ventures that have limited time, financial and human resources and additionally fast-changing business models makes this an almost unsolvable challenge. Yet, not measuring means making uninformed business model decisions without metrics and decision frameworks for their future sustainability impact. Solving this problem is important, as new ventures have the potential to contribute to the urgently needed disruption of currently non-sustainable production and consumption systems (Bidmon & Knab, 2018; Hockerts & Wüstenhagen, 2010; Loorbach & Wijsman, 2013; Pacheco et al., 2010; York & Venkataraman, 2010). Research and practice have responded to the general need for impact and value measurement with valuable contributions (see e.g., Bengo et al, 2015; Clifford et al, 2013; Kroeger & Weber 2014). However, our analysis shows that the central requirements of entrepreneurs are not yet met. This conceptual paper first explores the challenges for sustainability impact measurement in new ventures. To reduce these challenges we use stakeholder theory as a starting point, which leads us to Social Return on Investment (SROI) as a promising, but too complex measurement approach (Millar & Hall, 2013). To simplify SROI for the context of new ventures we integrate ideas from effectuation theory (Sarasvathy, 2001), Lean Startup (Blank, 2013a; Ries, 2011) and sustainable value added (Figge & Hahn, 2004). The resulting Lean Impact Measurement (LIM) approach constitutes a practical way to measure and forecast the impact of new ventures offering numerous opportunities for future empirical research on the sustainability contribution of entrepreneurs. Additionally, our research creates new insights on the stakeholders and issues that should be prioritized to create business model innovation for sustainability (Schaltegger, Lüdeke-Freund, & Hansen, 2016).

3.3 Why and how to measure the impact of new ventures

3.3.1 The importance of measuring sustainability impact of new ventures

Businesses are a major source of unsustainable development and a promising lever to increase sustainability (Figge & Hahn, 2004; Gladwin, Kennelly & Krause, 1995; Schaltegger et al., 2016; WBCSD, 2013; Weissbrod & Bocken, 2017). In theory, large corporations constitute the biggest lever to reduce negative externalities, but in practice, organizational inertia and the economic attractiveness of unsustainable business models prevent disruptive innovations for sustainability (Hockerts & Wüstenhagen, 2010; Weissbrod & Bocken, 2017). Some scholars have suggested that new ventures are more likely to cause the disruptive innovations we need, particularly in tandem with incumbent firms (Hockerts & Wüstenhagen, 2010). Similarly, it has been suggested that new business models play an important role in changing our unsustainable socio-technical systems (Bidmon & Knab, 2018). For example, if innovative ventures succeed, they put pressure on large corporations to follow. Practical examples for this dynamic can be found in the rise of electric cars headed by Tesla, the spread of microfinance after the success of the Grameen Bank or the rise of fair trade that originated with Max Havelaar.

Following this logic, entrepreneurship has the potential to fuel a sustainable turnaround in our economic system towards economic, social and environmental sustainability (Hockerts & Wüstenhagen, 2010; Pacheco et al., 2010; York & Venkataraman, 2010). However, investors, researchers, public authorities and founders themselves lack understanding 'if', 'how' and 'how much' positive (and negative) impact a venture will create (Battilana, 2015; Bengo et al., 2015; Dichter et al., 2016; Schaltegger et al., 2016; Sutch & Kirkland, 2014). This points out the importance of proper impact measurement for new ventures. As Bengo et al. (2015) summarized very well, insufficient measurement systems slow down sustainable entrepreneurs because they cannot demonstrate transparency and accountability (Nicholls, 2009), attract investors and resources (Saltuk et al., 2014; Plotnieks, 2014; Wilson, 2014) monitor business operations (Arena et al., 2015) and manage stakeholders (Clifford, 2014).

3.3.2 No suitable way to measure the impact of new ventures

To avoid these problems, academics and practitioners have developed and discussed various approaches for impact measurement, but no recommended standard emerged (Bengo et al., 2015; Clifford et al., 2013; Clark & Brennan, 2016; Clifford, 2014; Figge & Hahn, 2004; Hadad & Găucă, 2014; Kroeger & Weber, 2014; Mulgan, 2010; Nicholls, 2009; Weber & Kratzer, 2013).

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The numerous approaches can be clustered into three categories (Bengo et al., 2015): (1) Scorecards in which organizations define key indicators to track their performance (e.g., Kaplan & Norton, 2001; McLoughlin et al., 2009), (2) process-based approaches that collect data structured along an input-output-outcome-impact logic (e.g., Bagnoli & Megali, 2011; Hornsby, 2012), (3) synthetic indicators that allow comparison of impacts between different organizations (e.g., Grabenwarter & Liechtenstein, 2011; Lingane & Olsen, 2004). Depending on the stakeholder perspective, each of the three categories and their different approaches face valid criticism – for example they require too many resources, attempt to compare different outcomes, or ask for too many or too few standardized metrics (Bengo et al., 2015; Hadad & Găucă, 2014; Mulgan, 2010; Nicholls, 2009).

Specifically, with regard to new ventures, four problems of measurement have been highlighted: the dynamic environment of entrepreneurs, financial constraints, limited human capital, and poor data management systems (Dichter et al. 2016; Sutch & Kirkland, 2014). These problems match very well Sarasvathy's description of entrepreneurial conditions in her theory of effectuation (Sarasvathy, 2001). The theory describes entrepreneurs as explorers who face high uncertainty (i.e., a dynamic environment) with a limited set of means (e.g., financial constraints, limited human capital, poor data management systems) (Sarasvathy, 2001). Successful entrepreneurs navigate through these circumstances step-by-step to the most promising opportunities without a predefined goal (Sarasvathy, 2001). Introducing impact measurement into the iterative and dynamic development of new ventures means that entrepreneurs need to conduct impact assessments whenever their business model changes. Accordingly, the more complex and resource intensive an impact measurement approach is, the more it constitutes a reoccurring burden to entrepreneurs. This problem led to our research question: *How can we measure and forecast sustainability impact in a way that is practicable for new ventures and meaningful for internal and external stakeholders in terms of benchmarking?*

The research question emphasizes two aspects in measurement. First, how to measure effectual ventures in practice, and second, what needs to be measured to create meaningful insights for stakeholders. In the following, we first discuss the 'what' and then we dive into the more practical 'how'. In this discussion, we also clarify the key constructs of this article and its theoretical foundations.

3.3.3 Using a stakeholder perspective to identify what needs to be measured

We want to measure the effect of the independent variable new ventures on the dependent variable sustainable development. In this measurement, we concentrate on new ventures at an early stage that have a focus on the discovery and evaluation of their business model and

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not on the exploitation of a relatively established business model. Hence, new ventures that can easily adjust their business model to maximize their sustainability impact.

The effect on sustainable development is the dependent variable. Unfortunately, sustainability as a topic is linked to difficult value judgments about social and ecological justice within and between generations (Miller et al., 2014; Norton, 2005). This makes it a controversial topic with conflicting understandings and terminologies (Robinson, 2004). In this article, we use the terms sustainability and sustainable development interchangeably and base our understanding of sustainable development on the famous Brundtland Report (Brundtland Commission, 1987) taking the UN Sustainable Development Goals (SDGs) (General Assembly, 2015) as a reference point. In section 2.3 we will introduce concepts that hopefully help to sharpen how we can define and measure a new venture's contribution to sustainable development. At this stage and as a rule of thumb, a venture contributing clearly to one or several SDGs, without offsetting its positive impact by negatively impacting other SDGs, can be considered a sustainable venture.

Even though we take the SDGs as a reference point, measurement remains challenging due to the uncertainty, interdependencies, and trade-offs between SDGs (see Costanza et al., 2016; Nilsson, Griggs, & Visbeck, 2016; Sachs, Schmidt-Traub, Knoll, Durand-Delacre, & Teksoz, 2017). To navigate through this complexity towards the sustainability issues that should be measured for individual new ventures we rely on the widely used stakeholder theory (Donaldson & Preston, 1995; Freeman, 1984; Mitchell, Agle, & Wood, 1997). The theory argues that a venture creates a sustainable competitive advantage if it creates as much value as possible for the stakeholders that have an effect on it as well as the stakeholders that the venture affects (Freeman, 2010). These stakeholders include employees, shareholders, suppliers, and customers, but also stakeholder like local communities, interest groups or policymakers (ibid.).

Most research on stakeholder theory concentrates on theoretical discussions, the definition of salient stakeholders and managerial responses, particularly in large corporations (Freeman, 2010; Laplume, Sonpar, & Litz, 2008). Only to a limited extent, the theory has been applied in performance measurement, entrepreneurship research and sustainable development (e.g., Freeman, 2010; Steurer, Langer, Konrad, & Martinuzzi, 2005; Venkataraman, 2002). But when it has been applied in these fields, research suggests that relying on stakeholders can resolve the challenge to identify suitable indicators for different sustainability-related outcomes (Rowley & Berman, 2016), which is of great value for our research. It has also been highlighted that stakeholder theory is of great value to understand the "*equilibrating mechanisms*" (Venkataraman, 2002) through which entrepreneurs coordinate various stakeholders and create value for stakeholders in order to build viable ventures. Equally, Venkataraman has emphasized the importance of measuring the economic and social performance of

entrepreneurs (Venkataraman, 1997). In sum, previous research at the nexus of stakeholder theory, entrepreneurship research, and sustainable development suggests that stakeholder theory can be a great starting point to identify the relevant sustainability impacts of new ventures. Moreover, the limited research in this field (see Freeman, 2010; Laplume, Sonpar, & Litz, 2008) suggests that we can make valuable contributions to stakeholder theory: first, with research on measuring and weighing sustainability effects and second, by doing so in the context of new ventures.

3.3.4 Defining requirements that clarify how impact should be measured in new ventures

With the focus on stakeholder-based approaches to impact measurement, we examined the landscape of existing tools to impact measurement and identified Social Return on Investment (SROI) as a widely recognized approach to impact measurement that builds on the stakeholder perspective (Hall, Millo, & Barman, 2015). As the term Social Return on Investment suggests, SROI is a ratio between the monetized social⁵ value that an organization creates and the necessary monetized inputs to create this value. The underlying approach is similar to cost-benefit analysis, but SROI has an explicit focus on stakeholder involvement to capture the value of intangibles as it is perceived by stakeholders (Cordes, 2016; Hall et al., 2015; Lingane & Olsen, 2004; Millar & Hall, 2013; Nicholls & Cupitt, 2012). SROI includes outcomes from all dimensions of sustainability and uses monetization that allows for internal and external benchmarking (Nicholls & Cupitt, 2012).

The general characteristics of SROI make it a promising approach to measure the sustainability contribution of new ventures and navigate measurement efforts towards those aspects that are most relevant for affected stakeholders. However, in practice, SROI has primarily been used in larger non-profit organizations, and there have been concerns about its practicability (Hall et al., 2015; Millar & Hall, 2013; Moody et al., 2015; Watson & Whitley, 2016; Yates & Marra, 2016). Hence, it is not clear whether SROI can be applied in the context of effectual new ventures.

To test the suitability SROI we defined requirements for impact measurement in new ventures based on our initial review of the literature on impact measurement (see 2.1.). This yielded five requirements for impact measurement: to (1) measure at the impact level, (2) cover all three dimensions of sustainability, (3) provide forecasts, (4) allow for benchmarking and (5) create low effort for entrepreneurs.

Requirement 1 – Impact level. Sustainability should be measured at the impact level (not output, or outcome level), to create transparency about a business model's net benefits to

⁵ In SROI social value includes environmental value

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sustainable development. This requirement follows expert opinions and a widely used best-practice (Clark & Brennan, Clifford et al., 2013; 2016; Clifford, 2014; European Union, OECD, 2015; Grabenwarter & Liechtenstein 2011; Hornsby, 2012). Measurement at the impact level is best explained with our definitions of output, outcome, and impact that are based on the European Commission's GECES sub-group on Impact Measurement (Clifford, 2014):

- **Outputs** are the tangible products or services of an organization that directly affect stakeholders (e.g., provided employability trainings, sold photovoltaic panels)
- **Outcomes** are the positive and negative effects on stakeholders that can be linked to outputs (e.g., jobs for participants that were trained, renewable electricity generated)
- **Impacts** are the positive and negative effects on stakeholders that would not have happened without the particular organization (e.g., participants that found a job primarily due to the training and not due to other factors, renewable electricity that would not have been generated without the specific seller of photovoltaic panels)

There is an important difference between impact and outcome. Outcomes describe what an organization potentially contributes, but it remains unclear to what extent the outcomes materialize and result from the organization. Impact describes the contribution that is entirely due to a particular organization. The step to impact can be seen as a reality check in which four so-called counterfactuals (ibid.) are deducted from the outcome:

- **Alternative attribution** refers to outcomes that were caused by others (e.g., a partner that helped to provide the trainings on employability)
- **Deadweight** refers to what would have happened anyway (e.g., if 3 of 10 participants in the training would have gotten a job anyway due to macroeconomic developments)
- **Displacement** describes the relocation of negative effects (e.g., a trained applicant could replace a non-trained employee who is then unemployed)
- **Drop-off** describes the decreasing effect over time (e.g., the annual renewable electricity generation of a photovoltaic panel might decrease over time)

Requirement 2 – Economic, social & environmental sustainability. Measure how new ventures contribute to all three dimensions of sustainable development (social, environmental & economic) along the definition of the Brundtland Commission (Brundtland Commission, 1987). The measurement of all three dimensions is of great relevance as Sustainable Development Goals frequently have inherent trade-offs (Nilsson et al., 2016). Thus, it is necessary to measure if a venture reduces one externality at the expense of another externality.

Requirement 3 – Forecast. Impact must be forecasted. First, to be in line with the Brundtland Commission's definition of sustainability that includes intergenerational aspects (Brundtland

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Commission, 1987) and second, to account for the lack of historical data in new ventures that make forecasting the only meaningful approach to assess their sustainability.

Requirement 4 – Internal & external benchmark. We aim for internal and external benchmarking to create the greatest value for entrepreneurs and their stakeholders. Internal benchmarking with venture-specific performance indicators is valuable to manage operations within an organization (Bengo et al., 2015; Grabenwarter & Liechtenstein, 2011; Kaplan & Norton, 2001), but there is additional value in external benchmarks with peers that allow users to assess ventures' overall contribution to sustainability and draw strategic conclusions (Grabenwarter & Liechtenstein, 2011; Lingane & Olsen 2004).

Requirement 5 - Low effort. Effort must remain manageable in terms of time and resources to be practical for entrepreneurs. This requirement is based on studies that identified resource requirements as an important barrier for impact measurement (Clifford, 2014; Manetti, 2014) and it is strongly supported by effectuation theory that characterizes entrepreneurial circumstances as resource constraint and uncertain (Sarasvathy, 2001).

3.4 Discussing the potential to measure sustainability impact in new ventures with SROI

3.4.1 SROI nearly satisfies our requirements

In this paragraph, we explain SROI in more detail and points out in how far SROI satisfies the before stated requirements. While there are numerous ways to calculate SROI (Hadad & Găucă, 2014; Hall et al., 2015) we base our analysis on the SROI approach of the leading SROI organization Social Value International (Nicholls & Cupitt, 2012).

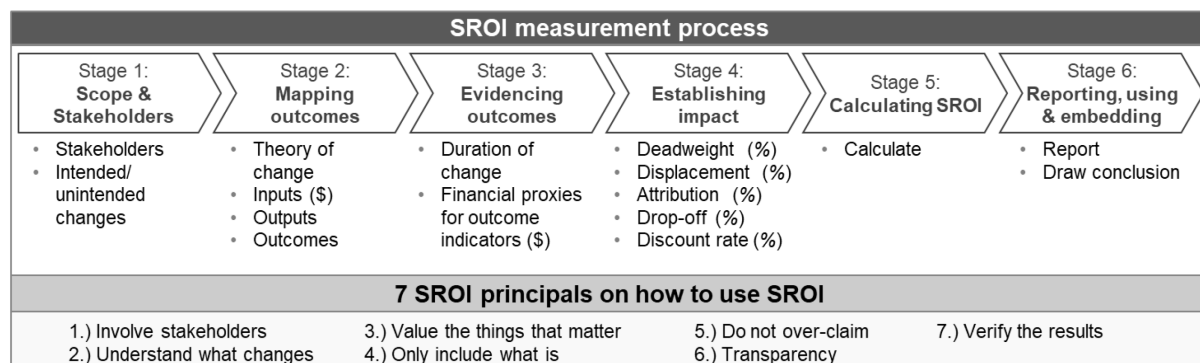


Figure 3.1 The six stages of SROI (adjusted from Nicholls & Cupitt, 2012)

In Figure 3.1 we summarized the SROI measurement process with its 6 stages, the main activities, and the guiding SROI principles. According to Social Value International (stage 1), an organization needs to start with identifying all stakeholders that are affected by its activities

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and analyze how their situation changes (positive and negative changes). Then (stage 2) outcomes from all dimensions of sustainability (requirement 2) need to be mapped for each stakeholder using the Input-Output-Outcome-Impact-model (requirement 1). Taking the example of a health care provider, the mapping begins with a monetized overview of inputs like labor or voluntary work and a quantified overview of outputs per stakeholder such as the number of treated patients. With the help of a 'theory of change', the outputs are linked to outcomes like improved health. To actually measure improved health outcome-indicators are used like the average number of sick days per year. This link to outcome-indicators allows users to measure how much the average health/outcome-indicator per patient improves per treatment/output. Then (stage 3) an organization needs to identify financial proxies for each outcome-indicator to monetize its social value – for example, the average cost of a sick day. The resulting outcome value needs to be corrected for counterfactuals (stage 4). This means that the outcome value is corrected for deadweight, attribution, displacement, and drop-off, in line with the earlier definition of impact. A discount rate needs to be determined, so that (stage 5) the impact can be forecasted for a five-year period (requirement 3), and a SROI ratio can be calculated. Finally, (stage 6), SROI provides guidelines on how to report and use all the collected data. The resulting monetary values allow for internal and external benchmarking (requirement 4).

To assure good quality throughout this process, seven principles have been defined: (1) involve stakeholders, (2) understand what changes, (3) value the things that matter, (4) only include what is material, (5) do not over-claim, (6) be transparent and (7) verify the results. To comply with these principles and their detailed descriptions, extensive primary data collection is necessary with techniques like one-to-one interviews, record keeping, focus groups, workshops and questionnaires (Nicholls & Cupitt, 2012).

The end result of such a SROI analysis is a comprehensive view on social, environmental and economic outcomes and how they are valued by stakeholders (Hall et al., 2015; Millar & Hall, 2013; Moody et al., 2015; Watson & Whitley, 2016; Yates & Marra, 2016). As we highlighted in the process described above and summarized in Table 3.1 below, SROI satisfies all our previously defined requirements apart from the 5th – it measures sustainability at the impact level, it covers all dimensions of sustainability, it can be used for forecasting, and it is suitable for benchmarking. However, the comprehensive and participatory nature of SROI suggests high resource requirements for impact measurement which does not satisfy our goal to measure with manageable effort (requirement 5).

Table 3.1 Detailed matching of SROI with the requirements for impact measurement in new ventures

	Does SROI satisfy the requirement
1. Measure sustainability at the impact level	Yes , this is part of the standard process in SROI (Hall et al., 2015; Lingane & Olsen, 2004; Nicholls & Cupitt, 2012)
2. All three dimensions of sustainability	Yes , but the degree can vary depending on stakeholders and SROI approach (Hall et al., 2015)
3. Forecasting	Yes , typically for five years (Nicholls & Cupitt, 2012)
4. Internal & external benchmarking	Yes , but for external benchmarks, it is crucial to consider contextual information (Gair, 2009; Lingane & Olsen, 2004; Manetti, 2014; Nicholls & Cupitt, 2012)
5. Effort must be manageable	Critical , the required resources and time have been highlighted as an important barrier to the application of SROI (Manetti, 2014; Yates & Marra, 2016)

3.4.2 Problems of SROI in literature and practice

To better understand the barriers and potential solutions for the application of SROI in new ventures, we reviewed criticism on SROI in the academic literature, its historical development and examined official publications from SROI organizations. In summary, we identified five intertwined problems around SROI (see figure 3.2): (1) lack of contextual information, (2) negligence of non-monetary impacts, (3) unreliable and hard to verify data, (4) low interest by stakeholders, and (5) resource requirements that exceed the perceived benefits (Hall et al., 2015; Millar & Hall, 2013; Moody et al., 2015; Watson & Whitley, 2016; Yates & Marra, 2016).

Problem 1 – Context. Contextual information is frequently neglected (Gair, 2009; Tuan, 2008). However, without adequate contextual information, SROI leads to oversimplified comparisons and conclusions based on an isolated SROI ratio with little meaning (Lingane & Olsen, 2004; Manetti, 2014; Nicholls & Cupitt, 2012).

Problem 2 – Monetization. Stakeholders focus excessively on the final monetary value (Tuan, 2008). Thus, everything that is not expressed in monetary terms is neglected (Manetti, 2014; McLoughlin et al., 2009). This is particularly true for so-called 'soft outcomes' or intangibles like self-esteem or interpersonal skills.

Problem 3 – Unreliable & hard to verify. The SROI results have been criticized as unreliable and difficult to verify with regard to stakeholder and outcome selection, assumptions for outcome indicators, financial proxies, counterfactuals, and discount rates (Lingane & Olsen, 2004; Millar & Hall, 2013; Moody et al., 2015; Yates & Marra, 2016). For example, Lingane and Olsen (2004) highlighted the challenge of data availability and consistency across SROI-analyses, Millar, and Hall (2013) pointed out the challenge in providing evidence around counterfactuals, and Manetti (2014) highlighted the practical limitations for external verification.

Problem 4 – Low interest by stakeholders. Some authors reported low interest and understanding of SROI from external stakeholders like investors (Manetti, 2014; Millar & Hall, 2013). To a certain extent, this problem is a consequence of the stated problems 1-3, as the insufficient use of contextual information (problem 1), the complexity of monetization (problem 2) and the hard to verify results (problem 3) make it hard for stakeholders to draw meaningful conclusions from SROI data.

Problem 5 – Effort exceeds benefits. Together the previous points create a situation in which the effort of measurement exceeds the benefits. A comprehensive SROI analysis requires considerable resources to collect and validate the necessary data with all affected stakeholders (Manetti, 2014; Yates & Marra, 2016). If internal and external stakeholders perceive SROI results as not useful, the cost of measurement exceeds the opportunity costs of doing the everyday work that creates the actual impact (Yates & Marra, 2016). Thus, SROI in new ventures might not be seen as a voluntary tool to learn and to improve an organization; instead, it becomes a tool of control for external stakeholders (Nicholls, 2009). We need to avoid this effect to satisfy our requirement 5 and create a manageable and practical tool for impact measurement in new ventures.

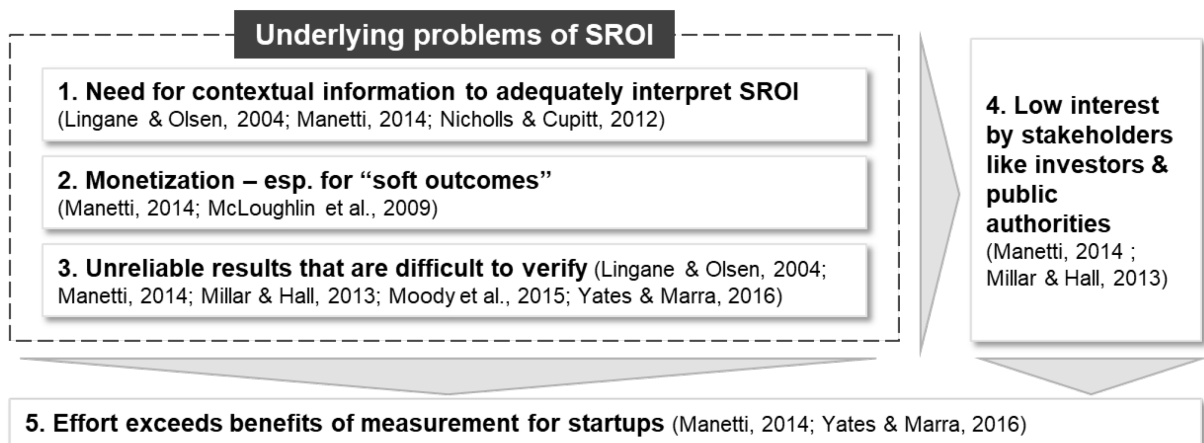


Figure 3.2 Overview of the linkages between the main problems of SROI in literature

Figure 3.2 summarizes the barriers to impact measurement with SROI. The linkages show that the overall problem of SROI is the imbalance between effort and perceived benefits of measurement (problem 5). As most of the stated problems have been observed in relatively mature social enterprises and non-profit organizations, this finding is important for our research. It suggests that new ventures with fewer resources and less experience will have even more problems to use SROI than mature organizations. Accordingly, it is unlikely that SROI in its current form can be used by entrepreneurs. To make SROI applicable for them and address some of the stated problems, we developed LIM. However, before we explain our approach in detail, it is important to clarify the underlying ideas.

3.5 The underlying ideas for our approach to impact measurement in new ventures

3.5.1 Impact measurement is a reoccurring effort for effectual entrepreneurs

We base our understanding of entrepreneurs on Sarasvathy's effectuation theory, which she developed through research on serial entrepreneurs (Dew et al., 2009; Dew et al., 2011; Sarasvathy, 2001; Sarasvathy & Dew, 2005). In her theory, she distinguishes between two models of decision-making – causal vs. effectual. Causation is a more analytical approach which assumes that the future is to some extent predictable (Sarasvathy, 2001). It constitutes the predominant approach in traditional entrepreneurship research (Dew et al., 2009). According to Sarasvathy (2001), causal thinkers try to identify an optimal effect (e.g., a value proposition for a new venture) and assess the best exploitation of means to create this effect (e.g., the ideal business model for the targeted value proposition). In contrast to this, she found that experienced entrepreneurs follow a more exploratory, iterative logic, which she called effectuation.

In practice, causation and effectuation are intertwined (Sarasvathy, 2001). For example, there is causal thinking involved when an effectual entrepreneur selects between the different effects he/she can create with the available means. Therefore, the dichotomy between causal and effectual decision-making is artificial, but it serves as a way to contrast the two different logics for decision-making and how they translate into action (Sarasvathy, 2001). Empirical findings emphasize the importance of effectuation theory by showing a positive relationship between venture performance and effectual strategy making (Read, Song, & Smit, 2009). This underlines the importance of tailoring impact measurement to effectual circumstances.

Impact measurement for new ventures naturally follows a causal logic as it tries to predict a future that is uncertain according to effectuation theory (Sarasvathy, 2001). Therefore, an effectual forecast about impact is in itself a contradiction. However, it is possible to adjust forecasting to the needs of effectual entrepreneurs – i.e., to make it more explorative and iterative (Dew et al., 2009; Sarasvathy, 2001). The solution circle shown in figure 3.3 provides a good illustration of the decision-making processes in causal and effectual ventures (Frederiksen & Brem, 2017) and it can be adapted to illustrate when and how impact measurement can take place (right part of figure 3.3).

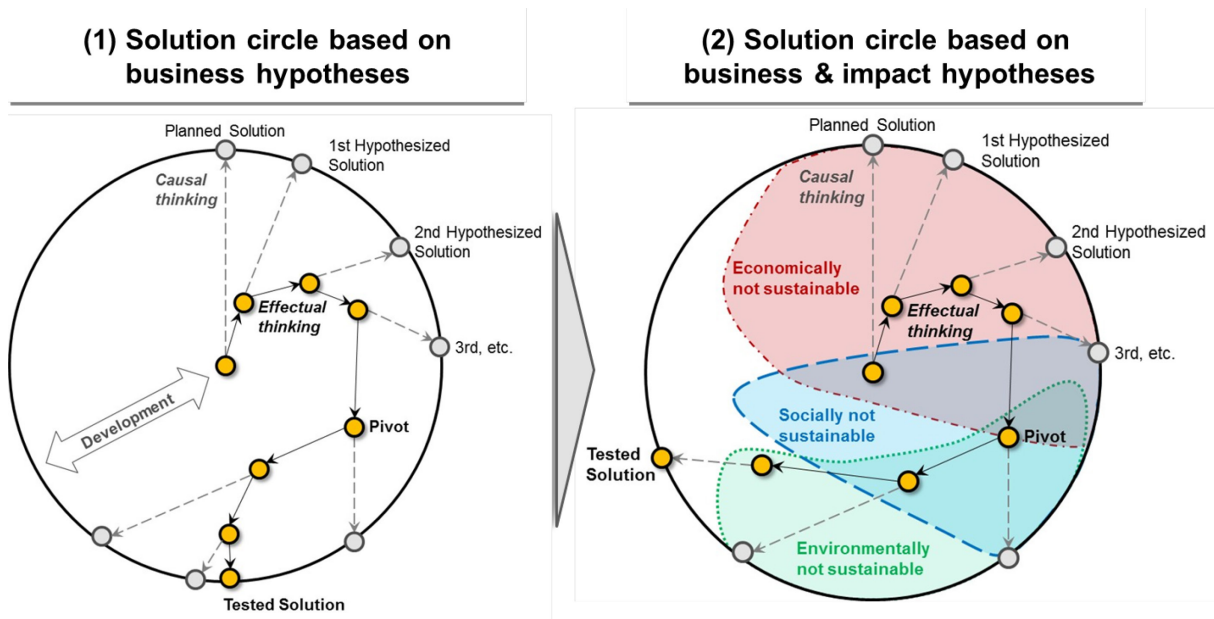


Figure 3.3 Illustration of the solution circle based on (1) business and (2) business & impact hypotheses (adjusted from Frederiksen & Brem, 2017)

3.5.1.1 Causal entrepreneurs in the solution circle

Following a causal logic, entrepreneurs would first make plans about the future, independently of available means and then execute the planned solution (Sarasvathy, 2001). Translated into the solution circle (left part of figure 3.3), this means that an entrepreneur begins at the center of the circle with a comprehensive analysis about the most promising business solution (the entirety of possible solutions is represented by the outer boundary of the circle). Then the entrepreneur draws a straight line from the center of the circle to the targeted solution which means the entrepreneur develops the optimal plan to realize the solution. Finally, the plan is executed.

For impact measurement, this logic assumes that an entrepreneur can conduct one comprehensive initial impact assessment to analyze the impact of all possible solutions (see right side of figure 3.3). Then the best combination of economic, social and environmental returns can be selected and the sustainable business model can be executed as planned. In light of the resource limitations in new ventures we discussed earlier (requirement 5 – low effort) and the effectual nature of successful entrepreneurs (Dew et al., 2009; Read, Song, & Smit, 2009; Sarasvathy, 2001), it seems unlikely that entrepreneurs first have the resources to develop one ideal causal plan that considers all possible impacts from the start; and second, that an entrepreneur can execute this plan without any effectual changes. Therefore, impact measurement should follow an effectual logic.

3.5.1.2 Effectual entrepreneurs in the solution circle:

Effectual thinking is an iterative process (illustrated with the yellow dots in figure 3.3). Due to the limitation of means, entrepreneurs have a limited set of solutions to choose from (only some parts of the solution circle), and they try to identify the most promising among them (Frederiksen & Brem, 2017). The decision process involves causation because an entrepreneur will have some hypotheses about the effects of the chosen solution. However, for an effectual entrepreneur, the hypothesized solution is not permanent as the process of execution will change the available means and create new opportunities (Sarasvathy & Dew, 2005). In light of new means and opportunities, old hypotheses can be rejected and more promising hypotheses can be developed (Frederiksen & Brem, 2017). This leads to an iterative process in which entrepreneurs identify available opportunities, select the most promising solution, execute it, learn, develop and again review the now available opportunities. This translates into the iterative step-by-step process with frequent changes in the planned solution, as shown by the yellow dots in figure 3.3.

If entrepreneurs follow this iterative logic of effectuation, they do not predict all possible impacts of their business model from the start. Instead, impact measurement becomes a reoccurring task that has to be performed for every new and changed hypothesis. At every iteration, an entrepreneur needs to test whether the hypothesized solution is sustainable economically, socially and environmentally and iterate towards a more sustainable solution (see right part of figure 3.3). The more complex and resource intensive the impact measurement at each iteration is, the more it becomes a reoccurring and unwelcome effort. This iterative and dynamic nature of impact measurement for entrepreneurs explains the need to keep the effort of measurement manageable (requirement 5), and it suggests the need to adjust SROI to the effectual circumstances.

3.5.2 Linkages between Lean Startup, effectuation theory and SROI

To adapt impact measurement to the effectual conditions of entrepreneurs we propose to integrate SROI into the Lean Startup approach. Lean Startup is widely used among entrepreneurs to improve their business model (Blank, 2013a; Ries, 2011), it is increasingly used in a wide range of public and private organizations as a way to create innovation (Blank, 2013a; Blank, 2013b; Blank, 2016; Harms, 2015; Weissbrod & Bocken, 2017), and it shares key ideas of effectuation theory (Frederiksen & Brem, 2017).

Similar to effectuation theory (Sarasvathy, 2001), Lean Startup sees uncertainty as a major constraint for entrepreneurs (Ries, 2011; Lean Startup principle 1 & 2 in Table 3.2). To minimize this constraint, Lean Startup seeks more control over uncertainty through iterative experimentation, customer feedback, and data collection so that key business hypotheses can

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be tested and improved (Blank, 2013a; Frederiksen & Brem, 2017; Ries, 2011). The process is called validated learning (Lean Startup principle 3), and it is organized in the build-measure-learn cycle (Lean Startup principle 4) (Ries, 2011). Depending on the tests' outcomes, the business model needs to be changed in so-called pivots (see figure 3.3). To keep everything well-structured, to measure progress, and plan work efficiently, Lean Startup calls for innovation accounting (principle 5) (Ries, 2011).

This process resembles the iterative effectual process described in the solution circle (figure 3.3). Therefore, Lean Startup provides a suitable effectual vehicle for impact measurement in new ventures. One key advantage is that the focus on hypothesis development and quantitative testing in Lean Startup (Mueller & Thoring, 2012) can be linked to SROI, including the data gathering that is necessary to validate and substantiate impact (Nicholls & Cupitt, 2012). We summarized the linkages between Lean Startup principles, effectuation theory and impact measurement in Table 3.2.

Table 3.2 Overview of linkages between Lean Startup, effectuation theory and impact measurement with SROI

Lean Startup principles (Ries 2011, 7-8)	Link to effectuation	Relevance for impact measurement with SROI
1. Entrepreneurs are everywhere <i>"The concept of entrepreneurship includes anyone who works within my definition of a startup: a human institution designed to create new products and services under conditions of extreme uncertainty."</i>	Effectuation theory emphasizes uncertainty as a key reason for iterative progress in new ventures (Sarasvathy, 2001).	In SROI entrepreneurs risk investing considerable resources to measure an unreliable impact (Manetti, 2014; Millar & Hall, 2013) that is likely to change when ventures evolve.
2. Entrepreneurship is management <i>"A startup is an institution, not just a product, and so it requires a new kind of management specifically geared to its context of extreme uncertainty."</i>	Experienced entrepreneurs use approaches that differ strongly from the causal logic of management education at universities (Dew et al., 2009)	SROI needs to be adjusted to the context of extreme uncertainty – i.e., especially a reduction of the criticized measurement effort (Manetti, 2014; Yates & Marra, 2016)
3. Validated learning <i>"Startups exist not just to make stuff, make money, or even serve customers. They exist to learn how to build a sustainable business. This learning can be validated scientifically by running frequent experiments that allow entrepreneurs to test each element of their vision."</i>	The emphasize on learning can be linked to the affordable loss and the leveraging contingencies principles in effectuation (Dew et al., 2009)	While SROI emphasizes learning and ideation with stakeholders (Nicholls & Cupitt, 2012) organizations perceive the process as burdensome and not beneficial (Manetti, 2014; Millar & Hall, 2013)

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4. Build-measure-learn <i>"The fundamental activity of a startup is to turn ideas into products, measure how customers respond, and then learn whether to pivot or persevere."</i>	The effectuation process with its expanding cycle of resources and a converging cycle of constraints (Sarasvathy & Dew, 2005) resembles the build-measure-learn principle	SROI is promoted as a regular management tool (Nicholls & Cupitt, 2012), but resource requirements constitute the main implementation barrier (Manetti, 2014; Yates & Marra, 2016)
5. Innovation accounting <i>"To improve entrepreneurial outcomes and hold innovators accountable, we need to focus on the boring stuff: how to measure progress, how to set up milestones, and how to prioritize work."</i>	Not specifically mentioned	Accountability and measurement of progress are key reasons for the use of SROI (Moody et al., 2015; Nicholls & Cupitt, 2012; Yates & Marra, 2016)

3.5.3 Simplifying SROI and integrating it into the Lean Startup approach

We have shown that the required effort to measure SROI is a major barrier to its application in the dynamic and iterative circumstances of a new venture. Therefore, it is not enough to integrate SROI into Lean Startup to sufficiently facilitate impact measurement. In addition to this, we propose to simplify SROI. The resulting combination of a simplified SROI within the Lean Startup approach is more likely to sufficiently reduce the effort of measurement for the effectual conditions in new ventures.

The changes we propose do not take away the need to assess how ventures affect their relevant stakeholders (Donaldson & Preston, 1995), but they reduce measurement to the key changes compared to existing alternatives. The changes were inspired by the following description of SROI and its role: *"The quantitative analysis of a company's impact should always begin from a theoretical ideal of zero negative impact, but information on how the company's performance compares with the next best alternative in its marketplace must be provided to give the SROI context and meaning. It is virtually impossible for any company in the present market context to be perfectly free of any negative impacts. When properly calculated, SROI reflects the relative improvements in well-being that a business delivers over the status quo, and thereby SROI becomes useful as a management and analytical tool. If we value companies' marginal improvements in social impact relative to their peers and base capital allocation and investment decision on these valuations, over time, market forces will drive industries toward sustainability."* (Lingane & Olsen, 2004, pp. 124–125).

We share the view that impact measurement should aim to capture all occurring impacts, but we also see that measuring all different impacts of an organization creates many practical challenges (see Figge & Hahn, 2004 and our previous discussions). To avoid these

challenges, we focus on the impact improvements relative to peers following the argument that successive improvements can support progress toward sustainability (Lingane & Olsen, 2004). The comparative approach is similar to Figge and Hahn's sustainable value added, which measures the additional sustainability value a business creates compared to a benchmark (Figge & Hahn, 2004). However, contrary to their approach we do not use national economic data as the benchmark. Instead, we propose to benchmark with the best available alternative. This alternative is defined as the single or a combination of solutions that current/future customers would use if this new innovation/venture did not exist. With our approach, we follow recent developments in the impact investing field and label this difference "*additionality*"⁶ (So & Staskevicius, 2015). Additionality simply measures the difference in positive and negative impacts between the existing alternative and the solution provided by the new innovation/venture. It is this additionality that should guide decision making for new ventures and impact investors. It gives entrepreneurs and their stakeholders a good indication if and how much sustainability value they potentially create and guides them towards more sustainable business models. In choosing different alternatives, it is possible to create different benchmarks and satisfy different information needs. For example, the comparison with the best available solution in the home market can inform immediate business model decisions, whereas a comparison with the best alternative globally could inform strategic long-term investment decisions. Another positive side effect, focusing on additionality (instead of all positive and negative impacts) greatly reduces measurement effort for entrepreneurs. This reduces the before stated problem that effort of measurement exceeds benefits for entrepreneurs.

3.5.4 Illustrating the idea with an example

Figure 3.4 illustrates the underlying logic with a hypothetical example. We assume a new venture introduces organic fair trade banana production in a region where the best available alternative is fair trade banana production. Fair-trade-only banana production is thus the alternative⁷. The example shows that introducing an innovation (combining fair trade *and* organic) will only create some significant changes compared to the alternative (see decreasing additionality of impact relative to the alternative in figure 3.4). Being able to provide organic *and* fair trade bananas requires business model changes that add ecological benefits to the social benefits of fair trade: Organic farming practices reduce waste that damages the

⁶ The term *additionally* is sometimes used not only from an organizations perspective, as described above, but as well from an impact investors investment perspective (McCreless, 2017). In the latter, Brest and Born referred to this term as "*the investment must increase the quantity or quality of the social or environmental outcome beyond what would otherwise have occurred*" (Brest and Born, 2013, p. 25).

⁷ We don't compare to conventional banana production to not over claim. Our potential customers for fair trade + organic bananas are a much smaller market than the market for conventional bananas.

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environment around non-organic farms, the elimination of pesticides increases workers' and local communities' health, and the elimination of nitrogen-based fertilizers leads to a reduction in greenhouse gas emissions. As described before, focusing only on these changes compared to the status quo has the advantage to greatly reduce measurement complexity. And at the same time, this allows identifying the additionality, i.e., the sustainability value added of a new venture.

The results can be used for benchmarking within or between new ventures at the level of outcome indicators, which are in our case (1) avoided waste in the local community (measured in tons) (2) the reduction in sick days for workers and local communities (measured in days) and (3) the reduction in greenhouse gas emissions (measured in tons). Additionally, benchmarking is possible between completely different indicators and different new ventures, if outcome indicators are monetized and thus translated into a single denominator.

It is important to note that the relative changes between the new venture's innovation and the alternative do not yet capture potential rebound effects from increased sales volumes due to relatively more attractive products/services of the new venture compared to the alternative. To address this problem we recommend to calculate impacts on a per product/service basis, as it allows adjusting the total impact easily to changing sales numbers. Thus, rebound effects from increased sales volumes compared to the alternative can be added as negative outcomes into the calculations.

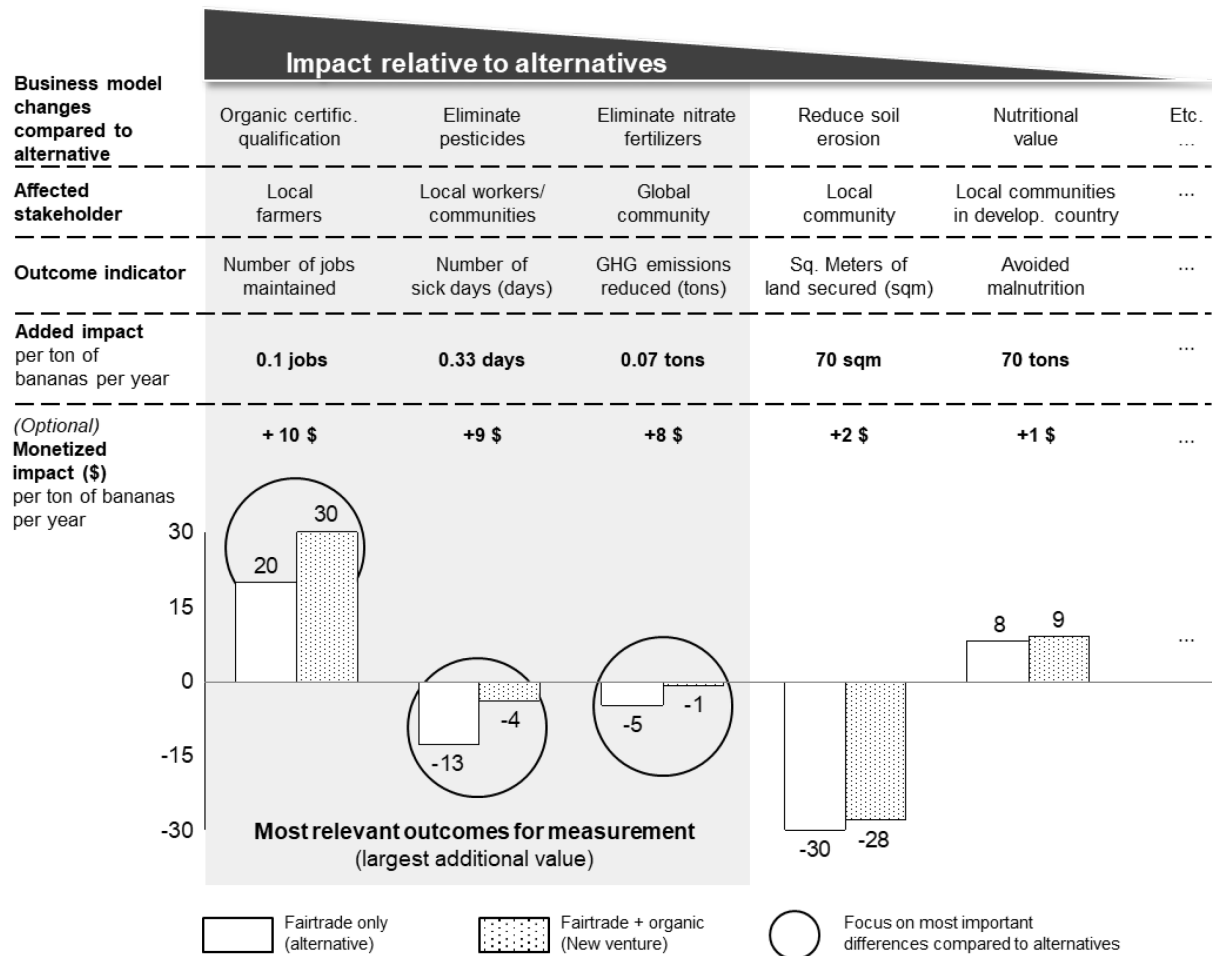
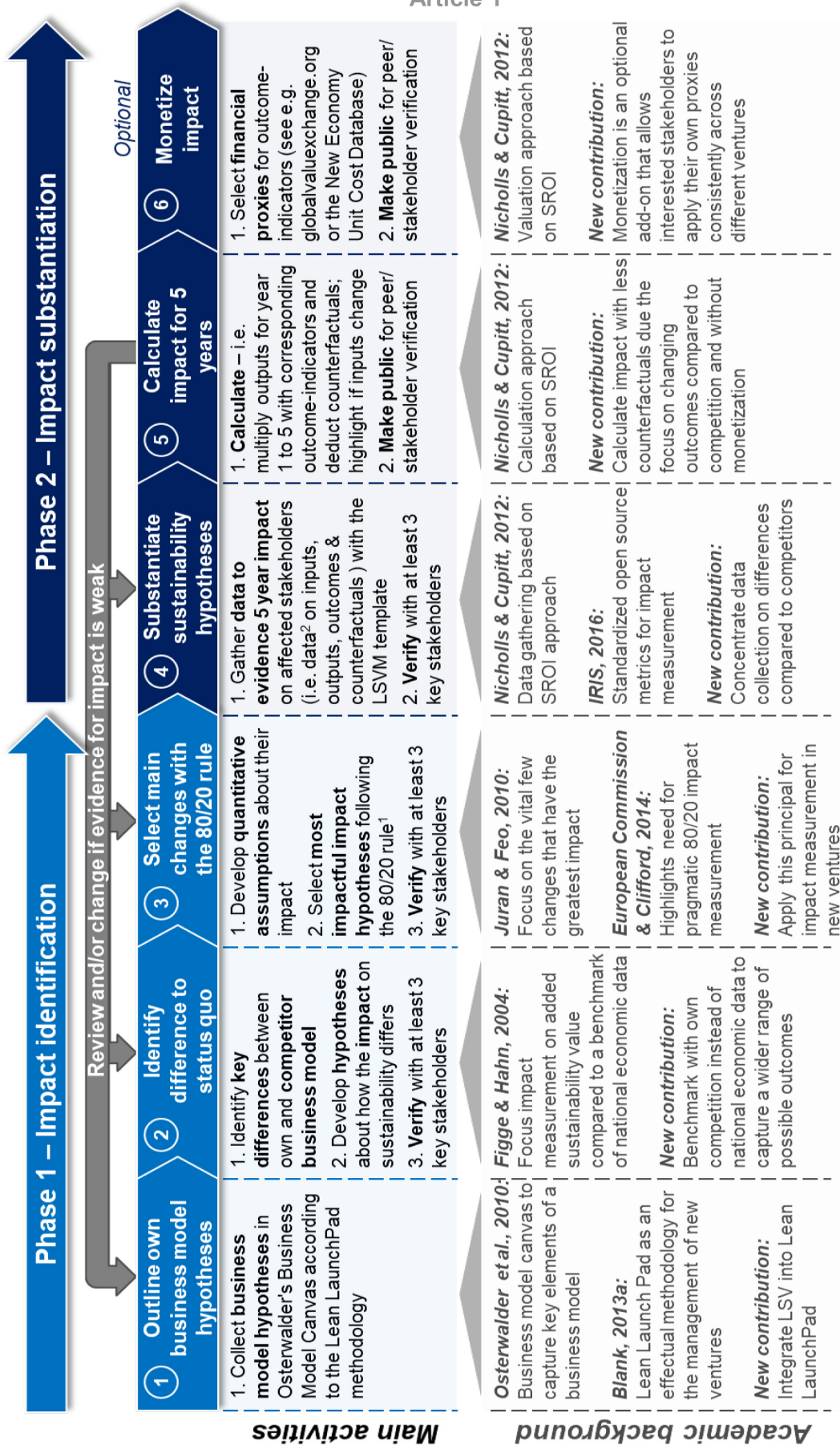


Figure 3.4 Hypothetical example explaining the calculation logic of our additionality perspective (Growing organic + fairtrade bananas in a region where only fairtrade bananas are produced)

3.6 Lean Impact Measurement (LIM)

To turn the before stated theoretical considerations into a practically testable measurement approach, we aggregated them in the LIM approach. As shown in figure 3.5, LIM consists of two phases: impact identification and impact substantiation phase.



1. Assumes that around 80% of the impact comes from 20% of the changes; 2. Use standard IRIS metrics if possible

Figure 3.5 Main activities and academic background for Lean Impact Measurement with its 2 phases and 6 steps

3.6.1 A practical guide for the 1st phase of LIM - Impact identification

Initially (step 1), entrepreneurs collect their key business hypotheses with the user-friendly “*Lean LaunchPad*” methodology (Blank, 2013a), which integrates Osterwalder’s business model canvas (Osterwalder et al., 2010) in the effectual Lean Startup approach (Frederiksen & Brem, 2017; Ries, 2011). Then (step 2) entrepreneurs need to assess where their business model differs from existing alternatives. Once entrepreneurs have identified the main differences in their business model they need to develop quantitative hypotheses about the positive and negative impacts of these differences. This allows them to identify the most impactful changes (step 3) using an 80-20 approach (Juran & Feo, 2010).

To reveal false assumptions about the alternative, to identify omitted impact hypotheses and to quantify the most impactful hypotheses, entrepreneurs should be pragmatic and use their available means in an effectual logic (Sarasvathy, 2001). The required research should be combined with the research that is necessary to test a venture’s business model hypotheses in the Lean Startup approach – for example interview stakeholders, do web research or test prototypes (Blank, 2013a; Ries, 2011). To verify results and avoid unnecessary data collection in the impact substantiation phase, assumptions should be verified as a rule of thumb by at least three key stakeholders (e.g., beneficiaries, investors, experts) and refined where necessary. In many cases, the identified and quantified impact hypothesis alone can provide meaningful evidence to review the business model and pivot (see figure 3.5).

Compared to SROI this first phase of LIM pulls forward parts of the deadweight analysis (i.e., what would have happened without the venture (Clifford, 2014) from stage 4 in SROI (see figure 3.1) to step 2 in LIM (see figure 3.5). In doing so, we avoid the disadvantage of SROI that a wide range of stakeholder and outcome data are collected from stage 1 to 3 that might be filtered out in the counterfactual analysis at stage 4 and turn out to be insignificant in the end. LIM avoids this and makes it easier to focus on the most impactful outcomes by applying the Pareto principle (Juran & Feo, 2010) that assumes that 80% of the impact results from 20% of the outcomes. Thereby, we follow the pragmatic recommendation of the European Commission’s expert group on impact measurement to aim for about 80% of the measurable effects (Clifford, 2014).

3.6.2 A practical guide for the 2nd phase of LIM – Impact substantiation

Once a venture has clarity about its business model and the most impactful hypotheses compared to the alternative the impact must be substantiated. The process itself is based on SROI (Nicholls & Cupitt, 2012) with the important difference that impact is calculated for a non-monetized outcome indicator.

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Phase 2 begins with data gathering (step 4) based on the SROI approach (Nicholls & Cupitt, 2012; Lingane & Olsen, 2004). It includes the collection of data on affected stakeholders, and the firm's inputs, relevant outputs, the link to outcomes, and counterfactuals for a five-year period. The forecast period can be adapted according to the availability of meaningful data and the specific context of a venture. The selected data should be verified as a rule of thumb by at least three key stakeholders. Then (step 5) the data are used to calculate a five-year impact forecast on the level of outcome-indicators preferably with standardized performance metrics like IRIS⁸ (IRIS, 2016). If inputs per output change compared to the alternative this has to be highlighted separately for each outcome-indicator. In the end, the collected data and the impact calculations should be made public so that stakeholders can review and verify the impact calculations. The monetization of outcome-indicators (step 6) remains optional contrary to the classical SROI (Nicholls & Cupitt, 2012).

3.6.3 The role of monetization in LIM

We made monetization an optional add-on to LIM because it poses an important barrier to a broad application and acceptance of SROI (Millar & Hall, 2013). But we did not abolish monetization completely as monetization has the great advantage that it allows translation of different outcomes into one number so that comparisons become possible between very different outcomes – e.g., CO₂ reduction, waste reduction, job creation, and health improvements. However, this advantage is linked to two disadvantages that explicitly need to be mentioned. First, the lack of consensus around the underlying value judgments that are necessary to monetize different outcomes (Figge & Hahn, 2004; Hadad & Găucă, 2014); simply consider the contentious literature on the social cost of carbon (Kotchen, 2018; Tol, 2008). The second disadvantage is important from a moral perspective and concerns more broadly any attempt to create a single synthetic indicator that combines ethically-laden outcomes. Such indicators can show an improvement even when tradeoffs are being made that are indefensible from a deontological moral perspective (see e.g., Arndt et al., 2012; Ravallion, 2018). In extreme cases, increased child labor might be offset by reduced GHG emissions. A seemingly pragmatic and certainly good answer is setting rules, such as “*no inclusion of negative impacts on society*” and “*no violation of ethical principles*” (Melhotra, Clavier & Baillard, 2018). Reality shows, however, that tradeoffs between sustainability goals are common (Nilsson et al. 2016), and the question is where the boundaries of “*no negative impact on society*” should be set? The clear recommendation to mitigate both mentioned disadvantages of monetization thus needs to be transparency, disclosing transparently impacts, assumptions, and contexts behind a monetized synthetic indicator value.

⁸ IRIS is a collection of metrics to measure social, ecological and economic performance (Iris, 2016)

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Despite these challenges clear advantages remain. In addition to the comparison of different outcomes, it is important to note that monetization can be used independently by ventures as well as interested stakeholders (e.g., investors, public authorities or researchers) (Ruff & Olsen, 2016). This allows interested stakeholders to use a consistent set of financial proxies that they deem suitable across different ventures. We strongly encourage this flexibility in monetization, but we at least advise against the use of discount rates to reduce complexity for entrepreneurs and avoid the intergenerational discrimination that contradicts the central tenet of sustainability (Brundtland Commission, 1987).

3.6.4 LIM allows for three types of benchmarking

For a new venture, the main focus of LIM is the identification and substantiation of the added value it creates compared to the alternative. The use of the alternative in LIM can be seen as the first of three external benchmarks. This peer-benchmark tells stakeholders how much better or worse a new venture creates certain outcomes compared to peers (in % or absolute terms). The second possible comparison is the outcome-benchmark. It compares two different ventures or two possible business models of one venture with regard to the same outcome – for example, avoidance of CO2 emissions. This can be of interest for entrepreneurs as well as stakeholders like impact investors when they consider alternative strategies aimed at the same outcome metric. The third possible benchmark is the monetized-benchmark. This benchmark uses financial proxies for outcomes to compare totally different outcomes in the same unit. Thus, comparisons become possible between the value of the CO2 reduction of venture-A and venture-B, the reduction of waste of venture-C and the reduction of youth unemployment of venture-D. This benchmark comes together with all the before stated pros and cons with regard to monetization.

3.6.5 Removed and remaining shortcomings of impact measurement in new ventures

With LIM we can mitigate the problems of SROI that we discussed earlier. Most importantly we provide context for measurement, remove the burden of monetization and make the process less complex and therefore easier to understand and verify. This reduces the overall effort for impact measurement and makes it more attractive for entrepreneurs and their stakeholders. The main changes per SROI problem are summarized in table 3.3 below.

Table 3.3 Overview of SROI shortcomings that LIM can reduce

SROI problem	Solution in LIM
1. Context	The alternative automatically creates a context for impact measurement. This facilitates the interpretation of results and resolves the first problem.
2. Monetization	For entrepreneurs, we remove mandatory monetization. Thus, the standard outputs of LIM are the peer-benchmark and the outcome-benchmark. But we maintain the advantages of a monetized-benchmark by making it an optional add-on that can be used by entrepreneurs as well as other stakeholders like investors, public bodies or researchers.
3. Unreliable & hard to verify	The focus on the alternative reduces complexity in measuring impact and increases transparency about the results which makes verification easier. The main elements of LIM phase 1 – impact identification (i.e., the selection of the alternative, identification of differences to the alternative and the selection of the main impact hypotheses) can be reviewed during a regular pitch process and in phase 2 – impact substantiation only the main impact hypotheses need to be reviewed in detail.
4. Low interest by stakeholders	It will be easier for stakeholders to understand and interpret impact measurement results as the underlying problems 1-3 have been reduced. Moreover, the linkage to the alternative is basically a competitive positioning that can be of additional value for investors. Therefore, we expect that stakeholder interest in LIM is likely larger than for SROI.
5. Effort exceeds benefits	Having addressed the underlying problems 1-3 the resource requirements for impact measurement will be lower. In addition to this, the potential increase in stakeholder interest (problem 4) can further reduce the opportunity cost to impact measurement.

Even though LIM addresses important problems of SROI it is important to mention the remaining shortcomings that result from the inherent trade-off between comprehensive measurement and simplification.

(1) Risk of false alternatives & hypotheses. In the impact identification phase, the most important risks are the selection of an unsuitable alternative and the use of false assumptions about most impactful contributions to sustainability. In line with the Lean Startup approach (Blank, 2013a; Ries, 2011) iterations with stakeholders and experts as well as pitch feedback can help to reduce this risk, but this cannot eliminate the risk altogether. For a start, we mitigate this risk with the guideline to collect feedback from at least 3 key stakeholders per iteration.

(2) Risk of low data quality. During the impact substantiation phase, the effort and challenge in the collection of adequate data for the most impactful hypotheses remain similar to impact measurement with SROI. To facilitate substantiation for practitioners, we recommend the use of existing support tools like the IRIS metrics, the globalvalueexchange or Big Society Capital's outcome matrix. Moreover, we propose to make impact calculations public so that feedback from peers and stakeholders can recalibrate wrong assumptions. Ideally, LIM data are collected and published in one central website to maximize transparency in LIM and create one nodal point for peer feedback. This website should have a feedback system similar to that

of Wikipedia⁹ – it should be possible to question elements of a venture's LIM impact statement and make suggestions for changes to create a more reliable impact statement.

(3) No absolute impact. Another important limitation in LIM is our focus on relative impact measurement that results from measuring only the changes compared to the alternative. While this reduces the complexity of measurement it also means that it is not possible to know if the overall contribution to sustainability is positive or negative. For example, a relative improvement in CO2 emissions still contributes to global warming. LIM cannot overcome this problem. However, if entrepreneurs want to measure their venture's absolute impact it is always possible to switch from LIM to SROI.

(4) Not in line with the 7 SROI principles. To make impact measurement more effectual and less complex LIM aims for the most impactful outcomes compared to the alternatives and makes monetization optional. In doing so we decided to deviate¹⁰ from the 7 SROI principles (see figure 3.1) that serve as a quality guideline for SROI impact measurement (Nicholls & Cupitt, 2012). However, as we designed LIM according to the SROI principles, it remains simple to switch from LIM to SROI. We encourage this transition for ventures that feel more comfortable in impact measurement, have a more stable business model and aim to get an understanding of their absolute impact.

3.7 Discussing the practical and scientific value of our research

LIM is our response to the initial research question on how to measure and forecast sustainability impact in a way that is practicable for new ventures and meaningful for internal and external stakeholders in terms of benchmarking. We developed LIM in a deductive effort integrating ideas from effectuation theory, stakeholder theory, SROI, Lean Startup and sustainable value added. The approach allows reducing the uncertainty in decision-making (see Alvarez & Barney, 2005) as it is practical enough to be applied in effectual new ventures while creating transparency on the sustainability impact of new ventures.

Due to its applicability in new ventures, LIM constitutes a great starting point for future empirical research. We recommend (1) action research, testing, and refining of LIM and adapting it to developing needs and standards in sustainable entrepreneurship and (impact) investing. We suggest (2) testing the prediction quality of the impact measurement forecasts made by LIM in order to create credibility amongst key stakeholders. We (3) additionally suggest applying this approach to both sustainability-oriented ventures and non-sustainability-oriented ventures in order to test the educational impact it has on decision making. We (4) recommend using LIM

⁹ <https://en.wikipedia.org/wiki/Help:Contents> (accessed 03.12.2018)

¹⁰ We conducted a test with the self-assessment tool of the British SROI network that indicated non-compliance <http://www.socialvalueuk.org/why-social-value/sroi-self-assessment-tool/> (accessed 03.12.2018)

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as a basis for studying how business performance relates to impact and whether and how performance drivers differ. The proposed research agenda aims to greatly improve decision-making processes for entrepreneurs and impact investors especially during early stages of ventures when the biggest decisions about future impact are made. The ultimate goal should be to make these decisions far more efficient and ultimately strongly increase impact from these ventures, fueling economic, social and environmental value generation.

In addition to the practical application of LIM and the potential for future research, the underlying reasoning of our research (chapter 3.4) offers new theoretical insights that are particularly relevant for stakeholder theory in the context of business model innovation. We argue that in the context of entrepreneurship and business model innovation entrepreneurs should not necessarily concentrate on so-called salient stakeholders that gain importance through their power, legitimacy or urgency of interests (see Mitchell, Agle, & Wood, 1997; Parent & Deephouse, 2007). To foster innovation entrepreneurs should concentrate their limited resources on stakeholders for which they can create the largest additional value compared to existing alternatives. In some cases, this can be the salient stakeholders, but the greatest additional value might lie elsewhere. To develop innovation it is important to direct the limited resources of entrepreneurs where they make the largest difference compared to existing alternatives.

This logic can be illustrated with the banana example from chapter 3.4. Following conventional stakeholder theory, banana consumers are salient stakeholder that require significant managerial attention. In absolute terms, they obtain important nutritional value from the bananas (see figure 3.4). However, the relative difference between organic and conventional bananas is marginal. Our research suggests that sustainable entrepreneurs should focus on issues where they can create the largest additional value compared to existing alternatives. In the banana example, pesticide reduction is such a case. In absolute terms, the value of pesticide reduction for the local community is comparably low, but the relative improvement from conventional to organic bananas make it a central topic for business model innovation.

This logic does not mean that entrepreneurs should ignore salient stakeholders (e.g., customers or shareholders). These remain crucial for the viability of the venture. However, for stakeholder theory, this logic implies that the response to ‘who and what really counts’ (Mitchell, Agle, & Wood, 1997) differs between entrepreneurs that focus only on viable business models and entrepreneurs that aim for business model innovation for sustainability. To create the initially stated disruption for sustainability (Hockerts & Wüstenhagen, 2010; Weissbrod & Bocken, 2017) we need entrepreneurs to concentrate on those stakeholders for which they can create the largest additional value for sustainability. LIM is our proposition to identify these stakeholders. Thus, we respond to Freeman et. al.’s (Freeman, 2010; Venkataraman, 2002) call for more research on organizational performance measurement,

and we do this in the context of new ventures where stakeholder theory has not been applied extensively (Laplume, Sonpar, & Litz, 2008).

3.8 Conclusion

New ventures can be important drivers for sustainable development (Hockerts & Wüstenhagen, 2010; Pacheco et al., 2010; York & Venkataraman, 2010), but the lack of proper impact measurement can be an important barrier to their success (Bengo et al., 2015). Our research revealed the challenge of forecasting and comparing sustainability at the impact level, across all three dimensions of sustainability, with a manageable effort for entrepreneurs. To better understand the shortcomings of existing approaches from the perspective of entrepreneurs, we examined impact measurement through the lens of effectuation theory (Sarasvathy, 2001). By doing so, we found that the causal logic of impact measurement (i.e., to predict future impact analytically) stands in conflict with the effectual logic of entrepreneurs (i.e., to perceive the future as uncertain and therefore not predictable) (Sarasvathy, 2001). Effectual entrepreneurs behave like explorers who try to take control over their uncertain future in an iterative process. Integrating causal impact measurement into this iterative, effectual process creates friction. With each iteration, the business model and therefore the impact can change. Accordingly, impact measurement needs to be repeated or updated, multiplying the effort of impact measurement in new ventures compared to more stable mature organizations. In response to this finding, we developed a two-phase approach for impact measurement in new ventures, labeled 'Lean Impact Measurement' (LIM). The proposed approach consists of six consecutive steps that can be split into an impact identification phase and an impact substantiation phase (see figure 3.5). The approach follows a stakeholder perspective and is based on the synthetic indicator Social Return on Investment (SROI) that we simplified and adapted to the effectual logic of experienced entrepreneurs (Read, Song, & Smit, 2009; Sarasvathy, 2001). To make our simplified SROI user-friendly we integrated iterative and hypothesis-driven elements of the widely used Lean Startup approach, as these elements are typically used by effectual entrepreneurs to develop their business models (Blank, 2013a; Frederiksen & Brem, 2017; Mueller & Thoring, 2012). The major changes to SROI are a.) focusing on the measurement of its relative contribution to sustainability compared to peers b.) using the Pareto principle to reduce the number of outcomes to be measured and c.) making monetization optional. Thus, LIM automatically creates a transparent, contextualized benchmark between a new venture and its peers that allows entrepreneurs and their stakeholders to identify improvement potential in the most impactful outcomes with less effort than SROI.

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Being able to measure the sustainability impact of new ventures with LIM opens up a wide range of future research opportunities on the sustainability contribution of new ventures. Moreover, our research for the development of LIM sheds new lights on stakeholder theory in the context of business model innovation for sustainability. Our research suggests that innovators should focus on those stakeholders for which they can create the largest additional impact compared to existing alternatives. This differs from the conventional focus on the most salient stakeholders (Mitchell, Agle, & Wood, 1997) and invites for more research on the role of stakeholder theory in business model innovation.

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4. Article 2: Testing the practicality of ‘Lean Impact Measurement’ to evaluate the sustainability impact of business models

Article 2

Testing the practicality of ‘Lean Impact Measurement’ to evaluate the sustainability impact of business models

Jannic Horne, Malte Recker and Ingo Michelfelder

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4.1 Abstract

Sustainable development has been recognized as the challenge of our time and sustainable entrepreneurship as an important lever to tackle this challenge. Accordingly, there is a need to help sustainable businesses to emerge. A range of tools has been introduced to support the discovery and exploitation of sustainable entrepreneurial opportunities, but our review of existing approaches showed that there are few tools for their quantitative evaluation. Lean Impact Measurement (LIM) is a new approach to identify, measure and compare the sustainable value creation of new ventures that have the potential to fill this gap. LIM has been designed with two goals, (1) to be practical for entrepreneurs and (2) to create impact metrics that can be used for benchmarking (article 1). This paper tests the practicality of LIM with entrepreneurs and their stakeholders. Therefore, it develops a teaching methodology for LIM and tests the approach with 58 different new ventures as well as some investors and incubators. As a result of this process, LIM is taught in a one day workshop, and an Excel-tool

is used to facilitate calculations. Workshop evaluations suggest that the LIM approach is indeed practical and has the potential to fill the gap of evaluation tools for sustainable business model development. Many participants value its good structure, user-friendliness, and the new business model insights. However, some participants still perceive LIM as too complex and they remain unsure about the validity of impact assumptions. In sum, our research supports the practicality assumption of LIM, and it highlights that many of the remaining challenges can be addressed with more automated solutions.

4.2 Introduction

Business model innovation and entrepreneurship have been recognized as an important way to solve many of today's societal challenges. This translated into a growing stream of literature that deals with sustainable entrepreneurship as a means to achieve sustainable development (Bidmon & Knab, 2018; Hall, Daneke, & Lenox, 2010; Cohen & Winn, 2007; Shepherd & Patzelt, 2011; Loorbach & Wijsman, 2013; York & Venkataraman, 2010). In line with the growing interest to make entrepreneurship a contributor to sustainable development, there is a growing interest in tools that help sustainable entrepreneurs to improve their business models. These tools have different roles in the business model development process and their specific advantages and weaknesses (see Evans, Rana, & Short, 2014; Geissdoerfer, Bocken, & Hultink, 2016; Jay & Gerard, 2015). In our review of existing tools, we identified the need for practical tools that combine quantitative and qualitative evaluation of sustainable business models (see Evans, Rana, & Short, 2014; Geissdoerfer, Bocken, & Hultink, 2016: 1219; Jay & Gerard, 2015). That such a combined evaluation tool is relevant can be derived from the below definition of business models for sustainability¹¹:

“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 this value, (iii) and how it captures economic value while maintaining or regenerating natural, social, and economic capital beyond its organizational boundaries.” (Schaltegger, Hansen, & Lüdeke-Freund, 2016: 6).

This definition leads to the question that is central to this research: how to describe, analyze and communicate the non-financial value a company creates. Existing tools and frameworks for sustainable business model development address these questions from a qualitative perspective, e.g., the value mapping tool or the flourishing canvas (Bocken, Rana, & Short, 2015; Bocken, Short, Rana, & Evans, 2013; Upward & Jones, 2015). Thus, these tools are

¹¹ We use the term interchangeably with sustainable business model

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very helpful to identify potential sustainability challenges in a business model and discover new opportunities, but they do not allow to quantify and weigh different impacts with regard to their contribution to sustainable development. Consequently, entrepreneurs have limited transparency over the potential impact of their business model and they cannot make informed strategic decisions to improve the business model. As a result, it remains difficult for internal stakeholders like the founders and employees as well as external stakeholders like investors, regulators or business partners to properly 'describe, analyze, manage and communicate' (see Schaltegger, Hansen, & Lüdeke-Freund, 2016: 6) the sustainability impact of a supposedly sustainable business model. Moreover, there is the risk that entrepreneurs follow vague ideas about sustainability that do not help to 'maintain or regenerate natural, social, and economic capital' (see *ibid.*).

Lean Impact Measurement (LIM) (article 1) is a new approach that tries to fill this gap by providing a practical qualitative and quantitative measurement approach that helps entrepreneurs and their stakeholders to understand what sustainability impact a venture's business model is likely to create compared to the status quo. The approach is based on a simplified version of Social Return of Investment that has been tailored to the effectual needs of new ventures. The approach is split into two phases. In the qualitative impact identification phase, the central impact levers of a venture's business model are identified – i.e., the USP in terms of sustainability impact. These key levers are translated into a pitchable theory of change, and they form the base for the second phase – impact substantiation. In this phase, quantitative assumptions about the future impact of a venture are developed using the simplified Social Return on Investment logic.

While the conceptual development of the approach has been outlined before (article 1), the approach has not yet been validated in practice. A precondition for this validation is the wider application of LIM by entrepreneurs. This article prepares the wider application as it clarifies how the LIM-approach fits into the existing landscape of tools for sustainable business model development, it develops an approach to teach LIM, and it verifies the practicality assumption of LIM as a practical tool for impact measurement in effectual ventures (see article 1). This translates into three research questions that we discuss in this paper:

- **RQ1:** How does LIM contribute to the sustainable business model development process?
- **RQ2:** How should LIM be taught to entrepreneurs?
- **RQ3:** Is LIM a practical approach to measure and forecast the sustainability impact of new ventures?

To answer the first question we examined the role of tools in entrepreneurship from an effectuation theory perspective and reviewed the landscape of academic tools for sustainable business modeling. This showed that LIM can potentially fill a gap of practical tools for the

evaluation of a venture's sustainability contribution. For the development of a suitable teaching format (responding to RQ2) we explored the research on entrepreneurship education. This led us to workshops as a preferred teaching format and the conceptual development of a LIM-workshop. The workshop design has been tested, evaluated and improved over 12 workshops before a final workshop design emerged. Throughout the development process, we collected data on the practicality of the LIM approach to answering the third research question.

The remaining article follows the before described structure of our research, it starts with the theoretical discussion and review of tools, leads to the methodology for the workshop design, testing and improvement, and it closes with a discussion of the effectiveness of the LIM workshop as a tool for impact measurement for effectual entrepreneurs.

4.3 How LIM can contribute to the sustainable business model development process (RQ1)

4.3.1 Effectuation theory as underlying theory and the role of tools

Before we dive into details on the entrepreneurial process and tools for sustainable business model development we want to clarify our understanding of entrepreneurial decision-making. Our thinking and research are strongly guided by effectuation theory (Sarasvathy, 2001). Following an effectuation logic, successful entrepreneurs strive in a dynamic and uncertain environment with limited resources (Sarasvathy, 2001; Read, Song, & Smit, 2009). They do not develop and then execute a comprehensive business plan with various uncertain predictions about the future (i.e., causation). Instead, effectual entrepreneurs follow an explorative, and iterative decision-making process along effectual principals – i.e., succeeding with available resources (bird-in-hand principle), weighing the pros and cons of available options (affordable loss), co-creating and sharing risks with others (crazy quilt principle), perceiving unintended discoveries as opportunities (lemonade principle) and actively shaping their success in the available stakeholders environment (pilot-in-the-plane principle) (Sarasvathy & Dew, 2005; Sarasvathy, Kumar, York, & Bhagavatula, 2014).

Even though effectual entrepreneurs are more likely to follow effectual principals than causal analysis in their decision-making, it is important to point out that both decision-making styles are intertwined in practice (Sarasvathy, 2001). Accordingly, effectual entrepreneurs make use of analytical business development tools. But these tools become more valuable for effectual entrepreneurs when they are adapted to the iterative and explorative logic of effectual decision-making. This means that tools should focus on experimental hypothesis development and iterative improvements to be of use for effectual entrepreneurs. Extensive analytical work with static results should be avoided. This claim is backed by the rise of dynamic and iterative business development concepts like lean startup or design thinking (Ries, 2011; Blank, 2013a;

Mueller & Thoring, 2012; Harms, 2015) that can be linked to effectuation theory (Frederiksen & Brem, 2017).

Tools for entrepreneurs can support different activities in this iterative business development process. This process usually starts with the discovery and evaluation of opportunities and is followed by their exploitation (Shane & Venkataraman, 2000)¹². Following an effectual logic, these activities occur in iterative cycles. This means entrepreneurial actions lead to new opportunities that can be discovered and need to be evaluated before they can be exploited or rejected (Sarasvathy, 2001; Sarasvathy & Dew, 2005). Various tools have been developed to support this process in conventional as well as sustainable businesses.

4.3.2 Tools for sustainable business model development

To support sustainable business model development we need tools for the discovery, evaluation, and exploitation of all three sustainability dimensions (economic, social and ecological). Traditional business model tools like the widely used Business Model Canvas (BMC) focus primarily on the economic dimension (Joyce & Paquin, 2016; Upward & Jones, 2015; Bocken, Short, Rana, & Evans, 2013). To complement these economic tools, social and ecological dimensions were added in a wide range of practitioner and theoretical tools (e.g., Evans, Rana, & Short, 2014; Tiemann & Fichter, 2014; Geissdoerfer, Bocken, & Hultink, 2016; Lüdeke-Freund, Massa, Bocken, Brent, & Musango, 2016). In the following, we will present some of the more widely cited theoretical frameworks and tools to clarify what contributions have been made and to show how the LIM approach can complement the existing tool landscape (see table 4.1). In this discussion we leave out tools that focus on specific sector and the wide range of practitioner tools like the B Lab impact assessment (B Lab, 2018) as their number exceeds the scope of this paper, their development is often not transparent enough from an academic viewpoint, and they are not necessarily embedded in scientific concepts and theories¹³.

¹² A discussion of the different schools of thought for the process is out of scope for this article – i.e. for example, the discussion on opportunity discovery, recognition or creation (Sarasvathy, Dew, Velamuri, and Venkataraman, 2005)

¹³ Nevertheless, we are well aware that some of these tools might be of great practical use.

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Table 4.1 Overview of entrepreneurship education tools for sustainable business model development and their focus along the venture development process

Focus	Authors	Citations Google Scholar	Tools	Discovery	Evaluation Qualitative	Exploitation Quantitative	Exploitation
Exploitation	Upward & Jones 2015	133	Flourishing Canvas	(X)	(X)	-	X
	Joyce, Paquin 2016	261	Triple Layered Business Model Canvas	(X)	(X)	-	X
Discovery	Bocken et al.. 2014	932	Sustainable Business Model Archetypes	X	-	-	(X)
	Breuer & Lüdeke-Freund 2014	35	Value Networks	X	-	-	(X)
Evaluation & Discovery (+Exploitation)	Bocken et al. 2013 & Bocken et al. 2015	251 / 99	Value Mapping Tool	X	X	-	-
	Geissdoerfer et al. 2016	61	Design Thinking + Value Mapping Tool	X	X	-	X

The selected tools were chosen to provide examples for the different focus areas, prioritizing tools with many citations (status 08.11.2018)

Qualitative categorization by authors of this article, based on descriptions provided by authors of the tools

Categories: X = in focus; (X) = partially covered; - = not in focus

To design a sustainable business model and explore the different options to **exploit opportunities** some authors took the widely used BMC as a starting point (e.g., Breuer, 2013; Joyce & Paquin, 2016; Upward & Jones, 2015). These approaches typically restructure or expand the classical BMC to incorporate environmental considerations as well as effects on stakeholders beyond the classical value chain. The extended BMCs support an inside-out perspective (Joyce & Paquin, 2016) that allows to better understand and design the business model elements from a triple bottom perspective (Elkington, 2002). However, these approaches do not address the topic of quantitative impact evaluate. Examples of these approaches are:

- Flourishing Canvas (Upward & Jones, 2015): Building on the successful Business Model Canvas (BMC) (Osterwalder, Pigneur, & Clark, 2010) Upward and Jones (2015) developed the Flourishing Canvas. Analog to the BMC the Flourishing Canvas helps to describe and refine the business model, but with a focus on strong sustainability (Upward & Jones, 2015). It redefines and adds categories to the classical BMC in order to form 'strongly sustainable business models' (SSBM) that take into account the carrying capacities of social and ecological systems. Even though the carrying capacity of social and ecological systems is central to the approach, it does not focus on measuring and comparing the benefits of different business model options with regard to their impact. For this, the authors refer to complementary system dynamics models that need to be developed (Upward & Jones, 2015).
- Triple layered business model canvas (TLBMC): Similar to the flourishing canvas the TLBMC builds on the BMC, but the authors leave the classical BMC unchanged. Instead, they add an environmental and a social BMC layer to capture the triple bottom

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line perspective for different kind of ventures. With their design, the authors want to encourage holistic and integrated entrepreneurial thinking on a high-level along the triple bottom line (Joyce & Paquin, 2016). Similar to Upward et al. (2015) the authors recognize the need for additional analytical tools and call for complementary tools that help to develop sustainable business model innovation with demonstrable impact (Joyce & Paquin, 2016).

Other tools have a clear focus on the **discovery of opportunities**. The so-called sustainable business models archetypes (Bocken, Short, Rana, & Evans, 2014) are the most widely cited example in this category. But there are also niche approaches like the value network workshop (Breuer & Lüdeke-Freund, 2014) that can help a group or network of entrepreneurs to discover new opportunities. Tools in this category have a strong focus on the discovery, and they can help with the exploitation, but they hardly address the evaluation:

- Sustainable Business Model Archetypes (Bocken, Short, Rana, & Evans, 2014): The authors developed eight archetypes for sustainable business models. These archetypes capture the core mechanisms that drive progress towards sustainable development in a business model like “*creating value from waste*” or “*encourage sufficiency*” (Bocken, Short, Rana, & Evans, 2014). In practice, the archetypes serve as inspirational tools for business model innovation and design. Thus, they primarily support the opportunity discovery for different business models, not taking into account the evaluation of opportunities.
- Value Networks (Breuer & Lüdeke-Freund, 2014): The workshop format focuses on the discovery of business model opportunities that create changes on a systemic level – i.e., they broaden the perspective from a single company to its industrial ecosystem. The resulting business model innovations are based on collaboration in so-called value networks that share normative values and goals. The evaluation of business model opportunities is not in focus.

In our search for evaluation tools, we primarily found tools that focus on **opportunity discovery with some degree of qualitative evaluation**. For example, the value mapping tool (Bocken, Short, Rana, & Evans, 2013; Bocken, Rana, & Short, 2015) helps entrepreneurs to identify what value a business model creates, destroys and misses from the perspective of different stakeholders in order to discover untapped sustainability potentials. This approach has been combined with design thinking (Geissdoerfer, Bocken, & Hultink, 2016) in order to also provide guidance during the exploitation. These approaches touch upon qualitative evaluation, but they do not offer quantitative evaluation.

- Value Mapping tool (Bocken, Short, Rana, & Evans, 2013; Bocken, Rana, & Short, 2015): The value mapping tool helps to discover new opportunities by reviewing what value a business model captures, destroys or misses from the perspective of different

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stakeholders – especially, customers, society, the environment and network actors (Bocken, Short, Rana, & Evans, 2013) It is a qualitative approach that focuses on idea generation and points to complementary tools for the evaluation. The authors explicitly call for future research on more quantitative approaches to improve decision-making (Bocken, Rana, & Short, 2015).

- Design thinking + value mapping (Geissdoerfer, Bocken, & Hultink, 2016): The value mapping tool has been extended to better support the exploitation phase. Therefore, the value mapping tool was combined with design thinking elements to create a workshop on sustainable business modeling with ideation, prototyping and testing phases (Geissdoerfer, Bocken, & Hultink, 2016). Quantitative impact evaluations remain out of scope.

Our review of existing approaches and discussed examples show that there is a lack of quantitative evaluation tools for sustainable business model development (see table 4.1). Looking beyond tools for sustainable business model development we found a wide range of tools that can help entrepreneurs to quantify some aspects of their business model – most importantly the life-cycle of their products ((Baumann, Boons, & Bragd, 2002); (Hansen, Grosse-Dunker, & Reichwald, 2009; Rossi, Germani, & Zamagni, 2016). However, most of these tools have been developed conceptually to capture only specific aspects of a business model; moreover, they have never been tested by businesses (Baumann, Boons, & Bragd, 2002; Rossi, Germani, & Zamagni, 2016). Thus, to the authors' knowledge, there are no quantitative evaluation tools that help entrepreneurs to measure and compare the impact of their entire business model on sustainability with one consistent approach.

Research suggests that investors, researchers, public authorities and entrepreneurs need such proper evaluation approaches, to know whether and how much a new venture will contribute to sustainable development (Bengo, Arena, Azzone, & Calderini, 2015; Dichter, Adams, & Ebrahim, 2016; Sutch & Kirkland, 2014). Bengo et al. (2015) summarized very well that the sustainable entrepreneurs without proper measurement cannot demonstrate transparency and accountability (Nicholls, 2009), attract investors and resources (Saltuk, Idrissi, Bouri, Mudaliar, & Schiff, 2014; Plotnieks, 2014; Wilson, 2014) monitor business operations (Arena, Azzone, & Bengo, 2015) and manage stakeholders (Clifford, 2014). Hence, tools for impact measurement of new ventures are of great importance.

Learning from the large numbers of product development tools that remain unused (Baumann, Boons, & Bragd, 2002; Rossi, Germani, & Zamagni, 2016) it should be added that it is not enough to develop tools for the qualitative and quantitative evaluation of sustainable business models. Instead, it is necessary to develop practical tools that entrepreneurs can integrate into their effectual business development process. Moreover, these tools should complement – not

compete with – the previously described tools to create the largest impact for sustainability (see Robèrt et al., 2002).

Summing up, the above analysis responds to research question 1 and shows that there is a gap of quantitative evaluation tools for sustainable business models that LIM can potentially fill if it is taught in a suitable manner. In addition to this, this chapter provided initial insights into the proper teaching methodology for LIM (RQ2). It finds that the practicality of LIM as a tool depends on its suitability for the effectual circumstances of entrepreneurs and its integration into the landscape of complementary tools.

4.4 Methodology for developing and testing the LIM teaching format

4.4.1 Lean Impact Measurement (LIM) for qualitative and quantitative evaluation

LIM is a response to the research question: *“How can we measure and forecast sustainability impact in a way that is practicable for new ventures and meaningful for internal and external stakeholders in terms of benchmarking?”* (article 1). The developed approach wants to strike a balance between practical impact measurements for entrepreneurs and valid impact quantifications. If both requirements can be satisfied, LIM has the potential to fill the previously described gap for qualitative and quantitative evaluation of sustainable business models. This article investigates the first aspect – practicality for entrepreneurs. It thus constitutes the groundwork for a wider application and eventual validation of the LIM measurements.

The approach itself is based on an effectual understanding of entrepreneurship (Sarasvathy, 2001) and it can be split into an impact identification phase and an impact substantiation phase (see figure 4.1 below). LIM is based on the Social Return on Investment (SROI) that has been simplified and adapted to the needs of effectual entrepreneurs (article 1). To make the approach more user-friendly elements of the widely used lean startup approach have been added (Blank, 2013a; Frederiksen & Brem, 2017; Ries, 2011). In the following, we give a brief description of the approach. A detailed description can be found in article 1.

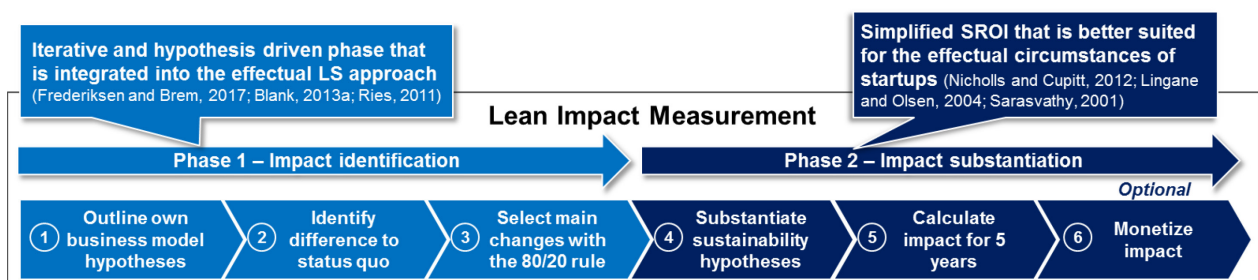


Figure 4.1 The two phases and six steps of Lean Impact Measurement

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The **impact identification phase** begins (step 1) with Osterwalder's business model canvas (Osterwalder, Pigneur, & Clark, 2010) in which new ventures collect their key business hypotheses along the lean startup approach (Blank, 2013a; Ries, 2011). Then (step 2) startups need to assess where their business model differs from existing competition and develop hypotheses about the resulting impact from a stakeholder perspective. Finally, (step 3), the most impactful changes need to be selected using an 80-20 approach (Juran & Feo, 2010). As a result of this phase, entrepreneurs obtain a theory of change that explains how their venture will likely contribute to sustainable development in comparison to the status quo – i.e., their USP in terms of impact. They can use this perspective for internal and external discussions on their business model. Moreover, this qualitative evaluation can already be used as a starting point to discover improvement potentials in a value mapping logic (see Bocken, Rana, & Short, 2015).

In the **impact substantiation phase** ventures quantify the selected hypotheses and calculate the impact with the simplified SROI approach. Therefore (step 4) they gather robust data on their expected outputs and affected stakeholders for a five-year period, define outcome indicators (preferably with standard IRIS metrics (IRIS, 2016) and quantify outcomes and counterfactuals. Then (step 5) the data are used to calculate a five-year impact forecast on the level of outcome-indicators. The calculation is based on the SROI calculation approach (see Nicholls & Cupitt, 2012). Contrary to the classical SROI (Nicholls & Cupitt, 2012), monetization of outcome-indicators (step 6) remains optional in LIM. This creates the opportunity to avoid the complexity and subjectivity of monetization (Figge & Hahn, 2004; Hadad & Găucă, 2014) which has been identified as a major obstacle to the application of SROI (Millar & Hall, 2013). In this paper, the calculated impact metrics are called 'Added Sustainability Values' (ASV) as they explain how much a venture contributes to sustainability compared to the status quo. The initial values can already be used for business decisions and in stakeholder discussions. However, the underlying assumptions are subject to review and refinement similar to the financial forecasts of ventures.

4.4.2 Developing a teaching format for LIM in four phases: exploration, conceptualization, improvement, and evaluation

The previous section shows that the concept of LIM has been described in sufficient detail and that it theoretically constitutes a practical approach for quantitative impact evaluation in new ventures. But the section also shows that the practicality for entrepreneurs and the validity of its measurements have not been verified empirically. A precondition to test both aspects is the successful teaching and real-world application of LIM in ventures. Taking into account our earlier discussion of purely conceptual and untested approaches there is a significant risk that the conceptual approach cannot live up to its ambitions (Baumann, Boons, & Bragd, 2002:

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419; Rossi, Germani, & Zamagni, 2016). Therefore we decided to develop a teaching format for LIM and test it with real entrepreneurs. Thus, we can provide answers to research question 2 (RQ2: How should LIM be taught to entrepreneurs?) and by evaluating the feedback of participants we can create insights on research question 3 (RQ3: Is LIM a practical approach to measure and forecast the sustainability impact of new ventures?).

We translated the ambition for LIM as a practical and relevant approach into three hypotheses:

- H1: Participants see the need for a structured process to assess their impact on sustainability.
- H2: Participants perceive our approach as helpful to identify and quantify their impact on sustainability.
- H3: Participants expect to use LIM in the future for decision making and reporting.

The development of the teaching format (RQ2) was guided by an adapted model of Geissdoerfer et al. (2016) and Bocken et al. (2011) (Geissdoerfer, Bocken, & Hultink, 2016; Bocken, Allwood, Willey, & King, 2011). Thus, we structured our research in an exploration, conceptualization, improvement and evaluation phase (see Table 4.2). During the exploration phase, we reviewed the existing literature on entrepreneurship education and learning to derive guiding principles and best practices for the teaching format. In addition to this, we conducted expert interviews and reflected upon our own professional teaching experiences to develop initial ideas about the teaching format. This was followed by the conceptualization phase. This phase was also guided by literature, expert interviews, and our own teaching experiences. It aimed for the development of an initial teaching format design. The improvement phase began with piloting and refining this initial design (a workshop and an Excel-tool). Over one year we conducted a total of 12 workshops with 87 individual participants from 58 organizations. For the testing, we aimed for real ventures some investors and incubators to avoid the frequent scientific shortcoming to test tools for business in non-representative settings (Baumann, Boons, & Bragd, 2002; Rossi, Germani, & Zamagni, 2016). To attract a wide range of ventures (i.e., from for-profit to non-profit and idea to growth stage) we held the workshop at different incubators and accelerators in Germany (esp. Berlin) and additionally organized independent workshops at Technical University Berlin. To improve the workshop format we initiated a feedback discussion at the end of every workshop and sent out an individual feedback questionnaire a couple of days after each workshop. In the questionnaire, we asked for feedback on the before stated hypotheses along a five-point Likert scale. Additionally, we offered open questions to collect improvement ideas. Finally, in the effectiveness evaluation, we looked beyond the improvement of the workshop to assess whether entrepreneurs find our approach practical and expect to actually use it in decision making and reporting. To assess the effectiveness we relied on the before stated questionnaire and the verbal feedback we received during the workshops. Additionally, we took into account

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expert feedback we gathered during our research. Going through the four phases, research question two and three can be answered.

Table 4.2 Development phases for the workshop (based on Geissdoerfer, Bocken, & Hultink, 2016)

Step	Activities	Tools	Inputs	Outputs
1. Exploration	Literature review Expert interviews	Un- & semi-structured interviews	Research question	Initial ideas about the workshop design
2. Conceptualization	Literature review Expert interviews Setting up a pilot workshop	Un- & semi-structured interviews Discussions Questionnaire	Initial ideas for the workshop design	First workshop design
3. Improvement	Workshops with entrepreneurs Expert interviews	Un- & semi-structured interviews Discussions Questionnaire	First workshop design	Iteratively improved workshop design
4. Effectiveness	Data analysis Expert interviews	Discussions Questionnaire	Participant feedback	Feedback on the overall effectiveness

4.5 Exploration - Educational framework to teach LIM

To properly teach LIM we studied the literature on entrepreneurship education. Building on Shane and Venkataraman's definition of entrepreneurship (Shane & Venkataraman, 2000) we follow Hindle's (2007) complementary definition of entrepreneurship education as: "*the transfer of knowledge about how, by whom and with what effects opportunities to create future goods and services are discovered, evaluated and exploited*" (Hindle, 2007: 4). This definition underlines the need to have suitable educational approaches/tools for all three activities – i.e., discovery, evaluation, and exploitation. We already discussed that there is a lack of suitable evaluation tools, a finding that the expert discussions during our research confirmed. This led us to the question of how a 'suitable evaluation approach should look like that can fill this gap? The literature on methods in entrepreneurship education emphasizes "*the importance of 'active', 'experiential', 'learning by doing' and 'real-world' pedagogies*" (Fayolle, 2013). Even though these aspects often remain vaguely defined, their relevance seems conclusive in the previously discussed context of effectuation (Sarasvathy, 2001) and under the assumption that entrepreneurship can be learned (Kuratko, 2005; Hindle, 2007). If those two aspects hold true, tools and knowledge about entrepreneurship should be taught in an active, experimental context (Keyser, 2000; Gemmell, Boland, & Kolb, 2012). In line with this argument Fayolle (2013) calls for stronger integration of entrepreneurial concept like effectuation into the design of teaching methods (Fayolle, 2013). These thoughts guided us towards a workshop as preferred teaching format based on Experiential Learning Theory (EPL).

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EPL understands learning as the creation of knowledge through the transformation of experiences in learning cycles (Kolb & Kolb, 2005). Idealized this cycle has four elements. It contains 'concrete experiences' that constitute the base for 'reflective observations' which can be turned into 'abstract conceptualizations' that can be tested through 'active experimentation'. These four elements fulfill two key tasks, gathering experiences and transforming them. The elements do not necessarily occur in this cyclical order, but research suggests that learning experiences should contain all four elements to suit learners with different learning styles (ibid.). To design a conclusive iterative learning experience that touches on all four elements we decided to teach LIM in a workshop format supported by an excel calculation tool. The selected format allows both theoretical education and practical experimentation during a single event. Moreover, using a workshop allows the research team to observe participant reactions, gather immediate feedback from the users and intervene as coaches when necessary. Other options like online webinars would have limited the opportunity to interact and learn from entrepreneurs, while several consecutive in-person sessions would have constraint testing with entrepreneurs.

Aiming for a workshop we gathered workshop elements for all four elements of EPL:

- **Concrete experience** should be possible through the independent development of impact hypotheses and variables in the venture teams together with active presentations of the results to peers.
- **Reflective observations** should be facilitated by giving venture teams feedback on their work, allowing them to provide feedback to each other and giving them time to reflect the experience prior to the next iteration.
- **Abstract conceptualization** is something we wanted to support by contrasting their own cases with our own illustrative example and by showing them the cases of other teams. Moreover, LIM requires entrepreneurs to assess at least 3 changes which requires them to assess potential impacts from different perspectives.
- **Active experimentation** should be possible at every new iteration. Whenever teams get a new exercise they have to integrate the theoretical lecture as well as their previous reflections to develop a solution.

With these initial ideas in mind, we aimed for an experiential learning experience that allows participants to contrast and refine old and new ideas in different circumstances so that new knowledge is created in 'learners' and not only transmitted to 'learners' (see Kolb & Kolb, 2005).

As the workshop approach targets a group of venture teams, we also took into account the group dynamics during the learning process. For example, Edmondson (1999) describes team learning *"as an ongoing process of reflection and action, characterized by asking questions, seeking feedback, experimenting, reflecting on results, and discussing errors or unexpected*

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outcomes of actions.” (Edmondson, 1999). For these processes to work smoothly an environment of ‘psychological safety’ is necessary (Edmondson, 1999; Harms, 2015; Kessel, Kratzer, & Schultz, 2012). This means that teams and individual team members require a low-risk environment that supports mutual trust. Unfortunately, assessing a venture’s impact on sustainability can involve the revelation of negative outcomes which can constitute a significant risk for entrepreneurs. To lower this risk and encourage an honest impact assessment the LIM workshop emphasizes a playful and experimental attitude without judgment.

In sum, we designed the workshop around the following key elements that have proven relevant in research and prominent concepts like the lean startup approach (Blank, 2013a; Harms, 2015; Kolb & Kolb, 2005; Ries, 2011).

- **Active cyclical learning** that splits the key elements of LIM into small parts and teaches these parts separately and with direct application to the own venture.
- **A combination of experiences**, this includes short lecture formats to provide key information, peer and group discussions to collect ideas and feedback, creative ideation phases in teams to develop a theory of change, presentations of theories of change with post-its and analytical phases to research and calculate impact metrics.
- **Peer feedback** to practice the stakeholder perspective in LIM, leverage the participants' knowledge and reflect on the learned processes from another perspective.
- **An experimental and hypothesis-driven approach** that allows people to refine and adjust their impact model from round to round in a low-risk environment.

4.6 Conceptualization – Development of a pilot workshop

Initially, we aimed for a half-day workshop with up to six ventures that is based on a stepwise, interactive learning experience. Guided by the two phases, six-step structure of LIM we had a natural split into a more interactive impact identification and a more analytical substantiation phase. Prior to these phases, we considered it necessary to add an introductory part to set the scene. Accordingly, we had three parts, introduction to the topic, impact identification and impact substantiation.

During the **introduction** (planned for 30 minutes) we had three main goals: first, to create a common understanding and a sense of urgency for sustainable development and impact measurement in new ventures, second, we wanted to give participants a general understanding of the workshop content and third, we wanted to create a collaborative, low-risk atmosphere. To realize the first two goals we relied on an introductory presentation and discussions with the group. To create a collaborative atmosphere we gave participants and the coaches time to express their backgrounds, explain their motivations and their expectations. Together with the small group size, the discussions about sustainability and an initial plea to

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be open for experimentation during the development of their impact hypotheses, we aimed for a psychologically safe atmosphere.

The main goal during the **impact identification** phase (planned for 80 minutes) was the development of a theory of change. To simplify the logic of the Input-Output-Outcome-Impact-Framework (see e.g., Clifford, 2014) and prepare participants for the LIM-approach, we proposed a simpler model that we call 'impact model' (see left part of figure 4.2). This model is created with post-its on the wall and does not capture the full theory of change. Instead, it identifies the key changes a venture creates compared to the status quo and prepares entrepreneurs for storytelling.

During the first iteration, the venture teams identify the 'status quo' in their market. This is the solution customers typically use to satisfy their need. Then they describe how their business model is different from the status quo along the elements of the business model canvas (Osterwalder, Pigneur, & Clark, 2010)¹⁴. We explained the logic based on an intuitive example¹⁵ before we let them work independently. After participants developed their first hypotheses they presented their findings to another venture team to receive feedback, and they had the opportunity to witness the other team's presentation. Finally, the results were discussed in the large group.

The second iteration started with time to refine the initial impact hypotheses in the venture teams. Then participants were asked to first, identify which stakeholders are affected most strongly by their business model differences compared to the status quo, and second, what exactly changes for the stakeholders. Again we illustrated the logic with our case example before the ventures worked on their own and presented their results to each other.

Overall, after the first two rounds venture teams had a pitchable model that communicates clearly what difference their venture makes compared to the status quo (see left part of figure 4.2). Finally, to close the impact identification phase and transition to the impact substantiation phase participants had to transfer their impact model into an excel file.

¹⁴ We begin the iterations with the status quo. Thus, we intentionally leave out step 1 of the standard LIM framework: 'Outline own business model hypotheses' (figure 4.2). We expect that entrepreneurs have those hypotheses anyway prior to the workshop.

¹⁵ To clarify the underlying logic of our approach we described the introduction of fair trade and organic bananas in a market with only fair trade bananas. This tangible example facilitates the illustration of the additionality perspective (adding organic benefits to the benefits of fair trade).

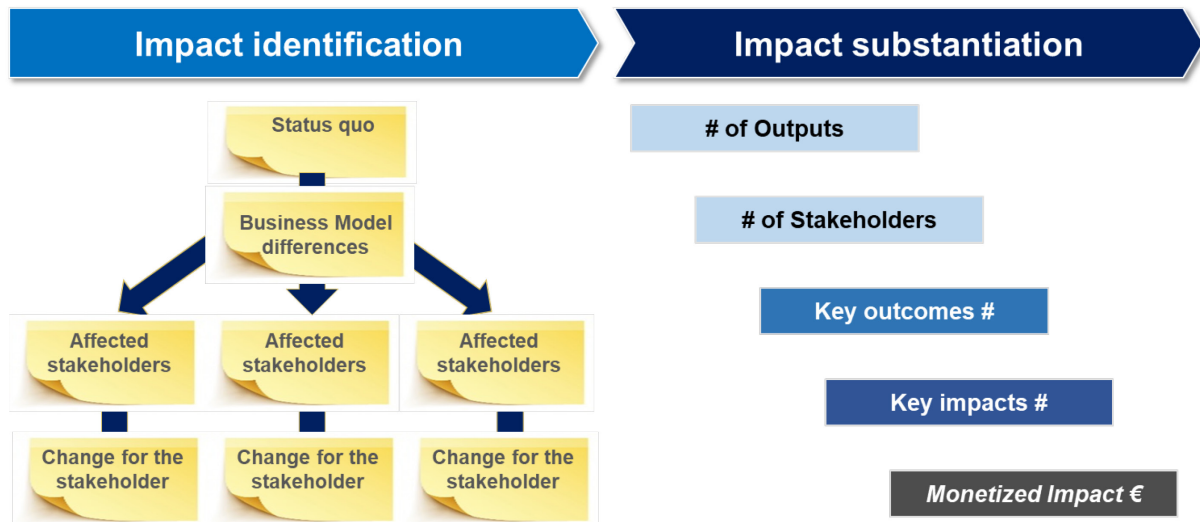


Figure 4.2 The main two phases of the LIM workshop

The **impact substantiation** phase (planned for 90 minutes) quantifies the impact model and calculates added sustainability values (right part of figure 4.2). As this phase relies strongly on calculations, we developed an Excel-tool that reduced efforts for the calculation to the definition of key variables. The tool guides users step by step through key variables for the calculation like the number of affected stakeholders per output or the expected outcome per stakeholder. To clarify the key steps we continued our example and showed participants each step of the calculation in the excel file. Then we gave them time to work on the key assumptions independently, supported by us.

4.7 Improvements – refining the workshop design

4.7.1 Testing the practicality of the workshop with real entrepreneurs

To test our approach, we conducted workshops at different venues and contexts to attract a wide range of entrepreneurs and potential users. Table 4.3 provides an overview of the conducted workshops and participants.

Table 4. 3 Overview of conducted workshops and participant feedback

Workshops	Number of organi- zations registered	Number of organi- zations participated	Numbers of individual participants	Number of completed feedbacks
1. CfE - Pilot	5	4	7	4
2. Impact Hub Berlin 1	4	4	5	5
3. TU Berlin 1	3	3	4	4
4. Impact Hub Berlin 2	6	4	7	6
5. TU Berlin 2	6	1	2	1
6. Factory Berlin 1	7	6	9	4
7. TU Berlin 3	9	7	13	11
8. F-Lane Event	7	6	9	5
9. TU Berlin 4	6	4	5	3
10. Social Impact Lab Berlin 1	5	5	9	8
11. Impact Hub Munich	11	9	10	8
12. Social Impact Lab Berlin 2	6	5	7	5
Total	75	58	87	64

In response to the earlier discussed shortcoming of tools that are primarily tested with students and in other non-representative settings (Baumann, Boons, & Bragd, 2002; Rossi, Germani, & Zamagni, 2016), we decided to test the workshop with real entrepreneurs as well as other potential users like investors. This made the sampling particularly challenging. Instead of integrating the workshop into mandatory university curricula, we had to convince independent organizations to invest half (later a full) working day into our workshop. After the first couple of workshops, we were able to build up a network in the social entrepreneurship scene (particularly in Berlin), which facilitated the marketing of the workshops. However, we experienced frequent short-term cancellations of entrepreneurs. In total 75 organizations registered for our 12 workshops, but only 58 organizations and 87 individuals took part. In some cases, we received cancellations on the day of the workshop with a short-term cancellation rate of 23%. The workshop itself was free, but participants had to fill out a comprehensive survey about their venture prior to the workshop (duration about 45 minutes). To our surprise, many ventures canceled even after having completed the survey. This exemplifies the strong dynamics of effectual entrepreneurs and it suggests relatively low importance of impact measurement compared to other business matters.

At the end of each workshop, we collected verbal feedback, and we sent out a web-survey about one week after the workshop. We decided against written feedback at the end of the workshop (an approach applied by Geissdoerfer, Bocken, & Hultink, 2016) as we wanted to give participants the opportunity to discuss the workshop with their team members and digest the content. The downside of this approach was the challenging collection of feedback surveys

ex-post. In some cases, it was not possible to collect feedback from the ventures. Across all workshops, we had a response rate of 74%.

4.7.2 Central insights from the workshops

Over the workshops, we gathered a wide range of feedback that led to important improvements in the workshop and Excel-tool. The quantitative feedback (using a 5 point Likert scale) provided important insights into the improvement phase and the first two hypotheses (see table 4.4).

Most participants expressed support for H1. 94% agreed (63% strongly agreed, 31% somewhat agreed) with the need for a structured process to assess the impact on sustainability (H1). There was also strong, but comparably weaker support for H2. 83% of respondents (41% strongly agreed, 42% somewhat agreed) with the statement that the workshop approach was helpful to identify their impact on sustainability and 87% agreed (39% strongly agreed, 48% somewhat agreed) that the Excel-tool was helpful to quantify their impact on sustainability. The quantitative responses suggest that almost all participants see a need for measurement (H1) and a majority of participants perceives our approach as helpful (H2). However, comparably weaker support for H2 suggests that a share of the entrepreneurs is not fully satisfied with our approach.

Concerning the quantitative results, it must be emphasized that the support for our approach varied strongly between the different workshops and more importantly, the number of participants varied between 2 and 13 and the survey response rates between 44% and 100%. This does not allow for a proper analysis of improvement from workshop to workshop and limits the validity of our results. Particularly, the missing responses could create a positive bias in our results if primarily unsatisfied workshop participants opposed responding. While this might be the case for some participants, we also received some critical feedbacks. Thus, we assume that a large share of the low response rate can be attributed to the before described pattern of unreliable entrepreneurs.

Table 4.4 Overview of feedback on learning hypotheses, n=57

LIM hypothesis (H)	H1: Participants see the need for a structured process to assess their impact on sustainability.	H2: Participants see our approach as helpful to identify and quantify their impact on sustainability.	
Survey questions (SQ)	SQ 1: <i>"I believe our business needs a structured process to assess our impact on sustainability."</i>	SQ 2.1: <i>"The workshop approach was helpful to identify our impact on sustainability."</i>	SQ 2.2: <i>"The Added Sustainability Excel-tool was helpful to quantify our impact on sustainability."</i>
Strongly agree	63%	41%	39%
Somewhat agree	31%	42%	48%
Neither agree nor disagree	3%	16%	9%
Somewhat disagree	2%	2%	3%
Strongly disagree	2%	0%	0%

To complement the quantitative findings and obtain more specific feedback we posed three open questions on (1) aspects that the participants liked, (2) aspects they did not like and (3) improvement ideas they have. During the improvement phase, we assessed the individual feedback after each workshop and addressed some of the concerns immediately.

To systematically analyze the individual responses for this article, we coded and categorized the individual responses. In table 4.5 we summarized the main feedback categories and counted how often certain topics were mentioned. The underlying code words for each category can be found in the appendix. Below we provide a short summary of received feedback:

- Summing up, the **positive feedback**, it can be said that many participants perceived our approach to be clearly structured and user-friendly valuing the two phases of impact identification and substantiation. They frequently mentioned the quantification of usually intangible impact with our Excel-tool and that they obtained new insights on their business models.
- Summarizing the **negative feedback**, it can be said that participants mentioned a wider range of concerns. Two concerns stand out. Most importantly concerns about the validity of the key assumptions and subsequent results as well as the remaining effort and complexity of using the Excel-tool. Participants want more automated and adaptable online solutions. Finally, some participants did not like certain aspects of our approach like the focus on forecasting.

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- The **improvement ideas** go in various directions, but they can be clustered to some extent. The most important cluster concentrates on better and additional features in the tool. Another cluster concentrates on improvement ideas for our teaching approach and the explanations we use. Some aspects like better text explanations could be easily addressed, whereas calls for instructional videos, online access, additional databases or automation exceed the capabilities of Excel as a tool. To address some of these ideas a web-tool would be necessary. Even though the authors agree that such a web-tool could be very beneficial, developing such a tool was out of scope for this research on the practicality of LIM.

Table 4.5 Overview of coded and categorized feedback from participants

What did you like about Added Sustainability Value Measurement (incl. the Excel-tool)?		What didn't you like about Added Sustainability Value Measurement (incl. the Excel-tool)?		How can we improve Added Sustainability Value Measurement (incl. the Excel-tool)?	
<i>Count</i>	<i>Feedback categories</i>	<i>Count</i>	<i>Feedback categories</i>	<i>Count</i>	<i>Feedback categories</i>
19	Good structure	15	Digital support	15	Digital support
18	Business model insights	12	Validity of the results	12	Teaching approach
14	Impact identification	8	Topic and/or approach	8	Explanations
11	User-friendly	6	Quantification of indicators	6	Approach
11	Excel-tool	6	Effort	4	More / other examples
9	LIM Approach	6	User friendliness	3	Monetization
7	Quantify intangibles	2	Comparability	3	Institutionalize LIM
6	Impact substantiation	1	Unclear demand from investors		
5	Teaching approach				

4.7.3 Key improvements of the workshop and Excel-tool

The verbal feedback we received during the workshop went into similar directions as the before stated written feedback. Following the verbal and written feedback and our own reflections of the workshop, we made some important changes to ensure participants are able to apply LIM independently after the workshop. Below the key changes are summarized:

- **Divided tasks:** Initially we assumed that participants could complete some more complex tasks in one step, e.g., defining and quantifying an outcome indicator. We learned that experience, understanding, and coordination in teams allowed only some participants to complete those tasks. Consequently, we split tasks into smaller steps.
- **Adding 2 hours especially for the impact substantiation:** There was a large variation in the time and support participants needed to develop quantitative assumptions with the

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tool. Sometimes due to the complexity of their business model and the related intangible outcomes, but also due to insecurity when working with numbers. Accordingly, we extended the workshop and added 2 hours to provide more guidance, especially during the impact substantiation phase. During the extended impact substantiation phase, we used the iterative, stepwise approach that already proved successful during the impact identification phase. This means we relied on several steps with an initial example followed by independent working sessions. Thus, we could guide all ventures through the impact substantiation phase for at least one change. This means they went through the entire LIM approach in about 6 hours, something we were not able to do in the 4 hours pilot workshop.

- **We introduced an indicative scoring model:** To smoothen the transition from the interactive development of the impact model in the impact identification phase to the calculations in the impact substantiation phase, we introduced a scoring model (especially, for less number driven participants). By selecting predefined categories for the number of affected stakeholders, the relative importance of the societal problem a venture addresses¹⁶ and the degree a venture solves a problem, the model calculates an outcome score between -10 (maximum negative effect) and +10 (maximum positive effect). Following this drop-down logic, venture teams had to start making assumptions for the counterfactual analysis in order to reduce the outcome score to an indicative impact score.

The introduction of the scoring model facilitated the transition to the impact substantiation phase for many participants as they were guided with predefined categories to their first assumptions. When we introduced the scoring, we emphasized that it is only a teaching tool and not a pitchable KPI. Nevertheless, some participants actually preferred the simplicity of the scoring model to the actual impact calculations (see improvement feedback in table 4.5).

- **Improved excel design and explanations:** During the workshop clarification questions and feedback from participants helped us to improve many of the written explanations in the Excel-tool. Additionally, the participant feedback helped to identify superficial and repetitive elements in the Excel-tool.
- **Remove group reflections:** To save time in the overall process we took out the group reflections in the impact identification phase. We observed primarily repetitive discussions during these group reflection that repeated ideas that were already expressed during the mutual discussions between venture teams.

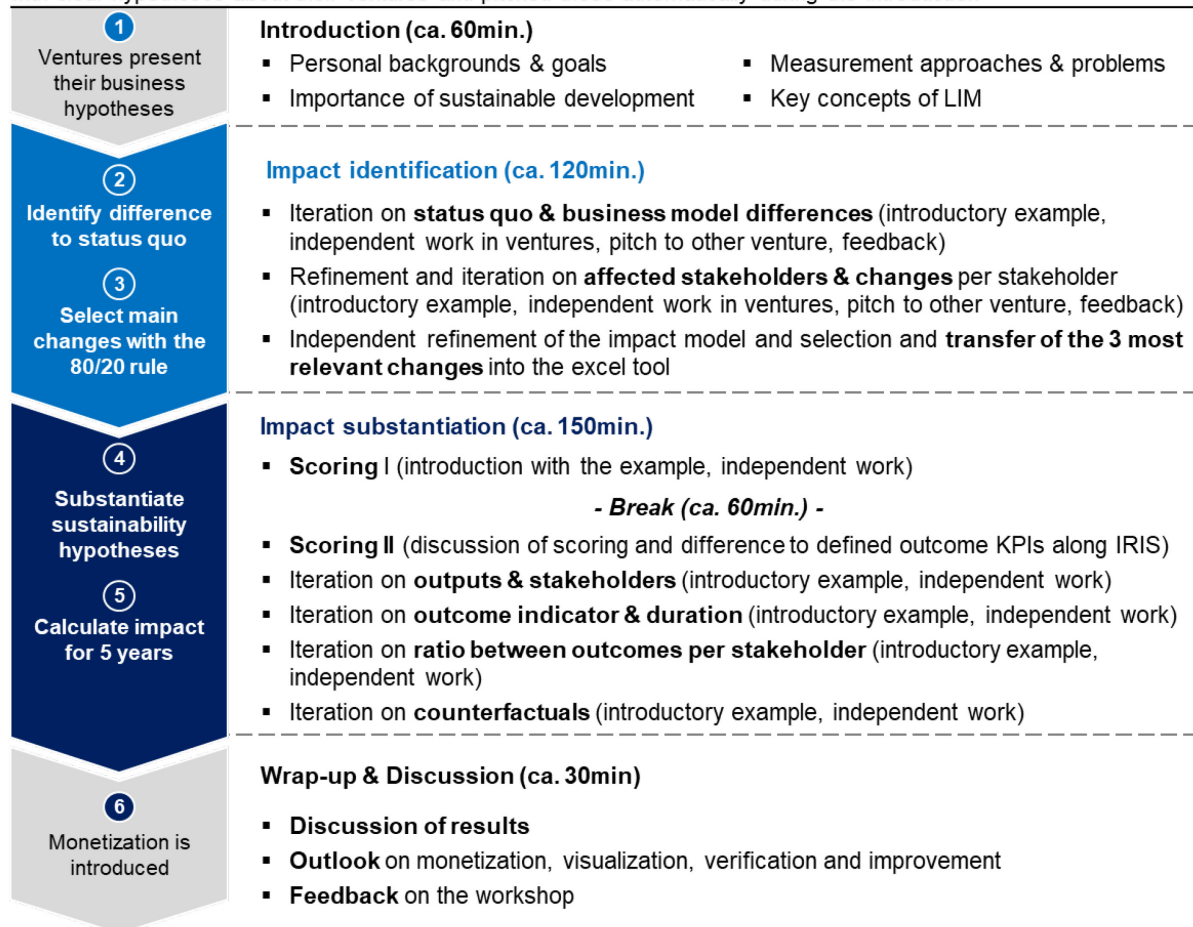
¹⁶ We provided the Sustainable Development Goals as a reference for the relative importance of a change.

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- **Clarify next steps in wrap-up and discussion:** To clarify potential next steps for the entrepreneurs we guided them through the optional monetization process in the excel file and pointed them towards the refinement of the assumptions as well as potential tools to improve their impact like the value-mapping tool (Bocken, Short, Rana, & Evans, 2013).

After incorporating all the obtained feedback we came to a final design for the workshop design (see figure 4.3) and a final structure for the Excel-tool (table 4.6). Both are summarized below. Additionally, the Excel-tool can be provided upon request from the authors.

Step 1 of the LIM-framework (figure 4.1) has been left out as a separate step, as entrepreneurs came into the workshop with clear hypotheses about their ventures and pitched those automatically during the introduction



The optional step 6 monetization (figure 4.1) is only presented, but not part of an exercise to save time. The excel tool contains a separate tab on monetization where the total monetary value can be easily calculated with (1) a financial proxy for each outcome and (2) an estimate for the cost difference between the inputs of the venture and the status quo.

Figure 4.3 Overview of the final workshop structure

Table 4.6 Overview of sheets in the Excel-tool

Sheet	Content
Theory of change	<ul style="list-style-type: none"> Describe the measurement context Define key theory of change variables Review your assumptions based on an indicative outcome & impact scoring
Added Sustainability Values	Change 1 <ul style="list-style-type: none"> Explain your key assumptions on outputs, outcomes and impact Quantify your assumptions
	Change 2 <ul style="list-style-type: none"> Explain your key assumptions on outputs, outcomes and impact Quantify your assumptions
	Change 3 <ul style="list-style-type: none"> Explain your key assumptions on outputs, outcomes and impact Quantify your assumptions
Impact Dashboard	<ul style="list-style-type: none"> Automatically generating an overview of outputs, affected stakeholders, outcomes, and impact
Monetization	<ul style="list-style-type: none"> Define financial proxies to monetize your impact Describe input changes for affected stakeholders in monetary terms Consolidate monetized impact
IRIS Indicators	<ul style="list-style-type: none"> Select IRIS indicators (esp. for outputs and outcomes) from the IRIS 4.0 Full Catalog

4.8 Effectiveness – LIM as a practical tool for entrepreneurs

Besides developing an effective way to teach LIM to entrepreneurs (RQ2), we wanted to validate the assumption that entrepreneurs perceive LIM as a practical approach to measure and forecast the sustainability impact of their ventures (RQ3). The previous discussion on the helpfulness of the workshop and the Excel-tool already showed that many entrepreneurs had a positive impression of our approach. However, to assess the practicality of the approach from the perspective of entrepreneurs it is important to know whether they continue to use the approach in the long-run. Ideally, this requires a longitudinal study of workshop participants. Unfortunately, this was out of scope for this research. Therefore we had to rely on the self-assessment of workshop participants (see table 4.7). According to their feedback, 72% of participants expect to use LIM to a certain degree in the future (28% strongly agreed, 44% somewhat agreed that they would review strategic decisions in the future with regard to their added sustainability value). Also 55% plan on reporting the Added Sustainability Values (19% strongly agreed and 36% somewhat agreed). And finally, 60% agreed to value the ability to monetize their Added Sustainability Values (27% strongly agreed and 33% somewhat agreed). These quantitative findings provide some, but no exhaustive support for the practicality of the LIM approach. While less than 10% of participants were certain that they would not use LIM in the future, it seems that many remain undecided. This emphasizes the need for additional longitudinal studies in order to obtain stronger support for the practicality assumption.

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Table 4.7 Overview of the survey responses on the effectiveness hypotheses, n=57

LIM hypothesis (H)	H3: Participants expect to use LIM in the future for decision making and reporting		
Survey questions (SQ)	SQ 3.1: <i>"In the future, we will review strategic decisions with regard to their Added Sustainability Value."</i>	SQ 3.2: <i>"We plan to report our Added Sustainability Value."</i>	SQ 3.3: <i>"Having a monetized added sustainability value is important for us."</i>
Strongly agree	27%	19%	27%
Somewhat agree	45%	36%	33%
Neither agree nor disagree	19%	34%	23%
Somewhat disagree	9%	11%	14%
Strongly disagree	0%	0%	3%

To complement the limited validity of the survey responses, we discussed our approach with experts on impact measurement, incubators, venture support organizations, impact investors and researchers (see table 4.8). We shared our approach with them and asked for feedback on its usefulness and applicability.

From experts and academia, we received mostly support for our approach with its simplified Social Return on Investment logic. Equally, many venture support organizations and incubators valued the practical applicability of our approach. However, some of our interview partners questioned the demand from impact investors and thus a central stakeholder for new ventures.

Our discussions with impact investors and impact measurement experts showed a more divided view on impact measurement. While everybody agreed on the lack of consistent and clear approaches to impact measurement, some interviewees were rather critical on impact measurement overall. The interested actors liked our approach but asked for the integration of additional features like risk assessments or goal setting to make it a comprehensive solution for decision-making. The critical group was skeptical about the generation of valid impact forecasts and the required effort. Instead, they favored financial metrics together with a convincing impact story.

The literature on impact measurement supports the observed divide. The lack of proper impact measurement is a topic that is discussed in wide-reaching publications like the Harvard Business Review asking: *"How do we make sure that the blossoming impact investment movement [...] actually leads to improvements in outcomes for the people and communities it is supposed to benefit?"* (Simon, 2018). The annual impact investor survey of the Global Impact Investment Network (Mudaliar, Bass, & Dithrich, 2018) equally underlines the need for impact measurement. According to their survey, 94% of investors say that the sophistication of impact measurement is a major challenge and 70% still use their own proprietary metrics and

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frameworks instead of a consistent, scientific approach. While the observed fragmentation and lack of sophistication underline the potential benefits of more consistent impact measurement approaches, they also suggest that parts of the impact investment scene are hesitant in the adoption of a more consistent approach to impact measurement.

Table 4.8 Overview of stakeholder groups that provided feedback on our approach.

Interview partner	Background of contacts	Contact via
5 x Impact measurement & consulting organizations	Advisors on impact measurement (partially with own approaches)	Face to face, phone, and email
4 x Incubators	Venture support programs and ecosystems	Face to face
2 x Social entrepreneurship support organization	Project management and education	Face to face and phone
2 x Impact investment funds	Impact investment expert	Face to face, phone, and emails
1 x Research conference	Various entrepreneurship researchers	Face to face

In sum, the participant feedback and our stakeholder discussions generally supported the LIM approach and our teaching methodology. However, our analysis also highlights that entrepreneurs and investors remain divided on LIM and the matter of impact measurement. Feedback suggests that more sophisticated software solution would increase the practicality of LIM. Entrepreneurs expressed a strong interest in more automation and additional features (see table 4.5). Similarly, investors asked for more features like risk assessments and goal setting options. Thus, practitioner feedback provides only partial support for the practicality of LIM with the current support software (RQ3).

4.9 Discussion

4.9.1 Challenges and opportunities for LIM

The previously discussed results show that entrepreneurs see the need for a structured approach to impact measurement (H1) and they support the LIM workshop and the LIM Excel-tool as a valuable approach to do so (H2). However, the results also point out the limitations and challenges of our approach as a practical approach to impact measurement (H3). Among the most important challenges, we want to discuss the validity of the estimates, the need to institutionalize impact measurement among impact investors (create external demand) and the call for more sophisticated software solutions.

The validity of the developed estimates is a serious concern. In the workshop, context entrepreneurs are guided through the development of key variables for the calculation of the added sustainability values with the Excel-tool. Following the lean startup methodology (Blank,

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2013a; Ries, 2011), entrepreneurs are encouraged to make assumptions that they have to refine and validate after the workshop with experts, stakeholders, and scientific sources. It remains unclear whether participants invest time after the workshop to verify and refine their initial assumptions as the study at hand concentrates on the workshop development and not its long-term effect. So far, we received some positive feedback from entrepreneurs that refined their assumptions, but we assume the degree of refined and validated LIM calculations varies strongly between participants. Future, longitudinal research should verify the long-term application and effectiveness in more depth.

To encourage refinement and validation of LIM assumptions by entrepreneurs, future demand of investor for impact metrics is crucial. The Global Impact Investor Network survey (Mudaliar, Bass, & Dithrich, 2018) and our own discussions with investors showed that impact investors have diverging views on impact measurement. If investors requested consistent impact metrics from entrepreneurs (such as the Added Sustainability Values of LIM), this would constitute a great incentive for entrepreneurs to refine and validate their impact assumptions. Thus, a virtuous circle seems possible. The more impact measurement is institutionalized among investors; the higher is the incentive for entrepreneurs to refine and validate their LIM assumptions, which would again increase the quality of the calculated metrics and increase the effectiveness of the LIM approach for impact investors. This virtuous circle would be fueled by investor interest.

Besides the importance of strong external incentives for impact measurement, it is important to make measurement as efficient and beneficial as possible to reduce barriers to measurement. Building on the participant feedback, it could be valuable to develop a web-solution that guides entrepreneurs stepwise through the calculation of key variables supported by features like pop-up examples, explanatory videos, integrated databases or automation. Integrating classical financial data and risk assessments into such a tool could further improve the value for entrepreneurs and interested impact investors (see chapter 4.6 and 4.7).

Institutionalizing LIM and developing a sophisticated software solution are both logical next steps from a practitioner point of view, but they significantly exceed the scope of a research project. The remainder of this research article summarizes the key practical and scientific contributions.

4.9.2 Scientific and practical contribution of this article

This paper responds to three research questions.

RQ1: How does LIM contribute to the sustainable business model development process?

RQ2: How should LIM be taught to entrepreneurs?

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RQ3: Is LIM a practical approach to measure and forecast the sustainability impact of new ventures?

By responding to these research questions important contributions to theory and practice were made. Responding to RQ1, the analysis showed that there are valuable academic tools for the exploration, exploitation and qualitative evaluation of sustainable business models (e.g., Bocken, Short, Rana, & Evans, 2013; Geissdoerfer, Bocken, & Hultink, 2016; Joyce & Paquin, 2016; Upward & Jones, 2015), but there is a lack of quantitative evaluation approaches for effectual, sustainable entrepreneurs that LIM can fill. Building on this finding, this paper develops (RQ2) and tests (RQ3) the first practical application of LIM. On the practical side, the development of a workshop and Excel-tool are certainly the most tangible contribution that participant valued for their good structure and user-friendliness and perceived as a way to obtain new insights about their venture. The development and empirical refinement of the teaching approach over 12 workshops with 87 participants and 64 individual feedbacks gives this study special scientific value. In particular, in comparison to the wide range of business tools that have been tested on students or in other non-representative settings (Baumann, Boons, & Bragd, 2002; Rossi, Germani, & Zamagni, 2016). Moreover, the empirical assessment of LIM's practicality offers answers to RQ3, which is important for the validation of LIM as an approach (article 1). This assessment generally confirms the practicality assumption of LIM, but it also reveals important practical and institutional challenges – most importantly, the limited practicality of Excel as a tool and need of broader investor demand for impact metrics to make measurement more attractive.

4.10 Conclusions

This research applied the conceptually developed Lean Impact Measurement (LIM) approach (article 1) in practice. LIM is a practical approach to measure and forecasts the added sustainability value of a new venture compared to the status quo based on a simplified Social Return on Investment calculation. Initially, this research examined the landscape of academic tools that support the discovery, evaluation, and exploitation (Shane & Venkataraman, 2000) of sustainable entrepreneurial opportunities. This points out the lack of quantitative evaluation tools for sustainable business models. LIM is supposed to fill this gap as an iterative and hypothesis-based approach to impact measurement in effectual new ventures (article 1). To properly translate the conceptual LIM approach into practice the literature on entrepreneurship education and available entrepreneurship tools have been studied. We followed an adapted version of Geissdoerfer et al. (2016) (Geissdoerfer, Bocken, & Hultink, 2016) and Bocken et al. (2011) (Bocken, Allwood, Willey, & King, 2011) for the development of the workshop with four phases: exploration, conceptualization, improvement and evaluation. In the exploration

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phase, we identified best practices in entrepreneurship education from research and practice (Blank, 2013a; Harms, 2015; Kolb & Kolb, 2005; Ries, 2011). Following this exploration, we designed the conceptual model of our workshop with a focus on cyclical learning, hypothesis-driven experimentation, peer feedback and the integration of various experiences for different learning styles. Over 12 workshops, with 58 organizations and 87 individual participants and additional expert discussions we refined our approach. In the final format, LIM is taught in a six hours workshop over three phases. The introduction phase aims to create a common understanding and a psychologically safe environment. Then the impact identification phase develops a qualitative impact model with ventures through several iterations. Finally, in the impact substantiation phase, participants translate their impact model into an Excel-tool before they are guided stepwise through the calculation to calculate so-called added sustainability values.

Participant feedback shows that a majority of participants expects to use LIM in the future and experienced the approach as a well-structured and user-friendly way to gain new insights about their business model. Thus, our findings support the assumption that LIM can serve as a practical tool to evaluate the impact of a business model. However, participant feedback also highlighted important challenges for the approach. Most importantly, the need to validate and refine assumptions and the desire for more sophisticated software solutions. To further validate the practicality of LIM longitudinal studies are needed that could additionally verify the validity of the LIM measurements.

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4.12 Appendix

Coded and categorized feedback to open question 1

What did you like about Added Sustainability Value Measurement (incl. the Excel-tool)?

<i>Count</i>	<i>Feedback categories</i>	<i>Coded feedback</i>
19	Good structure	Good structure
18	Business model insights	Good business model review, Broadened view, Strategic view, Define impact objectives
14	Impact identification	Stakeholder perspective, Pitch approach, Focus on key changes, Additionality perspective, Storytelling
11	User-friendly	User-friendly
11	Excel-tool	Excel-tool, Flexibility of tool, Visualization in the tool
9	LIM Approach	LIM Approach, Immediate results, Help for marketing, Cross-sector applicability, Combination of qualitative & quantitative, Builds on existing approaches
7	Quantify intangibles	Quantify intangibles
6	Impact substantiation	Calculation approach, Counterfactual analysis, Transparency about assumptions, Monetization
5	Teaching approach	Coaching, Explanation, Solution Circle

Coded and categorized feedback to open question 2

What didn't you like about Added Sustainability Value Measurement (incl. the Excel-tool)?

<i>Count</i>	<i>Feedback categories</i>	<i>Coded feedback</i>
15	Excel-tool	Complexity of tool, Tool wording, Excel as software, Limited options in Excel-tool, No online interface, No automation (more step by step process), Limited options in tool
12	Validity of the results	Validity of assumptions, Simplifications potentially ignore important impacts
8	Topic and/or approach	Complexity, Too detailed, SDG focus, No storytelling, IOOI, Focus on forecast, Focus on business model
6	Quantification of indicators	Quantification challenging, Intermediaries hard to measure, Identifying suitable indicators
6	Effort	Repeated measurement for each stakeholder, Effort to learn, More time, Need for data research
6	User friendliness	Explain calculations, More examples, Banana example not generalizable, More guidance, Less text material, Early warning that numbers are needed
2	Comparability	Not directly comparable, Show cumulative impact
1	Unclear demand from investors	Unclear demand from investors

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Coded and categorized feedback to open question 3

How can we improve Added Sustainability Value Measurement (incl. the Excel-tool)?

<i>Count</i>	<i>Feedback categories</i>	<i>Coded feedback</i>
15	Digital support	More self-explanatory tool, Simplified Excel, Usability, Online version, Instructional video, Distribute via Google Docs, Database with typical KPIs, Database with typical assumptions, More adaptation, Add selection for key stakeholders, Add features
12	Teaching approach	Show BMC, More coaching, Guide through tool stepwise, Early warning that numbers are needed, More interaction, less text material, Indicate limitations of the measurement, Longer workshop
8	Explanations	Tool wording, Facilitate indicator search, Explanation of counterfactuals, Explain variables, Explain calculations, Additional reading material after the workshop, Written guide
6	Approach	Standardized scale for the scoring, More structure, Mandatory negative impact assessment, Complexity, Adapt for intermediary business models
4	More / other examples	More examples, More complex example, Consistent example
3	Monetization	Monetization, More on monetization, More information on monetization
3	Institutionalize LIM	Upgrade impact scores for marketing, Scale the approach & tool, Make widely used standard

5. Article 3: Exploring entrepreneurship related to the Sustainable Development Goals – Mapping new venture activities with semi-automated content analysis

Article 3

Exploring entrepreneurship related to the Sustainable Development Goals

Mapping new venture activities with semi-automated content analysis

Jannic Horne, Malte Recker, Ingo Michelfelder,
Jason Jay and Jan Kratzer

Keywords: Entrepreneurship, New venture, Sustainable Development, Sustainable Development Goals, Content analysis

JEL Classification: E61; L26; Q00; Q01

5.1 Abstract

It is widely agreed that humanity faces major sustainability challenges that require immediate action. The Sustainable Development Goals (SDG) are the most recent political call for action in this direction. In this study, we examine what role entrepreneurship in Germany plays in achieving the German SDGs. Thus, we pick up the discussion on sustainable entrepreneurship as a lever for change and search for empirical evidence that entrepreneurs in Germany identify and develop opportunities along the entire SDG spectrum.

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For our study, we examined a total of 193 venture competitions in Germany, collected data on a total of 588 rewarded ventures and used a semi-automated content analysis process to allocate those ventures to the main 17 SDGs based on their business activities.

With our work, we contribute to theory by developing a scalable and repeatable approach to map SDG related activity of new ventures, and we contribute to practice by providing a detailed analysis of Germany's entrepreneurship landscape along the 17 SDGs.

We found a very heterogeneous distribution of entrepreneurial activities along the goals, but also significant correlations between multiple goals that are frequently addressed jointly. To better interpret the results, we contrasted entrepreneurial activity along the SDGs with the national overall SDG performance of Germany (Sachs et al. 2017). This revealed four patterns that we titled according to our policy recommendations 'encourage' (good national performance, low entrepreneurial activity), 'maintain' (good national performance, high entrepreneurial activity), 'boost' (low national performance, low entrepreneurial activity) and 'scale' (low national performance, high entrepreneurial activity). We conclude that policymakers and researchers should focus on awareness building and entrepreneurship education for SDGs in pattern 'boost' and investigate how to support growth of ventures in pattern 'scale' to reap the full benefits entrepreneurship can create for sustainable development. To efficiently boost and scale SDG activities, in particular, the identified correlation (i.e., potential synergies) between goals should be exploited.

5.2 Introduction

"The 17 Sustainable Development Goals and 169 targets which we are announcing today demonstrate the scale and ambition of this new universal Agenda. They seek to build on the Millennium Development Goals and complete what they did not achieve. They seek to realize the human rights of all and to achieve gender equality and the empowerment of all women and girls. They are integrated and indivisible and balance the three dimensions of sustainable development: the economic, social and environmental. The Goals and targets will stimulate action over the next 15 years in areas of critical importance for humanity and the planet". (General Assembly 2015)

The 17 Sustainable Development Goals (SDG) that the General Assembly adopted in September 2015 constitute the most widely accepted agenda for sustainable development today. They build upon the famous call for sustainable development in the Brundtland Report (Brundtland Commission 1987) and expand the incomplete Millennium Development Goals (MDG) with their narrow focus on poverty reduction (General Assembly 2015) to create the first global set of goals addressing all three pillars of sustainability. In doing so, the SDGs pick-

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up the scientific call for global Sustainable Development Goals (Griggs et al. 2013) and help to keep sustainable development a priority on political agendas worldwide. Today they provide the legitimate political framework upon which governments, civil society, and businesses can plan, measure and communicate their contribution to sustainable development.

The SDGs underline the immediate need to change the unsustainable development path that humanity pursues today. Humanity must take the *“bold and transformative steps which are urgently needed to shift the world on to a sustainable and resilient path”* (General Assembly 2015). In this transformation, businesses play an important role and particularly entrepreneurs (General Assembly 2015; Loorbach, Wijsman 2013; Sullivan et al. 2018; Figge, Hahn 2004; Hockerts, Wüstenhagen 2010; Weissbrod, Bocken 2017). With their ventures, entrepreneurs can create and catalyze the necessary structural changes that incumbents fail to perform for reasons like organizational inertia or the risk to cannibalize or destabilize existing unsustainable business models (Hockerts, Wüstenhagen 2010; Lüdeke-Freund et al. 2016). Accordingly, understanding whether and in which areas new ventures support the transition towards sustainable development is of special importance. But to the authors' knowledge, there is no empirical study that tried to create transparency on entrepreneurship's role towards achieving the SDGs.

To solve this problem, we developed a structured and scalable approach that allows mapping the activities of new ventures in Germany along the 17 SDGs. We used software supported semi-automated content analysis (Krippendorff 2012; Weber 1992; Neuendorf 2016) to examine a total of 588 ventures that were rewarded in one of 193 venture competitions in Germany in 2017. By doing so, we can draw conclusions on the activity patterns of German entrepreneurs regarding the national SDG targets.

Our data revealed a very heterogeneous distribution of entrepreneurial activities along the SDGs as well as a significant correlation between goals that entrepreneurs frequently address jointly. For the interpretation of the results, we contrasted the SDG activity of entrepreneurs in Germany with the national overall SDG performance (Sachs et al. 2017). This led to four patterns that we titled according to our recommended policy responses ‘encourage’ (good national performance, low entrepreneurial activity), ‘maintain’ (good national performance, high entrepreneurial activity), ‘boost’ (low national performance, low entrepreneurial activity) and ‘scale’ (low national performance, high entrepreneurial activity). These four patterns point policymakers to the most relevant areas for political interventions, and they constitute a starting point for future research.

Following this introduction, we give an overview of existing research on the role of entrepreneurship in sustainable development and examine existing attempts to measure progress along the SDGs. Out of this, we develop our two research questions (RQ1) *‘How can*

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we map the SDG related activity of entrepreneurs in Germany?’ and (RQ2) ‘Which SDGs show high entrepreneurial activity in Germany and which SDGs remain unaddressed?’.

Next, we outline the methodology used to map the SDG contribution of German ventures and present our empirical results. Following this, we discuss the findings and limitations of this research approach based on our two research questions. In addition to this we explore the potential role of entrepreneurship along two discussion questions: (DQ1) ‘*Can all SDGs be addressed by entrepreneurs?*’ and (DQ2) ‘*What can be done to optimize the activities of entrepreneurs along the 17 SDGs?*’. Concluding, we give policy recommendations and outline further research steps.

5.3 Background and research approach

5.3.1 Background – entrepreneurs as levers for sustainable development

There is a widespread agreement that our economic system causes many of today’s sustainability challenges, and it is equally clear that economic actors can play an important role in solving the sustainability challenges we face today (Cohen, Winn 2007; Loorbach, Wijsman 2013; Abdelkafi, Täuscher 2015; Boons, Lüdeke-Freund 2013). Sustainable entrepreneurship is often discussed as an important lever to overcome unsustainable patterns in our economic system (York, Venkataraman 2010; Shepherd, Patzelt 2011; Pacheco et al. 2010; Schaltegger et al. 2016). In particular, the entrepreneur’s abilities to create and catalyze structural changes in an industry have been praised. Entrepreneurs can initiate transformative changes in situations where incumbent businesses remain reluctant to change due to organizational inertia or the risk to cannibalize or destabilize existing unsustainable business models (Bidmon, Knab 2018; Hockerts, Wüstenhagen 2010; Lüdeke-Freund et al. 2016).

Capable sustainable entrepreneurs see unsustainable development as a market imperfection that they turn into business opportunities (Cohen, Winn 2007; Patzelt, Shepherd 2011; Pacheco et al. 2010). There is a large variety of for-profit and non-profit business models that these entrepreneurs (incl. intrapreneurs) can use to create and scale up their business models (Bocken et al. 2014; Lüdeke-Freund et al. 2016). The role of sustainable entrepreneurs for sustainable development can be summarized with the multi-level perspective of transition research (see Bidmon, Knab 2018; Loorbach, Wijsman 2013). If their venture succeeds their sustainable business model can outgrow its initial economic niche and destabilize the dominant socio-technical regimes. Together with changes in the socio-technical landscape, this can lead to meaningful societal progress towards sustainable development.

With this societal role of sustainable entrepreneurs in mind, it is important to understand under which conditions sustainable entrepreneurship occurs. Patzelt and Shepherd (2011) argue that

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sustainable entrepreneurship results from a combination of altruism, entrepreneurial know-how, and motivation. To mobilize these entrepreneurs, it is crucial to create awareness on the sustainability challenges and the related dangers for themselves, their dear ones and their communities. Building on this motivation the model assumes that entrepreneurs recognize sustainable development opportunities (Patzelt, Shepherd 2011).

Assuming the model of Patzelt and Shepherd is correct, entrepreneurial activity related to sustainable development (respectively the SDGs) depends largely on the available knowledge and awareness. In the context of Germany, previous research finds strong awareness about the need to overcome unsustainable behavior in civil society and business, but we also find low trust in the contribution of businesses (BMUB, UBA 2015; Accenture, Havas Media 2014; The Global Compact Network Germany et al. 2016). The contrast between the general awareness on sustainability and skepticism on business contributions raises the question whether Patzelt and Shepherd's model holds true – i.e., whether the knowledge in Germany translates into actions for sustainable development. Studies like the Green Economy Gründungsmonitor (Weiß, Fichter 2015) or the German Startup Monitor (Kollmann et al. 2017) shed some light on entrepreneurial activities in Germany, but they do not provide full transparency on venture activities related to sustainable development. However, without transparency on entrepreneurial activities related to the SDGs, policymakers and researchers lack indicators that show whether entrepreneurs already recognize and develop opportunities that help to achieve the SDGs. Mapping the activities of entrepreneurs in Germany to the SDGs can be a first step to create the required transparency.

5.3.2 Research Approach – mapping entrepreneurship activity to the SDGs

To date, SDG progress measurement relies on national statistical authorities or independent researchers that so far focus on the national progress along the SDGs (United Nations 2017; Nilsson et al. 2016a; Costanza et al. 2016; Sachs et al. 2017). To our knowledge, the contribution of a specific stakeholder group – like entrepreneurs – to the achievement of the SDGs is not tracked.

Experiences from the measurement of national SDG progress show that measurement is really challenging as there are interaction effects, trade-offs and vaguely defined goals (United Nations 2017; Nilsson et al. 2016a; Costanza et al. 2016; Sachs et al. 2017). Already the official resolution states that there is a gap in data collection and that in some cases there are no clear numerical targets (General Assembly 2015). These problems explain the challenge to comprehensively and consistently measure progress towards the SDGs. However, measuring progress on the 2030 Agenda is crucial to properly manage the transformation to sustainability.

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Accordingly, there are numerous attempts to overcome the stated challenges on the national level (United Nations 2017; Nilsson et al. 2016a; Costanza et al. 2016; Sachs et al. 2017).

In the context of progress measurement Constanza et al. (2016) explain well that in theory, it is necessary to track progress with an integrated system dynamics model that captures all interdependencies between the goals, but in practice progress is mostly tracked separately for each of the 17 SDGs in a dashboard logic (Costanza et al. 2016). Sachs et al. (2017) provide a good example of such a dashboard (see figure 5.1). For each SDG the dashboard integrates a wide range of statistical indicators on a national level and communicates the progress performance in a traffic light logic. For instance, Germany's performance for SDG 1 (no poverty) has been rated green as all three indicators for SDG 1 are above a predefined threshold. Used indicators are the poverty headcount ratio at \$1.90/day today and in 2030 as well as the poverty rate after taxes and transfers (see Sachs et al. 2017).



Figure 5.1 Exemplary SDG dashboard for Germany in the color code of Sachs et al. (2017). Green is used only if all sub-target indicators are achieved, yellow, orange and red indicate the increasing distance to achieving the SDG targets.

In the business sphere we could not find similar attempts to track and aggregate progress in a dashboard logic – neither for large corporates nor small and medium-sized enterprises. Existing guidelines as the SDG compass focus on measurement and reporting for large corporates linking SDG progress to sustainability reporting efforts (Global Reporting Initiative et al. 2015). Additionally, there are attempts to measure venture activities for different focus areas – for example, green ventures in Germany (Weiß, Fichter 2015) – but these cannot be connected directly to the SDGs. Structured approaches and more importantly data sources on the contribution of entrepreneurs to the SDGs could not be identified. Hence, mapping the activity of entrepreneurs related to the national SDGs constitutes a research gap, and due to the importance of the SDGs, the mapping is of significant relevance for a wide range of stakeholders, like policymakers, investors or entrepreneurs.

Our mapping of activities collects data based on the inputs, activities, and outputs of a venture and does not try to assess the potential outcomes and impacts as it would be done in a

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comprehensive impact assessment (see Clifford 2014). The depth of analysis is thus similar to that of the widely used Global Reporting Initiative (Global Reporting Initiative 2016). Accordingly, it is important to note that mapping activities to SDGs can only indicate a potential correlation of a business model to the SDGs, but it is no evidence for causation (causation would require a more detailed impact assessment along an input-output-outcome-impact logic for each venture, which is out of scope for our quantitative research approach).

Assessing the SDG related activity of entrepreneurs is linked to well-known challenges in the field of sustainable impact measurement and entrepreneurship research, most importantly the lack of historical data to be studied and the lack of resources in new ventures to start collecting missing data and reporting them (article 1; Clifford 2014; Dichter et al. 2016; Johnson, Schaltegger 2016; Recker and Michelfelder 2017). These challenges make our ambition – to track the activity of new ventures in Germany related to the national SDG – more challenging. To solve this problem, we built our research on data that are most widely available for new ventures, i.e., information from their own websites and those published in venture competitions. These two sources provide numerous information on a venture's business model, its industry sector and meta-information on the venture itself. Moreover, focusing on rewarded ventures provides some quality control in the very dynamic venture environment allowing to filter out immature ideas and ventures. The downside to this approach is a self-selection bias of ventures that participate in competitions. Some ventures might decide against venture competitions for example if they are already very successful. Accordingly, there is a risk that we systematically neglect certain groups of ventures.

With our approach, we differ from other evaluations of venture activity in Germany that either work with samples of ventures and extrapolate results for the entire population of German ventures (Weiß, Fichter 2015) or approaches that use surveys distributed among peers within a specific group of ventures (Kollmann et al. 2017). As we focus on ventures that are likely to have a meaningful impact on the SDGs we do not try to cover the entire venture population in Germany, instead we aim for a subset of ventures that were successful in venture competitions and take awards as an indicator for quality that suggests a higher chance to grow and have impact. With this focus on a subset of ventures we are closer to Kollmann et al. (2017) but decided to use publicly available text material that is available for a wide variety of ventures instead of surveys.

Our approach offers a structured and scalable way to map the activities of new ventures in Germany along the 17 SDGs and draw conclusions on the potential contribution of German entrepreneurs to the national SDG targets. We can thus follow the dashboard logic and create an SDG heat map for entrepreneurship in Germany. The mapping helps to understand which SDGs are primarily addressed, which remain unaddressed and it allows to identify patterns of SDGs that are typically addressed in combination.

With our approach we respond to two research questions:

(RQ1) '*How can we map the SDG related activity of entrepreneurs in Germany?*' and (RQ2) '*Which SDGs show high entrepreneurial activity in Germany and which SDGs remain unaddressed?*'

5.4 Methodology – applying software supported semi-automated content analysis

To answer our research questions, we selected content analysis as an appropriate research method to classify new ventures regarding their potential contribution to SDGs. Other studies with comparable objectives showed that content analysis is an appropriate and insightful method (Barringer et al. 2005; Perry und Bodkin 2000; Ritala et al. 2018; Roca and Searcy 2012; Weare und Lin 2016; Uotila et al. 2009;).

Content analysis is defined as a systematic approach to compress a large amount of text and words into predefined content categories based on rules of coding (Krippendorff 2012; Weber 1992; Uotila et al. 2009; Neuendorf 2016). In this study, the approach is used to create SDG categories based on coded keywords and search through venture texts. With the help of modern content analysis and qualitative data analysis software, it is possible to apply this approach to a large number of texts efficiently. We selected atlas.ti software due to its semi-automated auto-coding function for our study (Atlas.ti, 2018).

Literature differentiates two types of content analysis: first *emergent coding* also called *inductive coding* and second, *a priori coding* or *deductive coding* (Weber 1992). The deductive approach is based on a pre-existing coding system with predefined keywords, seen as the more directed approach. Whereas the inductive approach is based on developing the codes from the data themselves and refining them through the process, being the more conventional approach (Elo and Kyngäs 2008; Hsieh and Shannon 2005). Since we base our mapping on existing definitions and documentation of the SGD goals, we executed a deductive approach by using predefined keywords, which we used to code the venture texts.

Previous application and research have identified reliability as one of the most important success factors. Both consistency along the process and also between involved people is required to ensure quality results (Weber 1992). A set of explicit recording and coding instructions is seen as necessary to avoid reliability issues (Krippendorff 2012). This content analysis was performed as a semi-automated content analysis involving two coders. Both coders jointly reviewed the automatic coding of atlas.ti, discussed each individual match in the given context and confirmed/rejected the proposed matching. This stringent process was performed in sequential sessions over six weeks and strongly reduced the number of mismatches from the automated coding process and reduced variability.

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Our content analysis contains five steps: 1) defining the coding scheme, 2) sampling, 3) piloting the coding scheme, 4) coding and 5) analyzing and reporting (adapted from Neuendorf 2016).

5.4.1 Defining the coding scheme

The coding scheme is developed to support the coding process with defined keywords for each SDG (see the full list in the appendix). The keywords indicate the potential activity of a new venture if the respective keyword is found in the award text or online information.

The objective was to first identify keywords that holistically describe each SDG and its sub-targets based on the available definitions. Second, the selected words describe different levels of the respective change a new venture creates, for example, a description of the problem they want to address or specifications about their activity and the consequences that result from these activities.

As a starting point, we used the official document describing the SDGs (General Assembly 2015). With the help of a word count performed in atlas.ti (excluding stop word list) we identified the most used words for each SDG. The research team critically reviewed these word lists based on specificity to ensure low risk of misallocation and to reduce double counting (e.g., the term “*resources*” is often used in different contexts and therefore not included in the scheme). Thus, we excluded certain terms that were used in multiple SDGs but were not critical to the specific context. However, in some cases, we kept the same terms as the SDGs refer to similar issues, for example, equality is relevant for SDG 5 (gender equality) and 10 (reduced inequalities).

Additional adjustments for the coding scheme were done to sharpen the profiles of each SDG. For example, the aspect of innovation in SDG 9 (industry, innovation, and infrastructure) is partially true for most new ventures with their new ideas or business models. This basic contribution to innovation of each venture remains unquestioned. However, we followed the official definition of SDG9 that puts a focus on issues like knowledge transfer, infrastructure and research and development (General Assembly 2015). Accordingly, we excluded words like innovation that were frequently used for all kind of ventures but not specifically in the context of SDG 9.

Some SDGs cover broad areas and topics that can vary in their description. Consequently, the team searched for synonyms and common associations, which were then added to the scheme. For example, in SDG 9 we included keywords in the context of digitalization (e.g., internet of things, industry 4.0, automation) that relate to sub-target 9.5 “*upgrade the technological capabilities of industry sectors in all countries*” (General Assembly 2015).

We excluded too specific technical terms to avoid confusion and false allocation between SDGs. For example, we did not use a term like “*microplastic*” which is an important topic for

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SDG 14 (life below water), as microplastic is usually used in combination with search words like “*ocean*” or “*sea*”. Similarly, we did not include misleading technical terms like “*storage*” for SDG 7 (affordable and clean energy) which can be relevant in areas like energy, but also logistic or resource management. In tests, we found that “*storage*” is used in combination with the term “*energy*” so that leaving out “*storage*” does not miss SDG 7.

Since we included both English and German texts in the sample, the described process was executed for both languages with respective official documents (Die Bundesregierung 2016; General Assembly 2015). In a second step, we checked terminology regarding consistency in both languages and added missing words. For the semi-automated coding in atlas.ti we combined the word strings for both languages.

5.4.2 Sampling

The study’s sample is based on major venture competitions in Germany, including non-profit and for-profit ventures. Using existing competition overviews (Bundesministerium für Wirtschaft und Energie 2017; Für-Gründer.de 2017) we generated a list of 193 venture competitions that were the starting point for the sample. By selecting a German new venture sample, we discard the contribution of non-German ventures to Germany and its national SDG performance indicators.

Out of those competitions, we collected award-winning and distinguished ventures only for categories with a focus on new ventures (independent of topic) and only if their full name was given. Price categories for general innovation were excluded if they did not differentiate between new ventures and incumbent ventures. All competitions were executed in 2017 and respective awards text origin from the same year. Additional webpage information was downloaded end of 2017 and start of 2018. In the sampling process, we had to take out 75 competitions: 32 did not offer an award in 2017, 25 did not focus on ventures, 18 did not provide sufficient information online.

Overall, we created a sample of 588 ventures. The data set of each venture consists of the award text and information found on the venture’s webpage (or in some cases Facebook), in either German or English language. For those ventures winning multiple awards, we included all award texts. Award texts and webpage information was collected by hand, involving two researchers scanning venture webpages. As required by atlas.ti, we saved the web pages as pdf documents. As default, we saved the landing page of each address and one additional webpage with key business model information. The additional pages often fell in the categories “*about us*”, “*who we are*” and “*company*” or “*vision*” since they often contain valuable and specific information regarding the venture’s business model and thus the potential contribution to SDGs. If no website was available, we looked for Facebook pages and downloaded the

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same information. If no web material was available at all, we only integrated the award text in the sample.

Following our research set-up and focus on Germany, we excluded foreign companies.

In addition, we collected venture specific information during the sample creation, allowing us to better describe the sample and analyze the results afterward. This way we collected basic control variables like the founding year, legal entity type and postal code where available. Additionally, each venture was allocated to one category out of the International Standard Industrial Classification of All Economic Activities (United Nations Statistics Division 2018) and categorized as either startup, unclear or non-startup. Here we followed the general notion of startups as young and innovative growth ventures (Brettel et al. 2007; Kollmann und Hensellek 2017). More specifically, we applied the three criteria of the German startup monitor: startups are (I.) ventures that are younger than ten years, (II.) highly innovative in technology or in their business model and (III.) strive for significant growth in employees or revenue. To be considered a startup a venture must fulfill the first criteria and at least one of the other two criteria (Kollmann et al. 2017). This categorization was used by the two authors in order to characterize the sample regarding its startup focus and to compare startups and other entrepreneurship forms regarding their potential contribution.

5.4.3 Piloting the coding scheme

The coding scheme was tested on a sample of ventures. During the test, we identified and resolved problems with regard to wrong matches where possible. For example, the German term “*arm*” (for poor) generated many wrong matches since it occurs in “*warm*” and other unrelated words, consequently we restricted matches to the exact word with the help of quotation marks. Nevertheless, some keywords like “*jobs*” or “*career*” occurred on nearly every website and not only in the context of SDG 8 (decent work and economic growth). This confirmed our decision to use semi-automated coding with manual confirmation by two researchers instead of fully automated coding.

During the pilot, we also realized that some PDFs were not readable by atlas.ti and that in some cases text recognition of atlas.ti did not recognize the text leading to missing matches, which we resolved by using other PDF creation software.

The pilot could also invalidate concerns around different wording between the UN descriptions of the SDGs and the venture text material. We observed that both use similar words and a mixture of problem description and solution specification. Accordingly, there was no need to adjust the coding scheme to properly match venture text material to the SDG problem descriptions with the selected keywords.

5.4.4 Coding

The content analysis methodology is based on the number of occurrences of keywords in the analyzed data and helps to quantify content in terms of predefined search words (Bryman and Bell 2015). Accordingly, we documented the frequency of Sustainable Development Goal keywords from our coding scheme for each venture.

We decided to perform semi-automated content analysis, combining the advantage of an automated scan of all documents inputted in atlati with the opportunity to verify the search results, reducing random and wrong context matches (e.g., random keywords in the CVs of employees or event notes). The auto coding function was set-up with the following characteristics - ignore cases, strategy: expression, context: word, selected confirm matches, expand to: exact match.

The match review was based on general and SDG specific conditions. First, we excluded keywords found in competition or award names to avoid coding of information that is not directly linked to the venture. However, we included keywords found in the venture name as they indicate a clear commitment to a topic. Category names used to allocate ventures to certain industries or functions were confirmed.

Additionally, we defined specific coding rules for some SDGs since those can generate wrong matches based on wording and context (see table 5.1).

Table 5.1 Overview of SDG specific coding rules that were necessary for a consistent coding process

SDG 3: Good health & well-being	Basic research innovation that can be used for medical purposes but have no direct health benefits were excluded from SDG 3 (instead, SDG 9).
SDG 4: Quality education	If training enables customers to use a product they were excluded. Training that enables customers beyond the use of a specific product was included. Knowledge of sports/ physical exercises has been included.
SDG 7: Affordable & clean energy	We included energy efficiency related ventures with products that reduce energy consumption compared to alternative solutions in the market.
SDG 8: Decent work & economic growth	Job creation of new ventures has only been included if a venture specifically concentrates on the creation or allocation of jobs. Jobs that result primarily from educational activities were not considered for SDG 8.
SDG 9: Industry, innovation & infrastructure	The SDG definition is very broad which makes a clear differentiation challenging. We focused on the enabling aspects of new ventures - i.e., innovations that have a high chance to improve the productivity of other industries or provide significant benefits compared to previous solutions. Infrastructure innovation that affects an industry were included, infrastructure innovation that focuses on urban/ personal mobility was included in SDG 11.
SDG 10: Reduced inequalities	We excluded ventures that simply aim for markets in a developing country without specifically targeting the eradication of inequalities.
SDG 11: Sustainable cities & communities	For SDG 11 transport related activities were only included when they affect urban communities or human settlements.

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SDG 16: Peace, justice & strong institutions	Aspects concerning inclusion from SDG 5 and SDG 10 were not included. Security-related business models were only included if they create more transparency and/or accountability on a broader societal level.
SDG 17: Partnerships for the Goals	Aspects of fair trade were only included when they are part of broader cooperation with developing countries, not when organizations only purchase fair trade products (this was integrated into SDG 12).

5.4.5 Analyzing and reporting

After coding the documents, we exported the results in a code-summary table and cleaned the data in preparation for further analysis. The final data set contained the number of matches per SDG for each venture of the sample across all available documents.

Following the research questions, we applied descriptive statistics to get a first overview of general distribution and characteristics of the results. A correlation matrix was additionally used to better understand interdependencies between SDGs and general patterns.

The final discussion of results was done with the help of a matrix that plots entrepreneurial activity against the national SDG performance. Additionally, we prepared a dashboard (adapted from Sachs et al. 2017) to indicate main areas of entrepreneurial activity and interdependencies between SDGs.

5.5 Results – German venture activity concentrates on SDG 3 (good health and well-being), 4 (quality education), 9 (industry, innovation, and infrastructure) and 12 (responsible production and consumption)

Our final sample is based on data from 588 new ventures and a total of 1315 individual data sources (556 award descriptions and 759 websites) with a minimum of two data sources per venture. Following the before stated definition of startups (see Brettel et al. 2007; Kollmann und Hensellek 2017) 74% of the ventures could be classified as startups, less than 5% were clearly no startups and the remainder is unclear due to limited information. 34% of the ventures were active in manufacturing, 21% in information and communication and 10% in professional, scientific and technical activities. The remaining third spread over 13 other categories of the International Standard Industrial Classification of All Economic Activities (United Nations Statistics Division 2018). For 70% of the sample, we had information about their legal entity that shows that more than 60% are registered as a GmbH (limited liability companies), nearly 10% as UG (usually smaller limited liability company), around 8% as a private person and about 5% as e.V. (associations). Only 40% of the ventures provided information about their founding year. Among those ventures 41% were founded in 2017, 20% in 2016, 16% in 2015. Less than 24% were 3 years or older. We also collected geographic information for 80% of the sample and these data show that 50% of the ventures come from only three federal states

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Bavaria (17%), Berlin (17%) and North Rhine-Westphalia (16%). Baden-Württemberg (9%) and Hesse (8%) also have a meaningful number of awarded ventures. The remaining 33% spread over the remaining 11 federal states.

Table 5.2 Descriptive statistical overview of the total and two reduced samples based on quality thresholds for SDG matches

	All ventures (no threshold, all SDG matches)							Ventures (count threshold >0)			Ventures (count threshold >1)		
Ventures in sample	588 100%							-177	411	70%	-59	352	60%
Total SDG matches	Total 6159							Total	798		Total	602	
SDG	Sum of SDG matches	% of total	Min.	Max.	Standard Deviation	Sample Variance		Count of SDG matches (>0)	% of total		Count of SDG matches (>1)	% of total	
SDG 1: No poverty	11	0%	0	3	0,19	0,04		7	1%		3	0%	
SDG 2: Zero hunger	481	8%	0	56	4,24	18		52	7%		40	7%	
SDG 3: Good health & well-being	1092	18%	0	70	6,36	40,5		133	17%		97	16%	
SDG 4: Quality education	833	14%	0	53	5,83	34		86	11%		63	10%	
SDG 5: Gender equality	80	1%	0	25	1,39	1,92		12	2%		9	1%	
SDG 6: Clean water & sanitation	95	2%	0	56	2,49	6,22		11	1%		7	1%	
SDG 7: Affordable & clean energy	632	10%	0	75	5,93	35,2		51	6%		42	7%	
SDG 8: Decent work & economic growth	107	2%	0	22	1,75	3,06		17	2%		9	1%	
SDG 9: Industry, innovation & infrastructure	1085	18%	0	40	4,77	22,8		160	20%		130	22%	
SDG 10: Reduced inequalities	409	7%	0	64	4,12	17		49	6%		38	6%	
SDG 11: Sustainable cities & communities	483	8%	0	52	4,17	17,4		58	7%		49	8%	
SDG 12: Responsible consumption & production	594	10%	0	36	3,44	11,9		111	14%		82	14%	
SDG 13: Climate action	72	1%	0	13	0,87	0,75		26	3%		14	2%	
SDG 14: Life below water	24	0%	0	11	0,61	0,37		3	0%		3	0%	
SDG 15: Life on land	14	0%	0	6	0,3	0,09		6	1%		3	0%	
SDG 16: Peace, justice & strong institutions	139	2%	0	57	2,77	7,68		12	2%		11	2%	
SDG 17: Partnerships for the Goals	8	0%	0	4	0,2	0,04		4	1%		2	0%	

In our sample of 588 ventures, the frequency for the different SDG keywords varied strongly between ventures and across the different goals from 0 to a maximum of 75 SDG matches for a single venture (table 5.2 summarizes the sample statistics). The strong variation results in the high standard deviations and sample variance – especially, for the most frequent SDGs 3, 4 and 9 (each with more than 10% of matches). To some extent, the maxima can be attributed to ventures with a strong marketing focus, comprehensive text material on their website and ventures that won multiple awards. Additionally, differences between SDGs result from an

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unequal distribution/availability of suitable keywords per SDG. For example, we found a wide range of keywords for SDG 3, while there is only a limited number of suitable keywords for SDG 1 (no poverty). Also, some SDGs have keywords that need additional contextual information and interpretation, for example, SDG 17 (partnership for the goals) (see appendix). To avoid biased results due to variance we assessed only whether a venture is active in an SDG or not. The absolute number of keyword matches per SDG per venture was not used as the available text material per venture varied strongly, and the absolute frequency of keywords is not a reliable indicator to differentiate between levels of SDG activity. Additionally, we took out all ventures with less than two matches per SDG. This threshold reduced the risk of misallocation to an SDG due to individual remarks on a website or award text. This means we only examined ventures with at least two keyword matches from one data source or two matches from different data sources per SDG. Using these quality criteria, we discarded 236 ventures (40% of our sample) coming to a sample of 352 ventures with at least one valid SDG match for detailed analysis.

Out of the discarded 236, 177 ventures had no match and 59 ventures had only SDG matches below the threshold. A review of the 177 ventures without any matches showed two principal reasons, either a venture had not clear activity related to an SDG or there was hardly any written material for our analysis. A more detailed analysis of the split between the two groups would require manual coding of each website for the 177 ventures and is therefore out of scope for this paper on semi-automated coding. We definitely expect that some of the 177 ventures are active in an SDG domain.

In the remaining sample of 352 ventures, we found a very heterogeneous distribution. Based on our search string SDG 1 (no poverty), 5 (gender equality), 6 (clean water and sanitation), 8 (decent work and economic growth), 14 (life below water), 15 (life on land) and 17 (partnership for the goals) had less than 10 ventures with an SDG match while there was a clear concentration on SDG 3 (good health and well-being), 4 (quality education), 9 (industry, innovation and infrastructure) and 12 (responsible consumption and production) out of which each contributed more than 10% to the total matches.

Of the 352 ventures above the threshold, 198 ventures (56%) had only one SDG match, 96 ventures (27%) had two SDG matches, 33 ventures (9%) had three matches, 18 ventures (5%) had four SDG matches and some isolated cases had even more SDG matches (the maximum was one case with 8 SDG matches). To better understand the patterns behind ventures that are active in multiple SDGs we examined the correlation between different goals. As we translated the absolute frequency of matches per SDG into a binary system (which only indicates SDG activity or non-activity) a suitable test statistic for nominal data had to be used. We used Chi² test (Kaplan 2004) that allowed us to analyze the relationship between individual pairs of SDGs. Therefore, we first analyzed the pairs and then aggregated the results for the

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136 pairs into a correlation matrix. For easier interpretation, we translated the Chi² values into corrected contingency coefficient ranging between 0 (low relationship) and 1 (strong relationship) (Kaplan 2014). By doing so, we could identify 40 significant correlations between SDGs (29 with $p < 0.01$ and an additional 11 with $p < 0.05$).

For example, the strongest correlation could be observed between SDG 4 (quality education) and SDG 10 (reduced inequalities) with 0.55 ($p < 0.01$). In our sample, this result can be explained with various initiatives that provide training/enablement for refugees to facilitate integration into Germany. Another strong relationship could be observed between SDG 2 (zero hunger) and SDG 12 (responsible consumption and production) with 0.45 ($p < 0.01$) that can be linked to various ventures that sell organic and/or healthy food. The correlation is based on our search string with keyword matches like food, farm*, fish* for nutrition (SDG 2) and sustainable, local, etc. for sustainable/conscious consumption (SDG 12). Table 5.3 provides an overview of all 40 identified correlations.

Table 5.3 Correlation matrix with corrected contingency coefficients for the reduced sample (threshold >1). Chi² test statistics between SDG pairs (n = 558; df = 1).

Matrix: Corrected contingency coefficients																	
	SDG 1: No poverty	SDG 2: Zero hunger	SDG 3: Good health & well-being	SDG 4: Quality education	SDG 5: Gender equality	SDG 6: Clean water & sanitation	SDG 7: Affordable & clean energy	SDG 8: Decent work & economic growth	SDG 9: Industry, innovation & infrastr.	SDG 10: Reduced inequalities	SDG 11: Sustainable cities & communities	SDG 12: Responsible consumpt. & product.	SDG 13: Climate action	SDG 14: Life below water	SDG 15: Life on land	SDG 16: Peace, justice & strong institutions	SDG 17: Partner-ships for the Goals
SDG 1	/	0,36**	0,04	0,18**	0,26**	0,01	0,03	0,26**	0,02	0,03	0,03	0,25**	0,02	0,01	0,01	0,01	0,01
SDG 2		/	0,23**	0,05	0,03	0,13*	0,00	0,03	0,15*	0,11	0,02	0,45**	0,12*	0,11	0,36**	0,06	0,02
SDG 3			/	0,00	0,08	0,17**	0,03	0,08	0,07	0,02	0,01	0,00	0,02	0,05	0,04	0,09	0,07
SDG 4				/	0,25**	0,09	0,08	0,25**	0,14*	0,55**	0,07	0,03	0,07	0,04	0,07	0,10	0,03
SDG 5					/	0,02	0,05	0,14*	0,05	0,34**	0,01	0,04	0,03	0,01	0,01	0,03	0,01
SDG 6						/	0,13*	0,02	0,09	0,04	0,03	0,19**	0,03	0,01	0,01	0,02	0,36**
SDG 7							/	0,05	0,23**	0,11	0,24**	0,31**	0,35**	0,03	0,10	0,06	0,14*
SDG 8								/	0,00	0,34**	0,06	0,02	0,03	0,01	0,01	0,03	0,01
SDG 9									/	0,19**	0,14*	0,12*	0,22**	0,02	0,06	0,06	0,05
SDG 10										/	0,13*	0,04	0,06	0,03	0,03	0,16**	0,02
SDG 11											/	0,17**	0,16**	0,03	0,09	0,13*	0,03
SDG 12												/	0,35**	0,05	0,25**	0,02	0,20**
SDG 13													/	0,02	0,02	0,03	0,01
SDG 14														/	0,44**	0,01	0,01
SDG 15															/	0,01	0,01
SDG 16																/	0,01
SDG 17																	/

****.** Significance level $p < 0.01$; *****. Significance level $p < 0.05$

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The results of our sample create some transparency about the SDG domains that German ventures are directly involved in and we can observe some patterns between SDGs. However, due to the earlier mentioned interdependencies, trade-offs and vaguely defined goals (United Nations 2017; Nilsson et al. 2016a; Costanza et al. 2016; Sachs et al. 2017) it is important to analyze the observed results more into detail to avoid premature conclusions.

5.6 Discussion – Four identified patterns of SDG activity can guide policy making

In the following section, we review our approach and discuss our results with regard to our two research questions (RQ1 & RQ2) on German SDG entrepreneurship.

(RQ1) *‘How can we map the SDG related activity of entrepreneurs in Germany?’*

(RQ2) *‘Which SDGs show high entrepreneurial activity in Germany and which SDGs remain unaddressed?’*

In addition to this, we explore the potential role of entrepreneurship for sustainable development to support future research and policymakers. In doing so, we discuss the role of entrepreneurship along discussion questions to outline how far entrepreneurship in Germany can address the SDGs and contribute to their achievement (DQ1). Building on this, we explore important levers to improve the contribution of entrepreneurship in Germany (DQ2):

(DQ1) *‘Can all SDGs be addressed by entrepreneurs?’*

(DQ2) *‘What can be done to optimize the activity of entrepreneurship along the 17 SDGs?’*

1.1. **RQ1:** *How can we map the SDG related activity of entrepreneurs in Germany?*

Response: *Based on freely available web-material, semi-automated content analysis provides a scalable approach to map entrepreneurial activities along the 17 SDGs.*

In general, there are two potential data sources to measure the SDG related activity of new ventures. One can either interview/ survey the entrepreneurs and their stakeholders or one can rely on written materials like websites or third-party reports. In the first case, it is possible to obtain high-quality primary data, but it can be challenging to obtain a large, representative sample due to low response rates of entrepreneurs and intentional or subconscious biases towards a single SDG (Albino et al. 2009). In the second case, it is also possible to obtain primary data (i.e., information entrepreneurs decide to publish on their website) and secondary data (i.e., third-party reports on the venture, e.g., from an award jury). With the second option, there is no risk to obtain low response rates, and it is possible to collect different perspectives on one venture. However, source quality and source length can vary strongly between websites and reports. This includes the before mentioned risk for biased information towards a certain SDG, but the bias is considered to be weaker compared to the first case (Albino et al. 2009).

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Comparing both options, the second option stands out as the more scalable option. It allows to create a larger and more diverse sample and in combination with filter criteria (e.g., only ventures that were rewarded in a venture competition), it is possible to exclude immature ideas and ventures. Therefore, this option is more suitable to identify patterns of SDG related entrepreneurship on a large scale (e.g., for Germany). Natural downsides are the level of detail per venture, which is generally lower than in interviews or surveys, as well as a potential self-selection bias of ventures that take part in competitions. Scaling the approach to different geographical regions is possible but requires adjusting the coding scheme to specific cultural and language contexts.

The scalable approach creates a large set of data, and it is important to understand the inherent limitations of these data. As mentioned in the methodology section we analyzed the data with a semi-automated content analysis using search strings of keywords in atlas.ti. This means atlas.ti scanned source documents automatically for relevant German and English keywords, and the authors collectively reviewed the allocations to discount false matches. The central element of this approach is the selection of suitable keywords for each of the 17 SDG. As we discussed before the goals contain numerous interdependencies, trade-offs and they are vaguely defined goals (United Nations 2017; Nilsson et al. 2016a; Costanza et al. 2016; Sachs et al. 2017). This complicates a highly selective coding for related SDGs like SDG 5 (gender equality) and SDG 10 (reduced inequalities), and it makes it impossible to code highly selective search strings for each of the 169 sub-targets that make up the 17 SDGs. Accordingly, when our search string classifies a venture as a contributor to a certain SDG it is likely that only certain sub-targets of an SDG are actually addressed. Transferring this thought to our entire sample we expect that certain sub-targets in each SDG remain unaddressed even though the SDG itself is addressed. The specific pattern of addressed sub-targets should reflect the specific development needs of Germany with its specific social, economic and ecological conditions. For instance, in Germany, the eradication of hunger (SDG 2 – zero hunger) is not a major concern whereas obesity and malnutrition are serious problems mentioned (Sachs et al. 2017). Accordingly, we must interpret the observed patterns for the 17 SDGs in combination with background knowledge on Germany to draw valid conclusions with our methodology on a more detailed level.

*1.2. **RQ2:** Which SDGs show high entrepreneurial activity in Germany and which SDGs remain unaddressed*

Response: *Entrepreneurs do not address all SDGs equally, there is strong direct engagement around SDG 9 (industry, innovation & infrastructure), SDG 3 (good health and well-being) and SDG 12 (responsible consumption and production) and on the other end of the spectrum we find SDG 1 (no poverty) and SDG 17 (partnership for the goals) with little-observed activity.*

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In order to discuss the entrepreneurial contribution to SDGs in more depth, we relate the found activity to the national context, specifically the national German SDG performance (see figure 5.2). In our research, we follow the assumption that venture activity in an SDG is an indicator for future progress towards achieving the SDG. This assumption is not blind to the fact that many ventures in our sample might not be game changers with regard to sustainable development and some might actually create negative effects - considering, for example, the discussions about the rebound effect (Figge, Hahn 2004; Bocken, Short 2016). However, the absence of entrepreneurial activity in an SDG domain shows clearly that entrepreneurs do not find suitable opportunities to directly affect an SDG, regardless of the specific impact. In absence of active entrepreneurs in an SDG domain, we cannot expect many innovative solutions from the private sector for sustainable development – something that the 2030 agenda calls for (General Assembly 2015). Therefore, we consider the frequency of entrepreneurial activity in an SDG domain a prerequisite for progress and a valid, but not an exhaustive indicator. It is not an exhaustive indicator because it requires interpretation with regard to the specific national conditions and the various interdependencies between the goals.



Figure 5.2 Comparison of national SDG performance (color coding based on Sachs et al. 2017) and entrepreneurial SDG activity in Germany (color code based on the difference to mean – i.e., Green ≥ 71 ; Yellow 70-36; orange 36-18; red < 18)

Patterns of national SDG performance & entrepreneurial activity: Applying this thought we contrast our results for entrepreneurship in Germany with the national SDG dashboard (figure 5.2), which aggregates the national SDG performance by aggregating available indicators (see Sachs et al. 2017). The findings of this comparison are best illustrated in a matrix with, first entrepreneurial activity and second national SDG performance (figure 5.3). The matrix supports the synthesis and development of patterns and targeted policy recommendations.

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The simplified matrix shows four patterns of SDGs (figure 5.3). We have two categories where national performance and entrepreneurial activity are consistent (i.e., both dimensions are high or low). In the top right corner, we find those SDGs with consistent high national SDG performance and high entrepreneurial activity for SDGs 3, 4, 9, 10 and 11 - pattern 'maintain'. In the low left corner SDGs with low national SDG performance and low entrepreneurial activities for SDGs 5, 13, 14, 15, 16, 17 - pattern 'boost'. If both indicators show high performance, the correlation suggests that entrepreneurs are active in relevant SDG domains, while weak performance in both indicators suggests low societal SDG performance and no relevant entrepreneurial activities.

The remaining two quadrants indicate contradictory results, where national SDG performance and entrepreneurial activity do not go in the same direction. In the top left corner we have high SDG performance in Germany but low entrepreneurial activity for SDGs 1, 6 and 8 - pattern 'encourage'). In the low right quadrant, we have low national SDG performance and high entrepreneurial activity for SDGs 2, 7 and 12- pattern 'scale'.

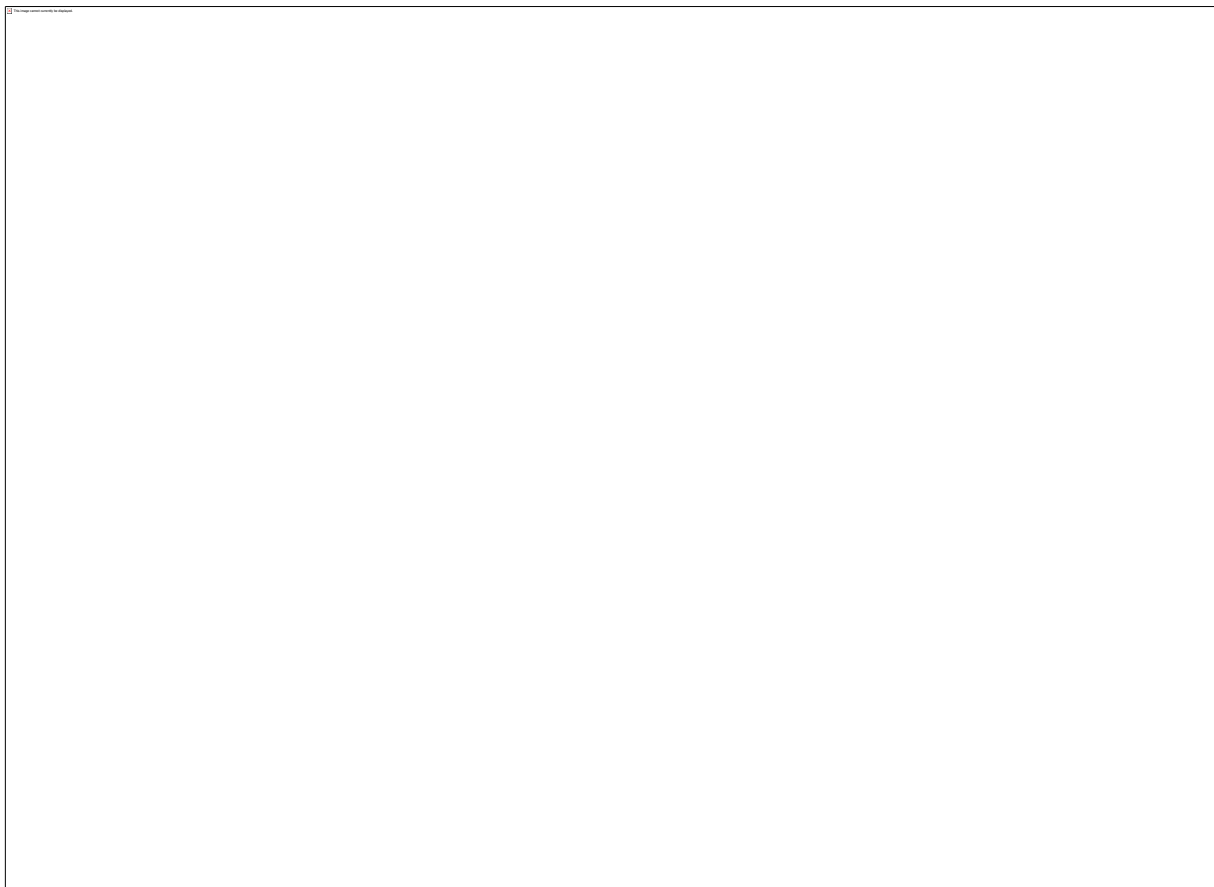


Figure 5.3 Matrix: Plotting SDGs according to national SDG performance and mapped entrepreneurial activity (national performance scores were distributed within their color category according to their scores in Sachs et al. 2017, entrepreneurial activity according to their difference to the mean; SDG logos edited from <https://sustainabledevelopment.un.org/>)

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Interdependencies: The observed patterns represent the direct entrepreneurial activities, but they neglect indirect effects. If we take the eradication of poverty (SDG 1) as an example, we have an SDG with low entrepreneurial activity, but high national performance. The underlying reason for this contradiction can be found in the applied macro-economic indicators that capture progress on a national level for SDG 1. Progress is measured with indicators like the poverty headcount ratio or the population with an income below 50% of the median disposable income (Sachs et al. 2017). Such indicators cannot directly be addressed by new ventures. However, ventures can indirectly fight the causes of poverty like a lack of education (SDG 4) or weak economies (SDG 9). Accordingly, we can assume that entrepreneurs primarily contribute indirectly to SDG 1 via other SDGs like SDG 4 and 9. Generalizing this thought, we assume that there are SDGs where there are little opportunities for entrepreneurs to directly contribute (see discussion question 1).

The various indirect activities to different SDGs highlight an important limitation of our approach: we can only map direct activities to an SDG with our search strings. Indirect effects are something we have to theorize about. This leads to our first discussion question whether all SDGs can be addressed with entrepreneurship?

1.3. **DQ1:** *Can all SDGs be addressed by entrepreneurs?*

Response: *Entrepreneurship can indirectly address all SDGs to some extent but we observe the biggest activity for SDG 3 (good health and well-being), 9 (industry, innovation, and infrastructure) and 12 (responsible consumption and production)*

Discussing entrepreneurial contributions to sustainable development we naturally move to the field of sustainable entrepreneurship that deals with the: “*recognition, development, and exploitation of opportunities by individuals to bring into existence future goods and services with economic, social and ecological gains*” (Belz, Binder 2017, p. 2). The focus of sustainable entrepreneurs lies on the development of opportunities independent of a limited set of legal entities or classical profit-oriented business models (Bocken et al. 2014). Instead, they deal with the recognition, development, and exploitation of opportunities in the entire spectrum of profit and non-profit organizations.

Considering the wide range of potential business models (Bocken et al. 2014; Pacheco et al. 2010) it is certainly possible to find entrepreneurial examples for all SDGs. However, our analysis reveals that certain SDGs are rarely addressed by entrepreneurs although national performance generates a visible need (pattern ‘boost’). Explaining this pattern, we offer two principal reasons: (1) many SDGs are addressed indirectly and (2) some SDGs are not suitable and/or attractive to be addressed by entrepreneurs. Moreover, we find SDGs with strong entrepreneurial activity, but low national performance (pattern ‘scale’), which we attribute to (3) missing scale of entrepreneurial activities and/or ineffective entrepreneurial activities that lead to low impact.

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(1) The previous discussions already showed that progress in some SDGs is tied to progress in other SDGs. SDG 13 (climate action) (Pattern 'boost') is arguably one of the best examples for strong interdependency with other SDGs. The key indicator of progress is CO₂ emissions. This means progress is linked to all energy consuming elements of society in our fossil fuel dependent societies. Accordingly, progress requires countless actions across the entire spectrum of SDGs. For instance, progress needs a wide range of technological innovation (SDG 9) – most importantly new sources of energy (SDG 10), we have to change the way we produce food (SDG 2) and we have to change the way we live and consume (SDG 11 and 12) and to enable all those things we need suitable education (SDG 4). We conclude that especially SDG 1 (no poverty), 8 (decent work and economic growth), 13 (climate action), 14 (life below water) and 15 (life on land) depend strongly on progress on other SDGs, but we must emphasize that more detailed assessments of interactions are necessary to draw reliable conclusions (Nilsson et al. 2016b).

(2) Despite the indirect and aggregated effects of entrepreneurs, some goals are less suitable for meaningful entrepreneurial contributions, most notably SDG 17 (partnership for the goals) (pattern 'boost'). Sachs et al. (2017) measure progress via government spending on health and education, tax revenues or the national financial secrecy score. The selected indicators depend primarily on the government with little room for independent entrepreneurial solutions. Similarly, SDG 16 (peace, justice, and strong institutions) (Pattern 'boost') depends largely on governmental action to improve indicators in the field of public safety, property rights or corruption. Even though there are examples like Parlamentwatch e.V. with their activities around transparent and accountable institutions or Mein Notruf GmbH in the field of public safety, the scope for entrepreneurship is limited (Parlamentwatch e.V. 2018; Mein-Notruf GmbH 2018)¹⁷.

(3) Identifying active entrepreneurs along the 17 SDGs, we cannot draw causal conclusions on the scale and potential impact of ventures. Therefore, a strong entrepreneurial activity does not automatically mean strong SDG contribution of ventures and it should not be mistaken as a causal driver for strong national performance. Nevertheless, strong entrepreneurial activity is an important prerequisite and driver for entrepreneurial contribution, especially with regard to future developments in an industry (Bidmon, Knab 2018; Hockerts, Wüstenhagen 2010). SDG 7 (affordable and clean energy) constitutes a good example of the lack of scale/impact despite strong entrepreneurial activity today. For meaningful performance on a national level, these SDGs require a system transition (Loorbach, Wijsman 2013). For the SDG 7 (affordable and clean energy) sub-level indicator "*share of national renewable energy in total final energy consumption*" (Sachs et al. 2017) this means that effective clean energy ventures obtain a

¹⁷ The stated examples are not part of our sample. They were only selected to exemplify the situation.

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dominant market share. This requires massive structural changes as part of the long-term transformation of the German energy system, the so-called “*Energiewende*”. Consequently, we can assume that today’s entrepreneurial activities can improve national performance only where structural circumstances allow effective clean energy ventures to scale-up and gain meaningful market shares. This requires strong political involvement, and it leads to a time lag between entrepreneurial activities and measurable performance improvements.

1.4. DQ2: Which SDGs show high entrepreneurial activity in Germany and which SDGs remain unaddressed?

Response: *Awareness building and a focus on synergies between goals can increase entrepreneurial activity along the SDGs; to increase the scale and impact of entrepreneurial activities on the SDGs more complex transition management measures are necessary that allow ventures to obtain meaningful market shares.*

After discussing the four patterns of SDGs, we want to end our discussion with hypotheses on how to optimize the activity and potential contribution of entrepreneurship along the 17 SDGs. It is out of scope for this paper to provide a detailed approach to eradicate all barriers that prevent a stronger role of entrepreneurs in all SDGs, and it is unlikely that all barriers can be removed. However, we identified certain levers that can contribute to more entrepreneurial action for sustainable development. Those levers specifically target SDGs in the patterns ‘boost’ and ‘scale’ as the national performance for these SDGs is low what makes a contribution from entrepreneurship more relevant. We see a two-step path to improve the contribution, first improving the activity by better recognition (move from pattern ‘boost’ to ‘scale’) and second, optimizing the impact of entrepreneurial activities (move from pattern ‘scale’ to ‘maintain’).

Better recognition (move ‘boost’ to ‘scale’): Boosting entrepreneurial activity can be achieved by various means. One suitable lever can be derived from Patzelt and Shepherd (2011), who argue that entrepreneurs can be mobilized with knowledge on sustainability and an understanding of the related dangers (Patzelt, Shepherd 2011). Assuming their model is correct the entrepreneurial activity related to the SDGs depends largely on the entrepreneur’s available knowledge and awareness with regard to the different SDGs together with a minimum level of entrepreneurial know-how. Accordingly, we expect awareness building to be the most relevant lever to enhance entrepreneurial action for SDGs in pattern ‘boost’ and to improve the opportunity recognition and hence the entrepreneurial activity for SDGs in pattern ‘boost’ (see figure 5.4). For example, growing awareness of plastic in the ocean through media and campaigns leads to many new ideas for both entrepreneurs collecting plastic waste and existing ventures reducing plastic use in their products (see e.g., Boyd 2017).

In addition, we observed that only 27% of all sample ventures are active in more than one SDG (based on the threshold of >1 discussed before). Nevertheless, we identified a significant

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correlation between SDGs indicating that show that some ventures are active in multiple SDGs (see table 5.3). The identified SDG combinations could be used to raise awareness (and potentially scale) for SDGs with low entrepreneurial activity. For instance, we identified a significant correlation of 0.35 ($p < 0.01$) between SDG 12 (responsible consumption and production) with strong entrepreneurial activity and SDG 13 (climate action) low entrepreneurial activity. This correlation should be exploited more to increase entrepreneurial activity for SDG 13 by raising awareness among entrepreneurs currently active in SDG 12 for potential synergies. Such synergies can provide important shared value opportunities (see Porter and Kramer 2011). A practical example of such synergies is the organic food industry. Many ventures currently focus on organic production, but not necessarily on regional and seasonal sourcing (with lower CO₂ emissions). Accordingly, they underuse the opportunity to climate action (SDG 13).

More such synergies between SDGs should be exploited. Our identified correlations can constitute a starting point for future research on SDG synergies, tailored policies, and ventures addressing multiple SDGs.

Improve impact (move 'scale' to 'maintain'): Our study does not respond to the important research gap of quantifying and weighing the impact of new ventures along the 17 SDGs. We merely map venture activities and take frequency of activity as an indicator of potential impact. Thus, our study identifies SDGs in pattern 'scale' (and shifted SDGs from pattern 'boost') as those with a need for further research on how to improve the scale and impact of ventures.

Our coding scheme for the identification of SDG patterns could be refined and extended in future research in an attempt to map the activities of entrepreneurs in more detail (e.g., on the level of the 169 SDG sub-targets). To improve scale and impact of ventures, future research should build on the established body of literature on success factors for new ventures (Song et al. 2008; Pacheco et al. 2010; Ardichvili et al. 2003; Cohen, Winn 2007) that highlights the complex interplay of endogenous (e.g., industry experience, patent, financial resources) and exogenous variables (e.g., market structures, level of competition, institutional settings) to explain venture success. On top of this policy, researchers should place special importance on the larger context of transition management and the related structural changes to enable the success of sustainable business models (Bidmon, Knab 2018; Loorbach, Wijsman 2013). The previously discussed correlations between SDGs can not only help to boost entrepreneurial activity, but they can also support scaling efforts. Correlations between SDGs should be considered to efficiently improve the national SDG performance through entrepreneurs that are active in multiple SDGs. Continuing the previous practical example of SDG 12 and 13, scaling regional and seasonal organic food production and not only organic food production would avoid trade-offs for consumers and policymakers as well as the emergence of path dependent, less sustainable business models.

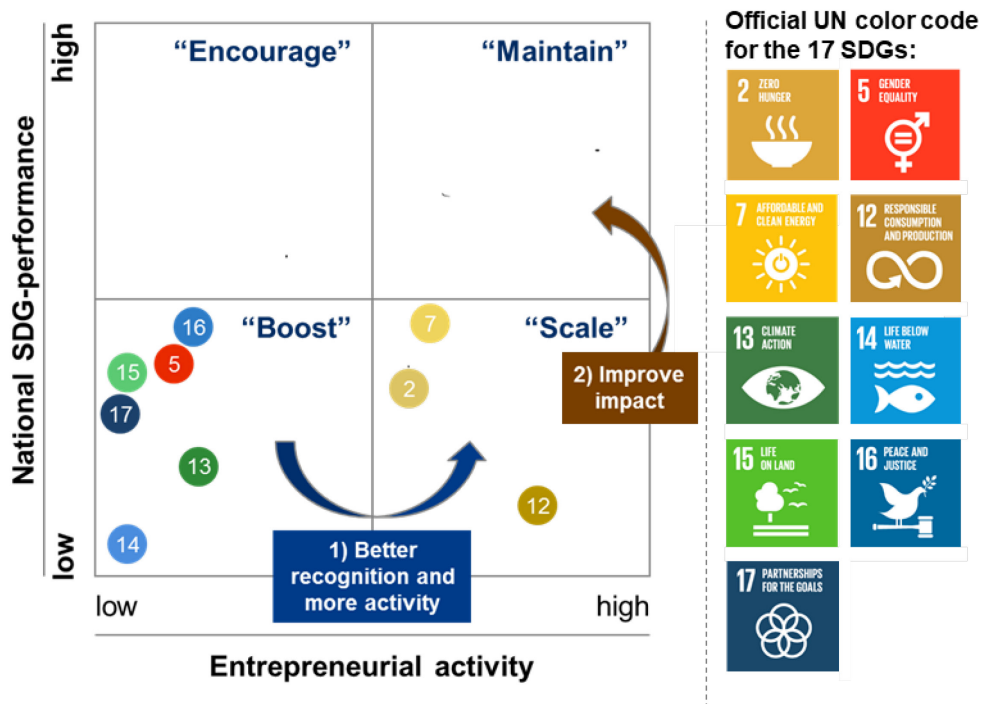


Figure 5.4 Improvement path – Boost awareness for SDGs with low entrepreneurial activity and develop measures to scale activities in areas with low national SDG performance (SDG logos edited from <https://sustainabledevelopment.un.org/>)

5.7 Limitations

Potential limitations caused by the selected research approach and the used methodology of semi-automated coding were discussed throughout the paper. Main challenges are related to the sample selection, the development of the coding scheme and the coding process. The focus on venture competitions causes risks to exclude certain new ventures, but the successful participation in competitions also constitutes a quality filter for immature ideas, and it provides a source for third-party information on the venture. Deductively defining and applying a coding scheme in a semi-automated process does not capture all potential SDGs and their sub-targets. However, piloting and iteratively improving the coding scheme as well as defining clear coding rules for the SDGs allows a consistent mapping process for our sample size. Additionally, the use of semi-automated coding allows researchers to discard wrong matches due to context or language errors that would occur in a fully automated process.

It is our hope that pointing out and discussing the strengths and the limitations of our research approach can avert the risk to draw wrong conclusions allowing the reader to get the most valuable insights from the given information.

5.8 Conclusion

In this study, we assessed to what extent entrepreneurship in Germany shows activity related to the SDGs. We examined a total of 193 venture competitions in Germany, collected data on a total of 588 rewarded ventures and used semi-automated content analysis to allocate those ventures based on their activities to the main 17 SDG goals. With our explorative study, we contributed to theory with the development of a scalable and repeatable approach to map SDG related activity of new ventures. Moreover, we contributed to practice by providing a detailed analysis of Germany's entrepreneurship landscape along the 17 SDGs.

We found a very heterogeneous distribution of entrepreneurial activities along the SDGs that we contrasted with the national overall performance of German ventures (figure 5.2 & 5.3). To derive policy conclusions, we plotted the SDGs in a matrix of entrepreneurial activity and national SDG performance. This yielded four simplified patterns. Pattern 'encourage' shows high national SDG performance, but low entrepreneurial activity (SDG 1: no poverty, SDG 6: clean water and sanitation) and SDG 8: decent work and economic growth), whereas pattern 'maintain' shows high national performance and high entrepreneurial activity (SDG 3: good health and well-being, SDG 4: quality education SDG 9: industry, innovation, and infrastructure, SDG 10: reduced inequalities and SDG 11: sustainable cities and communities). Given the overall good performance on the national level, both patterns indicate a low need for policy interventions to achieve the SDGs.

The need for action is different for patterns 'boost' and 'scale'. Pattern 'boost' indicates low national SDG performance and low entrepreneurial activity (SDG 5: gender equality, SDG 13: climate action, SDG 14: live below water, SDG 15: live on land, SDG 16: peace, justice and strong institutions, SDG 17: partnership for the goals), pattern 'scale' indicates low national SDG performance but high entrepreneurial activity (SDG 2: zero hunger, SDG 7: affordable and clean energy and SDG 12: responsible consumption and production). In both cases, the low national performance highlights the need to act. Therefore, entrepreneurship should be used as a potential lever for the structural changes necessary to improve the low national performance. For pattern 'boost' this means to design policies that create awareness of the problem among potential entrepreneurs together with improved entrepreneurship education. These measures can shift the SDGs in pattern 'boost' to 'scale'. The most critical step is to increase the impact of entrepreneurs in pattern 'scale' to lift them to the pattern 'maintain'. Obviously, entrepreneurs are only one actor in a complex societal interplay that aims for system change to sustainability. Nevertheless, entrepreneurs can play a central role in transition management (Bidmon, Knab 2018; Hockerts, Wüstenhagen 2010). Therefore, policymakers and researchers should focus specifically on entrepreneurs active in pattern 'scale'. This means we must identify and remove institutional and structural barriers for

entrepreneurs in pattern 'scale' and support them to grow. Only then entrepreneurship can truly play its part as a contributor to sustainable development.

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5.10 Appendix

Coding scheme:

SDG	Selected keywords (German and English)
SDG 1: No poverty	Armut "ärm*" Sozialsystem Sozialschutzsystem Grundsicherung Mikrofinanz* Basisschutz "arm*" poverty poor social protection system microfinanc* basic income basic provision basic social security
SDG 2: Zero hunger	Hunger Nahrung* nachhaltige Landwirtschaft Landwirtschaft Agrar* Saat* *Ernährung "essen*" "Bauer*" Kleinbauer Übergewicht* Fehlernähr* Adipositas Adipös Fettleibigkeit Obesitas food algricult* hunger farm* *nutrition sustainable farm* pastoralist fisher seed cultivat* domesticate livestock obesity overweight obese "eat*"
SDG 3: Good health & well-being	Gesund* Wohlergehen Müttersterb* Kindersterb* Epidem* Krankheit* Frühsterblich* Impf* Lebendgeburt* Neugeb* Arznei* Medikament* Medizin* Todes* Aids* Tuberkulose* Malaria* Behandl* "Sucht*" "Drogen*" Verletz* Lebenserwartung* Sterblichkeit Unfalltot* sex* Hygiene sauber* Ärzt* Arzt Doktor Patient Praxis Betreuung behind* Therapie Wohlbefinden Lebensqualität Pflege health diseases* medicin* mortal* birth* death* vaccine* well-being newborn neonatal mortality epidemics aids tuberculosis malaria narcotic* drug* injur* accident reproductive illness* hygien* life expectancy Doctor Therapy pharma* "Care" Handicap disab*
SDG 4: Quality education	*Bildung *bilden Qualifi* *schul* Analphabet* Schüler* lernen Unterricht* student Lehr* educat* vocation* training school literacy illiterate pupil teach* learn
SDG 5: Gender equality	Geschlechterg* Chanceng* Selbstbestimm* Diskrimi* Menschenhandel Verhütung* Gleichstellung* Mädchen Diversit* Kinderheirat Zwangsheirat Zwangsehe Genitalverstü* Beschneidung Gender Pay Gap Gender Wage Gap equality gender empowerment self-determine* discriminat* trafficking forced marriage genital mutilation circumcision child marriage Gender Pay Gap Gender Wage Gap emancipat* Emanz* Frau* Woman Women Girls

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SDG 6: Clean water & sanitation	Sauberes Wasser Sanitär* Wasserknapp* Wassernutz* Trinkwasser Notdurftverrichtung* Wasserqualität Abwasser Wasserressourcen Grundwasser Frischwasser WC clean water water usage water scarcity water quality water reuse water recycling water resources sanitation wastewater open defecation freshwater water-related wetland aquifer water efficiency water harvesting desalinat* toilette toilet
SDG 7: Affordable & clean energy	Energie* Erneuerbare Energie Energiewende Brennstoff* Strom* Windturbine Photovoltaik* Solar* Biogas* PV*Anlage Batterie* clean energy green energy modern energy renewable energy sustainable energy photovoltaic wind turbine solar biogas energy efficiency clean fossil-fuel energy infrastructure energy technology energy storage power supply energy grid power grid
SDG 8: Decent work & economic growth	Kinderarbeit Vollbeschäftigung Wirtschaftswachstum Bruttoinlandsprodukt* Arbeitspl* menschenwürdig* nachhaltiges Wachstum Zwangsarbeit Sklaverei Menschenhandel Kindersoldat* Arbeitsrecht* Wanderarbeit* prekär* Beschäftig* nachhaltiger Tourismus Arbeitslos* Arbeitsbeschaffung* *employ* labor labour economic growth gross domestic product economic productivity job creation sustainable growth job decent work slavery child soldiers sustainable tourism working environment worker
SDG 9: Industry, innovation & infrastructure	Infrastruktur* Industrialisierung Technologieentwicklung Technologieförderung Forschung* Internetzugang verkehr industrie 4.0 "Fahr* Mobilität Logistik* Industrie 4 künstliche Intelligenz maschinelles lernen infrastructure industrialisation industrialization research technology transfer technology support technology development access to internet internet access development spending R&D smart traffic transport digital* IoT internet of things industry 4.0 automat* augmented reality virtual reality driv* vehicle* "Mobility logistic* industry 4 machine learning artificial intelligence
SDG 10: Reduced inequalities	Ungleichheit* Einkommenswachstum Selbstbestimm* Inklusion Geschlechterg* Chanceng* Diskrimi* Lohnungleichheit* Arm und Reich Lohnunterschied* Entwicklungsl* Migration* Flüchtling Flucht Teilhabe Partizipation barrierefrei* Behinder* Diversit* flücht* Rollstuhl inequalit* unequal* income growth inclusion discriminat* equality poor and rich developing countr* migration inclusive refugee Disabilit* Wheelchair
SDG 11: Sustainable cities & communities	Nachhaltige Städte Nachhaltige Stadt Nachhaltige Gemeind* Gemeinde* Wohnraum Slum* *Verkehr* öffentlicher Nahverkehr ÖPNV Verstädterung Siedlung* Weltkulturerbe Weltnaturerbe Gentrifizier* komunal* Naturkatastrophen nachhaltiges Bauen nachhaltiges Baumaterial* nachhaltige Baumaterial* stadt städte kommun* städti* Elektro* Mobilität Logistik* sustainable cit* sustainable communit* public transport traffic settlement slum sustainable transport affordable transport safe transport accessible transport housing urbanization urbanization public space green space safe space disaster sustainable building building sustainable construction cultural heritage natural heritage city cities communit* electr* "Mobility logistic*

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SDG 12: Responsible consumption & production	Konsum* nachhaltige Produktion Produktionsmuster Ressourceneinsatz Ressourcennutz* Ressourcenproduk* Abfall* Abfälle Nahrungsmittelverschwendung Nahrungsmittelverluste Nachernteverluste Kreislaufwirtschaft Wiederverwendung Wiederverwertung Elektroschrott nachhaltiger Einkauf nachhaltiger Tourismus nachhaltig* umweltfreund* Recycling Recyc* E*waste sustainable production sustainable consumption consumption resource efficiency food waste food loss* post-harvest loss* circular economy circular business recycling waste reuse sustainable procurement sustainable tourism e*waste fair trade sustain* eco-friendly environmentally friendly share sharing organic "bio*" ecological
SDG 13: Climate action	Klimawandel* Klimaschutz* CO2 Treibhausgas* klimabedingt klimafolge* Klimaanpassung* Klimaauswirk* Emission* climate change climate action climate mitigation climate adaptation CO2 greenhouse gas climate related Emission
SDG 14: Life below water	Ozean* Meeresressource* Fischerei* Überfisch* Küstenökosystem* Fischbestand Fischbestände Aquakultur* Meerestechnolog* Kleinfischer marine ocean* fishing fisheries coastal overfishing aquaculture fish
SDG 15: Life on land	Bodendegradation Landökosysteme Desertifikation Wald* Artenvielfalt Wälder Wüstenbild* *aufforst* Wilderei Entwald* Biodiversität ökologische Vielfalt biologische Vielfalt bedrohte Arten Aussterben Neobiota invasive Arten invasive* gebietsfremde* Art* Ökosystemdiversität Flächenversiegel* Erosion biodiversity forest* desertificat* poach* reforest* terrestrial ecosystem* renaturation* natural habitat* extinction threatened species wildlife invasive species alien species eradicat* non-indigenous species impervious surface
SDG 16: Peace, justice & strong institutions	Friede* Gewalt* Justiz* Krimin* Rechtsstart* Waffen* Korruption Bestechung Kleptokrat* Völkerrecht* Menschenrecht* Mord* Verbrechen* leistungsfähige Institutionen rechenschaftspflichtige Institutionen inklusive Institutionen Sicher* justice peace violence "war" effective institution* accountable institution* inclusive institution* "crime" "criminal" judici* torture rule of law weapon illicit corrupt* brib* transparent institutions human rights international law kleptocracy participat* Secur*
SDG 17: Partnerships for the Goals	Entwicklungshilfe* Entwicklungszusammenarbeit* Nord-Süd-Zusammenarbeit Süd-Süd-Zusammenarbeit Dreieckskooperation* Leapfrog* Technologietransf* Kapazitätsaufbau* Capacity Building fairer Welthandel gerechter Welthandel Handelsbarriere* Protektionismus development aid development assistance development cooperation foreign aid capacity building north-south "ODA" official development assistance least developed countr* south-south triangular cooperation technology transfer technology facilitation leapfrog* fair trade trade barriers

6. Article 4: Modeling entrepreneurial opportunities for the rapid diffusion of sustainable venture ideas

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Modeling entrepreneurial opportunities for the rapid diffusion of sustainable venture ideas

Jannic Horne

Keywords: Entrepreneurship; Opportunity; Business Model; Innovation; Diffusion; Sustainability;

JEL Classification: L26, O33, Q01,

6.1 Abstract

This conceptual paper studies how entrepreneurs can contribute most strongly to sustainable development. Based on research on the sustainability transition, entrepreneurial opportunity and evolutionary economics a conceptual model is developed that first explains under which circumstances entrepreneurs decide to start a venture, second, it explains how the underlying new venture idea can be diffused, and third, it explains the role of sustainability considerations in this process. The model has two parts. The first part of the model explains that venture creation depends on an entrepreneur's opportunity confidence in a new venture idea under consideration of existing external enablers (Davidsson, 2015) and internal enablers. The second part of the model explains the diffusion of the venture idea along one of four diffusion pathways – 'growth', 'replication', 'M&A¹⁸' and 'mimicry' (Schaltegger, Lüdeke-Freund, & Hansen, 2016). This second part is influenced by the characteristics of the new venture idea, external enablers and the internal enablers of the newly created venture. During the process

¹⁸ Merger & acquisition

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sustainability considerations are only relevant if sustainability is central to the new venture idea, external enablers incentivize sustainability and/or entrepreneurs are intrinsically motivated to contribute to sustainable development. The model is illustrated with case studies from the mobility sector.

To show the application of the model in management and policy-making, it is used to explain the best conditions for rapid growth based diffusion of sustainable new venture ideas. The adapted model shows that rapid international growth is most suitable for externally enabled venture ideas that build on knowledge-intensive products/services that can be delivered at low cost to a globally dispersed and contested niche of customers through modern technologies and an effective international network. When these conditions do not apply less direct pathways for the diffusion (i.e., 'replication', 'M&A' and 'mimicry') might be more beneficial to rapidly diffuse a sustainable new venture idea.

6.2 Introduction

Creative destruction for sustainability or the "*Panacea Hypothesis*" (Hall, Daneke, & Lenox, 2010):

"A number of recent papers have evoked Schumpeter's (Schumpeter, 1942) concept of 'creative destruction,' arguing that new sustainability pressures create various types of market failure, opening up opportunities for new entrants ((Cohen & Winn, 2007); (Hall & Vredenburg, 2003); (Hart & Milstein, 1999); (Hart & Christensen, 2002); Senge, Carstedt, & (None), 2001). These authors identify entrepreneurship as a means by which market failures such as environmental and social disruptions can be ameliorated." (Hall, Daneke, & Lenox, 2010: 441).

Since Hall et al. (2010) wrote this paragraph, the literature on sustainable entrepreneurship as a driver for sustainable development has grown significantly (e.g., Bidmon & Knab, 2018; Bocken, Short, Rana, & Evans, 2014; Gast, Gundolf, & Cesinger, 2017; Schaltegger, Lüdeke-Freund, & Hansen, 2016). Much of this research supports the underlying hope that entrepreneurs can play a central role in the creation and rapid diffusion of innovation that can advance sustainable development. That this sustainable development is urgently needed is widely agreed (Brundtland Commission, 1987; General Assembly, 2015; Griggs et al., 2013; Rockström et al., 2009; Steffen et al., 2015). However, it remains unclear whether sustainable entrepreneurship can actually serve as this 'panacea', how it can do so and what its limits are. There is already a wide range of research that investigates this topic theoretically or through case studies (e.g., Belz & Binder, 2017; Bidmon & Knab, 2018; Boons, Montalvo, Quist, & Wagner, 2013; Hall, Daneke, & Lenox, 2010; Hockerts & Wüstenhagen, 2010; Schaltegger, Lüdeke-Freund, & Hansen, 2016), but to the author's knowledge there is no holistic model that explains how sustainable ventures are created and their ideas are diffused. To fill this gap

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existing research is extended and integrated into one model, which makes this paper a conceptual contribution (Gilson & Goldberg, 2015) that offers theoretical insights into the what, how and why of sustainable venture creation and venture idea diffusion (see figure 6.1). The model allows managers and policymakers to better understand the necessary circumstances to make entrepreneurship the initially quoted 'panacea' for sustainable development.

The questions that guide this research can be split into three research questions (RQ):

RQ1: Under which circumstances do entrepreneurs create ventures that contribute to sustainable development?

RQ2: Under which circumstances are the underlying venture ideas diffused rapidly?

RQ3: What role play sustainability considerations in the process?

To answer these questions this article brings together literature on the sustainability transition, entrepreneurial opportunity, sustainable entrepreneurship, and international entrepreneurship (see figure 6.1). Initially, the multi-level perspective (Geels, 2002; Bidmon & Knab, 2018) and literature on sustainable entrepreneurship are used to clarify the terminology of this article and describe the dynamic processes through which innovation can change the unsustainable status quo. Building on this, Davidsson's re-conceptualization of the opportunity construct (Davidsson, 2015) is used to develop the first part of the conceptual model that responds to RQ1 and describes how entrepreneurs identify and create ventures that can change the unsustainable status quo. Then the second part of the model is developed to answer RQ2 and describe how entrepreneurs can diffuse their new venture ideas through 'growth', 'replication', 'M&A' or 'mimicry' (Schaltegger, Lüdeke-Freund, & Hansen, 2016). To illustrate how the proposed model explains the creation and diffusion of new sustainable venture ideas four case studies from the mobility sector are presented.

Responding to the notion of 'rapid' diffusion in RQ2, the model is adapted to assess under which circumstances sustainable new venture ideas can be diffused rapidly through entrepreneurs. Therefore literature on international entrepreneurship and rapid internationalization is used to model the conditions for rapid international 'growth'.

Finally, the article responds to RQ3 and discusses the role of sustainability consideration in the process. Closing, key findings are summarized and future research opportunities are presented.

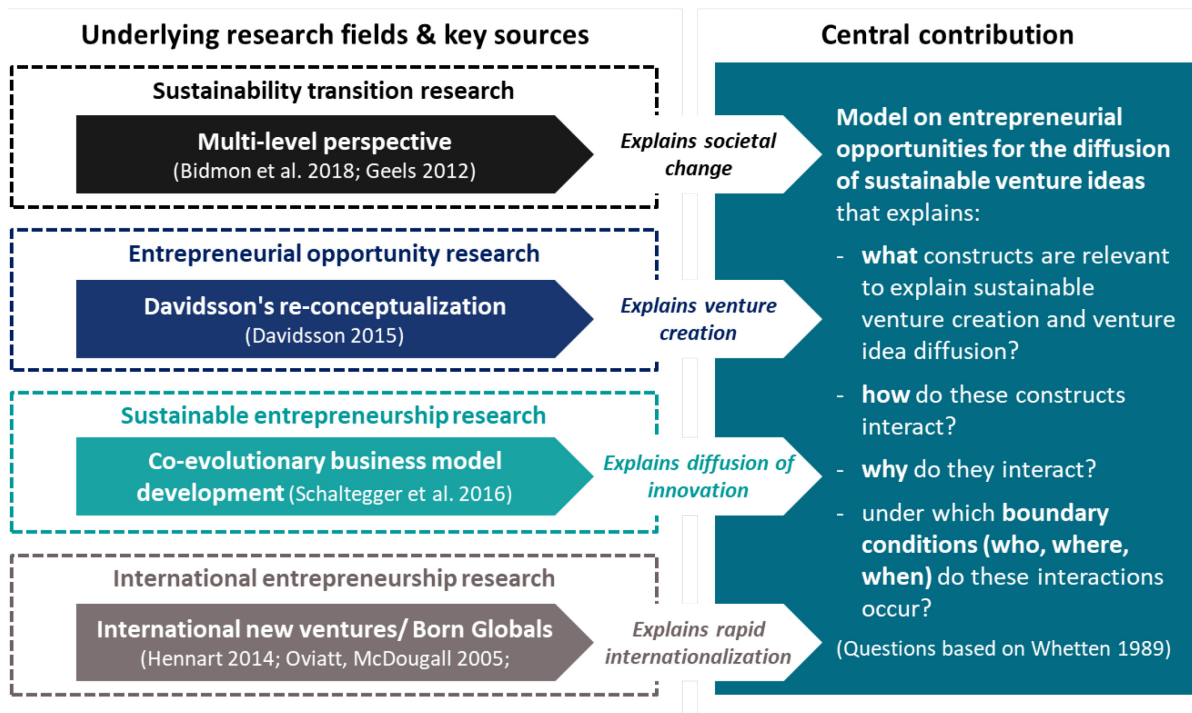


Figure 6.1 Overview of the underlying research fields for the proposed model and the central contributions of the model (own illustration)

6.3 Clarifying underlying constructs and perspectives on sustainability and entrepreneurship

6.3.1 The Multi-level perspective explains how sustainability transitions occur

The challenge of planetary boundaries and unsustainable lifestyles has been discussed in research and society for decades (Brundtland Commission, 1987; General Assembly, 2015; Meadows, 1972; Rockström et al., 2009). Out of this discussion, research on sustainability transitions¹⁹ emerged as an important stream of research that tries to explain the multi-actor, multi-level dynamics that are necessary to make our social systems more sustainable (see Geels & Schot, 2007; Markard, Raven, & Truffer, 2012; Rip & Kemp, 1998; Smith, Stirling, & Berkhout, 2005). Out of this research stream, this paper concentrates on the multi-level perspective (MLP) that draws from evolutionary economics, sociology of technology and neo-institutional theory (Geels, 2012; Markard, Raven, & Truffer, 2012).

The MLP assumes that transitions are not linear. Instead, they result from an interplay of three levels of society, the niche-level, the socio-technical regime and the socio-technical landscape (Geels, 2002; Rip & Kemp, 1998). On the bottom, there is the niche-level where new (radical) ideas are developed in a somehow protected environment (Kemp, Schot, & Hoogma, 1998).

¹⁹ There are various terms in use like transition studies (Markard, Raven, and Truffer, 2012) or system change (Geels and Schot, 2007). In this paper I use sustainability transition to highlight the goal of transforming society towards sustainable development.

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At this dynamic level experimentation and learning take place that constitute the base for successful innovation. The key actors on this level are visionaries, entrepreneurs, social movements and others who think outside the dominant mainstream (Geels, 2002; Geels, 2012; Kemp, Schot, & Hoogma, 1998). In the middle is the relatively stable socio-technical regime that can be characterized as mainstream actions, norms, and beliefs in society. Geels describes this level as dynamically stable (Geels, 2012). Even though at this level industry, technology, markets, policy, culture, and science interact continuously, the interactions only result in incremental and predictable changes due to path dependence, shared beliefs and other lock-in mechanisms (Geels, 2002; Markard, Raven, & Truffer, 2012; Kemp, Schot, & Hoogma, 1998). On top, there is the socio-technical landscape. It is defined by macro-trends and constitutes the frame for the niche-level and the socio-technical regime. Examples that Geels provides are the physical environment, political ideologies, social values, beliefs, the media landscape or macro-economic trends (Geels, 2012). This top level is relatively stable and changes only due to different types of large scale events (Geels & Schot, 2007). Potential causes for change can be shocks like the financial crisis in 2007/2008 as well as gradual developments like the diffusion of internet-enabled smartphones.

The MLP perspective argues that the interplay of these three levels is central to obtain more than incremental progress towards sustainable development – something humanity certainly needs to realize the proclaimed Sustainable Development Goals (see Boons, Montalvo, Quist, & Wagner, 2013; General Assembly, 2015). According to the MLP, progress occurs particularly if the socio-technical landscape changes and destabilizes the dynamically stable socio-technical regime. This can create windows of opportunities in which new ideas become real-world innovations that do not remain at the niche level but diffuse into society.

6.3.2 Sustainable entrepreneurs advance sustainable development when they translate new venture ideas into business model innovation

After introducing the MLP as a general framework for this article, it is important to clarify the constructs that are used hereafter (see Suddaby, 2010). Most importantly, these are the concepts sustainable, idea, innovation, and diffusion.

In the literature on sustainable entrepreneurship, there is no consensus on the term sustainable. During the research for this paper three main perspectives came up: A focus on ecological issues (e.g., Gast, Gundolf, & Cesinger, 2017; York & Venkataraman, 2010), a focus on entrepreneurs that simultaneously create value on all three pillars²⁰ of sustainability (e.g., Belz & Binder, 2017), and a focus on improvements along at least one of the three pillars of sustainability (e.g., Dean & McMullen, 2007; Schaltegger & Wagner, 2011; Dean & McMullen,

²⁰ The social, environmental and economical pillar.

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2007; Shepherd & Patzelt, 2011). In this article, I follow the latter perspective which concentrates on the expected progress in sustainable development compared to the available alternatives offering the broadest view on contributions to sustainable development.

This progress in sustainable development can result from a wide range of technical, organizational, commercial, social, and institutional ideas/inventions but only when these ideas/inventions are implemented and create actual benefits to sustainable development they can be considered sustainable innovations (Boons, Montalvo, Quist, & Wagner, 2013; Fichter & Clausen, 2016). Out of the wide range of potential sustainable innovations, this article concentrates on business model innovations which I understand as the implementation of new venture ideas by entrepreneurs. The underlying ideas for these business model innovations can be linked to other types of innovations (e.g., new technologies or organizational forms) but these underlying innovations are not in focus. This focus on the business model innovation (alias the implementation of new venture ideas) can be explained with the strong influence of business models on the successful diffusion²¹ of sustainable innovation to society (Boons, Montalvo, Quist, & Wagner, 2013); (Schaltegger, Lüdeke-Freund, & Hansen, 2016). In the terminology of the MLP, this logic can be summarized as using a business model to take a niche innovation to the socio-technical regime.

Using the MLP, Bidmon and Knab (Bidmon & Knab, 2018) studied this relationship in more detail (see figure 6.2) and identified three main roles for business models: (1) incumbent business models in the socio-technical regime stabilize the unsustainable status quo which makes it necessary that more sustainable (2) niche technology innovations as well as (3) non-technology niche innovations must find business models to outcompete incumbents. Their research shows that a business model is an important driver for the rise of sustainable niche innovation into the dominant socio-technical regime. Their research also underlines the need to better understand how businesses come into existence that change the dominant socio-technical regime. This means, to study what combination of entrepreneurs, niche technology innovation and/or niche non-technology innovation, and business models lead to scalable sustainable ventures in a given socio-technical regime and landscape.

²¹ More on diffusion in section 6.4.3.

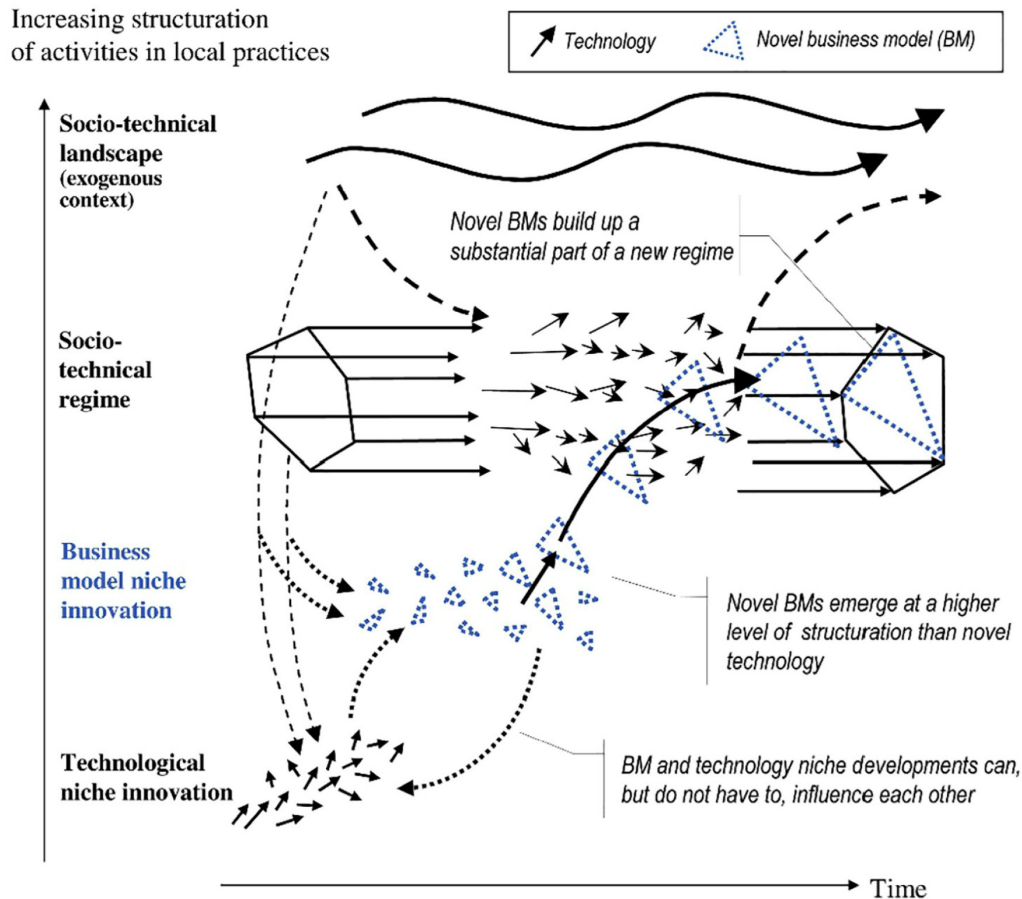


Figure 6.2 Business models as non-technological niche innovation (reprint from Bidmon, Knab 2018: 911 with permission from Elsevier)

6.4 Developing a model of entrepreneurial opportunities for the diffusion of sustainable venture ideas

This chapter examines the opportunity construct to derive a model that explains first the creation of new ventures and second the creation of new sustainable ventures. It thus responds to research question 1 (Under which circumstances do entrepreneurs create ventures that contribute to sustainable development?). Then, the model is extended to explain the diffusion of sustainable venture ideas in response to research question 2 (Under which circumstances are the underlying venture ideas diffused rapidly?). The extended model is applied to case studies from the mobility sector. Closing, the model is summarized together with a discussion on construct clarity.

6.4.1 Entrepreneurial opportunity can be described by a combination of new venture ideas and external enablers

The initially stated “*Panacea Hypothesis*” (Hall, Daneke, & Lenox, 2010) suggests that many of the sustainability challenges humanity faces today constitute entrepreneurial opportunities.

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However, the concept of opportunity itself is very controversial and requires some explanation (see Davidsson, 2015; Ramoglou & Tsang, 2016; Sarasvathy, Dew, Velamuri, & Venkataraman, 2005; Shane & Venkataraman, 2000; Short, Ketchen, Shook, & Ireland, 2009). Shane and Venkataraman are widely known for shaping research on the so-called individual-opportunity nexus – i.e., research on the characteristics and relationships between entrepreneurs and the opportunities they decide to pursue (Shane & Venkataraman, 2000). While the construct of the entrepreneur stands uncontroversial for the actor that decides to develop a venture around an opportunity, it remains relatively vague what the construct opportunity means (Davidsson, 2015). In his comprehensive literature review on the individual-opportunity nexus, Davidsson identified three main views on opportunities – the discovery view, creation view, and evolving idiosyncrasy view – and revealed various shortcomings for each of these views. To address these shortcomings he proposed to split the vague opportunity construct up into three different constructs that are more consistent and empirically testable (Davidsson, 2015: 683):

- **New venture idea (NVI):** *“An ‘imagined future venture’; i.e., an imaginary combination of product/service offering, markets, and means of bringing the offering into existence”*
- **External enabler (EE):** *“A single, distinct, external circumstance, which has the potential of playing an essential role in eliciting and/or enabling a variety of entrepreneurial endeavors by several (potential) actors”*
- **Opportunity confidence (OC):** *“The result of an actor's evaluation of a stimulus (External enabler or new venture idea) as a basis for the creation of new economic activity”*

In Davidsson's proposed approach the vague opportunity construct is divided into new venture idea and external enabler. The decision to act upon these two constructs depends on an entrepreneur's opportunity confidence. The new venture idea can be seen as a description of a business model like selling products online (Amit & Zott, 2001; Osterwalder, Pigneur, & Clark, 2010; Teece, 2010). The external enabler stands for the external circumstances that make a business model successful. For instance, the introduction of feed-in tariffs enabled the rise of renewable energy business models in countries like Germany (Couture & Gagnon, 2010) or the invention of the internet enabled a myriad of e-commerce business models (Amit & Zott, 2001). Whether an entrepreneur decides to start a business depends on awareness and subjective evaluation of available combinations of new venture ideas and external enablers – i.e., his/her opportunity confidence.

In Davidsson's model, the external enablers and the new venture idea describe an opportunity objectively, without an assessment of an entrepreneur's ability to realize the opportunity. He emphasizes that the opportunity confidence *“may or may not be well founded”* (Davidsson, 2015: 683). For the purpose of this research on the diffusion of sustainable venture ideas, it is important to understand whether opportunity confidence is well founded and what it is based

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on. It must be possible to explain why two different entrepreneurs that assess the same new venture idea with the same external enablers come to different levels of opportunity confidence. To explain such differences it is important to introduce a new construct that describes the internal circumstances against which an entrepreneur starts a venture. This construct can include very rational arguments like access to seed capital or industry experience, but it can also comprise very subjective aspects like personal dedication to a specific idea. Analog to the external enabler construct, I propose to call this new construct internal enabler defined as:

- **Internal enabler (IE):** A single, distinct, internal capability, resource or preference, which has the potential of playing an essential role in enabling and/or driving the creation and diffusion of a particular new venture idea with a given set of external enablers.

The new construct can include a wide range of capabilities, resources, and preferences that can have an important influence on a venture's performance; for example, intellectual property, experience, access to skilled employees, available networks or financial resources, but also the preferences of the entrepreneur or key partners. Aspects like this can explain why two different entrepreneurs have different levels of opportunity confidence if they assess the same new venture idea with the same external enablers. Following this logic, the definition of opportunity confidence has to be expanded to include the evaluation of external enabler, new venture idea and internal enabler. Academic backing for the relevance of the internal enabler construct can be found in various streams of literature. Among others in the resource-based view of the firm (see Bouncken, Muench, & Kraus, 2015), the dynamic capabilities perspective (see Schilke, Hu, & Helfat, 2018; Teece, Pisano, & Shuen, 1997; Weerawardena, Mort, Liesch, & Knight, 2007), research on new venture success factors (see Song, Podoyntsyna, van der Bij, & Halman, 2008) or the co-evolutionary analysis of business model development (see Schaltegger, Lüdeke-Freund, & Hansen, 2016).

Together the four constructs provide a good starting point for a conceptual model on venture creation within the multi-level perspective (MLP).

Increasing structuration
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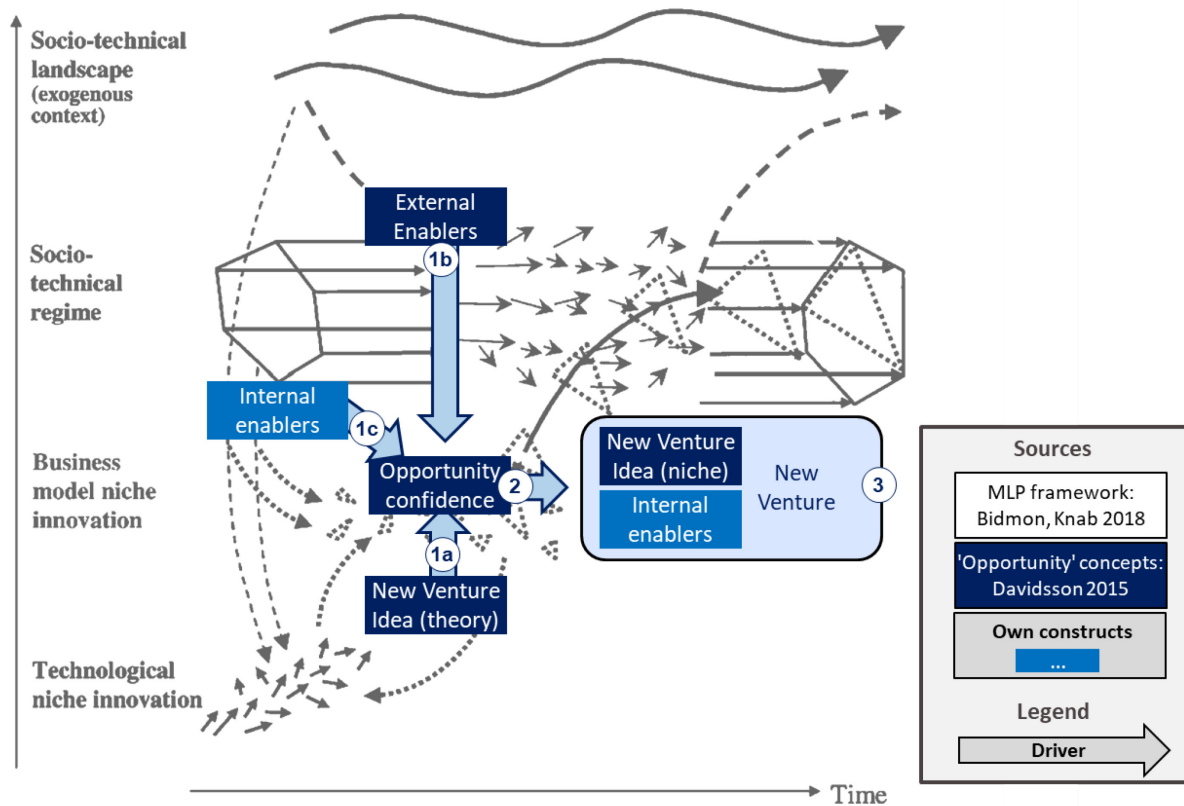


Figure 6.3 Model for entrepreneurial venture creation (own illustration based on Bidmon, Knab 2018)

Figure 6.3 illustrates what role the four concepts play in the venture creation process. New venture ideas can be found at the borderline between the technological niche innovation and business model niche innovation (1a). At this stage, there are various new venture ideas, but the opportunity confidence (2) of many entrepreneurs is too low to start a business. This means with their personal background they do not see a viable/competitive business model for the ideas in the given socio-technical regime. Entrepreneurs only decide to realize a new venture idea (1a) and start a new venture (3) if they have the subjective confidence (2) that there are external enablers (1b) that make the new venture idea viable and they perceive they have the internal enablers to succeed (1c). The external enablers (1b) are part of the socio-technical regime at the borderline to the socio-technical landscape. They are relatively stable, but they can change if the socio-technical landscape changes (see section 2.1). The internal enablers (1c) are mostly the result of past experiences and actions of an entrepreneur at the niche level as well as the socio-technical regime. Even though path dependence plays an important role for internal enablers they can also change for example due to finding new potential partners or learning new skills.

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Summing it up, new ventures are created when entrepreneurs obtain sufficiently high opportunity confidence in a new venture idea based on their assessment of external and internal enablers. The actual venture creation translates a theoretical new venture idea into a real business model innovation.

6.4.2 Sustainable new ventures result from a combination of new venture ideas, external enablers, internal enablers, and expected sustainability net benefits

Thus far, the model explains any kind of entrepreneurial opportunity independent of its impact on sustainability. To portray sustainable entrepreneurial opportunities the model has to be extended further. Building on the discussion on sustainability (section 6.3.2) it can be said that a 'sustainable' entrepreneurial opportunity must create:

- **Sustainability net benefits (SNB):** The net benefits for sustainable development (under consideration of negative externalities and rebound effects) that a new venture idea creates compared to available alternatives in the socio-technical regime.

Unfortunately, the actual sustainability net benefits can only be measured ex-post and measuring them is very complex (see Clifford, 2014; European Union & OECD, 2015; Hornsby, 2012; Nicholls, 2009). Thus, an entrepreneur has to rely on ex-ante assessments of the expected sustainability net benefits. Different approaches to making such predictions have been proposed (article 1; Lingane & Olsen, 2004; Millar & Hall, 2013). Following the logic of such predictive approaches, the before described model can be extended from describing the process of entrepreneurial venture creation to the process of sustainable entrepreneurial venture creation (see figure 6.4).

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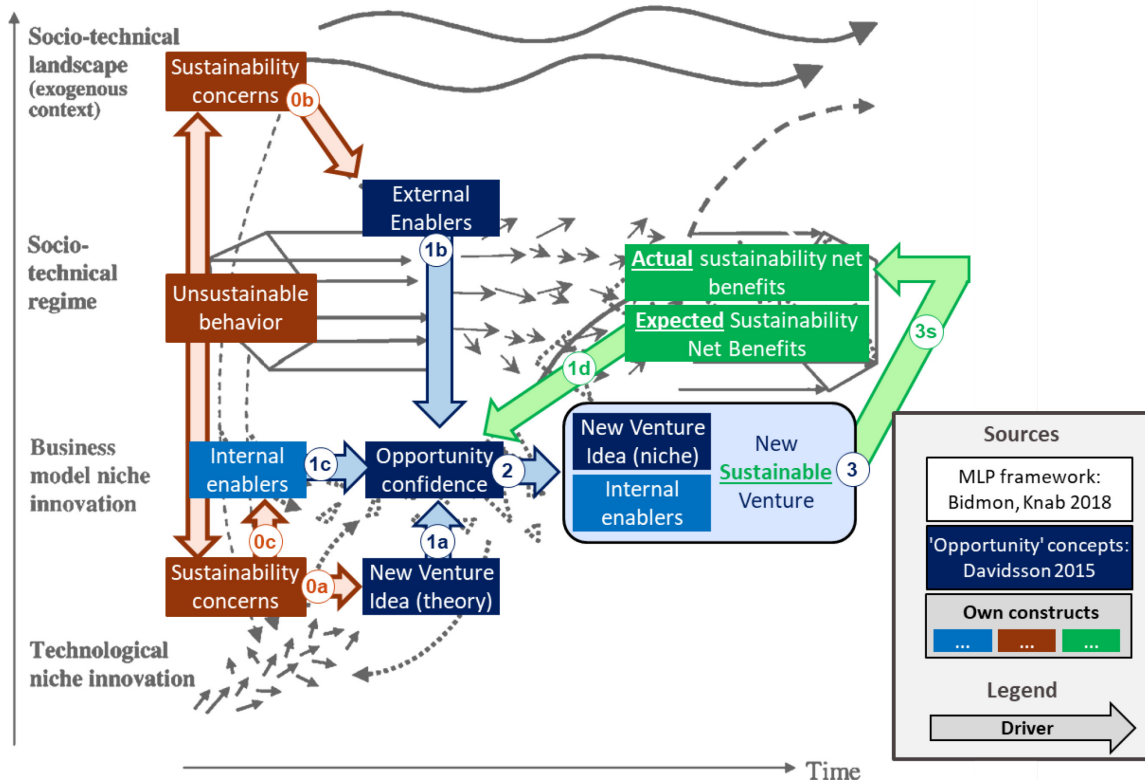


Figure 6.4 Model for sustainable entrepreneurial venture creation (own illustration based on Bidmon, Knab 2018)

In the extended model, the same constructs and relationship remain relevant: Opportunity confidence (2) of an entrepreneur brings together the subjective assessment of a new venture idea (1a), external enablers (1b) and internal enablers (1c). The only change is that an additional fourth construct, the expected sustainability net benefits (1d), also influence an entrepreneur's opportunity confidence. The notion 'expected' highlights that the sustainability net benefits are a subjective assessment that may or may not be well founded. There might be a gap between the expected sustainability net benefits (1d) and the actual sustainability net benefits (3s) that result from the created venture.

There are different mechanisms through which sustainability considerations become relevant in the venture creation process. However, the underlying cause is a general concern about unsustainable practices in the socio-technical regime. A good example is today's fossil fuel dependent mobility system and its impact on climate change. Concerns about this topic can translate into sustainability concerns at the niche level as well as the socio-technical landscape. Due to these concerns niche actors can be incentivized to create sustainable venture ideas like electric ridesharing taxis (0a), niche actors can be motivated to start a clean mobility venture (0c) and these concerns can lead to external enablers like subsidies for

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electric cars (0b). Thus, sustainability concerns translate into sustainability-oriented entrepreneurship.

It is important to note that sustainability considerations affect the venture creation process in combination with the other three constructs. For example, a profit-oriented entrepreneur working on electric ridesharing may only care about CO2 reductions if he/she can benefit from specific external enablers like subsidies. On the contrary, an intrinsically motivated entrepreneur working on the same issue might only care about the new venture idea due to its expected sustainability net benefits.

Such interdependencies exist also between the other three constructs independent of sustainability. For instance, the internal enabler 'professional experience in passenger transport' may only affect an entrepreneur's opportunity confidence if he/she assesses a new venture idea around transport. Accordingly, alone or in combination the four constructs influence an entrepreneur's opportunity confidence for the creation of a new sustainable venture.

6.4.3 To explain how new sustainable ventures change the socio-technical regime the diffusion of innovation must be modeled

The before stated model only responds to research question 1 and explains the creation of a new sustainable venture which raises a new venture idea from theory (1a) to practice at the level of a business model niche innovation (3). In order to respond to research question 2 and explain how new sustainable venture ideas rise from the niche level to the socio-technical regime, their diffusion must be explained.

Diffusion is usually described as the spread of innovation in a social system through communication that eventually leads to the adoption of the innovation (Rogers, 1983). In the context of this research, diffusion can be understood as the spread of a new venture idea to the socio-technical regime. This process can take place in different ways and it can be driven by different factors (see e.g., Fichter & Clausen, 2016; Rogers, 1983). To categorize the resulting patterns of diffusion in this research, I rely on the construct 'pathways to scale' (Schaltegger, Lüdeke-Freund, & Hansen, 2016). Building on evolutionary economics Schaltegger et al. (2016) identified four different pathways to diffuse a new venture idea and described the circumstances under which they typically occur. Below the four pathways are briefly described according to Schaltegger et al. (2016), but reformulated in the terminology of this paper:

- **Pathways to scale (5):** Four different approaches for the diffusion of a new venture idea to the socio-technical regime:
 - **Growth:** Market and society provide the necessary circumstances to scale the new venture (i.e., favorable external enablers) and the entrepreneur (or an intrapreneur) and

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his/her venture team have the desire, capabilities, and resources to bring the new venture to the socio-technical regime.

- **Replication:** Other niche entrepreneurs are attracted by the new venture idea, and they are able to replicate the idea with their own venture. Thus, replications by other niche-entrepreneurs diffuse the new venture idea and potentially raise it to the socio-technical regime in a decentralized bottom-up process.
- **M&A:** The new venture attracts the attention of incumbents that want to integrate and merge the new venture in their organization. Integrated into the incumbent the new venture idea becomes part of the socio-technical regime.
- **Mimicry:** Mass-market players are attracted by the new venture idea, and they are able to copy and modify the new venture idea. Thus, incumbents bring the new venture idea to the socio-technical regime integrated into their business models.

Each of these four pathways can – alone or in combination – help to diffuse a niche innovation and make it part of the socio-technical regime (Schaltegger, Lüdeke-Freund, & Hansen, 2016). When the different pathways occur can be explained based on the four constructs (see figure 6.5). The new venture idea (4a) explains the general business model characteristics of the new venture that can be translated into different ventures (e.g., type of product/service offered or the value chain composition), the external enabler (4b) stands for the external circumstances that either support or restrict the diffusion of a new sustainable venture idea (e.g., customer distribution, regulatory regimes or available entrepreneurial ecosystems), internal enablers (4c) provide insights into the specific internal capabilities, resources and preferences of a particular venture (e.g., access to capital, strategic partners to grow or desire to build an independent venture) and the expected sustainability net benefits (4d) capture how diffusion of a new venture idea through different processes will affect its contribution to sustainable development (e.g., limited availability of sustainable supplies or limited net benefits beyond a certain region).

The first three aspects (4a-4c) always influence the pathway to scale, whereas the latter aspect (4d) is only relevant if the venture is sustainability-oriented due to the new venture idea (e.g., selling renewable electricity or organic food), external enablers incentivize sustainability (e.g., regulation or consumer demand) and/or sustainability net benefits are important to the entrepreneur (and key stakeholders).

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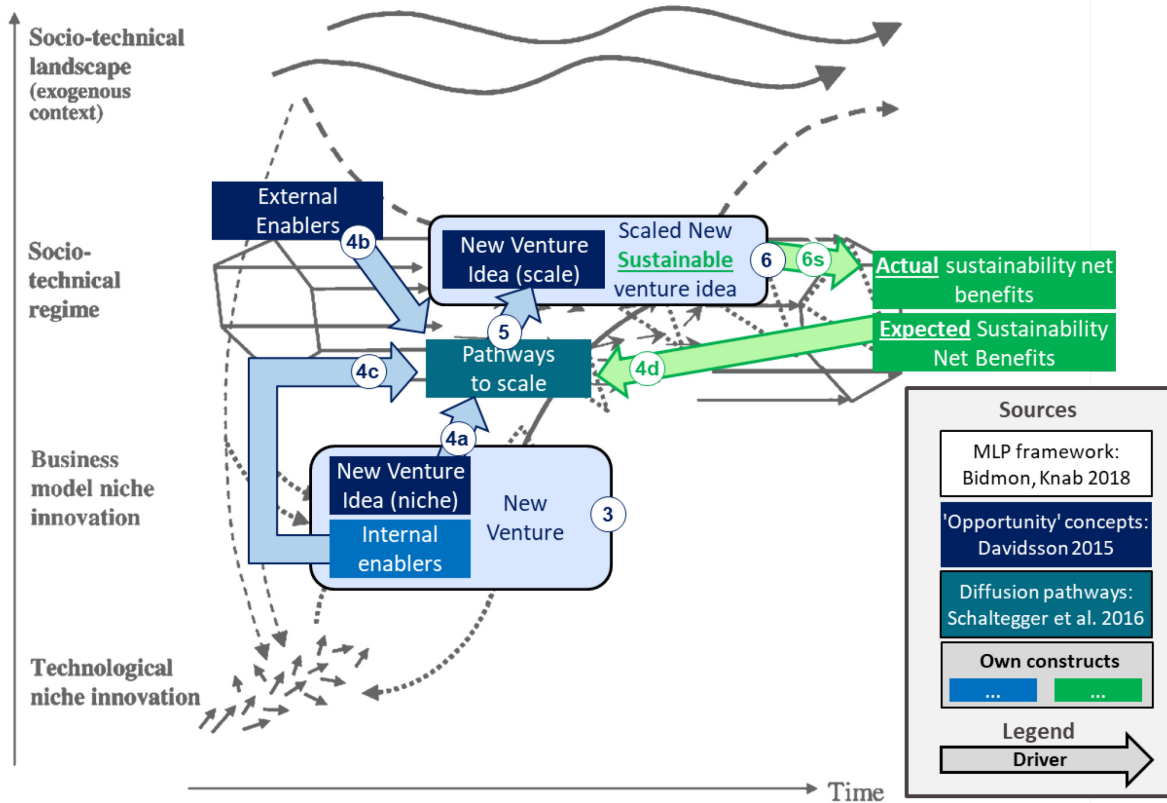


Figure 6.5 Model for the scalability of sustainable new venture ideas (own illustration based on Bidmon, Knab 2018)

6.4.4 Applying the introduced constructs to the four diffusion pathways

Together the proposed constructs can characterize the four pathways to scale and explain under which circumstances (i.e., different combinations of the constructs 4a-d) the pathways are most likely to support the sustainability transition. Table 6.1 below provides a structured overview of the four pathways based on the four constructs from the previous section. The given characterizations are generalizations of the research findings that cannot take into account all potential circumstances that lead to one of the four pathways. To illustrate these general descriptions the remainder of this section explores brief case studies from the mobility sector for each of the pathways.

Table 6.1 General description of the four pathways to scale based on the proposed constructs

		Growth	Replication	M&A	Mimicry/ Imitation
Summary	Process characteristics	Bottom-up (/top-down), centralized	Bottom-up, decentralized	Top-down, centralized	Top-down, decentralized
	Key actors	Entrepreneur (or intrapreneur)	Many entrepreneurs (or intrapreneurs)	Entrepreneur & incumbent intrapreneur	Intrapreneurs
	Conditions when pathway is best to diffuse a NVI with high SNBs	NVIs in promising market segments that attract enough capabilities/ resources to grow without dilution of their SNB	NVIs in promising market segments that attract many entrepreneurs are easy to copy without diluting the SNB	NVIs in promising market segments that are hard to copy for incumbent intrapreneurs & have SNB that are central to the NVI	NVIs in promising market segments that are easy to copy by incumbent intrapreneurs & have SNB that are central to the NVI
Characteristics of the pathways	New venture ideas (NVI)	Scalable business model in profitable, larger market	Replicable business model in profitable, larger market	Integrable business model in profitable, larger market	Imitable business model in profitable, larger market
	External enablers (EE)	Supportive EE, and no barriers (e.g. market size)	Supportive EE, and no barrier (e.g. regulation, IP)	Supportive EE, and no barrier (e.g. antitrust reg.)	Supportive EE, and no barrier (e.g. regulation, IP)
	Internal enablers (IE)	Capabilities, resources and preference to grow	Capability or resources that can be copied	Capability or resources that are hard to copy	Capability or resources that can be copied
	Sustainability net benefits (SNB)	Scalable without dilution of SNB (e.g. due to investors)	Replication does not dilute SNB (e.g. NVI variations)	SNB is central for the NVI (e.g. low risk of dilution)	SNB is central for the NVI (e.g. low risk of dilution)

Growth: Generally, this pathway is promising for new venture ideas in economically attractive market segments where entrepreneurs find enough capabilities and resources to grow their venture without diluting their sustainability orientation. A good example of this pathway is Tesla. The new venture idea of Luxury electric sports cars targets an attractive global market. The growing awareness about climate change, resource depletion, and air pollution constitute external enablers in favor of e-mobility that created sufficient opportunity confidence in the initial founding team (Euler Hermes, 2016; KPMG, 2017; McKinsey & Company, 2016). The key internal enablers for the success of Tesla are its focus on early experimentation with minimum viable products, Elon Musk as a charismatic leader, and a brand that attracts top talent and customer interest (Stringham, Miller, & Clark, 2015; Vance, 2015). Finally, electric cars are the core value proposition of Tesla. Thus, even though electric mobility is not without criticism it still creates significant sustainability net benefits compared to the fossil fueled cars in the socio-technical regime (see Grey & Tarascon, 2016; Lajunen & Lipman, 2016).

Replication: This pathway is more suitable for new venture ideas that are easy to copy for other entrepreneurs and have sustainability at their core. The venture idea of bike-sharing is a suitable example. It started in the Netherlands in 1965 and is today a global phenomenon with various business models that range from free-floating systems to fixed stations (van Waes, Farla, Frenken, Jong, & Raven, 2018). The external enablers of GPS technology, smartphones, urbanization, and favorable urban regulation support the spread of bike-sharing (DeMaio, 2009; Ricci, 2015). As the new venture idea itself is rather simple but requires city

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specific adoptions (e.g., to regulations, public transport, road systems) a wide range independent entrepreneurs can support the diffusion of the idea in different cities (e.g., Nextbike in Germany). Key internal enablers for a successful bike-sharing venture are for each city the size of the network, the available number of bicycles and the flexibility of the service (e.g., fixed stations vs. free-floating) (van Waes, Farla, Frenken, Jong, & Raven, 2018). Expected sustainability net benefits are core to the new venture idea and unlikely to be diluted. These benefits comprise among others an improved public transport system, the health benefits for users and CO₂-free transportation²² (Ricci, 2015).

M&A: This pathway is most suitable for new venture ideas in economically attractive market segments that are hard to copy for incumbent intrapreneurs and have sustainability at their core. Typically, incumbents decide to acquire ventures that would either grow alone to become a competitor and/or they acquire ventures that constitute a strategic fit for the corporate strategy. The university spin-off StreetScooter is a good example of this logic. The new venture idea is based on modular, low-cost electric vans that can be adapted to the needs of different professional customer groups (Kampker, Gerdes, & Schuh, 2017). Similar to the Tesla example, the growing awareness about climate change, resource depletion, and air pollution constitute external enablers that support the new venture idea and created sufficiently high opportunity confidence among the founders (Euler Hermes, 2016; KPMG, 2017; McKinsey & Company, 2016). Based on an early prototype, intrapreneurs at the Deutsche Post DHL Group became interested and contracted StreetScooter for the production of electric delivery vans (Kampker, Gerdes, & Schuh, 2017). This led to a close partnership and eventually the acquisition of StreetScooter by the Deutsche Post DHL Group. Expertise in innovation and engineering, as well as the university network, constitute initial internal enablers that were later complemented by the financial resources and the internal demand for electric vans by the acquiring Deutsche Post DHL Group. The expected sustainability net benefits are central to the new venture idea, and therefore there is a low risk that the acquisition dilutes the expected sustainability net benefits.

Mimicry: This pathway can be suitable for new venture ideas in an economically attractive market segment that are easy to copy for incumbent intrapreneurs and have sustainability at their core. In many aspects, mimicry is similar to replication making the previous example of bike-sharing also applicable here. The external and internal enablers and the expected sustainability net benefits remain the same, but instead of entrepreneurs (e.g., Nextbike), the new venture idea is taken up by intrapreneurs in large corporations (e.g., Call a Bike as a bike-sharing venture of the Deutsch Bahn in Germany) (DeMaio, 2009). Similar to the case of M&A,

²² However, CO₂-savings depend on the need to re-distribute bicycles by car (Ricci, 2015)

incumbents become active if they see a strategic fit between the new venture idea and their corporate strategy.

Following these examples, it is important to emphasize two additional aspects to the proper application of the model. First, the previous examples illustrate that a new venture idea can be diffused through different pathways in co-evolution (see also Schaltegger, Lüdeke-Freund, & Hansen, 2016). This means that the four pathways can occur in parallel (e.g., replication and mimicry for bike-sharing) and there are important linkages between the pathways (e.g., initial self-reliant growth of StreetScooter and later acquisition and scaling). Second, not all new venture ideas create sustainability net benefits when they are scaled. For all the above-mentioned mobility examples sustainability was a central element to the new venture idea. At first glance, scaling the new venture ideas created more benefits than comparable alternatives in the market. However, if we assume a free floating bike-sharing system is replicated/ imitated in a wide range of cities there might be cities with imbalanced usage patterns (e.g., everybody just rides bicycles downhill). This could create a strong need for car-based redistribution with the related negative climate effects (Ricci, 2015). A more drastic example is the oversupply of bikes in the very competitive China's bike-sharing market that resulted in congested cities and the scrapping of fully functional bicycles (Campbell, 2018; Haas, 2017). In such cases, less scale would increase the sustainable net benefits.

6.4.5 Bringing it all together in one conceptual model

Building on the previous arguments and the introduced constructs this section presents the complete conceptual model on entrepreneurial opportunities for the diffusion of sustainable venture ideas. In his critique of the 'opportunity' construct Davidsson (Davidsson, 2015) highlighted the need for clear constructs that are consistently used within a theory. Accordingly, it is important to clarify that there is no overlap among the proposed constructs and to show that each construct can be used consistently to explain entrepreneurial contribution to the sustainability transition. Therefore, the main goal of this section is to outline the linkages between the different constructs and showcase the construct clarity (see Suddaby, 2010).

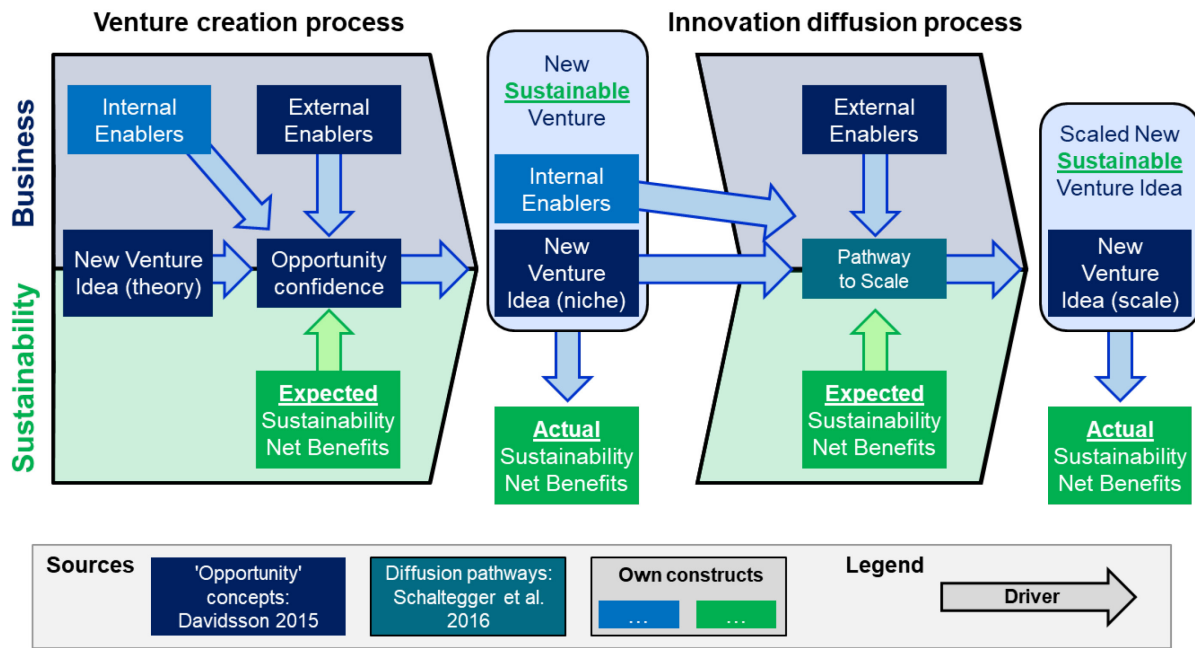


Figure 6.6 Model of venture creation and new venture idea diffusion (own illustration based on research from Davidsson, 2015; Schaltegger, Lüdeke-Freund, & Hansen, 2016)

Figure 6.6 shows the entire conceptual model with its two phases: (1) venture creation and (2) innovation diffusion:

(1) Venture creation process: This phase explains the conditions for the creation of a new sustainable venture. The starting point for this phase is the new venture idea that is entirely theoretical in nature. It stands for an “*imagined future venture*”, while the external enabler construct is a more tangible assessment of real world “*external circumstances*” that support or question a new venture idea (Davidsson, 2015: 683). Analog to external enablers, the internal enabler construct describes the internal capabilities, resources, and preferences of a potential entrepreneur that support or question a new venture idea. The construct of expected sustainability net benefit stands for the assumed sustainability improvements of a new venture idea compared to available alternatives in the socio-technical regime. Finally, opportunity confidence is a construct that stands for the subjective assessment of an entrepreneur whether to create or not create a new venture. This assessment takes into account the fit between the new venture idea, the available external enablers, internal enablers, and the expected sustainability net benefits. If the assessment leads to high opportunity confidence an entrepreneur creates a new venture. However, this subjective evaluation “*may or may not be well founded, leading to positive or negative effects for focal Actors and others*” (Davidsson, 2015: 683). Thus, prior to the venture creation, it remains unclear whether the new venture will be successful and whether it creates actual sustainability net benefits.

(2) Innovation diffusion process: The second phase explains how a new venture idea is diffused to the socio-technical regime. Initially, a new venture idea is embedded in the newly created venture, but then it can be diffused through one of the before stated four pathways to scale (growth, replication, M&A or mimicry). Whether the original entre-/intrapreneur or other entrepreneurs and intrapreneurs diffuse a new sustainable venture idea (or whether it is not diffused at all) depends on the previous four constructs – i.e., the characteristics of the new venture idea, supportive external enablers in the socio-technical regime, internal enablers of the new venture at the niche level and the expected sustainability net benefits of the new venture idea at scale. Together these four constructs explain whether, how and by whom a new venture idea is diffused to potentially change the socio-technical regime. Again, prior to the diffusion of the venture idea it remains unclear whether the changes of the socio-technical regime create actual sustainability net benefits.

The proposed model can help to understand, analyze and communicate how sustainable entrepreneurial opportunities for the sustainability transition come into existence. Thus, applying the model can guide entrepreneurs, managers and policymakers to more effective and efficient action towards the sustainability transition. To illustrate the application of the model and respond the notion of ‘rapid’ in research question 2 (under which circumstances is the underlying venture idea diffused rapidly?), the remainder of the article explores how the model can be applied to characterize sustainable venture creation and rapid international diffusion through the growth of the original venture. Thus, the next chapter explores how entrepreneurs can directly shape the sustainability transition internationally.

6.5 Entrepreneurial opportunities for rapid international ‘growth’

6.5.1 New venture idea, external enablers and internal enablers shape transaction costs and thus influence the speed of internationalization

Explaining the rapid growth of new ventures leads to research on international entrepreneurship and more specifically rapid internationalization. International entrepreneurship, in general, can be defined as “*the recognition, formation, evaluation, and exploitation of opportunities across national borders to create new businesses, models, and solutions for value creation, including financial, social, and environmental*” (Zahra, Newey, & Li, 2014: 138). Researchers of international entrepreneurship realized that the patterns of international expansions changed in the 1990s. Globalization and the underlying advances in ICT (information and communication technologies) and logistics began to accelerate market developments and intensify competition worldwide (Keupp & Gassmann, 2009; Knight & Liesch, 2016; Onetti, Zucchella, Jones, & McDougall-Covin, 2012; Oviatt & McDougall, 2005; Zahra, Rawhouser, Bhawe, Neubaum, & Hayton, 2008). Thus, previously used models like the

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Uppsala model of internationalization (Johanson & Vahlne, 1977) failed to explain empirical observations like the rapid internationalization of new ventures soon after their foundation (McKinsey & Company, 1993; Knight & Cavusgil, 2004; Oviatt & McDougall, 1994). The original Uppsala model expected ventures to first expand and learn in their domestic markets with gradual expansion to culturally and geographically close markets (Johanson & Vahlne, 1977; Johanson & Vahlne, 2009).

To study and explain the appearance of rapidly internationalizing new ventures early after their foundation two closely related concepts emerged: born globals (Knight & Cavusgil, 2004; Knight & Liesch, 2016) and international new ventures (Oviatt & McDougall, 1994). Born global is the more specific concept that concentrates on new ventures that focus on international exports/sales from the start, whereas international new venture is the more comprehensive concept that includes independent as well as corporate ventures that internationalize various value chain activities early on (Cavusgil & Knight, 2015). There is a wide range of research on born globals and international new ventures and their characteristics, capabilities, performance, strategies and the conditions under which they appear (see Knight & Liesch, 2016; Cavusgil & Knight, 2015; Chandra, Styles, & Wilkinson, 2012; Di Gregorio, Musteen, & Thomas, 2008; Fan & Phan, 2007; Gerschewski, Rose, & Lindsay, 2015; Hennart, 2014).

The goal of this chapter is to apply the previously developed model of entrepreneurial opportunities for the diffusion of sustainable venture ideas to rapid international 'growth'. For this goal, the research of Oviatt and McDougall (Oviatt & McDougall, 2005) provides a great starting point. They developed a widely cited model that explains under which circumstances new ventures can internationalize rapidly. According to their model the initial decision to internationalize depends on an existing entrepreneurial opportunity (the opportunity construct itself is not defined), available enabling technologies (e.g., ICT, logistics) and motivating forces of competition (e.g., the risk that competitors take over foreign markets first). If an entrepreneur perceives that the combination of variables supports internationalization, the actual speed of internationalization depends on the knowledge-intensity of the opportunity and the available international network of the entrepreneur (ibid.).

Oviatt and McDougall's model offers a good understanding of the decision and speed of internationalization. However, Hennart (Hennart, 2014) has further simplified the relationship by reducing rapid internationalization to a single denominator – transaction costs. Hennart has studied the concept of born globals and international new ventures through a transaction cost perspective and concluded that the type of business model and the level of related transaction costs explain rapid internationalization. With his focus on the business model, Hennart avoids the vague opportunity construct that Oviatt and McDougall take as a starting point for their model. Thus, Hennart's findings can be summarized as follows: New ventures can internationalize rapidly if the underlying new venture idea is based on selling [1.] niche

products/services, [2.] to internationally dispersed customers [3.] using low-cost information and delivery methods. Moreover, [4.] he observed that rapid internationalization often occurs for new ventures that have been started in countries with small home markets. This observation can be linked to the opportunity costs of not internationalizing and staying in a small home market. Finally, Hennart's transaction cost perspective also suggests that internationalization should further accelerate as long as transaction costs continue to decrease for example via better ICT, transport technologies or free trade policies.

6.5.2 Integrating the drivers of rapid internationalization into the model:

The findings of both perspectives can be integrated into the proposed model to explain under which circumstances sustainable entrepreneurs are most likely to start and grow new ventures that have an effect on the socio-technical regime (see figure 6.7 below). Following Oviatt and McDougall's model (Oviatt & McDougall, 2005) there are two main phases, first, the decision to internationalize and second, the speed of internationalization. This can be reformulated as first, the decision to create an international venture and second, the diffusion through rapid international growth (see left and right part of figure 6.7). The decision to create an international new venture is based on sufficiently high opportunity confidence. This means an entrepreneur must be confident that there are external enablers like enabling technologies and favorable competitive conditions as well as internal enablers like an international network that make the internationalization of the new venture idea beneficial. Whether an entrepreneur is then able to rapidly grow the venture internationally is based on the knowledge-intensity of the new venture together with the internal and external enablers.

The adapted model can be further specified with Hennart's analysis (Hennart, 2014). Following his findings opportunity confidence to create an international venture is higher and the international growth more rapid if the new venture idea concentrates on niche products/services that can be sold to an internationally dispersed customer group with low-cost information and delivery systems. Being based in a small home market additionally serves as an external enabler that drives internationalization.

It is obvious that the model could be further enriched with additional success factors like the need for dynamic learning capabilities (Weerawardena, Mort, Liesch, & Knight, 2007), the relevance of past learnings (Chandra, Styles, & Wilkinson, 2012), or the importance of motivated leadership with high opportunity confidence (Cavusgil & Knight, 2015). All the above examples can be important internal enablers that accelerate rapid international growth additionally. However, providing a full review of the success factors for rapid international growth is out of scope for this paper. The goal of this section is to illustrate the application of

the model. Thus, instead of adding more variables, the last paragraph of this article discusses the model for rapid international growth based on practical examples.

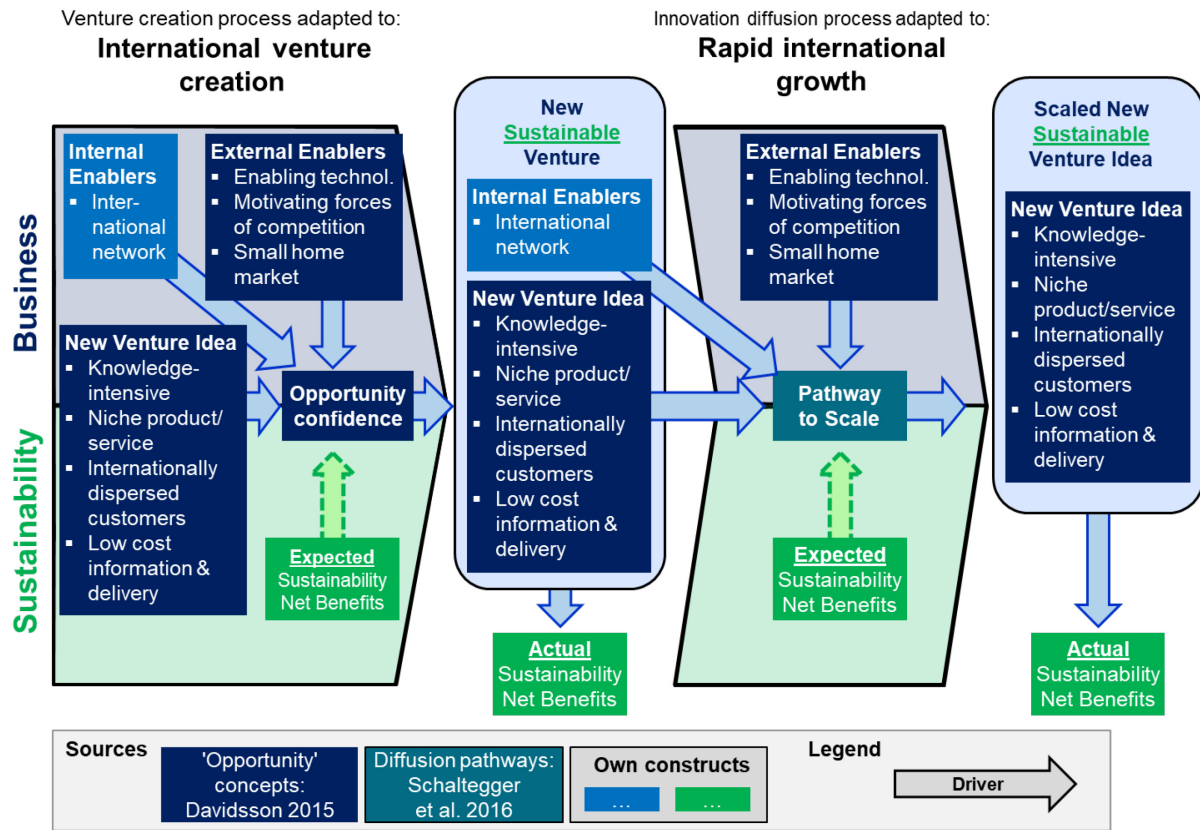


Figure 6.7 Key variables influencing the decision and speed of internationalization based on extended re-conceptualization of the opportunity concept (own illustration based on research from Davidsson, 2015; Oviatt & McDougall, 2005; Hennart, 2014; Schaltegger, Lüdeke-Freund, & Hansen, 2016)

6.5.3 Applying the model for rapid international 'growth' to e-mobility and bike-sharing

The model suggests that rapid international growth is most likely for externally enabled sustainable new venture ideas that build on knowledge-intensive products/services that can be delivered at low cost to a globally dispersed and contested niche of customers through modern technologies and an effective international network. To test this logic the model is applied to the previous cases examples of Tesla, Streetscooter, and bike-sharing.

Preconditions for rapid international growth at Tesla: Tesla's new venture idea of luxury electric sports cars is a niche product that has expected sustainability net benefits at its core. The new venture idea requires much knowledge and targets an internationally dispersed customer group. All the above aspects of the new venture idea support rapid internationalization with positive effects for the sustainability transition. However, the potential for low-cost information and delivery methods is limited. Even though its products are high-tech in many dimensions the product itself depends on traditional manufacturing processes,

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complex value chains, and local sales channels (Poultney, 2018; Vance, 2015). In all these domains enabling technologies like ICT and logistics create massive advantages in efficiency. Nevertheless, the physical nature of the value proposition limits low-cost delivery mechanisms compared to software companies for example. Also, the pressure to internationalize rapidly is limited as the strong global brand of Tesla differentiates Tesla from other competitors and much of Tesla's production capacities are consumed by the large US home market (DeBord, 2018). Overall, Tesla certainly internationalized relatively fast, but not compared to some software companies (e.g., Netflix, Spotify or Snapchat²³).

Preconditions for rapid international growth at StreetScooter: In many dimensions the case of StreetScooter is similar to Tesla; however, the new venture idea of modular, low-cost electric cars for different professions targets a much more diverse group of customers (e.g., delivery services as well as gardening services) with product that needs customization for different professions (e.g., maximum storage vs. mobile charging for electric gardening equipment) (Kampker, Gerdes, & Schuh, 2017). Accordingly, the new venture idea is more targeted towards a heterogeneous regional customer group than an internationally dispersed customer group. Also, the customer-specific adaptations constrain low-cost production and delivery. Thus, the model suggests that international growth for this venture is slower than for Tesla. In light of those considerations, the partnership (and later acquisition) with the Deutsche Post DHL Group makes sense as a way to create reliable demand for a standardized version of the electric car, instead of serving a wide range of individualized customers with very heterogeneous demands.

Recent international sales indicate that the initial growth within Deutsche Post DHL Group is not in conflict with scaling up gradually (The Business Times, 2018), but not rapidly.

Preconditions for rapid international growth of bike-sharing: Applying the analysis to bike-sharing explains why there are various local or regional replications and imitations instead of one dominant player (DeMaio, 2009; van Waes, Farla, Frenken, Jong, & Raven, 2018). The new venture idea itself is not very knowledge-intensive, and one venture cannot serve an internationally dispersed customer group as it has to set up and maintain physical bike-sharing systems across different cities with high delivery costs. All the above aspects of the new venture idea stand against rapid internationalization. The only positive aspect of the new venture idea is the niche customer group of bike-sharing – mostly younger urbanites (Ricci, 2015). Reviewing the external enablers also shows limited support for rapid internationalization. The enabling technologies GPS and smartphones support

²³ These examples just consider rapid growth, independent of their expected sustainability net benefits.

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internationalization as they create more user-friendly floating bike-sharing systems (van Waes, Farla, Frenken, Jong, & Raven, 2018) and the limited size of each city incentivizes the different bike-sharing ventures to expand to other cities. However, modern bike-sharing is new to many cities and requires city specific regulatory approval and often specific licenses which creates massive transaction costs during the scaling process (DeMaio, 2009; van Waes, Farla, Frenken, Jong, & Raven, 2018). To overcome this barrier the internal enabler 'international network' is an important lever. Unfortunately, it is difficult for one bike-sharing venture to establish and maintain good relationships to the countless cities that could potentially offer bike-sharing. Thus, the rapid international growth of a single bike-sharing venture is difficult. The recent bankruptcies of large venture capital-backed bike-sharing startups illustrates the challenges of rapid internationalization of bike-sharing (Deutsche Welle, 2018; Tsang, 2018).

The three examples above show that the model of entrepreneurial opportunities for the rapid diffusion of sustainable venture ideas constitutes a structured approach to assess and explain rapid internationalization for different new venture ideas. Analog to this analysis of rapid international growth, other diffusion pathways can be assessed to derive relevant insights for entrepreneurs, policymakers, and academia.

6.6 Discussing the applicability of the model in sustainable entrepreneurship

The following discussion concentrates on two things. First, it responds to research question 3 (What role play sustainability considerations in the process?) and clarifies under which conditions the expected sustainability net benefits can be maximized. Second, it provides guidance on how the model and findings of this research ought to be used.

6.6.1 Favorable external enablers are necessary to diffuse sustainable venture ideas

In the model, the expected sustainability net benefits only influence venture creation and venture idea diffusion in combination with the other three constructs: new venture idea, external enablers, and internal enablers (see discussion in section 3.2). The importance of the three constructs can vary between the creation and diffusion of sustainable venture ideas. Accordingly, it is important whether the expected sustainability net benefits are linked to the new venture idea, internal enablers and/or external enablers. During the initial creation of a venture, it can be enough to have a capable entrepreneur with a sustainable venture idea. But to scale this venture external enablers are necessary that support the sustainable venture idea. The need for favorable external enablers stands in conflict with the need for radical sustainable innovation mentioned in chapter 6.3 (see Boons, Montalvo, Quist, & Wagner, 2013; Rip &

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Kemp, 1998; Schot & Geels, 2008). In theory, we need radically more sustainable new venture ideas that are realized through scalable, strongly sustainable business models (Boons & Lüdeke-Freund, 2013; Geels, 2002; Schaltegger, Lüdeke-Freund, & Hansen, 2016; Upward & Jones, 2015). However, the more radical a sustainable venture idea is the more challenging it might be to find favorable external enablers in the socio-technical regime. For instance, there are new venture ideas around sufficiency with great environmental benefits, but many of them do not scale easily (see Bocken & Short, 2016). It can be expected that sufficiency based venture ideas simply lack external enablers in a socio-technical regime that is shaped by consumerism (Smith, Stirling, & Berkhout, 2005).

This example highlights that the radicalness of a new venture idea for sustainable development must be balanced with the available external enablers. The dominant socio-technical regime serves as a filter for the scalability of new venture ideas. Thus, unless entrepreneurs themselves take action to create supporting external enablers (see institutional entrepreneurship Pacheco, Dean, & Payne, 2010) sustainability-oriented entrepreneurs should focus on those new venture ideas that already have supportive external enablers or new venture ideas for which external enablers are likely to emerge in the foreseeable future. Only, new venture ideas that pass through this filter allow entrepreneurs to develop and scale the new venture idea along one of the four pathways to scale (see figure 6.5). This dependency on favorable external enablers contradicts the initially stated “*Panacea Hypothesis*” (Hall, Daneke, & Lenox, 2010) and defines the boundaries for sustainable entrepreneurship.

6.6.2 The model reduces uncertainty in sustainable entrepreneurship

Turning to the applicability of the proposed model, it must be pointed out that findings on a particular venture remain only valid until important variables change. Unfortunately, in the field of entrepreneurship changes are very frequent. Entrepreneurs act under uncertainty in a dynamic environment (Alvarez & Barney, 2005; Geels, 2002; Smith, Stirling, & Berkhout, 2005) and thus entrepreneurs have to learn and adapt continuously (Sarasvathy, 2001; Teece, Pisano, & Shuen, 1997). Following this logic of dynamic learning and adaptation, it can be expected that external enablers, the internal enablers, the new venture idea itself and the related sustainability net benefits change over time. To navigate through this dynamic uncertainty entrepreneurs have a limited set of options (Alvarez & Barney, 2005: 777–778):

“For example, data on consumer preferences can be collected, the successes and failure of other firms can be analyzed, and a variety of strategic and financial tools can be applied, all in an effort to increase the level of certainty associated with making a decision. However, it will often be the case that—even after all that can be done—the outcomes of decisions will often not be certain”.

The proposed model of entrepreneurial opportunities for the rapid diffusion of sustainable venture ideas can help entrepreneurs and their stakeholders to reduce uncertainty about a venture by offering a structured analysis of a new venture idea and its external enablers, internal enablers and expected sustainability net benefits. Thus, sustainability-oriented entrepreneurs face less uncertainty when they decide to start and scale a new venture. However, some uncertainty will certainly remain.

6.7 Conclusion

The initially stated “*Panacea Hypothesis*” (Hall, Daneke, & Lenox, 2010) suggests that many of the sustainability challenges humanity faces can be re-conceptualized as entrepreneurial opportunities. Investigating this claim, this research analyzed under which circumstances entrepreneurs create ventures that contribute to sustainable development, under which circumstances the underlying venture idea can be diffused rapidly and what role sustainability considerations play in the process. The multi-level perspective from research on the sustainability transition (Bidmon & Knab, 2018; Geels, 2002) constitutes the base for this analysis, together with Davidsson’s re-conceptualization of the opportunity concept (Davidsson, 2015) and the co-evolutionary perspective of business model development (Schaltegger, Lüdeke-Freund, & Hansen, 2016). It was possible to integrate the three perspectives into a conceptual model that explains under which conditions new venture ideas from the socio-technical niche can be diffused to the socio-technical regime. The model shows that entrepreneurs start a new venture when they have high opportunity confidence as a result of a subjective evaluation of a new venture idea, external enablers and internal enablers that support the idea. The same factors influence whether a new venture idea can be scaled to the socio-technical regime. In this model, expected sustainability net benefits affect the venture creation as well as the diffusion process only if a venture is sustainability-oriented. This sustainability orientation can be a central part of the new venture idea (e.g., selling renewable electricity or organic food), it can be incentivized by external enablers (e.g., regulation or consumer trends) and/or it can be an internal preference of entrepreneurs and their stakeholders.

The model has been applied to case studies in the field of e-mobility and bike-sharing to illustrate the four pathways (Schaltegger, Lüdeke-Freund, & Hansen, 2016) for the diffusion of sustainable new venture ideas – i.e., ‘growth’ of the original venture, ‘replication’ by other entrepreneurs, ‘M&A’ of the original new venture or ‘mimicry’ by large incumbents. Additionally, the model has been extended to explain conditions for rapid international ‘growth’. Enriched with insights from international entrepreneurship literature (especially, Hennart, 2014; Oviatt & McDougall, 2005) the model showed that rapid international ‘growth’ of a new venture idea is

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most likely for externally enabled sustainable new venture ideas that build on knowledge-intensive products/services that can be delivered at low cost to a globally dispersed and contested niche of customers with modern technologies and an effective international network. When these conditions do not apply 'replication', 'M&A' and 'mimicry' (or a combination of the four pathways) might be more beneficial to rapidly scale a sustainable new venture idea. Sustainability-oriented entrepreneurs and their supporters from business, civil society and politics should concentrate their efforts accordingly.

Summing up, this article contributes to research at the crossroad of sustainability transition, entrepreneurial opportunity, sustainable entrepreneurship, and international entrepreneurship. Its central theoretical contribution is the development and application of a model of entrepreneurial opportunities for the diffusion of sustainable venture ideas. This model allows researchers and practitioners to systematically analyze how and under which circumstances entrepreneurs can contribute most to sustainable development. To validate and refine the model empirical research is necessary. For instance, the model should be used to study the historical development of ventures in key industries. This could reveal key success factors for the creation and diffusion of sustainable new venture ideas. It would also be interesting to apply the model to the widely cited sustainable business model archetypes (Bocken, Short, Rana, & Evans, 2014). These archetypes can be seen as a starting point for new venture ideas in different industries with high expected sustainability net benefits. Future research could assess the opportunity confidence of potential entrepreneurs for the different new venture ideas and identify existing and missing internal and external enablers.

Closing it can be said that the model shows that entrepreneurship does not constitute a panacea on its own. But using the model it is possible to identify the levers for the creation and diffusion of sustainable venture ideas. Thus, entrepreneurs, policymakers, and their supporters can be guided to maximize the contribution of entrepreneurship to the sustainability transition.

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7. Summary of findings, limitations and future research

The four articles of this dissertation make a number of theoretical, empirical and practical contributions (see summary in table 7.1 below). This chapter summarizes these contributions, it discusses limitations and areas for future research.

Table 7.1 Overview of theoretical, empirical and practical contributions from the four articles

	Article 1 Develops Lean Impact Measurement (LIM)	Article 2 Tests the practicality of LIM	Article 3 Explores entrepreneurship related to the SDGs	Article 4 Models venture creation and venture idea diffusion
Theoretical contribution	<ul style="list-style-type: none"> - Identifies challenges for impact measurement in new ventures - Simplifies SROI based on effectuation theory - Introduces additional perspective of business model innovation to stakeholder theory 	<ul style="list-style-type: none"> - Finds empirical support for the practicality of LIM - Reviews existing tools for sustainable business model development 	<ul style="list-style-type: none"> - Develops a scalable and repeatable method to map SDG related venture activities 	<ul style="list-style-type: none"> - Models sustainable venture creation and venture idea diffusion - Clarifies indirect influence of sustainability considerations - Assess the best conditions for growth based diffusion
Empirical contribution	<ul style="list-style-type: none"> - Provides the conceptual foundation for future empirical studies 	<ul style="list-style-type: none"> - Tests the LIM workshop with 87 individual participants from 58 entrepreneurship organizations - Analyses 64 individual feedbacks 	<ul style="list-style-type: none"> - Analyses SDG activities of 588 ventures from 193 venture competitions in Germany - Finds correlations between jointly addressed SDGs 	<ul style="list-style-type: none"> - Discusses four illustrative case studies - Provides the conceptual foundation for future empirical studies
Practical contribution	<ul style="list-style-type: none"> - Proposes a practical approach to measure and forecast the sustainability contribution in new ventures 	<ul style="list-style-type: none"> - Develops a workshop format to teach LIM in practice supported by an excel tool 	<ul style="list-style-type: none"> - Provides a detailed analysis of entrepreneurship in Germany along the SDGs - Directs policymakers to SDGs that are insufficiently addressed by entrepreneurs 	<ul style="list-style-type: none"> - Guides entrepreneurs and policymakers to the best conditions for the creation and diffusion of sustainable venture ideas

7.1 Article 1

Summary of findings:

The focus of article 1 lies on theory. It reviews the challenges around sustainability impact measurement at the micro level and finds a mismatch between the effort and the benefits of impact measurement for entrepreneurs. To resolve this mismatch, the article identifies five requirements for impact measurement in new ventures that guide the development of a more suitable approach: Measurement must occur at the impact level, and it must capture all three dimensions of sustainability. The results must be useable as impact forecasts, and the results must be useful for internal and external benchmarking. Doing all this, the effort of measurement must remain low.

Summary of findings, limitations and future research

Building on stakeholder theory, Social Return on Investment (SROI) is identified as a nearly suitable approach; however, an analysis of the five requirements reveals that SROI requires too much effort. To reduce the required effort, SROI is adapted to the needs of effectual entrepreneurs (Sarasvathy, 2001). Therefore, SROI is simplified using learnings from the Lean Startup concept (Ries, 2011), the Pareto Principle (Juran & Feo, 2010) and the macroeconomic concept of Sustainable Value Added (Figge & Hahn, 2004). The result of this simplification is called Lean Impact Measurement (LIM). It reduces the measurement effort of SROI with three main changes. First, the approach only measures the additional sustainability value (or destruction) a new venture creates compared to the status quo. Second, LIM does not measure all outcomes. Instead, it concentrates measurement efforts on the most impactful changes a new venture creates compared to the status quo. Third, contrary to SROI, it is optional to monetize outcomes.

In addition to the LIM approach itself, the underlying reasoning in article 1 offers new perspectives on stakeholder theory in the context of business model innovation. The additionality perspective of LIM directs attention to stakeholders for which the largest additional sustainability value can be created. This perspective on stakeholders adapts the conventional understanding of salient stakeholders (Mitchell, Agle, & Wood, 1997) to the specific case of business model innovation for sustainability.

Limitations and opportunities for future research:

The simplifications that make LIM more applicable to effectual new ventures go along with some limitations. Most importantly, the approach does not offer absolute impact data. The approach can only create relative impact metrics in comparison to a benchmark. In addition to this, it requires users to make and refine assumptions about their most relevant impacts and gather reliable data for the LIM calculations. Accordingly, the quality of the results depends strongly on a carefully selected comparison, suitable assumptions and valid data for the calculation. Only under these conditions, the LIM approach has the potential to measure and forecast sustainability impact in a way that is practicable for new ventures, but still meaningful for external stakeholders in terms of benchmarking.

Thus, theoretically, LIM constitutes an efficient and effective approach to measuring the sustainability contribution at the micro level (responding to GRQ 1). However, subsequent empirical research must validate the two main assumptions about LIM: that it is efficient (i.e., it is practical for entrepreneurs) and effective (i.e., it creates meaningful data). Article 2 constitutes the starting point for the validation of the efficiency assumption, but additional longitudinal research is necessary to validate both assumptions completely. Once the LIM approach is validated and refined, it can be used to create more transparency about the mechanisms that create high sustainability impact ventures. For instance, the influence of a

Summary of findings, limitations and future research

venture's sustainability-orientation on a venture's sustainability contribution could be assessed, or it could be studied whether performance drivers in high impact ventures differ from conventional ventures.

7.2 Article 2

Summary of findings:

Article 2 tests empirically the first of the two assumptions about LIM – i.e., the practicality assumption. To test the practicality, the article initially reviews existing academic tools for sustainable business model development. This review shows where LIM can complement the existing tool landscape. To make this contribution in practice, the article translates the theoretical LIM process into a teachable format. Following Experiential Learning Theory (Kolb & Kolb, 2005) and best-practices from entrepreneurship education LIM is taught in a workshop supported by an Excel-tool. To refine this teaching approach and verify its practicality the workshop has been conducted 12 times, in total with 87 individuals from 58 entrepreneurship organizations. Along the process three types of data were collected: verbal feedback from the workshops, 64 completed written feedbacks and various expert interviews.

The collected data generally confirm the efficiency assumption – i.e., that LIM can serve as a practical tool to evaluate the sustainability impact of new ventures. However, feedback also highlighted that the simplifications of LIM create concerns about the validity of the measurements – i.e., its effectiveness. This concern can be explained with the need to carefully select and validate the assumptions for the LIM calculations. As already discussed in article 1, users that select assumptions without care and use them without verification do not obtain quality impact indications.

Limitations and opportunities for future research:

The lack of longitudinal data constitutes the most important limitation of article 2. Within the scope of this dissertation, the data collection concentrated on the feedback that participants provided soon after the workshop. Thus, it was not possible to collect data on the long-term application of LIM across a wider number of ventures. This points to the need for future longitudinal studies to observe the diligence of LIM measurement in practice. Such studies also constitute the base for the validation of the effectiveness assumption. Ideally, a sample of ventures uses LIM over a longer period of time. Then, the historical forecasts of the ventures can be reviewed and compared with actual impact data. This approach would also reveal common mistakes by practitioners and allow researchers to refine the approach in order to create more effective impact calculations. Finally, these impact calculations could be used to pursue the research opportunities discussed in article 1.

7.3 Article 3

Summary of findings:

The first two articles examine the challenge of effective and efficient measurement at the micro level. Article 3 does the same at the meso level for 588 ventures that obtained an award in one of 193 venture competitions in Germany. The large sample size allows to draw conclusions on entrepreneurship on a national level, but due to the sample size it is not possible to measure at the impact level (at least not with manageable effort). Instead, the proposed approach uses the description of a venture's activities as an indicator for its sustainability contributions along the 17 SDGs. Building on this correlation assumption, the article analyses online text material from ventures with semi-automated content analysis. The use of semi-automated instead of automated content analysis assures high quality in the allocation of SDGs to the 588 ventures. Compared to measurement at the impact level with LIM, the SDG mapping methodology captures entrepreneurial contributions to sustainable development less effective, but significantly more efficient, as the measurement does not require any active venture participation.

The approach reveals patterns of SDG related entrepreneurship in Germany. For example, the data show significant correlations between goals that are frequently addressed in a single venture and SDGs that are rarely addressed. Additionally, the article contrasts the observed entrepreneurial activities with the national SDG performance (Sachs, Schmidt-Traub, Knoll, Durand-Delacre, & Teksoz, 2017) which allows identifying SDGs that are insufficiently addressed by entrepreneurs despite a high societal need.

Together the observed correlations between SDGs and the identified gaps in SDG related entrepreneurship can guide German policymakers and sustainable entrepreneurs to fields where they are likely to create the largest sustainability impact. In addition to these empirical findings, the article offers a scalable and repeatable methodology to map SDG related entrepreneurship.

Limitations and opportunities for future research:

The proposed approach in article 3 has some limitations. The most important limitations are linked to the sample selection, the development of the coding scheme, and the coding process. The focus on venture competitions constitutes a quality filter for immature ideas, and it allows to obtain third-party information on the ventures, but it also creates the risks to exclude certain new ventures. Equally, piloting and iteratively improving the coding scheme cannot assure the identification of all potential SDGs and their sub-targets. Accordingly, there remains some doubt on the accuracy of the measurement so that users should be aware of a certain margin of error.

Summary of findings, limitations and future research

Future longitudinal and/or cross-country applications of the approach can be used to improve measurement accuracy and more importantly, they can improve our understanding of sustainability-related entrepreneurship. The resulting samples can be used to assess the validity of SDG related entrepreneurship as an indicator of entrepreneurial contributions to sustainable development. If the validity is confirmed, the approach can be used to study policy interventions and their effects on sustainable entrepreneurship. Insights from this research could greatly improve our ability to create successful sustainable entrepreneurial ecosystems. Moreover, the development of more automated text mining approaches could make the approach more accessible for practitioners and inspire researchers in subsequent research.

7.4 Article 4

Summary of findings:

While article 1-3 assess the measurement of sustainability impact at different scales, article 4 assesses under which conditions new ventures emerge that create sustainability impact, and it clarifies how sustainability considerations influence the process. The study proposes a conceptual model that explains under which circumstances new sustainable venture ideas from the socio-technical niche can be diffused to change the socio-technical regime. The model has two parts. The first part of the model explains that venture creation depends on an entrepreneur's opportunity confidence in a new venture idea under consideration of existing external enablers (Davidsson, 2015) and internal enablers. The second part of the model explains the diffusion of the venture idea along one of four diffusion pathways – 'growth', 'replication', 'M&A' and 'mimicry' (Schaltegger, Lüdeke-Freund, & Hansen, 2016). This second part is equally influenced by the three constructs of new venture idea, external enablers, and internal enablers. It is important to note that during the process sustainability considerations are only relevant if they are linked to one of the three constructs.

The proposed model helps researchers, entrepreneurs, and policymakers to identify the best conditions for the creation of sustainable ventures and the diffusion of underlying venture ideas. To illustrate this application, the model is adapted to explain the best conditions for the diffusion of sustainable new venture ideas through venture growth. The adapted model shows that rapid international growth is most suitable for externally enabled venture ideas that build on knowledge-intensive products/services that can be delivered at low cost to a globally dispersed and contested niche of customers through modern technologies and an effective international network. When these conditions do not apply less direct pathways for the diffusion (i.e., 'replication', 'M&A' and 'mimicry') might be more beneficial to diffuse a sustainable new venture idea rapidly.

Summary of findings, limitations and future research

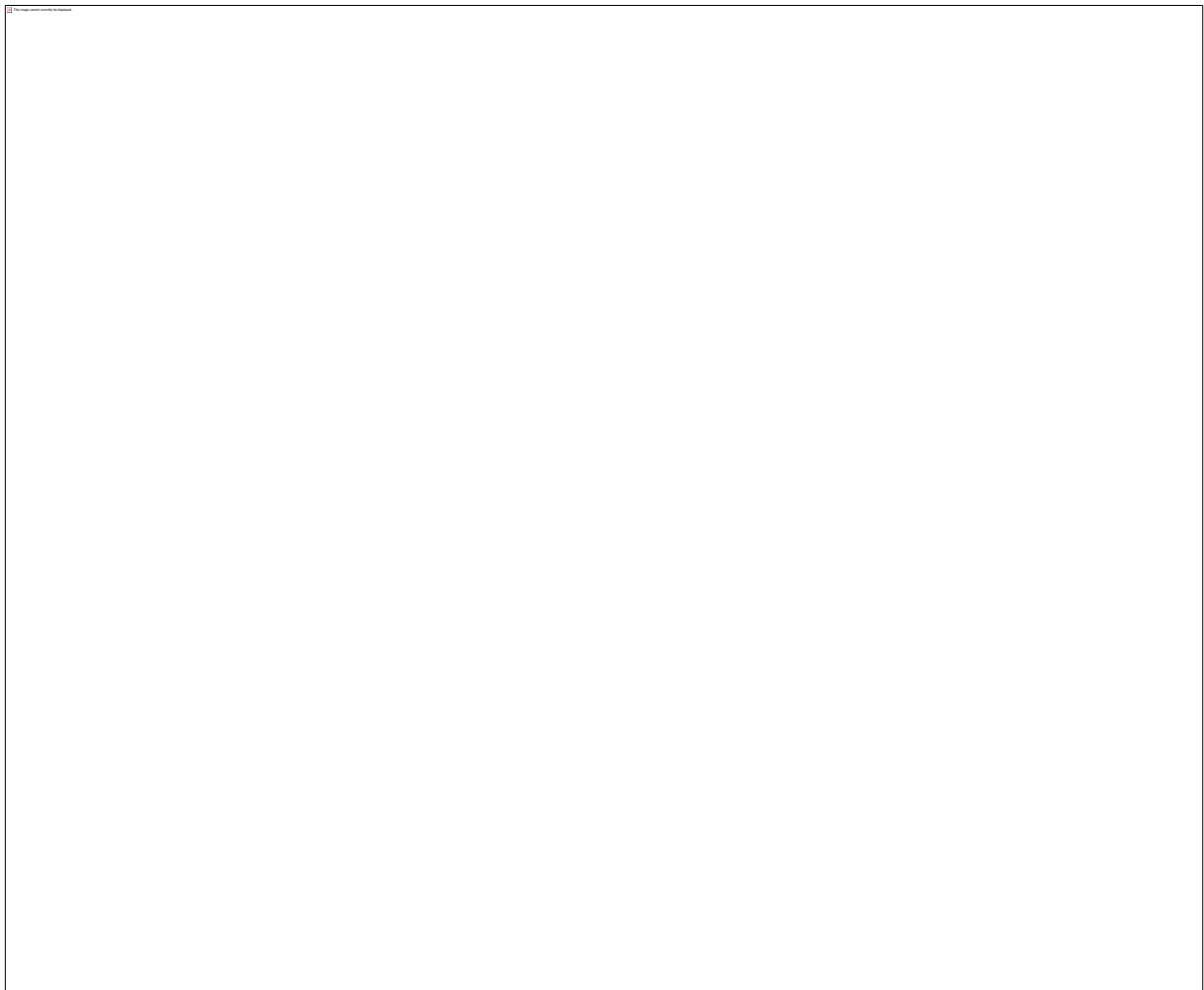
Limitations and opportunities for future research:

In its current state, the model constitutes a structured way to assess the conditions for sustainable venture creation and the diffusion of the underlying venture idea. But the validity of the model has only been illustrated with selected case studies from the mobility sector. To further review the validity of the model and test its value for subsequent research more empirical research is necessary. Such research can yield valuable theoretical and practical contributions on how to increase entrepreneurial contributions to sustainable development (GRQ 3). For instance, it could be of great value to better understand the opportunity confidence of potential entrepreneurs in different types of new venture ideas. Adding to this, it would be of great value to better understand which internal and external enablers are required to increase opportunity confidence in promising sustainable new venture ideas.

8. Overall discussion

After the summary of the key findings, limitations and future research areas in the previous chapter, this chapter discusses how the four articles contribute to the three guiding research questions (GRQ 1-3) (see table 8.1). GRQ 1 and 2 are closely related as both search for practical measurement approaches that strike a suitable balance between efficiency and effectiveness. The main difference results from the different levels of analysis. Accordingly, some findings apply equally to GRQ 1 and 2, while others are specific to the micro level (GRQ 1) or meso level (GRQ 2). The findings that apply to both questions are discussed first, followed by a discussion of the findings that are specific to each of the two levels of analysis. After this, the contributions to GRQ 3 are discussed. Hence, how the entrepreneurial contributions to sustainable development can be increased. Overall, the discussion translates the findings from the articles to a more general level preparing the overall conclusion.

Table 8.1 Overview how the four articles contribute to the three guiding research questions



Overall discussion

GRQ 1 & GRQ 2: Software solutions can minimize the trade-off between efficient and effective measurement at the micro and meso level, but some uncertainty remains

A central theme that equally shapes GRQ 1 and GRQ 2 is the trade-off between efficient and effective measurement (see also discussion in the introduction). Due to the effectual conditions of new ventures (see article 1) there is a strong need to minimize effort regarding data collection and data analysis. Responding to this need the articles 2 and 3 tested approaches that reduce the need for data collection and facilitate analysis with software. For article 2, this meant to facilitate calculations of impact with an Excel-tool; in article 3, this meant to use atlas.ti for semi-automated content analysis of text material from multiple ventures. In both cases software allowed to create measurements with a reasonable effort that otherwise would have been impractical. Nevertheless, the user feedback in article 2 and the need for human quality control in article 3 highlight the potential for even more automated software solutions. These findings suggest that the application of more sophisticated software solutions in the future will further reduce the trade-off between efficient and effective measurement.

Despite the potential of automated software solutions, the learnings from article 1-3 show that the effectiveness of sustainability measurements of new ventures will always remain limited for the micro and meso level. Due to insufficient historical data, measurement in new ventures is future-oriented and based on limited data and vague assumptions. This results from the effectual venture development process (see article 1) and translates into predictive measurements with limited validity. The feedback of LIM-users in article 2 underlines that this is not only a concern in theory but also in practice. Unfortunately, it is not possible to fully resolve this problem as uncertainty is inherent to entrepreneurship (Alvarez & Barney, 2005). Only to some extent, it is possible to factor in risks (e.g., the probability that a sustainable venture changes its business model). The model on venture creation and venture idea diffusion (article 4) can help to identify these risks. However, countless additional influences could potentially invalidate predictions about a venture's sustainability contributions. For example, it is not possible to foresee events like the Volkswagen emission scandal (Blackwelder, Coleman, Colunga-Santoyo, Harrison, & Wozniak, 2016) or new technologies like blockchain (Catalini & Gans, 2016). Such events can create unpredictable external enablers that change the diffusion potential of a sustainable venture idea and thus invalidate earlier measurements. Accordingly, the validity of predictive sustainability measurements in new ventures is always limited due to uncertainty at the micro level as well as the meso level.

GRQ 1: At the micro level it is possible to measure a venture's sustainability impact

The potential for more automated software solutions and the limited validity of predictive measurements apply to both levels of analysis, the micro and meso level. But there are also findings that are specific to the micro level of GRQ 1. Article 1 proposes an approach that

Overall discussion

allows capturing the sustainability contribution of an individual venture at the recommended impact level (see Clark & Brennan, 2016; Clifford, 2014; European Union & OECD, 2015). Thus, it proposes to directly measure the sustainability effect of a venture instead of measuring indicators that are likely to correlate with sustainability. Article 1 and 2 identify three main levers to keep measuring the impact of an individual venture relatively efficient: First, the before stated software support for data collection and calculations; second, measuring relative impact compared to peers instead of absolute impact to reduce the number of aspects that must be measured; and third, concentrating measurement on the most impactful changes from the perspective of stakeholders. Together these changes create a comparably efficient way to measure sustainability at the impact level, something that the empirical findings of article 2 confirm. However, the empirical findings also show that practitioners would appreciate even more efficient solutions.

GRQ2: Measurement at the meso level should prioritize efficiency over effectiveness

The analysis in article 2 shows that an approach like LIM – at least in its current form²⁴ – requires too much effort to measure the sustainability contribution for hundreds of ventures. Following the findings of article 3, samples of this size should not be measured at the impact level. As an alternative, it is possible to rely on indicators that correlate with sustainability. Ideally, these indicators can be extracted from data that are readily available without creating any effort for the ventures under investigation. Article 3 applied this idea using semi-automated content analysis of venture text material. The chosen indicators were words that point to activities along one of the 17 Sustainable Development Goals (SDGs). This allowed assessing the sustainability contributions of numerous ventures without creating any effort for the ventures under investigation. While this solution is very efficient, it comes at the expense of effectiveness. The usage of keywords as indicators cannot create sustainability measurements that are as effective as those of LIM. The learnings from article 3 point to the conclusion that measurements at the meso level must prioritize efficiency over effectiveness.

GRQ 3: To increase the sustainability contributions of entrepreneurs suitable internal and external enablers are crucial

In sum, the two proposed approaches allow to assess the sustainability contribution of new ventures at different scales and different levels of detail responding to GRQ 1 and GRQ 2. This leaves GRQ 3 unaddressed. Thus, the discussion on how the sustainability contribution of entrepreneurs can be increased? It is out of scope for this dissertation to discuss this question as detailed as the topic of measurement. But the three articles on measurement indirectly

²⁴ More sophisticated software solutions might reduce this problem and make LIM applicable for larger sample sizes.

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touch upon this question and most importantly, article 4 develops a model that explains under which conditions entrepreneurs change the unsustainable socio-technical regime. Thus, article 4 and the other three articles offer some insights on GRQ 3.

The model in article 4 shows that the three constructs – new venture ideas, internal enablers, and external enablers – explain the creation and diffusion of sustainable venture ideas. However, the importance of the three constructs differs between venture creation and venture idea diffusion. It can be assumed that many entrepreneurs can create a specific new sustainable venture with their internal enablers (e.g. financial resources or ventures specific skills) but the number of founders that can scale this venture is most likely more limited as most founders lack the necessary internal enablers (e.g., available networks or access to capital) and external enablers (e.g., supportive regulations or consumer trends). Concerning GRQ 3, it can be concluded that a new venture idea is a base for entrepreneurial contributions to sustainability, but internal and external enablers are decisive to realize and scale this contribution.

Article 4 highlighted that external enablers have a special role in the diffusion of sustainable new venture ideas. While internal enablers differ strongly between different ventures, many external enablers apply to all entrepreneurs in a socio-technical system. External enablers constitute a type of filter that allows or prevents new sustainable venture ideas to rise from the socio-technical niche to the socio-technical regime. For example, selling sustainable fashion can only scale if there is sufficient demand from conscious consumers. Equally, the diffusion of renewable energies business models depended largely on political support schemes. These examples point to the special role of external enablers as a precondition for large entrepreneurial contributions to sustainable development. Unfortunately, it is difficult for entrepreneurs themselves to create suitable external enablers unless they act as institutional entrepreneurs (see e.g., Pacheco, Dean, & Payne, 2010). This highlights the importance of factors beyond the direct reach of entrepreneurs in the creation of entrepreneurial contributions to sustainable development.

It is interesting to link the special role of external enablers with effectuation theory. As discussed in article 1, effectual entrepreneurs improve their business model through iterative learning and adaptation. They do not pursue very radical new venture ideas without adapting them. Bringing this behavior together with the model of article 4, it can be said that sustainable entrepreneurs should adapt and improve their sustainability contribution iteratively within the boundary conditions of available external enablers as too radical solutions are unlikely to scale up to the dominant socio-technical regime. The patterns of SDG related entrepreneurship in article 3 suggest that many entrepreneurs follow this behavior as their activities concentrate on a limited number of topics that external enablers support.

9. Overall conclusion

Main contributions:

This dissertation assesses entrepreneurial contributions to sustainable development. Thus, it contributes to research at the intersection of entrepreneurship, sustainability, and performance measurement. The main contributions of this dissertation are threefold. First, the conceptual development and practical application of Lean Impact Measurement (LIM) as a resource-friendly approach to measure sustainability contributions of individual ventures at the impact level. Second, the development and practical application of a semi-automated approach to mapping entrepreneurial activities for hundreds of ventures to the Sustainable Development Goals (SDGs). And third, the development of a conceptual model that explains the creation of sustainable ventures and the diffusion of the underlying venture idea.

These contributions are of great value for research and practice. LIM offers an approach to efficiently assess the sustainability of new ventures at the impact level which is unprecedented in entrepreneurship. This allows entrepreneurs to apply LIM internally for strategic decision making under effectual circumstances, but it also provides a measurement tool that can be valuable for external stakeholders like investors, incubators, and policymakers. The second approach, the mapping of SDG related entrepreneurship, offers an efficient measurement for hundreds of ventures. Thus, it is particularly relevant for researchers and policymakers to understand the patterns of entrepreneurial activities. Finally, the model on sustainable venture creation and sustainable venture idea diffusion can help stakeholders from the sustainable entrepreneurial ecosystem (e.g., researchers, investors or policymakers) to better understand the variables that increase entrepreneurial contributions to sustainable development.

These contributions have been embedded in empirical research. The practicality of the LIM approach has been tested in 12 workshops with 87 individual participants from 64 organizations. The semi-automated mapping of SDG-related entrepreneurship has been applied to 588 ventures that were awarded in one of 193 German venture competitions. And finally, the model on sustainable venture creation and venture idea diffusion has been illustrated in case studies from the mobility sector. These applications helped to refine and validate the developed approaches of this dissertation. Moreover, they translated the LIM approach into a practical workshop and Excel-tool that can be used by practitioners, and they revealed the heterogeneous distribution of SDG-related entrepreneurship in Germany. Building on these applications, there are many more opportunities to apply and advance the contributions of this dissertation.

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Outlook on future research opportunities:

The contributions of this dissertation offer numerous starting points for subsequent research – most importantly, empirical research. Initially, empirical research is necessary to refine and validate some of the limitations discussed in chapter 7. Then, more empirical research is needed to leverage the findings of this dissertation for the advancement of sustainable entrepreneurship research. For instance, longitudinal studies with the LIM approach could be the beginning of a comprehensive benchmark between early-stage ventures. A benchmark like this could be used to identify the variables that drive entrepreneurial contributions to sustainable development. Another promising research opportunity would be the application of the SDG mapping methodology to ventures in different years and across different countries. This would allow researchers to identify successful sustainable entrepreneurial ecosystems and it could help to derive learnings for less successful ecosystems. These learnings could be enriched with learnings from the proposed model on the creation and diffusion of new sustainable venture ideas. For example, the model could be used to study the lack of new sustainable ventures particularly in unsustainable industries. Such a structured analysis can reveal drivers and challenges for venture creation and sustainable venture idea diffusion. The three ideas are only illustrative examples of subsequent research projects that can result from this dissertation. Chapter 7 provides more examples, and each of the four articles discusses future research opportunities in more depth. In sum, it can certainly be said that there are many more opportunities for research at this nexus of entrepreneurship, sustainability, and performance measurement.

Closing this dissertation, I want to emphasize the relevance of more research in this field. This dissertation started with the huge sustainability challenges ahead of humanity (see e.g., Brundtland Commission, 1987; General Assembly, 2015; Meadows, 1972; Rockström et al., 2009), and it emphasized the special role of businesses. On the one hand, businesses are a major cause of unsustainable development, and on the other hand, they can make our societies more sustainable (see e.g., Bansal & DesJardine, 2014; Brundtland Commission, 1987; Cohen & Winn, 2007; General Assembly, 2015; Loorbach & Wijsman, 2013). Entrepreneurs have a special role in this quest for more sustainable businesses. Their role can be described nicely with a quote from the environmentalist and polar researcher Robert Swan who said that: *“the greatest threat to our planet is the belief that someone else will save it”* (Stevenson, 2012). Sustainable entrepreneurs are the people that do not have this belief. They take action and translate ideas for a better world into tangible innovation, and they diffuse these innovation into society. Due to their role as a catalyst for innovation (see e.g., Hockerts & Wüstenhagen; Schaltegger, Lüdeke-Freund, & Hansen, 2016) they are sometimes portrayed enthusiastically as a ‘panacea’ for the sustainability challenges ahead of humanity (Hall, Daneke, & Lenox, 2010). Even though the role of a ‘panacea’ might be exaggerated, their role

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as a catalyst for sustainable development certainly justifies special attention from research. This research must figure out under which conditions more people take action, and it must understand how people that take action succeed. This knowledge is of great value to create the conditions that make entrepreneurship as beneficial for sustainable development as possible. To build up the necessary knowledge, a wide range of research is required that exceeds the scope of a single dissertation. This dissertation concentrated on the question how to improve the measurement and management of entrepreneurial contributions to sustainable development. It is my hope that the findings of this research and all subsequent research will help to direct attention, time and resources where they do most good for sustainable development. Thus, this dissertation hopefully fills some gaps in this important field of research.

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