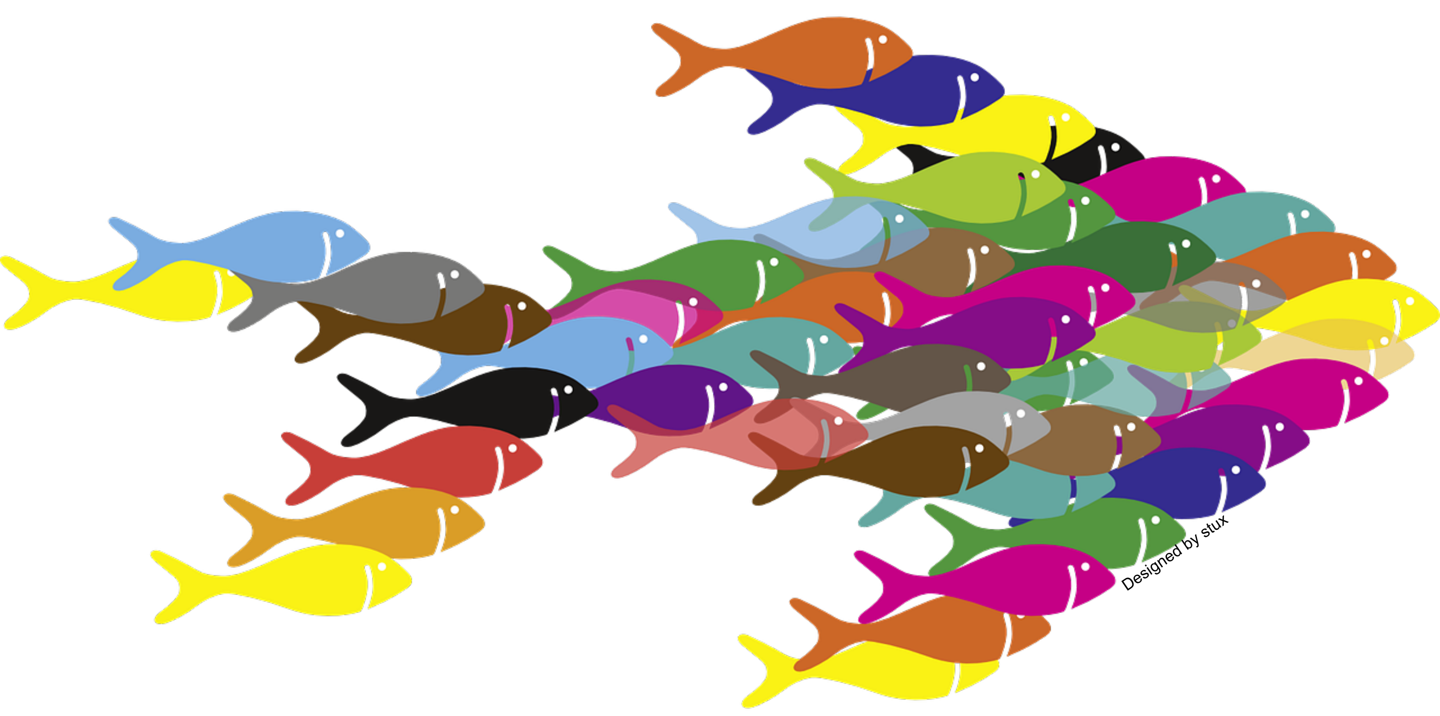
Peter Wehnert

Doctoral Dissertation

Crowd-based solutions for sustainability

The role of inbound open innovation approaches and crowdfunding in developing sustainable innovations



Crowd-based solutions for sustainability – the role of inbound open innovation approaches and crowdfunding in developing sustainable innovations

Der Rechts- und Wirtschaftswissenschaftlichen Fakultät / dem Fachbereich Wirtschafts- und Sozialwissenschaften

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Preface

"Personal participation is the universal principle of knowing."

Michael Polanyi & Harry Prosch, Meaning, 1975

Learning about sustainability management and business ethics in my Bachelor studies at Martin-Luther-University Halle-Wittenberg in 2007 woke up my passion for these streams and for academic work. Roughly at the same time, research increasingly addressed open innovation approaches and began to explore the phenomenon of crowdfunding. In 2014, I started to work as a scientific associate at Friedrich-Alexander-University Erlangen-Nuremberg (FAU) for a project to develop novel sustainability-oriented services for electric mobility. Throughout this project, I realized how important it is to open the development process for stakeholder participation in order to create successful and highly accepted sustainable solutions and decided to devote my thesis to participatory approaches for sustainability.

Developing sustainable solutions requires vast knowledge on environmental, social, and economic aspects and often confronts financing issues. Instruments that enable the participation of wide circles of stakeholders throughout the creation and funding process are, thus, of major importance for the success of sustainable solutions and ultimately essential cornerstones for sustainable development. Yet, research on participatory instruments in the context of sustainability is largely still in its infancy. This thesis seeks to address this gap exploring the role of open innovation approaches and crowdfunding for developing sustainable solutions.

Following the tradition of FAU's School of Business, Economics and Society to conduct interdisciplinary research, my doctoral thesis builds on various disciplines including informatics, sustainability and customer research. To include these perspectives, I worked with co-authors of diverse backgrounds from different institutions. Thus, this thesis highly benefitted from the interdisciplinary research tradition at FAU's School of Business, Economics and Society and I feel honored contributing to continue this tradition.

Acknowledgments

I would like to express my sincere gratitude to everyone and every institution that accompanied me in the preparation of my doctoral thesis. First of all, I wish to express my deepest gratitude to my supervisor and mentor Professor Dr. Markus Beckmann for his trust in me and my work, for his constant support and extremely constructive feedback, and for his outstanding leadership qualities. By always having an open ear for my academic and personal concerns, by providing academic guidance of inestimable value, and by giving me the opportunity to work on several of his chairs' projects he enabled me to develop my academic and professional skills.

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Furthermore, I would like to thank my colleagues at the Chair for Corporate Sustainability Management: Dr. Jens Heidingsfelder, Dr. Dimitar Zvezdov, Dr. Roya Akhavan, Prof. Dr. Anica Zeyen, Stella Blohmke, Laura Therese Heinl, Jennifer Adolph, Fenja Lüders and Susanne Piehl. Thank you for your outstanding support of my research projects, for your creative ideas and constructive feedback. Thank you for your motivation, especially in dealing with setbacks. I also would like to thank all co-authors that contributed to my doctoral thesis: Christian Baccarella, Christofer Daiberl, Christoph Kollwitz and Barbara Dinter. A special thanks also goes to all student assistants that supported my research. In addition, I would like to thank the School of Business, Economics and Society at the FAU, especially Dr. Dennis Kirchberg for giving me the opportunity to work with him, for cheering me up and for the welcome distraction playing table-football.

Moreover, I would like to thank Prof. Dr. Hans-Ulrich Zabel for awakening my passion for sustainability management and Prof. Dr. Ingo Pies and Dr. Stefan Hielscher for awakening my passion for scientific work.

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Crowd-based solutions for sustainability – the role of inbound open innovation approaches and crowdfunding in developing sustainable innovations

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This paper-based dissertation consists of four individual articles – referred to as chapters – that have been published or are manuscripts prepared for publication. With these four chapters the formal requirements of the University of Erlangen-Nuremberg's School of Business, Economics and Society for a paper-based dissertation are fulfilled. The chapters are arranged according to content in the following order:

Chapter I:

Wehnert, P., Kollwitz, C., Daiberl, C., Dinter, B., & Beckmann, M. (2018). Capturing the Bigger Picture? Applying Text Analytics to Foster Open Innovation Processes for Sustainability-Oriented Innovation. *Sustainability*, *10*(10), 3710. https://doi.org/10.3390/su10103710

Chapter II:

Wehnert, P., Baccarella, C. V., & Beckmann, M. (2019). In crowdfunding we trust? Investigating crowdfunding success as a signal for enhancing trust in sustainable product features. *Technological Forecasting and Social Change*, *141*, 128-137. https://doi.org/10.1016/j.techfore.2018.06.036

Chapter III:

Title: How do you like my crowd? Analyzing the effects of crowdfunding motivation and information specificity on consumers' perceptions of products from sustainable entrepreneurs

Authors: Wehnert, P., Baccarella, C. V., & Beckmann, M.

Chapter IV:

Title: Crowdfunding a sustainable future? A systematic literature review on crowdfunding and sustainable entrepreneurship

Author: Wehnert, P

Content

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Abstract

Sustainable development requires innovative solutions that not only consider the economic dimension but also environmental and social dimensions. Nascent sustainable entrepreneurs are considered to hold great potential for producing such innovations in a particularly radical form. Yet developers of sustainability-oriented innovations confront high risks and uncertainties, as both prospective sustainability effects and economic success are very difficult to predict. In addition, pursuing interrelated social and ecological objectives along the entire life-cycle of an innovation while encountering hardly predictable side effects raise the complexity in creating sustainable innovations. These factors often make it difficult to attract funding. Early-stage sustainable entrepreneurs are especially affected by financing problems because traditional investors tend to fund clearly profit-oriented businesses. Nascent ventures that pursue sustainability objectives typically face severe trust, reputation, and legitimacy issues as these come along with increased information asymmetries.

Tapping the crowd for knowledge with inbound open innovation approaches and for financing with crowdfunding is increasingly discussed as a remedy. This doctoral thesis addresses these issues as it seeks to answer the following research question: *How can inbound open innovation approaches and crowdfunding be applied and combined throughout the innovation process of sustainability-oriented innovations to effectively address specific issues of these types of innovations and its developers?* This thesis investigates and answers the research question in four chapters and a framing paper.

The first chapter addresses knowledge, complexity, and acceptance issues of sustainable innovations. Conducting an action research study, the first chapter examines how analytical methods can enhance the effectivity and efficiency of different inbound open innovation approaches in the context of sustainability-oriented innovations. More specifically, the chapter proposes to apply text analytics to capture broad knowledge and positions of stakeholders on sustainability aspects even if they do not participate directly in the innovation process. Exemplarily examining 1,898 articles which illustrate the public discourse on the topic of electric mobility in Germany through use of the text analysis software Leximancer, the chapter identifies possibilities and limitations of this approach. Based on that, it elaborates a framework for the application of inbound open innovation methods supported by analytical methods along the entire innovation process of sustainable innovation.

The second chapter addresses trust and legitimacy issues of nascent sustainable entrepreneurs who are developing sustainable innovations by analyzing how advertising crowdfunded products as such influences consumer attitudes. Based on the assumption that displaying crowdfunding success on a product advertisement provides a quality signal that affects customers' product perceptions and trust in sustainability attributes, an online experimental study with 530 participants is performed. The results of this experiment reveal that portraying crowdfunding success indeed affects product attitudes and the credibility of sustainability-related features. The findings also indicate that the impact of the crowdfunding success signal changes from positive to negative with increasing product complexity. Therefore, marketing managers are advised to mention a successful crowdfunding campaign only on low-complexity products like coffee or cacao. On such products, it serves as a quality signal that increases trust in a product's sustainability features and, thus, contributes to

solve trust and legitimacy problems, especially of early-stage sustainable entrepreneurs.

The third chapter further analyzes the signaling function of crowdfunding success and seeks to find the type of information related to crowdfunding that is relevant to consumers and how it should be communicated to raise their trust in that signal. Another online experimental study is conducted in which a low-complexity product with different information on crowdfunding success is shown to 180 participants. The chapter reveals that information on intrinsic funding motivation more positively affects consumers' product perceptions than stressing extrinsic funding motivation. The participants more positively affected by cues on intrinsic funding motivation also developed more trust in sustainability attitudes. Thus, entrepreneurs offering sustainable products of a relatively simple nature can especially benefit from these findings to further win trust among their customer base. Moreover, the results show that customers have no preference between specific and non-specific information on the crowdfunding process (e.g., number of funders, amount of collected money) and different label formats. These findings suggest that further research is needed on possible influencing factors, such as the issuer of the crowdfunding label.

The fourth chapter addresses financing, trust, reputation, and legitimacy issues of sustainable entrepreneurs. Conducting a systematic literature review covering 70 relevant publications, the chapter analyzes the whole nexus of crowdfunding and sustainable entrepreneurship. Based on that, the chapter provides guidance to sustainable entrepreneurs on how to tap crowdfunding and which aspects to consider in doing so. The chapter also shows interrelations between sustainable entrepreneurship and crowdfunding, derives propositions, and establishes a research agenda for every element in the system of crowdfunding and sustainable entrepreneurship.

The framing paper positioned at the beginning of this dissertation summarizes the results of the four chapters and assigns them to the phases of the innovation process. Based on that, it proposes a framework for combining inbound open innovation methods and crowdfunding throughout the innovation process of sustainable innovation. This frameworks aims to support innovation managers or sustainable entrepreneurs who develop sustainability-oriented innovation in tackling specific issues associated with this type of innovation. This framework is then discussed from a research perspective whereby overarching limitations and topics for future research are presented.

Keywords: sustainability-oriented innovation; sustainable entrepreneurship; open innovation; text analytics; silent stakeholder; crowdfunding; signaling; labels; crowdfunding success; funding motivation; information specificity; customer perception; action research; systematic literature review; experimental study

1. Introduction

Sustainable development[1] requires major socio-technical changes (e.g., Tukker et al., 2008). In many sectors, including food, transport, and energy, radical social and environmental performance improvements are needed (Geels, 2011). Innovations, especially radical ones that differ from the current system logic, are considered an important means of fostering such transformations (Schaltegger & Wagner, 2011). As niche innovators are more likely to create radical innovations, these ventures rather than established businesses drive major socio-technical changes (Testa et al., 2019). Sustainable entrepreneurs[2] are often discussed as niche innovators (Testa et al., 2019) and important drivers for bringing forth radical sustainable innovations (Bos-Brouwers, 2009; Schaltegger & Wagner, 2011).

Yet sustainable entrepreneurs face higher obstacles in acquiring financing because traditional investors finance purely profit-oriented businesses rather than ventures that also pursue environmental or social goals (Choi & Gray, 2008). Besides challenges to attract finance, nascent entrepreneurs are typically faced with an unestablished reputation, as well as a lack of legitimacy and trust — a phenomenon acknowledged as the "liability of newness" (Stinchcombe, 1965: 148). These issues arguably intensify when ventures pursue sustainability-related aims, as these come along with increased information asymmetries, resulting in further trust and legitimacy issues (Jahn et al., 2005).

Moreover, developing sustainability-oriented innovations (SOI)[3] confronts innovation management with enormous risks, challenges, and complexities (e.g., Ketata et al., 2015). For example, in addition to economic difficulties, including predicting consumer behavior and requirements, developers of SOI face challenges in meeting ecological and social objectives that are strongly interrelated (Hansen et al., 2009). Moreover, the social and environmental impacts of an innovation are, especially in the long term, hard to predict, as unexpected side effects such as growth risks or rebound effects can occur (Paech, 2007). Therefore, the development of SOI requires a broad knowledge on sustainability aspects that typically goes beyond the scope of a single organization (Hansen & Große-Dunker, 2013) and rather lies within the extended stakeholder network (Hörisch et al., 2014). Also, stakeholder participation is regarded as necessary to create robust (accepted among stakeholders) and effective solutions (high quality through incorporating stakeholders' knowledge) for sustainability challenges (Lang et al., 2012; Schaltegger, Beckmann, & Hansen, 2013).

Opening the innovation process for stakeholder involvement is thus increasingly discussed as a promising means to address both complexity issues related to the development of SOI (e.g., Adams et al., 2016) and typical problems that nascent sustainable entrepreneurs face (e.g., Nielsen et al., 2016). Since Chesbrough

[1] Sustainable development is defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987: 51).
[2] Sustainable entrepreneurship is defined as "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: 2).
[3] My understanding of SOI is based on the definition by Hansen and Große-Dunker (2013: 2407f.) , who define the concept as "the commercial introduction of a new (or improved) product (service), product-service system, or pure service which — based on a traceable (qualitative or quantitative) comparative analysis — leads to environmental and/or social benefits over the prior version's physical life-cycle ("from cradle to grave")".

(2003) defined the concept of open innovation (OI),[4] various research streams have emerged with this phenomenon, including on different approaches to crowdsourcing, such as co-creation or crowdfunding (Leopold, 2015). These approaches can be applied at different stages throughout the innovation process to enable stakeholder participation and contribution. In my dissertation, I focus first on the combination of different OI methods that enable knowledge inflows (inbound OI approaches)[5] throughout the innovation process and on problems that affect the application of these approaches in the context of SOI. Then I focus on crowdfunding[6] that enables knowledge exchange and the inflow of financial resources during the later phases of the innovation process, and on specific issues that arise when sustainable entrepreneurs tap crowdfunding to finance their intended SOI. Thus, my thesis builds on the assumption that all sustainable entrepreneurs aim to create SOI. Overall, I strive throughout my dissertation to answer the following overarching research question: *How can inbound OI approaches and crowdfunding be applied and combined throughout the innovation process of SOI to effectively address specific issues of these types of innovations and its developers?*

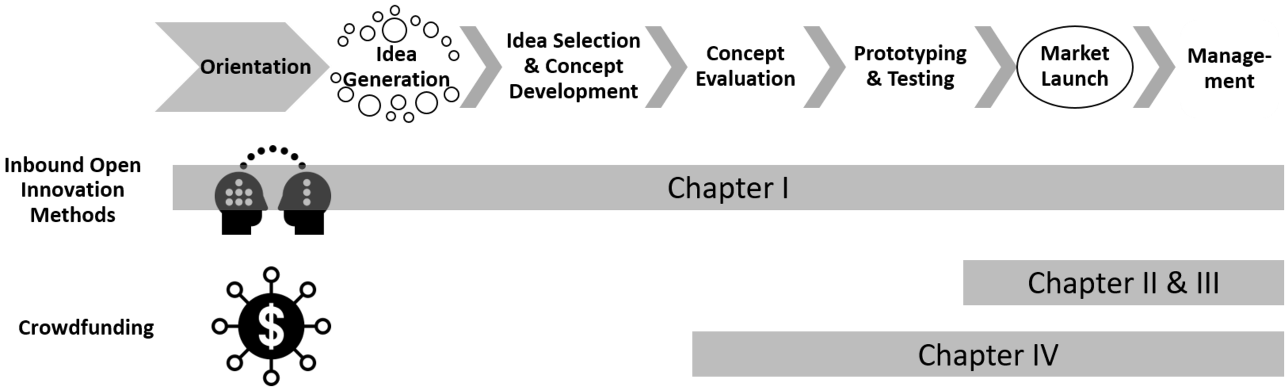

Fig. 1. Distribution of the dissertation's chapters in an innovation process model that is tailored to the specific requirements of SOI. This model is introduced in Chapter I (Wehnert et al., 2018) and based on the preliminary work of Paech (2007), Reichwald and Piller (2009), and Vahs and Brem (2015). The knowledge transfer icon was created by Duke Innovation Co-Lab (2013) and the crowdfunding icon by Iconathon (2018).

Consequently, an innovation process model tailored to the specific requirements of SOI forms the framework of my dissertation (see Fig.1). Differing from conventional innovation process models that typically start with idea generation followed by concept development and evaluation, prototyping and testing, and end with market launch (c.f., Reichwald & Piller, 2009), the SOI-tailored model starts with an orientation stage in which opportunities for SOI are identified and analyzed (Paech, 2007). Moreover, to account for, inter alia, unexpected side effects, the adjusted model ends with a management phase during which the innovation is

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[4] Throughout my dissertation, I work with a more recent definition by Chesbrough and Bogers (2014: 17), who define OI as "a distributed innovation process based on purposively managed knowledge flows across organizational boundaries."

[5] Based on the directions of the flow of knowledge the OI literature categorizes OI approaches into inbound (inflow from outside), outbound (outflow from inside) and combined types (e.g., Chesbrough & Bogers, 2014).

[6] In Chapters II and III, the prominent definition by Schwienbacher and Larralde (2010: 4) is applied, who characterize crowdfunding as "an open call, essentially through the Internet, for the provision of financial resources either in form of donation or in exchange for some form of reward and/or voting rights in order to support initiatives for specific purposes."
In Chapter IV, a more recent and holistic definition by Testa et al. (2019: 1) is used, who describe crowdfunding as the fruitful "interaction between a facilitating organization (or platform), a variety of founder campaigns who seek financial support for their ideas and ventures, and a large dispersed 'crowd' of individuals ('crowdfunders') who are enticed to invest, pledge, lend or donate to these ideas and ventures."

continuously examined (Vahs & Brem, 2015) in terms of its sustainability effects. Figure 1 shows these phases forming a linear development process model of SOI and gives an overview which chapter of my dissertation addresses which innovation phases. In the following section, I explain how (with which methods and theories) the individual chapters of my dissertation address the applicability of the respective OI methods in the different stages and summarize resulting potentials as well as constraints.

2. Summaries of the chapters

This section introduces the four chapters of my dissertation covering methods, theories, findings, and contributions. Table 1 gives an overview of the chapters before I describe these in detail.

Table 1
Overview of the four chapters.

Chapter title	**Key theories and literature**	**Research question(s)**	**Methods**	**Findings**
Capturing the bigger picture? Applying text analytics to foster open innovation processes for sustainability-oriented innovation	Stakeholder theory, open innovation, sustainability-oriented innovation	“How can text analytics of broad direct search data support open innovation for sustainability-oriented innovation?” (p. 2)	Action research, text analytics	• Public discourse data examined with text analysis supports the orientation phase best • Framework of using open innovation methods supported by analytical methods
In crowdfunding we trust? Investigating crowdfunding success as a signal for enhancing trust in sustainable product features	Sustainable entrepreneur-ship, crowdfunding, signaling, herding, social proof	“How does crowdfunding success influence consumers' product perceptions and trust in non-verifiable sustainability attributes at different levels of product complexity?” (p. 128)	Online experi-mental study	• Displaying crowdfunding success affects consumers’ product attitudes and trust in sustainability features • The effect of the crowdfunding success signal varies with product complexity
How do you like my crowd? Analyzing the effects of crowdfunding motivation and information specificity on consumers’ perceptions of products from sustainable entrepreneurs	Sustainable entrepreneur-ship, crowdfunding, signaling, consumer interference, cognitive evaluation,	(1) “How do cues about crowdfunder motivations and different degrees of information specificity of a crowdfunding success label affect customer perceptions?” (p. 3)	Online experi-mental study	• Portraying information on mainly intrinsic funding motivation affects customers’ product perceptions more positively than emphasizing extrinsic funding motivation

Chapter title	**Key theories and literature**	**Research question(s)**	**Methods**	**Findings**
	self-determination, value-belief-norm, label perception	(2) “How do customers’ sustainability orientations influence their perceptions of products linked to different crowdfunder motivations?” (p. 3)		• Positively affected participants by that information develop more trust in sustainability attitudes
Crowdfunding a sustainable future? A systematic literature review of crowdfunding and sustainable entrepreneurship	Sustainable entrepreneurship, crowdfunding	(1) “What is the state of research on crowdfunding and sustainable entrepreneurship?” (p. 2) (2) “How does the crowdfunding system work in the context of sustainable entrepreneurship?” (p. 2) (3) “How can sustainable entrepreneurs choose adequate crowdfunding platforms and types to match their needs?” (p. 2)	Systematic literature review	• Showing sustainable entrepreneurs how to tap crowdfunding and which aspects to consider • Elaboration of the interrelations between crowdfunding and sustainable entrepreneurship and provision of propositions and a research agenda for the components of that system

2.1 Capturing the bigger picture? Applying text analytics to foster open innovation processes for sustainability-oriented innovation

In the first chapter, written by Barbara Dinter, Christoph Kollwitz, Christofer Daiberl, Markus Beckmann, and Peter Wehnert, we begin with a reflection of the early innovation phases of SOI. These stages are of specific relevance for future sustainability impacts, as key decisions are taken on the profile of the innovation object that determine 75–85 percent of the life-cycle costs (Lang-Koetz et al., 2008). In these phases, different OI approaches, such as innovation communities or ideation workshops, are discussed as valuable tools to support the development of SOI by enabling stakeholder participation and, with that, the inflow of knowledge on environmental and social aspects (e.g., Arnold, 2011; Hansen et al., 2009, 2011). However, the relevant knowledge on sustainability aspects is distributed among a wide stakeholder network, including not only those directly involved in value creation, but also stakeholders (negatively) affected by the innovation object (Hörisch et al., 2014). Capturing that knowledge thus requires the broad participation of diverse actors in OI initiatives, which is in turn challenging, because some stakeholders are not willing or able to take part (e.g., Wendelken et al., 2014).

To elaborate the importance of this non-participation bias of OI initiatives in the context of SOI, we firstly bring together the central literature on SOI and OI. Resulting from that, and building on the stakeholder literature in which direct and indirect stakeholders are differentiated (Friedman et al., 2002; Rowley, 1997), we develop a definition of silent stakeholders,[7] summarizing the non-participation bias of OI initiatives. Having defined the problem, we address this issue in the context of SOI by proposing open direct search methods[8] supported by text analytics[9] to examine already existing external sources (e.g., specialized communities, social networks, or news websites) for sustainability-relevant stakeholder perspectives. To demonstrate the applicability of analytical methods in that context, we analyze the public discourse on electric mobility in Germany through text analytics, and show how this can foster the efficient inclusion of stakeholder perspectives from comprehensive data in OI processes for SOI. To this end, we conduct an action research study[10] guided by the following research question: *"How can text analytics of broad direct search data support OI for SOI?"* (Wehnert et al., 2018: 2). This is done within a research project that employs several OI approaches (ideation contests based on cooperation, innovation community, and workshops) to develop sustainability-oriented services in the area of electric mobility.

To examine the public digital discourse on electric mobility in Germany illustratively, we analyze 1,898 articles on that topic from the most relevant German news websites using the text analysis software Leximancer. We find that the mined text data best assist the innovation stages of orientation and idea generation for SOI. Within these stages, the mined discourse data can efficiently provide insights into sustainability-related aspects and stakeholders of the respective innovation space (electric mobility in this case), and thus support the identification of opportunities and analysis of potential SOI in that area. Also, this approach allows us to measure the word occurrence efficiently, which can serve as an indicator for the relevance of topics or stakeholders. Moreover, text analytics as applied here can support OI initiatives in the idea generation phase by, for example, determining which stakeholders to invite to ideation contests, innovation workshops, and communities. Yet this approach has various limitations, which we discuss thoroughly. One of these is that the mined data are too general to support idea generation with specific views from silent stakeholders.

Based on the limitations and our experiences throughout the action research, we suggest a framework of further open direct search approaches combined with text analytics throughout the innovation process to supplement OI methods for SOI. These methods are described in more detail in Section 3.1. The framework can serve as an instrument reducing risk in the creation of SOI. It also provides starting points for future research, as none of the proposed analytical methods has been empirically tested for applicability in that context.

Overall, with Chapter I, we contribute to the literature on SOI by addressing complexity issues and challenges

[7] We characterize silent stakeholders "as direct and indirect stakeholders of a potential innovation who are not willing and/or not able to participate in OI initiatives for that innovation" (Wehnert et al., 2018: 7).

[8] Piller and Hilgers (2016) describe a direct search as a classic approach to information retrieval in which actors search for relevant information by applying certain search criteria and algorithms. A direct search is defined as open if it is oriented as widely as possible and includes a broad range of sources (Laursen & Salter, 2006; Piller & Hilgers, 2016).

[9] "Text analytics is where a software tool parses text and extracts facts (addresses, parts, complaints) about key entities (customers, products, accounts). […] [it] always involves the transformation of unstructured data into some kind of data structure" (Russom, 2007: 6).

[10] "Action research simultaneously assists in practical problem-solving and expands scientific knowledge. It enhances the competences of the respective actors, being performed collaboratively in an immediate situation using data feedback in a cyclical process, aiming at an increased understanding of a given social situation. It is primarily applicable to the understanding of change processes in social systems and undertaken within a mutually acceptable ethical framework" (Hult & Lennung, 1980: 247).

such as meeting interrelated social and ecological targets (Hansen et al., 2009), or long-term effects that are difficult to predict (Paech, 2007). In this context, we add to discussion on the potentials and limitations of OI approaches for the creation of SOI (Arnold, 2011; Fichter, 2009; Hansen & Große-Dunker, 2013; Rauter et al., 2017). Furthermore, we have pioneered work in defining silent stakeholders, in linking this non-participation problem to SOI, and in proposing ways to identify these stakeholders and their perspectives. We thereby also contribute to the debate on indirect and direct stakeholders (Beckmann & Schaltegger, 2014; Figge et al., 2002; Friedman et al., 2002; Frooman, 1999; Rowley, 1997) and their involvement in the development of SOI (M. G. Arnold, 2011; Hansen & Große-Dunker, 2013).

For the innovation management of SOI, text analytics of broad discourse data can provide assistance in the orientation and idea generation phase by identifying sustainability-related actors, topics, and risks of an innovation field. As the majority of future sustainability impacts of an innovation are fixed in the early innovation phases (Fichter & Paech, 2004; Maxwell & Van der Vorst, 2003), our approach can offer an instrument to reduce risks when developing SOI. Moreover, the proposed framework, which can be applied to any publicly and intensively discussed innovation area, can enable managers to systematically disclose different perspectives and thus promote evidence-based decision-making for the entire development of SOI.

Yet these OI approaches (ideation contests, innovation community and workshops, and direct search methods) analyzed in the first chapter are limited to knowledge flows. In the later innovation phases, financing and legitimation aspects become increasingly important. An OI approach that can address both is crowdfunding. In the next three chapters, I examine crowdfunding as a tool to support the later innovation phases of SOI and, with that, financing and legitimacy issues of sustainable entrepreneurs.

2.2 In crowdfunding we trust? Investigating crowdfunding success as a signal for enhancing trust in sustainable product features

In the context of sustainability, crowdfunding has largely been discussed as an instrument to finance sustainable ventures (e.g., Calic & Mosakowski, 2016; Testa et al., 2019) and to increase their legitimacy (Lehner, 2013). While the majority of studies on crowdfunding and sustainability are devoted to analyzing the function of financing for sustainable entrepreneurs (e.g., Calic & Mosakowski, 2016; Hörisch, 2015, 2017), there is little empirical evidence regarding effects on legitimacy. In particular, not much is known about how crowdfunding influences acceptance in one of the most important stakeholders — the customers. Interestingly, this gap persists across the bandwidth of OI methods, although the fact that OI approaches allow stakeholder participation throughout the innovation process is often discussed as a lever to increase ventures' acceptance and legitimacy (e.g., Lee et al., 2010).

In the second chapter, written by Christian V. Baccarella, Markus Beckmann, and Peter Wehnert, we address this gap by examining the influence on potential customers' product perceptions of communicating the fact that a sustainability-oriented product has been successfully crowdfunded[11]. We thus focus on the later

[11] To define a sustainability-oriented crowdfunding project and their outcomes, we apply Hansen and Große-Dunker's definition of SOI to the crowdfunding context: we thus regard crowdfunding projects as sustainability-oriented, supporting "the commercial introduction of a new (or improved) product (service), product-service system, or pure service which—based on a traceable (qualitative

innovation phases — market launch and management (see Fig. 1) — in which sustainable entrepreneurs are, inter alia, confronted with the task of marketing their crowdfunded outcomes. Marketing sustainability-oriented products poses specific challenges, because sustainability attributes such as fair wages or environmentally friendly cultivation are typically not directly accessible to buyers, and thus come along with high information asymmetries (Jahn et al., 2005). These can result in consumer distrust (Akerlof, 1970) and consequently in decisions against the purchase of sustainable offerings (Koths & Holl, 2012). Therefore, sustainable ventures especially rely on quality signals such as third-party certifications that can bridge information asymmetries (Chkanikova & Lehner, 2015).

Drawing on signaling theory (Spence, 1973), the literature on herding behavior (Bikhchandani et al., 1992), and on social proof (Rao et al., 2000, 2001), we assume that portraying crowdfunding success can serve as a quality signal strong enough to positively influence customers' product attitudes and their trust in sustainable product attributes. We further assume that the effect of this signal is moderated by the complexity of a product,[12] as it affects consumers' information need concerning certain products (e.g., Choudhury & Karahanna, 2008), and therefore customers' perceived relevance of the credibility of sustainability attributes. Accordingly, we construct three hypotheses summarized by the overarching research question: *"How does crowdfunding success influence consumers' product perceptions and trust in non-verifiable sustainability attributes at different levels of product complexity?"* (Wehnert et al., 2019: 128). To answer this question and test the hypotheses, we conduct a between-subject 2 (crowdfunding success portrayed: yes vs. no) × 3 (product category: low complexity vs. medium complexity vs. high complexity) large-scale experimental study as an online survey.

Analyzing 530 completed questionnaires, we find that the crowdfunding success signal indeed has a significant influence on customers' product perceptions and trust in sustainability attributes. Moreover, we observe that the effect of this signal varies with different levels of product complexity. Contrasting our initial assumptions, signaling crowdfunding success only in the low product complexity category has a positive impact on consumers' product perceptions and on their trust in sustainable product attributes. With growing product complexity, the signal increasingly negatively affects customers' product attitudes. The signaling literature provides explanations for that. Boulding and Kirmani (1993) show that a signal's favorability depends on how credible it is perceived. Transferred to the signal of crowdfunding success, we argue that its credibility also depends on how confident customers are in the crowd's ability to assess a product and its characteristics realistically. While for less complex products customers might trust in the crowd to make a realistic assessment, they may be more skeptical for highly complex products. Thus, measures to increase the credibility of the crowdfunding success signal require scholarly attention. In Chapter III (see Section 2.3), we tackle this task.

Based on these findings, Chapter II contributes to theory and practice in various ways. Marketing managers

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or quantitative) comparative analysis—leads to environmental and/or social benefits over the prior version's physical life-cycle" (Hansen & Große-Dunker, 2013: 2407f).

[12] According to Scholz et al. (2010: 685), high product complexity is defined as a state "characterized by a comparatively large number of attributes and attribute levels that are relevant in purchase decisions."

should be careful in labeling successfully crowdfunded outcomes as such. When marketing low complexity goods such as cacao or coffee, they should use the crowdfunding success signal, as it positively affects consumers' product attitudes. In particular, sustainable entrepreneurs offering crowdfunded low complexity goods can benefit from increased trust in sustainability-related product characteristics. However, when marketing products of higher complexity, such as smartphones, our results indicate that managers should not label crowdfunded goods as such, or should find a way to increase the credibility of that signal.

These results indicate that the often discussed increase in legitimacy as a result of using crowdfunding (e.g., Lehner, 2013; Petruzzelli et al., 2019) is not true for all stakeholders. Among customers who were not involved in the crowdfunding process, labeling a crowdfunded outcome as such can even decrease acceptance of the product if it belongs to a high complexity category. We therefore extend the literature on the signaling impacts of crowdfunding to stakeholders not involved in the crowdfunding campaign. Research in that field, so far, has focused on attracting follow-up investments (Bocken, 2015; Lehner & Nicholls, 2014). Moreover, we add to the literature that addresses project quality during a crowdfunding campaign the perspective of quality assessment after a crowdfunding project has been funded (Mollick, 2013). Finally, we extend the discussion of crowdfunding in the context of sustainable development (e.g., Testa et al., 2019) by identifying potentials and limitations of the signaling function of crowdfunding success to increase trust in sustainable product features.

Having discovered that labeling a crowdfunded product as such influences customers' product perceptions, in Chapter III we examine more deeply under what conditions communicating crowdfunding success can create trust in novel products.

2.3 *How do you like my crowd? Analyzing the effects of crowdfunding motivation and information specificity on consumers' perceptions of products from sustainable entrepreneurs*

In the third chapter, written by Christian V. Baccarella, Markus Beckmann, and Peter Wehnert, we analyze which crowdfunding-related information appears relevant to consumers when advertising crowdfunded goods as such. Moreover, we investigate how this information should be communicated in order to enhance customers' product perceptions and their trust in sustainability attributes. For that, we first examine the literature on the trustworthiness of labels, which states that their credibility mainly depends on four factors: the label's information content; the specificity of the information content; the label issuer (e.g., governmental organization); and the involvement of customers concerning the product (Atkinson & Rosenthal, 2014). As we seek to understand the impact of crowdfunding-related facts, we focus on the label's information content and specificity.

A distinctive aspect of crowdfunding is that it is based on a large number of funders each contributing relatively small amounts of money. This foundation allows primarily intrinsically motivated funding decisions (Gerber & Hui, 2013) that differ from the dominantly extrinsically-driven investment logic of traditional financing. The focal motivations that drive crowdfunders' contribution decisions largely depend on the crowdfunding type[13] (e.g., Allison et al., 2015; Cholakova & Clarysse, 2015; Hossain & Oparaocha, 2017) because these are distinguished by the kind of compensation that backers receive for contributing (e.g., Griffin, 2012). Crowdfunding platforms that operate on a lending- or equity-based crowdfunding model are regarded as attracting mostly extrinsically motivated crowdfunders who, for instance, seek a return on their investment (Cholakova & Clarysse, 2015). Donation-based crowdfunding and prosocial lending, on the other hand, are viewed as attracting mainly intrinsically motivated backers who, for example, really care about the campaign (Allison et al., 2015; Hossain & Oparaocha, 2017). Platforms operating on a reward-based model are seen to attract a mix of intrinsically and extrinsically motivated backers (Hossain & Oparaocha, 2017).

Drawing on signaling theory (Spence, 1973) and consumer interference literature (Kardes, 1993; Kardes et al., 2004), we expect that varying the information on crowdfunders' dominant motivation for contributing can affect the impact of the crowdfunding success signal on customers' product attitudes. In particular, we assume that consumers perceive a product as superior and its characteristics as more trustworthy when funded by mainly intrinsically motivated backers who contribute because of real fascination in the product or who care about it instead of crowdfunders chiefly motivated by seeking a return on their investment. Moreover, as research points out that sustainability-oriented consumers are highly intrinsically motivated (e.g., van der Linden, 2015), and based on the premise that customers look for similar motivations in purchasing decisions, we expect that customers' sustainability orientation influences the persuasiveness of stressing intrinsic versus extrinsic funding motivations. Following Atkinson and Rosenthal (2014), we further assume that altering the specificity of the crowdfunding-related information content (e.g., money raised, number of crowdfunders) affects the influence of the crowdfunding success signal, and that this relationship is moderated by customers' product involvement.

Building on these assumptions, we construct a complex research framework consisting of four main and several sub-hypotheses that we summarize with the two overarching research questions: *(1) "How do cues about crowdfunder motivations and different degrees of information specificity of a crowdfunding success label affect customer perceptions? [(2)] How do customers' sustainability orientations influence their perceptions of products linked to different crowdfunder motivations?"* (Wehnert et al., n.d.: 3). To get to the bottom of these questions, we conduct an online experimental study with a 2 (stressing crowdfunders' intrinsic motivation vs. stressing crowdfunders' extrinsic motivation) × 2 (low information specificity vs. high information specificity) between-subject design.

Evaluating 180 completely answered questionnaires, we find that when labeling a crowdfunded product as such, stressing intrinsic funding motivation evokes significantly more positive product perception in customers than highlighting mainly extrinsic funding motivation. By positively affecting product attitudes, intrinsic funding cues indirectly increase consumers' trust in fairness, quality, environmental, and health attributes. Yet

[13] Differentiated by the type of compensation that crowdfunders receive for contributing, the literature (e.g., Griffin, 2012) distinguishes several types of crowdfunding: donating the money (donation-based); lending the contribution and receiving interest (lending-based) or not receiving interest (prosocial microlending); exchanging the money for a share of future profits or equity securities; pre-purchasing the goods to be funded; or receiving other rewards for contributing. In research and practice, the pre-purchase and reward-based type are often merged and referred to as reward-based crowdfunding. Throughout my dissertation, I follow this approach.

we find that consumers' sustainability orientations do not influence the effect of the funding motivation cues. Moreover, our results concerning the impact of information specificity indicate that for products characteristically evoking low involvement, consumers do not have a clear preference for more simple low information specificity labels over labels with high information specificity. Furthermore, in contrast to Atkinson and Rosenthal's (2014) results on label perception, we find that highly involved customers prefer a crowdfunding success label with low information specificity over one with high information specificity.

The findings of Chapter III extend the literature that analyzes the influence of backers' intrinsic and extrinsic motivations to contribute to crowdfunding campaigns (e.g, Allison et al., 2015; Cholakova & Clarysse, 2015) by adding the perspective of consumers in the market after a campaign has been funded. Thus, we place the debate on crowdfunders' motivations to contribute (e.g., Bretschneider & Marco, 2017; Cholakova & Clarysse, 2015) in a product marketing context. By demonstrating that stressing an intrinsically motivated crowd can reinforce the impact of the quality signal that crowdfunding success may provide, we add to our own research in Chapter II and to the literature on overcoming quality- and sustainability-related information asymmetries (Kirmani & Rao, 2000). Yet, our observation that displaying different label forms with altered levels of information specificity affect neither customers' product attitudes nor their trust in sustainable product attributes oppose the premises in the label perception literature (Atkinson & Rosenthal, 2014; Hodgkins et al., 2012). These findings point to a limited transferability of research on eco- or food labels for the creation of a crowdfunding label tailored to consumers' preferences.

Combining the findings of Chapters II and III to give practical recommendations, entrepreneurs offering novel sustainable products, or SOI, can not only use crowdfunding to finance their offerings and to enable knowledge inflows and outflows, but can also use a crowdfunding success label to influence customers' product perceptions. Our findings can therefore assist entrepreneurs in the market launch and management phase (see Fig. 1) when promoting crowdfunded sustainable goods as such. When marketing offerings of a rather simple nature, like coffee or cacao, it is recommended that entrepreneurs mention that a product has been successfully crowdfunded, as this increases consumers' product perceptions and their trust in sustainability attributes. To reinforce the effect of this quality signal, marketing managers are advised to stress intrinsic funding motivation such as belief or fascination in the product, and to mention crowdfunding types associated with intrinsic funding motivation (prosocial lending, donation- and reward-based) over types perceived as attracting mainly extrinsically motivated crowdfunders (lending and equity-based). To communicate intrinsic crowdfunding motivation in a practical way, we suggest adding testimonials of backers' reasons for contributing. Moreover, we recommend that entrepreneurs marketing their crowdfunded goods to do not refer uncritically to the literature on eco- or food labels (Atkinson & Rosenthal, 2014; Hodgkins et al., 2012) when designing a crowdfunding success label. Based on our findings, we suggest showing a crowdfunding label with low information specificity regarding the crowdfunding success, one that focuses on instruction and simplification while underlining intrinsic funding motivation. Ventures offering sustainable low complexity products that have been crowdfunded can especially benefit from our findings, as strong information asymmetries related to sustainable product attributes can be reduced.

However, these recommendations only apply for goods of a more simple nature, typically provoking little information search by customers, such as daily consumption products (e.g., coffee, tea, cacao). Entrepreneurs offering products of higher complexity (e.g., jackets, smartphones, laptops) are recommended not to display crowdfunding success until adequate communication measures such as labels issued by trustworthy third parties are explored. How a crowdfunding label should be designed for products of higher complexity remains an open question for future research.

Chapters II and III are focused on the last two innovation phases, after a good has been successfully funded and is ready for market launch. Yet sustainable entrepreneurs can benefit from applying crowdfunding to support their innovation processes — especially the latter four innovation phases — in various ways. In the next chapter, I holistically address the interrelationships of crowdfunding and sustainable entrepreneurship.

2.4 Crowdfunding a sustainable future? A systematic literature review of crowdfunding and sustainable entrepreneurship

In the fourth and final chapter, I examine the nexus of crowdfunding and sustainable entrepreneurship. Referring to the innovation process, I focus on the four later innovation stages: concept evaluation, prototyping and testing, market launch, and management (see Fig. 1). In these phases, crowdfunding offers entrepreneurs not only a financing alternative, but various other functions, including promotion (Belleflamme & Lambert, 2014), proof of concept (Cumming & Johan, 2017), assessment of a prospective innovations' market potential (Agrawal et al., 2014), and enabling mass customization and co-creation (Belleflamme et al., 2014). For sustainable entrepreneurs, these functions can present specific advantages in, inter alia, overcoming legitimacy issues and attracting follow-up investments from traditional financing sources (Bocken, 2015; Lehner & Nicholls, 2014). Yet, when sustainable entrepreneurs tap crowdfunding, new challenges arise, such as clarifying and justifying sustainability impacts (Cumming et al., 2017) or dealing with greenwashing (Hörisch, 2019). Effectively addressing these issues while not limiting the potential of crowdfunding for sustainable ventures requires a holistic understanding of the interdependencies of crowdfunding and sustainable entrepreneurship.

To elaborate these interdependencies, I perform a systematic literature review[14] (SLR) (Tranfield et al., 2003) on crowdfunding and sustainable entrepreneurship led by the following research questions: *(1) "What is the state of research on crowdfunding and sustainable entrepreneurship? [(2)] How does the crowdfunding system work in the context of sustainable entrepreneurship? [(3)] How can sustainable entrepreneurs choose adequate crowdfunding platforms and types to match their needs?"*(Wehnert, n.d.: 2). To address these questions, I first specify the terminology of the SLR that emerges from the intersection of entrepreneurship, sustainability, crowdfunding, and innovation. Based on that and discussions with peer researchers, I derive 31 keywords, determine five relevant research data bases for the document search, and define strict inclusion (peer-reviewed articles in English published in academic journals between 2006 and March 2019) and exclusion criteria (not clearly related to sustainable entrepreneurship and crowdfunding). Performing the

[14] According to (Tranfield et al., 2003: 207), a SLR is defined as a structured method that aims at "synthesizing research in a systematic, transparent, and reproducible manner."

search under these criteria, and manually adding relevant papers, my final sample contains 70 articles.

Examining these articles, I first provide a bibliographic analysis that describes the papers in terms of methods applied, regional focus, publishing journal, and year of publication. Summarizing the results of the bibliographic analysis, I find that research on crowdfunding and sustainable entrepreneurship is a young and expanding stream already hosting a considerable number of quantitative studies. Moreover, I find that the literature in that area mainly focuses on regions in the northern hemisphere. In the second step, I examine the content of the articles in detail using the software MAXQDA. Through the analysis, I identify seven main components of the crowdfunding system in which sustainable entrepreneurship is discussed: crowdfunding platforms, crowdfunders, campaign creators, campaigns, post-crowdfunding phase, and societal and regulatory environment. Furthermore, some papers address this whole system which I thus categorize as the holistic system perspective. Within these components, I describe the state of research regarding crowdfunding and sustainable entrepreneurship. Based on that, I advance propositions, draw implications, and recommend a research agenda for each component. In the following paragraphs, I will focus on describing the findings and propositions that affect the innovation process of sustainable entrepreneurs.

Referring to the innovation process, sustainable entrepreneurs tap crowdfunding in the phases of concept evaluation, prototyping and testing, and market launch, where their sustainable ventures especially require feedback, mass customization, financing, and promotion. Throughout these phases, the findings and propositions of my SLR suggest that sustainable entrepreneurs need to be especially careful when choosing the appropriate crowdfunding form (see 2.3) and platform type (platforms specialized in hosting sustainable ventures vs. non-specialized platforms). Crowdfunders' dominant motivation to contribute strongly affects the likelihood of funding sustainability-oriented campaigns (Hossain & Oparaocha, 2017) and varies among the crowdfunding types (see 2.3). Thus, sustainable entrepreneurs in particular need to consider the focal motivations that drive crowdfunders' decision-making when opting for a crowdfunding type. Hörisch (2017) and Meyskens and Bird (2015) suggest sustainable entrepreneurs to select the crowdfunding type according to their intended sustainability and market impact. Addressing the increasing financial need from the concept evaluation phase until the more capital-intensive stage of market launch, Lam and Law (2016) suggest sustainable entrepreneurs to combine different crowdfunding types with traditional funding instruments across these phases. Concerning the crowdfunding platform specialization, the literature recommends sustainable ventures to choose platforms specializing in hosting sustainability-oriented campaigns over more general platforms because of higher funding success rates (Hörisch, 2017).

Having decided on the crowdfunding form and platform type, sustainable entrepreneurs need to be aware that social and environmental targets are associated with stronger information asymmetries (Jahn et al., 2005). When creating crowdfunding campaigns, sustainable entrepreneurs should therefore be especially cautious (Cumming et al., 2017; Parhankangas & Renko, 2017) and must justify and clarify targeted sustainability impacts in campaign pitches (Parhankangas & Renko, 2017). In terms of the design of successful campaigns, my SLR reveals that sustainable entrepreneurs can draw on more scientific knowledge when choosing prosocial microlending or reward-based crowdfunding and far less knowledge when tapping lending, equity, or donation-based crowdfunding. Moreover, for community building and interacting with the crowd, sustainable ventures need to consider that the different types, roles, and motivations of crowdfunders are affected by sustainability topics (Petruzzelli et al., 2019).

For the marketing launch and management phases that correspond to the phase in the crowdfunding system after a campaign has been conducted (post-crowdfunding phase), the findings of my SLR suggest that sustainable entrepreneurs can especially profit from the quality signals that successfully conducting a campaign can send. This signaling function can assist sustainable entrepreneurs in attracting follow-up financing from professional investors (Bocken, 2015) and in advertising crowdfunded products as such (see 2.2 and 2.3) (Wehnert et al., 2019). Moreover, in the post-crowdfunding phase, the question of the actual implementation of advertised sustainability measures becomes relevant. Obliging ventures to disclose their realized (sustainability) impacts at this stage can address both greenwashing and fraud, which pose crucial problems to crowdfunding activities for sustainable entrepreneurship (Hörisch, 2019).

By elaborating, inter alia, the interdependencies between sustainable entrepreneurship and crowdfunding and the resulting managerial implications, I contribute to the literature in various ways. Among these contributions, I extend the literature on solving financing problems (e.g., Choi & Gray, 2008; del Brío & Junquera, 2003) and further issues associated with the “liability of newness” (Stinchcombe, 1965: 148) of sustainable entrepreneurs, including establishing legitimacy, trust, and reputation among stakeholders (Freeman et al., 1983). Moreover, I add to the discussion on the influence of crowdfunding on sustainable development (e.g., Testa et al., 2019). Finally, by proposing an agenda for future research on crowdfunding and sustainable entrepreneurship, the last chapter rounds off my research efforts on the interface of crowdfunding and sustainability.

3. Discussion

Having described the single contributions of each chapter, this section provides overarching practical (3.1) and theoretical implications (3.2). For that, and to answer the overarching research question, I integrate the findings across along the innovation process of SOI and derive contributions.

3.1 Overarching practical implications

Throughout the different chapters of my dissertation, it is clear that in order to create successful SOI, stakeholder participation in its development is inevitable. For that, the innovation management is recommended to carefully and systematically combine different OI approaches throughout the innovation process. In the next paragraphs, I propose an integrated framework (see Fig. 2) for the combination of inbound OI approaches and crowdfunding throughout the SOI innovation process based on the results of the chapters. This framework offers overall managerial implications that are then reflected from a research perspective in 3.2. At this point, it is important to note that the framework does not provide a rigorous plan for the application of these methods, but rather presents solutions to address the specific problems of SOI and their developers in each innovation phase.

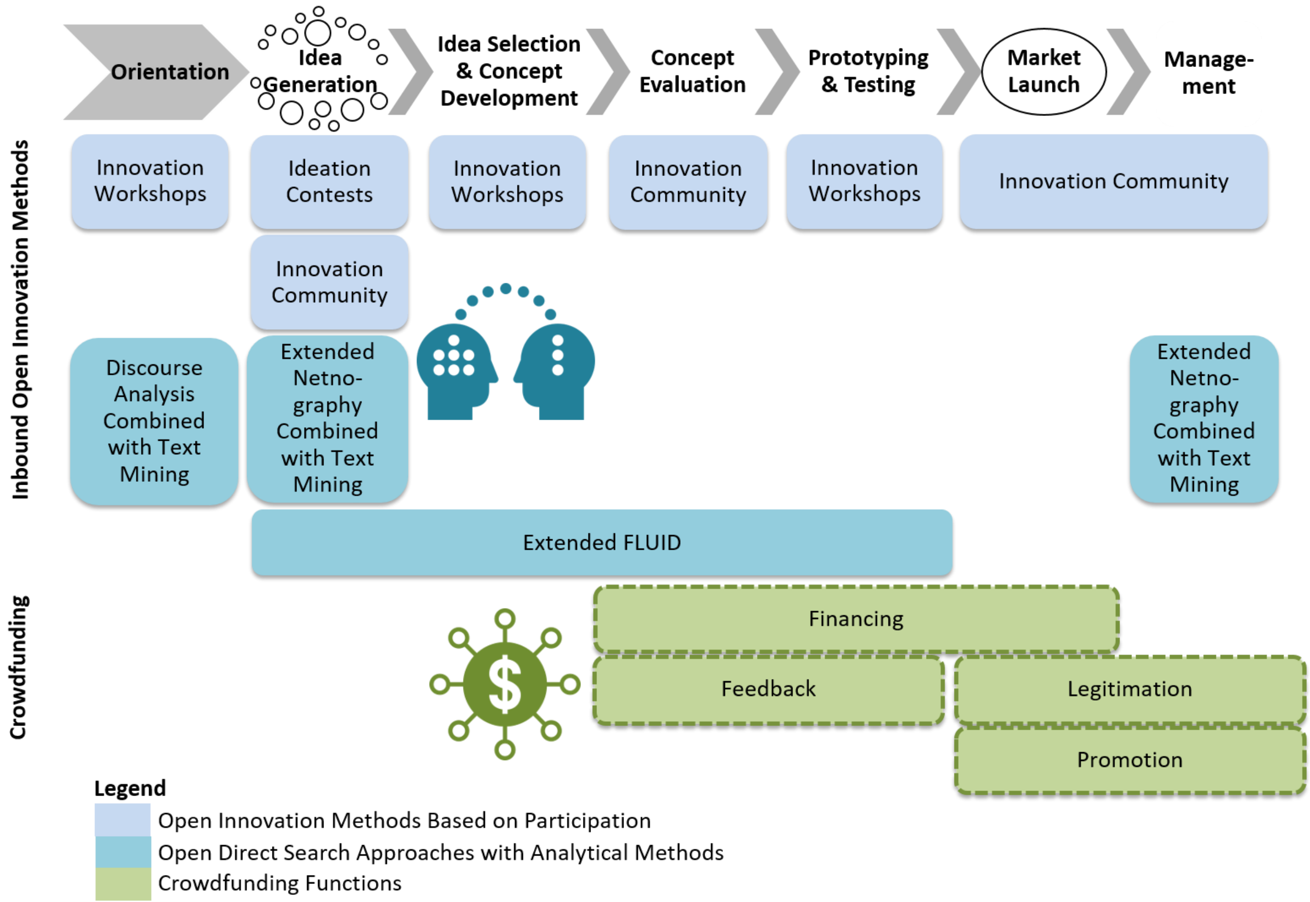

Fig. 2. Framework for the combination of inbound OI approaches supported by analytical methods and crowdfunding throughout the innovation process of SOI based on the results of the chapters. The innovation process model is based on Paech (2007), Reichwald and Piller (2009), and Vahs and Brem (2015). The knowledge transfer and crowdfunding icons were designed by Duke Innovation Co-Lab (2013) and Iconathon (2018).

In the initial innovation phase, the management has to identify and examine opportunities for a prospective innovation and determine the boundaries of an innovation space (Paech, 2007). In the context of SOI, especially sustainability-related issues, legislation, and interrelations need to be explored (Tyl et al., 2015). To deal with the complexities of SOI right from the start, I recommend applying the OI approaches of innovation communities and workshops that enable knowledge inflows from stakeholders. However, these instruments are costly, time intensive, and rely on the participation of stakeholders (e.g., Arnold, 2011). Thus, I suggest supplementing these OI approaches with open direct search tools (Laursen & Salter, 2006; Piller & Hilgers, 2016) such as public discourse analysis. To increase the efficiency and effectiveness of these instruments, I further recommend combining open direct search tools with text analytics if the innovation field is widely discussed in the public (like electric mobility). In accordance with the results of the first chapter, I recommend applying text analytics on public discourse data, as this can support the innovation management of SOI in discovering sustainability-related topics, risks, and actors, especially during the orientation stage.

In the phase of idea generation, the innovation management broadly collects ideas for the innovation object (e.g., Bürgel & Zeller, 1998). For the development of SOI, the innovation management needs to gather a wide range of needs, ideas, perspectives, and knowledge on the sustainability aspects of the innovation object (e.g., Hansen & Große-Dunker, 2013). For this purpose, a suitable solution is provided by a combination of innovation communities and workshops, along with ideation contests. In the preparation of these methods, the management can further process the information gathered in the orientation phase, for example, to determine which stakeholders to invite to innovation workshops. To collect more specific ideas and solutions for SOI, I suggest inviting lead users whose desires are typically ahead of average users and who themselves actively search for solutions (Piller & Hilgers, 2016), and to extend their circle to lead affected[15] who hold specific knowledge on environmental and social interrelations. Their identification can be automated and refined by data mining methods such as Pajo et al.'s (2015) fast lead user identification (FLUID) approach. To meet the specific requirements of SOI, I recommend extending this approach to identify the lead affected. Moreover, to capture as many relevant perspectives as possible, I recommend complementing the idea generation with netnography. This open direct search tool can enable managers to derive concrete ideas from the analysis of dialogues in social media (Kozinets, 2010), including specialized communities (e.g., goingelectric.de in the field of electric mobility). However, applying netnography to source ideas for SOI, requiring the consideration of perspectives of positively and negatively affected stakeholders (Hörisch et al., 2014), generates large amounts of data. Thus, I recommend the application of text analytics to support netnography. This combination can arguably offer innovation managers an efficient and effective tool to source additional ideas from silent stakeholders.

In the next stage, the innovation management evaluates the collected ideas in terms of their economic, environmental (Tyl et al., 2015), or social relevance. Then the management selects the ideas with the highest potential and translates these into concrete concepts (Verworn & Herstatt, 2003). When evaluating ideas for SOI and transforming these into concrete concepts, it is necessary to assess possible sustainability impacts across the whole life-cycle and to account for long-term effects (Paech, 2007). To address these complexities, I recommend that innovation managers apply existing sustainability assessment tools such as the sustainability innovation cube (Hansen et al., 2009) and conduct innovation workshops with heterogeneous stakeholders including lead users and lead affected. The decision of which stakeholders to invite to the workshops can be supported by the results of the application of text analytics to public discourse data and by the outcomes of the extended FLUID analysis.

During the concept evaluation phase, the innovation management broadly assesses the concepts. In doing so, sustainability impacts across the entire life-cycle again need to be evaluated (Paech, 2007). To evaluate SOI concepts broadly, assessments by a wide circle of relevant stakeholders are recommended (Blind & Quitzow, 2017). For that, the concept can be introduced to innovation communities (e.g., Daiberl et al., 2016). At the same time, the acquisition of financial resources moves into the fore from this phase onward, since the subsequent development of prototypes up to the market introduction is associated with a growing need for capital (Lam & Law, 2016). Crowdfunding offers the innovation management a tool by which to receive feedback, assess the market potential of a concept, and acquire financial resources spread wide across a crowd

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[15] The term lead affected refers to stakeholders who could be particularly (negatively) affected by the potential innovation. Just like lead users, lead affected actively search for solutions themselves and may already hold solution-oriented knowledge regarding sustainability issues.

of individuals (e.g., Testa et al., 2019). Yet sustainable entrepreneurs or SOI managers need to be careful when tapping crowdfunding, as their sustainability orientation comes with specific challenges, including greenwashing and an increased need for explanation. As described in detail in Section 2.4, based on the results of my SLR, I recommend that those undertaking these ventures should be especially careful when opting for a crowdfunding model and platform type (Hörisch, 2017; Lam & Law, 2016; Meyskens & Bird, 2015), and in creating campaign pitches (Cumming et al., 2017; Parhankangas & Renko, 2017).

In the phase of prototyping and testing, based on the evaluated concepts, prototypes are developed and then tested (Daiberl et al., 2016). To develop and test SOI prototypes, I recommend conducting further innovation workshops with experts, lead users and lead affected, and further stakeholders. The results of the extended FLUID analysis can support lead user and lead affected recruiting. The participants can also be recruited from a crowdfunding campaign — for example, by offering workshop participation as a compensation in reward-based crowdfunding. Moreover, if the SOI aims at high market and sustainability impacts (Hörisch, 2017; Meyskens & Bird, 2015) or if this stage requires more capital (Lam & Law, 2016), performing another crowdfunding campaign tapping a more profitable crowdfunding type (equity or lending-based) is suggested (Lam & Law, 2016).

During the market launch phase, the prototypes are developed to market maturity and commercialized. In this phase, marketing managers can benefit from the promotion effect if the SOI is presented on a crowdfunding platform (Belleflamme & Lambert, 2014). Moreover, the challenge of how to market a crowdsourced or crowdfunded SOI arises. Initial studies indicate that advertising crowdsourced (Nishikawa et al., 2017) and crowdfunded (Wehnert et al., 2019) products as such can positively affect customer perceptions. Yet this positive effect has so far only been reported for products of a more simple nature (crowdfunded cacao; crowdsourced snack pretzels, and a security buzzer for handbags) (Nishikawa et al., 2017; Wehnert et al., 2019). Thus, I only recommend portraying that a product has been successfully crowdfunded or crowdsourced for offerings of a more simple nature. Moreover, when displaying crowdfunding success for low complexity products, marketing managers can enhance the positive impact of the signal by stressing intrinsic funding motivation, as explained in detail in Section 2.3. In that way, consumers' trust in a product's sustainability attributes and their general product perceptions are positively affected. However, when advertising more complex products such as smartphones, marketing managers should not communicate that a product has been crowdfunded (see Sections 2.2 and 2.3). Furthermore, the capital required increases in this phase, as the final outcome is implemented on a large scale (Reichwald & Piller, 2009). To address the growing need for financial resources, sustainable ventures can enhance their chances of receiving follow-up funding from professional investors by showing that the SOI is based on a successful crowdfunding campaign and thus overcome disadvantages in attracting finance from traditional sources (Bocken, 2015; Lam & Law, 2016).

In the management phase, the SOI should be continuously analyzed regarding, for example, its sustainability effects to enable adaptations (Vahs & Brem, 2015). The role of stakeholder involvement to receive feedback is emphasized throughout this phase (Tufte & Mefalopulos, 2009). To capture feedback on a large scale, including from silent stakeholders, I recommend asking members of the innovation community for their opinions and to combine that with applying netnography on relevant social media supported by text analytics.

Overall, with these practical suggestions, the innovation management can reduce risks and complexities related to the development of SOI and address further issues of sustainable entrepreneurs, including financial shortfall and lack of legitimacy. In the following section, I describe how these proposed crowd-based solutions extend the existing body of literature.

3.2 Overarching theoretical implications

The development of SOI is associated with higher risks than conventional innovation as their market success and future sustainability impacts are uncertain (Hansen et al., 2009). Creating SOI also challenges innovation management due to its increased complexities (Ketata et al., 2015). In addition to hardly predictable consumer desires (Cooper, 2001), these complexities include the need to meet interrelated environmental and social aims (Hansen & Große-Dunker, 2013) and the difficulties in assessing long-term sustainability impacts (Paech, 2007). Knowledge on these aspects does not lie within an individual organization; rather, it is distributed among a wide range of stakeholders (Hörisch et al., 2014). The increased risks and complexities can lead to difficulties in financing SOI. In particular, nascent entrepreneurs face high hurdles to acquire financial resources for SOI as traditional financiers often prefer investing in purely profit-oriented ventures (Choi & Gray, 2008). Early stage entrepreneurial ventures also typically face trust, legitimacy, and reputation issues (Stinchcombe, 1965) that can intensify when pursuing sustainability objectives associated with high information asymmetries (Jahn et al., 2005).

The proposed framework first addresses knowledge- and legitimacy-related issues of SOI by suggesting combinations of different OI approaches and their reinforcement along the innovation process. This combination aims in particular at supporting the development of SOI by enabling the identification of a wide range of sustainability-related stakeholder perspectives, including those of silent stakeholders in an effective way. In doing so, the framework adds to the literature on mitigating uncertainties and risks throughout the innovation process of SOI (Lang-Koetz et al., 2008; Paech, 2007). Research in that field highlights the importance of the early innovation stages (orientation till concept development) for the creation of successful SOI, as the majority of future sustainability impacts are pre-determined in these stages (Bürgel & Zeller, 1998; Fichter & Paech, 2004; Maxwell & Van der Vorst, 2003). The proposed framework adds to that research by showing measures to efficiently identify sustainability-related information regarding an innovation object, including issues, actors, and viewpoints, along the innovation process. My dissertation also contributes to the literature on efficiency and effectivity issues of OI approaches applied in the context of sustainability (Arnold, 2011, 2017). In this regard, the framework especially addresses the non-participation bias (Wendelken et al., 2014), as well as cost and time issues of OI approaches (e.g., Arnold, 2011). Thus, my dissertation adds to the debate on importance and the applicability of OI methods for creating SOI (Arnold, 2011; Fichter, 2009; Hansen & Große-Dunker, 2013; Rauter et al., 2017).

Second, the framework addresses financing problems of SOI and other issues of nascent entrepreneurs that intend to create SOI by presenting these ventures with ways to fruitfully apply crowdfunding and to successfully market crowdfunded SOI. Making innovation managers of SOI or sustainable entrepreneurs who tap crowdfunding aware of specific challenges that come along with their sustainability-orientation, as well as how to address these challenges, contributes to the debate on the capabilities needed by sustainable ventures in order to apply crowdfunding (e.g., Calic & Mosakowski, 2016; Petruzzelli et al., 2019). Suggesting how to select crowdfunding platforms and types according to the specific needs of a sustainable venture adds to the discussion on choosing the most suitable crowdfunding type (Hörisch, 2017; Lam & Law, 2016; Meyskens & Bird, 2015). Moreover, by exploring ways to advertise successfully crowdfunded SOI, this dissertation sheds light on the blind spot of how customers perceive crowdfunded products. Pointing out that displaying crowdfunding success only affects customers positively when portrayed on a product of more simple nature, and increasingly negatively with growing complexity, also provides impulses for studying the perception of crowd-ideated products (Nishikawa et al., 2017). Research thus far has not taken into account the complexity dimension. In this way, my dissertation also adds to the more general debate on how stakeholder participation influences venture legitimacy (e.g., Lee et al., 2010). Finally, the framework contributes to the discussion on the role of crowdfunding for sustainable development (e.g., Testa et al., 2019).

Taken together, the elaborated framework extends the literature on complexity (Hansen & Große-Dunker, 2013; Ketata et al., 2015; Paech, 2007), risk (Hansen et al., 2009), and funding problems of SOI or sustainable entrepreneurs (e.g., Choi & Gray, 2008; del Brío & Junquera, 2003). It also adds to the literature on legitimacy, reputation, and trust issues which arise, in particular, if the developer is a nascent entrepreneur (Freeman et al., 1983; Stinchcombe, 1965). Moreover, the framework contributes to research on how to address these problems with stakeholder participation (e.g., Hörisch et al., 2014). Thus, this framework also adds to the discussion on the importance of participation to create robust solutions for sustainability challenges (Lang et al., 2012; Schaltegger et al., 2013).

4. Limitations, future research, and closing remarks

The framework has some major limitations that pave new ways for future research. In the following, I describe the most severe limitations from which I derive topics for further research. First of all, the framework includes only a few OI methods. Therefore, the proposed framework is neither comprehensive nor does it provide a sophisticated procedure for the application of inbound OI methods and crowdfunding throughout the innovation process of SOI. It rather shows some solutions for how to address issues of SOI and its developers in each innovation phase. Future research could, therefore, analyze the applicability of further OI methods, such as university research programs, scouting, or spin-ins (Chesbrough & Bogers, 2014), along the innovation process for SOI and propose a more comprehensive framework.

Second, the proposed open direct search methods and their reinforcement with analytical methods have not been empirically tested for usability in the context of developing SOI. Only the processing of public discourse data by text analysis for the creation of SOI has been empirically examined in the first chapter. Thus, future research could examine the practicability of netnography supported by text analysis and FLUID for the development of SOI.

Third, the suggestions to developers of SOI or sustainable entrepreneurs of how to tap crowdfunding are based on a SLR that lacks empirical foundation. Therefore, large-scale comparative studies on the success of different sustainable ventures among platform types and crowdfunding forms are needed. Moreover, future research could empirically investigate specific success factors of sustainable crowdfunding campaigns within the different crowdfunding categories and platform types.

Finally, concerning the marketing of SOI, the framework mainly covers suggestions on labeling a crowdfunded product as such in order to win consumers' trust and positively affect their product perception. Conducting a crowdfunding campaign can also influence future market performance by, for example, promoting an SOI or using network effects (e.g., Petruzzelli et al., 2019). Exploring ways to fully exploit the marketing potential of crowdfunding by using such levers could be especially useful to SOI and their developers as these typically face strong trust and legitimacy issues. In this context, future research could also compare the market performance of a crowdfunded or crowd-ideated SOI to a similar conventionally developed one by conducting large-scale comparative studies.

Despite these limitations, the elaborated framework offers orientation on how to reinforce inbound OI methods and combine these with crowdfunding throughout the innovation process to approach specific problems of SOI and its developers. In doing so, it contributes to exploiting the full potential of these OI methods and crowdfunding for sustainable development.

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Chapter I

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Capturing the Bigger Picture? Applying Text Analytics to Foster Open Innovation Processes for Sustainability-Oriented Innovation

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Abstract: In open innovation initiatives for sustainability-oriented innovations, it is indispensable to have a wide array of engaging stakeholders. Yet, as not all relevant actors are able or willing to participate, important opinions can go unnoticed. Due to such stakeholder selection effects, aspects of high relevance may remain uncaptured. To address this issue, we first define the concept of silent stakeholders and relate it to sustainability-oriented innovations. We then discuss the new approach of employing analytical methods to examine existing sources outside the innovation process for silent stakeholder opinions. For this purpose, we conduct an action research study demonstrating how to examine broad discourse data with text analytics for an open innovation project aiming to create a sustainability-oriented innovation. To this end, we develop an approach for the efficient integration of external sources in open innovation processes. We find that text analytics of broad discourse data can particularly support the orientation and idea generation phase for sustainability-oriented innovation. Furthermore, we identify possibilities for the application of further data mining methods to complement open innovation approaches along the innovation process. Building on that, we propose an integrated framework. Hence, we add to the literature on stakeholder participation, analytical methods and innovation management, as well as sustainability-oriented innovation.

Keywords: sustainability-oriented innovation; open innovation; text analytics; data mining; discourse data; silent stakeholder; action research

1. Introduction

Innovation can be specified as "the multi-stage process whereby organizations transform ideas into new/improved products, services or processes, in order to advance, compete, and differentiate themselves successfully in their marketplace" [1] (p. 1334). As such, it can contribute to the deployment of more sustainable processes, organizational methods, products, and services [2] and has, thus, been identified as an important means to support sustainable development [3,4].

However, the development of—particularly from a long-term perspective—successful sustainability-oriented innovation (SOI) requires wide knowledge of societal and ecological interrelations which usually does not exist within individual organizations [2]. In line with that, Hansen and Grosse-Dunker [2] emphasize that the creation of SOI can be facilitated through stakeholder participation. An instrument that can enable stakeholder involvement is open innovation (OI).

Yet, the challenge in OI processes for SOI is not merely the integration of stakeholders directly involved along the value chain, but also of those stakeholders concerned by (negative) social or environmental effects [5]. Therefore, it is vital to gather a wide range of relevant arguments. Thus, such OI initiatives call for the broad involvement of diverse actors.

While OI can give voice to stakeholders who freely share their arguments in the innovation process, the perspectives of actors not able or willing to take part may remain uncaptured [6]. Such selection effects of stakeholders can, thus, leave aspects of high relevance unconsidered. For example, Wendelken et al. [6] point out research gaps in examining such a non-participation bias.

One possibility to address this issue of what we define as "silent stakeholders" is to analyze external sources which may contain perspectives of pertinent stakeholders regarding the OI project. Such sources can range, for example, from social networks, forums of specialized communities, or other social media to news websites. So far, however, direct search OI methods [7] are neglected by research on OI [8].

Examining this kind of sources might represent an approach to include arguments of silent stakeholders in the innovation process despite their formal non-participation. Thereby underrepresented or unknown positions and aspects can be taken into consideration throughout the innovation process. Yet, evaluating such sources requires analyzing, structuring, and processing huge volumes of data. For that, analytical methods such as text analytics (TA) provide a suitable approach to address those issues with limited resources [9].

Against this backdrop, the following research question arises: *How can TA of broad direct search data support OI for SOI?*

To address this question, we conduct an action research study [10] within a research project in which OI processes serve to create sustainability-oriented services for electric mobility (e-mobility). First, we analyze in which innovation phases direct search methods can support conventional OI methods effectively. Second, to demonstrate how external sources can be analyzed efficiently for the integration of further perspectives in the OI process, we exemplarily examine the public digital discourse in leading German news websites concerning e-mobility. For the processing and examination of this rich database, we then apply methods of TA.

We find that the TA of broad discourse data is particularly suitable for supporting the early innovation phases of SOI. As these phases are of major importance in reducing risks and uncertainties regarding sustainability issues [11,12], we highlight the significance of our approach for the development of SOI. Moreover, we examine the potentials of other data mining approaches to supplement OI methods throughout the innovation process and propose a framework for that. Thereby we especially add to the discussion of the importance of OI for the development of SOI [13–15], to the literature on direct and indirect stakeholders [16–19], (open) innovation management [7,20–24], and analytical methods [25–27], as well as SOI [2,3,21,28–31].

This paper's structure is the following: Section 2 reflects the state of the research on OI and SOI based on the literature and explains the issue of silent stakeholders. Our methodology and study implementation is outlined in Section 3 before our findings are summarized and interpreted in Section 4. In Section 5, the applicability of broad direct search data analyzed by TA is discussed. Based on these insights, theoretical and managerial implications are derived in Section 6. Moreover, limitations and topics for future research are reflected upon.

2. Background and Terminology

2.1. Complexities of Sustainability-Oriented Innovation

Research on innovation from a perspective that includes economic, environmental, and social dimensions has emerged during the last decade [28]. Various terms exist that describe this holistic and integrative approach [29] including "sustainable development innovation" [32], "sustainable innovation" [33] or SOI [3,21] but to date, no clear definition of those terms has prevailed [30,34].

In the present paper, our understanding of this approach is based on the term SOI which Hansen and Grosse-Dunker [2] (p. 2407f.) define as "the commercial introduction of a new (or improved) product (service), product-service system, or pure service which—based on a traceable (qualitative or quantitative) comparative analysis—leads to environmental and/or social benefits over the prior version's physical life-cycle ("from cradle to grave")". This broad concept emphasizes economic, environmental, and social target dimensions along the innovation's life-cycle. Furthermore, it includes relative enhancements compared to former versions or another object and can thus also be considered as a process toward sustainability [29].

To specify sustainable innovations, Blind and Quitzow [30] collected different criteria from literature reviews of Hansen et al. [3], Schiederig et al. [28], Klewitz and Hansen [29], and Adams et al. [31]:

- The innovation object encompasses product, process, service, product-service system, and methodological innovations as well as organizational innovations.
- The market orientation of the innovation is characterized by the satisfaction of needs and their competitiveness on the market.
- The innovation should reduce negative environmental and/or social impacts.
- The whole life-cycle of an innovation should be considered, especially material flows and their ecological but also social effects.
- The intentions of the innovation are economic and ecological and/or social aspects.
- At the organizational level, the innovation should set a new standard.

Those aspects confront innovation management with increased complexity, risks, and uncertainties [35]. Traditionally, innovation management mainly focuses on the innovation object's economic success [36]. This creates already a great challenge for the management of conventional innovations since the difficult predictability of customer needs and behavior, besides future economic conditions, makes an innovation's market success uncertain [37]. The success of SOI, however, is not only measured in economic terms but takes social and environmental layers into account. Following that argument, Hansen and Grosse-Dunker [2] emphasize that economic, social, and ecological aims which form the "target dimension" of SOI are strongly interrelated. Bio-fuels, for instance, can contribute to reducing the transport sector's CO_2 emissions (positive ecological effect), but its cultivation may also lead to increasing food prices (negative social impact) [3,38,39]. Consequently, the management of SOI cannot consider the layers separately without considering the impacts on the others [2].

Another issue related to the target dimension is the uncertain direction of the environmental and social effects of innovations referred to as "directional risks" [40], i.e., their contribution to sustainable development is difficult to predict, especially in the long term [3]. Those types of risks include rebound effects or growth risks [21]. For instance, electric cars are discussed as a sustainable alternative to fuel-based automobiles if they are charged with energy from renewable sources (e.g., [41]). This can, however, lead to increased car ownership of environmentally conscious consumers who previously did not own a car [21].

Together with the target dimension, Hansen et al. [3] describe the 'life-cycle dimension' as vital to define the desired results of SOI. To detect and approach sustainability issues at their source, it is considered essential that SOI takes the whole value chain into account [2,42]. Innovation management in the context of SOI, thus, has to widen its traditional focus from the direct value creation for customers (phase of usage) to the complete life-cycle of an innovation [2]. In particular, as critical sustainability effects arise here, Hansen et al. [3] point out the major importance of five life-cycle phases for SOI: supply chain, manufacturing, packaging plus distribution, usage, and end-of-life. Along those phases, the management of SOI needs to consider economic, ecologic, and social target spheres which are interrelated and affected by directional risks. Therefore, the complexity, as well as success-related risks and uncertainties increase significantly by considering those three spheres in the target dimension along the entire life-cycle of an innovation [2].

Moreover, as SOI encompasses various forms of innovations, the "innovation type dimension" [3] adds further complexities. Since efficiency gains from technical innovations are often overcompensated by rebound effects and many life-cycle improvements depend on the intensified interaction between the producer and customer, Hansen et al. [3] emphasize the leveraging role of product-service system innovations and business model innovations for SOI. For example, car-sharing systems can reduce car ownership [43] and if the fleet is equipped with electric vehicles, it can raise acceptance for e-mobility and thereby induce a transition from fuel-based to electric cars [44].

As a consequence of the described multidimensional complexities, developing SOI requires a wide knowledge on social and environmental aspects exceeding the scope of one single organization [2]. To face the complexities and special challenges of SOI, Paech [21] suggests keeping the innovation object as moldable as long as possible to interact with various stakeholders when carrying out the innovation processes. Such stakeholder engagement can be enabled through OI.

2.2. *Open Innovation as an Instrument for Participation*

The concept of OI was originally introduced to describe emerging models of innovation that strongly rely on the contributions of external actors. These models are in contrast to the traditional organization of innovation which focuses on experts within the organization [45]. Today, OI has been researched extensively from different scholarly perspectives and is applied in various industrial domains [24]. Chesbrough and Bogers [8] define it as "a distributed innovation process based on purposively managed knowledge flows across organizational boundaries" (p. 17). In the literature, different advantages of following the OI paradigm are discussed [46–48]. Particularly, it is seen as a chance to innovate successfully and to improve the effectiveness ("fit-to-market") as well as efficiency ("time-to-market" or "cost-to-market") of the innovation process [20]. Furthermore, Yun et al. [49] show in their patent analysis that OI can have a positive impact on the sales of companies from the IT convergence sector.

OI can be conducted through different phases of innovation. Reichwald and Piller [20] adopt a linear development process comprising five phases: idea generation, concept development, prototype development, product/market test, and market launch. According to the authors, each phase can serve as the starting point for including external actors into development activities. Considering the above-described sustainability-related complexities, Paech [21] suggests adding a phase of orientation with respect to the problem definition at the beginning while Vahs and Brem [22] recommend supplementing a control phase at the end of the process. We use a combination of these suggested phases as our underlying innovation process model which is shown in Figure 1 and described in Section 3.2 in detail.

Figure 1. The model of the innovation process following Reichwald and Piller [20], Paech [21], as well as Vahs and Brem [22].

Dahlander and Gann [47] distinguish four basic OI approaches (cf., Table 1) based on the different directions of knowledge streams (outbound and inbound) and the kind of compensation (non-pecuniary and pecuniary).

As we seek to support the development of SOI from an innovator's perspective who sources information, our article focusses on inbound OI. Gaining external information is the heart of such approaches. For the operationalization of inbound OI approaches, Chesbrough and Bogers [8] identified different OI methods such as licensing IP, crowdsourcing, contests, and communities which enable organizations to manage purposive knowledge inflows. In our article, we particularly consider the following OI methods:

- Innovation workshops: Such workshops enable face to face interactions among their participants to find creative solutions for innovation-related problems. Often they are carried out with lead users of the product or service under consideration [50,51].
- Online innovation communities: Such communities allow their members to collectively discuss ideas and develop solutions. As they are realized via a web-based infrastructure, they foster knowledge transfer without any spatial or temporal barriers [52–55].
- Ideation contests: In an innovation contest, the organizer broadcasts a particular innovation-related challenge for which participants can contribute their proposals. Typically, these contests include certain rewards to foster motivation and are realized via the internet to ensure a broad reach [56–58].

Innovation workshops, online innovation communities, and innovation contests foster the inbound knowledge transfer from the perspective of the organizer. Amongst others, they can be applied to discover and harness ideas and expertise from various stakeholders such as customers, business partners, research institutes, as well as non-governmental or governmental organizations [13–15]. Furthermore, research indicates that solutions developed in a co-creative manner are more likely to be accepted by stakeholders than solutions derived from closed development initiatives [59]. Hence, OI can be a powerful means to foster successful and stakeholder-focused innovation. In the next subsection, we examine how innovation workshops, online innovation communities, and innovation contests can contribute to the development of SOI.

Table 1. The open innovation approaches following Dahlander and Gann [47].

	Pecuniary OI	**Non-Pecuniary OI**
Inbound OI	Acquiring: e.g., paying for ideas or technologies	Sourcing: e.g., obtain ideas or technologies without payment
Outbound OI	Selling: e.g., getting paid for ideas or technologies	Revealing: e.g., providing ideas or technologies without payment

2.3. Sustainable-Oriented Innovation and Open Innovation

Moving towards increasingly sustainable production and consumption forms typically requires more than just technological innovations but a systemic change in technologies, behaviors, and structures. As OI allows such complex questions to be addressed, it can contribute to the sustainability-oriented transition of organizations and society [60] and, therefore, also to SOI. Arnold [13] argues that each OI method has different potentials for the identification and resolution of sustainability challenges. In our action research study (cf., Section 3), we implemented a mix of the above mentioned OI methods (ideation contests, innovation workshops, as well as online and offline communities) to innovate services for e-mobility. Therefore, the following paragraphs focus on these methods and their potential to contribute to SOI.

Table 2 gives an overview of the potentials and target groups, as well as the costs of different OI methods. Regarding sustainability-oriented challenges, ideation contests allow the generation of a broad range of proposals. Nevertheless, the ideas submitted must often be refined. Due to their interactive elements, communities, as well as workshops, are appropriate to address and to discuss sustainability issues in more depth and to bring together diverse perspectives [13].

Regarding user groups, participants tend to be more specific, the higher the degree of user integration is. Innovation workshops, for instance, are particularly appropriate for lead users. With regard to our illustrative case in Section 3, such lead users could be, for example, drivers who already own and/or use electric vehicles. They are more capable and motivated to innovate new services for e-mobility than skeptics of this mobility form. Different user types participate in ideation contests and communities, but all of them are affected by or interested in the topic [13].

Table 2. The potential and costs of open innovation methods to contribute to sustainability-oriented innovation. Source: adapted from Arnold [13] (p. 372). In her overview, Arnold originally focused on the link between open innovation and corporate responsibility. As corporate responsibility and sustainability-oriented innovation relate to the contribution of a firm to both social and ecological objectives, we re-interpreted her overview, focusing on sustainability-oriented innovation.

Criteria of OI Method	Innovation Workshops	Community	Ideation Contests
Aims and functions	• Expand the knowledge base • Seek and find possible solutions • Initiate change processes • Support and legitimize decisions	• Expand the knowledge base • Initiate change processes • Legitimation of SOI • Discussion of interests and ideas	• Expand the knowledge base • Improve the organizations' image • Legitimation of SOI • Initiate change processes
User groups	Lead users, dedicated users	Very involved individuals interested in interaction and knowledge exchange	People concerned with the specific topic
Phases of innovation process	Depends on the desired objective	Depends on the desired objective	Depends on the desired objective
Users' knowledge	Need-based and solution-oriented	Solution-oriented	Need-based and solution-oriented
Costs	Appropriate—high	Very high	Appropriate—high
Influence on SOI	• Not just incremental, but also radical marketing or product innovations possible • Novel product or service strategy	• Not just incremental but also radical service or product innovations; • Announcing novel products or services	• Primary radical product, service, or marketing innovations • Announcing novel products or services • "Green Marketing" of enhanced products or social actions; • Novel product and service strategy

In order to acquire solution- and application-oriented knowledge, workshops and ideation contests are particularly helpful because users typically provide this kind of knowledge. On the other hand, working with communities may prove difficult because filtering ideas and solutions could be a time-consuming and costly procedure. In this context, organizations are advised to use communities only to address specific issues or problems which require a solution. Thus, a combination of communities and idea competitions can be better to refine specific ideas as well as to combine these ideas with issue-related and existing communities. Moreover, the coordination and programming of platforms for such communities are expensive. In contrast, innovation workshops and ideation contests require moderate organizational effort and thus have reasonable costs. In general, the following rule applies: the more comprehensive the solution should be, the higher the costs [13]. Section 3 describes the interaction of these methods to develop a specific SOI.

In summary, OI poses an important participatory approach for SOI, as it allows different stakeholders to be brought together around commonly perceived sustainability issues [13–15]. In line with that, Hansen and Grosse-Dunker [2] argue that the participation of stakeholders along the innovation process can ease the creation of SOI and decrease directional risks. Despite the existence of such arguments, however, little is known about OI in the context of SOI [30,34].

2.4. Silent Stakeholders

Scholars classify stakeholders as direct and indirect [16,17]. According to Rowley [18], direct stakeholders are actors related to an organization by direct exchange flows of resources, while indirect stakeholders are not related by such flows. Friedman et al. [19] describe direct stakeholders as actors interacting directly with a system or its output, and indirect stakeholders as "all other parties who are affected by the use of the system" [19] (p. 3). Considering the particular complexities of SOI, it is of uttermost importance to integrate not merely the direct stakeholders throughout the innovation procedure who take part in value creation (e.g., suppliers, manufacturers, lead users), but also those indirect stakeholders who might be (negatively) affected by the innovation's social or environmental effects (e.g., residents, road users, communities) [5]. Hence, collecting a wide range of relevant viewpoints is essential for SOI. For that, OI initiatives for such innovation rely on the participation of an extensive circle of diverse actors.

However, the arguments of actors who are either not able or not willing to participate may not be considered [6]. Actors may not be able to participate because they lack the time or competencies; or because they are simply unknown which makes it difficult to address and invite them. Actors may not want to participate in OI formats if they oppose lead actors, specific formats, or a focal technology. Environmental activists may, for example, hold relevant information about challenges of nuclear energy but may be hesitant to share it in an innovation process to improve (and thus legitimize) nuclear technology. We group these actors with the term "silent stakeholders" which we define as direct and indirect stakeholders of a potential innovation who are not willing and/or not able to participate in OI initiatives for that innovation. Because of the stakeholder (self-)selection effects resulting from this phenomenon, relevant perspectives may remain uncaptured. This is particularly critical in innovation processes for SOI as increased complexities such as growth risks or rebound effects [21] require a lot of knowledge on social and environmental aspects [2] which silent stakeholders may hold.

Integrating silent stakeholders can thus be of great importance for SOI processes. First, the consideration of silent stakeholder voices is useful for improving an innovation's sustainability contributions. What is more, the consideration of silent stakeholders is also relevant to increase an innovation's social robustness and legitimacy. After all, if an innovation violates the interests of so far silent stakeholders later on, they might not stay silent indefinitely. Yet, if silent stakeholders turn loud and voice their criticism, organize a protest, and veto an innovation at a much later stage, then adapting an innovation is much more difficult if not impossible.

While silent stakeholders' voices can be potentially relevant for SOI, they are, by definition, difficult to capture with conventional OI methods. Furthermore, the implementation of OI methods can be costly and time-consuming [13]. Online innovation communities, for example, enable participants to exchange available solutions or novel ideas without spatial or temporal hurdles. Thus, such communities can serve as a platform for ideation contests as well as broadcast search and thereby support innovation processes [52–55]. Yet, such communities need to be programmed, built up by acquiring members, and managed. In the long term, online community building is interesting as, once established, the thriving communities can provide a permanent participation infrastructure. However, in the short term, such OI methods can hardly produce better solutions for SOI [61].

A possible option to address those issues is to apply open direct search approaches to support OI initiatives. According to Piller and Hilgers [7], direct search relates to the classical method of information discovery in which actors actively search for suitable information, applying certain search terms and algorithms. If a direct search is oriented as broadly as possible to a wide range of sources, it can be defined as open [62]. Examples of open search methods are netnography and the lead-user approach [7].

Netnography is defined as a "qualitative research methodology that adapts ethnographic research techniques to study the cultures and communities that are emerging through computer-mediated communications" [63] (p. 61). As such, the approach provides a framework allowing scholars to analyze the culture of social media and online community data including chat rooms, virtual worlds, blogs, wikis, or social networking sites [63,64]. In doing so, netnography can provide information on cultural members, structures, and values [64] including consumer insights such as feedback on brands and products or innovative ideas [63]. Thus, it can generate information on stakeholder needs in an open direct search process by monitoring and analyzing the existing contributions of users in online communities [7].

The lead-user approach aims to integrate a selection of users in the innovation process who have particular desires prior to the average user and actively search for solutions [51]. This approach has proven to be particularly successful in finding technical solutions for a specific question [7]. For the identification of experts holding solution and market knowledge, an open but targeted search process in analogue markets is recommended [65]. Facing the specific challenges and complexities of SOI, we argue that this approach needs to be extended from lead users to lead 'affected' who hold knowledge about social and environmental interdependencies. Considering that, an extended lead-user approach would have great potential for the development of SOI.

OI research, however, has neglected research on open direct search methods and their integration in the innovation process. This is surprising as OI processes typically rely on voluntary participation and direct search methods could be used to mitigate the stakeholder self-selection effects and thereby give voice to the otherwise silent stakeholders. The following subsection, therefore, describes efficient and effective direct search approaches to improve the "fit-to-market", as well as "time-to-market" or "cost-to-market", of the innovation process for SOI.

2.5. Research Focus: Text Analytics in Direct Search Methods for Sustainability-Oriented Innovation

Open direct search might represent an approach that can address the issues described above by effectively examining external (from the perspective of a certain OI process) sources in which possibly pertinent stakeholders have shared their arguments in other formats thematically related to the respective OI project. Thus, considering their ideas, knowledge, and concerns can supplement any inbound OI process.

Depending on the innovation object, these sources can range from social networks (e.g., Facebook), micro blogs (e.g., Twitter), intermediary networks (e.g., LinkedIn), forums of specialized communities, to wikis, review-related websites, or news websites, etc. The examination of such sources might represent an approach to include perspectives of silent stakeholders in innovation processes, even without their direct participation in a certain OI initiative. For example, Twitter users might have discussed critical aspects of e-mobility such as visually impaired pedestrians having problems orienting themselves without engine noises. Discovering such issues might support the development of new services in that field such as special noisemakers. Thus, by analyzing such sources, unknown or underrepresented positions and aspects might be discovered and taken into account throughout the innovation process.

However, the amount of data from these sources can be immense. For instance, in Twitter, we monitored over one million e-mobility-related tweets in 2017 by applying respective search terms. Furthermore, each source has different properties such as search functions or filter options, and various kinds of extractable data such as (user-generated) topics, texts, videos, pictures, number of shares, likes, answers, etc. Filtering relevant aspects from such databases is, thus, highly complex. Therefore, evaluating this kind of sources requires analyzing, structuring, and processing large volumes of data. To this end, modern analytical methods, such as TA, can provide a suitable and efficient approach [9].

Yet, OI research has neglected research on open direct search methods [8], particularly in combination with analytical methods. However, some scattered approaches exist in the innovation and consumption research literature. Kaiser and Bodendorf [26] conducted a study on mining and analyzing opinions from consumer conversations in online forums concerning the iPhone. Their study shows how to identify opinion tendencies and influential users through applying different TA methods and a social network analysis [26]. Pajo et al. [27] proposed a "Fast Lead User Identification" (FLUID) approach by which data mining methods are applied on social networking websites to discover lead users in an automated and precise way. Kozinets [25] also mentions data mining and content analysis approaches in connection with data analysis for netnography. Furthermore, Lee et al. [66] developed an advanced method to observe trends in technological changes by analyzing patent relations based on the formal concept analysis tool for grouping objects with mutual characteristics, while Jeon et al. [67] processed patent information data to establish an approach to find potential innovation partners.

Yet, those approaches are scattered and barely linked to the innovation process. Examining a specific case about the applicability of TA on broad direct search data in OI processes for SOI can, thus, pose an important first step in examining the possibilities and restrictions of data mining in the context of sustainable development and innovation. Based on this review, the research question of the present paper can thus be restated: *How can TA of broad direct search data support OI for SOI?* While reflecting that specific case, we seek to give a holistic overview of the possibilities of the integration of direct search methods supported by data mining in OI processes for SOI.

3. Action Research Study

3.1. Description of the Action Research Cycle

To answer this question, we conduct an action research study [10] within a nationally funded research project on creating service innovations for e-mobility through an OI approach, which can be categorized as inbound and non-pecuniary (cf., Table 1). As some of the targeted service innovations, sustainability labels in the field of e-mobility were created through the combination of different OI methods. To demonstrate how external sources found through a broad direct search can be analyzed efficiently for the integration of further information in the OI process, we exemplarily examine the public digital discourse in articles on e-mobility published on leading German news websites. For the processing and examination of this rich database, we then apply methods of TA. Next, action research is outlined followed by an illustration of the project background.

According to Hult and Lennung [68] (p. 247), “action research simultaneously assists in practical problem-solving and expands scientific knowledge. It enhances the competences of the respective actors, being performed collaboratively in an immediate situation using data feedback in a cyclical process, aiming at an increased understanding of a given social situation. It is primarily applicable to the understanding of change processes in social systems and undertaken within a mutually acceptable ethical framework”. In order to tackle a real world challenge, action research is based on collaboration between academics and practitioners [69]. Often, the action research process is depicted in a cyclic model [70]. According to Susman and Evered [10], an action research project comprises five stages (cf., Figure 2): (1) diagnosing, (2) action planning, (3) action taking, (4) evaluating, and (5) learning.

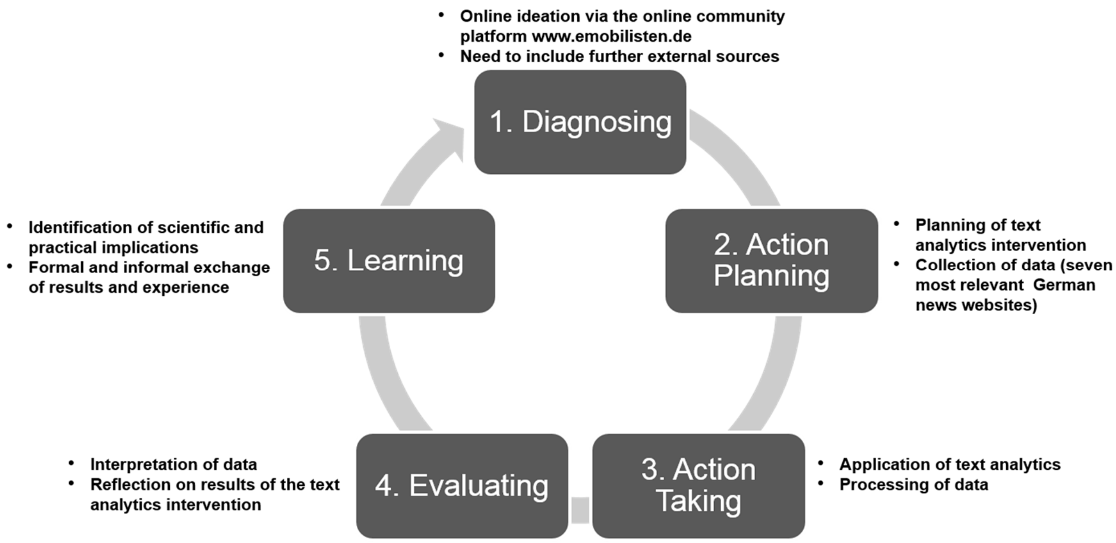

Figure 2. The applied action research cycle following Susman and Evered [10].

First, throughout the (1) diagnosis stage, as mentioned below (cf., Section 3.2), we encountered the challenge that most ideas were provided by a very active set of community members, mostly convinced proponents of e-mobility. Hence, we reflected on the possibilities to overcome this potential bias and to include heterogeneous demands of relevant stakeholders besides these community members. As a promising solution, we identified the public digital discourse concerning e-mobility in Germany as an already existing external source of knowledge. In order to analyze the public discourse on e-mobility, we (2) collected the data through direct search as well as planned and prepared the use of TA methods (e.g., cleaning the data), which we (3) applied in the third stage. Afterward, we (4) interpreted the results and reflected the application of TA methods. On the one hand, the (5) insights gained might be useful for a refinement and evaluation of the applied methods and, on the other hand, for the integration of further external data sources in the development of the sustainability labels.

3.2. Diagnosing the Project Background

We performed our study as part of the interdisciplinary multi-year research project "Community-based Service Innovation for E-Mobility" (CODIFeY). We chose CODIFeY because the fitting setting and the project duration allowed us to accompany the initiative for three years from 2014 to 2017. The main objective of CODIFeY was to raise the acceptance and amount of users of e-mobility within Germany by causing behavioral changes in individuals [71,72]. To reach this aim, an online community platform named eMobilisten (URL: www.eMobilisten.de) was set up in 2015. This platform incorporated three central elements:

1. Knowledge Creation: To reduce the lack of knowledge and to qualify community members to participate in service innovation, e-learning courses on e-mobility topics were provided. Additionally, community members were allowed to take part in the development of e-learning courses by contributing e-mobility-related experiences or knowledge.
2. Service Innovation: This module built upon several of the OI methods previously (cf., Section 2.2) described, namely ideation contests, the online innovation community, and innovation workshops. Based on these methods, community members cooperatively created novel services and solutions for e-mobility. After defining a certain innovation object, the services were developed in four consecutives phases (see Figure 1). In the early stages, ideas were collected, filtered, and selected. After that, the chosen ideas were transferred into concepts which were then evaluated. Based thereon, development and testing of prototypes took place. Subsequently, the market launch and management phases would have been conducted, but were not performed within the project CODIFeY.
3. Community Analytics: The behavior of participants on eMobilisten was monitored and evaluated by data analytics. Thereby, the interaction between service innovation and knowledge creation was promoted.

Moreover, permanent community management measures such as participant acquisition and relationship management supported the online innovation community.

As part of the service innovation component, the project consortium decided to develop sustainability labels for e-mobility. Such labels can assist in making sustainability-related attributes more transparent, reduce complexities as well as information asymmetries and thus support customers in purchasing situations [73]. Thereby, it can provide incentives for businesses to make their e-mobility solutions more social and environmentally friendly. Hence, those certifications can be categorized as product-oriented service SOI [2]. During the development of sustainability labels, questions emerge such as which stakeholders should be involved, which aspects should be certified, and which sustainability-related benchmarks should be included. Furthermore, the cost factors and complexities of such labels have to be limited to ensure the ease of implementation.

To facilitate the label development while addressing these questions, the OI methods communities, ideation contests, and innovation workshops were combined along the innovation process in CODIFeY. To do so, we followed the innovation process model shown in Figure 1.

- The “Orientation” phase serves to identify and analyze opportunities for SOI [21]. In this phase, the focus lies, in particular, on exploring the sustainability context including the concrete problems and legislation changes [74]. Thus, the boundaries of the innovation space are defined. In CODIFeY, secondary data were collected and analyzed manually followed by a workshop with e-mobility experts. As a result, this step yielded a categorization of sustainability-related effects and stakeholders of e-mobility (see [61]). Based on that categorization, opportunities for sustainability-oriented service innovations in the field of e-mobility such as sustainability labels were determined.
- In the next phase “Idea Generation”, ideas for the determined innovation objects are obtained in a broad way e.g., [11]. For the idea collection in CODIFeY, we used different online and offline channels. Online community members were encouraged to contribute their ideas and opinions by a call for ideas for the creation of sustainability labels for e-mobility. To reach out to many stakeholders and ensure participation, we promoted this call on social media (i.e., Facebook and Twitter) and via direct acquisition (i.e., email and telephone). Furthermore, ideas were collected during relevant offline events. During the idea generation, however, we encountered the challenges explained below. As our action research study is conducted during this phase, we explain the subsequent development process of the sustainability labels only hypothetically.
- Next, the phase of “Idea Selection and Concept Development” serves to screen and evaluate the obtained ideas according to their environmental, economic [74], or social relevance. We then selected and transformed the most promising ones into concepts of new offerings [75]. In CODIFeY, the collected ideas were first subjected to a quantitative and qualitative content analysis. Based on that, an offline innovation workshop was initiated in which heterogeneous stakeholders such as lead users or experts develop concepts for the respective SOI.
- In the “Concept Evaluation” phase, these concepts are then evaluated by relevant stakeholders, experts, and lead users [76]. To realize that, in CODIFeY, the online innovation community on eMobilisten assessed the SOI concepts in a survey format.
- Subsequently, the “Prototyping and Testing” phase serves to develop prototypes of the respective innovation based on the assessed concepts which are tested afterwards [76]. In CODIFeY, we created the prototypes internally in collaboration with experts. Testing was then realized by offline workshops in which experts and lead users, among others, participated in.
- The phase of “Market Launch” is about subsequently developing the final prototypes to market maturity and commercializing them with implementation partners. At this point, the final outcome reaches the end users in the market and is implemented on a larger scale addressing the actual target group [20].
- During the “Management” phase, the innovation is subject to a continuous examination in order to adapt it to possible changes or for repeated applications in the future [22]. Thus, the innovation is reviewed regarding, for example, its sustainability impacts. Tufte and Mefalopulos [77] emphasize the role of stakeholder engagement in this phase to give feedback and participate in formulating indicators as well as measurements for evaluation.

Throughout the idea generation phase, 54 ideas with 68 related comments regarding sustainability labels in the field of e-mobility were collected. Based on a content analysis, we identified four categories for which contributors take a label into account: car manufacturer, electric cars, charging stations, and providers of mobility services (e.g., delivery services). Afterward, we assigned the mentioned criteria including frequencies to the topics. In the category charging stations, for example, the origin of the electricity was mentioned 18 times, the usability six times, and the material of which the stations are made four times. However, we encountered the challenge that most of the submitted ideas and comments were contributed by a rather small number of e-mobility lead users. Thus, particularly with regard to SOI-related complexities, there was a need to enrich their ideas with the demands of other stakeholder perspectives, including silent stakeholders, in order to foster a broad acceptance of developments. The next section describes our approach to do so.

3.3. Action Planning and Taking—Application of Text Analytics

Since a manual analysis of the text data is virtually impossible due to the large number of news articles, we decided to apply computer-aided TA. By using TA, we are able to integrate a very large amount of unstructured information (in this case, news articles) into the innovation process in a short time and with manageable effort. In other words, the application of computer-aided analytical methods enables for the potential integration of silent stakeholders in the innovation process in order to better capture the bigger picture. A manual processing and evaluation of this information would not be justifiable from an economic point of view.

In particular, we used the TA software Leximancer to retrieve information from the texts and, thereby, gain insights into the public digital discourse on e-mobility in Germany. Leximancer can be used for quantitative content analysis on a relational and conceptual level by means of unsupervised machine learning algorithms [78]. Concisely, the tool extracts word frequency and co-concurrency information from natural text data and transforms this information into semantic concepts (words or phrases with similar or identical meanings) which are then visualized in so-called concept maps (cf., Figure 3) [79]. As shown by Martin and Rice's [80] study on enterprise risk profiling concepts, the concepts identified by Leximancer are very similar to the results of time-consuming manual coding. Leximancer is suitable for recognizing contextual relationships and structures in large amounts of unstructured text data and it is, thus, well-established in various research disciplines including health care services [81,82], information systems [83,84], and corporate sustainability management [85,86].

Our approach is inspired by Debortoli et al. [87], who applied the Cross-Industry Standard Process for Data Mining (CRISP-DM) [88] for their text mining tutorial. The CRISP-DM model is considered the most established methodology for analytics projects within the data science community and is therefore well suited for our context [89]. We roughly structured our analysis into the six phases problem understanding (modified from business understanding in the CRISP-DM), data understanding, data preparation, modeling, evaluation, and deployment. We explain these phases in more detail below.

First, in the problem understanding phase, we defined the objectives for our TA project from the initial situation in the research project CODIFeY. As mentioned above, we planned to capture the public digital discourse related to e-mobility in Germany in order to enrich the development of sustainability labels. More explicitly, our goal was to understand and structure topics of interest with regard to sustainability and e-mobility as well as to delve deeper into certain concepts and their semantic connections in the news articles.

Second, in the data understanding phase, we collected our initial data set, which consists of e-mobility-related online articles of German news websites (Bild, SPIEGEL ONLINE, FOCUS Online, WELT, ZEIT ONLINE, stern.de, and SZ.de) within a period of five years (2010–2015). These news websites have been selected by considering the following aspects:

- We have only included primary sources and no news aggregators, search engines, or other secondary sources.
- Since we aimed to capture the general discourse on the topic of e-mobility in Germany and no discussions in expert communities or specific regions, we have selected nationwide general interest media that are thematically broad-based.
- In order to ensure reliability and to achieve comparability within our sample, we chose only news websites operated by renowned German publishers.
- Since we analyzed articles published during a period of several years, we included only websites offering an online archive that allows us to access all articles published in the period from 2010 to 2015.

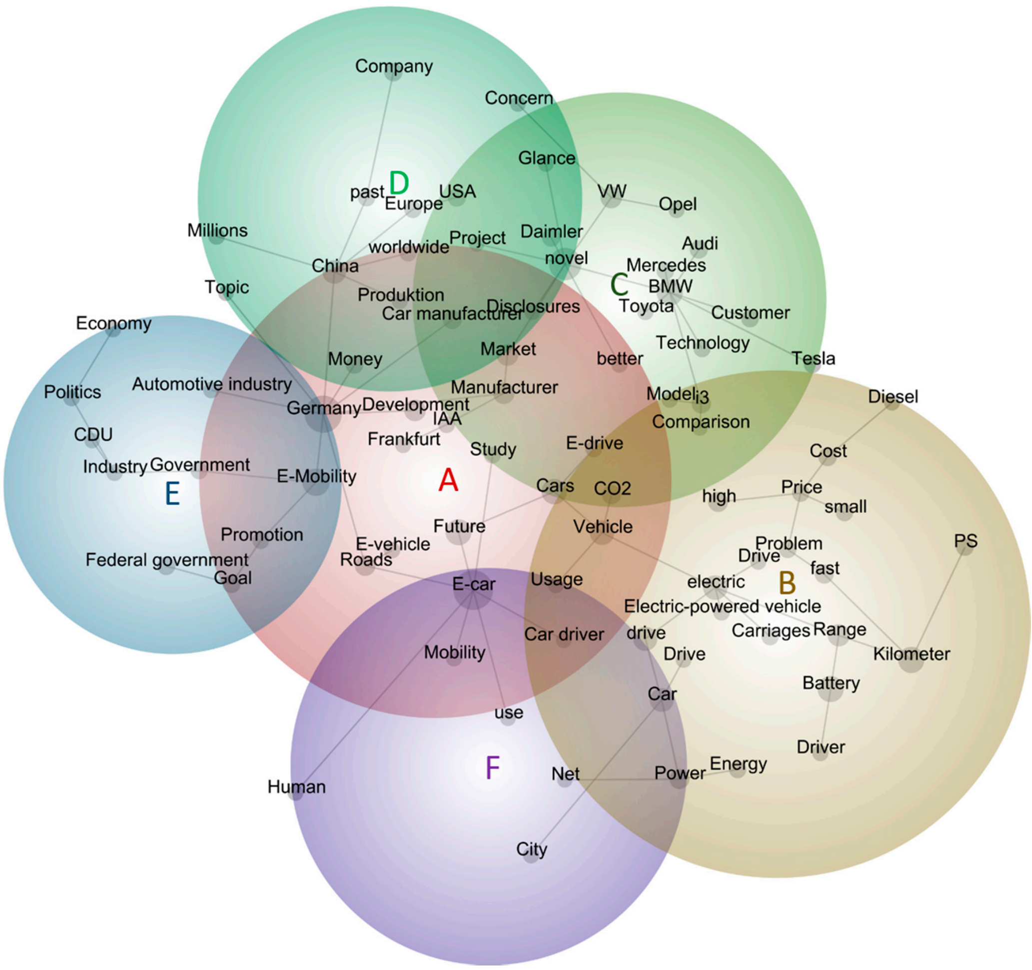

Figure 3. The overall concept map.

Considering these criteria, we have selected the news sites with the highest net reach in Germany [90]. The articles were manually downloaded as PDF files via the online archives of the news websites. To this end, we conducted a full-text search using the search term "Elektromobilität" (electric mobility). Our initial sample size consisted of 2054 documents. During an initial manual screening of the data, we noticed that we were not able to gather the articles from WELT in a processible format. Hence, we excluded these articles from the sample. Furthermore, we have removed articles which, although they have mentioned the term e-mobility, are only vaguely related to the topic. In the end, our adjusted database consisted of 1898 documents. The article length varies from short articles with only a few paragraphs to longer conductive articles with several pages (up to five). On average, an article consists of 56 sentences.

Third, in the data preparation phase, we applied Leximancer for various pre-processing tasks to improve the quality of our analyses. We used a predefined stop word list for German words, which was refined and modified in several iterations. In addition, we used various other functions of the software such as stemming, removal of HTML tags and URLs, and duplicate texts.

Fourth, while modeling, we performed a two-step analysis of our data set. First, we analyzed the entire corpus and visualized it by means of a concept map in order to get an overview of the topics discussed. To this end, we used Leximancer's linear topical clustering algorithm because it is more stable for highly networked entities as in our case [78]. Second, we focused on selected concepts that seemed relevant to us for the label development in CODIFeY. For this purpose, the Leximancer function "profiling" was applied. This function allowed us to examine texts in the spatial proximity of predefined concepts (in this paper, exemplified by the concepts CO_2 and battery; cf., Section 4) in order to gain a better understanding of the context in which they are discussed within the articles. For the analysis of these correlations, we used the Gaussian cluster algorithm of Leximancer and created concept clouds (cf., Figures 4 and 5) to display the results [91]. During the analysis, we found that the automatic recognition of concepts in the data did not work sufficiently well for our application scenario. As a result, concepts with identical or very similar meanings were treated separately. For example, four different concepts for batteries (battery, batteries, accumulator, accumulators) occurred. These issues may have been amplified by the fact that we have analyzed German texts. However, to improve the quality of results, we added manual coding to the automatic recognition of concepts.

Fifth, in the context of evaluation, we repeatedly discussed and reflected on interim results with fellow researchers in the CODIFeY project. In addition, we presented and applied our approach in three workshops with students and executives in order to uncover a potential for improvement and to demonstrate the practicability of our approach. Finally, we interpreted the results in the deployment phase, which is described in Section 4.

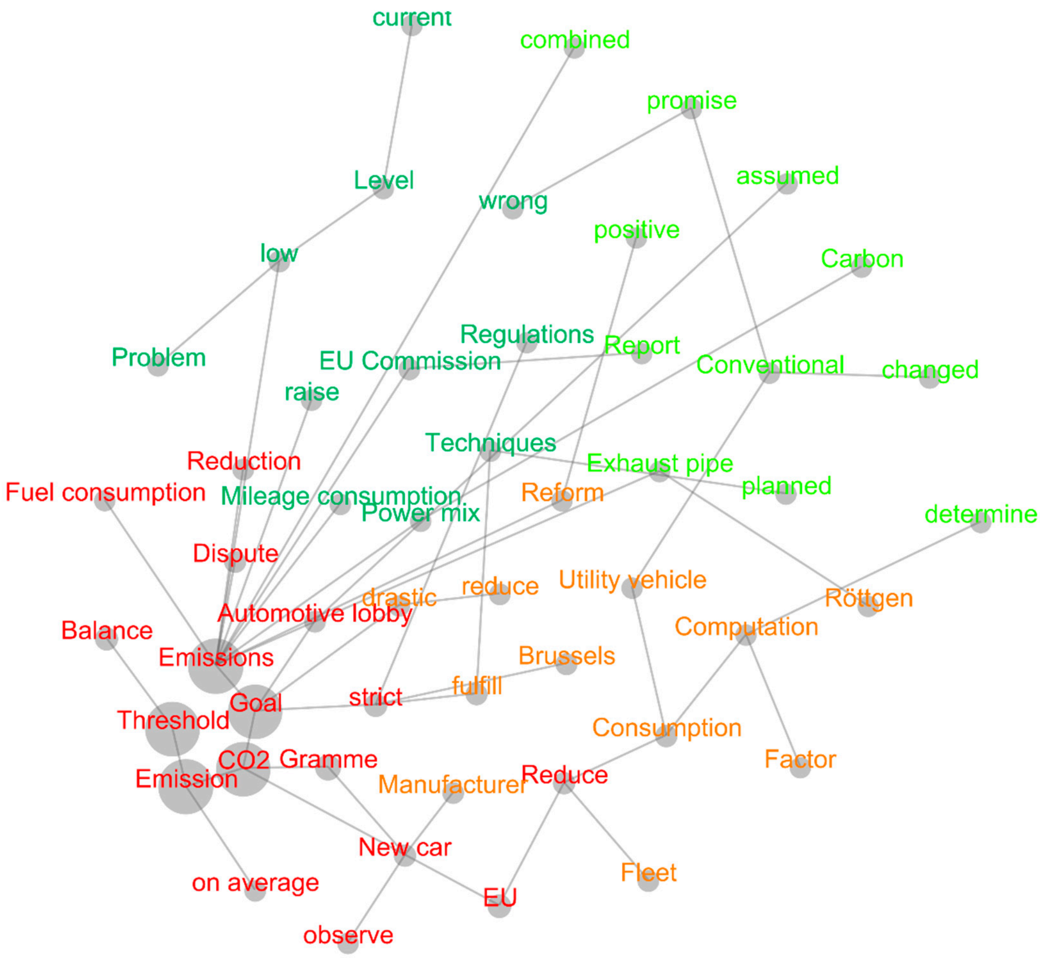

Figure 4. The semantic network of the CO_2 concept.

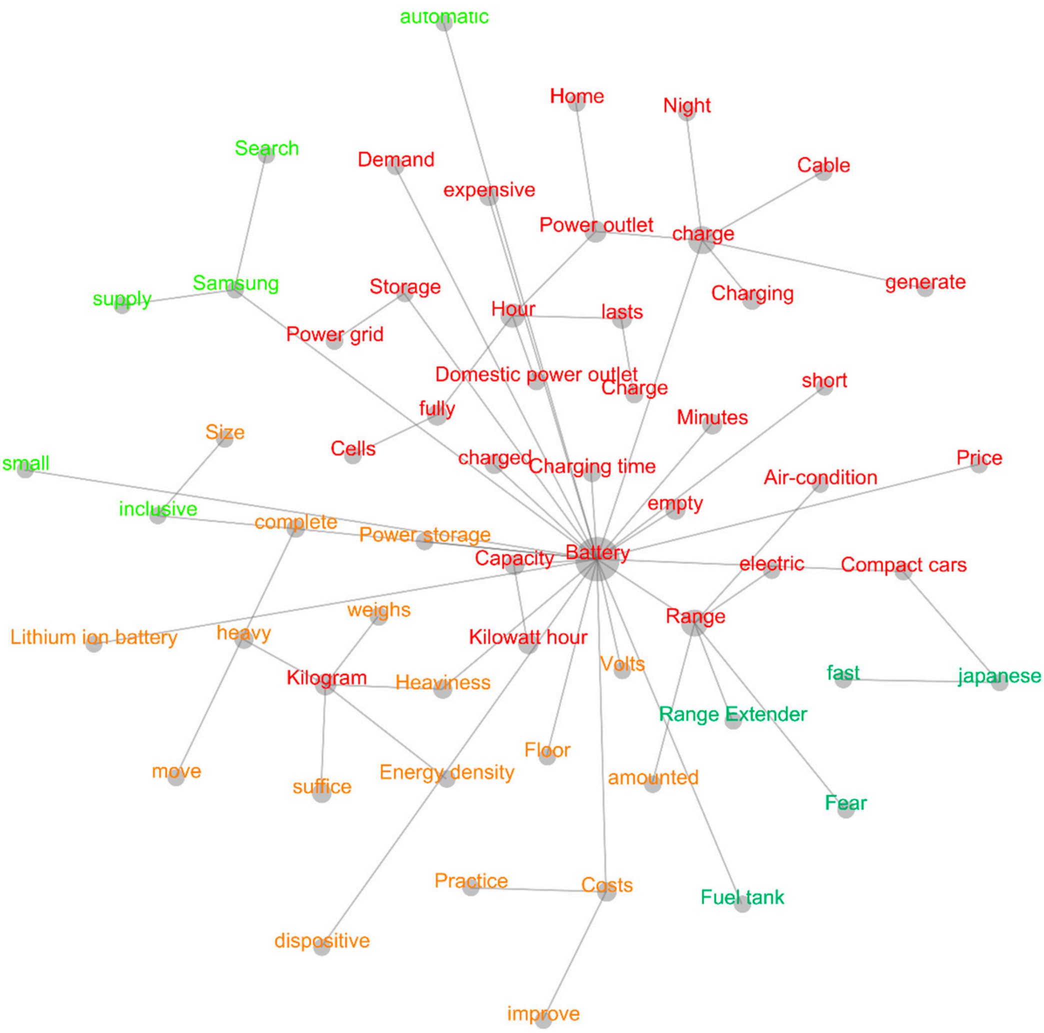

Figure 5. The semantic network of the battery concept.

4. Results

4.1. Findings from the Overall Discourse Analysis

This section presents the results from the TA processes, their interpretation and applicability in the innovation process for the sustainability labels. At the same time, this step represents stage (4) in the action research cycle: evaluation. Our first step in interpreting the TA results was to identify concepts and broader topic areas as well as their relationships to each other in the German discourse related to e-mobility. Figure 3 shows the overall concept map which results from our analysis of the text data. The concept map visualizes concepts as dots, where the size of these dots rises with increasing connectivity with other concepts on the map. Strong relationships between concepts are represented by edges, which leads to a network of related concepts. Concepts that occur frequently together in text sections are clustered in higher-level topic areas which are displayed as heat-mapped circles. The most relevant topic areas appear in red, the next one in orange and so on following the color circle. The following paragraphs describe the topic areas and the resulting recommendations for the sustainability labels in detail.

Electric mobility (A): This central topic area is connected to all other topic areas and hosts the most frequently discussed topics. Among these, automobile-related terms such as electric cars, automobiles, and electric vehicles can be found. Further central topics are Germany, the future, and industry-related subjects such as car manufacturers. This points to the major importance of the discussion about the future of the automobile sector in Germany. Those relations in the discourse can also give indications of the focus of sustainability labels. Hence, a focus on electric cars and their producers can be deduced from the discourse analysis.

Technology (B): The second most discussed thematic area hosts technology-related topics such as the battery, electric, energy, and drive. Furthermore, often addressed challenges and potentials in connection with the new technology can be found. Range, high speed, infrastructure, and battery, as well as monetary aspects such as price and costs, are associated with the topic problem. Moreover, drivers are often discussed in this context. On the other hand, potentials such as reducing CO_2 emissions, performance, and enjoyable driving experience are often mentioned. Accordingly, a focus on those technical components while addressing connected economic, ecological, and social challenges and opportunities can be reasonable.

Automobile manufactures (C): This thematic area includes diverse car manufacturers. Among these, mainly German companies such as VW, BMW, Mercedes, and AUDI are addressed. The only foreign producers often discussed are TESLA and Toyota. Furthermore, topics directly connected to the manufactures such as compact cars, technology, or electric drive are frequently mentioned. These results suggest considering cooperation with important manufactures for the label development.

Markets (D): This thematic area mainly addresses the global market for e-mobility. Topics such as worldwide scale, production, and businesses are discussed in the context of the leading markets of China, USA, and Europe. These results point out that sustainability labels for e-mobility should be developed for and distributed in those markets first. Interestingly, the topic of China is often mentioned in connection with the number one million which the German federal government was aiming for in terms of electric car ownership in Germany by 2020. This arguably reflects the fear of the German automotive industry and the government being overtaken by Chinese manufacturers.

Stakeholder (E): This cluster primarily hosts further stakeholders related to e-mobility. We identified broader terms such as politics, industry, and research as well as more specific terms such as SPD and CDU (important German parties), the federal government, and the automotive industry. Thereby, our results indicate close ties between politics, business, and research. Furthermore, related terms such as development, expansion, subsidies, and aims display how the mentioned stakeholders work together on the development of e-mobility in Germany. For example, money and subsidies are frequently discussed in the context of governmental and industrial collaboration in advancing electric mobility. For the development of sustainability labels for e-mobility, these results suggest considering cooperation with these stakeholders while also considering their respective ties and interactions.

Usage (F): This thematic area sums up topics related to the actual use of electric vehicles. The usage is particularly discussed in connection with urban areas. Furthermore, the issues of individual mobility and the electricity supply system are often mentioned in relation to the use of electric vehicles. For the development of the labels, it can, thus, be recommended to address the actual use of electric vehicles, especially in the urban context and to emphasize clean electric energy supply and individual mobility needs.

4.2. Findings from Zooming into Single Topics

To advance the interpretation for the development of sustainability labels in the field of e-mobility, we used the profiling function of Leximancer allowing a detailed analysis of every single term on the map in Figure 3. These zoom-ins also follow the heat map principle: the warmer the color of the term, the more often it was mentioned. In the following sections, we illustrate the example of zooming in and describing the topics of CO_2 and battery which we consider as highly relevant for the label development. Based on that, we make further recommendations for the sustainability labels.

CO_2 (cf., Figure 4): The most relevant terms in connection with CO_2 are limits, balance, European Union (EU), and aims. It becomes clear that the most important topic is the reduction of CO_2 emissions in accordance with the strict limits of the EU. In this context, politics-related terms such as Altmaier (German federal environment minister in 2012 and 2013), the EU Commission, Brussels, automotive lobby, and reforms are often coined. Furthermore, the comparison to diesel engines, fuel, and fuel consumption plays a major role in the discussion about the contribution of e-mobility regarding CO_2 savings. In this context, coal and energy mixes are often mentioned, reflecting the importance of the energy supply when charging electric vehicles. Moreover, the topics already indicate the diesel gate scandal which went public only at the end of 2015 and is, thus, only partially included in the data. In addition, automobile manufacturers and car fleets of companies are often discussed regarding CO_2 emission limits and reduction. These results indicate that sustainability labels for e-mobility should foster the reduction of CO_2 emissions, especially by promoting charging with renewable energy. Furthermore, particularly with regard to CO_2 limits, such labels should allow a comparison with vehicles powered by internal combustion engines and, thereby, emphasize the alternative which electric vehicles can represent within the car manufacturer's product portfolios and for car fleets of diverse companies.

Battery (cf., Figure 5): The most discussed terms related to battery focus on the charging process. Charging, charging time, range, charging stations, and sockets are often mentioned in this context. Moreover, challenges connected to the capacity such as energy density, fear, air conditioning, winter, weight, and low range are frequently discussed. Further challenges such as expensive acquisition costs and lifespan are also often mentioned. On the other hand, potentials such as recuperation by braking and energy storage as a buffer for the power grid are frequently discussed. In addition, technological aspects such as plug-in and range extender are often mentioned. For the label development, these results suggest specifically addressing the charging process and the mentioned challenges about the component battery. Additionally, these results suggest fostering the potential of applying batteries of electric cars as energy storage in the domestic context through bidirectional charging or as a stationary application after the battery has become too weak for the vehicle.

After the analysis of the overall map and the deeper analysis of relevant topics, it can be stated that the German e-mobility discourse has a very political character and focuses dominantly on electric cars, the challenges related to the battery and the charging process, as well as the automotive industry. Therefore, electric cars, their most discussed component, i.e., the battery, and charging processes can be important categories for sustainability labels. For the development of such labels, the automotive industry and the public sector represent important stakeholders. Furthermore, numerous technical aspects play important roles in the discourse, which could represent an obstacle for uninformed potential users. Consequently, a sustainability label addressing those aspects should also simplify these for potential customers. Additionally, science and politics are often mentioned in the discourse and should, therefore, be considered as important stakeholders for the label development.

4.3. Applicability in the Innovation Process for the Label Development

In the next step, we tested the results from the TA of broad discourse data for usability in the idea generation phase of the innovation process. In this phase, the resulting clusters and word occurrence supported the identification of important topics and stakeholders. Based on that, further stakeholders were invited to participate in the idea generation and the previously identified label categories were critically revised and thereby confirmed.

However, the structures that can be filtered from the concept maps and profiles were too general to support the idea generation phase with concrete ideas from silent stakeholders. Thus, we examined the applicability of the filtered structures in other phases and found that our TA results can best serve to support the orientation phase. In this phase, the structures filtered from the concept maps and profiles supplemented the previously made categorization of sustainability-related aspects of e-mobility with further topics and stakeholders. Particularly, the word occurrence served as an indicator of the relevance of certain aspects. We then used these findings for the label development. Furthermore, the mined data supported the identification of further opportunities for sustainability-oriented service innovations in the field of e-mobility. For example, based on the importance of the topic of batteries and its connection to environmental issues, we launched the idea generation for the further innovation challenge "A second life for electric car batteries".

Furthermore, we can derive implications about the efficiency and effectivity of the TA approach applied in CODIFeY. While the planning, data collection, execution, and interpretation of our TA approach took one month of working time for one person processing 1898 documents, a previously made manual collection and analysis of secondary data (cf., orientation phase in Section 3.2) took three months of working time for one person. Moreover, the manual coding only processed 43 relevant articles. By comparing the results of the manual processing with the outcomes of our TA approach, we evaluated the correctness of the identified topics and stakeholders. In doing so, we were able to validate the accuracy of our method. Thus, these results show that the structured screening with Leximancer can be faster and cheaper compared with a desktop research applying a manual evaluation while achieving similar results. More specifically, the topic modeling approach we conducted allows for the efficient evaluation of a vast amount of sources. Moreover, the fact that the amount of data proceeded with TA is almost arbitrarily scalable further underlines the efficiency of this approach. Furthermore, after testing our approach in different workshops with students and executives, we confirm the ease of use and practicability of our method.

Our results, thus, indicate that the TA of broad discourse data can particularly support the development of SOI in the very beginning of the of the innovation process: the orientation phase. The next section discusses the general applicability of our approach to foster OI processes for SOI.

5. Discussion

This section discusses the applicability of broad direct search data analyzed by TA to enrich OI processes. At the same time, it should represent stage (5) in the action research cycle (cf., Figure 2): learning.

By addressing the largely unexplored question of how the TA of broad direct search data can support OI for SOI, we propose one of the first approaches in developing a method for the efficient integration of external sources in OI processes through the application of TA. Our approach offers the possibility to capture a broad discourse and examine it from different perspectives at different levels of granularity. Considering the innovation process of SOI, we find that the TA of broad discourse data is best suited to support the orientation phase. In this phase, the mined text data can supplement the identification and analysis of opportunities for SOI by efficiently detecting sustainability-related topics and stakeholders of an innovation space (e.g., e-mobility). Moreover, the relevance of such aspects can be indicated through word occurrence. Thus, the TA of broad discourse data can enhance the efficient definition of the innovation space, the identification of concrete opportunities for SOI, and contribute to the preparation of the idea generation phase.

Furthermore, based on the experiences gained during the action research, we suggest applying different direct search methods combined with analytical methods in different phases along the innovation process of SOI (see Figure 6). These methods can then serve to complement OI approaches in the respective phase. Arguably, netnography can bring forth concrete ideas or feedback for a certain innovation because it aims to analyze the dialogues of potential customers or users [64]. Therefore, we propose the application of netnograhpy during the idea generation and management phase. In the case of SOI, however, this analysis should be widened to stakeholders potentially (negatively) affected by the innovations impacts [5], which requires consideration of additional sources and the processing of more data. Thus, netnography supported by data mining [25] can represent an efficient approach. More specifically, this could be realized by applying, for example, Kaiser's and Bodendorf's [26] opinion mining approach which is based on TA methods and a social network analysis.

Moreover, we recommend applying FLUID [27] to identify lead users efficiently. This has great potential to supplement indirect OI methods in the innovation phases of idea generation, idea selection and concept development, concept evaluation, and prototyping and testing. As it is highly relevant to generate solution-oriented knowledge in these phases [13], the efficiently identified lead users can then be invited to join indirect OI methods such as ideation contests or offline innovation workshops. Following the argument mentioned above, FLUID should also be widened to the identification of sustainability-relevant stakeholders in order to develop successful SOI. Synoptically, Figure 6 shows our proposed framework integrating the described indirect and direct search OI approaches combined with the discussed analytical methods along the innovation process for SOI. Building on that, the following section describes the theoretical and managerial implications as well as recommendations for future research.

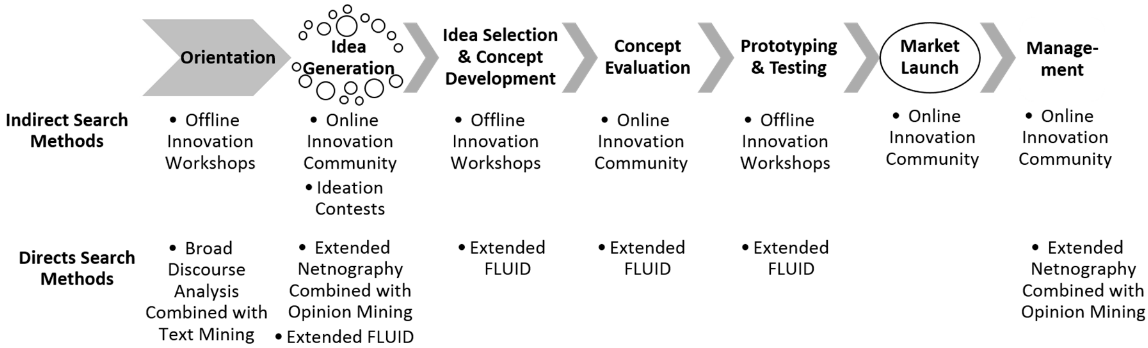

Figure 6. The open innovation methods and data mining support along the innovation process model following Reichwald and Piller [20], Paech [21], and Vahs and Brem [22], as well as building upon the results of our study.

6. Implications and Conclusions

By showing how TA of broad discourse data can support the early innovation phases of SOI, we expand the literature on opportunity identification [21] and analysis of sustainability aspects [74] in these phases. Furthermore, we add to the discussion of OI being an important instrument for the development of SOI [2,13,14,34].

Following Gregor's [23] taxonomy of theory types, our proposed framework contributes to the nascent theory for design and action in the field of OI for SOI. It presents prescriptive knowledge for planning and executing future inbound OI initiatives striving to give a voice to silent stakeholders. Besides, by introducing the framework, we add to the literature on direct OI search methods [7] as we link these with different data mining approaches to support indirect OI methods along the innovation process for SOI [21].

Moreover, our work is pioneering in its definition of the concept of silent stakeholders, relating this issue to SOI, and in its discussion of ways to identify them and their positions. In doing so, we add to the literature regarding direct and indirect stakeholders [16–19,92] and their participation in the creation of SOI [2,13]. Future research can use the concept of silent stakeholders to further investigate why certain actors are either not willing or able to participate in OI and how additional methods can capture the perspective of so-far silent stakeholders.

From a managerial perspective, TA, in the way we used it, can support the definition of the boundaries of the innovation space for SOI in which various sustainability-related topics, actors, and non-intended directional risks [21] are to be identified. Furthermore, we highlight ways to particularly support OI initiatives in the early innovation stages. For the development of successful SOI, this is of major importance as the majority of their future direct and indirect sustainability effects are pre-determined in the early innovation stages [42,93] from orientation to concept development. As central decisions on the profile of a new offering are being made, about 75–85% of the life-cycle costs are set within these phases [11,12]. Consequently, as these phases mark an important span to reduce risks and uncertainties concerning the market and technical [37] and sustainability issues [21], our data mining framework can pose an important tool to reduce risks in the development of SOI. More generally, we believe that our framework is appropriate to any innovation space that is publicly and extensively discussed. It enables practitioners to systematically disclose diverse viewpoints, fostering evidence-based decision making throughout the early stages of development.

Finally, by analyzing the limitations of our study, we derive recommendations for future studies in this field. First, considering the TA of broad discourse data, other relevant words could be considered as central terms of the word network (instead of e-mobility). Therefore, the identification of central terms is subjected to interpreter and selection bias. Furthermore, the database for the discourse relies on the usage of a single keyword ("Elektromobilität"). To capture more holistic e-mobility-related discourse data, other keywords may improve the database. Additionally, the stop word lists and clusters were created by experts and were therefore subjectively influenced. Such bias could be eliminated by the application of further TA operations (e.g., supervised machine learning).

From a methodological point of view, future research could analyze the same data with alternative methods, such as concept analysis, sentiment analytics, or further TA approaches. Furthermore, other databases and media such as social networks could be analyzed with regard to their usefulness as external sources for OI processes.

Another limitation lies in the analyzed news websites. On the one hand, these websites might offer a broad view of e-mobility. Given the existence of gate-keepers (in this case journalists), however, this form of public discourse might have its own selection-biases. As a result, it is possible that relevant silent stakeholders and their perspectives were excluded because of the filter function of the journalistic process. Even without such gate-keepers, certain stakeholder voices might be difficult to find in existing data sources as they do not equally participate in some discourses in the first place (such as in the case of elderly people and digital media formats). This shifts the focus towards the availability, diversity, and quality of the already existing data sources (e.g., data from social media) and towards the application of other methods of TA (e.g., concept extraction) to explore them. Thereby, existing direct search OI approaches (i.e., netnography, lead-user-identification) can represent important starting points for the application of analytical methods. However, future research is needed to test the applicability of mined data from such approaches throughout the innovation process. Particularly, the above-argued applicability of netnography supported by data mining and FLUID in certain phases of the innovation process for SOI should be tested, for example, in a more holistic action research.

Additionally, future research can refine the general idea of using TA for OI. From a conceptual perspective, a comparative framework could analyze the advantages and disadvantages of different text categories. Empirical research could explore how different real-life text categories yield different results with regard to the breadth and specificity of ideas for the OI processes. Coming back to the specific research question of this article, a next step to identify silent stakeholder perspectives could be to explore e-mobility-related social media where gatekeeper effects are less pronounced.

Notwithstanding these limitations, we are confident that our TA approach offers a fresh perspective for increasing the inclusivity, effectiveness, and efficiency of OI processes, particularly with regard to the complexity of SOI. SOI typically faces challenges such as unintended effects that can affect remote stakeholders outside the conventional innovation process. Exploring new ways in which to identify these silent stakeholders and their diverse needs is a worthwhile step in bringing to fruition the potential of OI for sustainable development.

Author Contributions: C.D., C.K., and P.W. conceived and designed the action research study; M.B. and B.D. were responsible for supervision; C.K. performed the text analytics operations and analyzed the data; P.W. wrote the paper. All authors contributed to the development of the manuscript.

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Chapter II

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In crowdfunding we trust? Investigating crowdfunding success as a signal for enhancing trust in sustainable product features

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ABSTRACT

Crowdfunding has been discussed as a tool for acquiring resources, a way of communicating information to potential investors, and a means of testing the market potential of entrepreneurial projects. Yet, little is known about how successful crowdfunding influences consumers' perceptions about a product or its features. We assume that mentioning a successful crowdfunding campaign in a product advertisement can provide valuable quality signals. Such signals are particularly relevant for sustainability-oriented products because sustainability attributes are often not directly accessible to potential consumers. Based on a 2 (crowdfunding: yes vs. no) × 3 (product category: low complexity vs. medium complexity vs. high complexity) experimental study (n = 530), we find that signaling crowdfunding success has an influence on product perceptions and on the credibility of sustainability attributes. Furthermore, we show that the effects of this signal depend on different levels of product complexity.

1. Introduction

In recent years, there has been an increasing interest in crowdfunding (CF) in theory and practice alike (e.g., Agrawal et al., 2015; Belleflamme et al., 2014). CF can be defined as “an open call, essentially through the Internet, for the provision of financial resources either in form of donation or in exchange for some form of reward and/or voting rights in order to support initiatives for specific purposes” (Schwienbacher and Larralde, 2010, p. 4). CF has not only been discussed as a way of acquiring necessary resources for entrepreneurial undertakings but also as an option to provide relevant information (e.g., Belleflamme and Lambert, 2014). So far, however, this potential signaling function of CF has only been examined with regard to its impact for investors (e.g., Mollick, 2014) and for campaign initiators on CF platforms (e.g., Agrawal et al., 2014). Yet, although it can be assumed that the fact that a product has been successfully crowdfunded might positively influence consumers' perceptions, there are no studies that explore this signaling effect of crowdfunded products on consumers.

Assessing the impact of CF success as a way of influencing consumers' perceptions is worthwhile given that, in the face of information asymmetries, consumers find it difficult to discriminate between high- and low- quality producers and therefore depend on additional quality signals (Kirmani and Rao, 2000). Such signals are particularly relevant for sustainability-oriented goods. Sustainability-related product attributes – for example the origin of raw materials – are difficult to verify and thus require consumers to have trust in provided information (Jahn et al., 2005). This lack of transparency and reviewability of product attributes can lead to a profound skepticism of consumers toward high-quality product characteristics (Akerlof, 1970) such as sustainability-related features. However, the relationship between the credibility of sustainability attributes and CF has not yet been investigated. This paper seeks to address this gap.

Whether consumers perceive sustainability-related attributes as credible arguably depends on how easy it is for them to understand and evaluate a product and its features. In this context, research shows that a consumer's information need also depends on the complexity inherent in products as higher levels of complexity come with an increased explanation need (e.g., Choudhury and Karahanna, 2008). However, research has not addressed how product complexity influences the perception of crowdfunded products and their sustainability attributes. We thus formulate the following overarching research question: *How does CF success influence consumers' product perceptions and trust in non-verifiable sustainability attributes at different levels of product complexity?*

In this paper, we seek to explore this question by applying an experimental study design. The paper is structured as follows: Section 2 reflects the state of the research on CF and sustainability as well as on CF and signaling. Furthermore, it explains and derives hypotheses regarding the relationship of CF success, consumers trust in sustainability

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attributes, and product complexity. Our methodology is outlined in Section 3, and Section 4 summarizes our results. In Section 5, we discuss and interpret these outcomes. Building upon these insights, we derive theoretical and managerial implications in Section 6. Furthermore, we discuss limitations and recommendations for future research.

2. Background

2.1. Crowdfunding sustainable development

Sustainable development, defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987, p. 51), requires innovative solutions to overcome unsustainable ecological and social market failures, with sustainable entrepreneurship being an important driver for creating and implementing such innovations (Beckmann et al., 2014; Schaltegger et al., 2018; York and Venkataraman, 2010). Unfortunately, to do so, sustainability-oriented entrepreneurs often lack access to adequate funding (Ortas et al., 2013). In this context, studies found that entrepreneurs pursuing environmental and social aims particularly face constraints in the early funding phases because investors often perceive those objectives as not as attractive as other, purely profit-oriented undertakings (Choi & Gray, 2008; Church, 2005).

Discussing ways to overcome this resource scarcity, research has focused on the financing function of CF, examining how CF can help to fund sustainability-oriented enterprises (e.g., Lehner & Nicholls, 2014; Hörisch, 2015). Initiating campaigns on CF platforms allows entrepreneurial projects to raise financial resources more easily from a large number of contributors (the "crowd"), with each individual investing only a relatively small amount of money and without being dependent on a big investor (e.g., Ordanini et al., 2011). Hence, the motives of crowd-investors may differ from those of professional ones who typically invest larger amounts of money with a clear financial objective behind their investment (Belleflamme et al., 2014). In this context, Gerber and Hui (2013) state that crowdfunders are often driven by normative or altruistic (Lindenberg and Steg, 2007) motives. Similarly, Lehner (2013) argues that such investors usually focus on entrepreneurs' core values and ideas instead of focusing on business plans or other securities.

Early empirical evidence about the appropriateness of CF as an alternative way to finance sustainable entrepreneurship and thereby contributing to sustainable development is ambiguous. On the one hand, Allison et al. (2015), for example, emphasized the importance of intrinsic motives for crowd-investors and Calic and Mosakowski (2016) found that a venture's sustainability orientation enhances the funding success of its CF projects. On the other hand, Moss et al. (2015), for example, claim that crowd-investors often act like traditional investors and Hörisch (2015) has not found any positive correlation between environmental sustainability orientation and CF campaign success.

All in all, empirical evidence in this field is still scarce and, therefore, a deeper understanding of the importance of CF as an instrument for financing sustainability-oriented ventures is necessary (Zeco et al., 2014; Manning & Bejarano, 2016). Moreover, CF has other yet unexplored benefits to contribute to the development of markets for sustainability-oriented ventures and hence to sustainable development. The following sections discuss the latent signaling function of CF success and its unaddressed potential to decrease sustainability-related information asymmetries.

2.2. Signals from crowdfunding

So far, research on CF and sustainability has focused on examining CF as an instrument for funding sustainability-oriented enterprises (e.g., Lehner & Nicholls, 2014; Hörisch, 2015). CF, however, has also been discussed as a way to provide valuable information by sending out signals to followers and supporters of specific CF campaigns (e.g., Belleflamme and Lambert, 2014). In this context, studies have primarily focused on the dynamics and signals between backers and campaign initiators during the funding process itself. Those signals can differ, depending on what type of CF is considered (Agrawal et al., 2014; Ahlers et al., 2015; Belleflamme et al., 2014). The literature names five broad types of CF differentiated by the compensation contributors receive for their investment: (1) pre-purchasing of the goods to be crowdfunded, (2) receiving other non-pecuniary rewards such as goodie bags, (3) donating, (4) lending, or (5) exchanging the contribution for a share of equity securities or future profits (Griffin, 2012). For example, CF campaigns can provide information about the market potential of an innovation (Belleflamme et al., 2014). In particular, pre-purchase CF can provide insights regarding the market potential of a product before the actual market launch (Agrawal et al., 2014). CF can thus help to increase product launch success rates (Lauga and Ofek, 2009). In addition, CF platforms can also be used as promotion or market research tools and can serve as a mechanism for gaining valuable feedback from potential consumers and insights regarding their preferences (Agrawal et al., 2014). Consequently, CF is considered as a tool that supports the testing, marketing, mass customization, and co-creation of new products and services (Belleflamme et al., 2014).

In addition to these advantages especially for project initiators, several studies have already analyzed how investors respond to specific signals sent during the CF process. In his study on the pre-purchase model of CF, Mollick (2014) discovered a positive relationship between funding tendency and quality signals embedded in CF campaigns, such as included videos, frequent updates, and correct spelling. Furthermore, based on a study on equity CF, Ahlers et al. (2015) found that the "crowd" perceives several cues, such as risk information disclosure, as credible signals for CF project quality which can subsequently increase the probability of successful funding. In line with that, Belleflamme and Lambert (2014) argue that equity CF in particular is most successful if creators are capable of decreasing the perceived uncertainty of potential funders.

While there is ample research on the effects of various signals during the CF process itself, research has barely addressed how CF influences consumer perceptions after a project has been successfully funded, especially with regard to consumers who were not directly involved in the CF process. This could be especially interesting because CF success could be a valuable signal for customers by indicating that a product is, for example, of superior quality, very popular or has a positive image and which could, therefore, positively affect consumer perceptions.

Especially in the face of information asymmetries, quality signals can help customers to discriminate between high- and low-quality offers (Kirmani and Rao, 2000). According to signaling theory (Spence, 1973), asymmetric information occurs when one party (buyer) in a transaction is less informed than the other party (seller). When faced with information asymmetries, consumers use different heuristics such as scanning for quality cues or asking peers. One of these cognitive "shortcuts" is to observe the behavior of others to guide one's own decision-making (Bikhchandani et al., 1992; Liu et al., 2015). This so-called "herding" behavior results from information asymmetries and implies that individuals follow the decisions of agents who are expected to hold more (credible) information than others (Bikhchandani et al., 1992). In such cases, individuals deal with uncertainties through imitation (Rao et al., 2001). The information provided by media coverage, for example, is often viewed as a "social proof" (Rao et al., 2000, 2001) of the credibility of specific firms or products because consumers believe that opinion leaders such as journalists possess trustworthy information that they themselves do not possess (e.g., Pollock and Rindova, 2003).

Similarly, as CF is a collective effort, potential customers could assume that the crowd consists of a large number of agents each holding valuable information about a product and its attributes because they invested their own capital and are prepared to risk all of it. Moreover, members of the “crowdfunding community” are often perceived as being close to future trends, bringing together lead-users and first-movers with a specific knowledge background in very specific domains (Ordanini et al., 2011). Thus, interested consumers might assume that the crowd possesses additional information that goes beyond the scope of their own understanding. Following the herd could then be a way of bridging information asymmetries. We therefore assume that CF success incorporates a certain social proof and can thus serve as a quality signal to potential customers that helps to decrease quality-related information asymmetries and thereby creates trust and enhances the credibility of product-related information that is provided.

Although there is no research on herding behavior in post-CF markets, studies have already found evidence for this “social mimicry” during the CF process. Research by Zhang and Liu (2012) on lending-based CF as well as on profit-sharing platforms by Agrawal et al. (2010) indicate that herding behavior among investors influences funding activities because individuals are more likely to fund a project when financing goals are about to be achieved (Belleflamme and Lambert, 2014). Following our argumentation, we propose the first hypothesis:

H1. Signaling CF success positively influences consumers' product perceptions.

2.3. Sustainability-related information asymmetries

Information asymmetries are particularly relevant in the area of sustainability (e.g., Cason and Gangadharan, 2002). In contrast to attributes that can be directly perceived or experienced, such as design or taste, sustainability attributes of products or services are mostly difficult to evaluate for consumers (e.g., Grüneberg et al., 2001). Due to complex and opaque production processes, individual consumers find it hard, prohibitively costly, or even impossible to verify a product's ecological features like pesticide use for cultivation or social criteria such as living wages and decent working conditions (Jahn et al., 2005). Thus, sustainability attributes turn into non-verifiable credence attributes, which go along with an increased information asymmetry (Jahn et al., 2005). For example, while consumers buy an organic apple because they prefer the fruit to be planted without chemical fertilizers or pesticides, this very quality feature is difficult – if not impossible – to verify when holding an apple in one's hand. As sustainability-related considerations create additional information asymmetries, they can lead to consumer distrust in these non-verifiable product characteristics (Akerlof, 1970). As a consequence, these credibility issues could negatively affect consumer perceptions of sustainable offers and reduce their willingness to pay for them. This could eventually inhibit the development of markets for products and services with such features (Koths and Holl, 2012).

Sustainability-oriented ventures must, therefore, communicate relevant product attributes in a transparent and credible manner in order to win customers' trust (Chen and Chang, 2012). To balance information asymmetries, Cho (2015) found that consumers, on the one hand, prefer holistic product information. On the other hand, the evaluation of holistic information is often too time-consuming and complex for them (Petty et al., 1983). To reduce complexity, companies can inform customers about the trustworthiness of the firm itself or their products synoptically by providing, for example, product certifications from third parties which can serve as credible quality signals that have been externally verified (e.g., Jahn et al., 2005). In this context, Chkanikova and Lehner (2015) emphasize the role of externally certified sustainability labels in establishing markets for sustainable products.

Sustainability labels are visual cues or additional references, often represented by a symbol, which signal ecological or social product attributes (D'Souza et al., 2007; Tang et al., 2004). The role of such labels is to make non-verifiable credence attributes transparent and to verify the credibility of the information provided (Rubik et al., 2008). Scanning for such labels can therefore be a useful heuristic for consumers who care about sustainability. However, customers are increasingly confronted with an ever-growing variety of different sustainability labels that should guarantee compliance with various criteria (National Research Council, 2010). The complexity of the “label market” can lead to uncertainty and confusion among consumers (Chen and Chang, 2013). To counteract this, third-party labels issued by sources of high credibility such as the European organic or fair trade labels can reduce uncertainty. For producers, however, such certification processes are costly, complex, and often time-consuming (cf. Cason and Gangadharan, 2002; Jahn et al., 2005) and can hinder sustainability-oriented entrepreneurs (particularly in their start-up phase) from getting certified. This shifts attention toward signaling devices that are not conventional sustainability labels.

Given the limits of conventional sustainability labels, sustainability-oriented entrepreneurs need to find alternative ways to make their products credible. As already argued in our discussion above on the mechanisms of herding and social proof, we suggest that CF success could also lead to trust in sustainable product features as a large number of individuals have approved and given legitimacy to a sustainability-oriented project. This is especially important because consumers need to rely on some form of heuristics, given the fact that sustainable product features typically go hand in hand with particularly pronounced information asymmetries (Jahn et al., 2005). In the absence of established sustainability labels, consumers could then take into account CF success as social proof of the trustworthiness of communicated sustainability features. In this case, herding behavior could also serve to balance sustainability-related information asymmetries. The result could thus be similar to the effect of third-party labels as successful CF might also signal credibility of the provided information. So far, research on CF and sustainability has not addressed this interplay. For sustainability-oriented entrepreneurs, however, it is of uttermost importance that they not only receive funding but that they also generate trust and credibility among potential customers. We therefore postulate our second hypothesis:

H2. Signaling CF success positively influences consumers' trust in non-verifiable sustainability attributes.

2.4. Product complexity

The degree to which consumers perceive the credibility of sustainability attributes as relevant can depend on the extent to which they are actually in need of information regarding a certain product. In this context, research shows that this information need also depends on product complexity (e.g., Choudhury and Karahanna, 2008).

Scholz et al. (2010, p. 685) define a high product complexity as a state that is “characterized by a comparatively large number of attributes and attribute levels that are relevant in purchase decisions”. Products with many attributes and functions, including, for example, additional services, are ascribed a high inherent complexity (Burnham et al., 2003; Park et al., 2008; Swaminathan, 2003). However, consumers' perceptions of product complexity are not only influenced by the sheer number of product attributes and functions (Park, 1976) but also depend on the perceived difficulty of product usage (Mukherjee & Hoyer, 2001) and on the number of different evaluation criteria (Park, 1976). Based on a literature review, Mützel and Kilian (2016) name automobiles, mobile phones, and buildings as suitable examples of high-complexity products and living room chairs or toothpaste as representatives of low-complexity products.

High-complexity products typically include goods which consumers do not buy on a daily basis. Rather, purchases of high-complexity products occur infrequently, with consumers facing numerous alternatives in different price categories offered by various brands (Swaminathan, 2003). Therefore, evaluating and comparing complex products requires a lot of cognitive effort and credible information (e.g., Choudhury and Karahanna, 2008). We thus assume that higher product

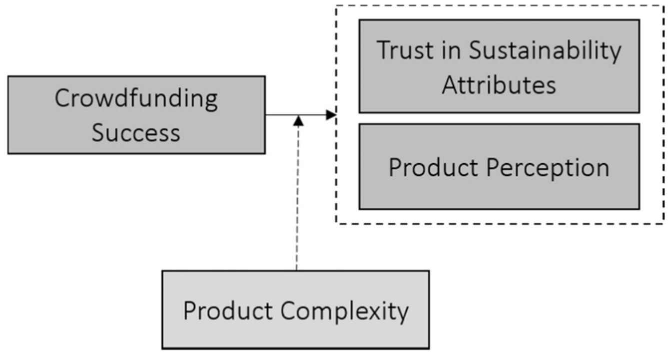

Fig. 1. Research framework.

complexity increases the information need about a product and that an increasing complexity has an influence on how its sustainability-related attributes are perceived. Given these assumptions, we posit:

H3. The influence of the CF success signal on consumers' perceptions of sustainability-oriented products varies with different levels of product complexity.

Fig. 1 serves to summarize the research framework of our paper. At the core of our analysis, we test the influence of CF success on consumer perceptions of products and trust in sustainability attributes. Additionally, we examine the role of product complexity on these relationships (cf. Fig. 1). To investigate this, we conduct an experimental study that we will describe in the following section.

3. Method

3.1. Data collection and setting

To investigate our hypotheses of whether and how signaling CF success and product complexity influence consumer perceptions of sustainability-oriented products, we used a 2 (crowdfunding: yes vs. no) × 3 (product category: low complexity vs. medium complexity vs. high complexity) between-subject experimental design.

Data collection took place between March 2017 and May 2017. We conducted an online survey and randomly distributed a short text invitation to participate in the study, together with the link to our questionnaire across various social media platforms, online forums, and other websites. The result was a convenience sample. Due to the fact that our intention was to obtain a balanced sample with individuals who might be sensitive to sustainability-related issues, we had no specific requirements for potential participants. All participants had the opportunity to enter a raffle for one of three 50 Euro gift cards. Since sustainability topics are related to environmental, altruistic, and other motivations (Stern, 2000), we additionally promised to donate 30 euro cents to the United Nations International Children's Emergency Fund (UNICEF) for each completed survey.

Participants were told that the main goal of the study was to explore consumer perceptions of sustainable innovations. After clicking on the survey link that was embedded in a short introductory text to our study, participants were randomly assigned to one of six different advertisements. After being exposed to one of the different advertisements, participants were asked to answer questions about the variables that were used for this study. In total, 534 individuals participated in this study. However, after eliminating four data sets with missing values, our data collection strategy yielded 530 fully completed questionnaires (for characteristics of our sample see Table 1).

Table 1
Sample characteristics.

Demographics	Percentage
Gender	
Female	60.2
Male	39.8
Age	
< 25	48.9
25–49	43.0
> 49	8.1
Household size	
1	20.6
2	35.1
3	20.0
4	18.5
> 4	5.7

Note: $N = 530$.

3.2. Stimuli

Our stimuli materials were designed by the authors and pre-tested on various occasions to eliminate potential misunderstandings and to keep the advertisements as realistic as possible. Three different versions of advertisements for three different product categories were created. All advertisements included a slogan, a body text, a fictional brand name with logo, and product pictures. For each product category, the body text included four different claims that were adapted to match the respective product categories: A quality claim (e.g., "Made of especially breathable and weatherproof fabrics"), a fairness claim (e.g., "Production is carried out under fair conditions"), a health claim (e.g., "Free from harmful pollutants"), and an environmental claim (e.g., "In addition, the packaging consists of recycled materials"). We made sure that the claims were of similar length, within an advertisement and across the different product categories. All claims were discussed with experts in the field of sustainability to ensure realistic language and phrasing.

In order to choose the three different sustainable products with different levels of complexity, we conducted an extensive search process including several steps. First, we searched on a commercial internet search engine for companies that offer sustainable products by using different keywords to get a sense of the variety of product categories and their characteristics. Second, we searched on various CF platforms for sustainable CF projects to get a better impression of sustainability-oriented CF projects that have already been successfully funded. To identify such projects, we applied Hansen and Grosse-Dunker's definition of sustainability-oriented innovations to the CF context. Thus, we regard sustainability-oriented CF projects as initiatives that support "the commercial introduction of a new (or improved) product (service), product-service system, or pure service which – based on a traceable (qualitative or quantitative) comparative analysis – leads to environmental and/or social benefits over the prior version's physical life-cycle" (Hansen and Grosse-Dunker, 2013, p. 2407f.). Following this definition, CF initiatives can be considered as sustainability-oriented when the supported product or service improves conditions for people and/or the environment by specifically addressing social (e.g., fair production) and/or environmental (e.g., pollutant free packing; usage of recycled materials) aspects. Finally, as a result of additional discussions with several senior researchers and experts in the field of sustainability, we compiled a selection of three different products (a cocoa product [low complexity], a jacket [medium complexity], and a smartphone [high complexity]) that we assumed would represent a sufficiently wide range of sustainable products with different levels of complexity.

To verify that the products indeed were perceived differently in terms of inherent product complexity, we conducted a pretest with 22 graduate students who were not aware of the study's topic or goal. Each student had to rate the level of complexity for each product on a one-item, seven-point semantic differential scale (from 1 – "not complex at all" to 7 – "very complex"). As expected, the different product categories were perceived differently according to their complexity level and in the expected order ($M_{Cacao} = 2.5$; $M_{Jacket} = 3.8$; $M_{Smartphone} = 5.2$; post hoc Bonferroni pairwise comparisons all ps $<$ 0.01).

Three fictitious brand names and logos were designed for this study to keep the setting as realistic as possible and to make sure that participants' responses were not predetermined in their evaluation of the products due to existing brands. In order to indicate whether a product was funded with the help of a CF campaign, two sets of advertisements were designed for each of the three product categories. For one set, a short description introduced participants to the fictitious brand that recently launched a new product and they were told that this product was successfully funded through a CF campaign. Moreover, we added a red label on the left upper corner of the advertisement ("Financed with crowdfunding – A lot of people have financially supported this idea!"). For the other set of advertisements, no such label was included and no information about a successful CF campaign was given. For a sample advertisement please see Appendix A.

3.3. Measures

Whenever possible, we used existing scales from the literature. Except for the single-item measure *recommendation intention*, all scales were rated from 1 to 7 (see also Appendix B).

To measure *attitudes toward sustainability claims*, we adapted a scale from Bart et al. (2005) that was originally developed to assess the degree of trust a consumer has regarding information provided on a certain website. Because information that is concerned with sustainability can be grouped into economic, social, and ecological dimensions (Gerlach and Schudak, 2010; Hanss and Böhm, 2012), we measured the trust a respondent has regarding a provided *quality claim* (Cronbach's $\alpha = 0.90$), a *fairness claim* (Cronbach's $\alpha = 0.92$), and an *environmental claim* (Cronbach's $\alpha = 0.93$). Environmentally friendly attributes often relate to a health dimension (e.g., reduced usage of pesticides) (Gerlach and Schudak, 2010). Therefore, we additionally measured the trust participants have in a *health claim* (Cronbach's $\alpha = 0.91$). All dimensions were measured using a two-item Likert-scale ranging from 1 ("low") to 7 ("high").

Brand trust was measured based on the scale of Chaudhuri and Holbrook (2001) with four items using a 7-point Likert scale (from 1 – "very strongly disagree" to 7 – "very strongly agree"). Cronbach's alpha was with 0.95 highly satisfactory for this construct.

Recommendation intention was measured with a single-item question ("How likely is it that you recommend this firm to a friend or a colleague?"), ranging from 0 ("completely unlikely") to 10 ("extremely likely") (Burner et al., 2001; Schreier et al., 2012).

Similar to Schreier et al. (2012), we measured *purchase intention* with two items using a 7-point Likert scale ranging from 1 ("completely unlikely" and "no chance, would never buy") to 7 ("very likely" and "practically certain, would definitely buy") (Cronbach's $\alpha = 0.80$).

Finally, we included *gender*, self-assessed *knowledge about sustainability* (single item 7-point Likert-scale; adapted from Klink and Athaide, 2010), and *crowdfunding familiarity* (dummy variable; adapted from Franke et al., 2006) as control variables to account for potential effects of prior experiences with CF or special interest in sustainability.

4. Results

The manipulation check confirmed that participants perceived the products significantly differently with regard to their corresponding level of complexity ($M_{Cacao} = 2.3$; $M_{Jacket} = 3.1$; $M_{Smartphone} = 4.0$; post hoc Bonferroni pairwise comparisons all ps < 0.01). Multivariate analysis of variance (MANCOVA) was used to explore our proposed hypotheses with *sustainability knowledge*, *crowdfunding familiarity*, and *gender* as covariates. Table 2 presents the means and standard deviations for the different experimental conditions, with the "crowd" column showing the results for participants who received the information that the product was crowdfunded and the "non-crowd" column showing the results for the control group who did not get this stimulus.

Table 2
Means of experiment's conditions.

	Crowd	Non-crowd
	M (SD)	M (SD)
Attitude toward quality claim		
Low complexity	4.68 (1.29)	4.50 (1.15)
Medium complexity	4.68 (1.35)	5.00 (1.03)
High complexity	3.86 (1.41)	4.30 (1.16)
Attitude toward fairness claim		
Low complexity	4.61 (1.44)	4.40 (1.15)
Medium complexity	4.74 (1.22)	4.55 (1.27)
High complexity	4.05 (1.48)	4.42 (1.22)
Attitude toward health claim		
Low complexity	4.26 (1.36)	4.08 (1.17)
Medium complexity	4.40 (1.23)	4.36 (1.16)
High complexity	3.35 (1.47)	3.43 (1.46)
Attitude toward environmental claim		
Low complexity	4.59 (1.44)	4.10 (1.23)
Medium complexity	4.48 (1.33)	4.41 (1.28)
High complexity	3.85 (1.58)	4.12 (1.29)
Brand trust		
Low complexity	4.15 (1.28)	3.96 (1.00)
Medium complexity	3.96 (1.20)	4.33 (1.10)
High complexity	3.53 (1.36)	3.85 (1.11)
Recommendation intention		
Low complexity	5.85 (2.62)	5.61 (2.45)
Medium complexity	5.61 (2.52)	6.38 (2.51)
High complexity	5.37 (2.63)	6.06 (2.31)
Purchase intention		
Low complexity	4.38 (1.42)	4.08 (1.37)
Medium complexity	3.90 (1.38)	4.18 (1.24)
High complexity	3.46 (1.34)	4.16 (1.19)

Note: $N = 530$, M = mean, SD = standard deviation.

In order to find evidence for our first and second hypotheses, we first analyzed the main effects of CF success on our dependent variables. The results reveal that the CF signal has a significant effect on our dependent variable *recommendation intention* ($F(1, 524) = 4.86$, $p < .05$, $\eta_p^2 = 0.009$). Although only significant at the 10% level, we also found effects on *brand trust* ($F(1, 524) = 2.88$, $p < .1$, $\eta_p^2 = 0.005$) and on *purchase intention* ($F(1, 524) = 3.38$, $p < .1$, $\eta_p^2 = 0.006$). However, across all product categories consumer perceptions were mainly less favorable for the crowdfunding condition thus leading to the rejection of H1 and H2. For product complexity, we found significant effects on *attitude toward quality claim* ($F(2, 524) = 16.82$, $p < .01$, $\eta_p^2 = 0.061$), *attitude toward fairness claim* ($F(2, 524) = 4.79$, $p < .01$, $\eta_p^2 = 0.018$), *attitude toward health claim* ($F(2, 524) = 27.53$, $p < .01$, $\eta_p^2 = 0.096$), *attitude toward environmental claim* ($F(2, 524) = 5.13$, $p < .01$, $\eta_p^2 = 0.019$), *brand trust* ($F(2, 524) = 7.46$, $p < .01$, $\eta_p^2 = 0.028$), *recommendation intention* ($F(2, 524) = 3.45$, $p < .05$, $\eta_p^2 = 0.013$), and *purchase intention* ($F(2, 524) = 7.63$, $p < .01$, $\eta_p^2 = 0.028$). Table 2 and post hoc Bonferroni pairwise comparisons reveal that for most variables, the high-complexity product category shows lower values regarding consumer responses compared to the other two less complex product categories when the crowdfunding signal is included. Our main results did not change when we excluded the control variables from the analysis. Moreover, our MANCOVA revealed that except for *attitude toward health claim,* there were significant interactions between the CF signal and product complexity on our dependent variables, thus supporting our assumption in H3 that consumer perceptions of CF success depend on the degree of complexity of a specific product. To further investigate this notion, we conducted separate MANCOVAs with all dependent variables and the same covariates for each of the product categories separately, and additionally for the crowd and the non-crowd conditions.

Attitude toward quality claim. The analysis of the simple effect showed that participants in the high-complexity product group had significantly more trust in the quality claim ($M_{non\text{-}crowd} = 4.30$ vs. $M_{crowd} = 3.86$) when the advertisement showed *no* CF signal ($F(1, 174) = 6.43$, $p < .05$, $\eta_p^2 = 0.035$).

Attitude toward fairness claim. Again, the analysis in the high-complexity product group indicates that the fairness claim was perceived less favorably for crowdfunded products ($M_{crowd} = 4.05$) than when high-complexity products were not crowdfunded ($M_{non\text{-}crowd} = 4.42$, $F(1, 174) = 3.35$, $p < .1$, $\eta_p^2 = 0.019$).

Attitude toward environmental claim. In contrast to the high-complexity group, participants in the low-complexity group significantly had more trust in the environmental claim when the product was successfully crowdfunded ($M_{crowd} = 4.59$ vs. $M_{non\text{-}crowd} = 4.10$, $F(1, 176) = 5.70$, $p < .05$, $\eta_p^2 = 0.032$).

Brand trust. For medium-complexity and high-complexity products, the results were not favorable when the corresponding product advertisements included a signal for CF success. Participants in the medium-complexity product group showed a more positive brand trust when the CF signal was omitted ($M_{non\text{-}crowd} = 4.33$ vs. $M_{crowd} = 3.96$, $F(1, 174) = 4.70$, $p < .05$, $\eta_p^2 = 0.027$). Although the results revealed only marginal significance, the same applies for participants in the high-complexity product group ($M_{non\text{-}crowd} = 3.85$ vs. $M_{crowd} = 3.53$, $F(1, 174) = 3.18$, $p < .1$, $\eta_p^2 = 0.018$).

Recommendation intention. Except for the low-complexity product category, participants were more likely to recommend a product to others when it was *not* crowdfunded ($M_{medium\text{-}complex} = 6.38$; $M_{high\text{-}complex} = 6.06$) than when it was crowdfunded ($M_{medium\text{-}complex} = 5.61$, $F(1, 174) = 4.73$, $p < .05$, $\eta_p^2 = 0.027$; $M_{high\text{-}complex} = 5.37$, $F(1, 174) = 4.90$, $p < .05$, $\eta_p^2 = 0.028$).

Purchase intention. We found evidence that although participants in the low-complexity group tend to show more favorable responses when the product was crowdfunded ($M_{crowd} = 4.38$ vs. $M_{non\text{-}crowd} = 4.08$; $F(1, 176) = 3.06$, $p < .1$, $\eta_p^2 = 0.017$), participants were more willing to purchase the high-complexity product when it had not been successfully crowdfunded ($M_{non\text{-}crowd} = 4.16$ vs. $M_{crowd} = 3.46$; $F(1, 174) = 12.13$, $p < .01$, $\eta_p^2 = 0.066$). The significant interaction effects on our dependent variables are visualized in Fig. 2.

5. Discussion

We find that signaling CF success has an influence on product perceptions in terms of recommendation intention, purchase intention, and brand trust as well as on the credibility of sustainability attributes regarding quality, fairness, and environmental friendliness (cf. Fig. 2). The direction and strength of this influence, however, vary with different levels of product complexity. In the low-complexity product condition (cacao), CF success evoked more favorable product perceptions and trust in sustainability attributes among almost all analyzed variables. In the case of medium-complexity products (jacket), besides trust in the fairness and environmental claim, CF success induced slightly more disadvantageous product perceptions and decreased credibility. In the high-complexity product group (smartphone), CF success evoked more *unfavorable* product perceptions and less trust in sustainability attributes across all analyzed scales.

In contrast to our original assumptions, our results indicate that with increasing product complexity, signaling CF success can also *negatively* influence consumers' product perceptions and trust in sustainability attributes. Referring to the herding heuristics (Bikhchandani et al., 1992) explained in Section 2.3, our findings suggest that consumers perceive the crowd as possessing additional and valuable information only in the low-complexity product condition. Since buyers possibly only follow the herd in this condition, the signal of CF success might just be suitable for bridging information asymmetries concerning attributes of less complex products. Thereby, we show that the social proof (Rao et al., 2000, 2001) which CF may provide can turn into a social *disproof*, depending on the contingency factors.

A possible explanation of these observations can be found in the signaling literature. A study by Boulding and Kirmani (1993) shows that the favorability of signals depends on the perceived credibility of the signal. Whether CF can generate such a credible signal thus also depends on how realistically the crowd itself can evaluate a product and its quality features. To assess low-complexity products, no or little expert knowledge is needed. In this case, the crowd can provide a valuable and credible assessment of given information. With increasing product complexity, however, it becomes more difficult for consumers with no expert knowledge to assess the product properly in terms of product and sustainability features. In fact, expert knowledge may be especially important for evaluating high-complexity products with a multitude of included technologies and features. The fact that conventional financial experts (e.g., banks or venture capital investors) did not (want to) invest in the product might then even send a *negative* signal. In other words, consumers might have less trust in new ventures which require funding from CF than in their counterparts that did not need CF to deliver highly complex products.

The credibility of a signal thus matters. In line with that, research on eco-labels as quality signals shows that their credibility varies with information specificity and source of the labels across different levels of product involvement (Atkinson and Rosenthal, 2014). Product complexity typically correlates with product involvement (Zaichkowsky, 1985). Therefore, a variation of the information content (e.g., amount of money raised or number of backers) and the source of the signal (e.g., from CF platforms, corporations, governmental or non-governmental organizations) might change the credibility and therefore the impact of the CF success signal. However, we found that depending on the situational context, the *same* signal can have different effects on consumer perceptions.

6. Conclusion and implications

6.1. Conclusion

Against the background of herding behavior and the given limits of sustainability labels to decrease information asymmetries regarding sustainable product features, we suggested communicating CF success as an alternative means to generate trust in sustainability features. Thus, we analyzed the influence of CF success on consumers' product and brand perceptions, and on their trust in sustainability attributes. Additionally, we examined whether different levels of product complexity have a moderating effect on these relationships. For our study, we used a 2 (crowdfunding: yes vs. no) × 3 (product category: low complexity vs. medium complexity vs. high complexity) experimental design.

Based on our experiment, we find that the CF success signal can have a favorable influence on consumer perceptions. The direction of this influence, however, depends on the presented product complexity. Interestingly, we found that whereas the product with the lowest perceived complexity induced substantially more positive product perceptions and a higher credibility of sustainability-related product attributes, the effect largely faded with increasing levels of product complexity. Therefore, our findings indicate that with growing product complexity, the favorable effect of the CF signal diminishes and, even conversely, more complex products seem to evoke more favorable consumer perceptions when they are *not* labelled as crowdfunded. Building on that, we describe theoretical and practical implications as well as topics for future research in the following sections.

6.2. Theoretical implications

The literature on the signaling functions of CF has mainly addressed the actors involved in the CF process in a more explorative way (e.g.,

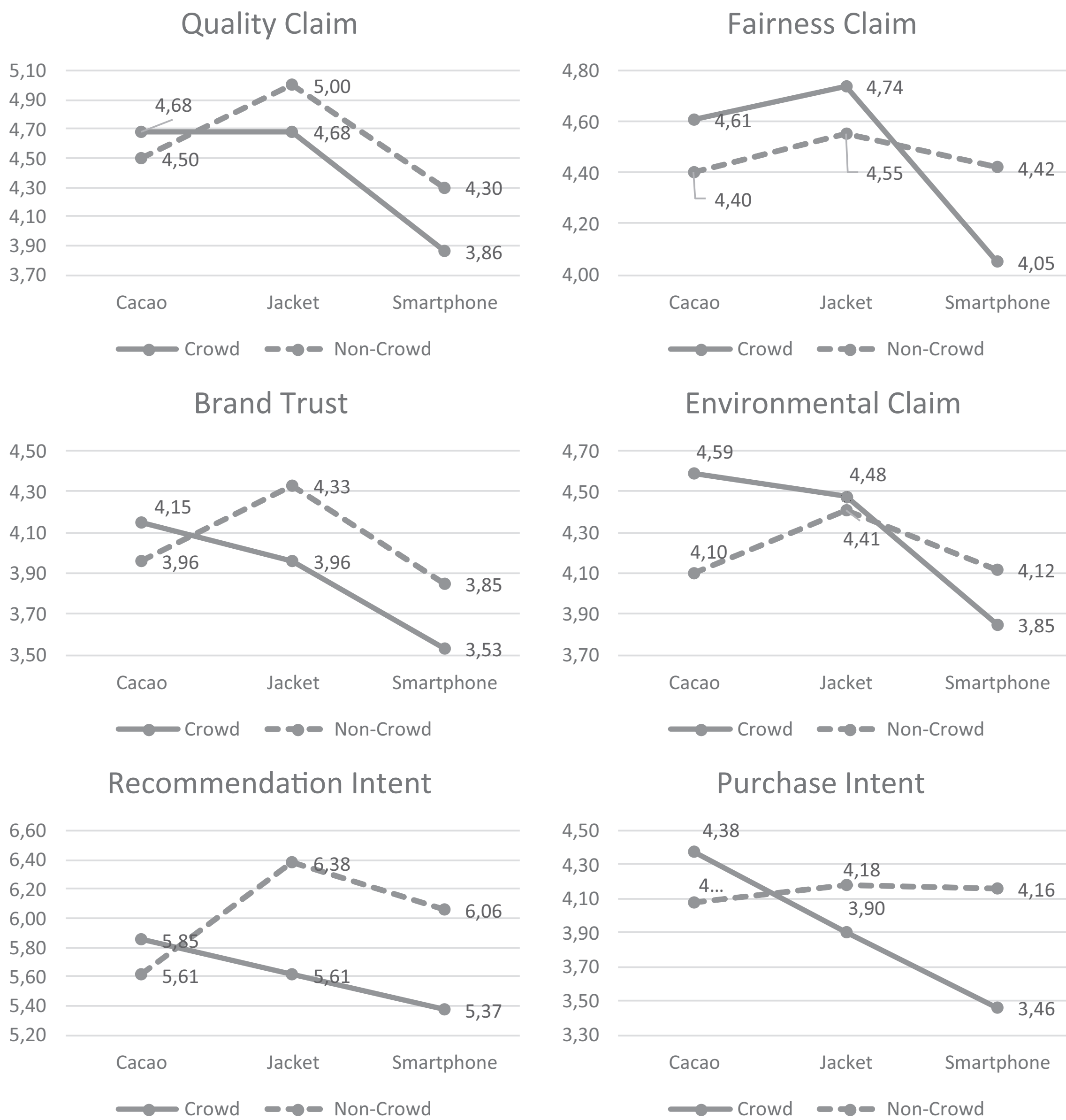

Fig. 2. Significant interaction effects.

Ahlers et al., 2015; Mollick, 2014). However, little is known about the signaling effects of CF to external stakeholders who have not been actively involved in the CF process – in particular the influence of CF success on consumer perceptions regarding the crowdfunded product. To the best of our knowledge, this is the first study analyzing the effects of CF success on consumers' perceptions in general and trust in sustainability attributes in particular.

By investigating the signaling effects of CF to external stakeholders, we extend existing literature on the signaling functions of CF for investors (Ahlers et al., 2015; Mollick, 2014) and enterprises (Agrawal et al., 2014). Furthermore, while the studies on the signaling functions of CF have been mainly explorative, we shed more light on the underlying dynamics driving those processes by studying a more specific case. In doing so, we go beyond the literature that has previously looked at how crowdfunding participants and venture capital investors asses project quality *during* the CF process (Mollick, 2013) by now adding the perspective of how the quality of crowdfunded products is evaluated *after* the project has been successfully funded.

Moreover, by analyzing the signaling functions of CF success, we add to existing research on the credibility of quality signals, particularly in the field of sustainability. Also, we contribute to the literature on information asymmetries between project backers and campaign initiators on CF platforms (e.g., Darke, 2013) by adding the perspective of consumers who may not have been involved in the CF process itself.

Finally, we add a new dimension to the discussion on the potential of CF to contribute to sustainable development. In this context, scholars primarily discussed CF as a means of financing sustainability-oriented ventures (e.g., Hörisch, 2015; Park, 2012). Few studies have analyzed the motivation of backers to invest in sustainability-oriented CF projects (Calic and Mosakowski, 2016; Nielsen and Reisch, 2016). By showing that the communication of CF success can enhance consumers' perceptions and trust in sustainability attributes, depending on the product complexity, we identify possible opportunities and limitations of the signaling function of CF success for enhancing trust in sustainable product attributes. This is important as sustainability-oriented entrepreneurs need to raise not only funding but also need to create trust and outreach among their customer bases when moving markets in a more sustainable direction.

6.3. Practical implications

From a managerial perspective, this study aims to support tailoring the marketing of sustainability-oriented goods in novel ventures in their *post*-crowdfunding market. Following our results, marketing managers should use the CF signal with caution. In fact, in some situations managers are not advised to communicate that a product was crowdfunded.

If, for example, a sustainability-oriented entrepreneur finances a project of a typical low-complexity good such as fair trade cacao or coffee with CF, marketers should mention the successful CF campaign behind it as it offers a positive signal to potential customers. For products of higher complexity like jackets or smartphones, however, managers should design their communication strategies without mentioning CF success or, on a more speculative note, explore ways to provide additional information about the CF process to make this signal more credible (Atkinson and Rosenthal, 2014). To increase credibility, an official CF certification awarded by CF platforms or other third-party organizations could be a viable option to further increase perceived trust. Another way to fruitfully use CF success as a quality signal could be to include a more narrative character regarding the way an entrepreneur addresses potential customers. The fact that we used a rather simple layout for our advertisements with limited ways to transport information may have had an influence on how credibly customers perceived the message. “Telling the whole story” behind a product may therefore be a valuable way to still include the CF signal, even in high-complexity products.

The results of this study suggest that managers need to take the complexity level of their products into consideration in order to determine whether to communicate the CF signal or not. Surveys with potential customers (e.g., during the funding phase on a CF platform) could support this assessment and could be highly useful when designing more sophisticated and effective communication strategies. In a nutshell, marketing managers of crowdfunded sustainability-oriented goods in novel ventures should use the CF signal with caution, depending on the nature of the product.

6.4. Limitations and future research

Of course, our study is not without limitations that, however, give directions for future studies. Thus, by considering the limitations of this study, we derive recommendations for further research in this area. First, we focused on analyzing the signaling effect of CF success on consumers' perceptions and trust in sustainability attributes. However, CF success might provide other desirable associations that may be important to customers or marketers, such as the influence on buyers' awareness of specific (sustainability-related) product attributes. Therefore, future research could address the relationship between the effects of the CF success signal and the awareness consumers have regarding sustainable product features, that is, the influence of that signal on the level of awareness which a producer is able to raise among the customer base.

Second, some limitations may be related to our research design. The sample for our study consists of a convenience sample of German participants who may have specific predetermined perceptions about sustainability-related topics. The generalization of our findings is thus limited. Accordingly, future research could take this into account by looking into cross-country comparisons and by exploring the effects of cultural differences on consumer perceptions. Furthermore, we considered only three different products. Future research could look into an expanded product sample to create a more nuanced view of the complexity layers and its effect on the relationship between the CF success signal and consumers' product- and sustainability-related perceptions. An expanded sample could further be suitable for analyzing different categories of sustainability-oriented innovations (Hansen and Grosse-Dunker, 2013), namely, product-service systems, pure products, or services. In doing so, the possible bias of product-related services influencing consumers' perception of product complexity may be eliminated. Moreover, the products in our sample have fictitious brands. There might, however, be a difference in terms of consumer perceptions for already established brands. In addition, we did not alter the source (e.g., official label from CF platforms) and information content (e.g., amount of raised money) of the CF signal. Future research could therefore explore differences in how CF success can be portrayed and how these differences influence consumer perceptions. Furthermore, we did not compare the effect of CF success with the effect of sustainability certifications or other related quality cues. To assess the strength of the CF success signal in comparison to the influence of third-party labels or other quality-related cues like “Made in Germany”, further research is needed. Finally, yet importantly, the design and layout of the advertisements as well as the communication of the CF cue (see Appendix A) could also be the subjects of future studies as we assume that perceptions about the CF signal may vary, based on different ways of communicating it.

Appendix A. Sample advertisement

Note: The advertisement was originally in German.

Appendix B. Constructs and measurement items

Constructs and measurement items
Attitude toward quality claim (based on Bart et al., 2005)
My overall trust that the product has the promised quality is…
My overall believability of the information about the product quality is…
Attitude toward fairness claim (based on Bart et al., 2005)
My overall trust that it has been paid attention to fairness regarding this product is…
My overall believability of the information that it has been paid attention to fairness regarding this product is…
Attitude toward health claim (based on Bart et al., 2005)
My overall trust that this product is actually healthy is…
My overall believability of the health-related information about the product is…
Attitude toward environmental claim (based on Bart et al., 2005)
My overall trust that this product is actually environmentally friendly is…
My overall believability of the environmental-related information about the product is…
Brand trust (Chaudhuri and Holbrook, 2001)
I trust this brand.
I rely on this brand.
This is an honest brand.
This brand is safe.
Recommendation intention (Burner et al., 2001)
How likely is it that you recommend this firm to a friend or a colleague?
Purchase intention (adapted from Schreier et al., 2012)
To me, purchasing a product from this company is…
What would be the future purchase probability of products from this company?
Knowledge about sustainability (adapted from Klink and Athaide, 2010)
Overall, I consider myself knowledgeable about sustainability issues.
Crowdfunding familiarity (adapted from Franke et al., 2006)
Have you ever participated in a crowdfunding campaign to support a product idea?
Would you ever consider starting your own crowdfunding campaign?
Do you personally know other people who have already participated in a crowdfunding campaign?

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Chapter III

Title: How do you like my crowd? Analyzing the effects of crowdfunding motivation and information specificity on consumers' perceptions of products from sustainable entrepreneurs

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How do you like my crowd? Analyzing the effects of crowdfunding motivation and information specificity on consumers' perceptions of products from sustainable entrepreneurs

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Crowdfunding is becoming the most important way to finance early-stage entrepreneurial ventures. Yet, little is known about how customers perceive resource acquisition via crowdfunding. When marketing crowdfunded products as such, entrepreneurs need to determine which crowdfunding-related information is important to customers and at which level of specificity it should be communicated. In contrast to traditional investment forms, crowdfunding rests on more diverse motivations such as primarily intrinsically motivated funding decisions. We assume that cues on funding motivation influence customers' product attitudes. Besides, we assume that other crowdfunding-related information, such as the number of funders, communicated in different degrees of specificity serves as a signal that affects consumers' product perceptions. Conducting a 2 (intrinsically motivated crowdfunding vs. extrinsically motivated crowdfunding) × 2 (low information specificity vs. high information specificity) experimental study (n = 180), we find that displaying cues on mainly intrinsic funding motivation influences customers' perception of crowdfunded products more positively than cues emphasizing extrinsic funding motivation. Via the mediator product attitude, this influence can even reduce pronounced information asymmetries related to sustainability features. Entrepreneurial ventures offering crowdfunded sustainability-oriented products may thus benefit from our findings in particular. Furthermore, we find that customers do not have clear preferences regarding information specificity and label directiveness, shifting light to other influencing factors such as the label issuer. From these findings, we derive recommendations on how to market crowdfunded products in accordance with the preferences of consumers.

Keywords: sustainability-oriented entrepreneurship; crowdfunding success; funding motivation; extrinsic motivation; intrinsic motivation; information specificity; experimental study; customer perception; signaling; labels

1. Introduction

The rise of crowdfunding (CF) platforms is dramatically affecting the way in which nascent entrepreneurs are financed (Mollick, 2014). The World Bank predicts that investments from CF will reach $90 billion by 2020, thus surpassing traditional forms of financing of early-stage ventures (Petruzzelli et al., 2018). The growth of this phenomenon is also accompanied by flourishing interest from academia. Schwienbacher and Larralde (2010, p. 4) provided a prominent definition of CF as “an open call, essentially through the Internet, for the provision of financial resources either in form of donation or in exchange for some form of reward and/or voting rights in order to support initiatives for specific purposes”. Based on the nature of the compensation that crowdfunders (i.e. the backers of a campaign) receive for investing, the literature distinguishes five types of CF: (1) to pre-purchase the offerings to be financed; (2) to gain other non-monetary rewards; (3) to obtain a share of future profits or equity securities; (4) to receive interest through lending; or (5) to simply donate (Griffin, 2012).

Among these forms of CF, there is an ongoing discussion about the focal motivations behind crowdfunders' decision-making and how these motivations influence resource acquisition (e.g., Allison et al., 2015; Cholakova & Clarysse, 2015). In this context, the literature primarily focuses on the financing aspect of CF with the aim of providing recommendations for early-stage entrepreneurial ventures on how to design financially successful campaigns. Yet, nascent entrepreneurs in particular also face constraints regarding the creation of legitimacy, trust, and reputation among their wider stakeholder network, including future customers (e.g., Freeman et al., 1983). This “liability of newness” (Stinchcombe, 1965: 148) has been widely illuminated over five decades. Lacking an established track record and long-term accumulated reputation, novel ventures thus need to be particularly cautious when designing marketing strategies for their crowdfunded offerings.

One aspect that could have a potential influence in this marketing challenge is how customers perceive the financing of novel products via CF and how entrepreneurs communicate this CF dimension. A recent study on the signaling functions of CF points out that mentioning a successful CF campaign with a logo on a product can, depending on the product's complexity, function as a positive quality signal (Wehnert et al., 2018) and thus help to reduce constraints resulting from the liability of newness. The same study, however, also reveals that displaying the same CF success label on products with higher complexity may cause negative credibility issues among potential buyers. Instead of asking *whether* communicating CF success positively influences product perceptions, these findings thus raise the question of *under which conditions* the communication of a CF label can generate trust in a novel product.

Against this backdrop, the general literature on the credibility of labels states that their trustworthiness depends on their information content and specificity, on the source issuing the label, and on customers' product involvement (Atkinson & Rosenthal, 2014). With regard to communicating a successful CF campaign, we therefore expect that variations in the label issuer and information content can affect the label's influence on consumer perceptions. In CF, the effect of the information content is particularly interesting because the information content can vary significantly with the different types of CF mentioned above. CF thus differs largely from traditional forms of investment. Unlike in traditional financing, which is typically dominated by extrinsic motivations, the investment decisions of crowdfunders can also be primarily intrinsically motivated (e.g., Gerber & Hui, 2013). Moreover, the choice of communicated (CF-related) information with different degrees of specificity, such as the number of funders, may also affect perceptions. Thus, we formulate a first overarching research question: *How do cues about crowdfunder motivations and different degrees of information specificity of a CF success label affect customer perceptions?*

The broadening of financing motivations from purely profit-oriented to also intrinsic forms observed in CF (e.g., Gerber & Hui, 2013; Allison et al., 2015) may be particularly interesting for sustainability-oriented ventures (e.g., Calic & Mosakowski, 2016). In fact, displaying signals through both intrinsic and extrinsic cues is especially relevant for sustainability-oriented offerings. First, such signals can reduce information asymmetries that typically characterize sustainable product features (Jahn et al., 2005). Second, research shows that sustainability-oriented consumers are strongly intrinsically motivated (e.g., Van Der Linden, 2015). Building on the assumption that consumers look for like-minded motivations, cues about mainly intrinsically motivated funding might be more persuasive to sustainability-oriented customers. Focusing on this difference between intrinsic and extrinsic motivations, we ask as a second overarching research question: *How do customers' sustainability orientations influence their perceptions of products linked to different crowdfunder motivations?*

In this article, we investigate these questions by conducting an experimental study. We organize the remainder of the paper as follows: The second section reviews the current state of research on CF and sustainability-oriented entrepreneurship, signaling, funding motivations, and sustainability-related value-orientations as well as different levels of label specificity. Based on the synthesis of these topics, we describe the construction of our hypotheses. In Section 3 we explain the methodology and in Section 4 we summarize our findings. We discuss and interpret these results and draw out the theoretical implications in Section 5. Based on these insights, in Section 6 we derive the managerial implications. In Section 7, we discuss the limitations of our study and make suggestions for further research. We complete the study with a conclusion in Section 8.

2. Background

2.1 Crowdfunding Sustainability-Oriented Entrepreneurs

CF is becoming the most important way to finance early-stage entrepreneurial ventures (e.g., Petruzzelli et al., 2018). Arguably, nascent sustainability-oriented ventures can particularly profit from this trend. Such firms typically face higher obstacles to the acquisition of financing because traditional investors often perceive a pure profit orientation as more attractive than pursuing additional environmental or social targets (Choi &

Gray, 2008). In this context, the literature points out that the motivations of crowdfunders who each invest relatively small amounts of money may differ from those of professional large-scale investors such as venture capitalists (Belleflamme et al., 2014). Some studies found evidence that normative or altruistic motives (Gerber & Hui, 2013) and intrinsic motivation (Allison et al., 2015) are the main drivers of crowd-investors' decision-making. Following this, Calic and Mosakowski (2016) suggest that an entrepreneur's sustainability orientation makes him or her more likely to acquire more resources via CF. Other studies suggest that this mono-causal relationship is questionable (Hörisch, 2015; Nielsen, 2017) and state that crowdfunders mostly behave like traditional investors (Moss et al., 2015). This ambiguity and scarce empirical evidence indicate that further research on the motivation of crowd-backers and the role of CF in financing sustainability-oriented ventures is needed.

In addition to the funding aspect, the literature has addressed other CF functions. On the one hand, the course of CF campaigns can give indications regarding the market potential of an offering (Belleflamme et al., 2014), which seems to be particularly the case in pre-purchase CF (Agrawal et al., 2014). In this way, CF can support entrepreneurs in elevating product launch success rates (Lauga & Ofek, 2009) and in raising follow-up investments from venture capitalists (Kaminski et al., 2018). On the other hand, CF platforms help promote offerings as well as receive customers' feedback and learn about their preferences (Agrawal et al., 2014). CF platforms can thus provide entrepreneurial ventures with a medium through which to promote offerings, to test their market potential, to support mass customization plus co-creation (Belleflamme et al., 2014), and to attract further investments from venture capitalists (Kaminski et al., 2018).

Overall, the present state of knowledge on CF indicates that sustainability-oriented companies in particular can benefit from this phenomenon. To this end, such enterprises need to know how to use this approach. From the extant literature, entrepreneurs can learn how to create successful CF campaigns and how to persuade crowdfunders with, for instance, embedded quality signals, such as accurate spelling, regular updates, and catchy videos in pre-purchase CF (Mollick, 2014) or information on risk disclosure in equity-based CF (Ahlers et al., 2015). While there is ample knowledge of the CF process itself, how crowdfunded products or services perform in the post-CF market is less well known. In fact, what the literature on CF barely addresses is how customers value CF success. In the phase after a product has been successfully crowdfunded, entrepreneurs face the challenge of how to market it. For that, it is important to know not only *whether* CF success affects customers but more importantly *how* to communicate it. The following sections shed light on this issue.

2.2 Crowdfunding Success as a Signal that Affects Consumer Perceptions

Besides acquiring resources, for nascent entrepreneurs it is of utmost importance to design sophisticated communication strategies with the aim of creating trust and outreach among their clientele. To this end, the marketing of a product that has been crowdfunded benefits from understanding how consumers perceive the product's CF background. Research on customer perceptions of CF outcomes, however, is still embryonic. Results from a recent experimental study indicate that portraying a successful CF campaign in product advertisements influences the perception of consumers similarly to quality-related cues such as "made in Germany" or "handmade" (Wehnert et al., 2018). More specifically, Wehnert et al. (2018) point out that displaying CF success on goods has a positive influence on customers' product perceptions as well as on trust in sustainability attributes when the product's complexity is low and yet grows increasingly negative with rising complexity.

The effect of CF cues on product perceptions can be explained by signaling theory and the consumer interference literature. Signaling theory (Spence, 1973) broadly describes the transfer of credible information in situations of asymmetric information in which one party (e.g., the customer) is less knowledgeable than the other (e.g., seller). Consumption-related information asymmetries vary across offers depending on their attributes and are particularly strong in the case of sustainability features (e.g., Cason & Gangadharan, 2002). Unlike appearance, color, and taste, sustainability attributes such as organic cultivation or fair wages are typically hard or even impossible for buyers to assess (Jahn et al., 2005). To earn trust among customers despite this, entrepreneurs are therefore advised to communicate sustainability features in a trustworthy and transparent way (Chen & Chang, 2012). To this end, sustainability labels awarded by credible organizations can serve as reliable quality signals (Chkanikova & Lehner, 2015). Yet, certification procedures are often pricy, laborious, and complex, which may prevent entrepreneurial ventures from obtaining these labels (Jahn et al., 2005).

Switching to the customer's perspective, buyers use diverse heuristics such as following other customers or screening for quality signals to overcome information asymmetries (Kirmani & Rao, 2000). Some of these heuristics are pooled and described by the consumer interference literature, which, in sum, explains that customers create spontaneous if–then connections between given information and decisions (Kardes, 1993; Kardes et al., 2004). Consumers, for example, typically associate high prices with high quality (e.g., Rao & Monroe, 1989), go to the more crowded restaurant when choosing between two unknown alternatives (Banerjee 1992), and perceive engines to be of higher quality when labelled "made in Germany" (Bilkey & Nes, 1982). More critical to our study, Nishikawa et al. (2017) found in field experiments that the cue "customer-ideated" on crowdsourced products pushed their sales up by 20% and that this is due to a quality-interference in the way that consumers perceive that crowdsourced products better address their needs. As these examples illustrate, focal signals that customers receive can change their views about the product.

CF success may be such a signal by simply pointing out that a product, for instance, is popular or of higher quality. Consumption literature further underpins this assumption by showing that customers willingly create number (Girotra et al., 2010) and user arguments (Schreier et al., 2012) for product assessments in the sense that users know best about other users' needs (Nishikawa et al., 2017). Following these arguments, a successfully crowdfunded product could signal quality because buyers might consider the large number of crowdfunders to belong to the same population as themselves. Thus, they possibly believe that many other customers who share the same needs know better which products can address them best than traditional investors would. Additionally, Wehnert et al. (2018) argue that potential buyers may be influenced by herding instincts and may follow the decision of the crowd, assuming that it consists of many individuals who may possess valuable information about the product. The results of their study suggest that CF success indeed functions as a signal that changes customers' product perceptions and affects sustainability-related information asymmetries (Wehnert et al., 2018). Thus, depending on product complexity, displaying a successful CF campaign can act as a quality signal leading to similar effects as product certifications. Accordingly, nascent entrepreneurs are advised to mention a successful CF campaign if the product is of a simple nature and to be careful or hide it if the product is more complex.

In short, for entrepreneurial ventures seeking ways to market their crowdfunded sustainability-oriented products, it is important to know not only *whether* to mention CF success but also *how* to credibly communicate it. Just like other quality signals, portraying the label "financed by a successful CF campaign" on a product under the wrong conditions can even unintentionally acerbate credibility issues among customers. In this context, the literature on eco-labels states that their trustworthiness changes with the label source and information specificity on the one hand and is contingent on consumer's product involvement on the other hand (Atkinson & Rosenthal, 2014). Consequently, altering the label issuer (e.g., an official label by a well-known certifier) and information content (e.g., received funds, type of CF) reconfigures the CF signal and can affect its credibility and with that its influence on product perceptions. As information regarding CF differs substantially from other types of financing, we focus on investigating this aspect. In contrast to traditional forms of investments, the decisions of crowdfunders to back certain campaigns need not be extrinsically motivated but can be mainly intrinsically driven (e.g., Gerber & Hui, 2013). Furthermore, referring to the numbers argument (Girotra et al., 2010), information about the numbers of backers and the amount of money collected might influence the strength of the CF success signal. Within the following sections, we explain how both types of information can influence the product perception of potential customers and derive hypotheses from that.

2.3 Extrinsic and Intrinsic Crowdfunding Motivations

To investigate how consumers perceive the motivations of a crowdfunded product's backers, it is first important to shed light on the motivations behind crowdfunders' decisions to back certain campaigns. Understanding these motivations is vital to entrepreneurial ventures when designing CF campaigns to fruitfully acquire financial resources. A young research stream focuses on examining backer's motivations. Several studies (e.g., Allison et al., 2014; Cholakova & Clarysse, 2015) in this stream apply the lens of cognitive evaluation theory (Deci, 1971) and self-determination theory (Deci & Ryan, 1985) to explain crowdfunders' motivations to back certain campaigns. The cognitive evaluation theory focuses on rewards undermining intrinsic motivation while the self-determination theory extends the former by concentrating on factors facilitating intrinsic motivation (Ryan & Deci, 2000a). Based on those theories inter alia, psychological research has widely addressed the influence of extrinsic and intrinsic motivations on people's behavior (Ryan & Deci, 2000b). Extrinsic motivation comes from "outside" and is triggered by external incentives or factors such as pecuniary compensation or appreciation by relevant persons (Deci & Ryan, 1993). Extrinsically motivated actions aim to foster beneficial and to avoid adverse consequences (Ryan & Deci, 2000b). Intrinsic motivations stem from "inside" and arise when individuals initiate actions without external stimuli or predictable consequences (Deci & Ryan, 1993). Intrinsic motivation is activated by internal factors such as pleasure, enjoyment, fascination, and curiosity (Ryan & Deci, 2000a).

In the CF community, reward-based platforms are considered as mainly attracting backers who want to support a campaign because they "enjoy" and "like" it (Schwienbacher & Larralde, 2010), while equity-based platforms are viewed as largely appealing to individuals seeking return on investment (Cholakova & Clarysse, 2015). Whereas liking and enjoying are seen as intrinsic motivations, pursuing return on investment is regarded as an extrinsic motivation. Thus, lending- and equity-based CF seems to attract mainly extrinsically motivated investors, while donation-, pre-purchasing-, and reward-based CF appears to attract primarily intrinsically motivated backers. Even though empirical findings in this context challenge a clear-cut distinction (e.g., Gerber & Hui, 2013; Allison et al., 2015; Cholakova & Clarysse, 2015) showing various funding motivations within the CF types, overall, the literature in this field underlines the tendencies regarding the prominent motivations within the CF forms.

While understanding crowdfunders' motivations is important for entrepreneurs to acquire financial resources, novel ventures facing the liability of newness also need to be careful when designing marketing strategies for crowdfunded products as they need to increase trust and reach among their customers. Yet, it is unknown how buyers of successfully crowdfunded products perceive the CF dimension of these offerings in the post CF-market and, more specifically, whether or how they respond to the motivations of the products' backers. Following the user (Schreier et al., 2012) and numbers argument (Girotra et al., 2010) described in Section 2.2, mentioning CF success on a product may signal quality as consumers can identify themselves with the crowd and may assume that it consists of customers who better know how to address their needs than traditional investors. If that is the case, customers may value investment decisions driven by motivations that are close to their own and that potentially differ from those related to traditional investments. Thus, mentioning intrinsic funding motivations on the "financed by a successful CF campaign" label may increase the credibility and with it the impact of the CF success signal. These assumptions are further substantiated by evidence from the product quality perception literature stating that intrinsic cues have a stronger influence on perceived-quality assessments than extrinsic ones (Szybillo & Jacoby, 1974). Following our argumentation, we propose the first hypothesis:

H1a: The communication of CF success mainly funded by intrinsically motivated backers (vs. extrinsically motivated backing) positively influences consumers' product perception.

2.4 Sustainability Motivations and Sustainable Purchase Behavior

Sustainability-oriented product features are typically characterized by pronounced information asymmetries (Jahn et al., 2005). This is particularly true for many process-related attributes such as fairness, animal welfare, or climate friendliness that consumers cannot verify themselves but nevertheless care about. Here, more information is needed about the production conditions or the reputation of the producer in order to trust the credibility of such sustainability attributes. In this situation, a successful CF campaign can signal that backers have approved of not only the product but also the claims behind it. This is particularly true when crowdfunders' support is driven by intrinsic motivation, thus signaling that they do not care about profit but care about the product's underlying sustainability idea. Assuming that crowdfunders had access to more information during the CF process, their intrinsic motivation may thus lend credibility to non-verifiable sustainability attributes. We thus posit as the second part of the first hypothesis:

H1b: The communication of CF success mainly funded by intrinsically motivated backers (vs. extrinsically motivated backers) positively influences consumers' trust in sustainability-related product attributes.

However, unlike the signaling effect of mentioning that a product has been successfully crowdfunded in contrast to not mentioning it, the signaling strength of stressing intrinsic versus extrinsic funding motivation might not be powerful enough to directly affect pronounced information asymmetries associated with sustainability features (e.g., Cason & Gangadharan, 2002). Yet, those customers whose product attitudes have been positively affected by the signaling effect of the cues about motivations are arguably more likely to perceive the product to be a more credible sender of additional signals. Eventually, positive effects on product attributes could then indirectly enhance trust in sustainability attributes promised by the product. Therefore, we additionally analyze the indirect influence of the cues about motivation on customer's trust in sustainability attributes through product attitude and propose a third part of the first hypothesis:

H1c: The communication of CF success mainly funded by intrinsically motivated backers (vs. extrinsically motivated backers) positively influences consumers' trust in sustainability-related product attributes indirectly through product attitude.

Furthermore, the influence of motivation-related cues may vary with consumers' own motivation and, more specifically, the extent to which consumers care about sustainability. Regarding this issue, sustainable-consumption research shows that there are different sustainability motivations that influence customers to purchase sustainably (e.g., Schuitema & de Groot, 2015). Typically, scholars in the field of sustainable behavior distinguish between biospheric, altruistic, and egoistic motivations (Verhoef & van Doorn, 2016). According to Stern et al. (1993), people with an egoistic motivation pursue the maximization of their individual outcomes, whereas people with an altruistic or biospheric motivation try to maximize the wellbeing of other individuals or the contribution to the natural environment. This builds on the Value–Belief–Norm (VBN) theory on environmentally significant behavior (Stern et al., 1999; Stern, 2000) which suggests that environmental beliefs follow personal values (cf. Fig. 1). If individuals believe that environmental conditions will threaten something they value and those individuals believe that they are able to reduce that threat, sustainability-oriented (purchasing) behavior can be evoked (Stern, 2000).

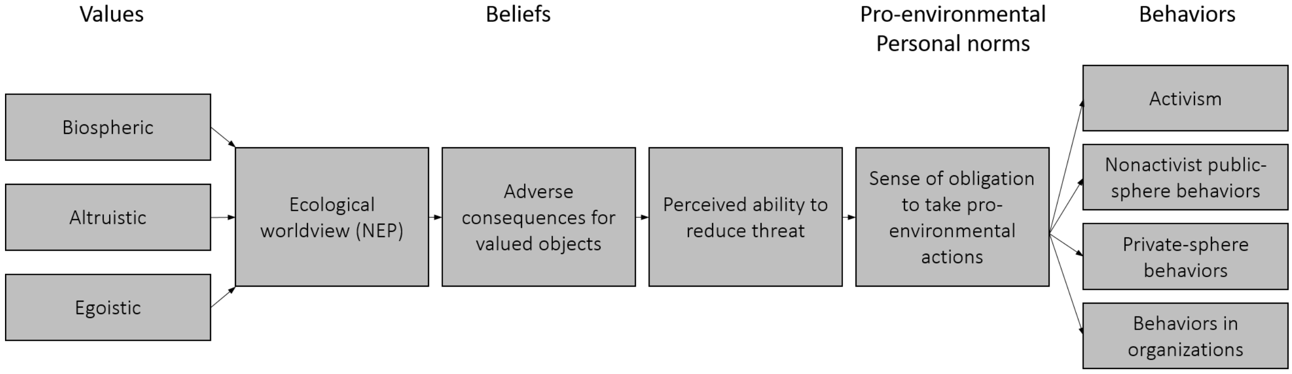

Fig. 1. Value–Belief–Norm model according to Stern (2000, p. 412).

The degree to which sustainability motivations are the key stimulus for a person might influence the kind of information the consumer seeks about the product and the extent to which he or she does so. Building on the assumption that customers look for like-minded motivations, altruistically and biospherically driven individuals are arguably more likely to be influenced by cues on intrinsic funding motivations because altruistic and biospheric motivations are also largely intrinsic. Egoistic motivations, on the other hand, have a tendency to be rather extrinsic. Accordingly, information on extrinsic funding motivation might rather influence individuals with egoistic sustainability motivations. Therefore, customers' specific sustainability motivation could influence not only the information need but also the signaling contribution that motivation-related CF cues can create for sustainable products. This is an interesting gap because it links the literature on sustainability motivations, signaling, and CF. We therefore postulate our second hypothesis:

H2: The influence of communicating the funding motivation behind a successful CF campaign on consumers' perceptions of sustainability-oriented products varies with different sustainability motivations.

2.5 Information Specificity and Product Involvement

As described in Section 2.2, labels can be effective instruments to support consumers in their information search. In order to tailor a CF label to the preferences of buyers, it is important to analyze how the label content and format may affect consumer perceptions.

According to the literature (e.g., Feunekes et al., 2007), labels can fall into three different main types. The *seal logo* contains a text or a picture mark that highlights certain properties. It strongly emphasizes the product by appearing only on selected products within a category. It typically contains a purely positive statement and does not support comparisons among labelled products. Negative product characteristics are not displayed. The USDA's or the European Community's organic seal, for example, follows this logic. The *traffic light logo* contains a familiar color signal (e.g., from red to green) anticipating an assessment and interpretation by reducing product differences to a ranking order. Given this label type, negative product features are recognizable. The energy efficiency label of the European Community, for instance, follows this principle. The *numerical logo* contains specific key figures or quantitative properties but no interpretation; consumers must determine and interpret the difference in characteristics between products themselves (Feunekes et al., 2007). Examples of this logic are the US nutrition facts or the CO_2 footprint in British food retailing.

In order to tailor labels to the preferences of buyers, it is important to consider their perceptions of general and specific statements (Kangun et al., 1991) and to choose the right level of detail as appropriately as possible (Borin et al., 2011). It is also known that specificity can lead to a more positive label perception for all three label types (Davis, 1993). What is less well known, however, is how consistent the persuasiveness of information is when the personal relevance of the product is different.

In consumer and marketing research, the personal relevance of an offer is measured by the involvement construct. Rothschild (1984, p. 216) describes involvement as "a state of interest, motivation or arousal" that has an important influence on information search, information processing, and decision-making. Depending on the object of consideration, this state of involvement of a consumer can be caused by his or her personality, the product, an advertisement, or a situation (Zaichkowsky, 1985). In line with that, McQuarrie and Munson (1992) state that involvement in the sense of personal relevance is determined by the importance to or interest of the respective consumer. It is often argued that information is questioned more strongly with increasing involvement (e.g., Sherif et al., 1965). Thus, highly involved customers are harder to convince and less satisfied with the same information.

In purchase situations, a combination of involvement and the situational context is described as the cause of the individual consumer's way of thinking (e.g., Hodgkins et al. 2012). More specifically, Grunter et al. (2010) describe consumers in purchase situations as seeing a trade-off between simplification, full information content, and decision compulsion. In such moments, the desire to obtain holistic information to make a sovereign decision competes with situational restrictions (Jacoby et al., 1974). In light of this contradiction, Hodgkins et al. (2012) proposed a classification of labelling types aiming to understand which one might be more efficacious in specific situations or for certain consumers. The central dimension in this scheme is referred to as *directiveness*, that is, the degree of instruction for the consumer in the purchase situation. Based on this, the typology distinguishes between *non-directive labels, semi-directive labels,* and *directive labels*.

Numeric logos are understood as *non-directive labels* transmitting holistic information through specific contents and reference units (Hodgkins et al., 2012). This enables customers to make a differentiated comparison. Without any simplification or instruction, however, this comparison is also difficult to make. *Directive labels*, that is, seal logos, move simplification and instruction into the center. Information about the trust-based characteristics is aggregated into a dichotomous decision question (Scott et al., 1994). The comparability among labelled offerings, however, is low. *Semi-directive labels*, that is, traffic light logos, are a hybrid form combining the instruction characteristic with comparability. The hybrid is less clear in its instruction and not as differentially comparable as *non-directive labels*. Studies show that s*emi-directive labels* are popular among consumers but often misinterpreted (Sacks et al., 2009).

The logic behind the categorization mirrors the mindset or decision-making of the respective consumer. As mentioned before, the individual consumer's decision-making is shaped by a combination of personal involvement and the situational context at the point of sale. The mindset in such situations moves on a spectrum from heuristic decision-making with low involvement and lack of time to systematic decision-making with high involvement and sufficient time (Hodgkins et al., 2012). Accordingly, it is assumed that with growing involvement, labels with increasingly specific information content are perceived as more useful. Numbers, quality, and accuracy are increasingly required (Petty & Cacioppo, 1981). Preference is given to *directive labels* in the case of low involvement, to *semi-directive labels* in the case of medium involvement, and to *non-directive labels* in the case of high involvement (Hodgkins et al., 2012). Involvement, thus, seems to be the independent variable of consumers' label preference. Underpinning this, Atkinson and Rosenthal (2014) found that the credibility of labels varies with information specificity along different intensities of involvement.

To adapt the communication of CF success to the customers' preferences, entrepreneurs need to know whether these correlations also apply to a CF label. We assume that different levels of information specificity portrayed through CF labels with different degrees of directiveness influence consumers' product perceptions.

Furthermore, we argue that product involvement moderates this relationship in the sense that less involved customers prefer no specific information and a directive label whereas highly involved consumers prefer specific information in the form of non-directive labels. Given these assumptions, we posit as the third and fourth hypotheses:

H3a: Differences in the level of information specificity when portraying a successful CF campaign influence consumers' product perceptions.

H3b: Differences in the level of information specificity when portraying a successful CF campaign influence consumers' trust in sustainability-related product attributes.

H3c: Differences in the level of information specificity when portraying a successful CF campaign influence consumers' trust in sustainability-related product attributes indirectly through product attitude.

H4: The influence of portraying a successful CF campaign with different information specificity levels on consumers' product perceptions varies with different levels of product involvement.

To sum up, our simplified research framework is shown in Figure 2. At the center of our study, we investigate the influence of extrinsic and intrinsic cues about the motivation of crowdfunders on consumers' product perception and trust in sustainability attributes with customers' sustainability motivation influencing this relationship. Furthermore, we test the impact of information specificity on customers' product perception plus trust in sustainability attributes and examine the role of product involvement in these relations. Moreover, we test whether a positive shift of consumers' product perceptions by cues on motivation or information specificity results in increased trust in the products' sustainability attributes. To explore all of this, we perform an experimental study as described in the next section.

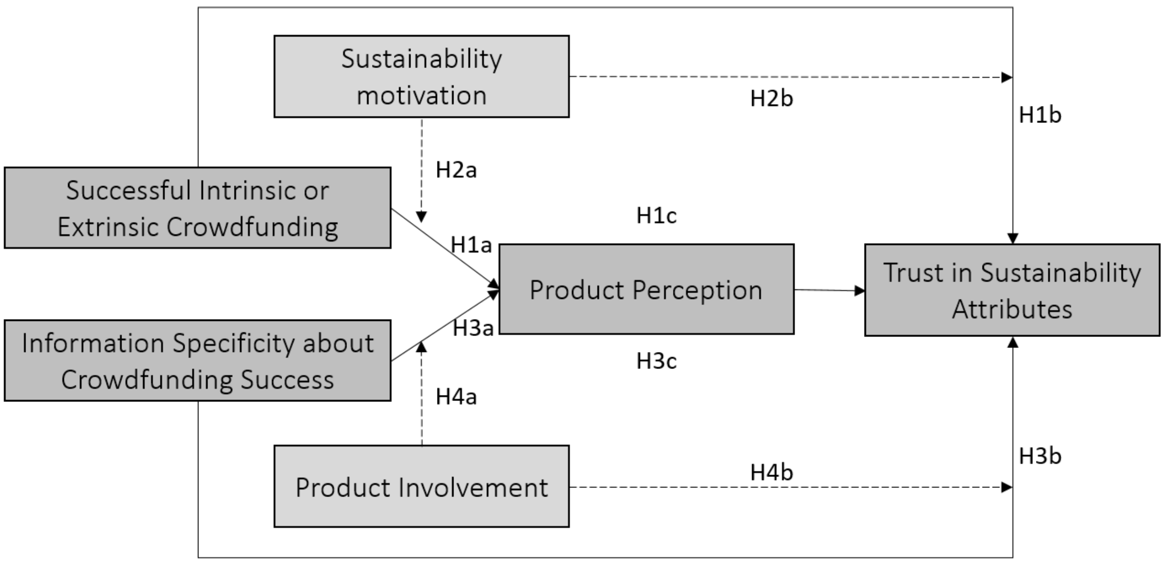

Fig. 2. Research framework.

3. Method

3.1 Overview, procedure, and stimuli

In order to investigate our hypotheses, we conducted an online experiment with a 2 (intrinsically motivated crowdfunding vs. extrinsically motivated crowdfunding) × 2 (low information specificity vs. high information specificity) between-subject design, thus resulting in four different conditions. We used convenience sampling and distributed a short introduction to our study with a link to the online questionnaire on online forums and social networking sites. After eliminating four outliers, we used 180 questionnaires for our analyses (62.2% female). The age of the participants ranged from 14 to 68 years (M = 31.42).

After clicking on the link, potential participants were directed to a further broad introduction to our study ("The aim of this study is to examine the perception of crowdfunded products"). There, we told them that for each completed survey we would donate €0.30 to the United Nations International Children's Emergency Fund (UNICEF). In addition, participants had the possibility of winning one of three €50 gift cards. After that, participants were randomly assigned to one of our four experimental conditions. We followed the approach of Wehnert et al. (2018) and based our experimental conditions on the product "cacao". The product was presented with a specifically designed product advertisement. The advertisement included a slogan, a body text, and a collage of four product-related pictures. The product advertisement contained four specific claims that addressed different sustainability-related product attributes: A quality claim ("natural and without additives – Maya Beans thus offers a high-quality and healthy alternative to industrial cacao"), a fairness claim ("farmers receive fair wages"), a health claim ("we purposely avoid substances that are harmful to health"), and an environmental claim ("the product comes from sustainable agriculture that preserves the rainforest and does not use pesticides").

We manipulated the *crowdfunding motivation* of backers (intrinsically motivated vs. extrinsically motivated) by varying the CF form. For the intrinsically motivated condition, we chose donation-based CF since backers give their money without expecting any compensation. For the extrinsically motivated condition, we chose a loan-based CF campaign since backers give their money and expect a concrete compensation for it. To present the respective CF background to participants, we first gave some information about the funding history of the product on a separate site. In the intrinsically motivated condition, we told participants that many consumers had supported the product idea by donating a certain amount of money to raise the necessary funds for the development of the product by the fictitious brand "Maya Beans". In contrast, we told participants in the extrinsically motivated condition that many consumers supported the product idea and that each of these consumers had lent some money to raise the necessary funds for the development of the product. In return, the donors received 6.5% interest per year for their money. After this information, participants were guided to a site with three testimonials for each condition. We showed short statements by three fictitious backers (with fictitious names and professions that were the same for the different conditions) to reinforce our manipulation. For example, for the extrinsically motivated condition, one statement was: "For me, 6.5% interest per year is a decent return. That's why I invested €100 in the development of this product". This information was given before showing the actual product advertisement.

Information specificity (low vs. high) was then manipulated by showing different levels of detail regarding the funding of the products with a label on the upper left side of the product advertisement. We developed, based on our conceptual discussion, both *directive* and *non-directive CF success labels* with different levels of information specificity as shown in Figure 3. We chose only the two most extreme label formats to test whether consumer preferences regarding the CF label follow the same logic as for other labels. The directive label (low-specificity condition) stated only that this product had been successfully crowdfunded and that many people supported the product idea. More specifically, the label told participants that the product was financed by loan-based CF (for the extrinsically motivated condition) or that it was financed with the help of donation-based CF (for the intrinsically motivated condition). The non-directive numeric logo (high-specificity condition) showed detailed information about the CF process. Thus, we integrated a label with detailed funding information, including the rate of interest, term of financing, or total financing volume for the extrinsically motivated condition and total funds received and number of backers or number of likes for the intrinsically motivated condition.

Fig. 3. Applied directive and non-directive crowdfunding labels.

After the exposure to the respective treatments (see also Fig. 3), we collected data regarding manipulation checks, relevant dependent variables, and the socio-demographic background.

3.2 Pretests

Before starting our main experiment, we performed two pretests. First, we conducted an online pretest that checked whether participants perceived the crowdfunded product as either intrinsically or extrinsically motivated. After being randomly exposed to one of the already mentioned experimental conditions, participants rated the funding motivation of backers on a seven-point semantic differential scale. Overall, 58 participants who were not part of the main experiment completed the pretest. The results show that participants rated funding motivation ($M_{intrinsic} = 2.39$ vs. $M_{extrinsic} = 5.43$, $p < .001$) significantly differently. In a separate online pretest, participants were randomly assigned to one of two information specificity conditions and had to evaluate the level of detail on a seven-point semantic differential scale. Thirty-three participants took part and the results support the intended differences in the level of information specificity ($M_{low} = 3.44$ vs. $M_{high} = 4.33$, $p < .05$).

3.3 Measures

Dependent variables: To measure attitudes toward sustainability claims we followed Wehnert et al. (2018), who adapted a scale from Bart et al. (2005). Attitudes were captured regarding four different sustainability-oriented product attributes and each was measured on a two-item Likert-scale from 1 (“low”) to 7 (“high”). Thus, we measured participants’ trust in a provided quality claim (Cronbach's $\alpha = 0.90$), a fairness claim (Cronbach's $\alpha = 0.94$), an environmental claim (Cronbach's $\alpha = 0.92$), and a health claim (Cronbach's $\alpha = 0.88$). The attitude towards the product was measured using a three-item seven-point differential scale with the anchors “favorable/unfavorable”, “bad/good”, and “negative/positive” (Mogilner et al., 2008). Cronbach's α for this scale was 0.92.

Moderating variables: To check whether participants’ sustainability motivations influence the proposed relationships, we followed Steg et al. (2006), who used an adapted short version of Schwartz’s (1992) universal values scale in the context of sustainability. Overall, three distinct sub-dimensions with four values each were measured: egoistic values (authority, wealth, social power, and influence; Cronbach's $\alpha = 0.80$), altruistic values (social justice, equality, a world at peace, and being helpful; Cronbach's $\alpha = 0.78$), and biospheric values (preventing pollution, protecting the environment, respecting the earth, and unity with nature; Cronbach's $\alpha = 0.85$). Participants rated the values on a nine-point scale ranging from –1 (“opposed to the values”) through 0 (“not at all important to me”) to 7 (“of supreme importance to me”). Moreover, we used the widely used ten-item seven-point differential scale from Zaichkowsky (1994) to measure participants’ product involvement (Cronbach's $\alpha = 0.88$).

Finally, we included age and gender as *control variables* in our analyses.

4. Results

4.1 Manipulation checks

Similarly to the procedure in the pretest, we performed two ANOVAs to check whether our manipulations had been successful. First, participants were asked to rate the intrinsic versus extrinsic motivation of the backers regarding the crowdfunded product on a seven-point semantic differential scale (from “intrinsically motivated” to “extrinsically motivated”). As assumed, participants perceived the donation-based condition ($M = 2.39$) as significantly different from the loan-based condition ($M = 4.60$, $p < .001$). Second, participants had to rate the level of detail of their respective product presentation on a seven-point semantic differential scale (from “not detailed” to “very detailed”). Again, the results show that the groups with low information specificity ($M = 3.30$) differed significantly from the groups with high information specificity ($M = 3.95$, $p < .01$). Both analyses reveal that our manipulations were successful.

4.2 Tests of hypotheses

Test of H1. To test our first assumption, H1a, we performed a univariate analysis of covariance (ANCOVA) with attitude towards the product as our dependent variable, with CF motivation as our independent variable and gender and age as covariates. The results showed a significant main effect of CF motivation on attitude toward the product such that participants reported more positive product evaluations in the intrinsically motivated condition ($M = 5.51$) than in the extrinsic motivation condition ($M = 5.04$; $p < 01$; $F(1, 176) = 9.046$). H1b stated that CF success mainly funded by intrinsically motivated backers (vs. extrinsically motivated backers) positively influences consumers’ trust in sustainability-related product attributes. We performed four ANCOVAs, each with one of the four dimensions of trust in sustainability-related product features as the dependent variable, CF motivation as our independent variable, and gender and age as covariates. However, we could not find any significant effect of CF motivation on the dependent variables. Thus, we have to reject H1b. H1c states that the communication of CF success mainly funded by intrinsically motivated backers (vs. extrinsically motivated backers) positively influences consumers' trust in sustainability-related product attributes indirectly through product attitude. To investigate this mediating effect, we applied bootstrapping analysis as described by Preacher and Hayes (2008). A mediation effect is existent when the 95% confidence interval (CI) does not contain zero. Bootstrapping analyses with the SPSS macro PROCESS for all of the four dimensions revealed that although there is no direct relationship between the independent variable and the dependent variable (see H1b), participants have more trust in the quality claim (LLCI = –.61; ULCI = –.13) fairness claim (LLCI = –.62; ULCI = –.13), environmental claim (LLCI = –.60; ULCI = –.13), and health claim (LLCI = –.52; ULCI = –.10) through product attitude when they have been exposed to an intrinsically motivated CF campaign. Thus, H1c can be supported.

Test of H2. H2 stated that the influence of communicating the funding motivation behind a successful CF campaign on consumers' perceptions of sustainability-oriented products (H2a) and on the trust in sustainability-related product attributes (H2b) is moderated by participants' sustainability motivations. To check these assumptions, we followed the procedures of Aiken and West (1993). We mean-centered the moderator variables (egoistic values, altruistic values, and biospheric values) and effect-coded CF motivation (–1 = intrinsic and 1 = extrinsic). Including the interaction terms between the moderators and CF motivation in the regression as the second step of the analysis did not lead to significant changes in R-squared for the dependent variables (attitude towards the product, trust in the quality claim, trust in the fairness claim, trust in the environmental claim, trust in the health claim). Moreover, we found no significance when the interaction terms were entered and therefore we have to reject H2a and H2b.

Test of H3. For H3a, we performed a univariate ANCOVA with attitude towards the product as our dependent variable, information specificity as our independent variable, and gender and age as covariates. For H3b, we performed four ANCOVAs, each with one of the four dimensions of trust in sustainability-related product features as the dependent variable, information specificity as our independent variable, and gender and age as covariates. However, we could not find any significant effect of information specificity on the dependent variables. Thus, we have to reject H3a and H3b. Given the missing significant relationships checked in H3a and H3b, we also have to reject H3c.

Test of H4. H4 assumed that the effect of information specificity on consumers' perceptions of sustainability-oriented products (H4a) and on the trust in sustainability-related product attributes (H4b) is moderated by participants' product involvement. Again, we mean-centered the moderator variable (product involvement) and effect-coded the information specificity (–1 = low and 1 = high). However, we have to reject H4a since we did not find any significant relationship between the moderator and product attitude. Regarding H4b, we found significant interactions of trust in the quality claim and trust in the environmental claim. For both variables, including the interaction term between product involvement and the moderators yielded a significant change in R-squared for the dependent variable. In addition, the interaction terms were significant on a 5%-level (β = –.193, p = .035 for the quality claim and β = –.152, p = .040 for the environmental claim. Looking more closely at the interaction at one standard deviation above and below the mean for product involvement showed that the effect on trust in the quality and the environmental claim is especially observable for participants with high involvement in the low information specificity group. In the high information specificity condition, it did not matter whether participants had high or low product involvement (see also Fig. 4). Thus, H4b can be partially supported.

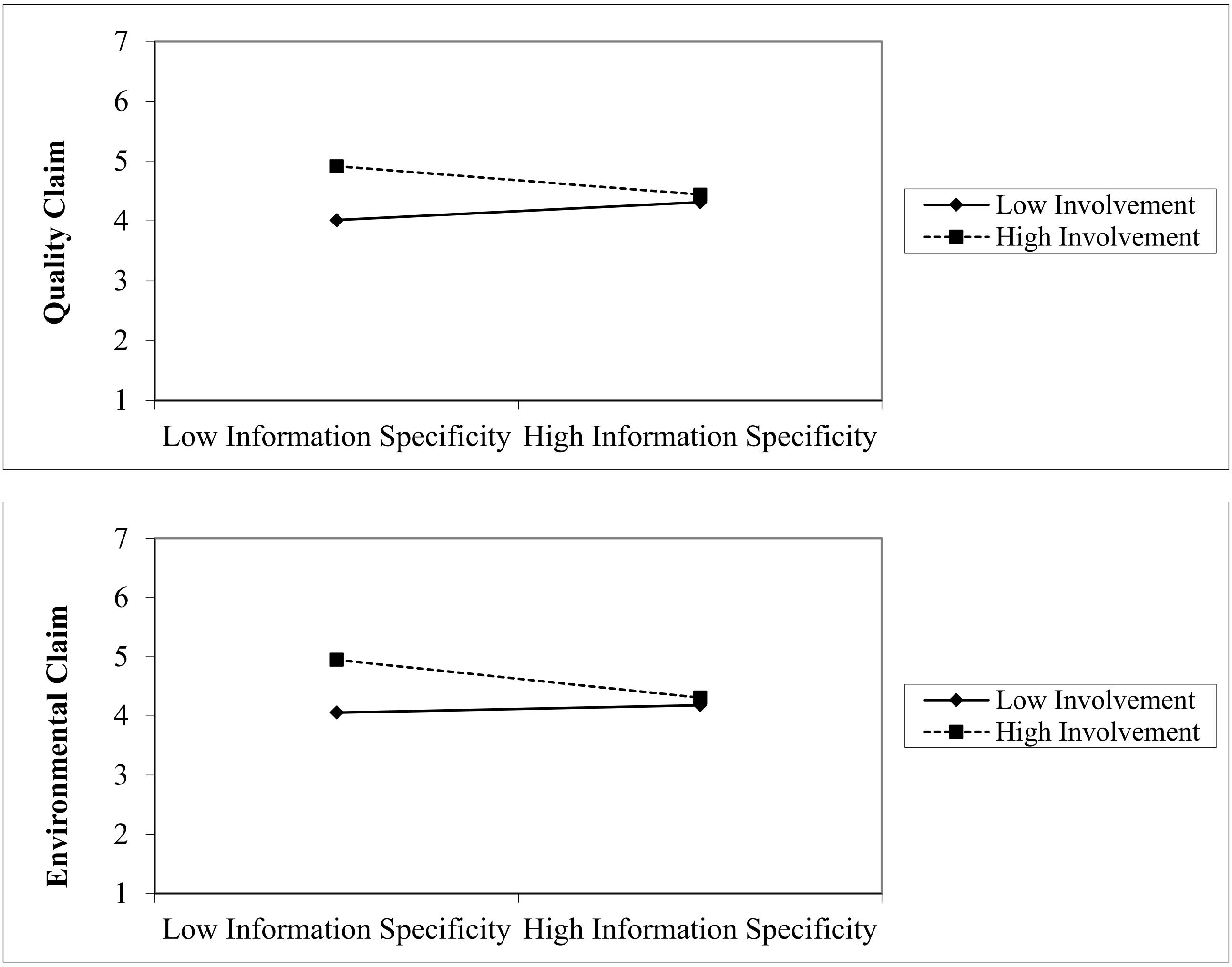

Fig. 4. Significant interaction effects.

5. Discussion

CF is revolutionizing the way in which nascent entrepreneurs acquire financial resources (e.g., Petruzzelli et al., 2018) and has thus mainly been addressed by researchers and practitioners from a financing perspective. Yet, academics have barely addressed the marketing effect of mentioning CF as a product's source of finance. While a recent study shows that merely mentioning a successful CF campaign on products can influence consumers' product attitudes (Wehnert et al., 2018), it remains unknown how different contents of CF-specific information as well as different forms of their presentation affect consumers' perception of crowdfunded offerings. Building on signaling theory, the consumer interference literature, and the literature on label perception, we shed light on this blind spot. We first tested the influence of cues about crowdfunders' motivation on the impact of communicating CF success in terms of consumers' product perceptions and trust in sustainability attributes. At the same time, we examined whether sustainability-related value orientations of customers affect this relationship. Second, we analyzed how portraying CF-related information with different levels of specificity influences the CF success signal to customers and examined the role of their product involvement in this correlation.

Regarding the first part of the analysis, we find that mentioning mainly intrinsic funding motivations indeed influences buyers' product attitude more positively than stressing extrinsic motivation of crowdfunders. Accordingly, customers seem to prefer crowdfunded products with cues about intrinsic funding motivation over their counterparts that display extrinsic funding motivation. Yet, we find that such cues affect consumers' trust in environmental, fairness, quality, and health attributes only indirectly, namely through product attitude. Furthermore, we find that specific sustainability motivations of customers do not influence the impact of motivation-related cues. Thus, compared to portraying mainly extrinsic funding motivation, cues stressing intrinsic funding motivation evoke more favorable product attitudes and indirectly increase customers' trust in sustainability-related product characteristics. With respect to the second part of the analysis, we find that displaying labels with different degrees of directiveness and information specificity influence neither customers' product perception nor their trust in sustainability features. Analyzing the effect of customer involvement on this relationship, however, we find that, in contrast to our original assumptions, highly involved respondents trust a product's quality and eco-friendliness more when exposed to a directive label with low information specificity than when exposed to a non-directive label containing high information specificity.

The findings of the first part of the analysis are fairly in line with the conceptual model drawn from the signaling theory and consumer interference literature in Section 2.2. Communicating mainly intrinsically driven funding motivations thus seems to function as a quality interference (Kardes et al., 2004), which possibly stems from the user (Schreier et al., 2012) and numbers argument (Girotra et al., 2010) that customers construct for product assessments. When receiving the information that a product has been successfully crowdfunded, consumers applying such arguments would arguably assume that the crowd contains many customers who – unlike traditional investors – *really* know how to address their needs. As already maintained in the literature (Wehnert et al., 2018), this seems to be the case for products of low complexity. Our findings indicate that for such products, customers trust a mainly intrinsically driven crowd that, for instance, is really fascinated by the product to know better how to address their needs than a primarily extrinsically driven crowd acting more like traditional investors. Emphasizing an intrinsically motivated crowd can therefore strengthen the impact of the quality signal that labelling a crowdfunded product as such may offer (Wehnert et al., 2018) and thus further support customers in overcoming quality-related information asymmetries (Kirmani & Rao, 2000).

By showing that cues about the funding motivation can have such impacts on potential buyers, the research presented here is uniquely placing the discussion about backers' CF motivations (e.g., Cholakova & Clarysse, 2015; Bretschneider & Leimeister, 2017) in a marketing context. Applying cognitive evaluation (Deci, 1971) and self-determination theory (Deci & Ryan, 1985), a few studies analyzed the influence of extrinsic and intrinsic motivations of crowdfunders for backing certain campaigns (e.g., Allison et al., 2015; Cholakova & Clarysse, 2015). We extend this stream of research by adding the perspective of customers in the post-CF market. From this perspective, we point out that backers' motivations activated by internal factors such as pleasure, enjoyment, and belief in the product are perceived as better by customers of simple products than motivations triggered by external incentives such as monetary compensation. By examining the perception of intrinsic versus extrinsic motivation, we also add to psychological research addressing the influence of these motivations on individuals' decision-making (e.g., Ryan & Deci, 2000b).

Moreover, on a more speculative note, our results indicate that low-complexity products are perceived more favorably when originating from pre-purchasing-, donation-, and reward-based CF as these forms appear to attract largely intrinsically motivated backers (Schwienbacher & Larralde, 2010) than being financed by equity- and lending-based CF forms, which are known to attract mainly extrinsically driven crowdfunders (Cholakova & Clarysse, 2015). Yet, ambiguous empirical findings in this area challenge this seemingly clear-cut distinction. Gerber and Hui (2013) interviewed ten crowdfunders from different reward-based CF platforms and highlighted three primarily intrinsic motivations, "help others", "be part of a community", and "support a cause", as well as one mainly extrinsic motivation, "collect rewards", as key drivers for backing campaigns. Allison et al. (2015) examined the effect that intrinsic and extrinsic motivating cues embedded in narratives of entrepreneurs has on investing behavior in crowdfunded prosocial microlending, a subcategory of lending-based CF. Results from this study indicate that highlighting the business opportunity in the narratives attracts lenders less positively than highlighting the project as an opportunity to support others (Allison et al., 2015). Contrary to these findings, a subsequent experiment by Cholakova and Clarysse (2015) with 155 crowdfunders found that backers' motivations for investing in (or respectively pledging to) projects on equity- (or reward-) based platforms are primarily financial or utility driven. In line with this finding, Bretschneider and Leimeister's (2017) results of a comprehensive survey among 309 backers reveal that investors in reward-, equity-, and lending-based CF have no altruistic motivations and are rather driven by "the prospect of rewards", "lobbying certain projects to fruition", "developing an online image", and simply "liking a certain venture". Overall, which motivations really have a central impact on funding decisions in different CF forms thus remains an open question. In fact, CF motivations are rather complex, multi-dimensional, and nuanced. However, as long as customers follow the general perception of the CF community in viewing donation-, pre-purchasing-, and reward-based CF as mainly intrinsically motivated and lending- and equity-based CF as mainly extrinsically motivated, our results indicate that the former mentioned types influence product perception more positively than the latter.

Yet, contrary to our assumptions described in Section 2.4, we find that cues about the funding motivation do not affect consumers' trust in products' sustainability attributes directly. The literature on signaling provides a potential explanation for this. Information asymmetries are particularly strong in sustainability-related product features (e.g., Cason & Gangadharan, 2002). While labelling a product as successfully crowdfunded in comparison to not communicating this can affect such pronounced information asymmetries (Wehnert et al., 2018), displaying cues on intrinsic versus extrinsic funding motivation is arguably a less evident signal. Thus, the quality signal that cues on motivation can pose may be not powerful enough to directly affect customers' trust in non-verifiable sustainability attributes. However, our results show that consumers whose product attitude has been positively influenced by cues on intrinsic motivation also trust a products' quality, eco-friendliness, fairness, and health claims more. Accordingly, we indeed find that cues stressing intrinsic funding motivation indirectly influence consumers' trust in sustainability attributes through increasing their product attitude in the first place. A potential explanation may be that the effectiveness of a signal depends on how credible consumers perceive its sender to be (e.g., Atkinson & Rosenthal, 2014). In a way, one could view the product itself as the sender making specific sustainability claims. As cues stressing intrinsic motivation increase the product's credibility directly, they then influence the product's sustainability claims indirectly.

Furthermore, we find that customers' sustainability motivations do not influence the impact of cues about the funding motivation. This can simply be explained by the fact that even though such motivations have an effect on consumers' sustainable purchase behavior (e.g., Schuitema & de Groot, 2015), this impact is not extensive enough to influence customers' information need regarding the product's funding. The fact that we could not find any significant influences of the sustainability motivation draws into question whether the established scale to determine personal sustainability-related motivations of Steg et al. (2006) based on Schwartz (1992) can be generally applied to pure purchasing decisions and shows its limitations.

According to the literature on label perception, another way to influence a label's impact is to change the specificity of its content (Hodgkins et al., 2012; Atkinson & Rosenthal, 2014). Applying this stream of literature to products typically evoking low customer involvement, we expected that portraying a directive label with low information specificity regarding CF success would lead more strongly to a quality interference (Kardes et al., 2004) and thus more positive consumer product attitudes compared with a non-directive CF label with high information specificity. For the analyzed product (cacao), however, we find that displaying such different label formats influenced neither consumers' product perceptions nor their trust in sustainability characteristics. These results are in opposition to our assumptions drawn from the literature on label perception (e.g., Hodgkins et al., 2012) in Section 2.5. A potential explanation might be that although we analyzed the two most extreme label formats, the resulting signal is not powerful enough to affect customers' product perception let alone to reduce pronounced information asymmetries typically evoked by sustainability attributes (e.g., Cason & Gangadharan, 2002). Furthermore, while our pretest and actual study confirm that respondents perceived the information specificity of both label types significantly differently ($p < .01$), the magnitude of this difference was relatively low (3.30 vs. 3.95). Another explanation is that customers, especially regarding the analyzed low-involvement product, simply do not care about the information specificity regarding the CF process.

Additionally, our results show that highly involved customers developed more trust in a product's eco-friendliness and quality when exposed to a directive label containing low information specificity than when exposed to a non-directive label with high information specificity. While these findings indicate that individual customer involvement influences the impact of different information specificity levels on consumers' product perceptions, this influence works in the opposite direction from that suggested by the literature on label perception (Hodgkins et al., 2012). A possible explanation for these observations is the fact that we analyzed only one product, evoking relatively little variation in individuals' involvement. Examining a sample with products inducing considerable differences in customers' information searches, such as coffee in comparison to laptops or cars, might show the overall effect of personal involvement to be more prominent and to shift in the expected direction, that is, that with increasing involvement, customers prefer semi- or non-directive CF labels with higher information specificity. However, our results indicate that the mechanisms behind label perceptions reflected in Section 2.5 do not apply to a CF label.

These findings shift the focus to other influencing factors. Regardless of the information content and its specificity, the CF label might be affected by credibility issues originating from the label source (Atkinson & Rosenthal, 2014), which we did not address in this study. In this context, Atkinson and Rosenthal (2014) suggest altering the label issuer in order to increase its credibility and thereby possibly affect consumers' trust in non-verifiable sustainability attributes. We discuss this and other recommendations for further research in detail in Section 7. Before that, we draw out the implications for practitioners.

6. Practical Implications

Our findings can assist entrepreneurial ventures in promoting their crowdfunded products as such. First, marketing managers of crowdfunded products should be aware that mentioning the CF type and associated information on crowdfunders' motivation influences consumers' product attitudes and indirectly their trust in the product's sustainability features. According to our results, marketing of crowdfunded goods of a simpler nature, such as cacao or coffee, benefits from stressing intrinsically motivated funding motivation such as fascination or faith in the product. In this context, marketing managers are advised to mention CF types that are perceived as attracting mainly intrinsically motivated crowdfunders (pre-purchasing-, donation-, and reward-based CF) over CF forms that are regarded as appealing largely to an extrinsically motivated crowd (lending- and equity-based CF). As a practical solution to communicate intrinsic funding motivation, as applied in our experiment, we recommend adding testimonials by a few investors containing their motivations to the respective CF type.

By indicating that the mechanisms underlying the label perception do not apply to the CF context, our research shows that practitioners cannot uncritically refer to research on, for instance, food or eco-labels (e.g., Hodgkins et al., 2012; Atkinson & Rosenthal, 2014) to tailor a CF label to the preferences of customers. Specifically, our study indicates that for crowdfunded products that typically induce little searching for information, such as goods for daily consumption (cacao, tea, etc.), the use of a directive label containing low information specificity or a non-directive label with high information specificity on the CF success does not make a difference in terms of customer perception. Marketing managers can therefore choose a label variant. Therefore, when marketing such products we suggest displaying a directive label with low information specificity on the CF success in the form of a seal logo focusing on simplification and instruction, as such a label is arguably easiest to create.

Merging the content and specificity parts of the analysis, we recommend that novel ventures market their crowdfunded products with a seal logo containing a simple and instructive cue about the CF success such as "this product has been successfully crowdfunded – many private individuals, just like you, supported this product idea with their own money" and adding a few testimonials by crowdfunders stressing their underlying intrinsic funding motivations like fascination or faith in the product. If the product has been financed by CF types that are regarded as attracting mainly intrinsically motivated crowdfunders, the CF form should be mentioned in the CF success cue (e.g., "this product has been successfully crowdfunded on a donation basis – many private individuals, just like you, donated their money to support this product idea"); if it has not, we recommend not disclosing the CF form.

In particular, entrepreneurial ventures offering crowdfunded sustainability-oriented goods can profit from these relations as pronounced information asymmetries typically related to such products can be decreased by stressing the intrinsic funding motivation. Thus, especially sustainability-oriented entrepreneurs can reduce constraints originating from the liability of newness by marketing their crowdfunded products as such while considering these aspects. However, these findings only apply to products for which consumers typically do not search intensively for information. We discuss these and other limitations in the following section.

7. Limitations and further research

By discussing the limitations of this study we deduce topics for future research in this still embryonic research area.

First, we analyzed just one product category (cacao). However, prior research indicates that the direction of the effect of mentioning a successful CF campaign on customers varies with different levels of product complexity (Wehnert et al., 2018). As cacao is a product with low complexity, we thus point out that our findings only apply to products of low complexity evoking low customer involvement. Building on the label literature (Hodgkins et al., 2012), regardless of our results, consumers' preferences for a CF label can shift with increasing product complexity and customers' information need to semi- or non-directional labels with higher information specificity. Furthermore, even the impact of cues about crowdfunders' motivation on customers might dramatically change with increasing product complexity in the sense that consumers of a high-complexity product might prefer more professional investment signals instead of merely liking or being fascinated by a product. With rising product complexity, preference could, thus, be given to extrinsic funding motivation. Therefore, future research could analyze the same influencing factors with regard to crowdfunded products with different levels of complexity and information need by comparing items such as coffee, jackets, laptops, or smartphones.

Furthermore, we only examined the influence of altering the funding motivation, label format, and information specificity on the impact of portraying CF success. Yet, there are other factors related to displaying CF success that might result in a quality interference. In particular, Atkinson and Rosenthal (2014) suggest that altering the source of the label can affect its credibility. For instance, if the label issuer is considered a trustworthy organization, it can function as a quality signal bridging consumption-related information asymmetries (Chkanikova & Lehner, 2015). Accordingly, future research can address the influence of the label source and further influencing factors on portraying CF success.

Moreover, we did not directly ask the respondents to evaluate the label and its credibility but rather assessed its impacts on their product perceptions and trust in sustainability-related attributes. Future research could, thus, explore the direct preferences of customers regarding CF labels.

Further limitations are related to the fact that the sample of our study consisted only of German respondents, who might be affected by, for instance, specific attitudes towards CF. This could affect the generalization of our findings. Therefore, future research could look into a transnational comparison and examine the effect of cultural differences on the analyzed influences regarding the presentation of CF success.

Finally, the displayed product advertisements' layout and design as well as the way in which we communicated different cues on crowdfunders' motivation within the CF success logo and the testimonials could be altered. We assume that varying these aspects can affect customers' perceptions. Accordingly, future research may address different options to design and communicate cues on crowdfunders' motivations.

8. Conclusion

Our study is the first in analyzing the effect of extrinsic versus intrinsic CF motivation as well as different levels of information specificity and label formats on consumers' perceptions of crowdfunded products. Our findings suggest that, against the background of signaling theory and consumer-interference literature, cues on mainly intrinsic funding motivation affect consumers' perceptions of crowdfunded goods more positively than stressing extrinsic funding motivation does. Through this impact on consumers' product attitude, we find that displaying cues about funding motivation indirectly influences even strong information asymmetries related to sustainability features. Regarding the analysis of information specificity, our results are in contrast to the literature on label perception as they indicate that for products typically evoking low involvement, customers do not clearly prefer directive CF labels with low information specificity over non-directive labels with high information specificity. Entrepreneurs can benefit from these findings in marketing their crowdfunded products as such. As even pronounced information asymmetries typically related to products' sustainability attributes can be reduced, entrepreneurial ventures offering sustainability-oriented goods financed by CF may profit from our results in particular. However, these findings only apply to products of low complexity that typically induce low customer involvement.

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Chapter IV

Title: Crowdfunding a sustainable future? A systematic literature review on crowdfunding and sustainable entrepreneurship

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Crowdfunding a sustainable future? A systematic literature review of crowdfunding and sustainable entrepreneurship

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Crowdfunding has enormous potential for sustainable entrepreneurs in overcoming financing issues, as well as a lack of reputation and legitimacy. However, new challenges arise to the involved parties when sustainable entrepreneurs tap crowdfunding such as how to phrase campaign descriptions in order to credibly communicate sustainability intensions and how to deal with greenwashing. To effectively address these issues without limiting the potential of crowdfunding, an overall understanding of the nexus of crowdfunding and sustainable entrepreneurship is needed. Conducting a systematic literature review, the paper at hand analyzes 70 publications on that nexus. Based on the analysis, this article elaborates interdependencies between crowdfunding and sustainable entrepreneurship, and provides propositions, and a research agenda for the key components of that nexus: crowdfunding platforms, crowdfunders, sustainable entrepreneurs and their campaigns, the post-crowdfunding phase, and the societal and regulatory environment.

Keywords: sustainability-oriented entrepreneurship; crowdfunding; systematic literature review

1. Introduction

While sustainability-oriented entrepreneurs are important contributors to sustainable development due to their special abilities to innovate radically (Geels, 2010), they face high hurdles in acquiring financing (del Brío & Junquera, 2003). The lack of trust, legitimacy, and reputation often faced by nascent entrepreneurs (e.g., Stinchcombe, 1965) also intensifies when pursuing further environmental and social targets because these are accompanied by increasing information asymmetries (e.g., Jahn et al., 2005).

Crowdfunding (CF) - described as the fruitful "interaction between a facilitating organization (or platform), a variety of founder campaigns who seek financial support for their ideas and ventures, and a large dispersed "crowd" of individuals ("crowdfunders") who are enticed to invest, pledge, lend or donate to these ideas and ventures" (Testa et al., 2019: 1) - may offer a remedy to the problems of sustainable entrepreneurs. One reason for this is the shift in investment motivations from pure profit to altruistic motives as allowed by collecting relatively small amounts of money from a large number of backers (Allison et al., 2015; Gerber & Hui, 2013). Running a CF campaign also assists entrepreneurs in marketing their ventures and can result in increased legitimacy that in turn may support sustainable entrepreneurs in particular in becoming more attractive to further investors (Bocken, 2015; Lehner & Nicholls, 2014).

Is CF therefore particularly advantageous for sustainable entrepreneurs? The success of CF initiatives that have become world-famous through their advertised positive environmental or social intentions such as The Ocean Cleanup, Fairphone, and Pleistocene Park, seems to suggest that it is. On the other hand, CF in the context of sustainable entrepreneurship also poses new challenges for the actors involved, including the need for entrepreneurs to clarify and justify environmental or social impacts in campaign pitches in order to convince crowdfunders to contribute (Cumming et al., 2017), as well as the need for CF platforms, backers, and policy makers to deal with greenwashing (Hörisch, 2019).

To exploit the potential of CF for sustainable development, researchers and practitioners need to find ways to address the challenges while supporting the positive effects of CF for sustainable ventures. To do so, an overall understanding of the interdependencies between CF and sustainability-oriented entrepreneurship is needed. Information about the role of CF in sustainable entrepreneurship is scattered across different disciplines, however, and has not been systematically captured. I have thus conducted a systematic literature review (SLR) (Tranfield, et al., 2003) around the intersection of CF and sustainable entrepreneurship, guided by three overarching research questions (RQs):

- *RQ1: What is the state of research on CF and sustainable entrepreneurship?*
- *RQ2: How does the CF system work in the context of sustainable entrepreneurship?*
- *RQ3: How can sustainable entrepreneurs choose adequate CF platforms and types to match their needs?*

To answer these questions, I structure the remainder of this study in the following way. In the second section, I specify the terminology of the paper by describing the contextual relationship between sustainability, entrepreneurship, innovation, and CF. In the following section, I describe the SLR method and its application. I then present the descriptive results, and in the penultimate section, describe the thematic results, discuss the findings and offer propositions, as well as an agenda for future research. In the last section, I describe limitations and finish the paper with a short conclusion.

2. Background

In order to derive relevant keywords for the SLR, the terminology of the study first needs to be specified. In this paper, the terms emerge from the interface between sustainability, entrepreneurship, innovation, and CF.

2.1 Sustainable development and entrepreneurship

The political concept of sustainable development is commonly known and defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987: 51). In an organizational context, this concept is referred to as corporate sustainability, implying structured management approaches to reconcile environmental and social goals with economic objectives that aim to enhance benefits for, and mitigate damage to, environment and society (e.g., Klewitz & Hansen, 2014).

Addressing unsustainable practices requires innovative solutions (e.g., York & Venkataraman, 2010). Accordingly, innovation is seen as an effective lever by which to foster sustainable development (Schaltegger & Wagner, 2011). In particular, it can facilitate the adoption of increasingly sustainable procedures, organizational methods, goods, and services (Hansen & Große-Dunker, 2013). Severe challenges such as climate change require radical environmental performance improvements that can only be achieved through profound structural changes in energy, transport, agro-food, and further sectors (Geels, 2011). To tackle such systematic problems, major socio-technical changes rather than incremental technological improvements are seen as necessary (Tukker et al., 2008). Such major changes are led by niche innovators rather than established companies, as they act in protected environments with specific demands and are thus more willing to support emerging innovations (Testa et al., 2019). Niche innovators are therefore more likely to bring forth radical innovations that differ from the logic of the current system (Geels, 2010).

Sustainable entrepreneurship – defined as "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: 2) – is seen as a key driver for the development of such innovations (Bos-Brouwers, 2009) and sustainable entrepreneurs are frequently niche innovators (Testa et al., 2019). Special capabilities such as lean organizational structuring enable these firms to create more radical sustainable solutions than larger companies (e.g., Schaltegger & Wagner, 2011). One focus of the SLR is therefore on these actors. I also consider entrepreneurial ventures focusing on either the social or the environmental dimension as sustainability-oriented, even though I refer to the holistic concept of sustainability. To determine an entrepreneur's sustainability-orientation, I follow the principle generally applied in the literature on sustainable innovations, considering novel products, methods, processes, or services as sustainability-oriented when they lead "to environmental and/or social benefits over the prior version's physical lifecycle" (Hansen & Große-Dunker, 2013: 2408).

Nascent entrepreneurs often face obstacles such as difficulties attracting finance or a lack of reputation, trust, and legitimacy – recognized as the "liability of newness" (Stinchcombe, 1965: 148) – which can hinder them in bringing their innovations to life (e.g., del Brío & Junquera, 2003). Sustainability-oriented entrepreneurs in particular face high hurdles in acquiring financial resources, as traditional investors (e.g., venture capitalists) are typically more likely to invest in purely profit-oriented ventures than in endeavors pursuing further social or environmental objectives (Choi & Gray, 2008). Furthermore, these targets involve higher information asymmetries and require more explanation (e.g., Jahn et al., 2005) which emphasizes the trust and legitimacy issues of sustainable entrepreneurs. CF has the potential to address these issues.

2.2 Crowdfunding characteristics in the context of sustainable entrepreneurship

The rise of the CF phenomenon may have enormous potential for early-stage sustainability-oriented ventures but also poses new challenges. This section outlines the possible enablers and constraints for sustainable entrepreneurs, as originating from the characteristics of CF.

Above all, CF is a financing instrument and is becoming the main source of capital for nascent entrepreneurs (e.g., Petruzzelli et al., 2019). Due to the unique setting of CF, in which backers individually contribute comparatively small amounts, their investment motivations might differ from those of traditional financiers such as angels or private equity (Belleflamme et al., 2014). In this context, Gerber and Hui (2013) as well as Allison et al. (2015) observed that crowdfunders are largely driven by altruistic or normative motives, and intrinsic motivation. In light of the greater obstacles faced by sustainability-oriented entrepreneurs in attracting funding (Choi & Gray, 2008), widening motives for financing from entirely profit-oriented to also intrinsic motivations may be especially beneficial such ventures (e.g., Calic & Mosakowski, 2016). The particular type of CF might have an important effect on attracting either mainly intrinsically or extrinsically motivated backers. The literature lists five categories of CF distinguished by the type of remuneration that crowdfunders receive for their contributions (e.g., Griffin, 2012):

- *Donation-based CF:* Backers donate their contributions;
- *Pre-purchase CF:* Crowdfunders buy the product of the campaign in advance;
- *Reward-based CF:* Backers obtain non-pecuniary rewards other than the goods to be financed;
- *Equity-based CF:* Crowd-investors receive shares of equity securities or prospective profits;
- *Lending-based CF:* Crowdfunders lend their money and gain interest in return. A special subcategory is *prosocial microlending* in which backers lend money without interest.

In practice, however, pre-purchased and reward-based CF are often combined (see Kickstarter.com) so that in addition to the goods to be funded offered in pre-sale, other rewards such as meetings with the developers are provided. I merge these two CF types and refer to them as reward-based CF in the remainder of the paper. This approach is in line with major databases containing CF statistics, including the World Bank (Best et al., 2013).

In the CF community, equity- and lending-based platforms are seen as attracting mainly extrinsically motivated backers seeking, for example, return of investment (Cholakova & Clarysse, 2015) whereas the other types are seen as attracting largely intrinsically motivated crowdfunders who, for instance, contribute because they are fascinated by an idea (Schwienbacher & Larralde, 2010). Accordingly, choosing the right type of CF might be particularly important for sustainability-oriented ventures.

The average amount of funding raised by each type of CF differs dramatically. Successful donation-based initiatives collect on average €2938, and reward-based campaigns reach approximately €7000 on average (Nielsen et al., 2017). Depending on whether the loans are individual or business loans, and whether they are unsecured or secured, the average outcome of successful lending-based campaigns ranges from €7082 to €79,132, whereas successful equity-based campaigns reach €504,832 on average (European Commission, 2015). Assuming that crowd-investors in equity- and lending-based CF indeed act more like traditional investors, this could be a disadvantage for large-scale sustainable campaigns if their sustainability-orientation goes hand-in-hand with higher risks or lower dividends (Hörisch, 2015).

Apart from the financing function, other CF features are often discussed. CF portals can provide entrepreneurs with a medium to advertise offers and to assess their market chances, as well as to perform mass customization and co-creation (Belleflamme et al., 2014). Such early-stage participation can result in increased legitimacy, from which sustainable entrepreneurs who are affected by high information asymmetries can especially benefit (e.g., Lehner & Nicholls, 2014). On the other hand, these entrepreneurs need to put more effort into preparing CF campaign pitches, as the environmental or social impacts they are aiming for require clarification and justification (Cumming et al., 2017).

This partial review of CF characteristics shows that this phenomenon can contribute to sustainable development by, for instance, addressing the liability of newness especially in sustainability-oriented ventures, but it also poses new challenges. Addressing these challenges requires an understanding of the interdependencies between CF and sustainability that could be highly important for both research and practice, in order to unlock the full potential of CF for sustainable development. A holistic overview of the actual state of research regarding CF in the context of sustainability can foster an overall understanding of the context. Yet, knowledge about the role of CF for sustainable entrepreneurship and sustainable development is scattered across various disciplines, including finance, information systems, and innovation management, and is not systematically captured. I therefore conduct a SLR focusing on CF and sustainable entrepreneurship guided by the RQs listed in the introduction.

2.3 Existing reviews

There are, so far, no SLRs on CF and sustainability. Only one bibliometric analysis studied the connection between CF and the sustainability orientation of entrepreneurs (Martínez-Climent et al., 2019), but it is largely descriptive and is based on keywords that do not cover the complexity of sustainability. The sources analyzed in the paper have nevertheless also been considered by my SLR, which is described in the following section.

3. Method: Systematic literature review

I conduct a SLR to systematically capture and synthesize the knowledge of CF and sustainable entrepreneurship. In contrast to conventional narrative-based reviews, a SLR is a structured method aiming at "synthesizing research in a systematic, transparent, and reproducible manner" (Tranfield et al., 2003: 207). This approach allows tracking of the processes and decisions of the reviewer, enabling follow-up studies to reproduce the SLR in order to update or revise it (Cook et al., 1997). SLRs include not only a quantitative descriptive analysis but also a qualitative theme analysis (Tranfield et al., 2003). The method typically consists of a structured multi-stage process, beginning with a planning stage, followed by a scoping exercise, the definition of search terms, selection of articles, data analysis, and synthesis of the articles (e.g., Denyer &

Tranfield, 2009; Garkisch et al., 2017). My SLR consists of these steps which are described starting with the scoping exercise in the following subsections. My study, in line with the characteristic contributions of SLRs (Tranfield et al., 2003), aims to frame the research area of CF in the context of sustainable entrepreneurship in order to identify emerging topics and central gaps, and thus to add to theory development in this field. For the sake of improving the reliability of this study, the research methodology, including the sampling, key words, and category building, was presented and discussed in various research colloquia with fellow researchers.

Scoping exercise. Following the literature on SLRs (e.g., Denyer & Tranfield, 2009), I conducted a scoping study prior to the actual SLR to familiarize myself with the relevant literature. During that study I identified key publications, and databases, tested keywords, and determined a suitable time frame for data retrieval (cf., Nielsen et al., 2016). As one result of this study, I decided to make the sustainability-related search terms as broad as possible, so as to eventually capture further domains of influence between CF and sustainability in addition to sustainable entrepreneurship. Consequently, by consulting the identified literature and academic peers I compiled a list of 31 keywords (cf. Table 1).

Search term selection. In line with Klewitz and Hansen (2014), I operationalized the keywords deduced from the scoping exercise in thematic clouds. To ensure a broad search I decided to use only two clouds, with one hosting the CF domain and the other the sustainability domain (cf. Table 1). The desired publications had to contain at least one keyword in each cloud. To find matching articles, I applied these keywords to the research databases EBSCO, Scopus, Science Direct, and ABI Inform, as well as the search engine Google Scholar. I selected this range of databases to facilitate the collection of interdisciplinary publications on CF, sustainability, and entrepreneurship, as well as financing and management of innovations. These databases and associated search engines operate with differing syntaxes, and thus I had to operationalize the keywords in different search strings (see Table 1 for an example) each covering the whole range of keywords.

Table 1
Operationalized keywords for the search process.

Clouds		Sample search string
Crowdfunding	**Sustainability**	
Crowdfund*, crowd-fund*, crowdfinanc*, crowd-financ*, crowdinvest*, crowd-invest*, co-financ*, co-invest*, crowdlend*, crowd-lend*, social lend*, groupfund*, group-fund*, groupfinanc*, group-financ*	Sustainab*, sustainable development, corporate sustainab*, CSR, societal, social, ethic*, fair, human*, eco*, environ*, green, clean*, renewable, circular, climate	(Sustainab* OR “sustainable development” OR “corporate sustainab*” OR CSR OR societal OR social OR ethic* OR fair OR human* OR eco* OR environ* OR green OR clean* OR renewable OR circular OR climate) AND (crowdfund* OR crowd-fund* OR crowdfinanc* OR crowd-financ* OR crowdinvest* OR crowd-invest* OR co-financ* OR co-invest* OR crowdlend* OR crowd-lend* OR "social lend*" OR groupfund* OR group-fund* OR groupfinanc* OR group-financ*)

Selection of articles. Entering the search strings in the databases resulted in an overwhelming number of articles. For the systematic selection of relevant publications I therefore used strict inclusion and exclusion criteria which are also described as necessary to ensure a high-quality SLR (e.g., Ahmad & Omar, 2016). First, to guarantee compliance with scientific standards and to ensure the focus on scientific knowledge, in line with other SLRs (e.g., Seuring & Müller, 2008) I included only peer-reviewed publications in the English language released in academic journals. Second, my SLR starts in 2006 when the term CF was used for the first time (Gerber et al., 2012) and ends in March 2019 when I conducted the search process. Following Candel (2014) I started the search procedure by querying the search strings in the full text. If the query resulted in more than 200 matches, I narrowed the search to title, abstract, plus keywords. If that still exceeded 200 hits, I applied the query only to the title. After the search process, I screened the remaining articles for duplicates and a clear relationship to CF and sustainable entrepreneurship. I excluded publications without such a relationship, and duplicates. After applying these inclusion and exclusion criteria my sample consisted of 66 articles which I analyzed in depth. During the analysis I manually added four relevant articles that were cited by articles in my sample but were not found through the search process. Figure 1 shows the systematic data collection step by step, including the number of identified articles. A detailed record of the entire data collection in the form of a comprehensive data extraction sheet is available to readers on request.

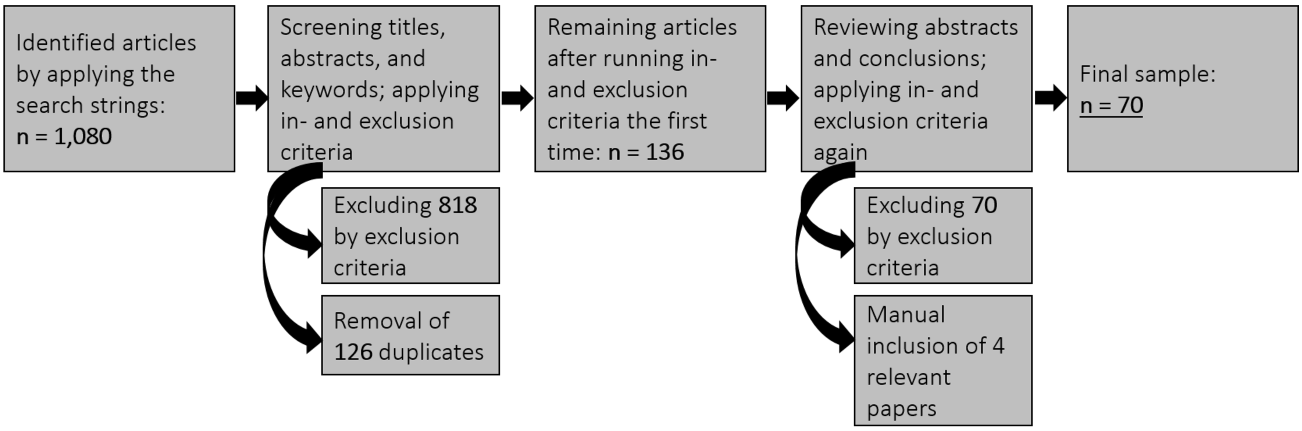

Fig. 1. Steps of the data collection with the amount of identified articles.

Data analysis and synthesis of the articles. In the final stages of my SLR, I performed a quantitative descriptive analysis and a qualitative theme analysis on the identified articles. I conducted the descriptive analysis based on the data extraction sheet (e.g., Denyer & Tranfield, 2009), aiming to map the research area of CF in the context of sustainable entrepreneurship. As in other SLRs (e.g., Heidingsfelder & Beckmann, 2019), I used the software MAXQDA for the subsequent qualitative thematic analysis, facilitating a detailed analysis of data by, for instance, coding and structuring. The findings of the descriptive and qualitative analysis are described in the following results sections. In the first section, I mainly address RQ1 and present an overview of the research field by providing a bibliographic analysis describing the articles in terms of, for example, year of publication, countries focused, or methods used. In the thematic results section, I primarily address the second and third RQ providing an in-depth analysis of CF and sustainability-oriented entrepreneurship.

4. Descriptive results

The primary source of empirical evidence in my sample is the quantitative approaches of 34 papers, followed by 19 articles using qualitative methods. Among the qualitative approaches, 16 papers apply single or multiple case studies, and three articles conduct interviews. Conceptual studies are used in 11 articles, the third largest number. Two papers apply mixed methods, two articles conduct a literature review, one paper uses the Delphi method and in another article the method was not specified.

The articles focus mainly on countries in North America, Europe and Asia; 37 address CF and sustainable entrepreneurship in individual countries of these continents or look at this nexus on a whole continent (Fig. 2). Most studies (7) focus on the US, followed by Europe (5), China (4), Germany (4), and the UK (3). The other countries are addressed by only by one or two papers. 33 articles do not focus on specific countries. The lack of studies focusing on regions in the southern hemisphere appears to be the first blind spot identified by my SLR in the literature on CF and sustainable entrepreneurship. The few articles I found that address regions in, for example, Africa, do so in contexts other than entrepreneurship.

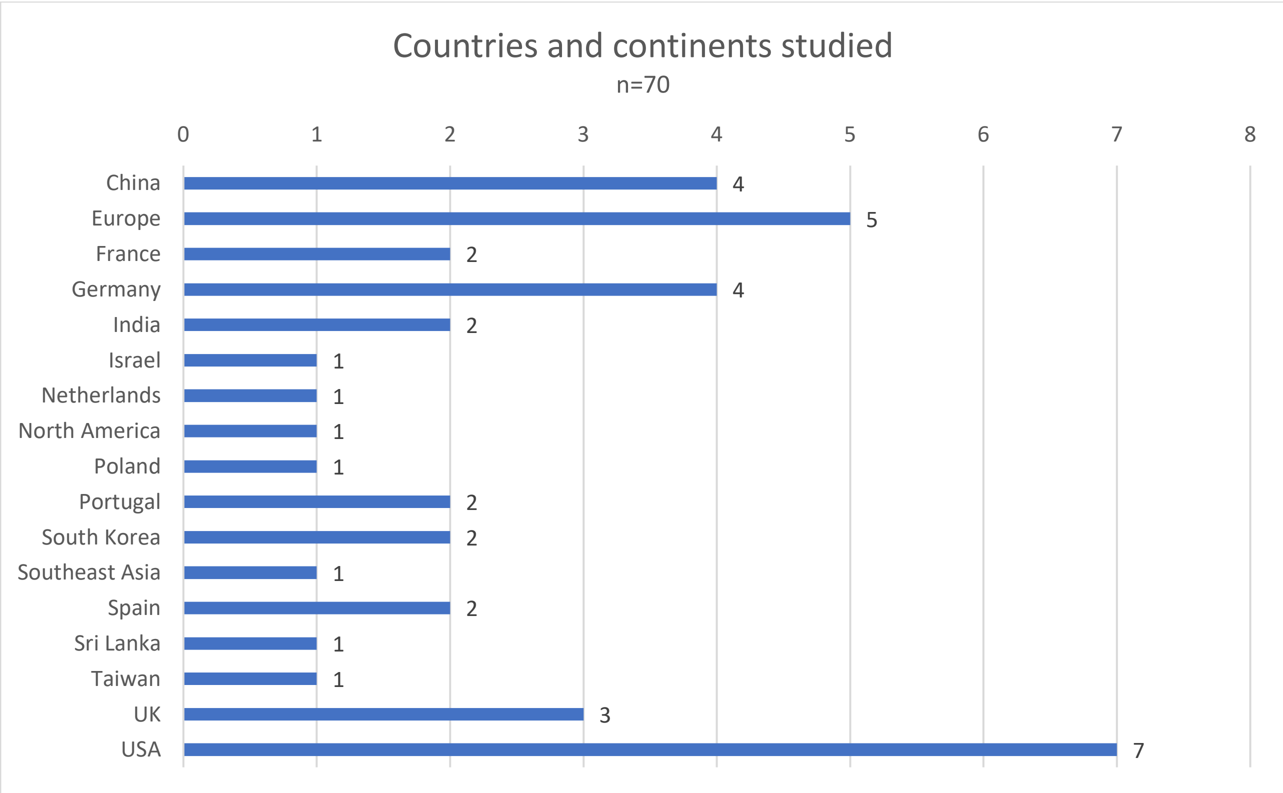

Fig. 2. Countries and continents studied in the articles.

The journals with the most publications identified by my SLR (Fig. 3) were Technological Forecasting and Social Change with seven articles, Journal of Cleaner Production (5), Sustainability (3), and Strategic Change (3). The journals with a strong sustainability focus (Journal of Cleaner Production and Sustainability) play a leading role, as does Technological Forecasting and Social Change, which dedicated a special issue to the topic of CF and sustainability. These are followed by journals with a focus on strategy, financing, and entrepreneurship.

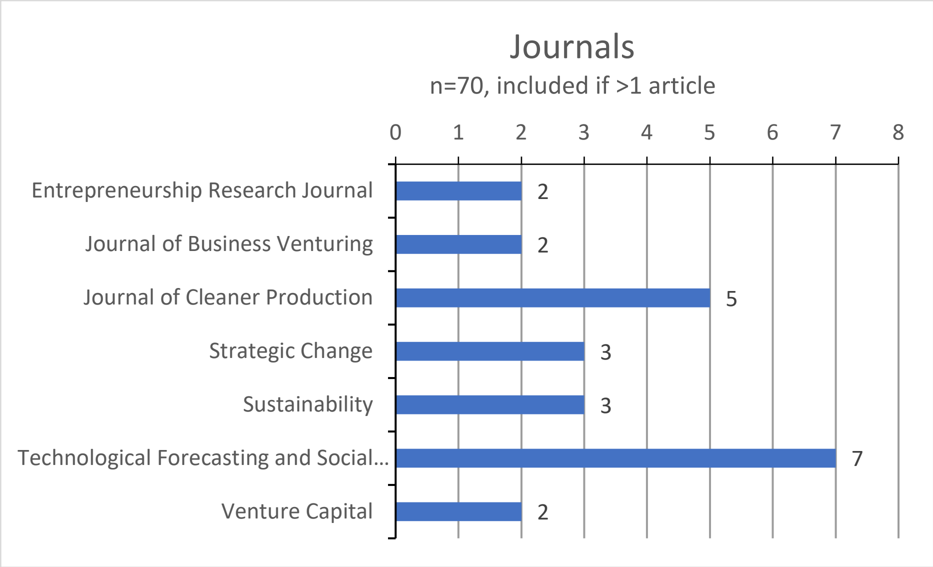

Fig. 3. Journals with the most publications.

Analysis of the years of publications (Fig. 4) reveals that research on CF and sustainable entrepreneurship is still very young. Starting in 2013, there has been an increase in article releases up to today. The figures from 2019 suggest that this trend is likely to continue. In the first three months of 2019 15 articles had already been published, which equals the number of publications in the previous year.

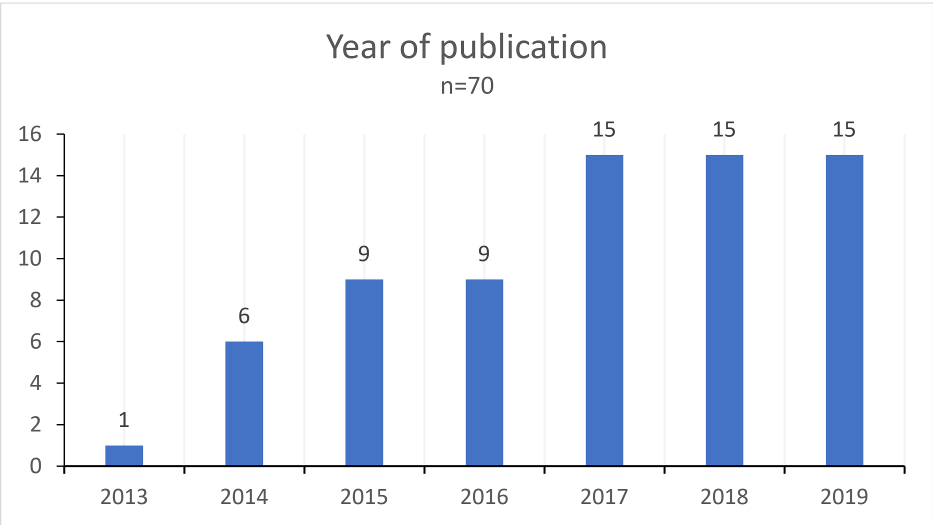

Fig. 4. The years of publications.

In summary, the descriptive results show that CF and sustainability-oriented entrepreneurship is a young and expanding research area that already hosts a considerable number of quantitative studies. However, as Hörisch (2015) also reported, I also found throughout my SLR that most of the quantitative studies on CF in the context of entrepreneurship are affected by the issue that not all CF campaign initiators are entrepreneurial ventures. On the other hand, CF initiatives are ventures that pursue financial independence and thus share similar characteristics with entrepreneurs (Hörisch, 2015). The quantitative studies for the thematic analysis in the following section are thus still a relatively solid foundation if we read their results with care, while the qualitative articles require more interpretation.

5. Thematic results and discussion

The thematic analysis aims to systematically categorize the article content and to identify interrelationships (cf. Klewitz & Hansen, 2014). I followed a largely inductive and interpretative approach for this synthesis process, using categories that emerged throughout the detailed analysis of the articles with the software MAXQDA. I identified seven major components of the CF system in which sustainability-oriented entrepreneurship is discussed: the holistic system perspective, CF platforms, backers, campaign initiators, campaigns, post-CF phase, and societal and regulatory environment (see Fig. 5). These categories build upon on the conceptual studies of Petruzzelli et al. (2019) and Lehner (2013). In the following subsections, I will describe the state of research on sustainability-oriented entrepreneurship within these components. On this basis, and the descriptive results, I will draw implications, advance propositions, and suggest a research agenda for each element. In this section, I mark additional literature that does not stem from the sample but is needed for explanations or to describe implications with "!".

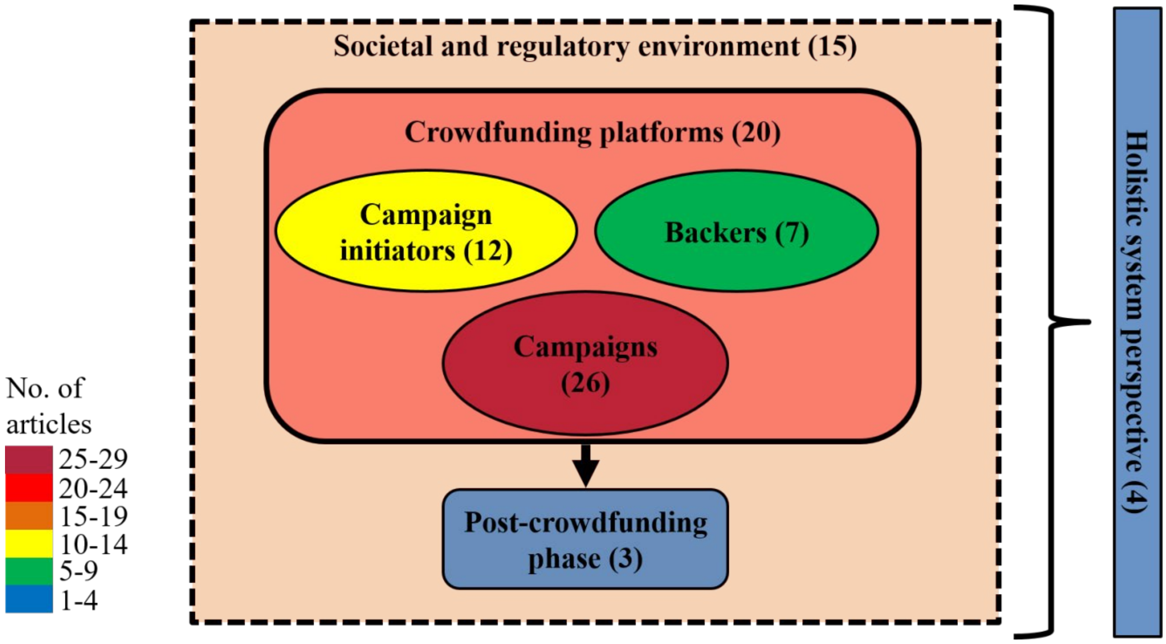

Fig. 5. Crowdfunding components based on Petruzzelli et al. (2019) and Lehner (2013) in which sustainable entrepreneurship is discussed, including numbers of articles that address these elements.[1]

5.1 Opening the framework by applying a holistic system perspective

A few studies in my sample (4 out of 70) analyze the whole CF system in the context of sustainable entrepreneurship (Lehner, 2013; Meyskens & Bird, 2015; Petruzzelli et al., 2019; Testa et al., 2019). These conceptual studies have decisively contributed to the categorization of the thematic areas in my study and will play a major role in the following individual subsections.

The two earlier conceptual articles in my sample shed light on the role of CF in social ventures. Lehner (2013) creates an early schema of CF's inner workings applied in the context of social entrepreneurship. Meyskens

[1] I coded the articles according to which component they mainly address. Multiple coding per article was possible but the papers should have a clear focus on the component.

and Bird (2015) develop a conceptual framework to support social entrepreneurs and financiers in choosing the most suitable CF type given a campaign's social and economic value creation targets. I will discuss this framework in light of empirical studies in my sample in Section 5.5.

The more recent papers in my sample focus on CF in the context of sustainability-oriented entrepreneurship. Testa et al., (2019) analyze the potential of CF for sustainable entrepreneurs through the lens of the multi-level perspective (Geels, 2002!). By reinterpreting general outcomes of the CF literature in the sustainability context, Petruzzelli et al. (2019) provide a another conceptual framework to examine the relationship of CF and sustainability. The framework consists of five modules: CF platforms, project initiators, backers, campaigns, and their outcomes. Inspired by their framework, I categorized the literature on CF and sustainable entrepreneurship into similar components while adding the societal and regulatory environment, and the holistic system perspective.

In the following subsections (5.2 – 5.7), I will present the thematic results and discuss these within the individual components. I will then conduct an overarching discussion from a holistic system perspective (5.8).

5.2 Crowdfunding platform component

With 20 articles, CF platforms are the second most addressed topic in my sample (Ashta et al., 2015; Bouaiss et al., 2015; Braund & Schwittay, 2016; Callaghan, 2014; De Broeck, 2018; Frey, 2019; Gassmann et al., 2010; Grove, 2019; Hörisch, 2017; Hossain & Oparaocha, 2017; Kim & De Moor, 2017; Marom, 2017; Nigam et al., 2018; Owen et al., 2018; Porlezza & Splendore, 2016; Rey-Martí et al., 2019; Roesch-McNally & Rabotyagov, 2016; Royal & Windsor, 2014; Sun et al., 2018; Vasileiadou et al., 2016). In the context of sustainability, these intermediaries are discussed as sustainable entrepreneurs themselves. CF platforms that specialize in hosting sustainability-oriented campaigns are also often addressed.

The contribution of CF platforms to sustainable entrepreneurship is discussed controversially. On the one hand, CF platforms are seen as important intermediaries that support sustainability-oriented entrepreneurs in overcoming financing issues (e.g., Calic & Mosakowski, 2016; Testa et al., 2019), in enabling participation, co-creation, publicity, and product testing (e.g., Lambert & Schwienbacher, 2010!), in legitimizing their projects and, thus, in attracting follow-up investments from traditional channels (Bocken, 2015; Lehner & Nicholls, 2014), and in stimulating behavioral changes in society by promoting sustainability (Light & Briggs, 2017). In this regard, most empirical studies focus on either environmental or social entrepreneurship. Empirical studies on environmental entrepreneurs underline the potential of CF platforms to finance and disseminate their projects (De Broeck, 2018; Lam & Law, 2016; Vasileiadou et al., 2016). The findings of articles addressing social entrepreneurship in particular highlight financial inclusion function of CF platforms (e.g., Kim & De Moor, 2017).

On the other hand, hosting sustainability-oriented initiatives involves increased information asymmetries and risks for backers (e.g., Hörisch, 2015). Among other issues, increased information asymmetries, fraud, lack of transparency, property rights violations (Burtch et al., 2014; Hossain & Oparaocha, 2017; Lam & Law, 2016), and ethical concerns (e.g., Berliner & Kenworthy, 2017) limit the potential of CF platforms to contribute to sustainable entrepreneurship. CF platforms may also be used to finance unsustainable ventures, such as violence entrepreneurs who are fighting for or against the Islamic State (Grove, 2019).

Effectively addressing these problems plays a major role in both the credibility of CF platforms per se and the sustainability contribution of these intermediaries. While most of the literature regards (see 5.7). this as a political task and focuses on adaptations in the regulatory framework (e.g., De Broeck, 2018; Hossain & Oparaocha, 2017; Nigam et al., 2018), CF platforms specialized in hosting sustainable projects appear to be pioneers in implementing more proactive solutions. At this point it is important to note that in addition to more generic CF platforms such as Kickstarter there is a whole range of explicitly sustainability-related CF platforms such as Oneplanet, Bettervest, Greenrocket, and Ecocrowd. Using measures like preselecting campaigns according to their estimated sustainability effects, feasibility analysis, project promotion and monitoring, these platforms provide proof of sustainability-orientation and build trust among both investors and initiators (Hörisch, 2017; Rey-Martí et al., 2019). The empirically demonstrated much higher success rates of projects on these platforms confirm the validity of these measures (Hörisch, 2017; Vasileiadou et al., 2016). Nigam et al. (2018) and De Broeck (2018) underline the economic relevance of platforms specialized in hosting renewable electricity projects which largely operate as lending-based and are also associated with high risks. Based on these findings, I advance the first proposition:

Proposition 1.1: *Platforms specialized in hosting sustainability-oriented campaigns play a pioneering role in implementing approaches targeting sustainability-related barriers by building trust and legitimacy among backers and initiators, and thus increase campaign success rates.*

In addition to these measures, corporate social responsibility (CSR) and sustainability management approaches may also provide proactive solutions for CF platforms, but are largely neglected in research and practice alike. Marom (2017) first addresses this topic by suggesting a stakeholder rating system for CSR among CF intermediaries. CSR and sustainability management methods typically enable ventures to actively tackle sustainability issues and to create trust plus legitimacy among stakeholders (e.g., Beckmann & Heidingsfelder, 2018!). I therefore advance the second proposition:

Proposition 1.2: *The development of dedicated CSR policies or management standards to ensure sustainability can foster the ability of crowdfunding platforms to tackle sustainability issues, and build trust and legitimacy among their stakeholders.*

These thematic findings of the SLR regarding CF platforms and derived propositions extend the current literature in various ways. They add to the general discussion of the role of CF for sustainable development (e.g., Testa et al., 2019), and highlight the contribution of sustainability-specialized platforms for sustainable entrepreneurship, especially by developing proactive solutions to mitigate investor risks. Furthermore, by indicating that the application of CSR and sustainability management methods among CF platforms can effectively address CF-related sustainability-issues, this SLR adds to the discussion of the areas of application of these approaches. (e.g., Beckmann & Heidingsfelder, 2018!; Beckmann & Schaltegger, 2014!).

Another issue related to sustainability-oriented solutions, however, is that their effects on sustainable development, particularly in the long term, are difficult to predict (Hansen & Große-Dunker, 2013!; Paech, 2007!). By enabling stakeholder participation in the early stages of an innovation, CF platforms might be useful in detecting and avoiding unintended negative sustainability effects before the actual market launch. Addressing this interplay and developing approaches to deal with this issue is my first recommendation for future research. Some initial studies analyze the role of CF platforms in entrepreneurial ecosystems (e.g., Hussain et al., 2018!). It would be interesting to explore differences regarding the role and influence of CF on sustainable entrepreneurial ecosystems (Cohen, 2006!). Following the propositions, I suggest more research on sustainability-specialized platforms, and in particular, whether and how these actors achieve high success rates compared to non-specialized platforms. Large scale comparisons between sustainability-specialized and non-specialized platforms and surveys among backers could shed light on success factors. In addition to funding success of campaigns, it would be interesting to compare other success factors relevant to sustainable entrepreneurship between theses platform types, such as outreach among potential customers. More research is needed on the dark sides of CF (e.g., financing violence entrepreneurs or ethical problems) and mitigating measures. Future research could develop effective CSR or sustainability management schemes for CF platforms. For that, more research is needed to identify sustainability-related stakeholders and their needs, influences and contributions.

In sum, these articles point to the importance of sustainability-specialized CF platforms for financing sustainable entrepreneurs that initiate CF campaigns. The campaign initiators component is discussed in the following section.

5.3 Campaign initiator component

Several papers (12 out of 70) identified in my SLR focus on the perspective of sustainability-oriented entrepreneurs that initiate CF campaigns (Bergamini, Navarro, & Hilliard, 2017; Bernardino & Santos, 2016; Bernardino, Santos, & Ribeiro, 2016; Cumming et al., 2017; Hörisch, 2015, 2017; Lam & Law, 2016; Lehner & Nicholls, 2014; Meyskens & Bird, 2015; Parhankangas & Renko, 2017; Petruzzelli et al., 2019; Ryu & Kim, 2018). In this component, the literature largely addresses drivers and barriers of sustainable ventures regarding the application of CF and, in particular, the challenge of which CF type to choose. By merging the existing literature on that component, this subsections in particular contributes to answering RQ3.

CF poses enormous opportunities for sustainability-oriented entrepreneurs. Overcoming the specific funding and legitimacy issues of these ventures and enabling participation, co-creation, product testing, awareness raising, and marketing support are frequently discussed (Bergamini et al., 2017; Calic & Mosakowski, 2016; Lehner & Nicholls, 2014; Meyskens & Bird, 2015; Testa et al., 2019). In the phase after a campaign has been successfully financed, CF also has special potential for sustainability-oriented entrepreneurs in terms of attracting follow-up investments (Bocken, 2015; Lehner & Nicholls, 2014). Moreover, advertising a successfully crowdfunded product as such can send quality signals to customers that affect their product perception and their trust in a product's sustainability attributes (Wehnert et al., 2019).

On the other hand, the increase in information asymmetries associated with sustainability topics confronts campaign creators with additional challenges. In order to persuade crowdfunders to contribute, sustainability-oriented ventures must justify and clarify the social and environmental effects (Cumming et al., 2017; Parhankangas & Renko, 2017). These ventures thus arguably need to pay more attention to the credibility of their communication. They also need to consider the success factors of campaigns more carefully, and put additional effort into preparing campaigns in terms of, for example, descriptions, gallery elements, and video pitches (Cumming et al., 2017). The ability to purposefully interact during and after CF campaigns with a heterogeneous community of backers (Petruzzelli et al., 2019), whose circle is likely to widen through sustainability issues, is regarded as critical for CF and market success. In addition, sustainability-oriented ventures need special capabilities when using their social, symbolic, and cultural capital to build a community of funders and to identify and exploit opportunities (Lehner, 2014). In the post-CF phase, these ventures need to be especially careful when marketing crowdfunded sustainability-oriented products (Wehnert et al., 2019). Based on the discussion of the advantages, disadvantages, and capabilities of sustainable entrepreneurs in the context of CF, I propose:

Proposition 2.1: *Crowdfunding poses specific opportunities for sustainability-oriented ventures in overcoming financial disadvantages and legitimacy issues that can lead to follow-up investments and increased trust among customers, but also challenges in justifying and clarifying the sustainability impacts which demand special abilities.*

Tapping CF confronts sustainable entrepreneurs with highly complex decisions such as choosing between sustainability-specialized and non-specialized platforms, or between CF types. Initial studies indicate which category of sustainable venture should tap which CF type. Choosing platforms specialized in hosting sustainability-oriented ventures seems more promising in terms of successful funding rates (Hörisch, 2017). Following Meyskens and Bird (2015) and Hörisch (2017), it is suggested that ventures aiming at small sustainability and market impacts tap reward-based CF, while large scale sustainable entrepreneurs targeting high market impacts and growth opt for equity- or lending-based CF. Ventures aiming for high social and low economic value creation should tap donation-based platforms (Meyskens & Bird, 2015). According to Lam and Law (2016), sustainable ventures are further recommended to combine different CF types along their projects' lifecycles: Projects in their inception or prototype phase and small-scale campaigns should raise funds by reward- and donation-based CF that hosts a larger proportion of intrinsically motivated backers but generate less funds on average. To finance the more capital-intensive stages (startup, early growth, and expansion) lending- or equity-based CF can be tapped once investors have assessed the project's profitability. This evaluation can be more favorable if a campaign has already been successful in other CF types. More traditional and larger financiers can be subsequently attracted with increasing CF contributions and acceptance among backers. Accordingly, I propose:

Proposition 2.2: *Sustainability-oriented ventures are more successful on platforms specialized in hosting sustainable ventures and should choose the most fitting crowdfunding type according to their financial needs, the scale of their targeted sustainability and market impacts, or combine the types along their project's lifecycle.*

These findings and propositions add to the discussion of the abilities, benefits, and challenges that CF requires or poses to sustainable ventures (e.g., Calic & Mosakowski, 2016; Petruzzelli et al., 2019; Testa et al., 2019), and to the debate about which CF type these ventures should best tap (Hörisch, 2017; Lam & Law, 2016; Meyskens & Bird, 2015). These findings thus also extend the more general literature on overcoming the financing issues of sustainability-oriented entrepreneurs (e.g., Choi & Gray, 2008!; del Brío & Junquera, 2003!) and other problems related to the liability of newness (Stinchcombe, 1965!) such as building trust, reputation, and legitimacy among stakeholders (Freeman et al., 1983!).

Overall, however, the state of empirical research regarding the perspective of sustainable entrepreneurs tapping CF appears to be rather limited. Thus, future research could empirically investigate the perspective of sustainability-oriented ventures on the usage of CF. In particular, interviews with sustainable campaign initiators could reveal further drivers, barriers, and capabilities regarding the application of CF. Additionally, it would also be interesting to analyze the impact of specific attributes of entrepreneurs on backing decisions for sustainability-oriented campaigns. For example, the gender of the entrepreneur seems to have an effect on the trust of backers (Greenberg & Mollick, 2017!). Crowdfunders may perceive female entrepreneurs as more trustworthy than male-led ventures and, thus, rather fund female-led projects (Johnson et al., 2018!). Quantitative studies about which category of sustainable venture should tap which CF type, on which platform (sustainability specialized vs. non-specialized), and how to combine different CF types and traditional financing channels along the projects' lifecycles are needed.

When tapping CF, sustainable entrepreneurs as campaign initiators need to consider various types of backers and their motivations. In the next section, I will describe how the importance of motivations and role of backers change when sustainable ventures tap CF.

5.4 Backer component

The crowd is seen as a highly heterogeneous community of backers and persons with interest in a campaign (Ryu & Kim, 2016). Understanding different types of backers, their roles, and motivations is of great importance to campaign initiators (e.g., Allison et al., 2015). Seven out of 70 articles in my sample address these topics (Allison et al., 2015; Bretschneider & Marco, 2017; Burtch et al., 2014; Hossain & Oparaocha, 2017; Petruzzelli et al., 2019; Ryu & Kim, 2016; Xiang et al., 2019).

Previous studies identified several types of backers driven by a different set of motivations and observed herding behavior (Bretschneider & Marco, 2017; Ryu & Kim, 2016; Xiang et al., 2019). Hossain and Oparaocha's (2017) conceptual framework on the dominant motivations of crowdfunders in each CF type seems to be of particular relevance for sustainability-oriented entrepreneurs. Following that, the motivations of backers in equity- and lending-based CF are dominantly extrinsic, while in prosocial lending and donation-based CF social and intrinsic motivations dominate. In reward-based CF a mix of intrinsic, social, and extrinsic motivations drives funding decisions (Hossain & Oparaocha, 2017). Compared to campaigns focusing on monetary targets, projects pursuing environmental or social aims are thus arguably more attractive to backers in prosocial lending, donation-, and reward-based CF, and less attractive to investors in equity- and lending-based CF. As the findings in Section 5.5 on platforms not specialized in hosting sustainability-oriented campaigns largely support that categorization, I propose:

Proposition 3.1: *On non-specialized crowdfunding platforms, sustainability-oriented initiatives are more attractive to backers in prosocial lending, donation-, and reward-based crowdfunding than other campaigns, and less attractive to investors in lending- and equity-based crowdfunding.*

Researchers typically differentiate between egoistic, altruistic, and biospheric motivation to explain sustainability-oriented behavior (Verhoef & van Doorn, 2016!). Individuals with a dominantly biospheric or altruistic motivation pursue the maximization of the benefit to the natural environment or the wellbeing of others, while individuals with a primary egoistic motivation try to maximize their own outcomes (Stern et al., 1993!). The degree to which these sustainability-related motivations are the vital stimulus of backers might decisively influence their funding decisions towards sustainable campaigns. Placing the sustainable behavior literature in the CF context and building on proposition 3.1, I propose next:

Proposition 3.2: *Prosocial lending, donation-, and reward-based crowdfunding tend to attract biospheric and altruistic driven backers, while lending- and equity-based crowdfunding tend to attract rather egoistic motivated backers.*

Furthermore, when sustainability-oriented ventures seek CF support, the circle of potential backers and interested parties is likely to increase due to, inter alia, the advertised social and environmental claims of their campaigns (c.f., Hörisch et al., 2014!). The importance of the types, roles, and motivations of backers also shifts when sustainable ventures tap CF. For example, backers within communities that benefit from a social project may be more prone to actively promote it. Backers can actively provide support to mitigate uncertainties that typically come along with sustainability-oriented campaigns (Hörisch, 2015). According to Petruzzelli et al. (2019), the success of sustainability-oriented campaigns relies more on committed backers who actively promote the project within their networks and thus contribute to the mitigation of uncertainties. Although this has not yet been empirically investigated, I concur with the argumentation of Petruzzelli et al. (2019) and propose:

Proposition 3.3: *Sustainability-oriented initiatives increase the circle of potential backers and are associated with changes in the importance of motivations, types, and roles of backers such as the criticality of committed backers for the success of sustainability-oriented campaigns.*

This proposed increase in potential crowdfunders and the shift in their roles that comes with sustainability-oriented ventures tapping CF adds to the debate on the types of backers, their motivations (Bretschneider & Marco, 2017; Ryu & Kim, 2016) and roles (Petruzzelli et al., 2019). The results and propositions regarding backers also extend the discussion about the dominant motivations behind crowdfunders' backing decisions in certain CF types (Allison et al., 2015; Cholakova & Clarysse, 2015; Hossain & Oparaocha, 2017) by adding a differentiation between sustainability-specialized and non-specialized platforms.

Future research could empirically test the dominant motivations in each CF type and how these influence the resource acquisition of sustainability-oriented entrepreneurs. Developing and testing such a framework for CF platforms specialized in hosting sustainable entrepreneurs would also be interesting. I suggest further research on how sustainable CF campaigns affect types of backers, their roles, and motivations. Comparing surveys among crowdfunders on sustainability-specialized CF platforms and non-specialized platforms could shed light on that. More research on the role of committed backers for sustainability-oriented campaigns is needed. In particular, quantitative studies analyzing the influence of committed backers on the success of sustainability-oriented campaigns versus other CF projects are needed. I also recommend more research on how committed backers can be identified and purposefully addressed.

Together with the motivation of the crowd, it is important to understand how crowdfunders respond to certain aspects of project pitches in order to predict the success of CF campaigns. The following section sheds light on success factors and the likelihood funding of sustainable ventures.

5.5 Campaign component

Research on CF has extensively addressed success factors of CF campaigns. For example, Mollick (2014!) found that certain quality signals of reward-based CF campaigns, including proper spelling, regular updates, and embedded videos, positively affect the likelihood of funding, while Ahlers et al. (2015!) underline the importance of lowering backers' perceived uncertainties through measures such as risk information disclosure in equity-based CF. Several studies have found evidence of herding behavior (e.g., Bretschneider & Marco, 2017; Zhang & Liu, 2012!) in different CF types. The importance of these topics in the context of sustainability is also reflected by the number of articles in my sample. The majority of the publications in my sample (26 out of 70) examine the way that backers respond to the sustainability orientation of campaigns in different CF types and further success determinants of sustainable campaigns (Allison et al., 2015; Bento et al., 2019; Berns et al., 2018; Bretschneider & Marco, 2017; Burtch et al., 2014; Calic & Mosakowski, 2016; Cecere et al., 2017; Chen et al., 2018; Chen et al., 2017; Cumming et al., 2017; del Savio, 2017; Hörisch, 2017, 2015; Hsieh et al., 2019; Jancenelle & Javalgi, 2018; Jancenelle et al., 2018; Manning & Bejarano, 2017; Moleskis et al., 2018; Moss et al., 2018; Motylska-Kuzma, 2018; Parhankangas & Renko, 2017; Pietraszkiewicz et al., 2017; Rijanto, 2018; Vismara, 2019; Xiang et al., 2019; Yang et al., 2019). The current state of research on these aspects is presented below for each CF form.

Studies focusing on sustainability-oriented projects tapping *prosocial microlending CF*, so far, have only addressed the effect of a campaign's social orientation on backing decisions. These studies (Allison et al., 2015; Jancenelle et al., 2018; Moss et al., 2018) consistently find that a project's social orientation has a positive effect on lending decisions. Yet, signaling high project quality and low financial risks seems to be the basis for financial success (Berns et al., 2018). Campaigns with high financial and social attractiveness thus appear to be most successful in prosocial microlending CF (Berns et al., 2018).

Although *donation-based CF* is associated with a strong intrinsic and social motivation of donors to contribute (e.g., Hossain & Oparaocha, 2017), it turns out to be one of the least researched CF types in my sample regarding these topics, with only two identified articles. The analyzed studies of donation-based CF indicate that campaigns addressing social and environmental issues are particularly successful in terms of reaching their funding goals (Rijanto, 2018) and that contributions to environmental campaigns are driven by altruism rather than herding (Yang et al., 2019). These few empirical findings indeed underline the suggestion of Hossain and Oparaocha's (2017) conceptual framework that prosocial lending and donation-based CF host a large share of intrinsically driven backers. A sustainability-orientation thus appears to be advantageous for campaigns on donation-based CF and prosocial lending platforms. Accordingly, I propose:

Proposition 4.1: *Compared to other crowdfunding campaigns, sustainability-oriented initiatives are more successful on donation-based crowdfunding platforms and on prosocial lending platforms if general success factors have been accounted for.*

Compared to the other CF forms, sustainability-oriented ventures that tap *reward-based CF* can draw on a larger body of scientific knowledge. Studies of non-sustainability-specialized CF platforms, partly indicate that a campaign's sustainability-orientation (Motylska-Kuzma, 2018) or specifically environmental-orientation (Hörisch, 2015) do not influence funding success. Yet, the larger share of studies indicate better prospects of success for projects with sustainability ambitions. According to Calic and Mosakowski (2016), campaigns with a social orientation are more likely to reach their funding aims compared to other initiatives in the analyzed project categories (technology, film and video), whereas projects with an environmental orientation can only expect a higher financing probability in the environmental technology. Subsequent research by Pietraszkiewicz et al. (2017), Cecere et al., (2017), and Xiang et al. (2019) confirms the positive effect of a campaign's social orientation on the likelihood of funding. Hörisch's (2017) study of sustainability-specialized CF platforms demonstrates comparatively very high success rates of sustainability-oriented small-scale campaigns but not for larger-scale initiatives. These findings support Meyskens and Bird's (2015) framework and Lam and Law's (2016) suggestion for larger-scale initiatives to tap lending- or equity-based CF platforms specialized in hosting sustainable ventures.

Concerning concrete success factors, Hörisch (2017) underlines the importance of frequent campaign updates and target amount for funding success. Specifically, environmental-oriented ventures can arguably increase funding success chances in reward-based CF by creating tangible rewards, portraying certifications, allowing for general success factors, and aiming at developing outcomes for end consumers (Hörisch, 2015). Building on further empirical findings, the success of environmental-oriented initiatives seems to be more sensitive to video pitches, being certified, and to the campaign's target amount (Cumming et al., 2017), as well as reputation and brand building, demand analyses, keeping in touch with the crowd (Chen et al., 2018), and price setting (Chen et al., 2017). Social-oriented campaigns are recommended to avoid financial rewards, and to offer original rewards that give backers a warm glow experience (Cecere et al., 2017), and address challenges in quantifying and communicating social effects by using linguistic styles that make the campaign and its creators more understandable and that establish personal connections with backers (Parhankangas & Renko, 2017). Campaign initiators are suggested to put their project in relation to ongoing social movements (Hsieh et al., 2019). By considering these success factors a sustainability-orientation can be advantageous for raising funds through reward-based CF. According to these findings, I propose:

Proposition 4.2: *A sustainability-orientation is not per se advantageous for successful fund raising through reward-based crowdfunding but considering sustainability-specific and general success factors and choosing platforms specialized in hosting sustainable projects can increase the likelihood of funding.*

Project creators aiming at larger market and sustainability impacts are recommended to opt for *equity- or* *lending-based CF* that can meet the increased need for financial resources (Hörisch, 2017; Lam & Law, 2016). In practice, lending-based CF has become the most important CF type for renewable energy initiatives (Nigam et al., 2018). Despite the economic relevance of these CF types for environmental initiatives (De Broeck, 2018; Nigam et al., 2018), the success factors of sustainability-oriented campaigns and whether their orientation affects funding success seem to be barely researched regarding equity- and lending-based CF.

When tapping these CF types, sustainable entrepreneurs need to shift the focus from backers who are also potential customers to investors or shareholders (e.g., Petruzzelli et al., 2019) for which monetary return is seen as the main motivation (e.g., Cholakova & Clarysse, 2015). Therefore, projects pursuing additional social or environmental aims that are associated with higher risks and uncertainties (Hörisch, 2015) may be less attractive to crowdfunders in these CF forms (Hossain & Oparaocha, 2017). Xiang et al. (2019) confirm this assumption by finding that a campaign's social orientation leads to reduced support from investment backers. Motylska-Kuzma (2018) and Vismara (2019), however, find that a campaign's sustainability-orientation does not affect the funding probability, but attracts more restricted investors who also take into account the non-monetary aspects of projects (Vismara, 2019). Bento et al.'s (2019) findings on clean-tech projects tapping lending-based CF platforms specialized on hosting these campaigns indicate that in addition to financial returns backers also value social or environmental effects, as they tolerate higher risks for relatively lower returns. According to Vasileiadou et al. (2016) and Hörisch (2017), campaigns opting for lending-based CF are more successful on sustainability-specialized platforms. Besides that, little is known so far about the success factors of sustainable campaigns in equity- and lending-based CF. In general, risk information disclosure and other measures to decrease the perceived uncertainties of investors are seen as important (Ahlers et al., 2015!). Based on these first contradictory results, I propose:

Proposition 4.3: *Among the crowdfunding types, the lending- and equity-based forms pose the highest potential to finance large-scale sustainable projects whose sustainability-orientation is, especially when opting for sustainability-specialized crowdfunding platforms, not per se disadvantageous for successful fund raising through these types.*

These thematic findings and resulting propositions concerning CF campaigns add to the current literature in numerous ways. First, they add to the discussion about how a venture's or campaign's sustainability-orientation affects funding success in different CF types (Allison et al., 2015; Calic & Mosakowski, 2016; Hörisch, 2015, 2017). Second, they add to the debate on the general (e.g., Ahlers et al., 2015!; Mollick, 2014!) and sustainability-specific success factors (Berns et al., 2018; Cumming et al., 2017; Parhankangas & Renko, 2017) of CF campaigns. Third, they add to the literature on crowdfunders' motivations to pledge in the different CF forms (Allison et al., 2015; Cholakova & Clarysse, 2015; Hossain & Oparaocha, 2017).

When summing up the findings in the campaign component, it seems surprising that despite the economic relevance of lending- and equity-based CF to finance sustainable ventures (see also 2.2 for average funding outcomes), both these types and donation-based CF are relatively neglected by research in the field of sustainable entrepreneurship. Building on that and the propositions, I suggest further research into the sustainability-specific success factors in donation-, equity- and lending-based CF. Quantitative large-scale studies are needed to assess how a campaign's sustainability-orientation affects resource acquisition in these CF types. Campaign initiators need to know whether it is better to opt for sustainable-specialized platforms or not for each CF type, and how the success factors change between specialized platforms and other platforms. Comparative quantitative studies can shed light on these factors. On the other hand, sustainable ventures tapping prosocial lending or reward-based CF can draw on a larger body of research when designing campaigns. The next section describes the current knowledge on the outcomes of sustainability-oriented CF campaigns.

5.6 Post-crowdfunding phase

The post-CF component covers publications on the consequences of CF campaigns such as the impacts on the actual completion of the project, and on the provision and commercialization of its outcomes (e.g., Petruzzelli et al., 2019), the consumers' perceptions, the market success, and environmental plus social effects. Hörisch (2019) argues that to contribute to sustainable development it is not enough that sustainability-oriented entrepreneurs receive resources via CF, but that they actually implement their projects. Despite the importance of the post-CF phase for sustainable development, there are only three scientific publications focusing on this component (Hörisch, 2019; Petruzzelli et al., 2019; Wehnert et al., 2019) and so it appears to be the least addressed category in my sample.

The few initial studies that address the post-CF phase largely focus on economic aspects of successful CF projects. In spite of concerns that projects might intentionally not be realized as there are typically no sanctions enforced (e.g., Lehner, 2013), studies register high rates in, for example, delivering rewards (96.4% of reward-based projects, but, 75% of these delayed; Mollick, 2014!) or repaying loans (98,8% of projects on Kiva.org; Dorfleitner & Oswald, 2016!). Hörisch (2019) finds similarly high realization rates for environmental-oriented CF projects. Analyzing 58 projects on the German lending-based platform Bettervest, which aims to combat climate change, he observes that 92.9% of the funded organizations implemented the advertised measures. Yet, Hörisch (2019) also finds that very few projects disclose information regarding environmental effects, which hampers an evaluation of the implemented measures. Building on these arguments, I propose:

Proposition 5.1: *The post-crowdfunding phase is key to the realization and evaluation of sustainability impacts which therefore calls for adequate forms of sustainability information disclosure.*

Sustainability-oriented ventures may especially benefit from the legitimization function and quality signals that running a successful CF campaign can send (Petruzzelli et al., 2019; Wehnert et al., 2019). In that way, entrepreneurs whose environmental and social aims otherwise make them appear less attractive to traditional financiers can increase their chances of appealing to professional investors (Bocken, 2015; Lehner & Nicholls, 2014). In turn, it is necessary to inform investors extensively about risks, including sustainability-related risks. If the campaign initiating venture develops products or services for customers it may benefit from the quality signal that succeeding in CF provides (Wehnert et al., 2019). It is worth noting, however, that depending on the product's complexity, the effect on consumers' product perceptions and their trust in sustainability attributes can be either positive or negative (Wehnert et al., 2019). Sustainable entrepreneurs are therefore well advised to handle this signal with care. Accordingly, I propose:

Proposition 5.2: *Sustainability-oriented ventures can especially benefit from the quality signals and legitimization function of crowdfunding success by lowering sustainability-related information asymmetries and attracting further professional investors, but that requires specific knowledge about how to handle the crowdfunding success signal.*

By underlining the importance of the post-CF phase for both sustainability-oriented entrepreneurs and their contribution to sustainable development, these findings and propositions add to the debate regarding the impact of CF for sustainable development (e.g., Testa et al., 2019). Proposition 5.2 emphasizes the potential of the signaling functions that successfully passing a CF campaign can create for sustainable ventures in order to attract follow-up investors (Bocken, 2015; Lehner & Nicholls, 2014) and customers (Wehnert et al., 2019).

According to these propositions, further research on the signaling functions of a successful CF campaign and how to apply these to the benefits of sustainability-oriented ventures is necessary. More research into the implementation rates of sustainable projects is needed. In this context, it would be interesting to compare the rates between sustainability-specialized and non-specialized platforms based on quantitative studies. Research could address effective measures to increase information disclosure among successfully funded initiatives.

As for the other analyzed components, many issues in the post-CF phase, such as information disclosure, can be addressed by regulations which are described in the following section.

5.7 Societal and regulatory environment

The societal and regulatory ecosystem is discussed as a fundamental lever for bringing to fruition the full potential of CF for sustainable entrepreneurship. On the other hand, CF is discussed as playing a role in shaping sustainability-related governance "not only for enabling additional funding mechanism, but also by facilitating and providing societal support, which can translate in political support" (Vasileiadou et al., 2016: 150). A considerable number of publications (15 of 70) addresses the regulatory or societal environment in the context of CF and sustainable entrepreneurship (Butticè et al., 2019; Chen et al., 2018; Cumming et al., 2017; De Broeck, 2018; Hörisch, 2019; Hossain & Oparaocha, 2017; Laurell et al., 2019; Lehner, 2013; Lehner & Nicholls, 2014; Marakkath & Attuel-Mendes, 2015; Nigam et al., 2018; Owen et al., 2018; Petruzzelli et al., 2019; Reiser & Dean, 2015; Vasileiadou et al., 2016). The influential factors of a nation's institutional setting and socio-cultural aspects regarding the development of sustainable CF initiatives and specific governmental policies are particularly addressed.

Sustainable CF projects are described as prospering well in institutional environments that support and promote CF and the development of sustainability-oriented ventures (Petruzzelli et al., 2019). In this context, the literature emphasizes the role of government, social banks, media, and other actors in creating enabling settings (e.g., Lehner & Nicholls, 2014; Nigam et al., 2018). The media, for example, is discussed as an important player in raising awareness of CF and sustainability (Laurell et al., 2019; Nigam et al., 2018). Socio-cultural aspects such as the level of individualism in a society and economic factors such as rising oil prices affect the diffusion of sustainable CF initiatives (Cumming et al., 2017).

So far, the literature has mostly addressed the role of governmental policy for CF in the context of sustainable entrepreneurship. Policy makers are advised to combine different promotion and regulation instruments (e.g., Chen et al., 2018) to support CF activity for sustainability initiatives. Tax reduction, guarantee instruments, taking risks, and raising awareness (Lehner & Nicholls, 2014), as well as promoting CF and sustainable concepts (Chen et al., 2018) are recommended for promotion. Especially in connection with renewable energy CF projects that typically involve high risks, promotional instruments are often addressed. In this context, stable long-term market premium schemes, such as feed-in-tariffs or the UK-based Renewable Heat Incentive are highlighted as favoring CF activity for renewable electricity (De Broeck, 2018), and as being utilized by CF platforms to support communities and to drive energy infrastructure expansion (Nigam et al., 2018). These schemes can lower risks and increase trust among backers (Nigam et al., 2018). On the other hand, once such schemes are implemented the CF activity relies heavily on them (De Broeck, 2018). Expiring schemes and policy uncertainty negatively affect CF activity for renewable energy projects (De Broeck, 2018).

On the regulation side, policy makers are advised to introduce CF specific investor protection (Vasileiadou et al., 2016), antifraud (Hossain & Oparaocha, 2017), money laundering (Marakkath & Attuel-Mendes, 2015) and copyright laws (Chen et al., 2018), as well as implementing special legal statuses for sustainability-specialized CF platforms (Marakkath & Attuel-Mendes, 2015) and sustainability-oriented ventures (Lehner, 2013). In this context, Reiser and Dean (2015) highlight the positive effects of the US Internal Revenue Code's section 501(c)(3) for CF platforms and backers by sorting out greenwashed initiatives through merging tax benefits for mission-driven ventures with an increased burden on shareholder profits. These measures penalize greenwashed initiatives that in reality prioritize shareholder profits over their mission (Reiser & Dean, 2015). Nigam et al. (2018) describe the UK regulations and guidelines on lending- and equity-based CF as pioneering in lowering risks related to investments in renewable electricity projects because these, inter alia, show ways to investment-protections and increase backers' risk awareness. In the post-CF phase, regulators are advised to urge entrepreneurs advertising sustainability intentions to disclose information on the realizations of sustainability measures while ensuring that this does not limit the contribution of CF to supporting sustainability-oriented ventures (Hörisch, 2019). According to these arguments, I propose:

Proposition 6.1: *As crowdfunding's contribution to supporting sustainability-oriented entrepreneurs largely relies on the societal and regulatory settings, the relevant actors, including government, banks, and the media, need to create an enabling environment for crowdfunding in the context of sustainable entrepreneurship.*

Proposition 6.2: *To effectively address the sustainability issues of the crowdfunding components, policy makers are advised to introduce a combination of promotion (tax reduction, guarantee instruments, risk taking, awareness raising, support of crowdfunding and sustainable concepts) and regulating measures (crowdfunder protection, antifraud, money laundering, and copyright laws; special legal statuses for sustainable platforms and ventures).*

These findings and propositions add to the debate about creating an enabling environment for CF and sustainable entrepreneurship (e.g., Lehner, 2013). By indicating sustainability issues regarding the key elements of the CF nexus (see Fig. 5) and emphasizing the role of policy makers in addressing them, this SLR can support recent endeavors to develop regulatory frameworks such as the attempt of the European

Commission to create an EU-wide CF framework (European Commission, 2018!) in strengthening the contribution of CF for sustainable entrepreneurship.

Drawing on the propositions 6.1 and 6.2, future research could address the circumstances under which CF activity for sustainable entrepreneurship prospers best. In this context, more research into the key players and their roles, as well as into influential socio-cultural and economic factors is needed. I recommend more research into the promotion and regulation measures that policy makers should introduce to create an enabling environment for CF to support sustainability-oriented ventures. Different country-specific regulatory frameworks and their impact on CF activity can be compared, to determine whether country specific or cross-country regulatory frameworks (e.g., EU-wide) support CF for sustainable ventures best. It would also be interesting to explore best practices (e.g., which actors to include in stakeholder dialogues) for policy makers to create regulatory CF frameworks that benefit sustainable development.

5.8 Closing the framework: An overarching discussion from a holistic system perspective

In the last step of the discussion I will reflect on these findings and propositions from a holistic system perspective and clarify the contributions of my SLR. This section also summarizes the answers to the RQs.

Overall, the thematic results show that the CF platform component with 20 articles, the campaign element with 26, and the societal and regulatory environment with 15 articles are predominantly addressed in the context of sustainable entrepreneurship. On the other hand, the component of campaign initiators with 12 articles, the module of crowdfunders with seven, the holistic system perspective with four, and the post-CF component with three articles are relatively neglected. My SLR thus reveals some imbalances between the actual relevance of a topic and the attention it receives from academia. For example, it becomes obvious that the post-CF phase needs more research due to its importance. Although the largest share of articles in my sample addresses the campaign component, very few articles focus on lending-based CF that, conversely, has the highest economic relevance in supporting sustainable entrepreneurs (De Broeck, 2018; Nigam et al., 2018). As shown in the descriptive results section (see 4), while CF is often discussed as an instrument for allocating resources to poor countries or regions (Ashta et al., 2015; Kim & De Moor, 2017; Royal & Windsor, 2014), the literature on sustainability-oriented entrepreneurship and CF barely addresses regions in the southern hemisphere.

Despite these imbalances, my SLR identifies central impacts from the current research on CF and sustainable entrepreneurship for each CF component. In this context, it is first important to distinguish between two main discussions identified by my SLR. First, the debate on CF platforms as sustainable entrepreneurs themselves (see first part of 5.2) and second, the discussion on sustainability-oriented entrepreneurs tapping CF. The overview of the main effects (see Fig. 6) focusses on the second stream and can therefore be understood as relationships that stand out when sustainable entrepreneurs enter the CF stage. The next three paragraphs describe these relationships in a nutshell, with the aim of summarizing the answers to RQ2, RQ3.

CF offers specific advantages for sustainable entrepreneurs (see 5.3) but also involves specific challenges. Starting with the decision about which CF form and platform type (sustainability-specialized vs. non specialized) to opt for, sustainable ventures are confronted with specific challenges when tapping CF. Ventures need to consider that the dominant motivations of backers change across the CF types, which decisively effects the likelihood of funding sustainable campaigns (e.g., Hossain & Oparaocha, 2017) (see 5.5). Meyskens and Bird (2015) and Hörisch (2017) recommend sustainability-oriented entrepreneurs to choose the CF type according to their intended market and sustainability impact. Hörisch (2017) suggests these ventures to opt for platforms specializing in hosting sustainable projects, as these promise higher success rates. Lam and Law (2016) recommend sustainable entrepreneurs to combine different CF forms and traditional financing sources along their projects' lifecycles.

Having chosen the CF type and platform, sustainable ventures must be particularly careful when designing campaign pitches (Cumming et al., 2017; Parhankangas & Renko, 2017), as environmental and social targets involve higher information asymmetries (Jahn et al., 2005!). To convince crowdfunders, these ventures thus need to clarify and justify ecological and social effects (Parhankangas & Renko, 2017) and pay more attention to campaign success factors (Cumming et al., 2017). Sustainable ventures can draw on a relatively large body of knowledge when tapping reward-based CF or prosocial microlending, but not when opting for donation-, lending- or equity-based CF (see 5.5). Community building and especially the ability to interact purposefully with crowdfunders is seen as crucial to the successful completion of CF campaigns (e.g., Lehner, 2014; Mollick, 2014!). In doing so, sustainable entrepreneurs need to consider various types of backers with different funding motivations whose circle is likely to broaden through sustainability topics (see 5.4), and whose roles, such as the criticality of committed backers, are shifting (Petruzzelli et al., 2019).

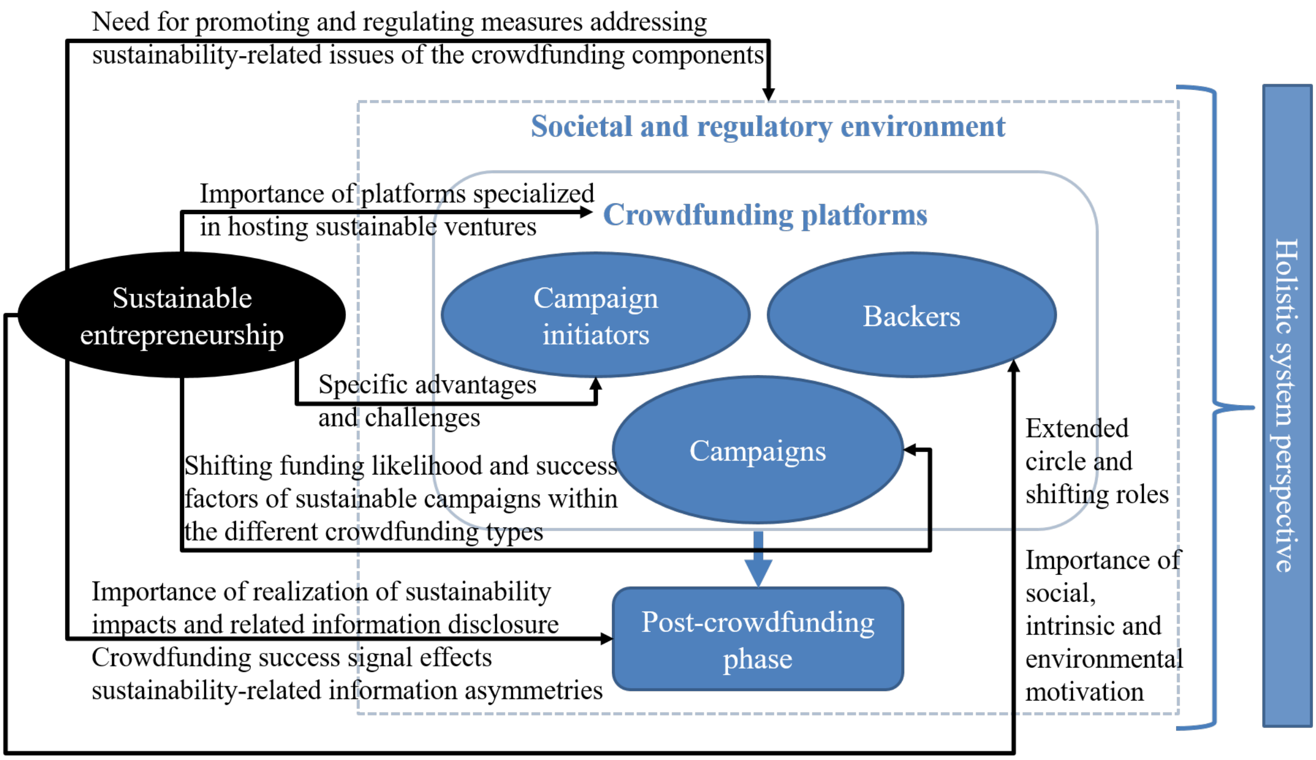

Fig. 6. Overview of the key effects on the crowdfunding components that arise when sustainable entrepreneurs tap crowdfunding.

In the post-CF phase, especially sustainable ventures can benefit from the quality signals that successfully passing a CF campaign can send in terms of attracting further professional investors (Bocken, 2015; Drover et al., 2017!; Roma et al., 2017!), and in reducing information asymmetries related to sustainable product attributes (Wehnert et al., 2019). To do so, however, entrepreneurs need to be cautious when advertising crowdfunded sustainability-oriented outcomes (Wehnert et al., 2019). In the post-CF phase the question also arises regarding the extent to which the advertised measures are actually implemented. To prevent greenwashing and fraud, Hörisch (2019) suggests regulators to push ventures advertising sustainability effects to document and comprehensively disclose the realization of these effects while keeping bureaucracy to a minimum. The regulatory and societal setting are seen as key elements in unleashing the potential of CF for sustainable entrepreneurship. In this context, the literature emphasizes the role of government, social banks, the media, and other actors in creating enabling settings that support both CF and the development of sustainability-oriented ventures (e.g., Lehner & Nicholls, 2014; Nigam et al., 2018). To date, the literature has focused on the role of governmental policy in supporting CF activity for sustainable entrepreneurship (see 5.7). For that, policy makers are recommended to combine various promotion and regulatory instruments (e.g., Chen et al., 2018).

In proposing these central relationships, my SLR makes a decisive contribution to explaining the interdependencies between CF and sustainability-oriented entrepreneurship. This in turn contributes to the existing studies that address the holistic system or parts of it (Lehner, 2013; Meyskens & Bird, 2015; Petruzzelli et al., 2019; Testa et al., 2019) but do not consider the whole range of literature available on CF and sustainable entrepreneurship. Having analyzed that literature, the findings of my SLR suggest that the whole CF system and its components are strongly affected when these are considered in the context of sustainable entrepreneurship.

The key impacts (see Fig. 6) conclude the framework of this review but open some doors for future research. Considering the imbalances mentioned at the beginning of this section, the post-CF phase, success factors of sustainable ventures tapping lending- and equity-based CF, and regions in the southern hemisphere require more attention from research. Moreover, although the findings of my SLR are based on a relatively large number of quantitative studies (see 4), all of the main relationships and posed propositions require further empirical research. Following on from these content-related restrictions, the next section looks at the limitations of the way I applied the SLR, and sums up the article.

6. Limitations and concluding remarks

Tapping CF confronts sustainability-oriented entrepreneurs with highly complex decisions, such as which CF type on which platform (sustainability-specialized platforms or more general ones) to best choose, how to phrase campaign pitches to clarify the sustainability impact, and how to communicate CF success after a campaign has been successfully funded. Drawing on the current state of the literature, this paper provides sustainability entrepreneurs and other actors involved with an overview of which aspects to consider, advances propositions, and offers a research agenda for the main components in the field of CF activity for sustainability-oriented entrepreneurship: CF platforms, crowdfunders, entrepreneurs and their sustainability-oriented campaigns, post-CF phase, and societal and regulatory environment.

The SLR has various limitations, however. First, the identification of articles depends on the keywords applied and on the selection of the author. The search in some databases was limited to the title and the abstract, but it is possible that the paper in the main text still focuses on the searched topics. Some articles that match the research focus might not have been detected. Second, this SLR is limited to scientific peer-reviewed articles that are published in journals and written in English. As a result, some relevant literature, such as the practitioner-oriented reports of the World Bank, have not been considered. Third, the thematic analysis, the propositions, and research agenda are based on a qualitative interpretation of the identified literature on CF, plus sustainable entrepreneurship and are, therefore, affected by interpretation bias.

Despite these limitations, this SLR provides an overview of the research on CF and sustainability between 2006 and March 2019 which enables the systematic development of a research agenda and propositions for the key components of CF and sustainable entrepreneurship.

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Sustainable development requires innovative solutions that not only consider the economic dimension but also environmental and social dimensions. Nascent sustainable entrepreneurs are considered to hold great potential for producing such innovations in a particularly radical form.

Yet developers of sustainability-oriented innovations confront high risks and uncertainties, as both prospective sustainability effects and economic success are very difficult to predict. In addition, pursuing interrelated social and ecological objectives along the entire life-cycle of an innovation while encountering hardly predictable side effects raise the complexity in creating sustainable innovations. These factors often make it difficult to attract funding. Early-stage sustainable entrepreneurs are especially affected by financing problems because traditional investors tend to fund clearly profit-oriented businesses. Nascent ventures that pursue sustainability objectives typically face severe trust, reputation, and legitimacy issues as these come along with increased information asymmetries.

Tapping the crowd for knowledge with inbound open innovation approaches and for financing with crowdfunding is increasingly discussed as a remedy. This doctoral thesis addresses these issues as it seeks to answer the following research question: *How can inbound open innovation approaches and crowdfunding be applied and combined throughout the innovation process of sustainability-oriented innovations to effectively address specific issues of these types of innovations and its developers?* This thesis investigates and answers the research question in four chapters and a framing paper.

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