Crowdsourcing innovation

Understanding online idea generation and knowledge production

Brita Schemmann

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ISBN: 978-94-629-5955-2
Coverphoto: Shutterstock
Layout: wenz iD | Wendy Schoneveld
Printing: ProefschriftMaken | Proefschriftmaken/nl

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Crowdsourcing innovatie

inzicht in online ideegeneratie en kennisproductie

(met een samenvatting in het Nederlands)

Proefschrift

ter verkrijging van de graad van doctor aan de Universiteit Utrecht op gezag van de rector magnificus, prof. dr. H.R.B.M. Kummeling, ingevolge het besluit van het college voor promoties in het openbaar te verdedigen
op vrijdag 1 juni 2018 des middags te 12.45 uur

door

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TABLE OF CONTENTS

1

Introduction

1.1 THE RISE OF CROWDSOURCING

Crowdsourcing is far more than a new buzzword. In fact, crowdsourcing is influencing the ways we work, do business and innovate, and many of its outcomes have become an integral part of our daily lives (Howe, 2008). Over the last 15 years we have seen how new business models, such as Threadless, iStock photography or Airbnb, are successfully utilising the (creative) resources of 'the crowd'. We have witnessed the rise of product review sites like TripAdvisor that rely on the crowd to openly share their experiences of hotel stays so as eventually to sell such services. We have observed how organisations are outsourcing a wide range of tasks and small jobs – which previously would have been undertaken by an employee or a selected supplier – to a crowd of potential 'click-workers' via online marketplaces like Amazon Mechanical Turk. We have seen scientists relying on crowds of enthusiastic amateurs to classify pictures of galaxies or transcribe ancient texts using platforms like Zooniverse. And we have witnessed how organisations increasingly use the crowd to innovate, for example by finding solutions to challenging research and development (R&D) problems, generating fresh ideas for new products and even raising the necessary funds for innovative projects and start-ups via crowdfunding campaigns.

It is therefore not surprising that the phenomenon of crowdsourcing is increasingly attracting academic attention. The Scopus database of peer-reviewed research literature currently mentions 8,156 academic contributions with the word 'crowdsourcing' in their title, abstract or keywords, compared to only 658 contributions at the end of 2011 when the work on this thesis started.[1] A 2016 study estimates that there are currently around 2,300 crowdsourcing platforms worldwide, acting as an intermediary between a crowdsourcing organisation and the contributing crowd, for example to coordinate a wide range of simple micro tasks, creative design and idea generation tasks or complex problem-solving tasks (Leimeister, Zogaj, Durward, & Blohm, 2016). According to Katz (2017), about half a million crowd-workers are currently active on the Amazon Mechanical Turk platform, which is possibly the biggest intermediary for the crowdsourcing of simple, micro tasks. In fact, the crowd is most likely to be even larger as Amazon has not updated this number in years. And by 2015, 85 of the 100 best global brands[2] already reported having used some kind of crowdsourcing (Roth, 2015).

With regard to the use of crowdsourcing for innovation in particular, the following examples, which have already received some academic attention, help to demonstrate the size of this phenomenon. To begin with, one needs to mention the intermediary

1 The search was carried out on November 15, 2017.
2 Best global brands chosen in the year 2014.

InnoCentive (examples of studies that refer to InnoCentive are: Acar & van den Ende, 2016; Brabham, 2008; Garavelli, Petruzzelli, Natalicchio, & Vanhaverbeke, 2013; Lakhani, Jeppesen, Lohse, & Panetta, 2007). InnoCentive reached out to the crowd to facilitate companies' challenging and often R&D-related problem-solving efforts even before the term 'crowdsourcing' existed; it has broadcasted more than 2,000 challenges so far. More than 380,000 potential solvers from around 200 countries are currently registered on the platform.[3] Companies such as Ford, GlaxoSmithKline and Thomson Reuters as well as organisations like NASA and several foundations use the platform to look for innovative solutions to often scientific or technical problems and have offered more than US$50 million in prize money so far. InnoCentive reports having an 80% success rate for its challenges.[4]

Other intermediary platforms focus more on the involvement of the crowd in generating ideas for new goods, services or business models. A recent study found about 600 publicly available competitions on twelve idea crowdsourcing intermediaries[5] held between 2013 and 2016, half of which were broadcasted in 2016 (eYeka, 2017). Some organisations even set up their own platforms to ask the crowd for their ideas. The computer technology company Dell was among the first to do this when it set up its own idea crowdsourcing platform in 2007. Since its launch more than 27,000 ideas for new goods and services have been generated via Dell's IdeaStorm platform[6] and more than 550 of these ideas have been implemented so far. Consequently, IdeaStorm and its publicly available data have also attracted the attention of numerous studies (e.g. Bayus, 2013; Chan, Li, & Zhu, 2015b; Di Gangi & Wasko, 2009b; Huang, Singh, & Srinivasan, 2014).

Involving the crowd in the generation of innovative ideas and solutions has also become very popular with governments, governmental agencies and municipalities as well as non-governmental and public-sector organisations (e.g. Hilgers & Ihl, 2010; Kube, Hilgers, Koch, & Füller, 2015; Nam, 2012; Seltzer & Mahmoudi, 2013). Some of these crowdsourcing attempts even try to tackle the complex and sometimes 'wicked' problems of our time (for examples of such attempts see: Armisen & Majchrzak, 2015; Chan, Dow, & Schunn, 2015a). Up until now, the United States Agency for International Development (USAID) has launched nine so-called Grand Challenges for Development to find new ways to

3 Figures as self-reported by InnoCentive on https://www.innocentive.com/about-us/ (retrieved November 19, 2017).

4 Success rate self-reported by InnoCentive on https://www.innocentive.com/offering-overview/premium-challenges/ (retrieved November 19, 2017).

5 Namely the intermediary platforms eYeka, Agorize, Atizo, Battle of Concepts, HyveCrowd, Jovoto, Mindsumo, Mofilm, OpenIdeo, Tongal, Userfarm, Zooppa.

6 Figures as self-reported by IdeaStorm on http://www.ideastorm.com/ (retrieved November 19, 2017).

address pressing problems such as water management in developing countries, saving lives at birth or access to electricity in sub-Saharan Africa.[7]

Generating ideas or finding solutions with the help of an unspecified group of potential solvers is not an entirely new phenomenon. Early in the 18th century the British Government offered prize money to whoever could come up with a simple and practical method for the precise determination of a ship's longitude at sea, one of the most pressing scientific problems at that time (Dahlander & Piezunka, 2017). In the same century, the French Academy of Science offered an award to anyone who could come up with a better method for producing soda ash (Myers, 2003, p. 291). In 1869, Napoleon III announced a challenge to find a process to manufacture a substitute for butter to feed his troops (Adamczyk, Bullinger, & Möslein, 2012). But as these examples show, these types of early crowdsourcing were more the privilege of kings, governments or other large national institutions, who had the power, resources and visibility to successfully reach out to a crowd of potential solvers.

The rise of modern information and communication technologies, especially the Internet, has initiated a wave of online crowdsourcing activities. As an open and ubiquitous way to communicate and to network, the Internet has helped tremendously to reduce the costs of communication and the constraints of distance, and it provides better access to different sources of innovation (Blind, 2011; Sawhney, Verona, & Prandelli, 2005). It has therefore never been so easy and cheap for organisations to reach out to a large and diverse crowd that is capable and willing to put in the time and effort to solve R&D problems, to suggest ideas for new products or to work towards new approaches that help tackle wicked societal or environmental problems. Using online platforms, it is now possible to involve a crowd across borders and disciplines and with different levels of expertise. As a result, it is also possible to reach out to the problem-solving and idea-generation capacities of professionals, for example scientists, in the same field as well as to the capacities of professionals in other areas or disciplines and to the idea-generation capacities of amateurs such as users, customers or citizens (Piller & Walcher, 2006; Sawhney et al., 2005). Due to the rise of the Internet, the crowd has been praised as a new innovation partner (Boudreau & Lakhani, 2013).

However, the different mechanisms that make innovation crowdsourcing work are not yet fully understood, and there are at least two good reasons why it is important to expand our knowledge in this area. First, as shown above, the outsourcing of idea generation and new knowledge production to the crowd has become a widely used practice to facilitate

7 All challenges can be found on https://www.usaid.gov/grandchallenges (retrieved November 20, 2017).

innovation and new product development. Consequently, we need to fully understand how it works and what works best. Second, innovation crowdsourcing links to several debates and open questions in current innovation research, especially around the successful integration of users in open innovation practices, the improvement of the idea generation phase within the 'fuzzy' front end of innovation, and the production of knowledge in new, 'fluid' forms of organising. Research on innovation crowdsourcing provides the opportunity to contribute valuable insights to these broader topics and debates.

1.2 DEFINING INNOVATION CROWDSOURCING

Before introducing the research focus of this thesis in more detail, it is important to understand what crowdsourcing is and how it is defined. The term 'crowdsourcing' – defined as 'outsourcing to the crowd' – was first used and defined by Jeff Howe in 2006 as:

> 'the act of a company or institution taking a function once performed by employees and outsourcing it to an undefined (and generally large) network of people in the form of an open call. This can take the form of peer-production (when the job is performed collaboratively), but is also often undertaken by sole individuals. The crucial prerequisite is the use of the open call format and the large network of potential laborers.' (Howe, 2006)

This definition captures the fundamentals of modern crowdsourcing. First, there are the similarities with the practice of outsourcing, with crowdsourcing also focusing on using outside resources to accomplish a variety of different jobs or tasks that have previously been carried out by an internal employee (for examples of such tasks see: Garrigos-Simon, Gil-Pechuán, & Estelles-Miguel, 2015; Schenk & Guittard, 2011; Ye & Kankanhalli, 2013). However, unlike outsourcing, the task is not assigned to a pre-selected supplier. Instead, crowdsourcing uses an open call to reach out to an undefined crowd of potential suppliers who are mostly individuals and who freely decide whether they want to contribute to the crowdsourced task (Afuah & Tucci, 2012). The crowd then usually simultaneously works on the given tasks (in collaboration with others or not), and upon completion the crowdsourcing organisation will use those outcomes that (best) meet their needs (Schenk & Guittard, 2011).

This thesis focuses on the use of crowdsourcing to generate new ideas and solutions for potential innovations and, in particular, for new product development. As all the crowdsourcing addressed in this thesis is non-discriminatory, the participating crowd is made up of a variety of individuals with a wide range of expertise and backgrounds and whose identities are not necessarily known to the crowdsourcing organisation,

as contributors do not (have to) reveal them (Djelassi & Decoopman, 2016). Special emphasis is placed on the use of crowdsourcing to generate ideas for new products, i.e. manufactured goods or service products, from an unspecified crowd of (potential) users who can be customers or citizens.

Typically, the crowdsourcing process in these open calls for ideas is as follows (based on D.C. Brabham as cited in Goffin, Lemke, & Koners, 2010). First, the idea-seeking organisation identifies a problem or a question for which it needs innovative input, for example a quest for new product ideas. Second, the idea-seeker broadcasts this problem or question online to an undefined crowd and asks the crowd to suggest ideas. Third, some contributors within the crowd, so-called 'ideators', suggest their ideas. The suggested ideas are publicly visible to the entire crowd. Fourth, the crowd is asked to comment upon the suggested ideas and to vet them, for example using an online voting system. Both comments and votes are also visible to the entire crowd and it is not only possible to comment upon an idea but also to react to other comments made. All comments are arranged in so-called commenting threads, which are attached to the initial ideas that started the discussion. Contributors in open idea calls can therefore act as ideators, commenters and voters, with these roles not being mutually exclusive. Fifth, the idea-seeker decides which idea(s) meet(s) their needs and will be put into practice. In the context of this thesis, i.e. open idea calls, the idea-seeker is not only looking for one or very few 'winning' ideas, but is aiming to generate a whole range of ideas that they can implement. Sixth, the idea-seeker owns those chosen ideas and can profit from their use.

This crowdsourcing process leads to a range of open questions that need to be addressed to better understand how organisations can successfully source new ideas and solutions from the crowd. By answering these questions, this thesis sheds a more systematic light on several important factors that influence crowdsourced idea generation and knowledge production. In this regard, the phenomenon of innovation crowdsourcing touches upon different strands in current innovation research, which will be briefly introduced and discussed in the following section of this introduction.

1.3 THE PLACE OF CROWDSOURCING IN INNOVATION RESEARCH

The following three strands of current innovation research are particularly important for the theoretical framework of this thesis.

1.3.1 Crowdsourcing in times of shifting innovation paradigms

The times of innovation paradigms that saw producers or entrepreneurs as the only sources of innovation and that determined innovation to be a closed process with new ideas and knowledge always having to originate and be used within the organisation have long gone. New distributed innovation paradigms, referred to as 'user innovation' or 'open innovation', have been found to be more appropriate for capturing the (potential) sources of innovation and successful innovation activity, and have thus received a lot of academic attention in the past 25 years. Within this context, crowd-related innovation phenomena and practices such as idea crowdsourcing have received increased attention from strategy, organisational and innovation research (Felin, Lakhani, & Tushman, 2017). It is therefore important to take a closer look at these new innovation paradigms and how the use of crowdsourcing and the research focus of this thesis relate to them.

One of the new paradigms, usually referred to as user innovation, is inseparably connected to the work of Eric von Hippel. In the late 1970s, he introduced a customer active paradigm (CAP) of innovation in contrast to the previously dominant manufacturer active paradigms (MAP) (von Hippel, 1978a, b). At the core of the MAP, which von Hippel considered to be the typical paradigm in the consumer product industries, is the conviction that it is always the organisation that plays the active role within the innovation process. This usually involves collecting and analysing information about customer needs, coming up with ideas for new goods or services and testing these ideas against consumers' perceptions and their purchase decisions (von Hippel, 1978a). The role of the (potential) customers or users within this paradigm is passive, i.e. they only respond when spoken to, for example when taking part in a market research activity. In line with the often cited logic of Henry Ford – 'If I had asked people what they wanted, they would have said faster horses'[8] – the reason for this passive role is the firm conviction that customers or users are not able to come up with innovative ideas for products they might need (O'Connor, 1998). Based on a 'technology push' strategy, new technical inventions therefore need to be 'pushed' into the market through R&D, as users are incapable of saying what they need in terms of new products or technology (Bennett & Cooper, 1981; Christensen & Bower, 1996). Consequently, it would not be beneficial to directly ask them what they need. The use of crowdsourcing to generate ideas for new products or other innovations conflicts with these assumptions and this innovation paradigm. In fact, research focusing on user involvement via crowdsourcing in the consumer products sector has shown that the ideas of users can compete with the ideas suggested by professionals, and that user ideas are even likely to be better in terms of novelty and customer benefit (Poetz & Schreier,

8 It is not clear whether Henry Ford really said this (Vlaskovits, 2011), but it captures very well the established doubts of manufacturers concerning their customers' ability to articulate ideas for innovative products.

2012). In addition, it has revealed that new products based on crowdsourced ideas are also more successful in the market (Nishikawa, Schreier, & Ogawa, 2013).

Taking these insights into account, it can therefore be argued that the successful involvement of the crowd in the generation of ideas for new products supports the customer active paradigm (von Hippel, 1978a, b) that goes even beyond the 'market-pull' strategy, which involves satisfying customers' needs but not implementing their ideas (Bennett & Cooper, 1981). In the CAP – which von Hippel first described and observed for new industrial products – it is the customer who takes the initiative to develop an idea for a new product that is needed and then approaches a company who might be able to produce and supply the new product. Companies in this paradigm play a passive role in the idea generation process and wait for customers' new product requests, screen these (concrete) ideas and select those which seem most promising for them (von Hippel, 1978a, b). Given the close relationship between companies and their customers in the industrial products sector resulting in often tailor-made products, the observation of users playing an active part in the early stages of new product development may not be so surprising. However, the insight that idea crowdsourcing can also be a way to successfully involve users in the consumer products sector is interesting, and insights gained through crowdsourcing research can be useful to better understand the underlying mechanisms of this.

The positive influence of customer activities – or, more generally speaking, of user activities – on innovation and new product development can even go beyond the generation of ideas. A range of studies found that in many areas (e.g. library information systems, banking services, sporting equipment or industrial products), users also modify existing products, innovate themselves to serve their needs and often freely share these innovations with other users in innovation communities, and that these user innovations often become new commercial products (e.g. Morrison, Roberts, & von Hippel, 2000; Oliveira & von Hippel, 2011; Shah, 2000; Urban & von Hippel, 1988). Given the size of these observations, von Hippel, Ogawa, and de Jong (2011) argue that we have entered 'the age of the consumer-innovator', as millions of consumers innovate to create and modify consumer products to fulfil their needs in all areas of life. Given these insights, it can be assumed that among the (potential) users who become involved through crowdsourcing some will not only be able to articulate ideas for new products but will also possess some knowledge of how to develop them.

The observations of von Hippel and other scholars eventually led to the new, user innovation paradigm. A user in this context can be anybody who uses a new solution or product and can therefore be, for example, a consumer, customer, client, citizen, patient

or student (Sundbo & Toivonen, 2011). At the core of the user innovation paradigm are so-called 'lead users', who 'face needs that will be general in a marketplace – but face them months or years before the bulk of that marketplace encounters them, and (…) are positioned to benefit significantly by obtaining a solution to those needs' (von Hippel, 1986, p. 796). Involving lead users in the idea generation for new products, for example using special toolkits, can therefore be beneficial for organisations and the resulting products are likely to be commercially more successful than new products that are being developed without lead user involvement (Lilien, Morrison, Searls, Sonnack, & von Hippel, 2002; Piller & Walcher, 2006; von Hippel, 2005).

To sum up, it can be stated that the sourcing of ideas from (potential) users can be beneficial for the development of product innovations. Insights from user innovation research indicate that there may be some users within the crowd who might be more capable of contributing useful ideas and relevant knowledge in this process. Research on innovation crowdsourcing is therefore partially embedded in user innovation research. Moreover, some of the insights gained from this research can contribute to a better understanding of how users can be successfully involved in the development of innovative consumer goods and services for end-users.

The user innovation paradigm is not the only new paradigm that acknowledges the growing importance of external sources, users, for example, but also suppliers or competitors, for the innovation process. Chesbrough's open innovation paradigm (Chesbrough, 2006a, b) challenges the views of those who see innovation primarily as a closed and company-internal process with no knowledge flowing across the organisational boundary. The closed innovation paradigm is built on the assumption that innovation requires control. According to this paradigm – and similar to the MAP – 'companies must generate their own ideas and then develop them, build them, market them, distribute them, service them, and support them on their own' (Chesbrough, 2006b, p. XX). While this model worked well in many industries for quite some time, Chesbrough found that the closed innovation model started to erode in the late 20th century for several reasons. Some of these are particularly relevant for the context of innovation crowdsourcing. Due to the growing mobility of highly qualified employees and increasingly knowledgeable customers and suppliers, important knowledge increasingly exists outside the research laboratories. Organisations can and should therefore open up and utilise both internal as well as external ideas for their innovation purposes (ibid.).

This 'outside-in' or 'inbound' process of open innovation, defined as 'enriching the company's own knowledge base through the integration of suppliers, customers, and

external knowledge sourcing' (Enkel, Gassmann, & Chesbrough, 2009, p. 312) is partly also inspired by the insights gained from the aforementioned user innovation research. However, the perspectives taken in user innovation and in open innovation research differ substantially. While user innovation research aims to understand why and how (some) users generate ideas, and even innovate, and how some of these ideas and innovations eventually enter the market to become commercial products, inbound open innovation research focuses on the questions of how organisations can best source and utilise external ideas and knowledge to innovate and be successful in the market. Both paradigms acknowledge that the locus of innovation or knowledge can be outside the firm (in user innovation within users specifically), but while the key stakeholder in user innovation research is the user, the key stakeholder in open innovation research is the innovating organisation (Bogers & West, 2012). User innovation and open innovation research are therefore often interested in the same distributed innovation phenomena, such as the emergence of open source software communities or idea crowdsourcing practices – but they address these from different perspectives (Bogers & West, 2012; Lakhani & Panetta, 2007).

This thesis uses insights from both perspectives and both streams of literature. While the crowdsourcing practices that are at the core of this thesis are clearly a phenomenon of open innovation – with the locus of ideas and knowledge being outside the organisation (i.e. with the crowd involved), but with the organisation managing the process and utilising the outcome – it is also important to take account of insights from user innovation research as they bring the perspective of what drives users' creative behaviour. By combining both the open and user innovation perspectives, the insights gained in this thesis will help to deepen our understanding of open innovation practices that go beyond innovation-related knowledge flows between organisations (e.g. suppliers, competitors, external R&D-organisations) by involving the crowd made up of a large number of often anonymous users as an innovation partner (Schenk & Guittard, 2011).

1.3.2 Crowdsourcing at the fuzzy front end of innovation

The crowdsourcing attempts that this thesis focuses on aim to generate ideas for new products from the crowd. With successful idea generation being one of the crucial steps early in the innovation process, the second major strand of research that this thesis touches upon deals with the so-called 'front end of innovation' (FEI). This research has found the FEI, consisting of opportunity identification and strategic planning, idea generation and screening, concept definition and development (Khurana & Rosenthal, 1998; Koen et al., 2001), to be an important phase within the innovation process, and companies can benefit substantially if they effectively manage or improve it (e.g. Dahl & Moreau, 2002; Khurana & Rosenthal, 1998; Kim & Wilemon, 2002; Reinertsen, 1999; Smith

& Reinertsen, 1998; Verworn, 2009). However, parts of this early phase of the innovation process have also been described as being 'fuzzy' with the processes and activities being informal, unpredictable, knowledge-intensive, erratic and often even chaotic (e.g. Alam, 2006b; Kim & Wilemon, 2002; Koen et al., 2001; Reid & De Brentani, 2004; van den Ende, Frederiksen, & Prencipe, 2015).

As ideas can be seen as 'the lifeblood for firms in generating new products or services, new business models, new processes, and bringing about general organisational or strategic change' (van den Ende et al., 2015, p. 482), the increasing tendency to generate ideas from a crowd of external experts or hobbyist volunteers via open calls or challenges becomes a highly relevant matter for innovation practice and research (ibid.). Van den Ende et al. (2015) highlight two particularly important issues related to the FEI that need addressing: (1) how to efficiently and effectively (pre-)select good ideas and (2) how to best design, manage or even control the highly uncertain and fuzzy idea generation process. Both issues are closely linked to insights gained from creativity research and are highly relevant for research on idea crowdsourcing. They will therefore be addressed in different ways in the following four chapters of this thesis.

Regarding the first issue of idea selection, we know that successful ideation, defined as 'the process of generating or conceiving of ideas and concepts that may be useful for attaining some desired state or outcome' (Briggs & Reinig, 2007, p. 1), is also to some extent a numbers game, with the greater number of ideas being suggested increasing the likelihood of finding a good and suitable one (Osborn, 1953). Creativity research therefore often focuses on the quantity of the creative ideas generated (Diehl & Stroebe, 1987; Paulus & Yang, 2000; Pissarra & Jesuino, 2005; Stroebe & Diehl, 1994). But, as not all ideas will be equally good or useful, the idea-seeker then must detect and select the best ideas from the bulk. This requires a lot of effort and bears the risk that good ideas might not receive the attention and consideration they need (van den Ende et al., 2015). Idea crowdsourcing struggles with these issues as well. These crowdsourcing activities have the potential to generate large numbers of suggestions from external contributors (Dahlander & Piezunka, 2014). This inevitably leads to the problem of idea selection and limited attention for each suggestion, which can be problematic and is likely to narrow the idea-seekers' attention to those ideas they are most familiar with (Piezunka & Dahlander, 2015). To facilitate the efficient (pre-) selection of those crowdsourced ideas that the idea-seeker might find useful and would therefore implement, we therefore need to know more about the characteristics of crowdsourced ideas that have been implemented and about the ideators who suggested them.

Regarding the second issue of designing, managing and controlling a highly uncertain ideation process, open idea calls need to focus on two very different objectives simultaneously. While there is a need to create an open and creative climate that inspires and allows the crowd to suggest and refine a large number of potentially innovative ideas, there is also a need to align the ideas with the strategic goals of the idea-seeker (van den Ende et al., 2015). Managing these two objectives at the same time is not only important for the successful use of crowdsourcing via an open idea call, but it will also lead to more valuable outcomes in the FEI (ibid.).

Managing idea crowdsourcing successfully is different and more complex than the management of activities previously used to capture external ideas, for example traditional suggestion boxes. As described above, idea crowdsourcing via an open call creates an open and interactive ideation process with the crowd being able to read other ideas, provide feedback, further elaborate or refine ideas or encourage others to suggest ideas (Bergendahl & Magnusson, 2015). These publicly visible activities are not only likely to influence the ideation process taking place in these open idea calls, they also provide a lot of data regarding this process. The empirical studies in this thesis make use of these data to better understand the underlying mechanisms of crowdsourced ideation and thereby address important questions related to the FEI. As well as being useful to further improve the design and use of idea crowdsourcing attempts, they contribute to the FEI literature by adding greater clarity to the fuzzy stages at the front end of innovation.

1.3.3 Crowdsourcing in fluid environments

When aiming to better understand innovation crowdsourcing – which is at the core of this thesis – one also needs to pay attention to a relatively new area of research which aims to make sense of knowledge-sharing and production in a digital environment. Advanced information and communication technologies, and the Internet in particular, enable new and often 'fluid' forms of organising (Faraj, Krogh, Monteiro, & Lakhani, 2016). These typically bring together a crowd of people, who usually do not know each other, in support of a shared activity or interest (ibid.). Within this context, innovation and knowledge production in so-called online or virtual communities that 'bring together individuals with mutual interests using electronic mediation to overcome the same-place, same-time limitation inherent in face-to-face settings' (Faraj & Johnson, 2011, p. 1464) has already attracted academic attention from both knowledge management and distributed innovation research. These studies often focus on virtual communities of practice (e.g. Ardichvili, Page, & Wentling, 2003; Jeppesen & Laursen, 2009), open source software communities (e.g. Dahlander & Magnusson, 2005; Lakhani & Wolf, 2005) or online user communities (e.g. Frey & Lüthje, 2011; Füller, Matzler, & Hoppe, 2008).

We also deal with these new forms of organising when looking at innovation crowdsourcing where the idea-seeker asks a crowd of (potential) users to freely and voluntarily reveal their new product ideas in what we consider to be 'online innovation collectives'[9] (studies that focus on such collectives include for example: Bayus, 2013; Di Gangi & Wasko, 2009b; Kathan, Hutter, Füller, & Hautz, 2015; Martínez-Torres, Rodriguez-Piñero, & Toral, 2015). Characteristic of these new forms of organising are the highly unstructured, uncertain and fluid conditions in which the activities, in this case the generation of ideas and the production of idea-related knowledge, take place.

The fluid conditions in the online innovation collectives that are at the core of the studies in the following three chapters can be described as follows. The interaction in these collectives is mostly unstructured as the crowd can usually write and contribute whatever they want. Moreover, the interaction is both asynchronous and low in media richness (Faraj & Johnson, 2011), which influences the ability to provide immediate feedback and leads to a lack of situational cues (e.g. gender, organisational rank) and interactional cues (e.g. facial expressions, voice intonation) (ibid.). The tasks given to the crowd are mostly open and unspecific (e.g. the suggestion of ideas for new products). Consequently, there is high uncertainty regarding what a contributor needs to do to suggest an idea that the idea-seeker will find useful. Unlike in other, more stable forms of organising, there is a lack of hierarchies or structures that determine who will participate in which activities (Faraj et al., 2016), and even the membership in such collectives is very fluid: anyone who has access to the Internet can become a member. And as there are no barriers to joining or leaving, members constantly flow into and out of the collective and show very different levels of activity (Faraj, Jarvenpaa, & Majchrzak, 2011; Faraj et al., 2016). With no repeated interactions or sustainable roles, the crowd involved lacks the sense of being embedded in a network of relationships and social ties (Faraj et al., 2011; Kane, Majchrzak, Johnson, & Chenisern, 2009). Looking at these characteristics, the conditions in the online innovation collectives that this thesis focuses on in its three empirical studies seem to be typical today for a growing number of working and knowledge-sharing environments. And many of these characteristics are not likely to be beneficial to the open sharing of ideas and the production of new knowledge.

However, despite this 'fluidity' and uncertainty, the crowd that is active in these online innovation collectives not only suggests ideas that the idea-seeker finds useful (e.g.

9 These are also often referred to as 'communities'. However, we argue that the term 'communities' is to some extent misleading here as this refers to groups of individuals who already have some 'sense' of community and share some kind of a common bond (Blanchard & Markus, 2004; Dolata & Schrape, 2016). We therefore follow Kane, Majchrzak, Johnson, and Chenisern (2009) and prefer to use the term online innovation 'collective' rather than community for these open online innovation efforts that crowdsource ideas for new goods, services or processes.

Bayus, 2013; Li, Kankanhalli, & Kim, 2016; Muhdi, Daiber, Friesike, & Boutellier, 2011), but also sometimes shares its knowledge by commenting on the suggested ideas (e.g. Adamczyk, Bullinger, & Moeslein, 2011; Füller, Hutter, Hautz, & Matzler, 2014; Seeber, Zantedeschi, Bhattacherjee, & Füller, 2017). With an increasing amount of creative and knowledge work done online and the number of idea crowdsourcing activities quickly growing, we need to better understand the mechanisms that influence the production of new knowledge in fluid forms of organising. We therefore need more insights to know *how* and *when* knowledge is being accumulated and what is likely to facilitate or hinder this in an online innovation collective. This thesis will contribute to finding answers to these questions and to gaining a better understanding of knowledge production in fluid forms of organising.

1.4 OVERVIEW OF THIS THESIS

Successful idea generation, selection and management are crucial in the early stages of any innovation process (van den Ende et al., 2015). We already know that the use of crowdsourcing during this phase can be beneficial and can lead to product ideas that are novel, show customer benefit and are likely to be more successful in the market than products that are based on the ideas generated by professionals (Nishikawa et al., 2013; Poetz & Schreier, 2012). However, the underlying mechanisms of innovation crowdsourcing are not yet properly understood and there are open questions regarding the ideation and knowledge production capacities that can be gained using crowdsourcing. Consequently, the objective of this thesis is to advance our understanding of crowdsourced idea generation and knowledge production and to shed a more systematic light on different characteristics of successful innovation crowdsourcing by focusing on the following guiding research question:

How can organisations successfully source new ideas and solutions from the crowd?

The crowdsourcing process as outlined in Section 1.2. leads to open questions that will be addressed within this context. As not all ideas are equally useful for the idea-seeker and only some are being put into practice (see, for example, the crowdsourcing attempt by Dell mentioned above), what are the characteristics of those ideas perceived as useful and therefore implemented by the idea-seeker? Who are the successful ideators who come up with ideas that will be implemented, and how do they behave online during the idea call? Can the idea-seeker also count on the crowd to share their insights and

knowledge to help elaborate and further develop the different ideas suggested, and what helps or hinders this? And how can the existing insights gained within ten years of innovation crowdsourcing research be linked to each other to better understand what makes crowdsourcing work for different areas of knowledge production?

Consequently, this thesis is composed of four scientific studies – three empirical studies and one integrative literature review. Focusing on different individual research questions and using different units of analyses (i.e. the crowdsourced idea, the ideator, the accumulation of idea-related knowledge and the area of knowledge production within the crowdsourcing space), all four studies contribute important insights to help find answers to the guiding research question of this thesis. Accordingly, as a first step, this thesis provides some insights into the characteristics of the crowdsourced ideas that are selected for implementation by the idea-seeker and the characteristics of those ideators who are likely to be successful in suggesting such an idea. As a second step, the thesis sheds light on the question of what facilitates the accumulation of knowledge in online innovation collectives and brings together the various insights from crowdsourcing research in a structured and meaningful way, defining what makes innovation crowdsourcing work for different areas of knowledge production. For both steps, we consider the relevant findings from current innovation crowdsourcing research as well as from the aforementioned research strands that focus on: the integration of users via distributed innovation practices; ideation and creativity at the FEI; and the production of knowledge in new, fluid forms of organising.

The following two sections of this introduction provide an overview of this thesis, the specific research questions addressed in each chapter and the results gained in each study.

1.4.1 Characteristics of implemented ideas and successful ideators

'Put simply, creativity is about the generation of ideas, and innovation is about putting them into action' (Gurteen, 1998, p. 6). As any idea is useless unless it is used (Levitt, 1963), the first empirical study of this thesis focuses on the characteristics of those ideas that have been chosen by the idea-seeker to be put into practice. A growing number of organisations now use the crowd – made up of (potential) users – to generate a broad variety of ideas for new goods or services that they could offer. These open idea calls can lead to large numbers of ideas, not all of which will be perceived by the seeker as being equally useful or suitable. Thus, detecting the ideas that a company wants to implement can be problematic and require a lot of effort (Poetz & Schreier, 2012).

One way to address this issue and to gain first insights into the successful generation of ideas from the crowd is to find out more about the characteristics of the ideas that are implemented. Chapter 2 therefore focuses on the following research question:

Which ideator and idea-related characteristics determine whether an idea suggested in a long-term open idea call is implemented by the crowdsourcing company?

Publicly available data from a large open idea call, run by an internationally active beverage producer and coffeehouse chain, were collected and used to answer this question. Using a cross-sectional research design, the results show that implemented ideas are more likely to be popular with the crowd, potentially innovative and more likely to come from ideators who pay major attention to the ideas of others. Contrary to initial expectations, implemented ideas are not more likely to come from ideators who suggest many ideas.

Research on user innovation in particular suggests that not all ideators will be equally capable of coming up with an innovative or good idea (e.g. Lüthje, 2004; Schuhmacher & Kuester, 2012; von Hippel, 1986) – ideas that the idea-seeker would like to implement. Some support for this is also found in Chapter 2 of this thesis which shows that implemented ideas are more likely to come from ideators who pay a lot of attention to other ideas in the open idea call. Moreover, we know from research focusing on creativity at the FEI that creative people are likely to possess certain behavioural characteristics such as openness to experience, curiosity and support of other ideas (e.g. Amabile & Gryskiewicz, 1987; Salter, Wal, Criscuolo, & Alexy, 2015; Stock, von Hippel, & Gillert, 2016). To develop an understanding of how successful ideators (i.e. those who come up with ideas that are perceived as useful by the idea-seeker and thus implemented) are likely to behave online will not only be valuable for the (pre-)selection of ideas, it will also be useful to improve the design and management of idea calls in ways that ideators with certain behavioural characteristics are attracted and encouraged to submit ideas. Consequently, Chapter 3 addresses the following research question:

Which characteristics of ideators' online behaviour influence their success in open idea calls?

To shed light on this question, detailed data regarding the ideators' online behaviour during the entire idea call are needed. Publicly available data from an idea call crowdsourced by the city of Munich were therefore collected to provide the data needed. Using a cross-sectional research design, the results reveal that displaying solution-oriented behaviour and showing openness and appreciation towards other ideas are key characteristics of

successful ideators' online behaviour. When looking at these behaviours in more detail, the former is found to be characteristic of ideators who are likely to suggest an idea that is implemented but is only an improvement of an existing (service) product, and the latter is found to be characteristic of ideators who are likely to suggest an idea that is implemented as well as being novel to the unit of adoption. Paying attention to other ideas before suggesting one's own or showing collaborative behaviour by providing constructive input to other ideas are not found to be characteristic of the online behaviour of successful ideators.

1.4.2. Knowledge accumulation and production in the innovation crowdsourcing space

As explained earlier in this introduction, online idea calls not only ask the crowd to suggest ideas, they also allow the crowd to discuss, elaborate or refine the ideas that have been suggested. This can be interesting as idea-seeking efforts, in particular those that invite a diverse crowd consisting of (potential) users with no specific expertise to individually come up with a wide range of ideas on fairly broad topics (e.g. ideas for new products), tend to lead to a wide variety of ideas that are not very well elaborated, lack detail or are even incomplete (Di Gangi, Wasko, & Hooker, 2010). Keeping in mind the fluid conditions in these online innovation collectives, it does not seem very likely that relevant idea-related knowledge will be accumulated through the comments of the crowd. However, first insights gained from research that has analysed the content of such comments (Adamczyk et al., 2011; Füller et al., 2014; Hutter, Hautz, Füller, Mueller, & Matzler, 2011; Seeber et al., 2017) indicate that the crowd's comments should be considered and that relevant knowledge can be gained from these comments and online discussions. This can eventually improve the chances of an idea being perceived as useful and being implemented by the idea-seeker (Di Gangi & Wasko, 2009a; Seeber et al., 2017). Consequently, comments made by the crowd could be very valuable for the idea-seeker to better understand the ideas suggested in such a call, and subsequently to successfully source ideas from the crowd. Understanding the mechanisms that help or hinder knowledge accumulation taking place in this environment is therefore important to making better use of the idea crowdsourcing potential. Chapter 4 therefore focuses on the following research question:

Which idea- and interaction-related factors influence idea-related knowledge accumulation in idea commenting threads?

To address this question, data were collected on all the comments made by the crowd during the previously mentioned idea crowdsourcing call for new digital services in the city of Munich. A cross-sectional research design was then applied to assess which factors influence the accumulation of idea-related knowledge in a commenting thread. Factors

related to the relative advantage of the initial idea, i.e. idea novelty and idea popularity, and factors related to the interaction in the commenting thread are both found to be important for the amount of knowledge being accumulated. Regarding the interaction taking place in the commenting thread, it is important that the first comment is not a negative one and that commenters directly interact with each other. Comments that try to activate other commenters' input are not important for the amount of idea-related knowledge accumulation in the thread.

The insights gained in the empirical studies in Chapters 2 to 4 as well as through the fast-growing number of empirical research that address the different underlying mechanisms of innovation crowdsourcing, clearly show the need for an analytical framework defining the different areas of knowledge production within the innovation crowdsourcing space. Such a framework will make it possible to synthesise the different empirical findings in a meaningful way and to spell out how new ideas and solutions can successfully be sourced from the crowd.

The resulting framework developed in Chapter 5 is based on the work of Whitley (2000) and takes into account the fact that innovation crowdsourcing projects can differ substantially in their cognitive and social dimensions of knowledge production. The framework defines four different areas of knowledge production within the innovation crowdsourcing space depending on the level of uncertainty of the innovation task assigned to the crowd and on the mutual dependency among the crowd to produce the ideas or solutions needed. Using this framework, the integrated literature review addresses the following research question:

What makes innovation crowdsourcing work in different areas of knowledge production?

Analysing the insights gained from 67 empirical studies and synthesising the different factors that influence the production of knowledge in the four different areas, the results show that the mechanisms that are important to make crowdsourcing work differ depending on the area of knowledge production. Consequently, there is no single approach or strategy that will be equally useful for all innovation crowdsourcing attempts. Instead, the ways in which the task is formulated and presented to the crowd, the incentives offered to the crowd and the ways in which the idea- or knowledge-seeking organisation interacts with the crowd will have to differ depending on the area of knowledge production.

Finally, Chapter 6 concludes this thesis by discussing the different insights gained in relation to the overarching research question and the different strands of innovation research they can contribute to. Potential areas for future research are also suggested.

2

Crowdsourcing ideas: Involving ordinary users in the ideation phase of new product development

This chapter is based on:
B. Schemmann, A. M. Herrmann, M. M. H. Chappin & G. J. Heimeriks (2016):
Crowdsourcing ideas: Involving ordinary users
in the ideation phase of new product development.
Research Policy, 45(6): 1145-1154.

ABSTRACT

Online idea crowdsourcing, via long-term open idea calls, is increasingly being used by companies to collect new product ideas from ordinary users. Such open idea calls can result in thousands of suggested ideas and detecting the ones that a company wants to implement can be problematic. Empirical research in this area is lacking. This chapter therefore investigates which ideator- and idea-related characteristics determine whether an idea for new product development (NPD) is implemented by a crowdsourcing company. To answer this question, we use a cross-sectional research design to analyse publicly available data from an open idea call, run by an internationally active beverage producer. Our results reveal that ideators paying major attention to the crowdsourced ideas of others, the popularity of the idea, and its potential innovativeness positively influence whether an idea is implemented by the crowdsourcing company. Contrary to our initial expectations, the motivation of an ideator (reflected in the number of ideas suggested) does not influence the likelihood of an idea being implemented.

2.1 INTRODUCTION

Despite the existing research to improve the understanding of new product development and advances made in this area, the failure rate of newly introduced products is still as high as about 40% (Castellion & Markham, 2013). One major problem is anticipating what the (potential) consumers actually need, i.e. which products they are actually willing to buy. Therefore, knowledge about consumer preferences can be important in distinguishing product success from product failure. Research on the so-called 'front end of innovation' (FEI) has shown that companies can benefit substantially if they effectively manage and improve the early stages of the new product development (NPD)[10] process (e.g. Khurana & Rosenthal, 1998; Reinertsen, 1999; Verworn, 2009). Within the FEI, the most important stages for successful innovation are typically referred to as the ideation phase, where the generation, screening and selection of creative and commercially valuable ideas take place. One way to reduce the risks and uncertainties related to consumer behaviour has been found in a strong user perspective and a deep understanding of user needs during the FEI in general and the ideation phase in particular (Flint, 2002; Kim & Wilemon, 2002; Lüthje & Herstatt, 2004).

Different ways in which users can play an active role in NPD have been emphasised by innovation research over the last 30 years. Ranging from von Hippel's customer active paradigm (von Hippel, 1978a) and customers as a potential source of innovation in Chesbrough's open innovation paradigm (Chesbrough, 2006a) to numerous studies which show that some users actively innovate for their own needs in open source software and other user communities, this literature illustrates how users can be a valuable and active resource within the innovation process in general and for NPD in particular.

More recently online idea crowdsourcing for NPD has become very popular among companies in different industries. According to Howe (2006) 'crowdsourcing is the act of taking a job traditionally performed by a designated agent (usually an employee) and outsourcing it to an undefined, generally large group of people in the form of an open call'. Therefore, crowdsourcing can be used not only for idea generation but for a whole range of tasks. Earlier examples and studies have already highlighted how organisations can potentially benefit from the use of crowdsourcing for different purposes (e.g. Brabham, 2009; Kleemann, Voß, & Rieder, 2008; Poetz & Schreier, 2012). Hoping to gain direct access to the crowd's knowledge of user needs to generate concrete ideas for new products and to use the crowd's expertise to solve problems, companies have increasingly made use of crowdsourcing (for an overview see for example: Bonabeau, 2009; Haller, Bullinger, & Möslein, 2011).

10 In this thesis the term 'product' refers to manufactured goods and service products.

Many online idea crowdsourcing platforms are open to everybody who has access to the Internet and no specific training or expertise are needed to become an ideator and suggest a solution. Unlike open source software or other special-interest communities, such platforms therefore often attract a large crowd of people consisting of ordinary users and not necessarily experts or lead users. In line with Magnusson (2009), we here define an 'ordinary' user to be a user or potential user who is not a lead user and who is not expected to possess any special expertise in a certain area. While some evidence exists that ordinary users can produce more original and radical ideas than professional developers or users possessing superior knowledge of the underlying technology or product (Kristensson, Gustafsson, & Archer, 2004; Magnusson, 2009), research focusing on the involvement of ordinary users is still limited. This chapter therefore focuses on the involvement of ordinary users in online idea crowdsourcing.

Thus far, empirical research on online idea crowdsourcing has focused on the following areas: (1) the motivation of the ideators (e.g. Dahlander & Piezunka, 2014; Frey, Lüthje, & Haag, 2011; Muhdi & Boutellier, 2011); (2) the idea generation process, i.e. the comparison of different idea generation methods (Schweitzer, Buchinger, Gassmann, & Obrist, 2012), the design of online idea contests (Boudreau, Lacetera, & Lakhani, 2011; Walter & Back, 2011) and the effects of crowding on idea selection (Piezunka & Dahlander, 2015); and (3) the outcome of idea crowdsourcing, i.e. the market potential and success of crowdsourced ideas (Kornish & Ulrich, 2013; Nishikawa et al., 2013), the influence of ideator expertise on idea quality (Jeppesen & Lakhani, 2010; Poetz & Schreier, 2012), the influence of cooperative orientation on idea innovativeness in innovation contests (Bullinger, Neyer, Rass, & Moeslein, 2010) and the factors influencing the originality of crowdsourced ideas (Franke, Lettl, Roiser, & Tuertscher, 2013). In sum, scholars focused on ideators' motivation, the crowdsourcing process itself and on explaining the outcome. Although it is highly relevant for the organisation to be aware of the factors determining the outcome of crowdsourcing initiatives and particularly the implementation of crowdsourced ideas, knowledge in this area is limited. This study addresses this research gap. Some of the earlier studies in this area identified ideator or idea-related characteristics that can influence the outcome (e.g. Bayus, 2013; Di Gangi & Wasko, 2009b). Importantly, though, with the exception of Piezunka and Dahlander (2015) who included different dimensions of distance, these two groups of characteristics have so far been studied separately. To better understand the outcome of idea crowdsourcing initiatives, in particular why some ideas are more likely to be implemented than others, it is necessary to include ideator and idea-related characteristics in the same analyses.

Moreover, the majority of research on idea crowdsourcing focuses on temporary online idea contests. These contests run for a few weeks or months and often search for a single

idea or a small number of ideas or solutions to a fairly specific question or problem. Very little research has been conducted on long-term open idea calls. These can last over several years and generate a large number of ideas of very different quality concerning an often rather broad topic, such as ideas for new products. Examples of such open idea calls can be found in different sectors and countries: in the IT sector the IdeaStorm platform operated by the company Dell has already collected more than 23,000 ideas since 2007, the Japanese household goods manufacturer and retail company Muji has crowdsourced about 8,000 ideas so far via its Idea Park platform, and the German-based drugstore chain DM has already managed to generate more than 2,000 new product ideas for its own natural cosmetics brand. As open idea calls can easily result in hundreds or even thousands of suggested ideas, it can be challenging for the crowdsourcing company to detect those which they find worth implementing. Levitt already stated in 1963 that 'ideas are useless unless used' (Levitt, 1963, p. 79). So, the best proof of an idea's value for NPD is its implementation by the company.

In this chapter we therefore investigate the factors determining whether a crowdsourced idea is implemented. More specifically, the aim is to understand the influence of ideator and idea-related characteristics on the likelihood of an idea being implemented in a long-term open idea call. Accordingly, the question we here address is: *Which ideator and idea-related characteristics determine whether an idea suggested in a long-term open idea call is implemented by the crowdsourcing company?*

The contributions of the empirical study in this chapter are twofold. First, we contribute to the literature on long-term online idea crowdsourcing. Thus far, most studies focus on the temporary idea contests. Also, not much is known about what determines whether an idea is going to be implemented by the crowdsourcing company. Second, the outcomes of this study can provide some useful first insight for companies that consider using long-term open idea calls. More precisely, the results can help to understand which ideator and idea-related characteristics explain the implementation of ideas. Based on the findings of this study, companies can for instance try to attract ideators with specific characteristics that appear to be important for the suggestion of ideas that the company finds valuable. Furthermore, the results offer suggestions for the selection of those ideas that are likely to be implemented.

To shed light on the research question we carried out binary logistic regression analyses on a dataset from one of the idea crowdsourcing platforms most widely used, which has been in operation for more than five years. The platform, run by an internationally active beverage producer and retailer, is open to any English-speaking user and contains user ideas and suggestions for product innovations.

The remainder of this chapter is structured as follows. Section 2.2 provides an overview of the literature and the theoretical framework used from which we derive the hypotheses to be tested. Section 2.3 explains the methodology and Section 2.4 reports the results obtained. Finally, Section 2.5 discusses the findings and concludes by highlighting the implications and limitations of the research, as well as areas for future study.

2.2 THEORETICAL BACKGROUND

Idea crowdsourcing can be seen as a part of Chesbrough's open innovation paradigm, which assumes that companies can and should also use external ideas for their innovation purposes (Chesbrough, 2006b). This process is mostly referred to as 'inbound open innovation' (Huizingh, 2011). In the case of crowdsourcing, however, the process builds upon the external ideas of individuals and not of other organisations, such as universities or suppliers (West & Bogers, 2014). To crowdsource ideas for new products, companies can either set up their own online platform to obtain ideas or use an intermediary platform for this purpose. In contrast to ideation which takes place in open source or user innovation communities, it is the crowdsourcing company which controls the ideation process, observes and analyses the user communication and discussion of the ideas suggested and finally decides which ideas will be developed further. The commercialisation of the new products is also carried out by the company. The crowdsourcing company also needs to decide whether to use a temporary online idea contest or a long-term open idea call. In this empirical study we focus on the latter.

2.2.1 The value of crowdsourced ideas

Online idea crowdsourcing is likely to generate a large number of very different ideas, especially if it is carried out as a fairly unspecific call that is open to all ordinary users (Blohm, Leimeister, & Krcmar, 2013). The company then has to filter these ideas with tremendous effort to identify the ones they consider most valuable and therefore worth implementing (Poetz & Schreier, 2012). However, the detection of these potentially valuable ideas is crucial if the crowdsourcing of user ideas is to lead to new products. Thus far, however, little is known about the factors determining which crowdsourced ideas are likely to be implemented. Walter and Back (2011) for instance found that the duration of online idea contests or the strength of the brand have no effect on the average quality of the generated ideas – with the quality being assessed via a crowdsourced rating among the platform users. Moreover, they found that higher rewards offered to successful ideators only lead to a better quality of ideas when offered in highly specific idea contests. In another study, Nishikawa et al. (2013) compared the eventual market success of user ideas generated via an idea crowdsourcing platform with those generated by designers.

They revealed that products based on the chosen user ideas performed better on the market in terms of sales revenues and were more likely to still be on the market three years after introduction. However, these studies do not provide insight into the characteristics of those ideas that will be implemented by the company.

Research by Franke et al. (2013) points to the importance of idea originality. They found that the originality of any ideator's idea is largely random. Poetz and Schreier (2012) showed in an empirical study on ideas for solving a problem concerning baby products that the ideas of ordinary users scored higher than ideas generated by professionals in terms of novelty and customer benefit, but were somewhat lacking in terms of feasibility. This indicates that idea novelty might impact on the potential idea success, i.e. the chances that an idea will be implemented by the company.

In addition to the importance of idea novelty for the implementation of an idea, research has also shown that it might be important to analyse how popular an idea is among the crowd. In their study on the idea crowdsourcing platform Dell IdeaStorm, Di Gangi and Wasko (2009b) show how a very popular idea was adopted by the company.

Some research also analysed ideator-related characteristics of successful ideas. Bayus (2013), who also looked at the crowdsourcing platform Dell IdeaStorm, found that ideators who suggested more than one idea were more likely to generate an idea the company considered worth implementing than ideators who came up with only one idea.

In sum, earlier research in the context of crowdsourcing has shown that it is important to look at the idea novelty and popularity as well as the ideator's activity when aiming to explain the implementation of ideas.

2.2.2 Development of hypotheses

Since empirical research about the outcome of online idea crowdsourcing is still limited, we also use knowledge from three related areas of research to build our hypotheses. Research on (1) user innovation and (2) open source communities has provided important insights concerning the motivation and behaviour of innovating users, and the outcome of (3) creativity research is important for our understanding of idea generation processes.

Research on user innovation has shown that users often play a very active role within product innovation processes (Baldwin, Hienerth, & von Hippel, 2006; von Hippel, 1978a, b). Cases of such user innovations have, for instance, been described for the development of trend sports equipment (Franke & Shah, 2003), computerised library information systems (Morrison et al., 2000) or banking services (Oliveira & von Hippel,

2011). However, research on user innovation has also shown that successful user innovators possess particular characteristics. Von Hippel's lead user concept is therefore based on the assumption that not all users are equally capable of generating and suggesting ideas for new products (Gruner & Homburg, 2000). In contrast to ordinary users those lead users 'face needs that will be general in a marketplace – but face them months or years before the bulk of that marketplace encounters them, and (…) are positioned to benefit significantly by obtaining a solution to those needs' (von Hippel, 1986, p. 796). Therefore, these lead users can not only assist market research as a kind of 'need-forecasting laboratory' but they can also serve companies with concrete new product concepts and even designs, as they tend to develop new products to satisfy their own needs (von Hippel, 1986). Numerous studies on what is often called the lead user method have already proven that the integration of such lead users' ideas and expertise in a company's new product development processes can be very beneficial for the innovation process and its outcome (e.g. Herstatt & von Hippel, 1992; Lilien et al., 2002; Lüthje & Herstatt, 2004).

The Internet has enabled user innovators to collaborate in ways never before possible. The development of open source software via an open source community, viz. a crowd of (lead) users who are capable of writing code and therefore of inventing and continuously developing software for their own needs and the needs of other users, is one of the most important and researched areas here. Just as von Hippel proved for the lead users, the contributors to open source products are strongly driven by their own needs for the software they are developing (Hertel, Niedner, & Herrmann, 2003; Lakhani & Wolf, 2005).

Following up on these literature strands, the first two hypotheses focus on the influence of ideator-related characteristics on the likelihood of an idea being implemented. They are based on the assumption that not all users within the crowd will be able to generate the same quality of ideas. As we know from the lead user research mentioned earlier, the motivation of such users to come up with ideas and solutions is very high, as they expect to obtain great benefit from the solution to their needs (Lüthje, 2004; von Hippel, 1986). Therefore, they often voluntarily interact with other users or innovate collaboratively in innovation communities (Franke & Shah, 2003). Frey et al. (2011) found that the intrinsic enjoyment of contributing is positively associated with the number of relevant postings i.e. postings that were relevant for the final solution proposal. A high level of intrinsic motivation, which is reflected by the suggestion of more ideas, will therefore result in better ideas. As mentioned above, this is supported by the findings of Bayus (2013) concerning the potential success of ideas obtained from ideators who suggest more than one idea. To assess whether the ideas that are implemented are more likely to come

from those ideators within the crowd of ordinary users who suggest many ideas, the first hypothesis to be tested in this study therefore is:

H1 *Highly motivated ideators who suggest many ideas are more likely to suggest ideas that are implemented than less motivated ideators who suggest only few ideas.*

Research has shown that users who innovate to satisfy their own needs also differ from other users in the way they interact within the community. Franke and Shah (2003) found that, within voluntary special-interest sports-related communities, those users who improved existing products or even created new products spent significantly more time with the community than users who did not. A study on a community-based innovation contest for student teams carried out by Bullinger et al. (2010) showed that curiosity and support for other ideas were important characteristics of potentially successful ideators. This is in line with a number of studies related to creative processes and idea generation within groups. They have shown that idea sharing and the exposure to other creative ideas can enhance one's own creativity, which eventually leads to the production of not only larger numbers of ideas but also more creative ones (Garfield, Taylor, Dennis, & Satzinger, 2001; Nijstad & Stroebe, 2006; Paulus & Yang, 2000). Despite the risk that the attention towards other ideas and the interaction between ideators might negatively influence the development of ideas, because ideators build on already existing ideas (Girotra, Terwiesch, & Ulrich, 2010), we assume that ideators who pay major attention to the ideas of other ideators will come up with more creative ideas which are therefore more likely to be implemented. This leads to the second hypothesis:

H2 *Ideators who pay major attention to the ideas of others are more likely to suggest ideas that are implemented than ideators who pay little or no attention to the ideas of others.*

As mentioned above, the characteristics of an idea, such as popularity or novelty, can also impact on the likelihood of an idea being implemented. Idea popularity can be important, because it can be seen as an indicator for user interest in the idea and the future product. Therefore, some online idea generation platforms try not only to crowdsource the ideas, but also to involve the crowd of ordinary users in the discussion and pre-selection of ideas. On many idea crowdsourcing platforms users can vote whether they like, or dislike, a proposed idea. Such pre-selection mechanisms are based on the idea of collective intelligence, or the so-called 'wisdom of the crowds' as described by Surowiecki (2004). Based on the presentation of very different cases, he argues that decisions based upon the views or votes of a large group of independently deciding individuals are often better and more precise than decisions made by an elite few, no matter how distinguished the

latter maybe. As mentioned earlier, Di Gangi and Wasko (2009b) found some indication for a positive relationship between idea popularity and idea implementation. The third hypothesis to be tested in this study therefore is:

H3 *Ideas that are on average popular with the crowd are more likely to be implemented than ideas that on average were identified as unpopular.*

Several studies also stress the importance of idea novelty for the success of NPD (e.g. Dahl & Moreau, 2002; Howell, 2005). Despite warning that user involvement during the ideation phase will at best produce very incremental innovations (Alam, 2006a), the involvement of users in the generation of ideas for NPD has been proven to enhance the novelty of the ideas produced (Kristensson, Magnusson, & Matthing, 2002). As stated in the introduction of this chapter, the development and introduction of new products is a risky process. To avoid such risks, companies could therefore prefer those ideas which contain little or no innovative potential (e.g. those ideas which ask for the reintroduction of a product or an extension of an already existing service). These are also often easier to implement. However, research by Witell, Löfgren, and Gustafsson (2011) showed that users were not only capable of coming up with new, potentially innovative product ideas. More importantly, they also found that the ideas identified as being attractive for NPD were more original than those ideas which were judged less promising. Therefore, it can be argued that ideas which possess some innovative potential are more likely to be chosen for implementation than ideas which do not. This leads to the fourth hypothesis:

H4 *Ideas that are potentially innovative are more likely to be implemented than ideas that are not potentially innovative.*

2.3 METHODOLOGY

In order to study which ideator and idea-related characteristics determine whether an idea is implemented, we use a cross-sectional research design. The unit of analysis is the crowdsourced idea. While the following insights are based on quantitative analyses, we offer additional anecdotal evidence to illustrate the findings of this study from a qualitative perspective.

2.3.1. The data

The study uses publicly available data from an online idea crowdsourcing platform run by an internationally active beverage producer and retailer. The launch of the highly popular

idea crowdsourcing platform was part of a larger company attempt to focus more on its customers, their needs and their ideas.

The platform is very suitable for the purpose of this research, as it contained about 90,000 crowdsourced ideas at the time of our data collection. Consequently, it constitutes one of the largest open idea crowdsourcing platforms that are publicly available. Moreover, the platform offers the information needed for our analyses. Importantly, the platform publicly states which ideas have been reviewed and whether they have been implemented or rejected. This is essential, because information about rejected ideas is often not available on comparable platforms. Furthermore, it is an open ongoing idea call rather than a temporary idea contest and does not offer any financial rewards to the successful ideators. The platform is open to every (English-speaking) user and no special expertise is needed to suggest an idea. It generates a wide variety of ideas concerning manufactured and service products, as well as processes. It is also attractive because the company is not an IT, software or technical enterprise – whose users might naturally be more open and used to online crowdsourcing – and operates in an industry of the consumer product sector, which offers products used by a very wide and diverse group of customers.

The platform works as follows. All Internet users can register free of charge to become a member of the online community. Members can then share their ideas with the company and other users alike, place comments on other users' ideas, or simply vote whether they like or dislike an idea. These are typical functions of idea crowdsourcing platforms. Members are free to suggest all sorts of ideas for new products or processes. Those members who comment a lot on other users' ideas receive a virtual badge, which is visible to all platform visitors. All comments on ideas are publicly visible and all members can react to other users' comments. The first step of the company's idea evaluation process consists in identifying a subset of those ideas to be considered in more detail. To this end, the ideas are first evaluated by a selected group of more than forty employees of the crowdsourcing company, who are regarded as experts in their respective fields. There are two ways in which these experts can create a subset of ideas to be considered further.

First, the company uses an algorithm that identifies potentially valuable ideas. This algorithm[11] takes into account when the idea was suggested and the number of votes and comments it has received. Second, in addition to this algorithm, the expert employees

11 It can be expected that if the company used a different algorithm, this may well lead to a slightly different subset of crowdsourced ideas being considered by the company. However, we think that this would hardly change the results of our study, because – as indicated by the descriptive statistics – the ideas studied vary systematically on all independent variables under investigation. This, in turn, makes it possible to assess the effect of these ideator and idea-related characteristics on the likelihood of implementation.

are also free to consider any other idea they find promising. The second step consists in the evaluation of the pre-selected ideas by these experts. The experts will then present the ideas they consider most promising to the company's key decision makers and recommend how the selected ideas can be implemented in a third step. In a fourth step, a final decision is taken about the ideas to be implemented. Once this process is completed, all platform visitors can see whether the idea has made it so far as to be reviewed by one of the experts and whether it has been implemented or rejected by the company.

We designed our empirical approach as follows. In spring 2012, we collected publicly available data on 92,382 ideas that were included in the platform at that time. Out of these 92,382 ideas, 348 had already been implemented or were in the process of being implemented, 230 ideas were currently under review and 1,108 ideas had been reviewed but were rejected. This implies that the majority of the crowdsourced ideas (namely 90,696 ideas) had not (yet) received any kind of consideration by the company experts. Since this research aims to understand why some ideas are implemented while others are not, only those ideas that have been reviewed can be included in the further analyses. In other words, we had to exclude those ideas that had not been considered by the company at the time we collected the data, because we could not determine whether these ideas would eventually be implemented or rejected. Consequently, the following analyses consider neither those ideas that have not been reviewed by the company experts nor those that were in the process of being reviewed in spring 2012. Therefore, the final dataset used contains those 1,456 ideas for which the company's review process was completed.

2.3.2 Measurement

The dependent variable is the company's judgement of an idea to be of value for NPD with the result that the idea is either *implemented or rejected*. Consequently, the dependent variable is dichotomous and is operationalised with the use of the idea status indicated in the platform: ideas which are implemented or in the process of being implemented by the company are coded as 1. Rejected ideas are coded as 0.

The independent variable *ideator motivation* (H1) is measured as the total number of ideas suggested by the respective ideator. For each idea the ideator suggested on the platform the respective idea receives 1 point. In order to correct for the skewed distribution of values on the variable, the respective square root values are calculated and used in the analyses.

The independent variable *attention paid to other ideas* (H2) is operationalised on the basis of the commenting behaviour of each ideator. The platform enables every member

to read all ideas and to comment on them. Members who are very active in commenting are publicly acknowledged by the company. The *attention paid to other ideas* variable is thus dichotomous and assumes a value of 1 if the ideator of the respective idea has been acknowledged for his or her active commenting behaviour and a value of 0 if this is not the case.

To operationalise the third independent variable, we use the voting behaviour of the crowd. All registered users have the opportunity to vote once on every idea posted, indicating whether they like or dislike it. Each positive vote counts 10 points and each negative vote counts -10 points, which implies that most ideas obtain either a positive or a negative final result. An average outcome of 0 points, i.e. the same amount of positive and negative votes or no votes at all, is rare (only 71 ideas). The independent variable *idea popularity* (see H3) is therefore a dichotomous variable, with a value of 1 for all ideas that overall receive a positive voting result and a value of 0 for all ideas that overall receive a negative voting result. The 71 ideas which have been reviewed by the company but have received neither a positive nor a negative result have been discarded from the analysis, as we cannot determine the popularity of these ideas.

The ideas generated via the online platform differ regarding their novelty and potential innovativeness. The ideas were therefore analysed to assess whether, or not, they contained any innovative potential. It was assumed that some users also used the crowdsourcing platform to publish their complaints concerning goods or services, or to ask the company for price reductions. Such suggestions are, in our view, not innovative. The same holds for crowdsourced ideas that ask for the reintroduction of products that were offered by the company in the past. Based on these assumptions, we analysed the ideas by their title and coded them on the basis of whether they are potentially innovative. Ideas with the following suggestions or requests are considered not to be innovative: reintroduction of previous products; simple price reductions or products for free; feedback, customer complaints or criticism; requests for additional store locations, for more products of an already existing kind or for an extension of an already existing service. On the other hand, ideas with the following suggestions or requests are considered to be potentially innovative: introduction of products or processes that are new (to the company); advertising or pricing ideas which go beyond a simple price reduction or a request for free products; suggestions for improvements of existing products or processes; products for a new target group; new product combinations within the existing product range; and technological advancements or ideas concerning the company's corporate social responsibility. For 369 ideas it is not possible to determine whether they are potentially innovative according to the aforementioned parameters. These ideas are therefore coded as 'not possible to determine'.

Even though no particular expert knowledge of the beverage and retail sector is needed to code the various ideas according to these parameters, we also asked a food marketing expert to code a subset of the ideas according to the aforementioned parameters in order to cross-check our classification. An interrater reliability analysis using the Cohen's kappa statistic was performed to determine consistency among coders. The interrater reliability was found to be Kappa = .653 ($p < .001$), which shows that there was substantial agreement between the two raters. The differences between the two raters occurred mainly in cases that were coded as not identifiable by rater 1 versus not potentially innovative by rater 2. We decided to follow the more conservative coding. The independent variable *idea innovativeness* (H4) is therefore dichotomous with a value of 1 if the idea is potentially innovative and a value of 0 if this is not the case. Ideas which do not allow for such judgement by their title are coded as missing values (counts for 25.3% of the cases).

To control for unobserved temporal factors which might influence the number of ideas implemented, such as the amount of attention that the company paid towards the crowdsourced ideas in different years or when different annual budgets for NPD were available, we added *time* as a control variable into our analyses. To this end, we constructed dummy variables for each year of the idea call. More concretely, all ideas suggested in the first calendar year of the call receive a value of 1; all ideas suggested in the second calendar year receive a value of 2 and so forth. We compared the results obtained from controlling for time on the basis of separate year dummies with the results obtained when a single time dummy, ranging from 1 to 5, was used. As we observed no differences in the results based on these alternative controls, we decided to use the single variable for reasons of simplicity.

To enable a better understanding of the ideas suggested on the platform and of the variables used in the analyses, we report two sample ideas in Textbox 2.1.

2.3.3 Analysis

Given that the dependent variable is a binary variable, we conduct a binary logistic regression analysis. We run three different models. In the first model, we only include the control variable, i.e. *time*. In the second model, the independent variables are included. Finally, the third model includes the control variable together with the independent variables. In addition to conducting these quantitative analyses, we also offer some systematic anecdotal evidence illustrating the findings in a qualitative manner.

Textbox 2.1

Sample idea to illustrate an idea that was reviewed and implemented
Idea title: 'Bite size pastries' The idea asks the company to introduce bite size pastries with new flavours. It was proposed by an ideator who suggested 61 ideas via this platform. This ideator also paid major attention to other ideas. The idea of bite size pastries was popular among the crowd and received overall 605** positive votes. Given that the idea suggests a potentially new product, we coded the idea as potentially innovative. The company decided to implement this idea.
Sample idea to illustrate an idea that was reviewed and rejected
Idea title: 'Have the previous logo on the *COMPANY NAME* drinks' This idea asks for the re-introduction of the previous company logo on a certain product range. The ideator did not suggest any other idea and did also not pay major attention to other ideas. The idea was unpopular among the crowd and received overall 15** negative votes. We coded this idea as not be innovative, because it merely asks to bring back something that already existed in the past. The company rejected this idea.

** One-tenth of the number of positive or negative points that an idea received.

2.4 RESULTS

Table 2.1 provides an overview and descriptive statistics of the variables used. It shows that about a quarter of the ideas were judged as valuable and therefore implemented. Interestingly, only a small number of the ideas were suggested by ideators who paid a lot of attention to other ideas. Furthermore, about two-thirds of the ideas were popular and almost half of the ideas were potentially innovative.

The results for the binary logistic regression are shown in Table 2.2. The tests of all models against the respective constant-only model are statistically significant, indicating that the predictors together reliably distinguished between an idea being implemented or not. Nagelkerke's R^2 is .208 for model 1, and .193 for model 2 and .295 for model 3.

In an assessment of the predictive power of each independent variable for model 3 the Wald criterion shows that the variables *attention paid to other ideas*, *idea popularity*, *idea innovativeness* and the *time* control variable made a significant contribution to the prediction. These findings are in line with model 2 and model 1. Only the independent variable *ideator motivation* is not statistically significant.

The results regarding the control variable *time* remain largely unchanged and significant at a .01 significance level for both model 1 and model 3. The results for model 3 show that the odds of an idea being implemented decrease by a factor of .552 when time increases by 1, keeping other variables constant. In other words, at the start of the crowdsourcing platform more ideas were implemented. Therefore, it is also important to control for time.

Table 2.1 Summary statistics for dependent, independent and control variables

Variables	N	Minimum	Maximum	Mean	Std. Deviation
Dependent variable					
Idea implemented or rejected	1456	0	1	.24	.427
Independent variables					
Ideator motivation*	1456	1	23.19	1.79	2.299
Attention paid to other ideas	1456	0	1	.07	.248
Idea popularity	1385	0	1	.66	.473
Idea innovativeness	1087	0	1	.44	.497
Control variable					
Time	1456	1	5	3.40	1.213

* The variable was normalised using a square root transformation.

Following hypothesis H1, we would expect that ideas which are implemented are more likely to come from highly motivated ideators who suggest many ideas than from less motivated ideators who seldom suggest ideas. The results however show that there is no empirical support for this hypothesis at a .05 significance level. We find no indication that the motivation of the ideator to suggest many ideas determines whether an idea is implemented. Thus H1 is not supported by empirical evidence.

Hypothesis H2 leads to the expectation that ideas that are implemented are more likely to come from ideators who have paid major attention to other ideas. Net of other variables, the results show that the odds of an idea being implemented are 2.774 times higher for ideas that are suggested by ideators who pay major attention to the ideas of others when compared to ideas that are suggested by ideators who pay little or no attention to the ideas of others. Empirical support for this hypothesis is found at a .05 significance level.

Following hypothesis H3, we would expect that ideas that are implemented are more likely to be popular with the crowd of users than ideas which are judged not valuable. The results shown in Table 2.2 support this hypothesis by empirical evidence at a .01 significance level. Net of other variables, the results show that the odds of an idea being implemented are 3.787 times higher for ideas that are on average popular with the crowd when compared to ideas that are on average unpopular with the crowd. In line with hypothesis H3, we thus find that the popularity of an idea actually determines whether an idea is implemented.

Hypothesis H4 leads to the expectation that ideas that are potentially innovative are more likely to be implemented by the company. The results show that the potential

Table 2.2 Binary logistic regression of *ideator motivation*, *attention paid to other ideas*, *idea popularity* and *idea innovativeness* on idea implementation
(Results of binary logistic regression analyses: odds ratio Exp(*b*) presented)

	Model 1 control variable only		**Model 2** all independent variables		**Model 3** full model	
0 = Rejected ideas 1 = Implemented ideas	***b***	**Exp*(b)***	***b***	**Exp*(b)***	***b***	**Exp*(b)***
Constant	1.326**		-2.892**		-.444	
Ideator motivation			-.085	.919	-.135	.874
Attention paid to other ideas			.907*	2.476*	1.020*	2.774*
Idea popularity			1.893**	6.638**	1.332**	3.787**
Idea innovativeness			1.033**	2.809**	.944**	2.570**
Control variable: time	-.744**	.475**			-.595**	.552**
N	1037		1037		1037	
$R^2_{\text{Nagelkerke}}$	.208		.193		.295	

* *p*-value <.05; ** *p*-value < .01
model 1: chi-square = 161.260, *p* = .000 with df = 1
model 2: chi-square = 148.656, *p* = .000 with df = 4
model 3: chi-square = 237.363, *p* = .000 with df = 5

innovativeness of an idea significantly increases the likelihood of the idea being implemented. Thus, empirical evidence also supports H4 at a .01 significance level. Net of other variables, the results show that the odds of an idea being implemented are 2.57 times higher for ideas that are potentially innovative when compared to ideas that are not innovative.

We also conducted the following three types of robustness checks to assess the sensitivity of the results to changes in model specifications.

First, since some ideas which were analysed had been suggested by the same ideators, the observations for the independent variables *ideator motivation* and *attention paid to other ideas* might not be completely independent. To control for this, we also ran the analysis with clustered robust standard errors. The results remained the same.

Second, as already mentioned in the measurement section we also replaced the continuous *time* control variable with a categorical dummy variable for each calendar year. It does not lead to any significant differences in the results based on the alternative controls for time.

Third, we omitted in our models those 71 ideas which had neither a positive nor a negative popularity score. To assess their impact on the results, we first coded these

71 ideas as having received a positive popularity score. When re-running the analyses, the results remained stable. We obtained similarly stable results when subsequently re-running the analyses while including the same ideas after having assigned them a negative popularity score.

Overall, these additional analyses demonstrate the robustness of the results reported in Table 2.2.

Based on a Mill's method of difference design (see Hancké, 2009), the following anecdotal evidence corroborates our quantitative findings from a qualitative perspective. First, let us consider the examples of an implemented and a rejected idea each that, regarding our independent variables only differ in the attention that the ideator paid to other ideas. The implemented idea with the title *'Bring back the "real" *REGISTERED TRADEMARK* bears.'* was suggested by an ideator who paid major attention to other ideas. The rejected idea *'Gold Card choices! offer some different rewards Please!',* on the other hand, was suggested by an ideator who paid no major attention to the ideas of others. Both ideas were proposed by ideators who suggested a similar number of ideas each and both ideas received a similar number of positive votes. Both ideas were considered non-innovative, as they asked for the reintroduction of a product and for free products, respectively. These two samples illustrate the quantitative finding that ideas from ideators who paid major attention to other ideas are more likely to be implemented than ideas from ideators who did not do so.

Second, let us turn to two sample ideas which, regarding our independent variables, differ only in terms of their popularity. The idea *'What about coffee + alcohol?'* received 26 negative votes and was rejected by the company, whereas the idea *'Sell reusable sleeves'* received 3298 positive votes was implemented. Both ideas were proposed by ideators who suggested two ideas each and paid no major attention to other ideas. Both ideas were considered potentially innovative as they suggested a possibly new product offer. Consequently, these two sample ideas illustrate the positive effect of an idea's popularity we observed in the quantitative analyses.

Third and finally, let us turn to two sample ideas which, regarding our independent variables, differ only in their potential innovativeness. The idea *'Please bring back the former paper cup (or cup manufacturer)'* was considered non-innovative and rejected by the company, whereas the idea *'polycarbonate-free travel cups',* which was considered potentially innovative, was implemented. Both ideas came from ideators who suggested a similar number of ideas and neither ideator paid major attention to other ideas. Both ideas received a similar number of positive votes. These examples illustrate the

quantitative finding that potentially innovative ideas are more likely to be implemented than non-innovative ideas.

2.5 DISCUSSION AND CONCLUSION

This study provides insight into the ideator and idea-related characteristics that determine whether an idea suggested by an ordinary user in a long-term open idea call is implemented. We first assessed two important ideator-related characteristics: ideator motivation and attention paid towards other ideas. The results show that – contrary to our expectations – highly motivated ideators who suggest many ideas are not more likely to generate ideas that are implemented than those users who only suggest one or a few ideas. The intrinsic enjoyment of the ideator to contribute ideas to a crowdsourcing platform does not lead to the generation of 'better' NPD ideas for the crowdsourcing company. This challenges the findings of Bayus (2013), who found that those ideators who suggested two or more ideas to the Dell IdeaStorm platform were more likely to suggest an idea the organisation finds valuable enough to implement than those ideators who suggested only one idea.[12] This might be explained by the fact that an open idea call for IT goods and services might attract a different kind of crowd than an open call for food, beverage and retail ideas. Possibly the former attracts more users with special expertise than the latter.

Regarding the second ideator-related characteristic, we find – in line with creativity research – that the attention the ideator pays to other ideas positively influences the likelihood of an idea to be implemented. The findings of this study are also in line with the findings of Franke and Shah (2003) and Bullinger et al. (2010), who saw similar effects for ideation in special-interest sports-related communities and an idea competition for university students. Our results indicate that this does not only hold for users with a certain expertise but also for the ordinary users in online idea crowdsourcing.

Furthermore, the results show that idea popularity, based on a simple like or dislike rating mechanism, indeed constitutes an important characteristic of ideas that are to be judged as valuable for NPD by the company. While not every ordinary user might be able to come up with innovative or valuable ideas, the crowd of ordinary users is collectively capable

12 Due to the fact that the ideator motivation variable was not far off being significant at .05 significance level in model 3 and also indicated a negative relationship with the dependent variable, we also tested a different model in which we replaced the original continuous ideator motivation variable with a dichotomous variable analogous to the one used by Bayus. The result, which was significant at .01 significance level, showed that ideas which were implemented were in fact less likely to come from ideators who suggested more than one idea than those ideas, which were rejected (Exp(b) = .536).

of identifying those ideas that are valuable for the company. An area that needs further assessment is to what extent a high number of positive votes also exerts some pressure on the company, thus increasing the likelihood of such ideas being implemented.

Finally, the results of this study illustrate that ideas that are potentially innovative are more likely to be implemented than ideas that are not innovative. Academics who are sceptical about the involvement of ordinary users during the ideation phase warn that this will not lead to the implementation of really new ideas (Alam, 2006a; Bennett & Cooper, 1981). Our study, however, demonstrates that too much scepticism is unfounded. While we cannot determine how radically innovative – and therefore 'risky' – the crowdsourced ideas are, the results show that crowdsourcing during the ideation phase of NPD leads to the generation of ideas that are, potentially at least, new to the company – and thus valuable for the company. No indication was found that online idea crowdsourcing mainly leads to the implementation of 'safe' ideas which contain no innovative potential at all. Our findings therefore show that the usefulness of idea crowdsourcing goes beyond improving a company's customer orientation image (Fuchs & Schreier, 2011) or being an online campaign that helps to gain publicity and visibility (Djelassi & Decoopman, 2013).

Like all research, this study also has its limitations and raises suggestions for further research.

First, the study is solely based on the publicly available data generated from a single platform of an international player in the beverage production and retail industry. Even though the data used is extensive and the platform used is one that had been in operation for five years at the time of the analysis, our findings may not be completely applicable to idea crowdsourcing in other industries. But with respect to similar open idea calls in comparable industries we consider the results to be applicable. We consider those open idea calls to be similar that are comparable regarding the predicted outcome of the task that the crowd has been given, regarding the kind of crowd involved to fulfil this task, and regarding the degree to which the individual crowd members depend upon each other to do so. These considerations are based on Whitley's (2000) framework for understanding the different properties of idea generation stating that differences in knowledge development can be conceptualised along the dimensions of 'task uncertainty' and 'mutual dependency'. Task uncertainty concerns the unpredictability of task outcomes. While all idea generation activities are uncertain, since outcomes are not repetitious and predictable, some ideation tasks are inherently more uncertain than others. Some crowdsourcing tasks are more standardised, and there is an (implicit) understanding of the types of solution required. Since in our study the call was very open and scarcely

standardised there is greater uncertainty due to a wider scope of different types of contributions. Mutual dependency refers to the extent to which a community relies upon knowledge provided by others inside and outside the community in order to make a significant contribution (Whitley, 2000). In this sense, the outcome of an idea generation activity depends on strength of connection and frequency of interaction. In this study, though, we focus on ordinary users who do not rely on other knowledge but perform tasks alone, needing no specific training or expertise to become an ideator. Analyses of data from other long-term open idea calls in comparable and different industries will be useful to verify our claims.

Second, the empirical study in this chapter only uses data which was publicly available on the platform. This already provides interesting insight into the effect of ideator and idea-related characteristics on idea implementation. More refined measures of ideator-related characteristics (for instance the exact number of comments made by an ideator) or idea-related characteristics (for instance the actual innovation potential of the ideas suggested) might be useful to gain even deeper insights. Along those lines, further research on ideator and commenter behaviour and interaction on such platforms would be interesting. Even though our dichotomous variable that measured the attention ideators paid to other ideas is useful as a starting point, additional behaviour and interaction-related measurements might lead to greater insights.

Third, because the participants of such open idea calls are usually allowed to stay anonymous, data on the personal characteristics of ideators – such as their age, gender or location – were not available to us. Nevertheless, it could certainly be valuable to assess how such additional control variables impact on the results obtained.

Last, in this quantitative research we were interested in the relationships in terms of effects between ideator and idea-related characteristics and idea implementation. Future qualitative research may provide insights in the underlying mechanisms, thus complementing our results.

Despite these limitations, this empirical study contributes to a better understanding of ordinary user involvement in NPD via online idea crowdsourcing. Most of the previous idea crowdsourcing research focused on temporary idea or problem-solving contests rather than ongoing idea calls. Given that such competitions often attract experts who compete for suggesting the best solution to a specific problem, this chapter contributes novel insight about crowdsourcing new product ideas from ordinary users. Consequently, the findings of this study do not only speak to the literature on idea crowdsourcing but also to those literature strands that investigate the role of users within the innovation process, most notably the literatures on (lead) user innovation and open source innovation.

More concretely, we contribute to these research strands by investigating whether the involvement of ordinary users can be valuable, and in what way, during the ideation phase of NPD. In particular, we illustrate which ideator and idea-related characteristics can help to identify those user-generated ideas that are of potential interest for companies. Due to the large numbers of ideas that are often being generated, this is crucial for the success of the crowdsourcing and therefore the NPD process.

The findings of the study in this chapter, therefore, also bear some practical and managerial implications for companies or organisations that consider using open calls to crowdsource ideas for their NPD. First, companies should be aware that those ideators who suggest many ideas on such platforms are not necessarily the most useful for obtaining the kind of ideas that the company wants to implement. Thus, incentives that reward the suggestion of a large number of ideas by the same ideator might only result in more ideas which are not necessarily those that the company perceives as valuable. Instead, ideators should rather be stimulated to pay attention to the ideas suggested by others, as this seems to have a positive effect on the quality of the ideas suggested. Second, given that the wisdom of the crowd helps to identify ideas that are perceived as valuable, even simple online voting systems can constitute a meaningful tool for platform-integrated market research.

3

The right kind of people: Characteristics of successful ideators' online behaviour

This chapter is based on:
B. Schemmann, M. M. H. Chappin & A. M. Herrmann (2017):
The right kind of people: Characteristics of successful ideators' online behaviour.
Creativity and Innovation Management, 26(3): 277-290.

ABSTRACT

Open online idea calls are an increasingly popular way to crowdsource ideas. Such calls tend to attract a diverse crowd that suggests a variety of ideas. To detect the most promising from this mass of ideas, we identify online behavioural characteristics of successful ideators, i.e. those who suggest ideas that are implemented. The research in this chapter is based on binary logistic regression analyses of a dataset from a call for ideas crowdsourced by the city of Munich. We found that characteristics linked to suggesting possible solutions and to showing positive attention towards other ideas are key features of how successful ideators behave online. We also found that the first is a characteristic of ideators who are likely to suggest an idea that is implemented but not novel. The latter is a characteristic of ideators who are likely to suggest an idea that is implemented and novel. Paying attention to other ideas before suggesting one's own and providing constructive input to other ideas are not found to be characteristics of successful ideators. The findings contribute to a better understanding of successful ideators' online behaviour and thereby open up new opportunities for the detection of ideas that the idea-seeker wants to implement.

3.1 INTRODUCTION

A growing number of companies and organisations use online idea calls not only to generate ideas for new goods or services but also to find solutions to societal needs or ecological problems. Current examples are calls for product ideas launched by companies like Dell, Starbucks and Muji, as well as calls targeting societal or governmental topics organised by the Office of the United Nations High Commissioner for Refugees (UNHCR), the European Commission or numerous municipalities or governments worldwide. Unlike online idea contests, these online idea calls are not searching for one single, or very few, winning idea(s) or solution(s). Instead, organisations using such calls aim to generate – and eventually implement – a wide variety of valuable ideas, taking advantage of external knowledge and creative input for innovation and product development purposes. Calls for ideas can last a few weeks or even several years and tend to attract a diverse crowd of ideators to suggest their ideas. Consequently, calls typically result in a broad variety and often large numbers of ideas, and detecting the most promising ones can be an issue for the idea-seeker and require tremendous effort (Poetz & Schreier, 2012; van den Ende et al., 2015).

From research on user innovation and user involvement in new product development, we know that some people are more capable of coming up with innovative ideas than others (Lüthje, 2004; Schweitzer, Gassmann, & Rau, 2014; von Hippel, 1986). This difference has also been identified by studies on online idea generation (often referred to as 'idea crowdsourcing'). Looking at an idea contest for new online services, Schuhmacher and Kuester (2012) found that ideators with a lot of use experience and who are dissatisfied with existing services provide ideas of higher quality, as assessed by expert ratings of idea novelty, feasibility and relevance. Focusing on an online design contest, Füller, Hutter, and Faullant (2011) showed that ideators with a positive co-creation experience, which is based on a feeling of autonomy, competence and task enjoyment as well as on that of being part of the community, are more likely to deliver high quality designs based on expert ratings. However, at least when it comes to the ideators' ability to come up with original or novel ideas, it is still not that easy to explain why some ideators suggest better ideas than others. Franke et al. (2013) assessed (among other factors) the influence of a range of different ideator-related characteristics, such as expertise, creativity, motivation or outsiderness, on the degree to which the ideas suggested by the ideator differ from existing paradigms and involve new functions. They found these ideator-related characteristics not to be important for the outcome.

The analysis of ideators' behaviour during the idea generation (or ideation) process provides another perspective on the question why some ideators come up with better

ideas than others. Bullinger et al. (2010) focused on the cooperative behaviour shown by teams of ideators in the competitive setting of an online community-based innovation contest. They found that teams that show very high as well as very low cooperative behaviour towards other teams tend to suggest ideas that received high ratings for their novelty and usefulness. While Bullinger et al. (2010) (like the studies mentioned in the previous paragraph) used survey data or focus groups to gain insight into the behaviour of ideators, the following research mentioned in this paragraph used data that became available during an online ideation process. Also in the competitive setting of a contest – in this case an online design contest – Kathan et al. (2015) used data from online commenting and found that those ideators who show direct or indirect reciprocal cooperative behaviour by assisting other ideators through commenting on their ideas are likely to suggest design ideas of highest quality. Using data from the non-competitive Dell IdeaStorm platform, Bayus (2013) found that, for serial ideators, past success is negatively related to the diversity of any future suggestions and so negatively influences the likelihood of them suggesting additional ideas that will be implemented. By looking at the commenting behaviour, he found that this effect is somewhat mitigated for ideators who commented on a wide set of others' ideas.

Although not within the context of online idea calls or contests, the importance of interaction behaviour during the ideation process for the ideation outcome is also reflected by some literature that focuses on company-internal innovation. In line with the insight that within the idea initiation phase of company-internal innovation processes the structure and content of social networks among colleagues are important for idea acceptance (Kijkuit & van den Ende, 2010), some studies have analysed the influence of an employee's networks on that employee's innovative performance. They found that, while more connections within the network result in a higher proportion of high-quality ideas (Björk, Di Vincenzo, Magnusson, & Mascia, 2011; Björk & Magnusson, 2009), larger numbers of structural holes in such a network lead to lower-quality ideas (Björk et al., 2011), with both high and low quality being based on the novelty and usefulness of the idea. However, it is not only the size and structure of the networks that matters. Again not focusing on online idea calls or contests, but this time looking at innovators outside companies, research on innovating users revealed that these innovators show a certain interaction behaviour: Franke and Shah (2003) found that innovators in voluntary special-interest sports communities often share innovation-related information during the ideation process, and Lüthje (2004) showed that innovating users of outdoor sport products can be identified by their intensive search for information about new products.

Taking these insights into account and also knowing that creative behaviour is based on particular traits, such as being more open to new experiences, more self-confident and

more ambitious (Feist, 1998, 2010), we deem it important to pay attention to the online behaviour of ideators in idea calls when trying to understand the ideation outcome. While the studies mentioned before focus on explaining why some ideators do better with regard to suggesting more ideas or ideas of better quality – based on either expert or peer ratings that assess idea novelty, feasibility, relevance or usefulness – they do not explain why some ideators are more likely to come up with ideas that are actually later taken up and implemented. Only the study by Bayus (2013) contributes to this question, but with a special focus on serial ideators. However, following Levitt's statement that 'Ideas are useless unless used. The proof of their value is their implementation' (Levitt, 1963, p. 79), it is especially important to pay attention to those ideators who are likely to suggest ideas that the idea-seekers will implement. Despite the already emphasised importance of different ideator behaviour, it still remains unexplored as to whether ideators' online behaviour can be used to detect those ideas that are likely to be implemented and, if so, to identify online behavioural characteristics of those ideators likely to be successful. Interestingly, though, the impact of online interaction, such as votes and comments in online idea generation, has mainly been analysed in relation to the idea or ideator being commented on (e.g. Dahlander & Piezunka, 2014; Di Gangi & Wasko, 2009b). To our knowledge, the online behaviour of ideators (for example, voting or commenting) and how this online behaviour relates to their likelihood of being successful (which we define as suggesting ideas that are implemented after being proposed)[13] in the setting of an idea call has received little academic attention so far. Addressing this gap in the research, this chapter focuses on the following question: *Which characteristics of ideators' online behaviour influence their success in open idea calls?*

To shed light on this question, we carried out binary logistic regression analyses using a dataset that we composed on the basis of an open online idea call administered by the city of Munich. Running from December 2010 to February 2011, the call invited citizens to propose ideas for new digital services in Munich.

The relevance of our study is confirmed by the increasing popularity of, and academic attention paid to, the generation of ideas online over the past ten years. Given the crucial role of successful ideators within this process, it is particularly important to learn more about their online behaviour. This is even more relevant, because idea calls typically guarantee the anonymity of ideators. Therefore hardly any information about their demographics or expertise is available. At the same time, such idea calls produce rich data on ideators' online behaviour. Analyses of these data thus seem important in singling out successful ideators.

13 From now on referred to as 'idea(s) that is/are implemented'.

Our contributions to the field are twofold. First, by identifying important online behavioural characteristics of successful ideators, we contribute to filling a gap in the idea crowdsourcing literature (Zhao & Zhu, 2014) and towards a better understanding of how the online behaviour of ideators, who succeed in suggesting an idea that is implemented, reflects the findings from (offline) user innovation and creativity research. Second, beyond these theoretical insights, our results also contain managerial implications for those organisations that are interested in using online idea calls to generate ideas for new goods or services. By providing a better understanding of the characteristics of successful ideators' online behaviour, it will be possible to pay special attention to the ideas of those ideators. The insights gained therefore contribute to finding answers to the problem of effective idea detection and selection within the 'fuzzy' front end of innovation (van den Ende et al., 2015). Moreover, they can be useful for the design of future idea calls to especially attract those ideators or to stimulate behaviour that leads to the suggestion of ideas that the idea-seeker wants to implement.

The remainder of this chapter is structured as follows. In Section 3.2 we provide an overview of the literature and the theoretical framework used, from which we derive the hypotheses to be tested. Thereafter, we explain in Section 3.3 the methodological approach and then report the results obtained in Section 3.4. In Section 3.5 we discuss the findings, highlight the managerial implications and point out the limitations of this research as well as areas for future study. Finally, we present our conclusions in Section 3.6.

3.2 LITERATURE FRAMEWORK AND HYPOTHESES

The theoretical framework of this study is based on knowledge derived from creativity research as well as from research on user innovation and online idea crowdsourcing. We aim to understand which characteristics of ideators' online behaviour influence their success in open idea calls, which we define as the likelihood of suggesting an idea that is implemented after being proposed. Therefore, we look at two groups of online behaviour that are discussed in detail in the following two subsections. The first group leads to hypotheses regarding the ideators' *ideation capacity* and is based on the insight that lead users and innovating users intentionally invest time and effort into the development of ideas. The second group leads to hypotheses regarding the ideators' *attention to other ideas* and is based on the insight that creative individuals and innovating users are curious and open to new ideas or experiences and pay specific attention towards other ideators' ideas.

3.2.1 Ideators' ideation capacity

The first group of hypotheses is based on insights from research on user innovation. Over the last 40 years, this research has found evidence that (certain) users or consumers can be a useful source of innovation (for an overview, see Bogers, Afuah, & Bastian, 2010). One cornerstone of this research area is von Hippel's 'lead user' concept, which states that such innovating users, so-called lead users (von Hippel, 1988), have needs that foreshadow general demand in the marketplace. They are therefore likely to develop new products that are commercially attractive (von Hippel, 1986). Important for the context of our research is that such innovating users have been described as possessing special traits and displaying distinct types of behaviour. Eric von Hippel (2005) found, for example, that the motivation of lead users is particularly high, because they expect to obtain high benefits from the solution to their needs. Therefore, they often voluntarily interact with other innovating users or even innovate collaboratively in special-interest communities (Franke & Shah, 2003) or open-source software communities (Lakhani & Wolf, 2005). Importantly, users who innovate display a different behaviour from those who do not. Users with ideas for innovations, for example, more often seek information about new products than non-innovating users and have also been found to exchange information with other users who share similar interests (Lüthje, 2004).

Given that online idea calls often do not offer any monetary rewards to successful ideators, it can be assumed that one of the major motives to participate by suggesting ideas for new goods or services is the desire to use these products eventually. Ideators therefore suggest ideas which they would like to see implemented. From user innovation research we also know that innovating users have not only been found to experience and articulate a need for products that do not yet exist (Herstatt & von Hippel, 1992), but they are also likely to actually develop new goods and services, ranging from industrial products to sporting equipment as well as retail banking services and computerised information search systems used by libraries (Morrison et al., 2000; Oliveira & von Hippel, 2011; Shah, 2000; Urban & von Hippel, 1988). This more solution-oriented rather than need-related behaviour has also been witnessed online. An analysis of online contributions by lead users to mobile service innovation projects showed that 'the value of their contributions stems from their ability to suggest solutions instead of simply describing problems or stating customer needs' (Mahr & Lievens, 2012, p. 167).

We can therefore expect that successful ideators will not only communicate their requirements for new products but will also make suggestions about how their ideas can be implemented. From the perspective of the idea-seeking organisations, the ideas of such ideators should also be more attractive as they are more developed and concrete.

This increases the likelihood that the ideator will be successful in terms of suggesting an idea that is implemented.

H1a *Ideators who develop their own idea(s) by making suggestions about how their idea(s) can be implemented are more likely to be successful than ideators who only phrase their idea(s) in the form of a wish or requirement.*

Bilgram, Brem, and Voigt (2008) point out that a great advantage of less competitive offline or online user communities is the mutual assistance and free revealing of information that can be witnessed among their members. Unlike idea contests that only search for a (few) winning idea(s), online idea calls are looking for a wide variety of ideas that can be implemented. It can thus be assumed that this environment also leads to cooperative behaviour or merely friendly rivalry.

Given that lead users possess relevant solution-oriented knowledge, they are also more likely to contribute knowledge to online communities (Jeppesen & Laursen, 2009). Jeppesen and Laursen (2009) found that users with a high degree of lead-user characteristics tend to enjoy sharing their knowledge by giving assistance and advice to other users in the online community. They found peer recognition to be one of the key drivers of sharing knowledge and assisting others. This is supported by Mahr and Lievens (2012), who found that the reasons to contribute to virtual lead-user communities include both extrinsic motives, such as peer recognition, and intrinsic motives, such as curiosity or supporting others.

Interestingly, sharing ideas and assisting others are equally important for the development of user innovations in an offline context. Accordingly, Franke and Shah (2003) found in voluntary special-interest communities that innovators can be differentiated from non-innovators by the duration and intensity of their interaction with other community members. They found that innovators are more likely to give assistance and advice to other innovators within the community. It can therefore be assumed that the ideation capacity of successful ideators is reflected in the amount of constructive input they provide to other ideators' ideas.

H1b *An increase in the amount of constructive input provided on other ideators' ideas is positively related to the likelihood of ideator success.*

3.2.2 Ideators' attention to other ideas

The second group of hypotheses is based on the insight that creative individuals as well as innovating users are open to new ideas and experiences and pay specific attention

towards the ideas of other ideators. Ocasio (1997) defines 'attention' to encompass among other things the focusing of time and effort by individuals on certain issues or possible solutions. Consequently, research on attention often points out that it is a scarce resource and deals with the question why people, mostly in an organisational setting, pay attention 'to particular events or phenomena, given the almost infinite set of targets toward which it could be directed' (Dane, 2013, p. 46). This question of attention allocation is also important when trying to understand people's behaviour online. In the context of an intra-organisational online discussion forum, Haas, Criscuolo, and George (2015), for example, found that a match between the expertise possessed by a provider and the expertise needed to solve the problem increases the likelihood of attention allocation. As research on online idea calls or contests has shown that ideators often pay attention to other ideators' ideas (e.g. Bullinger et al., 2010; Chan et al., 2015b; Kathan et al., 2015; Schemmann, Herrmann, Chappin, & Heimeriks, 2016), we find it important to also consider this attention behaviour of ideators and to analyse how it relates to the likelihood of being successful.

Insights from creativity research can be useful to understand this online attention behaviour of successful ideators. For two reasons we consider results of creativity research to be relevant for our study. First, idea generation is one of the critical processing activities involved in creative thought (Vessey & Mumford, 2012), and second, the numerous definitions of creativity (for an overview, see Batey, 2012) all stress that the outcome of creative behaviour (e.g. an idea) needs to be both useful as well as novel. The crowdsourced ideas for new goods, services or processes that are implemented by the idea seeker do at least clearly fulfil the usefulness constraint, and we already know from research on online idea crowdsourcing that ideators are also highly capable of coming up with novel ideas (Poetz & Schreier, 2012).

As successful ideation is part of the creative process, we therefore argue that ideators who are successful in online idea calls will also show some behaviour typical of creative individuals. Creative individuals have been described as possessing particular traits and tendencies. Based on a meta-study of personality and creative achievement in the arts and sciences, Feist (1998, p. 304) concluded that, 'empirical research over the past 45 years makes a rather convincing case that creative people behave consistently over time and situation and in ways that distinguish them from others'. This has delivered insights into the kind of personality traits that make creative thought, behaviour and achievement more likely. For instance, certain cognitive traits (such as openness) and motivational-affective traits (such as drive and intrinsic motivation) were found to be important (Feist, 2010). Of the 'Big Five' personality traits combined in the Five Factor Model of personality, 'openness to experience' has been identified as a crucial characteristic of creative

individuals (Dollinger, Urban, & James, 2004; McCrae, 1987). People who score high on the openness factor are curious and often look for unfamiliar situations to gain new experiences and perspectives (McCrae & Costa, 1997). They therefore tend to appreciate new things which, combined with a greater sensitivity to a range of different experience, may cause them to create novel solutions or creative ideas (George & Zhou, 2001). Extraversion and openness to experience were consequently found to improve creative performance (Sung & Choi, 2009). Moreover, being open to other ideas was identified as an important (social) skill displayed by creative R&D scientists (Amabile & Gryskiewicz, 1987). Salter et al. (2015) support this by showing that by being open, R&D scientists and engineers benefit from variety and alertness, making them better prepared to develop new and valuable ideas. We therefore argue that this openness and curiosity of creative individuals will not only be displayed in higher levels of attention towards other ideas, but that this attention will be positive and appreciating this other input.

Consequently, and important for our context, positive effects of openness have also been determined for idea generation by users or in an online innovation contest. While Stock et al. (2016) showed in a recent study on innovating and non-innovating users that a higher score of openness to experience is positively related to the likelihood of coming up with new product ideas, Bullinger et al. (2010) found for online community-based innovation contests that ideators' curiosity about and support for other ideas result in a high degree of innovativeness. We consequently assume that those ideators who are positively attracted to new ideas and therefore show positive attention to other ideators' ideas are more likely to be successful.

H2a *An increase in the amount of positive attention paid towards other ideators' ideas is positively related to the likelihood of ideator success.*

If attention is paid to other ideators' ideas while coming up with an idea, then this can influence the quality of the idea that will be suggested. Research on idea generation in groups shows, for example, that sharing ideas and the exposure to other creative ideas can enhance one's own creativity, which eventually leads to the production of more creative ideas (Nijstad & Stroebe, 2006; Paulus & Yang, 2000). This is also supported by Garfield et al. (2001) who found that the likelihood of coming up with a paradigm-modifying idea increases if the ideator is exposed to other paradigm-modifying ideas during the ideation process, and by Shalley and Perry-Smith (2001) who showed that ideators who have been given a creative example of a solution displayed more creativity than those who have not. We therefore argue that ideators' pre-ideation attention to other ideas also needs to be taken into account when trying to understand ideator success.

Online ideation processes often provide the opportunity to observe ideators' pre-ideation attention to other ideas by looking at the commenting and voting behaviour. Consequently, we also find support for our argument in some studies that focus on ideator and idea success in open idea calls. A study based on the idea call by the company Dell indicates that ideators who pay major attention to other ideators' ideas – meaning that they show a diverse commenting activity on other ideas – are more likely to be successful (Bayus, 2013). And recently a study on an idea call for new product development in the food and beverages sector showed that idea implementation was positively related to the ideator's intensive commenting behaviour shown during the call (Schemmann et al., 2016). Based on these insights we consequently assume that paying attention to the ideas of other ideators before suggesting an idea is important for successful ideation and that successful ideators are therefore likely to do so.

H2b *Ideators who pay attention to other ideators' ideas prior to suggesting their own first ideas are more likely to be successful than ideators who do not pay any attention prior to suggesting their own first ideas.*

3.3 METHODOLOGY

In order to study the relationship between ideators' behaviour online and their success in an open idea call, we use a cross-sectional research design, in which the unit of analysis is the ideator.

3.3.1 The data

To answer our research question, we used data from an online idea call organised by the municipality of Munich. It took place from December 2010 to February 2011. The call for ideas, named MOGDy, was run on the adhocracy.de platform, a non-profit platform which allows public organisations and communities to organise e-participation projects free of charge. MOGDy asked citizens to suggest new 'ideas for digital Munich', i.e. new or improved digital services that can be offered to people in Munich. The initiative was among the first of its kind in Germany and received public attention as well as two international awards[14] (Dapp & Seeger, 2011).

To participate, citizens only had to register on the platform by giving themselves a unique user name. Then they were able to suggest ideas, comment on ideas and vote

14 Best-practice award given by the European Public Sector Awards 2011 and third place for the most innovative e-government project awarded by the 11th eGovernment-Wettbewerb.

on whether they liked or disliked any of the ideas suggested in this call. Neither voting nor commenting was mandatory. All users of the platform were able to read all ideas and comments and to see how many positive or negative votes an idea had received. All registered users were allowed to use a fictitious user name and so did not need to reveal their real identity nor provide personal information to the organisers or the audience. A publicly visible individual 'profile' page, automatically created for each registered user, allowed us to keep track of all the ideas suggested as well as all the comments made and votes provided by each individual user.

The call organisers asked for ideas for innovations and improvements linked to (new) digital services, including those enabling new forms of e-participation to be provided for the citizens of Munich (see Dapp & Geiger, 2011). The organisers aimed to generate a wide variety of ideas related to 'digital Munich' and to encourage broad citizen participation (Viola, 2010), and registered users were allowed to post any idea they liked or found suitable in this context. As a result, the ideas suggested ranged from the introduction of free wireless Internet access across the city and the request for online voting in political elections to a new mobile service enabling drivers to pay for parking tickets online and an online service to help parents find day care for their children. Besides these ideas that are new to the city or beyond, the ideators also suggested improvements to existing services, for example changes or enhancements to the city's official website (www.muenchen.de) or to other existing (online) services delivered by the city's service providers. Some moderators were active on the platform. They provided answers to questions concerning the idea call, calmed down unsuitable discussions or asked questions if ideas or comments were unclear.

The city's idea evaluation and selection process officially started in early 2011 after the organisers of the idea call handed a list containing all ideas suggested on the platform to the city's IT management responsible for the city's digital and online strategy and control. The following idea evaluation process involved a variety of people working within the city's IT management, different units of the municipality and different providers of public services, and led to discussions concerning the extent to which the ideas could provide (strategic) input to the city's e-government strategy and roadmap or could be put directly into practice to improve existing online services, such as the city's official website. Based on our analyses of different sources of information available online, such as the municipality's IT blog, project reports or the records of meetings involving different entities, we can state that this process often involved extensive discussions bringing in, as mentioned before, a range of different people from different entities. The process formally ended in 2013 with the adoption of the e-government strategy and roadmap.

This online idea call is particularly suitable for our research as it offers rich and publicly available information about the ideation and interaction behaviour of each ideator. Given that we are looking at the success of ideators (i.e. whether or not they suggested an idea that is later (partially) implemented), we also needed to assess the implementation of ideas. It is therefore important that the call was completed sufficiently long ago to be able to assess whether the respective ideas have been taken up in some way. After removing double entries and ideas suggested outside the realm of the call, the dataset contained 72 ideators who suggested 128 ideas, voted 859 times and wrote 307 comments on other ideators' ideas.

3.3.2 Measurement

The dependent variable *ideator success* is operationalised as follows. Given that online idea calls are looking for as many ideas that can be implemented as possible, we first measured the ideator's success in its basic form: the ideator's general ability to suggest at least one idea that is later (partially) implemented. To assess whether an idea or a suggested service has been, or is, in the process of being implemented, we carried out an extensive online search. We consider this to be a suitable process, as consultation with members of the team that organised the idea call showed that – due to the evaluation and selection process mentioned before – there is no single unit in the municipality that would be able to provide us with this necessary information concerning all ideas suggested. For 48 of the 128 ideas[15] used in the analyses, we found information or signs that the ideas were in some way taken up and implemented, or were in the process of being implemented. For the other 80 ideas, we either found information that the ideas were rejected, that the services already existed at the time of suggestion, or that there were no signs of the ideas being taken up or such services being implemented. Based on this information, we coded ideator success as a dichotomous variable, whereby successful ideators (i.e. ideators who suggested at least one idea that was (partially) implemented or in the process of implementation) are coded as 1. Ideators who were not successful are coded as 0.

For further in-depth analyses and robustness checks, we also operationalised the dependent variable in two alternative ways, namely by combining idea implementation with two other important measures of creativity: idea novelty and idea originality. To do so, we carried out an Internet search with the aim of assessing whether an idea that was

15 Many of the ideas that were in some way taken up and implemented were simply improvements of existing services or ideas for very incremental innovations. Both can be implemented without much effort or any risk. This explains why the implementation rate in our study is much higher than the implementation rate that is common in R&D projects that search for more radical innovations and are therefore associated with a high level of (financial) risk, as the outcome is often uncertain (Jones, 2013).

(in the process of being) implemented was also novel, i.e. new to Munich. This version of the dependent variable (*implemented ∩ novel*) is also dichotomous. Here successful ideators – those who suggested at least one idea that is considered to be creative (namely implemented as well as new to Munich) – are coded as 1. All other ideators are coded as 0. In addition, we analysed whether ideators suggested ideas that were (in the process of being) implemented but not novel to Munich (e.g. an improvement). For this version of the dependent variable (*implemented ∩ not novel*), ideators who suggested at least one idea that was implemented but not novel are coded as 1. All other ideators are coded as 0. Given that some ideators suggested ideas similar to those suggested by other ideators, we also analysed whether ideators were successful in coming up with ideas that were implemented as well as original among the ideas suggested in this call. This version of the dependent variable (*implemented ∩ original*) is therefore again dichotomous: successful ideators (i.e. ideators who suggested at least one idea that was implemented and original among the ideas suggested) are coded as 1 and all other ideators as 0.

The independent variables used in this study are operationalised as follows.

The independent variable *idea development* (H1a) is measured according to whether an ideator always made suggestions about how his/her idea(s) could be implemented. We therefore analysed the content of all ideas suggested and created the following dichotomous variable: ideators who always made some kind of suggestion as to how their ideas could be implemented are coded as 1, ideators who did not are coded as 0.

The independent variable *input to other ideas* (H1b) is operationalised according to the number of times that an ideator provided constructive input to other ideators' ideas. We therefore analysed the content of all comments made and looked for comments that developed other ideas, for example by providing arguments why the idea should be implemented or how this idea could be further developed. The resulting variable is continuous: for each constructive comment made, the commenting ideator receives 1 point. In order to correct for the skewed distribution of values, the variable is then log-transformed.

The independent variable *positive attention to other ideas* (H2a) is measured by the number of times that an ideator voted positively on other ideators' ideas. We use the voting not the commenting behaviour to operationalise this variable as we observed that ideators who comment on other ideas almost always also vote on the idea they commented upon. In contrast, voting on other ideas does not always go hand in hand with also commenting upon these ideas. Moreover, comments do not always contain a definite statement concerning the overall perception of the idea commented upon. We

consequently consider the ideator's positive voting behaviour to be the precise measure for this independent variable. Any 'self-votes' by the ideator on his/her own idea as well as any multiple votes by the same ideator on the same idea were omitted. Consequently, the variable is continuous: for each positive vote on other ideas, the voting ideator receives 1 point. To correct for the skewed distribution of values, this variable is then also log-transformed.

The independent variable *pre-ideation attention* (H2b) is operationalised according to whether or not an ideator commented or voted (positively or negatively) on other ideators' ideas before suggesting his/her own first idea. The variable is dichotomous: ideators who voted or commented on other ideators' ideas before suggesting their own first idea are coded as 1, ideators who did not are coded as 0.

We also included three control variables in the analysis. First, we controlled for the *technical knowledge* displayed by ideators. The call looked for all types of ideas for digital Munich. No particular (technical) expertise was needed to suggest an idea. Nevertheless, in some cases ideas or comments show that their writers possess some technical knowledge. Such technical knowledge could enable ideators to suggest ideas that were better developed and therefore more likely to get implemented. At the same time, such ideators could be more capable of commenting. Accordingly, we analysed all ideas suggested and comments made to assess whether the respective ideator demonstrated technical knowledge. We considered this to be the case when technical terminology[16] was used. The resulting dichotomous variable takes the value of 1 for those ideators showing technical knowledge and the value of 0 for those ideators who do not.

Second, we controlled for the point in time at which the ideator decided to participate in the call. The idea call was communicated to the citizens of Munich through a campaign using online and offline media. This campaign took place in different waves throughout the duration of the call. Depending on the media used, ideators with specific backgrounds could have been motivated to participate in the call at different points in time. If motivations to join the idea call differed systematically throughout the call, this could influence the ideation behaviour. To control for systematic variations over time, we include the ideator's *registration day* as a continuous control variable. The value of 1 is given if the ideator registered on the first day of the call, the value of 2 for those who registered on day two, and so forth.

16 The idea call asked the crowd to suggest ideas for new digital services in Munich. Technical terminology was therefore defined as any IT-related terminology that exceeds the basic terminology needed for the non-professional, everyday use of such digital services.

Table 3.1 Descriptive statistics of ideator success measured against number of ideas suggested

<table>
<tr><td rowspan="3">72 ideators
47% successful</td><td rowspan="2">25 serial ideators
72 % successful</td><td>12 ideators suggested 2 ideas
67 % successful</td></tr>
<tr><td>13 ideators suggested more than 2 ideas
92 % successful</td></tr>
<tr><td colspan="2">47 single ideators
36% successful</td></tr>
</table>

Third, we controlled for the fact that ideators who suggested many ideas had a higher chance that at least one idea was implemented. The descriptive statistics in Table 3.1 show that this is the case in our study: serial ideators who suggested two or more ideas were more successful than single ideators. Furthermore, ideators who came up with more ideas may also have been more active commenters and voters. We therefore control for *idea frequency* in the form of a continuous variable: for each idea suggested, the ideator receives 1 point. In order to correct for the skewed distribution of values, the variable is transformed using a reciprocal transformation.

The coding for the independent variables *idea development* and *input to other ideas* and for the control variable *technical knowledge* was conducted by the author of this thesis only. To determine whether the coding scheme is clearly defined and enables accurate assignment of codes, we used a method suggested by Poole, van de Ven, Dooley, and Holmes (2000, p. 167). Therefore, we chose a random subsample of the dataset. Based on the coding scheme, this subsample was then coded by an academic who was not involved in the research project. Using the Cohen's kappa statistic[17] we found substantial agreement among raters. Discrepancies between raters were analysed and discussed to be sure that there were no systematic problems with the coding scheme.

3.3.3 Analysis

Given that the dependent variable *ideator success* is dichotomous, we conducted binary logistic regression analyses. Overall, we report seven models. In model 1, we only included the three control variables. In model 2, the control variables are included together with the two independent variables related to the ideator's *ideation capacity.* In model 3, the control variables are assessed together with the two independent variables related to the ideator's *attention to other ideas*. Finally, in model 4, we included the control variables and all independent variables.

17 Cohen's kappa statistics: for the independent variable *idea development* Kappa is .800 (p<.001), for the independent variable *input to other ideas* Kappa is .814 (p<.001) and for the control variable *technical knowledge* Kappa is .737 (p=.001).

For further in-depth analysis we ran three additional models, also including all control and independent variables. The models differ from each other in their dependent variable. In model 5, successful ideators suggested an idea that was not only implemented but at the same time novel (*implemented* ∩ *novel*). By contrast to model 5, in model 6 successful ideators suggested an idea that was implemented but not novel (*implemented* ∩ *not novel*). Finally, in model 7 successful ideators suggested an idea that was implemented and at the same time original among the ideas suggested in the call (*implemented* ∩ *original*).

3.4 RESULTS

In this section we first provide some descriptive statistics of the variables used in the analyses. We then present the results of the binary logistic regression analyses carried out showing support for hypotheses H1a and H2a. No support was found for hypotheses H1b and H2b. Some additional analyses using different versions of the dependent variable by including idea novelty and idea originality help to better understand how these findings relate to being successful at suggesting different types of ideas that are implemented.

Table 3.2 shows that almost half of the ideators were successful in suggesting at least one idea that was implemented. Furthermore, almost half the ideators always made suggestions about how their ideas could be implemented or paid attention to other ideas before suggesting their own first idea. Only a few ideators displayed technical knowledge in their ideas or comments.

The results of the binary logistic regression assessing the impact of *ideation capacity* and *attention to other ideas* on *ideator success* are shown in Table 3.3.

The tests of all models against the respective constant-only model are statistically significant, indicating that the predictors together reliably distinguish between an ideator being successful or not. Accordingly, Nagelkerke's R^2 is .192 for model 1, .332 for model 2, .280 for model 3 and .378 for model 4.

In an assessment of the predictive power of each independent variable for model 4, the Wald criterion shows that the independent variables *idea development, positive attention to other ideas* and the control variable *idea frequency* are significant predictors. By contrast, *input to other ideas* and *pre-ideation attention* are not statistically significant. These findings are robust across models 1–4, as the same independent variables are revealed to be statistically significant or insignificant. The independent variables *input to*

Table 3.2 Descriptive statistics of dependent, independent and control variables

		N	Min	Max	Mean	Std. Dev.	Pearson Correlation					
							1	2	3	4	5	6
	Dependent variables											
	Ideator success	72	0	1	.47	.503						
	implemented ∩ novel	72	0	1	.36	.484						
	implemented ∩ not novel	72	0	1	.15	.362						
	implemented ∩ original	72	0	1	.29	.458						
	Control variables											
1	Technical knowledge	72	0	1	.17	.375						
2	Registration day	72	1	79	14.81	18.548	-.131					
3	Idea frequency [a]	72	0	.92	.22	.314	.114	-.159				
	Independent variables											
4	Idea development	72	0	1	.46	.502	.262**	.169	-.379***			
5	Input to other ideas [b]	72	0	1.20	.34	.375	.156	-.348***	.431***	.020		
6	Positive attention [b]	72	0	1.85	.66	.570	.040	-.272**	.330***	.031	.638***	
7	Pre-ideation attention	72	0	1	.42	.496	.076	-.247**	.035	.071	.455***	.573***

* *p*-value <.10; ** *p*-value <.05; *** *p*-value <.01
[a] Variable was transformed using a reciprocal transformation
[b] Variables were transformed using a log10 transformation

other ideas and *pre-ideation attention* and the control variables *technical knowledge* and *registration day* are not statistically significant.

The results regarding the control variable *idea frequency* remain largely unchanged and significant at a .01 or a .05 significance level for all four models. In all models, a positive relationship is observed. In line with our expectations, ideators who suggested two or even more ideas were more likely to be successful in this idea call. It is therefore important to control for *idea frequency*.

Hypotheses H1a and H1b lead to the expectation that ideators showing a greater *ideation capacity* are more likely to be successful. To be precise, we expect that ideators who always make suggestions on how their ideas could be implemented (H1a) and ideators who provide more constructive input to other ideators' ideas (H1b) are more likely to be successful than ideators who do not. The results show empirical support for hypothesis H1a at a .05 significance level. Net of other effects, model 4 illustrates that the odds of an ideator being successful are 6.14 (= Exp of 1.815) times higher for ideators who make

Table 3.3 Binary logistic regression analyses of ideator success in suggesting ideas that are implemented

0 = ideator not successful 1 = ideator successful	**Model 1** Only controls	**Model 2** Ideation capacity + controls	**Model 3** Attention to other ideas + controls	**Model 4** Full model
	b (S.E.)	*b* (S.E.)	*b* (S.E.)	*b* (S.E.)
Constant	-.653 (.402)	-1.904 (.684) ***	-1.252 (.563) **	-2.082 (.754) ***
Control variables				
Technical knowledge	.356 (.706)	-.336 (.743)	.463 (.717)	-.179 (.754)
Registration day	-.004 (.014)	-.009 (.017)	.000 (.015)	-.010 (.017)
Idea frequency	2.605 (.885) ***	3.943 (1.257) ***	2.094 (.931) **	3.653 (1.298) ***
Ideation capacity				
Idea development		1.865 (.746) **		1.815 (.774) **
Input to other ideas		.703 (.878)		.453 (1.126)
Attention to other ideas				
Positive attention			1.573 (.702) **	1.244 (.747) *
Pre-ideation attention			-.960 (.751)	-1.059 (.808)
R^2 Nagelkerke	.192	.332	.280	.378
N	72	72	72	72

* *p*-value <.10; ** *p*-value <.05; *** *p*-value < .01
model 1: chi-square = 11.180, *p* = .011 with df = 3
model 2: chi-square = 20.580, *p* = .001 with df = 5
model 3: chi-square = 16.926, *p* = .005 with df = 5
model 4: chi-square = 23.960, *p* = .001 with df = 7

some suggestions about idea implementation compared with ideators who do not do this. While H1a is empirically supported, the models do not lend empirical support to hypothesis H1b at a .1 significance level. The results highlight that ideators are more likely to be successful when they display their ideation capacity by always making suggestions on how their ideas could be put into practice; showing their ideation capacity by the extent to which they develop the ideas of others has no significant impact on their success.

Following hypotheses H2a and H2b, we would expect that ideators who *pay attention to other ideas* are more likely to be successful. To be precise, we expect that ideators who show more positive attention to other ideators' ideas (H2a) and ideators who pay attention to other ideas before suggesting their own first idea (H2b) are more likely to be successful than ideators who do not show this behaviour. While the results lend support to hypothesis H2a, the results for hypothesis H2b are not statistically significant at a .1 significance level across all models. Net of other variables, the results show that the odds

of an ideator being successful are 3.469 (= Exp of 1.244) times higher with a one-unit increase in positive attention to other ideas. We thus find that the amount of positive attention an ideator pays to other ideas influences whether the ideator is successful. The results highlight that ideators are more likely to be successful when they show that they are open to other ideas by paying more positive attention to other ideas. However, paying attention to other ideas prior to suggesting their own first idea has no significant impact on their success.

The three additional binary logistic regression analyses we conducted provide further insights into how ideators' behaviour influences their capacity to suggest ideas that are implemented and novel (model 5), implemented and not novel (model 6) or implemented and original (model 7). Interestingly, the results obtained (see Table 3.4) do not fundamentally differ from those of the first four models but provide further insights concerning the different influence of the variables linked to *ideation capacity* and the ones linked to *attention to other ideas*.

The tests of all models – each using a different version of the dependent variable – against the respective constant-only model are statistically significant, indicating that the predictors together reliably distinguish between an ideator being successful or not. Accordingly, Nagelkerke's R^2 is .316 for model 5, .348 for model 6 and .431 for model 7.

In line with models 1–4, models 5–7 reveal a positive effect of the control variable *idea frequency*: ideators who suggested two or even more ideas are also more likely to be successful in terms of the respective dependent variables used in the models.

Also in line with models 1–4, models 5–7 indicate that only the variables *idea development* and *positive attention to other ideas* significantly contribute to the models' predictive power at a .05 or a .1 significance level. However, only in model 7 do both variables turn out as significant predictors of whether an ideator is likely to suggest an idea that was implemented as well as original among the ideas suggested. For ideators' success in terms of suggesting an idea that was implemented and new to Munich (model 5), their displayed *positive attention to other ideas* is the only significant predictor, while for ideators' success in terms of suggesting an idea that was implemented but not novel (model 6), their *idea development* behaviour is the only significant predictor.[18] The results therefore indicate that the influence of ideators' *idea development* behaviour and displayed *positive attention to other ideas* on the ideators' success is different for novel and not-novel ideas.

18 Given that the number of cases is relatively small, we also tested all three models by entering the control variables and the *ideation capacity* and *attention to other ideas* variables separately into the analyses. Overall, the same variables made a significant contribution to the prediction of ideator success.

Table 3.4 Binary logistic regression analyses of ideator success in suggesting ideas that are implemented as well as novel, not novel or original

0 = ideator not successful 1 = ideator successful	**Model 5** DV: implemented ∩ novel Full model	**Model 6** DV: implemented ∩ not novel Full model	**Model 7** DV: implemented ∩ original Full model
	b (S.E.)	*b* (S.E.)	*b* (S.E.)
Constant	-2.422 (.738)***	-3.262 (1.145) ***	-3.116 (.941) ***
Control variables			
Technical knowledge	861 (.765)	-21.619 (10181.592)[a]	-.528 (.883)
Registration day	-.001 (.017)	-.035 (.026)	-.020 (.020)
Idea frequency	2.803 (1.245) **	4.490 (1.977) **	4.842 (1.641) ***
Ideation capacity			
Idea development	.976 (.783)	2.335 (1.266) *	2.357 (1.039) **
Input to other ideas	-.210 (1.080)	-.186 (1.373)	-1.015 (1.254)
Attention to other ideas			
Positive attention	1.320 (.752)*	.124 (.885)	1.448 (.833)*
Pre-ideation attention	-.676 (.763)	-.277 (.865)	-1.335 (.875)
R^2 Nagelkerke	.316	.348	.431
N	72	72	72

[a] Large values are due to the fact that all successful ideators did not show any technical knowledge.
DV = dependent variable
* *p*-value <.10; ** *p*-value <.05; *** *p*-value < .01
model 5: chi-square = 18.887, *p* = .009 with df = 7
model 6: chi-square = 16.062, *p* = .025 with df = 7
model 7: chi-square = 24.612, *p* = .001 with df = 7

Table 3.5 summarises the results of the analyses carried out.

In addition to these core analyses, we also conducted the following robustness checks in order to assess the sensitivity of the results to changes in model specifications.

First, given that creativity is the capability to come up with ideas that are not only useful but also novel, we checked the contributions of all variables on a subset of those ideators (N = 60), who suggested at least one idea that contained at least one dimension of novelty according to the six dimensions of service innovations developed by den Hertog, van der Aa, and de Jong (2010). The results remained the same as in models 1–4 for this subset of ideators.

Table 3.5 Summary of the findings

		Ideator success = suggesting an idea that is implemented	Ideator success = suggesting an idea that is implemented and novel	Ideator success = suggesting an idea that is implemented but not novel (e.g. improvements)	Ideator success = suggesting an idea that is implemented and original in the idea call
Hypothesis	**Relationship tested**	**Hypothesis supported?**	**Hypothesis supported?**	**Hypothesis supported?**	**Hypothesis supported?**
H1a	Development of own idea(s) → higher likelihood of ideator success	**Yes**	No	Yes	Yes
H1b	Amount of constructive input on other ideators' ideas → higher likelihood of ideator success	**No**	No	No	No
H2a	Amount of positive attention to other ideators' ideas → higher likelihood of ideator success	**Yes**	Yes	No	Yes
H2b	Pre-ideation attention to other ideators' ideas → higher likelihood of ideator success	**No**	No	No	No

Second, we also ran a logistic regression on the idea level (with robust standard errors clustered by ideator), including the *technical knowledge* shown in the idea, the *day of idea suggestion*, and the *number of ideas suggested* by the respective ideator as control variables. The results for the independent variables *idea development* (in this case of the respective idea), the ideator's *input to other ideas, positive attention to other ideas and pre-ideation attention* before idea suggestion were similar to what we found in the regression models 1–4 at the ideator level. Accordingly, the regression at the idea level also revealed that the *idea development* and the ideator's *positive attention to other ideas* are significantly related to the likelihood of the idea being implemented. Similarly, the ideator's constructive *input to other ideas* and *pre-ideation attention* turned out to have a negative, but not significant, influence.

Third, we also assessed whether the *negative attention paid to other ideas*, operationalised as the number of times an ideator votes negatively on other ideas, has an influence on the likelihood of being successful. Here the Wald criterion shows that the independent variable *negative attention* made no significant contribution to the prediction at a .1 significance level. In addition, the relationship for this variable was negative if both *positive attention* and *negative attention to other ideas* were included in the same model. The results for all other variables remained the same.

3.5 DISCUSSION

This study shows that the online behaviour of ideators can be utilised to discern whether they are likely to be successful in an online idea call. The data support our assumption that both the online behaviour related to the *ideation capacity* of ideators and the way they *pay attention to other ideas* can be useful in distinguishing those ideators who are likely to be successful from those who are not.

First, we assessed two key characteristics related to the *ideation capacity* of ideators. To begin with, we find in line with hypothesis H1a that ideators who suggest ideas that not only ask for the introduction or improvement of (new) digital services but also offer some advice on how to implement them are more likely to be successful. In other words, successful ideators are those who point to possible avenues for solutions as well as to unmet needs. In line with the findings of Mahr and Lievens (2012), we can therefore state that the value of successful ideators' contributions lies in their solution-oriented behaviour, which goes beyond a mere statement of their needs. Interestingly, though, we also find that these ideators do not necessarily suggest creative ideas, i.e. ideas that are implemented and also new to the unit of adoption. When looking at the likelihood of suggesting creative ideas, ideators who always make suggestions on how to implement their ideas are not more likely to be successful. Unlike the solution-oriented behaviour of lead users (e.g. Morrison et al., 2000; Oliveira & von Hippel, 2011; Shah, 2000; Urban & von Hippel, 1988) that we discussed in the literature section, this kind of solution-oriented behaviour observed in online idea calls seems to be more related to suggesting improvements to existing services than to suggesting ideas for innovative goods or services. Despite the solution-oriented behaviour shown, we must therefore question whether successful ideators in online idea calls in this regard show the behaviour of lead users.

Interestingly, and contrary to what we expected from the knowledge sharing behaviour observed for user innovators in offline and online contexts (Franke & Shah, 2003; Jeppesen & Laursen, 2009), the amount of constructive input provided to other ideators' ideas has not proven to determine ideator success. An explanation for this discrepancy and therefore the lack of support for hypothesis H1b could be that knowledge-sharing and giving assistance and advice to others in the (online) community can sometimes absorb valuable time that the ideators otherwise could have used to suggest and develop their own ideas. Another explanation could be that at least some successful ideators feel that their ideas do compete with the ideas of other ideators. In this case, they might show less the behaviour of lead users – or what Hutter et al. (2011) in the context of an idea design contest describe as 'communitors' (i.e. those ideators who

come up with attractive ideas and make many cooperative comments) – and instead show the behaviour of 'competitors' (i.e. ideators who also come up with attractive ideas but only make few or competitive comments). A possible explanation for this can be found in the previously mentioned study by Kathan et al. (2015). This showed – also looking at the competitive setting of an idea design contest – that free-riding behaviour can also be beneficial as it allows the ideator to benefit from the comments received without investing any time or effort in developing the ideas of other ideators.

Second, we then assessed two key characteristics related to ideators' *attention to other ideas.* Here we find in line with hypothesis H2a that ideators who tend to be curious and open to new or other ideas, as they pay a lot of positive attention to other ideators' ideas, are more likely to be successful. This shows that the important trait and tendency of creative individuals to be open towards new experiences and ideas (Dollinger et al., 2004; McCrae, 1987; Sung & Choi, 2009) are also reflected in the online behaviour of successful ideators. Moreover, this is emphasised by the fact that we not only find the amount of positive attention shown towards other ideas to be positively related to the likelihood of coming up with an idea that is implemented, but that this behaviour is also positively related to the likelihood of suggesting an idea that is implemented as well as novel to the unit of adoption. Consistent with a recent user innovation study that explored links between the Big Five personality traits and the successful accomplishment of different stages in the innovation process (Stock et al., 2016), we find some indication that being open and paying positive attention to ideas is an important trait of those ideators who are successful in coming up with an idea for a novel service product that is implemented. However, it is not an important trait of those ideators who tend to successfully suggest improvements of already existing services. We also assessed whether the converse behaviour, namely negative attention to other ideas, is related to ideators' success. We do not observe any effects.

Contrary to both our initial expectations and to findings from research on offline idea generation in groups (Nijstad & Stroebe, 2006; Paulus & Yang, 2000), in our online context we do not observe that those ideators who are paying attention to other ideators' ideas before suggesting their own first idea are more likely to be successful. There are two possible explanations for this discrepancy and therefore for the lack of support for hypothesis H2b. First, findings from creativity research suggest that the positive effect of pre-ideation attention to other ideas only occurs when the ideator was exposed to examples of creative or even paradigm-modifying ideas (Garfield et al., 2001; Shalley & Perry-Smith, 2001). As online idea calls contain both creative as well as not-creative ideas, ideators who pay attention to other ideas before suggesting their own are likely to be exposed to both types of ideas. The effects of both could thus be balanced.

Second, different to previous studies on online idea calls indicating that an ideator's attention to other ideas – based on their general commenting behaviour – has a positive effect on the likelihood of idea implementation (Bayus, 2013; Schemmann et al., 2016), our study focuses on the ideator's pre-ideation attention as reflected in both their votes and comments on other ideas before suggesting their own. When trying to explain the effect of ideators' pre-ideation attention, and therefore their exposure to other ideas, we argue that one needs to take into account comments as well as votes made or distributed before idea suggestion. Whereas general commenting behaviour can have a positive effect, the behaviour of showing pre-ideation attention towards other ideas has not proven to be a characteristic of successful ideators' online behaviour.

3.5.1 Managerial implications

Our findings bear managerial implications for organisations considering using online calls to generate ideas for new goods or services.

The idea-generation phase as part of the front end of innovation is often considered to be fuzzy: it is highly informal and often erratic, with the outcome of the ideation process being highly uncertain (van den Ende et al., 2015). One of the issues in this early phase of innovation is how to quickly detect promising ideas and to screen out less useful ones (ibid.). As idea crowdsourcing can lead to large numbers and a broad variety of ideas, identifying promising ideas can be problematic and often requires a lot of effort from the idea-seeker (Poetz & Schreier, 2012; van den Ende et al., 2015). One way to reduce this effort is to focus on the ideas suggested by those ideators who are likely to come up with ideas that are likely to be implemented. Our findings show that paying attention to the online behaviour during the idea call can help to identify those ideators. Therefore, organisations should consider ideators' online ideation behaviour as well as the attention they pay to other ideas; this can provide valuable information regarding which ideators are likely to suggest useful ideas. More concretely, these findings indicate that organisations should look for those ideators who not only phrase their ideas by articulating a wish or requirement but also make some suggestion on how their ideas can be implemented. Moreover, organisations should especially observe those ideators who show that they appreciate other ideators' ideas.

Our findings can be useful not only for identifying ideas that the idea-seeker might want to implement, but also for idea-seekers wanting to improve the design of future idea calls. Ideators should be encouraged to make suggestions about how their ideas could be implemented. This increases the likelihood that they will come up with ideas that are perceived as useful. Moreover, asking ideators to suggest possible solutions or designs might even attract those ideators who like to show solution-oriented behaviour online.

In contrast, pre-ideation attention to other ideas should not necessarily be encouraged as it does not have a positive effect on ideators' creativity or success.

3.5.2 Limitations and future research

Like all research, this empirical study has its limitations and raises suggestions for further research.

First, our study is based solely on data generated from a single call for ideas – for new digital services in Munich. Despite the soundness of the data available on the online behaviour of ideators during this call, there is a constraint in the fact that the study is based on one particular case that generated ideas for new digital services in a not-for-profit environment. Therefore, the findings may not be applicable to online idea calls in different contexts. But, with respect to similar open idea calls in comparable contexts, we consider our results to be applicable. Also taking into account the work of Whitley (2000), we consider those open idea calls to be similar that are comparable regarding: the uncertainty of the ideation task that the crowd has been given; the kind of crowd involved; the degree to which individual crowd members depend upon each other to fulfil this task; and the benefits a successful ideator can expect. Analyses of data from other idea calls in comparable contexts will therefore be useful to verify our claims. Furthermore, future research might also attempt to confirm the characteristics of successful ideators' online behaviour found in this study in different contexts and environments.

Second, given that ideators in open calls for ideas are usually allowed to remain anonymous, data on the personal characteristics of ideators – such as their age, gender or location – were not available to us. It would certainly be valuable to assess how such additional control variables impact on the results obtained.

Third, the number of cases used in the analysis is relatively small. Even though we extensively crosschecked the robustness of all our models, analysis of a larger dataset would be useful.

Fourth, we are interested in the influence of ideator behaviour, and operationalised ideator success as the ability to suggest at least one idea that is (partially) implemented. Consequently, our unit of analysis is the ideator. Importantly, though, some ideators suggest numerous ideas that are implemented. Consequently, one could argue that success varies more importantly at the level of the idea rather than that of the ideator.

As mentioned in the results section, we tried to take this into consideration by running similar analyses at the idea level. These showed similar results. Nevertheless, future analyses focusing on 'idea' as the core unit of analysis would be desirable to crosscheck our findings.

3.6 CONCLUSION

Despite these limitations, our findings contribute to a better understanding of the online behaviour shown by successful ideators in open idea calls and thereby fill a gap in the idea crowdsourcing literature. We also show that results from research on (offline) creativity and innovating users are – to some extent – applicable to the context of online idea calls. Concretely, the findings can be summed up as follows. First, we found the positive attention towards other ideators' ideas and behaviour which not only states needs or identifies problems but also suggests solutions to be key characteristics of successful ideators. Second, while suggesting possible solutions is an important characteristic of ideators who are likely to suggest an idea that is useful but only an improvement, paying positive attention to other ideas is an important characteristic of ideators likely to suggest an idea that is useful and at the same time novel. Third, neither paying attention to other ideators' ideas before suggesting one's own nor providing constructive input to other ideas were found to be characteristic for successful ideators. Our findings therefore illustrate that an analysis of ideators' online behaviour can be useful to identify those ideators who will potentially succeed in suggesting an idea that will be implemented. This can also open up new opportunities for the detection of ideas that the idea-seeker wants to implement and, as a result, contribute to finding answers to the problem of effective idea selection within the fuzzy front end of innovation.

4

Facilitating idea genesis: Knowledge accumulation in online innovation collectives

This chapter is based on:
B. Schemmann, M. M. H. Chappin, A. M. Herrmann & G. J. Heimeriks (under review): Facilitating idea genesis: Knowledge accumulation in online innovation collectives.

ABSTRACT

The rise of the Internet has opened up new ways to generate ideas, share knowledge and to support open innovation processes in online innovation collectives. Understanding what facilitates the elaboration and development of ideas in online idea calls is crucial to making better use of the crowdsourcing potential for new product development (NPD) and other innovation purposes. We therefore assess what influences idea-related knowledge accumulation in commenting threads. Using data collected from a crowdsourced idea call for new digital services, we apply a cross-sectional research design to assess the influence of factors related to (1) the relative advantage of the initial idea and (2) the interaction in the commenting thread. The results show that the relative advantage of the initial idea – both in terms of novelty and popularity – has a significant positive effect. The interaction also has significant effects: while a negative comment at the beginning has a negative influence, direct interaction between commenters has a positive effect on idea-related knowledge accumulation in a thread. Concerning the latter, it does not seem to matter whether the interaction creates a valuing or a questioning climate.

4.1 INTRODUCTION

Technological advances and the rise of the Internet have opened up new ways of using outside knowledge and external ideas for innovation purposes and to organise open innovation processes (Dodgson, Gann, & Salter, 2006). In particular, activities often referred to as 'crowdsourcing' enable organisations to make use of collaborative knowledge production during any phase of the innovation process (West & Bogers, 2014). Through online idea crowdsourcing, organisations (such as companies, non-profit organisations, governments or municipalities) increasingly aim to generate fresh ideas for new products or processes, unsolved scientific or societal issues or even new policies by involving a crowd of people, such as (potential) customers, citizens or scientists (examples can be found in the following publications: Bayus, 2013; Brabham, 2008; Koch, Rapp, Füller, & Hilgers, 2015; Kube et al., 2015; Lakhani et al., 2007; Schweitzer, Rau, Gassmann, & van den Hende, 2015). Online idea crowdsourcing as a way of facilitating open innovation within the 'fuzzy' front end of the innovation process has thus received much academic and managerial attention in the last ten years (Chesbrough & Bogers, 2014; Sloane, 2011). Various insights have been gained regarding the conditions under which organisations can benefit from these external ideation and problem-solving capacities for their innovation processes and success (e.g. Afuah & Tucci, 2012; Jeppesen & Lakhani, 2010; Poetz & Schreier, 2012; Terwiesch & Xu, 2008).

Interestingly, the accumulation of knowledge regarding an initial idea through the crowd's comments has so far received hardly any academic attention within this online ideation context. While the mechanisms that drive crowd-based knowledge accumulation in other online contexts, such as the collection of knowledge in open online co-production communities or projects (e.g. the online encyclopaedia, Wikipedia), have been assessed by a wide range of studies (e.g. Dejean & Jullien, 2015; Kane, Johnson, & Majchrzak, 2014; Levine & Prietula, 2014) we still know relatively little about what facilitates or hinders the 'genesis of an idea', being a process that eventually leads to a 'more completely developed description of the "sensed" idea or product concept' (Koen et al., 2001, p. 50f.). Understanding this process is, however, crucial, especially as open idea-seeking efforts that invite a diverse crowd of (potential) users (e.g. consumers or citizens) with no specific expertise to individually come up with a wide range of ideas for a fairly broad purpose (e.g. ideas for new products) often lead to a wide variety of ideas that are not very well elaborated, are lacking detail or are even incomplete (Di Gangi et al., 2010). This makes it hard for the idea-seeker to understand what has been suggested by the crowd and to decide whether an idea is worth considering further. One way to tackle this problem is to enable the crowd itself to discuss, elaborate or even further develop the suggested ideas. If these comments help to refine and better describe the initial idea, for example, then this

can be beneficial: it can enhance the chances of an idea being perceived as useful or even being implemented by the idea-seeker (Di Gangi & Wasko, 2009a; Seeber et al., 2017). Consequently, it can also be argued that accumulation of idea-related knowledge by the crowd can increase the idea-seeker's yield of ideas in an open online call.

The question of knowledge accumulation taking place within commenting threads is not only interesting from a managerial perspective, it is also very relevant from a broader theoretical perspective as it contributes to our understanding of knowledge sharing and accumulation in new knowledge production environments. In the past two decades, new information and communication technologies have 'fundamentally altered the nature of community building, collaboration, and organizing in economic and social life' (Faraj et al., 2016, p. 668). At the core of this are different types of online communities or collectives that are often considered to represent new forms of organising by bringing together large numbers of people – often strangers – in support of a shared activity or interest (ibid.). This can range from the aforementioned coordinated co-production of an artefact (e.g. encyclopaedia articles) to the independent suggestion of new product ideas.

One way to capture these new knowledge production environments can be found in the work of Whitley (2000). According to Whitley, the production of knowledge can take place in environments that may differ in the mutual dependence among the crowd involved and the level of uncertainty that the given task contains. Based on these dimensions, we argue that some of these online innovation collectives are similar to what Whitley considers to be 'fragmented adhocracies', where the environment of work is unmarked and changing, processes are fluid and the crowd is not interconnected. According to Whitley's framework, the knowledge production environment in the online innovation collective that we focus on in this study can be defined by a lack of functional as well as strategic dependence and high levels of technical and strategic task uncertainty. Given such an environment, it seems unlikely that we will witness 'idea genesis' through the crowd's comments or, to put it more precisely, that idea-related knowledge accumulation will take place in the commenting threads.

However, previous research has found that the crowd does engage in idea elaboration and development through comments (e.g. Adamczyk et al., 2011; Füller et al., 2014; Seeber et al., 2017). We argue that the idea-related knowledge accumulation in commenting threads will be influenced by both the characteristics of the initial idea and factors related to the interaction in the commenting thread and therefore address the following research question: *Which idea- and interaction-related factors influence idea-related knowledge accumulation in idea commenting threads?* We consider two types of factors, those related to: (1) the relative advantage of the initial idea (i.e. the influence of the idea's novelty and

popularity); and (2) the interaction of the commenters involved (i.e. the influence of input activation, the 'seed' comments at the beginning of the thread and the direct interaction taking place among commenters).

Based on data that we collected from an online call for ideas organised by the municipality of the city of Munich, we use a cross-sectional research design involving negative binomial regression to analyse the impact of different idea-related and interaction-related factors on idea-related knowledge accumulation in a commenting thread.

Our findings contribute to a better understanding of knowledge accumulation in a new unstructured, uncertain, asynchronous and fluid knowledge production environment. Focusing on online innovation collectives, we contribute to the literature on (collaborative) knowledge production, but also to the literatures on open innovation and online idea genesis for new product development. In addition, our findings will help to improve online idea crowdsourcing by making better use of the external knowledge available.

The remainder of this chapter is structured as follows. Section 4.2 introduces the theoretical background for this study and in Section 4.3 we develop the hypotheses to be tested. Section 4.4 explains the methodology used and Section 4.5 reports the results obtained. Section 4.6 discusses the findings, highlights the theoretical and managerial implications and points out the limitations of our research as well as areas for future study. Finally, our conclusions for this study are presented in Section 4.7.

4.2 THEORETICAL BACKGROUND

In particular, so-called online or virtual communities that 'bring together individuals with mutual interests using electronic mediation to overcome the same-place, same-time limitation inherent in face-to-face settings' (Faraj & Johnson, 2011, p. 1464) have already attracted substantial academic interest from research focusing on knowledge management or innovation (e.g. Ardichvili et al., 2003; Dahlander & Magnusson, 2005; Jeppesen & Laursen, 2009; Levine & Prietula, 2014; Mahr & Lievens, 2012). An increasing amount of attention (e.g. Bayus, 2013; Di Gangi et al., 2010; Fredberg & Piller, 2011; Schemmann et al., 2016; Schuurman, Baccarne, De Marez, & Mechant, 2012) is also being paid to the *fluid* types of idea or innovation collectives, which we define as virtual places where a voluntary crowd – often made up of (potential) users or customers – with usually no specific expertise is asked to reveal their ideas for new products or innovations to the idea-seeking organisation. The crowd receives hardly any guidance to fulfil this task. Our study focuses on knowledge production in these open online idea calls.

4.2.1 The knowledge production environment

Based on the work of Whitley (2000), we argue that these open idea calls take place in online innovation collectives that need to be seen as knowledge production environments with a high level of task uncertainty and where the crowd does not depend upon each other to fulfil the knowledge production task, for example suggesting an idea for a new product.

In these online innovation collectives, we find a fairly unstructured and uncertain task environment: participants can usually write and do what they want (as long as they stick to some basic rules) and receive only little or no guidance concerning what should be and what needs to be done. Therefore, there is much uncertainty regarding what is necessary to suggest or develop an idea that will eventually be implemented. There are no set hierarchies and no binding constraints concerning who is allowed or supposed to participate in which activities (Faraj et al., 2016). According to organisational theory, such non-routine tasks can be considered highly uncertain as they cannot build on any established procedures (Faraj & Yan, 2009).

Unlike traditional organisational forms, these collectives are characterised by their fluidity of membership, with members showing very different levels of activity and members (and their interests, identities and efforts) constantly shifting and flowing into or out of the collective as barriers to enter or to leave are very low (Faraj et al., 2011; Faraj et al., 2016). As anyone can become a member, such collectives usually lack clearly articulated identities or ideologies, which makes it difficult to develop a sense of a collective identity (Boons, Stam, & Barkema, 2015). Moreover, as members do not depend upon each other in order to make a useful contribution and tasks are not designed to be performed by an interdependent group of people, there is no functional dependence (Whitley, 2000) or structural task interdependence (Wageman & Gordon, 2005). There is also no strategic dependence, as members of the collective do not rely on reputation gained through peer recognition (Whitley, 2000).

Due to these characteristics, collaboration in these online innovation collectives is based on fluid connections (Faraj et al., 2011; Kane et al., 2009): members in such 'fluid collectives' do not share common emotional bonds or mental models and are not structurally embedded in a tightly knit network of relationships and social ties to the other members through repeated interactions, sustainable roles or other traditional networking mechanisms. Instead, relationships have mostly low levels of mutual engagement and shared understanding (Lindkvist, 2005).

The online innovation collectives that we focus on in this study therefore often operate under conditions, such as a lack of structural task interdependency or weak social ties, that contrast with conditions found to be beneficial to the sharing and production of knowledge in traditional, offline environments (Wasko & Faraj, 2005). Despite this, research on idea crowdsourcing has already indicated that ideas suggested online are sometimes being further developed by the crowd: when provided with the necessary features (such as wiki technology or commenting functions), participants in online innovation collectives have been found to engage in idea elaboration and development leading to better quality ideas (Blohm, Bretschneider, Leimeister, & Krcmar, 2011).

4.2.2 The production of idea–related knowledge

The content of comments in online innovation collectives has been found to facilitate the idea-related knowledge production process in different ways, namely by evaluating ideas, pointing out potential problems, clarifying ideas through questions being asked, offering constructive suggestions to further develop ideas, or by comparing the suggested ideas with already existing solutions (Adamczyk et al., 2011; Füller et al., 2014; Hutter et al., 2011; Seeber et al., 2017). So comments can contribute not only to the validation of ideas, but also to the advancement and variation of ideas and knowledge (Grabher & Ibert, 2014).

Research has shown that the comments of peers can help to shape and improve the quality of an initial idea – i.e. its novelty, usefulness, elaboration, and workability (Ye, Blohm, Bretschneider, Goswami, Leimeister, & Krcmar, 2016). There are different ways comments can do this, for example, via constructive criticism, suggestions or the request for more detail. Füller et al. (2014) defined seven categories of qualitative comments that they observed in an online innovation collective. One of these, 'constructive suggestion', contains detailed suggestions concerning how the initial idea can be further improved. We argue here that such constructive suggestions can contain very different types of idea-related knowledge made available by the crowd. In line with other research on the knowledge being developed through comments in online innovation crowdsourcing, suggestions or statements can thus contain additional facts that elaborate the idea, refer to already existing solutions in similar contexts, point out potential trade-offs by identifying potential problems or conflicting requirements, and can even extend the initial idea by combining it with other solution-oriented suggestions (Majchrzak & Malhotra, 2016; Majchrzak, Malhotra, & Mertens, 2015). Interestingly, Hutter et al. (2011) found that knowledge that further shapes the initial idea is not only found in comments that primarily focus on making suggestions, but also in comments that originate from constructively criticising or defending the initial idea.

Empirical knowledge concerning what might facilitate idea-related knowledge accumulation in commenting threads is still limited. Some studies have analysed what encourages people to comment in such environments (Hutter et al., 2011; Ogink & Dong, 2017) but have not paid attention to the outcome of commenting, i.e. whether or not these comments eventually helped to shape the initial idea. Moreover, research that analysed knowledge sharing and production in online innovation collectives and the role of comments in this context has often adopted a network perspective. Such papers use the network structure as a proxy for information flow (e.g. Füller et al., 2014; Hutter et al., 2011; Martínez-Torres, 2014; Wasko, Teigland, & Faraj, 2009). However, this approach can be limited when trying to understand what facilitates the accumulation of idea-related knowledge in a commenting thread. As Boudreau, Gaule, Lakhani, Riedl, & Woolley (2014) point out, empirical work focusing on the *structure* of an information flow often ignores the actual *content* of that flow. Furthermore, network positions may not adequately address the strategic aspects of knowledge sharing or production which explain why knowledge is being accumulated within the same network at certain moments (i.e. for certain ideas) while at other moments (i.e. for other ideas) the members of the same network choose not to share their knowledge through comments (ibid.)

Initial studies, however, indicate that the interaction among commenters can influence the occurrence of idea-developing comments within a discussion thread (Majchrzak & Malhotra, 2016; Majchrzak et al., 2015). The underlying assumption of these studies, which look at comments and knowledge production in sequences, is that comments and their content are a reaction to a sequence of at least two or three previous comments. This assumption can be problematic when analysing the comments in an online innovation collective, where interaction is asynchronous (Faraj & Johnson, 2011). In such an environment, feedback on previous comments is often delayed, interruptions or long pauses in communication are likely to occur, and different topics are active at the same time (Boudreau et al., 2014). This may result in discontinuous and seemingly disjointed discussions (ibid.) and sequential analyses may consequently be limited in their ability to explain overall knowledge accumulation in a discussion thread. Moreover, comments in a discussion thread can also be a mere reaction to the initial idea that started the thread and may not consider any previous comments in that thread. Consequently, if we want to understand the idea-related knowledge accumulation that is taking place in an online commenting thread, we need to consider idea-related as well as interaction-related factors.

Based on these insights, this empirical study therefore focuses on the accumulation of idea-related knowledge that leads to a more elaborated description of the initial idea,

provides the idea-seeker with additional information and insights concerning idea implementation, potential problems or risks, or even adds further innovative features to the initial idea.

4.3 DEVELOPMENT OF HYPOTHESES

We therefore look at two types of factors that might influence idea-related knowledge accumulation in a commenting thread, those relating to: (1) the relative advantage of the initial idea and (2) the interaction of the commenters involved in the commenting thread.

4.3.1 Influence of the relative advantage of the initial idea

Members of online innovation collectives freely decide whether to share their opinions and knowledge through making a comment upon an idea or another comment. To understand idea-related knowledge accumulation taking place in a commenting thread, we need to understand how the characteristics of the initial idea might influence this.

Research that focuses on the role of knowledge remixing for knowledge production in open innovation communities, especially open source communities, shows that relatively advantageous source innovations are a good starting point for future related developments (Haefliger, Krogh, & Spaeth, 2008; Stanko, 2016). Given the fact that the development of ideas takes time and effort, it seems plausible that certain ideas are likely to receive richer attention from the crowd than others.

Necessity is one of the core reasons for people to innovate (Franke & Shah, 2003; Stock, Oliveira, & von Hippel, 2014; von Hippel et al., 2011). Satisfying one's own needs for new or better products has consequently been found to be an important motivation for contributing in virtual communities where members collaborate to develop new products or solutions, for example, in open source software communities (Hertel et al., 2003; Lakhani & Wolf, 2005) or in other types of virtual user-innovation or innovation crowdsourcing attempts (Füller, 2010; Füller, Faullant, & Matzler, 2010; Jeppesen & Frederiksen, 2006; Nambisan, 2002). Research on the use of crowdsourcing for new product development has shown that some of the ideas suggested are popular with the crowd involved and others are not (Martínez-Torres et al., 2015; Schemmann et al., 2016). It can be argued that popular ideas are the ones that at least a part of the crowd has a certain need for and would thus like to see being implemented by the idea-seeker. One can assume that the crowd will put more effort into developing ideas that they like and have a certain need for, and that the popularity of an initial idea will thus have a positive

influence on the amount of knowledge being accumulated in the respective commenting thread. This leads to the following hypothesis.

H1 *The popularity of the initial idea positively influences the amount of idea-related knowledge accumulation in the commenting thread.*

Not all ideas suggested by the crowd in an open call are new to the unit of adoption. Some suggest mere improvements of existing products or solutions, propose products that already exist, or recommend bringing back products that formerly existed (Schemmann et al., 2016). By comparison, novel ideas – just like novel projects – are more uncertain and therefore require higher levels of collaboration and knowledge accumulation from different sources (Hsieh & Tidd, 2012). In line with this, first insights indicate that ideas which suggest the introduction of novel products or processes tend to attract more (controversial) discussions by the crowd (Martínez-Torres et al., 2015). Compared to not-novel ideas, it can therefore be assumed that novel ideas are more likely to trigger input due not only to enthusiasm but, in particular, to discussions on different concepts, potential risks or possible misunderstandings. This leads to the following hypothesis.

H2 *The novelty of the initial idea positively influences the amount of idea-related knowledge accumulation in the commenting thread.*

4.3.2 Influence of the interaction of the commenters involved

Besides the influence of the relative advantage of the initial idea, factors related to the interaction among commenters within the thread are likely to define an atmosphere that helps or hinders the accumulation of idea-related knowledge. As we have shown above, the online innovation collectives that we focus on in this study operate under structural conditions, and in an environment, that are not necessarily beneficial to knowledge accumulation. The comments and the interaction taking place in a commenting thread therefore need to be beneficial to the production of knowledge by facilitating a sense of connectedness and mutuality (Wageman & Gordon, 2005).

Research on online collectives that create and maintain open source software or online reference books has shown that a joint task can cause a sense of common identity in online communities (Ren, Kraut, & Kiesler, 2007). This has positive effects on the sharing of knowledge. A joint task is one that involves inputs from all members (ibid.). It can therefore be assumed that those threads containing comments which stress the necessity for other commenters' input to elaborate or develop the initial idea or which directly ask for other input will help to create a feeling of a joint task and therefore facilitate knowledge accumulation in the thread.

Moreover, comments that encourage others to participate are direct signs of cooperative behaviour, which has been found to be beneficial to collective knowledge development tasks, such as problem solving (Chiu, 2000). Such activating comments have been found to occur as a part of 'generative role-taking' within online communities. Here, members of the community voluntarily step in with, for example, activating comments that help to facilitate interaction and encourage collaboration in order to ensure productive knowledge sharing (Faraj et al., 2011; Majchrzak, Faraj, Kane, & Azad, 2013).

We therefore hypothesise that the direct activation and encouragement of commenters' input will be beneficial to knowledge accumulation taking place in a thread.

H3 *The direct activation or encouragement of commenters' input has a positive influence on the amount of idea-related knowledge accumulation in the commenting thread.*

From collective forms of knowledge production, such as group problem-solving processes, we know that rudeness has a negative effect on the outcome (Chiu & Khoo, 2003). Evaluations of ideas can range from polite agreements to rude disagreements (ibid.). An opening comment that disapproves of the initial idea and clearly states that the idea is not good and/or that no further discussion of the idea is needed has the potential to be perceived as rude, as this can reduce public perception of the ideator's competence. This would hinder the development of a common ground (ibid.) and therefore the accumulation of knowledge. Similar negative effects for the generation of input have been described as 'evaluation apprehension' in idea generation processes (Paulus & Yang, 2000). These can occur when people are afraid of negative evaluations by others in the group (ibid.).

We therefore argue that knowledge accumulation is negatively affected if is blocked early in the commenting thread, for example by a negative seed comment (i.e. the opening or first-level comment in the thread) on the initial idea. This leads to the following hypothesis.

H4 *A negative seed comment negatively influences the amount of idea-related knowledge accumulation in the commenting thread.*

A sense of connectedness and mutuality can be created via direct feedback and interaction among members and has been found to be a motivator for members to collaborate on open innovation platforms (Antikainen, Mäkipää, & Ahonen, 2010). Listening and responding to other commenters' input are therefore direct signs of cooperative behaviour (Chiu, 2000). Moreover, reactions to commenters' input may show other (potential) commenters that the crowd cares about such input and opinions.

The resulting feeling of support and recognition has been found to be positively related to the contribution of knowledge in online communities (Ye, Feng, & Choi, 2015). Some even argue that members seeing people get credit for sharing their knowledge leads to the creation of trust, which then fosters knowledge production in virtual collectives (Lin, Hung, & Chen, 2009). Directly referring to the input of other commenters in the thread can thus be seen as the most basic form of showing some acknowledgement of other input. We therefore assume that it will also foster the same positive effects.

In line with studies that looked at the drivers for knowledge-sharing or even co-creation behaviour in voluntary online communities (Lin et al., 2009; Roberts, Hughes, & Kertbo, 2013), we therefore hypothesise that direct interaction between commenters taking place in a thread is beneficial to the accumulation of knowledge.

H5a *The amount of direct interaction and engagement with other commenters' input in the thread has a positive influence on the amount of idea-related knowledge accumulation in the commenting thread.*

Direct interaction of commenters and the engagement with other input in the thread can take place in different ways. For example, the comments can acknowledge and value other input, but they can also question or even criticise it. This can eventually lead to a more valuing interaction climate or an interaction climate that is dominated by comments that question or criticise other input in the thread. Knowing that an open and constructive climate is beneficial to collective creative processes (Antikainen et al., 2010), we here assume that a mainly valuing and acknowledging climate will have a positive effect on the amount of knowledge being shared in the thread, as this will be helpful for a sense of mutuality. On the contrary, an interaction climate dominated by questioning comments is likely to have a negative effect, as members may fear that their input will also be negatively evaluated by other members (Diehl & Stroebe, 1987). This leads us to the following sub-hypothesis of the previous hypothesis.

H5b *A valuing interaction climate has a positive effect and a questioning interaction climate has a negative effect on the amount of idea-related knowledge accumulation in the commenting thread when compared to no interaction (climate) at all.*

4.4 METHODOLOGY

To test the above hypotheses, we applied a cross-sectional research design, in which the unit of analysis and unit of observation are the thread of comments that an initial idea

received. First, we used descriptive statistics to explore the accumulation of idea-related knowledge in idea-commenting threads. Second, we used negative binomial regression analyses to study the influence of idea- and interaction-related factors on the amount of idea-related knowledge accumulated in a commenting thread.

4.4.1 The data

For this study we used data from an online innovation collective organised by the municipality of Munich. The call for ideas, which took place from December 2010 to February 2011, was operated on the adhocracy.de platform, a non-profit platform which allows public organisations and communities to organise e-participation projects free of charge. The idea call asked citizens to suggest new 'ideas for digital Munich', i.e. new or improved digital services offered to the people who visit or live in Munich. The initiative was among the first of its kind in Germany and received public attention as well as two international awards (Dapp & Seeger, 2011).

To participate, citizens had to register by giving themselves a unique user name. Participants were allowed to use a fictitious user name and so did not need to reveal their real identity to the organisers or the audience. They were then able to suggest ideas and make comments. Moreover, they could vote on whether they liked or disliked any of the ideas suggested in this call. All participants were able to read all ideas and comments and to see how many positive or negative votes an idea had received. When participants entered the idea call's website, the first page displayed some instructions as well as a list of the seven most recently suggested ideas. When clicking on a 'more suggestions'-button, the participant was taken to a page that listed all ideas suggested so far. Participants could choose different options for the order in which ideas should be displayed (for example, sort by the latest idea, the latest comment, the current number of positive or negative votes, or alphabetically). The default ordering option was a dynamic order based on the current number of positive versus negative votes.

The idea-seeker asked for ideas for innovations and improvements linked to (new) digital services (Dapp & Geiger, 2011). The aim was to generate a wide variety of service ideas related to 'digital Munich' and to encourage many citizens to participate (Viola, 2010). Therefore, participants could post any idea they considered suitable in this context and freely comment on all ideas, as well as on other comments made. All comments related to an idea were made visible in a thread that also contained the comments made on other comments in the same thread.

This online idea call is particularly suitable for our research as it offers rich and publicly available information about the ideation and commenting process. Given that we are

interested in the factors that influence idea-related knowledge accumulation taking place, it is also important that the dataset provides us with commenting threads that are potentially both rich in content as well as diverse in the number of comments they do contain. Both are the case for the dataset we used in the analyses. Moreover, precise time stamps for each comment provided us with information concerning the chronological order of the comments, which is important to test our hypotheses 3 to 5. After cleaning the data of double entries and ideas suggested outside the realm of the call, the dataset used in the analyses contains 127 idea-related commenting threads[19] that received 697 comments made by 179 commenters. The average comment contains 40 words. The average commenting thread contains 5.49 comments, with the overall range from a minimum of one comment to a maximum of 38 comments.

4.4.2 Measurement

For the operationalisation of the dependent variable as well as the independent variables *input activation, negative seed comment, direct interaction* and *interaction climate* we assessed the content of all comments using qualitative content analysis. The coding process was carried out manually (using a software for qualitative data analysis, NVivo, to keep track of it) and started with the formulation of a written coding scheme, describing categories of different ways in which comments can contribute to the development of the initial ideas. The coding scheme was tested and refined several times before the final coding scheme was defined. The coding for the dependent variable, as well as the four independent variables mentioned above, was then conducted manually by the author of this thesis only. To determine whether the coding scheme is clearly defined and enables accurate assignment of codes, we used a method suggested by Poole et al. (2000, p. 167). Consequently, we chose a random subsample of the dataset. Based on the coding scheme, this subsample was then coded by an academic who was not involved in the research project. Using the Cohen's kappa statistic[20] we found substantial agreement among raters. Discrepancies between raters were analysed and discussed to be sure that there were no systematic problems with the coding scheme.

The dependent variable in our study is operationalised as follows. To determine the amount of *idea-related knowledge accumulation* in a commenting thread, each comment was assessed as to whether it contains any of the three categories classifying different forms

19 There were an additional seven ideas that received no comments at all. As the unit of analysis is the idea-related commenting thread they are not part of the population.

20 A selection of 31 seed comments and 100 (non-seed) comments belonging to 31 randomly selected threads were coded. We report the following Cohen's kappa statistics based on coding on the comment level: for idea-related knowledge inputs Kappa is .876 (p-value < .001), for input activation statements Kappa is .905 (p-value < .001), for negative seed comment statements Kappa is .870 (p-value < .001), for direct interaction with other input Kappa is .980 (p-value < .001), for valuing other input Kappa is .880 (p-value < .001) and for questioning other input Kappa is .931 (p-value < .001).

of idea development: 'idea elaboration', 'idea implementation' and 'idea constraints'. The first category, 'idea elaboration', includes statements that further elaborate the initial idea, either by describing parts of the initial idea in greater detail or by adding details regarding the service concept, value system, revenue model, organisational or technical delivery system of the initial idea or the kind of customer/citizen interaction it will involve (based on the six dimensions of service innovations developed by den Hertog et al. (2010)). The second category, 'idea implementation', includes statements that make suggestions on how the initial idea could be implemented. This includes pointing out already existing solutions elsewhere, making suggestions on which people or organisations could be involved or contribute expertise, or mentioning possible steps that should be taken to make this idea work and to implement it. Finally, the third category, 'idea constraints', contains statements that point out potential problems or risks that are associated with the idea suggested and that need to be considered or overcome. Textbox 4.1 shows some examples of such input. These categories are not mutually exclusive. Therefore, a comment can contain different categories of idea development. Moreover, some comments contain idea development items that were already mentioned by previous comments in the same thread. Such 'repetitions' were omitted and not included in the amount of *idea-related knowledge accumulation* taking place in a commenting thread. Each idea-developing category touched upon in one of the comments in a thread is assigned one point. The resulting dependent variable is a count variable: the number of times idea development took place in a commenting thread.

The independent variables used in the analyses are operationalised as follows.

The independent variable *idea popularity* (H1) is measured according to whether the initial idea was on average perceived as popular by the members of the community. The members could freely express which ideas they found useful and would like to see pursued by the idea-seeker by voting whether they like or dislike an idea. We therefore define ideas that mainly received positive votes (i.e. 'likes') from the community as being perceived as useful. We therefore created the following dichotomous variable: initial ideas that mainly received positive votes are coded as 1, initial ideas that did not are coded as 0.

The independent variable *idea novelty* (H2) is operationalised based on whether the initial idea was new to the unit of adoption (i.e. the city of Munich). To assess this, we carried out an extensive Internet search to find out whether the service proposed in the initial idea was new to the city, or even beyond, at the time it was suggested. Ideas that were assessed as novel included, for instance, the introduction of free wireless internet access in public places or the introduction of an innovative online 'queuing' application to enable better use of queuing time when dealing with the public authorities. Ideas that

Textbox 4.1 Examples of different types of idea-developing input

Examples for further idea elaboration*
A high level of data security should be taken into account right from the beginning.
Why not add a push-service with location-based information concerning the dates when the normal rubbish / the recyclables / the paper will be collected? … And an additional app should allow one to report any full paper or glass containers by simply pushing a button.
It will be important that the device automatically switches to the new system when entering a new WLAN.
Examples for a suggestion towards idea implementation*
An example can be found in Frankfurt: http://www.frankfurt-gestalten.de. It was first started by some political scientists and some salaried computer programmers; after some media coverage additional members were found. At present the team consists of 7 volunteers.
Instead of programming an app, please do first offer an open, well documented interface to allow such a service to be developed for different types of platforms.
For implementation one could cooperate with other services (public transport for example is facing the same situation) or one could use crowdsourcing and involve the citizens to enter this data into the system.
Examples for mentioning idea constraints*
Digital or online voting is not so much security problem (here the systems that are available on the market are already quite advanced), but much more the (currently not available) transparency of the process – this is also the tenor of the judgement of the Federal Constitutional Court of March 2009. With this judgement the 'Transparency of the Election Process' has practically gained constitutional status and has the same effect as a 6th principle of electoral law. The problem could only be solved if the creator of the software published at least the source code as open-review. This however contradicts major economic interests.
This would be very handy, but we should not forget that many of the things mentioned are only valid if they contain an official verification or they have been signed…
Online voting would be great; being an experienced IT-specialist I know how such voting could be easily forged. Therefore, this should not be implemented!

*Examples of comments were translated from German into English language by the author of this thesis.

were assessed as not novel included, for instance, the improvement of the design and functionalities of the city's official website or the idea for an already existing navigation system for cyclists. Consequently, the resulting variable is dichotomous: initial ideas suggesting services that were new to the city (or beyond) are coded as 1, initial ideas suggesting services that already existed or were mere improvements of existing services are coded as 0.

The independent variable *input activation* (H3) is measured according to whether the commenting thread contains any comments that actively ask other commenters for their input by asking questions or by motivating other commenters to collectively develop

the initial idea. To ensure that we analyse the influence of input activation on idea-related knowledge accumulation within a commenting thread, only comments made before the final idea-developing comments were incorporated. This led to the following dichotomous variable: commenting threads that contain an activating comment are coded as 1, commenting threads that do not are coded as 0.

The independent variable *negative seed comment* (H4) is operationalised based on an assessment of the first comment (seed comment) that started the commenting thread. The resulting variable is dichotomous: threads with a seed comment expressing that the initial idea is not good and/or no further discussion or development of it is needed are coded as 1, all other commenting threads are coded as 0.

The independent variable *direct interaction* (H5a) is measured based on the amount of direct interaction that took place among commenters within a thread. We defined direct interaction as being shown in those comments that directly refer to another comment in the thread, for example, by valuing or questioning other commenters' input or by asking other commenters to specify their input. For each comment that refers to another commenter's input within the same thread, the commenting thread receives 1 point. Again, we only included those comments that were made before the final idea-developing comment within the thread. The variable is log-transformed.

The independent variable *interaction climate* (H5b) is operationalised according to whether the comments that directly refer to the input of other comments within the same thread (see independent variable *direct interaction*) mainly value and acknowledge (i.e. *valuing climate*) or mainly question or even criticise this other input (i.e. *questioning climate*). A third category contains those commenting threads where no direct interaction took place (i.e. *no interaction climate*). The resulting independent variable is therefore categorical with *no interaction climate* being the reference category. In total, there were three commenting threads that did contain direct interaction among commenters but where the number of valuing and questioning comments was balanced. These three threads were included in the questioning climate category.

We also included two control variables in the analysis. These are operationalised as follows.

First, we controlled for the *idea timing*, i.e. the day of the idea call on which the initial idea was suggested. This is important, as ideas suggested early within the call have more time not only to accumulate any idea-related knowledge but also to receive any activating comments or comments that directly refer to other commenters' input than ideas suggested towards the end of the idea call. To control for systematic variations over

time, we include the idea timing as a control variable. The value of 1 is given if the initial idea was suggested on the first day of the call, the value of 2 for those ideas that were suggested on day two, and so forth. To correct for the skewed distribution of values, we used log-transformation.

Second, we controlled for *idea elaboration*. The initial ideas differ quite a lot in their elaboration, i.e. in the number of words they contain. The amount of elaboration could positively influence the amount of idea-related knowledge accumulation: more elaborated ideas might raise more knowledge-intensive discussions as they contain more information. Consequently, it is important to also control for the elaboration of the initial idea. We therefore included *idea elaboration* as a control variable whereby each word in the initial idea receives 1 point. The variable is then log-transformed.

4.4.3 Analysis

Given that the dependent variable amount of *idea-related knowledge accumulation* is a count variable, we conducted negative binomial regression analyses. Overall, we report six models. In model 1, we included only the two control variables. Model 2 contains the control variables together with the two independent variables related to the relative advantage of the initial idea. In model 3a, the control variables are assessed together with the three independent variables that are related to the interaction of the commenters involved in the thread. Model 3b includes a sub-analysis on *interaction climate*, including the same variables as model 3a but replacing the independent variable *direct interaction* with the variable *interaction climate*. Finally, model 4a is the full model containing the control variables and all independent variables, as already included in models 2 and 3a. Model 4b again includes a sub-analysis on *interaction climate* and therefore contains the control variables and all independent variables, as already included in models 2 and 3b. We looked at the variance inflation factor to be sure that multicollinearity is not an issue.

4.5 RESULTS

In this section, we first provide some descriptive statistics of the variables used in the analyses. We then present the results of the negative binomial regression analyses carried out.

4.5.1 Descriptive results

Idea-related knowledge accumulation does not take place for all initial ideas and in all commenting threads. In the online innovation collective analysed in this study, seven initial ideas did not receive any comments at all, whereas the remaining 127

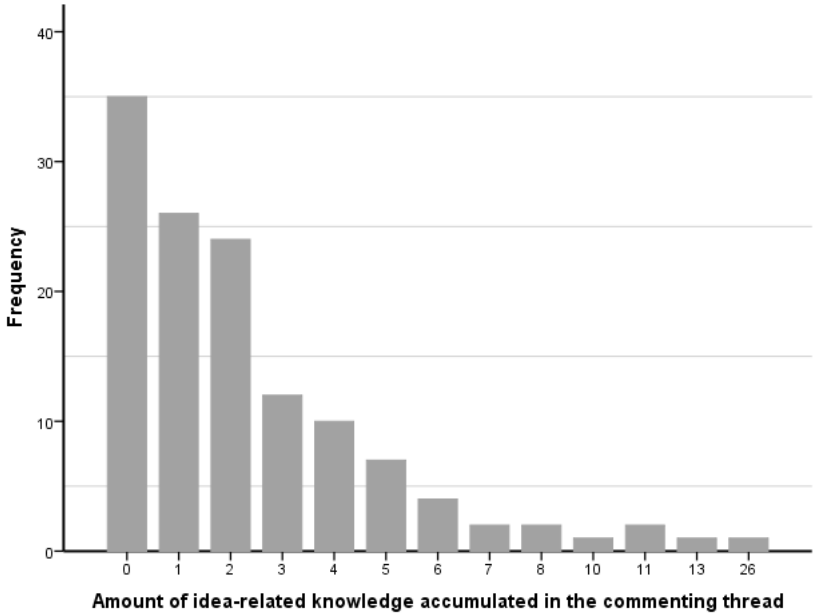

Figure 4.1 Number of threads containing certain amounts of idea-related knowledge accumulation

ideas did receive at least one comment. Moreover, Figure 4.1 shows that 35 out of the 127 commenting threads did not accumulate any idea-related knowledge and 26 only received one knowledge item. A total of 42 threads accumulated three or more knowledge items and five commenting threads accumulated ten or more idea-related knowledge items. On average, commenting threads accumulated 2.44 knowledge items.

Out of the 697 comments included in the analyses, 146 contain 'idea elaboration' input, 109 include input towards 'idea implementation' and 50 comments contain input regarding 'idea constraints'. While more than half of the commenting threads (72 threads) contain 'idea elaboration' input, 58 accumulated knowledge regarding 'idea implementation' and 37 contain comments regarding 'idea constraints'.

Table 4.1 shows that the great majority of initial ideas were popular with the crowd and more than half of the initial ideas suggested were new to the city. Furthermore, about one-fifth of the threads contained input-activating comments and almost a third of the commenting threads started with a negative seed comment. As only about one-third of all commenting threads contain direct interaction among commenters, about one-fifth of all threads have a questioning interaction climate and even fewer (13%) have a valuing interaction climate; all other threads contain no interaction climate as they do not contain any direct interaction.

Table 4.1 Descriptive statistics of dependent, independent and control variables

		N	Min	Max	Mean	Std. Dev.	Pearson Correlation							
							1	2	3	4	5	6	7	8
	Dependent variable													
	Idea-related knowledge accumulation	127	0	26	2.44	3.292								
	Control variables													
1	Idea timing[a]	127	0	4.34	2.03	1.499								
2	Idea elaboration[a]	127	2.30	5.80	4.12	.738	.046							
	Independent variables													
3	Idea popularity	127	0	1	.85	.358	.007	.105						
4	Idea novelty	127	0	1	.60	.492	.100	.109	.017					
5	Input activation	127	0	1	.22	.416	-.198 **	-.047	-.096	-.029				
6	Neg. seed comment	127	0	1	.32	.469	.009	-.168 *	-.183 **	.085	-.164 *			
7	Direct interaction[a]	127	0	2.40	.46	.660	-.358 ***	-.001	-.213 **	-.010	.374 ***	-.023		
8	Valuing climate	127	0	1	.13	.333	-.155 *	.042	-.107	-.076	.084	-.059	.389 ***	
9	Questioning climate	127	0	1	.19	.393	-.299 ***	-.061	-.192 **	-.015	.180 **	.140	.639 ***	-.183 **

[a] Variables were transformed using a log-transformation
* *p*-value <.10; ** *p*-value <.05; *** *p*-value < .01

4.5.2 Results of negative binomial regression analyses

The results of the negative binomial regressions assessing the influence of the relative advantage of the initial idea and the influence of the interaction of the commenters involved on the amount of idea-related knowledge accumulation in the commenting thread are shown in Table 4.2.

The tests of all models against the respective constant-only model are statistically significant, indicating that the predictors together reliably influence the amount of idea-related knowledge being accumulated in a commenting thread. Accordingly, the Nagelkerke Pseudo-R^2 is .248 for model 1, .312 for model 2, .434 for model 3a, .394 for model 3b, and .491 for model 4a and .464 for model 4b.

In the assessment of the different independent variables in model 4a, we see that the independent variables *idea popularity, idea novelty, negative seed comment, direct interaction* and the control variable *idea timing* are significant predictors. By contrast, the independent variable *input activation* is not statistically significant. The same is true for model 4b, which replaces the independent variable *direct interaction* with two

Table 4.2 Results of the negative binomial regression analyses of idea-related knowledge accumulation in a commenting thread

	Model 1 Only controls	**Model 2** Relative advantage IVs + controls	**Model 3a** Interaction IVs + controls	**Model 3b** same as 3a, but sub-analysis on interaction climate	**Model 4a** Full model	**Model 4b** same as 4a, but sub-analysis on interaction climate
Constant	.356 (.559)	-.200 (.570)	.337 (.516)	.311 (.552)	-.183 (.508)	-.341 (.548)
Control variables						
Idea timing	-.401 (.065)***	-.402 (.063)***	-.268 (.058)***	-.302 (.063)***	-.262 (.054)***	-.290 (.057)***
Idea elaboration	.286 (.131)*	.203 (.126)	.192 (.117)	.227 (.124)	.109 (.106)	.141 (.113)
IVs: Relative advantage of initial idea						
Idea popularity		.678 (.289)*			.633 (.244)**	.663 (.260)*
Idea novelty		.464 (.189)*			.424 (.153)**	.536 (.165)**
IVs: Interaction in the thread						
Input activation			-.035 (.197)	.148 (.200)	-.068 (.177)	.101 (.182)
Neg. seed comment			-.716 (.194)***	-.777 (.208) ***	-.637 (.182)***	-.712 (.196)***
Direct interaction			.559 (.120)***		.581 (.105)***	
Valuing climate				.685 (.237) **		.792 (.214)***
Questioning climate				.622 (.225) **		.745 (.205)***
L-ratio Chi2 test	35.488***	46.572***	70.806***	62.232***	83.86***	77.45***
AIC	499.27	492.19	469.95	480.53	460.9	469.31
Nagelkerke Pseudo-R^2	.248	.312	.434	.394	.491	.464
N	127	127	127	127	127	127

* *p*-value <.05; ** *p*-value <.01; *** *p*-value < .001
Standard errors in parentheses
IVs = independent variables

independent variables measuring the interaction climate in the commenting thread. In this model, the same independent variables and control variables are statistically significant. Moreover, both of the interaction climate-related variables, i.e. *valuing climate* and *questioning climate*, are statistically significant when compared to no interaction climate. These findings are robust across all six models 1 to 4b, as the same independent variables are revealed to be statistically significant or insignificant. The control variable *idea elaboration* is not statistically significant.[21] The results regarding the control variable *idea timing* remain largely unchanged and significant at a .001 significance level for all

21 The control variable *idea elaboration* is only significant (*p*-value = .029) in model 1 that contains only the control variables.

models. In all models we observed a negative relationship. The later the idea has been submitted, the lower the amount of idea-related knowledge being accumulated in the commenting thread that refers to that idea. It is therefore important to control for *idea timing*.

Based on our hypotheses, we expected commenting threads with initial ideas that are on average popular (H1) and commenting threads with initial ideas that are new to the unit of adoption (H2) to accumulate more idea-related knowledge. The results presented in model 4a show empirical support for hypotheses H1 and H2 at the .01 significance level. Model 4a illustrates that holding other variables constant, the expected number of knowledge accumulation is multiplied by a factor of $e^{.633} = 1.883$ for a thread on a popular idea compared to a thread on a not-popular idea. Similarly, the expected number of knowledge accumulation is multiplied by a factor of $e^{.424} = 1.528$ for a thread on a novel idea compared to a thread on a not-novel one, holding other variables constant.

We also expected commenting threads that contain a comment that activates or encourages other input (H3) to accumulate more idea-related knowledge. The results provide no support for hypothesis H3 across all models. Moreover, we expected commenting threads with a negative seed comment (H4) to accumulate less knowledge. The results lend support to this hypothesis H4 at .001 significance level. Net of other variables, the results in model 4a show that starting threads with a negative seed comment multiplies the expected number of knowledge accumulation by a factor of $e^{-.637} = .529$. Finally, we expected greater amounts of direct interaction among commenters in a thread (H5a) to accumulate more idea-related knowledge. The results illustrate (at .001 significance level) that an 1% increase in the number of direct interactions among commenters within a thread increases the amount of knowledge accumulation by .581%, holding other variables constant. In addition, we had the expectation that more knowledge is accumulated in commenting threads with a valuing interaction climate and less in those with a questioning interaction climate when compared to commenting threads with no interaction climate (H5b). Hypothesis H5b is partly supported and partly rejected. Contrary to our expectations, we not only find a statistically significant positive relationship between a mainly valuing interaction climate and the amount of knowledge accumulated (at a .001 significance level), but also between a questioning interaction climate and the amount of knowledge being accumulated in the thread (at a .001 significance level). Net of other effects, model 4b shows that being a thread with a valuing climate (compared to no interaction climate) multiplies the expected number of knowledge accumulation by $e^{.792} = 2.209$ and being a thread with a questioning climate (compared to no interaction climate) multiplies the expected number of knowledge accumulation by $e^{.745} = 2.106$.

4.5.3 Robustness analyses

In addition to these core analyses, we also conducted the following robustness checks to assess the sensitivity of the results to changes in model specifications.

First, we assessed whether a positive seed comment, i.e. an opening comment that expresses that the initial idea is good and should be further discussed or developed, has an influence on the amount of idea-related knowledge accumulation. We therefore used model 4a and replaced the independent variable *negative seed comment* with an independent variable *positive seed comment*. While the results for all other variables in the model remained the same, the variable *positive seed comment* had no significant effect on the amount of knowledge accumulation at a .1 significance level.

Second, we used negative binomial models because of overdispersion. We also ran the same analyses using Poisson and Quasi-Poisson models. Moreover, we log-transformed the dependent variable and ran an OLS-analysis. The results of all these additional analyses provide similar insights to the analyses reported in this chapter.

Third, given that 23 out of the 127 commenting threads included in the analyses did only receive one comment and do therefore not contain any *direct interaction* (and *interaction climate*) by default, we ran the models again, excluding those 23 commenting threads. The results for all variables remained largely the same and no significant changes were observed.[22]

Fourth, we included those three commenting threads that had received equal numbers of direct comments valuing or questioning other input in the thread in the independent variable *valuing climate* instead of *questioning climate*. The results for all variables remained largely the same and no significant changes were observed.

4.6 DISCUSSION

Our results show that idea-related knowledge accumulation in online innovation collectives is possible but cannot be taken for granted. In many commenting threads no idea-related knowledge is shared or accumulated. This is not surprising given the fluid knowledge production environment we are looking at. However, we have also shown that substantial amounts of idea-related knowledge are being accumulated in some commenting threads. This can include statements that elaborate the initial idea by

22 Only in model 3a does the control variable *idea elaboration* become significant at a 0.1 level.

describing parts of it in greater detail or by adding further details, statements that contain suggestions on how or with whose assistance the initial idea could be implemented, or statements that draw attention to potential problems or risks associated with the initial idea and that need to be considered or solved. This supports previous studies that already suggested or pointed out that the comments of peers in online crowdsourcing can aid idea genesis by elaborating, shaping or even improving the quality of an initial idea (Füller et al., 2014; Majchrzak & Malhotra, 2016; Ye et al., 2016). Consequently, it is important to understand what facilitates this. We therefore considered different idea- and interaction-related factors that are likely to influence the accumulation of idea-related knowledge in commenting threads and found both types of factors to be important.

First, we assessed the influence of two key characteristics related to the relative advantage of the initial idea that ought to be developed. In line with our hypotheses, we find that both the overall popularity and the novelty of the initial idea have a positive influence on the amount of idea-related knowledge being accumulated. Knowledge production therefore seems to be affected by certain characteristics of the initial idea, to be precise, whether it is a relatively advantageous starting point for further elaboration and development. Knowledge accumulation can thus be positively influenced by the crowd's interest in and need for a new product, with initial ideas that are popular with the crowd receiving more idea-developing input than initial ideas that are not. Satisfying one's own needs has already been described as an important factor in other environments of collaborative innovation work (Hertel et al., 2003; Lakhani & Wolf, 2005) or in virtual user innovation or co-creation communities (Füller, 2010; Jeppesen & Frederiksen, 2006; Nambisan, 2002). In the fluid crowdsourcing environment assessed here, it also seems as if the crowd's effort to accumulate knowledge around an idea is influenced by whether the crowd likes and needs the suggested product or solution.

We also find that idea-related knowledge accumulation is influenced by the novelty of the initial idea. The task of developing novel ideas is highly uncertain, which provides room to bring in knowledge from different sources. Consequently, commenters can get credit for many different types of input. As ideas for services that are new to the unit of adoption are also likely to contain more potential risks (Cooper, 2003) than suggestions for mere improvements of already existing services, a fundamental way of providing input on such novel ideas can be by pointing out possible risks and constraints that are related to it. An additional analysis based on an independent samples t-test supports this assumption: commenting threads on novel ideas accumulate significantly more knowledge regarding idea constraints than commenting threads on ideas suggesting an improvement.

Second, we then assessed the influence of different key characteristics related to the interaction taking place in the commenting thread. Our findings show that different interaction characteristics support or hinder idea-related knowledge accumulation in a commenting thread.

In line with our hypothesis, we find that a negative seed comment at the beginning of the commenting thread has a negative effect on the amount of idea-related knowledge being accumulated. This is consistent with our expectation that such an early negative evaluation of the initial idea has a kind of 'blocking effect' for the development of a common ground that is needed to further develop and elaborate the idea. With no mutual dependence among the members in such online innovation collectives, an early negative statement might hinder the development of what Wageman and Gordon (2005) describe as an 'emergent task interdependence' based on the interaction among the commenters.

Moreover, we also find support for our expectation that the amount of direct interaction and feedback among commenters within the thread positively influences the amount of idea-related knowledge accumulation. We therefore extend Chiu's (2000) argument that responding to other comments is a direct sign of cooperative behaviour, by showing that direct interaction actually leads to greater amounts of knowledge being accumulated. In addition, our findings suggest that direct interaction among commenters could be beneficial to a feeling of mutuality and trust among the commenters; this has been found to be an important prerequisite for the disclosure of knowledge in online communities (Lin et al., 2009; Ye et al., 2015). Faraj et al. (2016) recently supported this notion by explaining that, through such online discussions and interactions, meanings are continually negotiated and the flow of knowledge will be accelerated.

Our findings concerning the possible influence of the interaction climate on the amount of knowledge accumulation only partially support our expectations. While we find support for our hypothesis that an interaction climate that mainly values other commenters' input positively influences idea-related knowledge accumulation, we also find – contrary to what we expected – that this is also true for commenting threads with a mainly questioning interaction climate when compared to threads with no interaction (climate). Given the positive influence of direct interaction among commenters within a thread on the amount of knowledge being accumulated, it can therefore be argued that *how* the commenters interact is not important, instead it is important that they *do* interact. A possible explanation for the positive effect of a questioning climate can be that those commenters who feel that their input is being questioned by others in the thread react to this by developing their input even more. This would support other findings that

suggest that, unlike in face-to-face interactions, disagreements in online interactions do not seem to threaten the continuation of the discussion (Chen & Chiu, 2008). Instead, disagreements are likely to lead to further discussions and better elaboration of the input, which can be beneficial for the accumulation of knowledge in the thread.

Contrary to what we expected, we do not find that the encouragement and activation of commenters' input are beneficial to idea-related knowledge accumulation. A possible reason for this could be that such activating comments might simply lead to more comments in a thread, but not necessarily to ones that further elaborate or develop the initial idea. Our findings indicate that comments that specifically try to activate other input do not help to create that feeling of a shared task which would be beneficial to the accumulation of knowledge in the thread.

4.6.1 Theoretical and managerial implications

By focusing on knowledge production in online innovation collectives this study contributes to an important question in current management research, that is, the study of new forms of knowledge production in communal systems, such as online collectives and crowdsourcing (Birkinshaw, Healey, Suddaby, & Weber, 2014). More precisely, this study addresses an important phase at the front end of the innovation process by providing insights into the factors that facilitate crowdsourced knowledge production and accumulation in idea-related commenting threads. Thus far, studies have focused on the individual comment and its position in a sequence of other comments (Majchrzak & Malhotra, 2016; Majchrzak et al., 2015) or in relation to the commenter's position in the network (Füller et al., 2014). But, within the environment of an online innovation collective, the overall accumulation of idea-related knowledge taking place in the commenting threads has been neither researched nor explained. With this study, we show that such knowledge accumulation can be observed, and that idea- and interaction-related factors influence the amount of knowledge accumulation. Our findings speak to a growing amount of literature that aims to explain how knowledge is being produced, shared and accumulated in new online environments that are unstructured, uncertain, asynchronous and fluid (e.g. Faraj et al., 2011; Faraj et al., 2016).

Our findings are not only relevant from a theoretical perspective, they also contain practical implications for those organisations that are already, or are interested in, using idea crowdsourcing and online innovation collectives for their new product development and innovation purposes.

First, we show that the comments made in the idea-related commenting threads can accumulate knowledge that facilitates idea genesis by describing the initial idea in more

detail, adding further features to it, suggesting how or with whose assistance it could be implemented, or pointing out potential problems or risks that need to be considered or solved. All of this is knowledge and idea-related input that is likely to be of relevance for the idea-seeker. As the amount of such useful input is positively influenced by the relative advantage of the initial idea (i.e. its novelty and popularity) the idea-seeker is likely to gain additional insights for those suggested ideas that are potentially more relevant to be considered for implementation. Consequently, paying attention to the input of commenters in such online innovation collectives can be a way to diminish the problem of not very detailed or even incomplete initial ideas (Di Gangi et al., 2010). This could eventually help to make better use of open innovation efforts through idea crowdsourcing.

Second, our findings also show that idea-related knowledge accumulation cannot be taken for granted and will not happen for all ideas. Therefore, idea-seekers should pay attention to certain characteristics concerning the interaction in the thread that are likely to help or hinder productive knowledge accumulation. The idea-seeker could, for example, involve moderators to facilitate interaction in the commenting thread. Instead of posting activating or encouraging comments these moderators could make sure that they post a 'welcoming comment' when a new idea has been suggested to make sure that the first comment on an initial idea is not a negative one. Moreover, they could directly comment on other commenters' input to show the members in the collective that their ideas and input are being heard and possibly even challenged.

4.6.2 Limitations and future research

Like all research, this study has its limitations and raises suggestions for further research.

First, our study is based solely on data generated from a single online innovation collective – a call for ideas for new digital services in Munich. Despite the richness and the soundness of the commenting data available, analyses of data from other online innovation collectives in comparable contexts and environments will be useful to verify our claims.

Second, given that the commenters in such online innovation collectives are usually allowed to stay anonymous, data on characteristics such as the age, gender or profession of the commenters were not available to us. In future research it would certainly be valuable to include such personal characteristics as additional control variables (for example, the age range or the expertise of the commenters involved in a thread) to assess whether there is any impact on the results obtained.

Third, we were not able to directly observe or measure the perceptions of commenters regarding their feelings of mutuality, task interdependence or connectedness and how this might be influenced by the interaction taking place in a commenting thread. Further research is needed to gain deeper insights into this matter and how it might have an effect on the outcome of knowledge accumulation.

Finally, future research could also assess how and to what extent the input accumulated within a commenting thread has been used by the idea-seeker when having to decide which ideas to adopt and how they will be shaped into new products.

4.7 CONCLUSION

We can conclude that different factors influence the amount of knowledge accumulation taking place in online innovation collectives where the task is highly uncertain and members of the crowd do not depend upon each other to make a useful contribution. Both factors related to the relative advantage of the initial idea (i.e. the overall popularity and the novelty of the initial idea) and factors related to the interaction among commenters (i.e. negative seed comments and the direct interaction among commenters) influence idea-related knowledge accumulation in a commenting thread. This study thereby contributes to a better understanding of knowledge accumulation in those online innovation collectives that operate in unstructured, uncertain, asynchronous and fluid knowledge production environments. In addition, our findings can help to improve online idea crowdsourcing for new products or solutions by making better use of the external knowledge available and the potential to crowdsource idea genesis.

5

Searching for external ideas and solutions: What makes innovation crowdsourcing work?

This chapter is based on:
B. Schemmann, G. J. Heimeriks, M. M. H. Chappin & A. M. Herrmann (submitted):
Searching for external ideas and solutions: What makes innovation crowdsourcing work?

ABSTRACT

Within the last ten years we have witnessed a surge in empirical studies that address the use and usefulness of crowdsourcing within the open innovation context. However, what is lacking so far is an analytical framework that enables us to synthesise the empirical findings regarding the factors that influence the knowledge production outcome when relying on the crowd to come up with innovative solutions or ideas. Such a synthesis is essential when trying to understand what makes crowdsourced knowledge production work and for making the right choices about how to design a crowdsourcing project or platform to find ideas or solutions for the type of problem at hand. To better understand what makes crowdsourcing work, we first develop a framework that structures the different areas of knowledge production within the innovation crowdsourcing space, based on their level of task uncertainty and mutual dependency within the crowd to fulfil the task. Using this framework, we then review the relevant literature to identify and synthesise the different factors that have found to be important for the crowdsourcing of new ideas and solutions.

5.1 INTRODUCTION

Using the technical capabilities of modern ICT, an increasing number of organisations are turning to the crowd when looking for external solutions to complex problems or new ideas for new products or processes. Within the last ten years, a substantial amount of academic attention has therefore focused on the use of crowdsourcing for innovation-related knowledge production. Empirical studies have already shown that ideas and solutions generated from the crowd can be innovative as well as useful (Mahr & Lievens, 2012; Poetz & Schreier, 2012), and that 'for certain types of problems, crowds can outperform your company. You just need to know when – and how – to use them' (Boudreau & Lakhani, 2013, p. 61).

Existing literature and research on innovation crowdsourcing often focus on a single type of problem or task that is outsourced to the crowd, on data from one crowdsourcing project or platform, or on a specific innovation crowdsourcing case study. Within the last five years in particular, we have witnessed a surge in empirical studies that address the use and usefulness of crowdsourcing within the innovation context. This has led to a wide variety of unstructured and sometimes even conflicting insights on a range of mechanisms that influence the production of new knowledge in different problem-solving and idea-generation environments. Examples include the motivations that drive crowd participation, the influence of different types of incentives, and the effect of feedback provided from the knowledge-seeker. Such findings are all very important for the successful design of future crowdsourcing attempts. However, as Boudreau and Lakhani (2013) point out, defining what makes crowdsourcing work depends on the type of problem or task and therefore the type of knowledge or input needed. Looking at a body of ten years of intensive research in this area, this chapter brings these different insights together in a meaningful and structured way to better understand *what makes innovation crowdsourcing work for different areas of knowledge production*.

So far, a number of structured literature reviews that (partially) deal with innovation crowdsourcing have created different crowdsourcing typologies with some of the types being unrelated to the production of new knowledge or innovation (Ali-Hassan & Allam, 2016; Estellés-Arolas & González-Ladrón-de-Guevara, 2012). Alternatively, they have focused on structuring the key topics and applications addressed by crowdsourcing research so far (Hossain & Kauranen, 2015) and organising existing literature based on its different theoretical foundations (Palacios, Martinez-Corral, Nisar, & Grijalvo, 2016). In addition, some reviews focused on: a certain type of crowd, for example, customers (Bretschneider & Zogaj, 2016; Chang & Taylor, 2016); type of crowdsourcing, for example, online contests (Natalicchio, Messeni Petruzzelli, & Garavelli, 2014); or the use of crowdsourcing for specific industries (Mao, Capra, Harman, & Jia, 2017; Wei, 2013).

What is still lacking is a synthesis of the different empirical findings analysing what factors influence the knowledge production outcome when relying on the crowd to come up with innovative solutions or ideas. Such a synthesis, however, is essential when trying both to understand what makes crowdsourced knowledge production work and to make the right choices on how to design a crowdsourcing project or platform so as to find ideas or solutions for the type of problem at hand. Following the well-known systemisation of knowledge production by Whitley (2000), we therefore first develop a framework that structures the different areas of knowledge production within the innovation crowdsourcing space, based on their level of task uncertainty and mutual dependency among the crowd to fulfil the task. Using this framework, we then analyse the relevant literature to identify and synthesise the factors that empirical studies in the field have found to be important for the knowledge production outcome.

Our review shows that, depending on the type of knowledge input needed from the crowd, different factors are important for attaining the intended knowledge production outcome. The results of the literature review are therefore relevant for knowledge-seeking organisations wanting to design crowdsourcing projects likely to produce the outcomes they are aiming for. Our results also provide a new theoretical perspective on existing innovation crowdsourcing research and the empirical insights gained through this research so far. We show the value of Whitley's work (2000) for crowdsourcing research and point out areas of research that have not received much attention so far and can provide interesting questions for future research.

This chapter is structured as follows. In Section 5.2 we introduce our analytical framework and define four areas of knowledge production within the innovation crowdsourcing space. Section 5.3 then describes the methodology used and in Section 5.4 we present the findings of our structured literature review in an integrated way. In Section 5.5 we discuss the findings of this review by referring to the analytical framework and pointing out limitations as well as areas for future research. Finally, Section 5.6 presents the theoretical and managerial implications and our conclusions.

5.2 ANALYTICAL FRAMEWORK

The term 'crowdsourcing' was first defined by Jeff Howe in 2006 as:

> 'the act of a company or institution taking a function once performed by employees and outsourcing it to an undefined (and generally large) network of people in the form of an open call. This can take the form of peer-production (when the job is performed collaboratively), but is also often undertaken by sole individuals. The crucial

> prerequisite is the use of the open call format and the large network of potential laborers.' (Howe, 2006)

Therefore crowdsourcing – just like outsourcing – can be used by an organisation for a wide variety of both simple and complex tasks (Schenk & Guittard, 2011; Ye & Kankanhalli, 2013). Unlike outsourcing, the task is not assigned to a pre-selected supplier but to a crowd of potential suppliers (mostly individuals) who simultaneously work on the given task. Upon completion, the organisation will then choose those outcomes that best meet its needs (Schenk & Guittard, 2011). The construction of the crowd is based on self-selection, with the participating members freely deciding whether they want to contribute something to the given task (Afuah & Tucci, 2012).

Recently, Fedorenko, Berthon, and Rabinovich (2017) pointed out that the crowdsourcing literature consists of two major streams. The first stream (which this study focuses on) is related to innovation management research and mainly addresses the creativity and problem-solving capacities that can be gained using crowdsourcing. The second stream is more organisationally focused and aims to understand how new business models based on crowdsourcing create and capture value.

Specifically, this study is interested in the use of crowdsourcing to generate (new) knowledge input for potential (radical or incremental) innovations and product development. Such knowledge includes, for example, both specific solutions for R&D problems and broad ideas that can be used to develop new goods and services or even new perspectives on a complex problem. Other typical crowdsourcing tasks often discussed within the innovation context, such as the generation of funds to finance innovative projects (crowdfunding) or the outsourcing of simple design tasks (graphic or logo designs), are not considered in our study.

Characteristic of all the crowdsourcing addressed in this chapter is the call for participation being non-discriminatory (Djelassi & Decoopman, 2016). The participating crowd is therefore made up of a variety of individuals, often with a wide range of expertise and backgrounds, who are not necessarily known to the knowledge-seeking organisation, as participants often do not have to reveal their identity (ibid.). The use of crowdsourcing is especially beneficial when the knowledge-seeker is not sure who might possess the new knowledge or input that are needed. Otherwise, it is more efficient to simply count on internal problem-solving or traditional outsourcing to a designated agent (Afuah & Tucci, 2012).

Focusing on the use of crowdsourcing for innovation-related knowledge production, we first organise this crowdsourcing space into four areas of knowledge production.

5.2.1 Knowledge production within the innovation crowdsourcing space

Previous studies have already developed different theoretical frameworks or taxonomies to provide a structural understanding of crowdsourcing within the innovation context. These frameworks are, for example, very useful to: capture how crowdsourcing relates to different innovation models, such as user, producer or collaborative ones (Baldwin & Hippel, 2011); categorise different types of value that can be gained from crowdsourcing in a variety of contexts, not necessarily innovation-related ones (Bauer & Gegenhuber, 2015); or differentiate organisational approaches to innovation crowdsourcing, for example open vs closed or internal vs external attempts (Garavelli et al., 2013). However, these frameworks either cannot or can only partly be used to define the different forms of knowledge production when trying to crowdsource new ideas or solutions.

Other papers propose frameworks that are more relevant for our context. They differentiate crowdsourced knowledge production based on either variations in task or problem complexity and problem framing (Felin & Zenger, 2014; Lopez-Vega, Tell, & Vanhaverbeke, 2016) or on differences regarding the dependencies or collaboration of the crowd involved (Boudreau & Lakhani, 2009; Majchrzak & Malhotra, 2013; Simula & Ahola, 2014). Other scholars propose frameworks or taxonomies that consider both task structure and dependencies (Boudreau & Lakhani, 2013; Nakatsu, Grossman, & Iacovou, 2014). However, they do not specifically focus on the use of crowdsourcing to produce ideas or novel solutions; they also incorporate its use to accomplish simple and often repetitive tasks. Consequently, the production of innovative knowledge is only partially addressed and differentiated by these frameworks.As the generation of new knowledge and ideas is always characterised by both task uncertainty and dependencies within the knowledge production process, we argue that the crowdsourced production of knowledge can also be delineated this way. In line with Boudreau and Lakhani (2013) and Nakatsu et al. (2014), we thus suggest that a framework that helps to differentiate crowdsourced knowledge production needs to consider both the nature of the task given to the crowd and the necessity to collaborate to fulfil the task.

A good way to understand and capture new knowledge production can be found in the work of Whitley (2000). Even though Whitley's work focuses on the organisation of knowledge production in the modern sciences, we argue that the basic underlying cognitive and social dimensions are also very useful for describing knowledge production within the innovation crowdsourcing space. In line with our argument above, Whitley (2000) points out that the production of new knowledge can take place in environments that differ regarding their level of 'task uncertainty' and 'mutual dependence'. We therefore argue that the nature and formulation of the task given to the crowd (cognitive dimension) and the dependencies that exist within the crowd to

accomplish this task (social dimension) define the knowledge production outcome that can be expected from the crowdsourcing project.

Whitley (2000) differentiates between 'technical' and 'strategic' task uncertainty. Technical task uncertainty arises when contributors do not really know what kind of solution or input the knowledge-seeker is looking for. To be relatively sure what a sought-after contribution needs to comprise, the problem needs to be well-structured and clearly defined and the given task needs to be restricted to a certain outcome that can be explicitly articulated. Strategic task uncertainty can here be understood as the degree to which the contributors know which are the most pressing issues that need addressing and what the knowledge-seeker's favoured solution could be. The two types of uncertainty are linked to each other, with technical task uncertainty likely to lead to strategic task uncertainty.

Whitley (2000) also differentiates between two types of mutual dependence, i.e. 'functional' and 'strategic' dependence. The first, functional dependence, can here be understood as the extent to which the contributors in the crowd depend upon each other to collaboratively come up with the solution or input that the knowledge-seeker is looking for. The second, strategic dependence, refers to the degree to which contributors rely on peer recognition within the crowd and therefore have to persuade the crowd of the quality or importance of their knowledge input to ensure that their contribution will be used or considered by the knowledge-seeker. Thus, a contributor's input must be meaningful not only to the knowledge-seeker but also to the crowd. Depending on the degree of (functional and/or strategic) dependency, the level of sociality in a crowdsourcing project can range from 'thin' to 'thick' (Felin et al., 2017).

Knowledge production within the innovation crowdsourcing space can differ in its technical and strategic task uncertainty (i.e. cognitive dimension) and its functional and strategic dependence (i.e. social dimension). One can imagine that differences in these dimensions will influence the knowledge production outcome: when task uncertainty is lower, concrete solutions for a problem or task are likely to arise; when task uncertainty is higher, knowledge input will be more conceptual. When there is no dependency among contributors, then the knowledge produced is likely to be the result of independent individual problem-solving or ideation efforts; when the contributors depend upon each other, then the solutions suggested are likely to be influenced by different perspectives and areas of expertise. We therefore propose that the innovation crowdsourcing space can be structured into four different areas of knowledge production, namely: for the generation of ready-to-use solutions to specific problems; for the interdependent development of ready-to-use products or solutions;

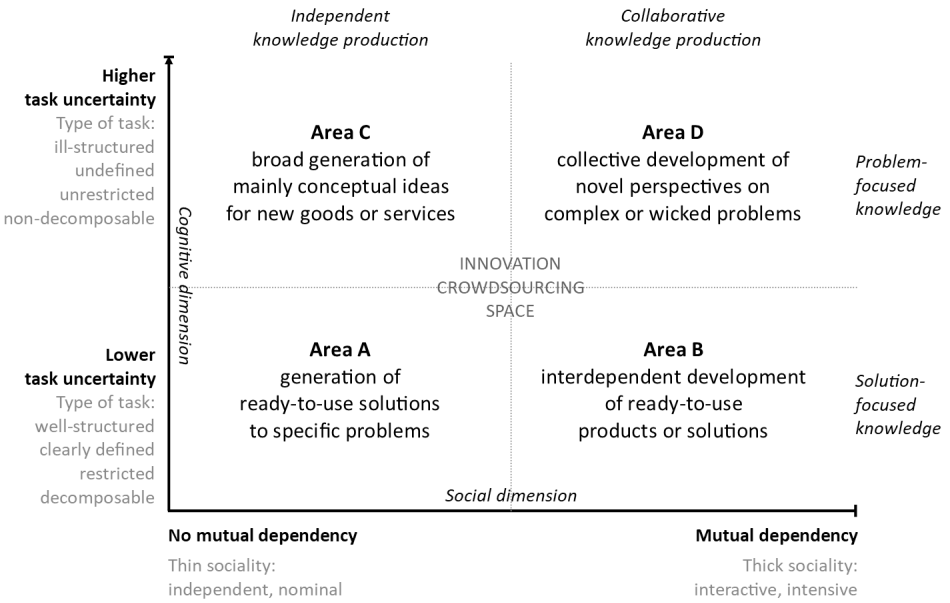

Figure 5.1 The innovation crowdsourcing space and its areas of knowledge production

for the broad generation of mainly conceptual ideas for new goods or services; and for the collective development of novel perspectives on complex or 'wicked' problems. Figure 5.1 shows these areas and how they relate to the aforementioned cognitive and social dimensions.

Naturally, there is some overlap between the four areas. However, it can be assumed that the production of knowledge in each area can and will be subject to different underlying mechanisms and will be affected by a range of influencing factors. It is crucial to define these in order to explain what makes crowdsourcing work. Based on the framework, for example, we expect that the ways tasks need to be presented to the crowd will differ and that the appropriate formulation of the task will be important. As the need to collaborate in the four areas differs, it can also be assumed that the motivations of contributors will differ and that the interaction of the crowd will be more important in some areas than in others.

5.2.2 Four areas of knowledge production

As outlined above, the importance of the task and task uncertainty (i.e. how well-defined is the task and what kind of solutions does it require?) and task interdependence (i.e. can the task be solved by an individual or is collaboration of the crowd needed?) as well as the link between the nature and definition of the problem and the different approaches

to solving it have already been recognised in the crowdsourcing literature and in some existing frameworks. This literature will therefore be used to support and exemplify our framework and the four areas of knowledge production.

5.2.2.1 Generation of ready-to-use solutions to specific problems (area A)

In area A, the focus is on the generation of what Mahr and Lievens (2012) describe as solution-focused input, i.e. input and solutions that not only match the task at hand but can also be immediately used or integrated into the development of a new product. To enable the crowd to come up with such ready-to-use solutions, the nature of the problem needs to be 'decomposable' to some extent (i.e. it must be possible to break the problem down into components), so that the broadcasted task can be clearly defined and suitable solutions can be clearly identified (Boudreau & Lakhani, 2009; Felin & Zenger, 2014). Therefore, the problem often needs to be 'translated' and broken down, allowing a diverse crowd of potential solvers to understand and tackle it (Boudreau & Lakhani, 2013). So-called intermediaries, such as InnoCentive or NineSigma, that broadcast the problem on behalf of the knowledge-seeker therefore work closely with their clients to clarify the problem and define the task in such a way that possible solutions can be developed and identified (Boudreau & Lakhani, 2009).

Problems that are best addressed in this area usually lack established paths to solution or best-practice approaches to tackle them (Garcia Martinez & Walton, 2014). It is therefore often not clear what skills or expertise and which approach will eventually lead to the best solution for these often technical or R&D problems (Boudreau & Lakhani, 2013; Felin & Zenger, 2014). Consequently, the problems given to the crowd in this area are best solved by broad experimentation, leading to multiple novel solutions from which the knowledge-seeker can then choose (Boudreau & Lakhani, 2009; Boudreau & Lakhani, 2013; Felin & Zenger, 2014). Therefore, contributors within the crowd usually work on the task in isolation from both other contributors and the knowledge-seeker (Boudreau & Lakhani, 2009; Majchrzak & Malhotra, 2016). This thin or nominal form of sociality is clearly linked to the competitive nature of these crowdsourcing projects; the motivation of contributors is to compete and potentially win by offering the best solution to the problem (Felin et al., 2017). Current crowdsourcing literature often addresses this area of knowledge production as innovation contests or tournaments, competitive markets, crowd or problem-solving contests.

5.2.2.2. Interdependent development of ready-to-use products or solutions (area B)

Area B also concentrates on solution-focused input, for example, to develop ready-to-use new product solutions. Therefore, the cognitive dimension of knowledge production in area A and B is similar. However, there is more emphasis on the decomposability of the problem (West & O'Mahony, 2008) and the process is based on the principles of open

collaborative innovation. For the open collaborative innovation process, a modular task is crucial: it allows separate parts of the overall task to be worked on by different contributors independently and in parallel (Baldwin & Hippel, 2011). This points out the main difference between area A and area B: while in area A contributors do not depend upon others within the crowd to provide the kind of solution or input that the knowledge-seeker is looking for, in area B contributors rely upon the crowd and other contributors' work to produce the solution that is needed. Consequently, the main difference lies in the social dimension and the dependencies within the crowd. Knowledge production in area B utilises the expertise of a well-connected network of experts who are working on a specific topic based on a shared goal and shared methods of working (Simula & Ahola, 2014).

Typical examples of this area of knowledge production are collaborative communities, such as firm-hosted or sponsored open source software communities, where the production of new knowledge is not a temporary challenge but more a long-term or ongoing requirement. Here, the crowdsourced innovation task entails cumulative knowledge production that continually builds upon past advances (Boudreau & Lakhani, 2009). Therefore, information is shared freely in relatively rich communication channels within these communities and contributors tend to accumulate and recombine existing ideas and knowledge (Boudreau & Lakhani, 2013; Felin & Zenger, 2014). In area B, we therefore find relatively thick forms of sociality: due to common goals, cooperation and task interdependence, coordination and interaction between contributors are necessary (Felin et al., 2017). Knowledge exchange and interactions within the crowd are encouraged, with the aim of eventually developing a culture of sharing and a sense of affiliation (Boudreau & Lakhani, 2009).

It is important to point out that, in these communities that 'are organised to marshal the outputs of multiple contributors and aggregate them into a coherent and value creating whole' (Boudreau & Lakhani, 2013, p. 66), dependence can also be strategic. In this case, contributors do not so much rely on other contributors' knowledge input but on having their contributions approved or promoted by the crowd. An example for such dependency based upon peer-recognition is the platform LEGO Ideas (formerly known as LEGO Cuusoo): here a new product idea needs to gain the support of at least 10,000 crowd members within a certain timeframe to be considered for production by the knowledge-seeker (Antorini & Muñiz Jr, 2013). Of course, such mechanisms go hand in hand with intensive collaboration through commenting and peer-advice on how to further develop and improve the original idea (ibid.).

5.2.2.3 Broad generation of mainly conceptual ideas for new goods or services (area C)

Unlike in area A and B, knowledge production in area C does not primarily aim for solution-focused input. Instead, knowledge production in this area mainly leads to problem-focused

contributions. These contributions are not ready-to-use solutions; instead, they are more a source of inspiration and usually need to be interpreted and adapted by the knowledge-seeker before they can be integrated into new solutions or products (Mahr & Lievens, 2012). The knowledge-seeker therefore needs to invest time and resources to discover and exploit the true value of these more conceptual contributions (Ye & Kankanhalli, 2013).

In an open call for participation the crowd is given an ill-structured and undefined task (such as the generation of ideas for new or improved products), often with an unrestricted timeframe and no given deadline for task completion (Ye & Kankanhalli, 2013). Typical examples are the idea-generation platforms operated by the computer technology company Dell or by the Japanese retail company Muji. The aim of such an open task and approach is to gain access to novel and diverse of ideas through broad idea generation and by involving as many contributors as possible and making it very easy to contribute (Huang et al., 2014; Simula & Ahola, 2014). This obviously leads to higher task uncertainty: the crowd does not know exactly what types of solutions the knowledge-seeker is looking for or what input the knowledge-seeker will consider useful.

Similar to knowledge production in area A, no collaboration among contributors is necessary to deliver the intended knowledge input. Contributors therefore generate and suggest their ideas independently. However, some collaboration is possible through, for example, peer-feedback via commenting functions (Huang et al., 2014). Consequently, there is no functional or strategic dependence and sociality can be considered as thin: contributors (e.g. customers) typically gather around the knowledge-seeker (e.g. a company looking for new product ideas) and provide their ideas and input directly to the seeker without having to collaborate with each other (Simula & Ahola, 2014).

5.2.2.4 Collective development of novel perspectives on complex or wicked problems (area D)

Just like area C, knowledge production in area D aims for problem-focused contributions not ready-to-use solutions. The task outsourced to the crowd is ill-structured, undefined and therefore malleable and usually based on a problem of a complex or even wicked nature. Such problems cannot only be interpreted, understood and structured in very different ways, they are also often 'unsolvable' as there is no objectively optimal solution to them (Brunswicker, Bilgram, & Fueller, 2017; Porter, Tuertscher, & Huysman, 2016). As any possible path to solution may reveal or even lead to additional problems in other areas, such problems are non-decomposable and tasks cannot be modularised. Thus, task uncertainty is very high in this area. Examples for such tasks are often related to finding new ways to address important societal and environmental challenges of our time (see for example Armisen & Majchrzak, 2015; Boudreau & Lakhani, 2013; Nam, 2012), but they can also relate to an organisation's complex 'visionary' questions (see for example Brunswicker et al., 2017).

Work on these problems requires integrating across diverse perspectives and incorporating very different areas of expertise, usually distributed between many different people (Brunswicker et al., 2017; Majchrzak & Malhotra, 2016). Therefore, there is a high level of mutual dependency. Knowledge production in this area is a highly collaborative and interactive process, based on open communication and sharing of ideas and sometimes including vigorous debates about the issues at hand (Nam, 2012). A typical format for knowledge production in this area is temporary, online brainstorming sessions, so-called innovation 'jams', designed not to reach an artificial consensus but to encourage rich conversations within the crowd to develop new perspectives and ideas for a complex question (Armisen & Majchrzak, 2015; Bjelland & Wood, 2008). It is then the job of the knowledge-seeker to turn these novel perspectives into concrete innovative solutions (Bjelland & Wood, 2008).

5.3 METHODOLOGY

To better understand what influences the production of knowledge in the four different areas within the innovation crowdsourcing space, we conducted a structured review of empirical literature that has addressed what factors influence the input or production of ideas and solutions in innovation crowdsourcing projects. This approach enables us to integrate a range of formerly separate insights. To do so, we use an integrative literature review approach as described by Torraco (2005); this approach reviews and synthesises the representative literature on a research topic to integrate existing knowledge and to contribute to the production of scientific knowledge by providing new frameworks and perspectives on the topic.

As the terminology commonly used in innovation crowdsourcing research is far from being an established one,[23] searching for literature that simply contains the word 'crowdsourcing' in the title or abstract involves the risk of missing important studies that do not use this term, but which could contribute important findings. Instead, such a

23 The papers that were eventually included in our review use the following terminology to refer to the different crowdsourcing projects as: open innovation project/competition, (online) innovation contest, science contest, online contest, online crowdsourcing contest, idea generation contest, open competition, (IT-based/online) idea competition/contest, Internet-based user idea contest, creativity contests, markets of ideas, crowdsourcing community, online community, (online/virtual) user innovation community, (online) open innovation community, co-design community, firm-hosted (collaborative) online community, (ongoing) crowdsourcing community, gated community, sponsored open source community, firm-hosted (online) user community, virtual idea community, idea crowdsourcing community, market research online community, distributed innovation, sponsored open source software project, crowdsourced ideation platform, company-sponsored online co-creation brainstorming, crowd-based knowledge sourcing, (virtual) co-creation platform/project, virtual customer integration, customer co-creation project, virtual idea generation environment, open idea call, online crowdsourcing platform, innovation jam, firm-sponsored civic innovation crowdsourcing, web-based innovation platform, collaborative innovation challenge.

search would lead to a substantial amount of papers not relevant for our review as they deal with other types of crowdsourcing unrelated to innovation context, for example, crowdwork, or crowdfunding.

Keeping these problems in mind, we therefore used the following approach to systematically identify the relevant papers for our literature review. Using Scopus, we searched for those papers that cite (at least) one of ten early papers that have been widely cited in publications on innovation crowdsourcing and which we therefore consider to be 'cornerstone-papers' for this area of research (these papers are: Afuah & Tucci, 2012; Brabham, 2008; Dahlander & Magnusson, 2005; Franke, Keinz, & Schreier, 2008; Franke & Shah, 2003; Füller, 2010; Jeppesen & Frederiksen, 2006; Jeppesen & Lakhani, 2010; Poetz & Schreier, 2012; West & Lakhani, 2008). We decided to use the database Scopus as a comparable search in the Web of Science proved to be less comprehensive.

To ensure that the studies included have undergone a peer-review process and therefore meet necessary quality standards, we only included papers that were published in academic journals. In addition, we limited the search to English-languages articles that have been published in a journal belonging to one of the following subject areas (as defined by Scopus): business, management and accounting; economics, econometrics and finance, computer science, decision sciences; social sciences; engineering; psychology; arts and humanities. The literature search carried out on 23 July 2017 led to 1,506 references[24] (including double entries, as many of the papers cite more than one of the ten cornerstone-papers). Omitting the double entries left 1,081 unique references. As we wanted to keep the initial search as open as possible, we then searched among these papers for those that contain one (or several) of the following words in their abstracts: crowd*, innovation, idea, problem-solving, product, open source, contest, broadcast search, community. This left us with 915 references.

After a closer inspection of each abstract, 244 references were left that could contain empirical studies suitable for our research. The abstracts of the excluded papers did show that it: addresses a different aspect of crowdsourcing (e.g. crowdfunding, microtask-management, crowd-based science, crowd-based business model creation) or new

24 This search lead to the following number of citations and exports of papers: Afuah, A., & Tucci, C. L., 2012 (228 citations in total, 115 exported), Brabham, D. C., 2008 (698 citations in total, 198 exported), Dahlander, L., & Magnusson, M. G., 2005 (206 citations in total, 98 exported), Franke, N., Keinz, P., & Schreier, M., 2008 (87 citations in total, 49 exported), Franke, N. & Shah, S., 2003 (532 citations in total, 301 exported), Füller, J., 2010 (162 citations in total, 99 exported), Jeppesen, L. B., & Frederiksen, L., 2006 (425 citations in total, 253 exported), Jeppesen, L. B., & Lakhani, K. R., 2010 (296 citations in total, 179 exported), West, J., & Lakhani, K. R., 2008 (158 citations in total, 79 exported), Poetz, M. K., & Schreier, M., 2012 (268 citations in total, 134 exported).

product development/co-production not involving online crowdsourcing; is not an empirical study (e.g. a literature review, conceptual paper, introduction to a special issue); deals with types of (online) communities that are not the focus of our study (e.g. Q&A forums, customer care communities or user (innovation) communities not organised or sponsored by an organisation); or focuses on a different type of customer–company interaction (e.g. the co-production of services, brand co-creation).

Next, we analysed each of these 244 papers by carefully looking at the articles themselves to find out which contain empirical studies addressing factors that could influence the production of knowledge within the innovation crowdsourcing space. After a careful assessment of these 244 papers, a final 66 papers containing suitable empirical studies were selected for the review. Again, we excluded papers on the reasons mentioned above. In addition, we did not select papers dealing with simple design tasks (such as T-shirts or logos) or companies' internal (ideation) processes or that focused on idea screening and selection methods rather than the *production* of ideas and solutions. Moreover, we had to exclude those papers where it was not clear what area of knowledge production they address. We also excluded all those studies that do not address factors that influence the production of knowledge on the online platform. As expected, only 19 of these 66 papers contain the term 'crowdsourcing' in their title and/or their abstract; this shows that a search based on this keyword would not have been suitable to detect the literature needed for this review. Finally, we added one of the previously mentioned cornerstone-papers (i.e. Jeppesen & Frederiksen, 2006) to the pool of papers to be analysed, as it fits our selection criteria but did not cite any of the other, previously published cornerstone-papers and was therefore not automatically included through the Scopus search. A total of 67 papers was therefore used for the review.

We then assessed each paper in detail and first decided which area of knowledge production it addresses. As we are interested in the different factors that influence the production of knowledge in the four areas, we then very openly assessed each paper to collect insights regarding different factors addressed. After collecting the influencing factors, it became clear that they could be grouped. We thus grouped the factors related to: the motivations, expertise, effort and engagement of the *contributors* involved; the formulation, framing, transparency and accessibility of the *task* outsourced to the crowd; the *interaction* between contributors as well as between the knowledge-seeker and the crowd. We then synthesised these insights for the four different areas of knowledge production within the innovation crowdsourcing space. This allows us to understand the systematic differences in what makes crowdsourcing work when aiming for specific knowledge production outcomes.

5.4 INFLUENCING FACTORS OF CROWDSOURCED KNOWLEDGE PRODUCTION

The empirical studies that are the foundation for our literature review represent a good mixture of methods, with 24 of the studies using a qualitative and 39 using a quantitative approach (five of them based on experiments); four studies used a mixture of qualitative and quantitative methods. They have all been published since 2005, with 17 papers published before 2012, 21 published from 2012 to 2014 and the remaining 29 published since 2015. Interestingly, most of the papers (39 in total) address knowledge production in area C, eleven papers address knowledge production in area A and twelve in area B. Only five of the papers address knowledge production in area D; all of these have been published in the last two years. The table in the Appendix of this thesis provides an overview of all papers used in the literature review and lists their knowledge production and crowdsourcing context as well as the methodology used in each paper.

Not surprisingly, the 67 papers differ quite a lot in their units of analyses and in the research questions they focus on. While some provide very rich insights into different factors influencing the knowledge production process in the respective area, others only address these influencers as one aspect, or even as a sub-aspect, of their studies. Thus, the 67 papers do not all provide equally 'rich' insights and are therefore used in different detail for our review. Moreover, especially in area C, some influencing factors have already been addressed by several papers, leading to similar results. In these cases, we group these insights accordingly. Only very seldom did papers present results that – at first sight – seemed to contradict the findings of other papers. These very few seeming contradictions could all be resolved by taking a closer look at the details of the crowdsourcing projects analysed the in these studies. In this way, differences in the results could be explained by differences in the conditions of the crowdsourcing attempts assessed (e.g. the type of crowd involved) and the insights gained from these papers are presented accordingly.

The following results of our literature review show how each area of knowledge production is influenced by a range of different factors related to the *contributors* involved, the design of the outsourced to the crowd and the *interaction* during the knowledge production process. Often these influencing factors are very much interlinked, as the detailed analyses for the different knowledge production areas will also show.

5.4.1 Influencing factors for knowledge production in area A

In their cornerstone-paper, Poetz and Schreier (2012) proved that – compared to internally generated solutions – the solutions suggested by the crowd are likely to be more novel

and also show more customer benefit. This requires a *contributing crowd* that possesses a certain *expertise*, i.e. experience with the underlying problem, sound technical knowledge of related products and expertise in problem-solving (ibid.). Attracting the right crowd of solvers – those who are likely to have the expertise and knowledge needed to come up with the solutions that the knowledge-seeker is looking for – is therefore crucial (Garavelli et al., 2013; Lopez-Vega et al., 2016).

To ensure those contributors with the needed expertise self-select, the formulation of the *task* is important (Garavelli et al., 2013): in line with the cognitive dimension of this area of knowledge production, the *formulation* of the task should not only contain a detailed description of the problem to be solved, it should also define criteria for the solutions that the knowledge-seeker is looking for. This includes the announcement of objectives and constraints and, in some cases, even tests, which the solvers can carry out themselves to check whether their solutions are suitable. Moreover, these crowdsourcing projects look for ready-to-use-solutions for often challenging R&D or technical problems, which require not only specialised expertise but also the disclosure of solution knowledge and protected information. This means the broadcasting of the task needs to include information on how intellectual property matters will be handled (ibid.). Depending on the problem at hand, the *framing* of the problem should also be used either to provide an alternative understanding to a specific problem, thereby increasing the chances of finding a suitable solution by opening up alternative, boundary-spanning paths to solutions, or to reduce the number and heterogeneity of proposed solutions and avoid problems caused by crowding, thereby increasing the possibility of detecting the suitable solutions (Lopez-Vega et al., 2016). Crowdsourcing intermediaries will assist knowledge-seekers with the optimal framing of their problem to gain the intended outcome (ibid.).

There is some evidence that the contributors' expertise on its own might not be enough: the *contributors' effort and engagement* are also important. At least in software algorithm programming contests, solvers who participate regularly in such contests tend to perform better than those who do not (Khasraghi & Aghaie, 2014). In these cases, it will then make sense to establish a 'community of solvers' who participate regularly and thereby further develop their problem-solving skills and their expertise to develop novel, ready-to-use solutions. Effort – in this case the willingness to invest a lot of time to come up with a creative solution – is also crucial, whether looking for a creative solution in the contributor's own area of expertise (if the problem is distant to their own expertise) or in different areas (if the problem is close to their own area of expertise) (Acar & van den Ende, 2016). Both are possible paths to a suitable solution for a challenging problem. But it is not only the willingness to devote time and effort that influences the creativity of solutions, the emotional and cognitive engagement of the crowd is also important, i.e.

being enthusiastic and emotionally connected as well as concentrating and focusing a lot of attention on the competition and its task (Garcia Martinez, 2015). Consequently, the creation of a stimulating problem-solving environment is a vital condition when looking for novel and creative solutions. Emotional engagement can be positively influenced by offering the crowd a variety of different and creative tasks, avoiding excessive control of the problem-solving process, and by providing the contributors with some feedback on how they are performing (Garcia Martinez, 2015). Regarding the latter, knowledge-seekers should be careful: performance feedback can have a negative effect on the contributor's cognitive focus and engagement (ibid.).

Other important questions are what *motivates contributors* to engage and to put in the effort to suggest novel solutions and what incentives a knowledge-seeker can offer to attract the right crowd. Usually, monetary incentives are offered to those contributors who come up with the best solutions to the problem. Such incentives work when the size of the reward offered is perceived as appropriate by the contributors (Garcia Martinez & Walton, 2014). What is perceived as appropriate does depend upon how demanding and time-consuming the task is (Pellizzoni, Buganza, & Colombo, 2015) and upon the organisation seeking for the solution: a large and well-known company looking for solutions should not try to be a penny pincher when outsourcing a challenging problem to the crowd, as this is likely to be perceived as disrespectful and will therefore not help to motivate participation (Garcia Martinez & Walton, 2014). Interestingly, a financial reward for the winning solution in combination with increased competition can also positively influence the performance of the highest skilled contestants: if financial rewards are offered and the contestants know that the number of contributors rises, then the performance of most contributors decreases, but the top contributors respond with even better performance (Boudreau, Lakhani, & Menietti, 2016). However, this is only true for competitions with higher task uncertainty, otherwise increased competition seems to have a negative effect on the quality of the best contributions (Boudreau et al., 2011). For knowledge production in area A, where task uncertainty is comparatively low, putting the crowd under pressure with increased competition should probably be avoided. Finally, knowledge-seekers should make sure that they are perceived as trustworthy, by keeping their promises and paying attention to their contributors' interests: this will have a strong influence on a contributor's intention to participate again in another competition (Garcia Martinez, 2017).

5.4.2 Influencing factors for knowledge production in area B

Unlike knowledge production in area A, studies show that contributors in area B depend upon each other to come up with a solution that fulfils the requirements of the knowledge-seeker. Interestingly, there are examples of crowdsourcing projects

that were not originally designed for collaborative knowledge production; instead they started off as an attempt to find the best answer to a challenging problem through a participating crowd that independently suggests possible solutions. But, as the competition went on, contributors realised that real progress towards finding the desired – and therefore winning – solution can only be made if they joined forces by sharing their ideas, merging previously independent approaches and collaborating with other contributors (Villarroel, Taylor, & Tucci, 2013). In the example, this was facilitated by a platform that allowed the participating crowd to freely reveal even codified information and knowledge (in this case, algorithms and code) in the online forum and to incorporate other contributors' software code into their own solutions (ibid.). Furthermore, this contest was designed as a long-term development process with many intermediate steps and even the award of 'progress prizes', under the condition that the winners reveal their intermediate solutions to the crowd (ibid.). The *interaction* of the crowd is therefore vital for this area of knowledge production. To ensure that people with different expertise and skills can all contribute to the solution from their perspective, the interaction between contributors needs to take place in an organised way and knowledge should be developed in threaded discussions, so that new input can build on existing input to eventually come up with one functioning solution for the given task (Hess, Randall, Pipek, & Wulf, 2012).

Knowledge-seekers in this area should therefore provide interaction tools, such as online forums and mailing lists, to facilitate interaction not only between contributors but also between the knowledge-seeker and the crowd (Dahlander & Magnusson, 2005). This is particularly important as the latter has a strong influence on the *contributors' motivation and effort.* Crowdsourcing in this area of knowledge production only works if the seeker manages to attract enough contributors who are – often over longer periods of time – willing and able to collaboratively develop a new solution. This can be an issue: in sponsored (open-source) software development projects (a good example for this knowledge production area), the knowledge-seeker will have to compete with other communities for the attention for potential contributors (Dahlander & Magnusson, 2005). The backbone of these communities is often made up of intrinsically motivated volunteers, who are likely to honour the knowledge-seeker and its products and who are often hobbyists in the field in which they innovate (Jeppesen & Frederiksen, 2006; Schlagwein & Bjørn-Andersen, 2014; Shah, 2006; Spaeth, von Krogh, & He, 2015). These hobbyists, who are not in competition with each other, are willing to freely share their knowledge and ideas with the crowd and the sponsoring organisation (Jeppesen & Frederiksen, 2006). Thus, monetary incentives do not seem to be an important motivator. An experiment that invited programmers to contribute to a fictional firm-sponsored open-source software project even showed that financial rewards may negatively affect

participation. This was the case when the contributors saw their needs for autonomy, competence, and relatedness as inhibited by the offering of a financial reward (Alexy & Leitner, 2011).

Instead, the *motivation of contributors* stems from a wish to be recognised by the knowledge-seeker (Jeppesen & Frederiksen, 2006) and from a positive identification with the knowledge-seeker and the crowdsourcing community (Langner & Seidel, 2015; Spaeth et al., 2015). This is often based on a shared mission for excellence and opportunities for learning from a shared body of knowledge (Seidel & Langner, 2015). The knowledge-seeker should therefore try to create an environment that accounts for those interests and helps to increase the perceived credibility of the seeker. Active and open collaboration with the crowd, which treats contributors like innovative colleagues or employees, is one way to do this (Dahlander & Magnusson, 2005; Langner & Seidel, 2015). This includes the visible acknowledgement and promotion of valuable contributions (Jeppesen & Frederiksen, 2006; Langner & Seidel, 2015), involving employees from the knowledge-seeker working as peers in the crowdsourced projects (Dahlander & Magnusson, 2005; Langner & Seidel, 2015) and offering benefits to the participating crowd, for example earlier access to certain software (Dahlander & Magnusson, 2005). It can also help if the community feels that there is only a 'porous boundary' between the community and the seeker; this can be facilitated by, for example, inviting contributors to visit the knowledge-seeker, active hiring from the crowd and even establishing friendship between employees and community members (Langner & Seidel, 2015). Moreover, the knowledge-seeker should build a community management team that regularly interacts with the contributing crowd, paying quick attention to their needs or dissatisfactions, and should invest in contributors' own development projects, for example, by providing room for these on the crowdsourcing platform (Langner & Seidel, 2015). To establish a credible reputation, the knowledge-seeker could provide continuous (technical) assistance to the crowd or could collaborate with leading contributors who can help to represent the seeker and the community to potential contributors (Spaeth et al., 2015). In addition, the knowledge-seeker needs to openly explain to the community which of the developed input will be or will not be used by the seeker (Schlagwein & Bjørn-Andersen, 2014).

Such openness and collaboration with the community and the mostly intrinsically motivated, hobbyist nature of the crowd can cause challenges for the *task design*. On the one hand, the crowd and the knowledge production in this area demand a certain amount of project autonomy as well as transparency and accessibility in the production process (Balka, Raasch, & Herstatt, 2014; Seidel & Langner, 2015; West & O'Mahony, 2008). On the other hand, it is in the interest of the knowledge-seeker to steer and manage the process

to make sure that they gain the intended outcome (West & O'Mahony, 2008). For this reason, empirical insights dealing with knowledge production in open-source software communities are not really useful when trying to understand knowledge production in this area: when a corporate sponsor moves in and governance and ownership structures are changed, this has an effect on the effort and engagement of the crowd (Shah, 2006). Knowledge-seekers in this area need to find the right balance between surrendering control over the knowledge production process and offering interesting opportunities for participation; both are necessary to gain valuable contributions from the community and for sustainable participation.

5.4.3 Influencing factors for knowledge production in area C

Unlike the knowledge production process in area B, in area C the crowd does not have to collaborate to produce the intended knowledge outcome. Moreover, allowing the crowd to edit each other's ideas does not necessarily have a positive effect on the quality of the ideas generated, i.e. novelty, relevance, elaboration and feasibility (Blohm et al., 2011). Aiming for broad idea generation, crowdsourcing projects in this area first need to attract a big crowd, usually of users or consumers who are willing to participate and to share their ideas with the knowledge-seeker. One challenge is that the *motivation of the potential contributors* to do this can vary quite a lot and is likely to include a range of different factors: some contributors are mainly driven by monetary or other rewards and others by their dissatisfaction with existing products or solutions and their needs for better ones; some are mainly curious or interested in new ideas and others simply enjoy taking part in the ideation process (Aitamurto, Landemore, & Saldivar Galli, 2017; Füller, 2010). Other strong motives to participate are learning and gaining new expertise, contact with peers, opportunities for self-marking, and being recognised by the crowd or the knowledge-seeker (Bretschneider, Leimeister, & Mathiassen, 2015; Leimeister, Huber, Bretschneider, & Krcmar, 2009).

This leads to the question of what incentives knowledge-seekers can offer to attract the 'right' crowd for their purpose. Research results indicate that there is no single strategy that will fit all motivations and crowdsourcing projects. If the crowd mainly consists of students, for example, then monetary or non-monetary prizes – such as gifts, certificates or the invitation to special workshops – and appreciation shown by the knowledge-seeker can be important ways to encourage participation and the generation of creative ideas which the knowledge-seeker finds useful (Ebner, Leimeister, & Krcmar, 2009; Leimeister et al., 2009; Mack & Landau, 2015; Salgado & De Barnier, 2016; Zhao, Renard, Elmoukhliss, & Balague, 2016). If the crowd mainly consists of professional users of a product, for example in the medical field, then monetary incentives or gains in prestige are not important drivers to contribute. Instead, the need for better or innovative products

and a personal interest in innovation in the field are crucial motivations (Füller et al., 2010). Customers of consumer products are likely to be motivated by their perception of empowerment (i.e. feeling able to really contribute to the knowledge-seeker's new product development process) and their enjoyment of ideation tasks (Füller, Mühlbacher, Matzler, & Jawecki, 2009). Consequently, knowledge-seekers wanting new ideas have to consider carefully what type of crowd they want to attract before deciding which incentives they want to offer.

Besides offering monetary or non-monetary rewards to all contributors who suggest ideas that the knowledge-seeker finds useful, crowdsourcing projects in area C can use certain design features that might attract contributors. These include: making visible who has the best ideas, for example via leader boards, which can attract contributors who enjoy competition and for whom self-marketing is important; providing chat-functions or other interactive features, which can appeal to those who enjoy being in touch with likeminded peers; enabling the crowd to vote and comment upon the ideas suggested, which can attract contributors driven by their wish to be recognised by the crowd (Bretschneider et al., 2015; Zhao et al., 2016). However, such incentives can lead to problems. Offering monetary rewards to those who suggest ideas that the knowledge-seeker finds useful can negatively influence idea novelty, as contributors start to focus their efforts on suggesting ideas that are more feasible and seemingly more relevant for the knowledge-seeker but less innovative (Schuhmacher & Kuester, 2012). This can contradict the overall intention to look for fresh ideas that the knowledge-seeker can use for the development of new products and innovative solutions. Leader boards and other measures that show off a contributor's activity status can attract people who possess 'Machiavellian' personality traits, who show a desire for status but usually suggest ideas of a low quality (Hutter, Füller, Hautz, Bilgram, & Matzler, 2015). Finally, giving the crowd the opportunity to vote on the ideas suggested may help with the contributors' feeling of being recognised, and possibly even empowered, but this can change suddenly if the crowd feels that the knowledge-seeker is not willing to take up their advice and to implement the ideas they like best (Di Gangi & Wasko, 2009b).

Assigning parts of the idea (pre-)selection *task*, for example by indicating idea popularity through simple voting mechanisms, can also cause problems: with the ideation task given to the crowd being very broad and undefined, there is a high risk that innovative input will not receive much attention from the crowd (Martini, Massa, & Testa, 2012, 2014; Rossi, 2011). In particular, when trying to generate ideas for new consumer products from a strong brand or fan community, conservative or even 'nostalgic' tendencies and attitudes that can exist in such communities can be a problem (ibid.). The ideas that are liked best by the crowd tend to be the ones that are less innovative but focus on

increasing customer benefits (Martínez-Torres et al., 2015; Schuurman et al., 2012). While such ideas can still be useful for the knowledge-seeker, there is a risk that innovative ideas will be missed – especially when a crowdsourcing project receives large numbers of ideas, which is likely to narrow the knowledge-seeker's attention to those ideas that are most popular (Piezunka & Dahlander, 2015). Moreover, while some contributors tend to suggest ideas that are much liked by the crowd, others tend to suggest ideas that are marginal, less mainstream and therefore not very popular (Huang et al., 2014). If the knowledge-seeker relies on the pre-selection made by the crowd and only gives feedback to those contributors with the popular ideas, then these ideators will suggest more, while contributors of marginal ideas cease suggesting ideas (Huang et al., 2014). This is likely to have negative effects for the variety of the ideas generated, leading to mainly popular but not necessarily novel ideas.

Knowledge-seekers in area C should carefully think about the *formulation and framing* of the ideation *task*. The formulation of the task should be clear and simple and should not contain too much detailed information to enable the broad and unprompted suggestion of ideas from a large crowd (Muhdi et al., 2011; Parjanen, Hennala, & Konsti-Laakso, 2012). Information should be easily accessible and the language used should cohere with the one used by the crowd (Rossi, 2011). The task should clearly state in which area new ideas are required (e.g. new products or improved processes), or define a certain theme for which novel input is needed (Muhdi et al., 2011). The right formulation and framing of the task are crucial, as the crowd will submit input based on how they understood the question. If the task can be understood differently, this can lead to input that the knowledge-seeker is not looking for and therefore to an unsatisfactory outcome (ibid.). In some cases, for example when looking for new functionalities and designs of a product, the use of special online toolkits can be helpful to assist the crowd to come up with ideas in a more structured way (Piller & Walcher, 2006). Involving employees of the knowledge-seeker as 'tutors' can also help contributors to better explain their ideas (Filieri, 2013). However, the task should still be open enough to first encourage the broad generation of input and ideas (Parjanen et al., 2012). Then, in a second step, the knowledge-seeker should start to interact with both the crowd and individual contributors to obtain deeper insights on, for example, (potential) customers' expectations or fears and to possibly refine the contributors' 'raw' ideas to further develop and transform them into innovative solutions (Mortara, Ford, & Jaeger, 2013; Muhdi et al., 2011).

The *interaction* between the knowledge-seeker and the crowd has a strong influence on the idea generation process. Feedback from the knowledge-seeker on the ideas suggested is especially vital. If contributors receive feedback on their ideas, then this enhances the feeling of being respected and listened to; in turn, this has a positive effect

on the likelihood of further idea suggestion and future participation (Boons et al., 2015; Dahlander & Piezunka, 2014). If the knowledge-seeker makes the acknowledgement of ideas visible to the entire crowd, then this will increase the contributors' efforts to suggest further ideas even more (Fombelle, Bone, & Lemon, 2016). To keep ideas flowing in, it is not only important that the knowledge-seeker responds to the ideas suggested but that this is done quickly (Chan et al., 2015b; Chen, Marsden, & Zhang, 2012; Dahlander & Piezunka, 2014; von Briel & Recker, 2017). Consequently, it is crucial that the knowledge-seeker invests time in developing and maintaining interaction and relationships with the participating crowd (Fredberg & Piller, 2011). If knowledge-seekers are not only interested in collecting more ideas (from the same contributors), but also in generating more input that could be useful for them, then their feedback should not merely acknowledge the receipt of an idea but should also give information about the idea's current status and potential use for the knowledge-seeker (Chen et al., 2012). This will encourage the contributor to suggest more ideas and input that the knowledge-seeker will find useful (ibid.). Constructive input via comments from the crowd can further enhance this, leading to better idea production by the same contributor (Kathan et al., 2015).

The results mentioned above indicate that the *contributors' effort and engagement* during the idea call is important for the outcome. Ideas that are perceived as valuable by the seeker are likely to come from contributors who are very active on the platform and comment a lot on other ideas that have been suggested (Bayus, 2013; Li et al., 2016; Schemmann et al., 2016). Despite some risk that this can have a negative effect on the variety of the ideas (Bayus, 2013), these efforts should be encouraged. However, ideators should not be encouraged to actually use other ideas when creating their own: ideas that are perceived as valuable by the knowledge-seeker are more likely to be 'self-initiated' and to not directly build upon previous ideas or input (Mahr & Lievens, 2012).

Likewise, contributors should not necessarily be encouraged to suggest a lot of ideas (Jensen, Hienerth, & Lettl, 2014; Schemmann et al., 2016), especially not after they have already come up with an idea that the knowledge-seeker declared to be useful (Bayus, 2013). Such successful contributors then become less creative and start to imitate their previous successful idea (ibid.). Thus, knowledge production in this area benefits more from the broad ideation activity of a large crowd than from the intensive ideation activity of a few.

5.4.4 Influencing factors for knowledge production in area D

Compared to the amount of research on the other three areas of knowledge production, research on area D is still in its early stages: only five studies, all published in the last three years, could be included in our analyses. Consequently, not much empirical knowledge

exists regarding what different factors help or hinder knowledge production in this area. What is already clear from these five studies is that much attention needs to be paid to understanding and supporting the interactive knowledge production process, which is vital for this area (Chan et al., 2015a; Majchrzak & Malhotra, 2016).

As a first step, knowledge-seekers need to define and formulate a *task* that would benefit from intensive interaction and the sharing of diverse knowledge and perspectives (Majchrzak & Malhotra, 2016). The task design should encourage an open and transparent dialogue, controversial discussions (including the expression of subjective opinions and the articulation of different viewpoints), the combinations of different thoughts and solutions, and the collaboration of contributors (Brunswicker et al., 2017). Moreover, information regarding the context of the complex or wicked problem to be addressed should be broadcasted (ibid.). One way to do this, and to attract people to contribute, can be through gamification, such as communicating background information in the form of short stories, blog entries or comic strips, or allowing contributors to set up and define a virtual identity (Scheiner, 2015).

In the next step, a large and truly diverse crowd needs to be attracted to participate (Brunswicker et al., 2017). *Contributors* should represent a variety of expertise and backgrounds, different levels of experience and familiarity with the topic and bring in different cognitive resources and perspectives on the problem at hand (Armisen & Majchrzak, 2015; Brunswicker et al., 2017; Majchrzak & Malhotra, 2016). Advertising the challenge on social media sites and through word-of-mouth recommendation – asking contributors to advertise the challenge in their own networks – can be good strategies to attract the crowd needed for the task (Brunswicker et al., 2017).

Finally, a process needs to be designed and established that enables collaborative knowledge production and allows contributors to build upon other contributors' inspirations, as this will positively influence the creativity of the input (Chan et al., 2015a). The process among contributors seems to be one of the keys to producing new knowledge in this area: the process starts with sharing different inputs concerning the problem, usually in no particular order. This unstructured process helps the crowd (and the knowledge-seeker) to develop a better understanding of the problem and of the conflicts that are related to the problem. Eventually, contributors will start to integrate some of the different problem-related knowledge which has been previously posted and post a paradox which aligns different perspectives and provides a new understanding of the task objective. This assists other contributors to formulate different suggestions that could help to tackle the problem and serve as starting points for further collaborative knowledge production (Majchrzak & Malhotra, 2016). It also seems important not to

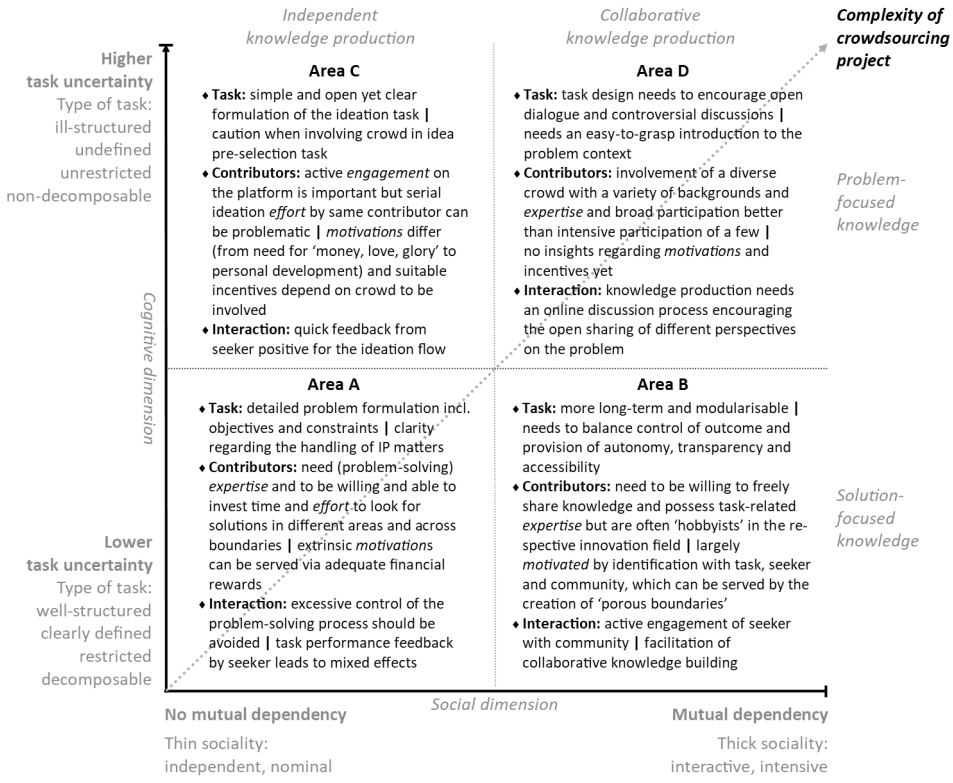

Figure 5.2 Influencing factors on knowledge production within the innovation crowdsourcing space

encourage the same contributors to post a lot of ideas and insights, as innovative posts in the discussion threads are likely to come from contributors who only posted once in the thread (Armisen & Majchrzak, 2015).

Figure 5.2 summarises what influences the production of ideas and knowledge for the four different areas within the innovation crowdsourcing space.

5.5 DISCUSSION, LIMITATIONS AND AREAS FOR FUTURE RESEARCH

The results of our structured and integrated literature review confirm that, depending on the intended knowledge production outcome and the type of input needed from the crowd, different measures will help or hinder in making innovation crowdsourcing work. As summarised in Figure 5.2, the production of knowledge in the four areas

that we developed and used as an analytical framework is influenced by the ways the task is formulated and presented to the crowd, differences in the motivations and the engagement of the contributing crowd involved, and by how the knowledge-seeker interacts with the crowd and the contributors interact with each other.

We therefore argue that all the empirical insights gained on the different factors that influence crowdsourced knowledge production become even more meaningful when they are seen within the context of the area of knowledge production they refer to. The results of the structured literature review demonstrate that there is no single approach or strategy that will be equally useful for all innovation crowdsourcing attempts. Instead, potential influencing factors (e.g. monetary incentives) that can be very valuable in one area (e.g. area A) may not be important in other areas (e.g. area B and C). Our analytical framework and the four different areas of knowledge production that we developed for the innovation crowdsourcing space can therefore also be useful in understanding why some of the different empirical studies have led to different and sometimes inconsistent results. Taking again the example of the influence of monetary incentives, it makes sense that adequate monetary incentives (i.e. rewards for the best solutions) can be attractive in a knowledge production environment like area A, where the nature of the task is less uncertain and the solvers compete to come up with the best solution to the problem, while they are not likely to be useful in the collaborative environment of area B. Another example that shows the value of our analytical framework can be found when looking at the influence of recurring solver or ideator engagement: for knowledge production in areas A and B, the development of a certain problem-solving expertise is needed to develop the ready-to-use solutions that the knowledge-seeker is looking for, so the continuous involvement of a crowd of solvers who contribute their knowledge and solutions more or less regularly will make sense. In knowledge production areas C and D, however, where the aim is to broadly generate a wide range of conceptual ideas and new perspectives on a complex problem, serial idea generation by the same contributors is not necessarily helpful and risks simply generating more of the same input.

Based on our results, we also argue that the complexity of a crowdsourcing project differs substantially depending on the area of knowledge production addressed. While the problems addressed in area A can be very challenging, they are nevertheless of a well-structured and clearly defined nature. This means potential solvers can be instructed on what a solution needs to incorporate to potentially solve the problem. Moreover, potential solvers do not need to rely on the crowd to produce the knowledge needed. Considering all this, knowledge production in area A is a lot more definitive and predictable than knowledge production in area D, where tasks are undefined and unrestricted and problems to be solved are very complex or even wicked, needing the

input of a diverse crowd and different perspectives. It can therefore be argued that the complexity of a crowdsourcing project rises as task uncertainty and mutual dependency grow (see Figure 5.2). Consequently, the successful creation of crowdsourcing attempts in area D especially, but also in area B (where the knowledge seeker needs to find the right balance between surrendering control and offering interesting opportunities for participation) or area C (where finding the right incentives to motivate broad participation can be problematic) becomes a lot more challenging than the design of crowdsourcing projects in area A.

Interestingly, despite its complexity and the challenges related to it, crowdsourcing for knowledge production in area D has received comparatively little academic attention so far. While we already know a lot about the motivations of the crowd to participate in crowdsourcing projects in areas A, B and C, for example, we do not know what might motivate the crowd to participate and collaborate in projects that try to generate new insights to tackle complex or wicked problems. Consequently, we do not know what incentives might be suitable to attract the right crowd for the task and how this highly uncertain task should best be formulated and framed to attain the intended outcome. Even our knowledge regarding the online interaction process, which the literature shows is crucial for crowdsourced knowledge production in this area, is still very limited. At the same time, the use of online crowdsourcing could be a new and promising way to develop new perspectives and paths to solutions to those problems that need the input of many minds and that can only be dealt with collaboratively as there will never be an optimal way to solve them. More research is needed if we want to understand the underlying mechanisms that facilitate the use of crowdsourcing for the collective development of novel perspectives on complex or even wicked problems.

Our review also has limitations. First, the use of crowdsourcing for innovation purposes is still a rather new research field and, as we pointed out in the methodology section, the terminology used is still far from established. This leads to the potential problem that a literature search based on keywords might not detect many of the papers that are important for the context of our review. To minimise this risk, we therefore used a search based on early cornerstone-papers and kept the initial search as open as possible, then manually selecting those articles relevant to our research question. Nevertheless, we may have missed some empirical contributions that could have added further value to this review. Second, as most of the crowdsourcing research so far has been eager to show the potential of crowdsourcing for innovation, there is an under-representation of insights that describe factors that actually hinder obtaining the intended results. This positive bias means most of the empirical research on innovation crowdsourcing so far neglects to find and describe the factors that explain why crowdsourcing attempts

sometimes fail to generate the knowledge needed. Such insights, however, would also be valuable in fully understanding what makes crowdsourcing work and should also receive some attention in future innovation crowdsourcing research.

5.6 IMPLICATIONS AND CONCLUSION

Our proposed framework, which defines four areas of knowledge production within the innovation crowdsourcing space, and the results of our integrated literature view have theoretical as well as managerial implications.

5.6.1 Theoretical implications

Using the work of Whitley (2000), we developed a framework that captures four different areas of knowledge production when aiming to use the crowd for generating ready-to-use solutions to specific problems (area A), for the interdependent development of ready-to-use products or solutions (area B), for the broad generation of mainly conceptual ideas for new goods or services (area C), or for the collective development of novel perspectives on complex or wicked problems (area D). This framework not only helps to better grasp the production of knowledge within the innovation crowdsourcing space, it is also useful for embedding existing empirical findings from innovation crowdsourcing research within the bigger picture of new knowledge production. Moreover, the results from our structured literature review show that such an analytical framework is necessary when trying to synthesise existing knowledge on the factors that help or hinder crowdsourced knowledge production and therefore enable us to understand what makes crowdsourcing work.

5.6.2 Managerial implications

As the title of this chapter already indicates, this study also has managerial implications for those organisations that may want to involve the crowd in their search for innovative solutions or ideas. Based on the results of our literature review, we make the following suggestions when aiming to generate knowledge or input in one of the four areas.

When aiming to *generate a ready-to-use solution to a specific problem*, it is crucial to precisely formulate the objectives and constraints of the problem that needs to be solved and to clearly communicate upfront how intellectual property matters will be handled. Contests offering adequate financial rewards, that match the scope of the problem and the financial resources of the knowledge-seeker, are a good way to attract the right crowd. It is advisable to reach out to a crowd of solvers who are willing to (frequently) put in time and effort to search for suitable solutions in their own or in different areas of expertise

and who have, or will develop, some expertise in problem-solving and generating novel ready-to-use solutions. Using the services of an intermediary with an already established crowd of solvers will thus be valuable in this area. They can also assist the knowledge-seeker with the optimal task or problem formulation.

For the *interdependent development of ready-to-use products or solutions*,knowledge-seekers need to find the right balance between guiding the development of solutions to gain the outcomes that they are looking for and giving the crowd enough freedom for self-actualisation by allowing them to come up with possible solutions that the crowd can also benefit from. Thus, knowledge-seekers need to think carefully about possible governance structures for such crowdsourcing projects and how they can communicate these to the crowd to create an environment in which the participating solver community sees their needs respected. To motivate participation, knowledge-seekers should actively engage with the community and aim to break down the boundary between the seeker and the solvers. To ensure that people with different expertise and skills will contribute to the solution, the task needs to be modularisable and should encourage knowledge-sharing as well as collaboration between contributors using suitable online interaction tools.

When aiming for the *broad generation of mainly conceptual ideas for new goods or services*, knowledge-seekers should carefully consider which incentives are likely to drive the crowd they want to involve. Motivations to participate can range from money, love and glory (Malone, Laubacher, & Dellarocas, 2009) to the need for better products or even gains for personal development. Knowledge-seekers should not only be aware of the motivations that drive their crowd, they should also be aware of the negative side-effects that some incentives, such as monetary rewards or gains in prestige, may have. The initial formulation of the task should be as clear and simple as possible to encourage the broad and unprompted generation of ideas. The refinement and filtering of these raw ideas should be tackled as a second step. If the crowd is involved in the pre-selection of ideas, the knowledge-seeker needs to have suitable measures in place that will prevent potentially innovative ideas being missed. Quick feedback from the knowledge-seeker is important to keep ideas flowing in. However, in this area of knowledge production encouraging individual contributors to suggest many or additional ideas is mostly not beneficial, as this is likely to result in many similar ideas rather than broad idea generation.

Insights regarding the use of crowdsourcing for the *collective development of novel perspectives on complex or wicked problems* are still limited. First insights indicate that the knowledge-seeker needs to develop a task or a question that encourages an open and

transparent dialogue and provides room for controversial discussions. With a complex or even wicked problem, it is important to provide the crowd with an easy-to-grasp introduction to the context of the problem. Core elements of the knowledge production process in this area are the design of an online discussion process that involves a wide variety of contributors with different expertise and experience, the sharing of different perspectives on the problem at hand, and the integration of this input to spark off innovative ideas that can provide new perspectives on how to tackle the problem.

Our structured literature review helps to better understand what helps or hinders the crowdsourced production of knowledge in different areas. This is not only important for organisations considering crowdsourcing external solutions for technical or R&D-related problems or using the crowd to come up with fresh idea for new products, it is also relevant from a theoretical perspective, as it synthesises the empirical findings of ten years of innovation crowdsourcing research in a systematic knowledge production context.

6

Conclusions

The three empirical studies and the integrated literature review in this thesis focused on different individual research questions that all contribute to advancing our understanding of how organisations can successfully source new ideas and solutions from the crowd. This final chapter therefore summarises and reflects upon the overall insights gained and suggests potential areas for future research.

6.1 MAKING CROWDSOURCING WORK

The findings in Chapters 2 and 3 show that useful ideas for new goods or services can be sourced from a crowd, consisting of ordinary users, customers or citizens. It is also possible to source useful ideas on how existing products can be improved. However, the crowdsourcing of ideas that the seeker finds useful can be a highly selective process (see Chapter 2). Special attention should therefore be paid to those ideas that are popular with the crowd (see Chapter 2), but the idea-seeker should be aware that the ideas which are very popular with the crowd might not be the most innovative ones (see Chapter 5). Thus, idea-seekers should be careful in involving the crowd in the pre-selection process of ideas. Instead, the idea-seeker should pay closer attention to the ideas of ideators who are more likely to suggest ideas that the seeker will find useful and would therefore like to implement.

The insights gained in Chapter 3 show that successful ideators tend to display online behaviour that distinguishes them from other ideators in the crowd. Idea-seekers, especially those who are looking for new product ideas, should therefore pay special attention to ideators who are very curious and open to other ideas, and thus tend to show that they highly appreciate other ideas through their behaviour online. Idea-seekers, who are (also) looking for ideas that can improve existing products, should make sure that they consider the ideas of those ideators who show solution-oriented behaviour instead of only stating their needs for new products. The latter insights indicate that the solution-oriented knowledge of successful ideators in open idea calls should probably not be overestimated, especially when aiming to source ideas for innovative products. Furthermore, successful ideation does not seem to improve when ideators are being exposed to other ideas before suggesting their own. This might just lead to extending or building on other ideas instead of suggesting different ideas, which decreases the perceived value of these ideas (see Chapter 5). Consequently, this kind of behaviour should not be encouraged in these crowdsourcing projects. Different to the behaviour of user innovators, the results do not show that successful ideators are likely to assist other ideators by sharing their knowledge through their comments (see Chapter 3).

However, allowing the crowd to comment on the ideas suggested can still make sense – even in the fluid environment that these open idea calls operate in. Even though there is no set mutual dependency in open calls for new product ideas, (i.e. the crowd does not necessarily have to work together to suggest an idea that the seeker finds useful), the crowd can still be helpful in gaining a better and possibly more complete understanding of the ideas suggested (see Chapter 4). The findings show that the comments of the crowd can contain input on how to implement the idea and on potential risks, problems or insights that help to further develop an idea. As novel ideas and popular ones, are both more likely to accumulate such useful insights through the crowd's comments, idea-seekers might even be able to increase their yield from these idea calls if they gain a better and more complete understanding of the ideas suggested. The results in Chapter 4 also show that such idea-related knowledge-sharing cannot be taken for granted and that different factors will help or hinder knowledge being accumulated. Idea-seekers should make sure that they place a positive comment on any suggested idea to avoid a negative opening comment blocking the accumulation of idea-related knowledge in the commenting thread. Moreover, instead of trying to encourage the crowd to comment through activating comments, the idea-seeker should encourage direct interaction among commenters, as this has a positive effect on the amount of knowledge being accumulated on an idea.

When summarising these findings from Chapters 2 to 4, as well as the findings from the relevant literature dealing with broad generation of ideas from the crowd (see Chapter 5), the following managerial implications arise. Both private and public organisations can count on the crowd to contribute useful input to a highly uncertain task, namely the successful generation of ideas for new or improved goods or services that they can offer to their customers and citizens. To do so, the crowd does not necessarily need to possess any special expertise or knowledge. It can also be made up of ordinary users who are willing to express their ideas for new products that they would like to see being offered in the future. The task should thus be formulated in a clear and very simple way to encourage a diverse crowd to suggest their ideas. Keeping this in mind, the outcome of such idea crowdsourcing attempts tends to be a broad variety of mainly conceptual ideas, i.e. ideas that are likely to be still fairly 'raw' rather than ready-to-use solutions. Thus, the idea-seeker needs to consider carefully how to handle the idea selection process, as not all of the ideas suggested will be equally valuable for the idea-seeker.

Allowing the crowd to vote on which ideas they like or dislike can be a useful design feature of such idea calls but, as mentioned above, the idea-seeker should be cautious about simply relying on votes as this could narrow attention to less innovative ideas. To avoid this, idea-seekers should also pay special attention to the ideas of those ideators who have

indicated through their voting behaviour that they are open to other ideas. It can also be valuable to allow and encourage the crowd to contribute knowledge that facilitates the 'genesis' of the suggested ideas. Commenting functions should therefore be offered to enable the crowd to comment upon the ideas proposed and to interact with each other. It is crucial that the idea-seeker does not 'lean back' during the idea-generation process but actively shapes this interaction and is responsive by providing quick feedback on the ideas suggested. Moreover, it is vital that idea-seekers know what really drives the crowd they want to activate for their idea crowdsourcing project and to offer incentives that best serve these motivations. Depending on the crowd involved, motivations to contribute can range from the need for better products, to personal learning or the desire for money, love or glory. In any case, incentives should not encourage (few) serial ideators to suggest many – often similar – ideas. Instead, incentives should encourage the broad generation of ideas by a large crowd of single ideators.

With all these dos and don'ts that can help the successful sourcing of ideas from the crowd, it is important to keep in mind that these findings are likely to be specific to this particular area of knowledge production that aims to generate a broad range of mainly conceptual ideas for new goods and services. Based on their level of task uncertainty and the mutual dependency among the crowd to produce the knowledge (e.g. an idea or solution) the seeker is looking for, Chapter 5 therefore defines four different areas of knowledge production within the innovation crowdsourcing space. The open idea calls mentioned above fall into the area defined by its high task uncertainty and no set task dependency. The integrated literature review which synthesises the results of relevant empirical crowdsourcing studies clearly shows that the mechanisms that make crowdsourcing work vary for the different areas of knowledge production.

The results from the literature review in Chapter 5 therefore indicate that the sourcing of a ready-to-use solution for a clearly defined problem or knowledge production task (i.e. a less uncertain task) requires a different design than the sourcing of a broad range of mainly conceptual ideas. If the potential solvers do not need to work together to produce the solution the knowledge-seeker is looking for, then a contest offering adequate incentives, for example financial rewards, for the most suitable solutions will work. If the potential solvers need to collaborate to interdependently produce the knowledge that is needed, then a competitive environment is obviously not helpful. Instead, the knowledge-seeker needs to create an environment that the contributors enjoy working in. This also requires the seeker to actively participate in the work of the community to break down the boundaries between the crowdsourcing organisation and the contributing community. Moreover, the seeker needs to be careful not to control the knowledge production process too much and should provide the crowd with some freedom to follow their own

knowledge production interests. For both knowledge production tasks, it is important that the objectives are precisely formulated and that the crowd involved possesses the necessary expertise to solve the problem at hand.

Consequently, all insights gained in this thesis and from crowdsourcing research in general should always be seen in the context of the respective area within the innovation crowdsourcing space. Potential idea- and knowledge-seekers need to be aware that the ways in which a crowdsourcing project will have to be designed and managed will depend on the area of knowledge production the seeker is aiming for. As not all areas have received the same amount of scientific attention so far, the depth of insights that have been collected to understand what makes crowdsourcing work differs noticeably (see Chapter 5). While the area that aims to generate a broad range of mainly conceptual ideas for new goods and services – being the area that the three empirical studies of this thesis also focus on – has attracted substantial attention (especially within the last five years), the area that aims for the collective development of novel perspectives to address complex or wicked problems has attracted only little attention so far and still needs to be explored. Challenges that have been identified so far for this area of knowledge production include the design of an easily understandable introduction to the problem to enable and encourage a diverse crowd to share their knowledge and perspectives on this matter, and the design of an online discussion process that leads to the integration of different inputs and perspectives and sparks innovative ideas on how to tackle the problem.

6.2 UNDERSTANDING IDEATION AND KNOWLEDGE PRODUCTION IN AN OPEN, FUZZY AND FLUID ENVIRONMENT

These findings also speak to different strands in current innovation research, especially the successful integration of users via open innovation practices, the improvement of the idea-generation phase at the fuzzy front end of innovation (FEI), or the production of knowledge in new, fluid forms of organising. They also raise a number of relevant questions that need to be addressed by future research.

Due to the rise of the Internet, the use of crowdsourcing is often seen as having the potential to take open innovation processes to a new level. Consequently, inbound processes should now also consider the crowd – an undefined and often large group of people – as being a potential source of ideas and solutions. This thesis shows that if the intention is not to primarily source solution- but problem-focused knowledge, then the crowd involved does not even have to possess special expertise to make useful contributions. Thus, it can also be useful to reach out to a crowd made up of *ordinary*

users, for example customers, consumers or citizens with no particular expertise in new-product development or even problem-solving, but with the ability to express what goods or services they need and would like to use in the future.

Yet more conceptual clarity for the use of innovation crowdsourcing is needed, not only to understand what makes crowdsourcing work but to scientifically integrate this new phenomenon into broader strands of innovation research and theory. This will also emphasise the theoretical contributions gained from studying the crowdsourcing phenomenon. The framework developed in Chapter 5 accounts for this need for more conceptual clarity by capturing different areas within the innovation crowdsourcing space based on a broader and established concept of knowledge production. With much of the empirical research within the realm of innovation crowdsourcing (including the three studies in Chapters 2 to 4) focusing on a single crowdsourcing project or a single platform, the generalisability of the insights gained from these studies is always an issue. The framework in Chapter 5 is one way to approach this issue, as it enables embedding the empirical insights gained in the appropriate area of knowledge production within the innovation crowdsourcing space. This contributes to strengthening the findings of these empirical studies and to highlighting those questions and areas of knowledge production that have not received much attention so far.

Accordingly, when using this framework to organise the different empirical insights gained on the factors that influence knowledge production in innovation crowdsourcing attempts, it becomes very clear that the collective development of novel perspectives to address complex or wicked problems has not received much attention so far. However, as one can argue that many of today's problems are becoming increasingly complex, interconnected and often truly wicked, new ways to address or solve these problems are likely to need an open process that takes account of very different perspectives and sources of knowledge. As these are unlikely all to be present in a single entity, an open innovation approach is needed to collectively produce new knowledge to tackle these problems. Consequently, the use of crowdsourcing could be promising as it enables reaching out to a diverse crowd and a wide variety of perspectives and ideas via a non-discriminatory call. The non-discriminatory design, meaning that everybody can freely decide whether he or she wants to join the participating crowd, could then be a real advantage as it provides access to many different ideas and sources of knowledge. However, it could also become problematic if some important perspectives are not represented within the crowd due to this process of self-selection. This leads to the question of how 'open' the crowdsourcing process should ideally be to provide new paths to solutions for these complex problems. Further research will be needed to gain deeper insights into the use of crowdsourcing for this important area of knowledge production.

Another question that arises from this thesis and still needs to be answered from a distributed innovation perspective is, whether and how the use of crowdsourcing in the innovation process can also provide access to lead users whose ideas tend to be the origin of so many innovations in a wide range of industries. The results in Chapter 2 indicate that although successful ideators in online idea calls show signs of creative behaviour they are probably not lead users. Due to the great innovative potential that resides in those lead users, innovation crowdsourcing projects and open idea calls, in particular, could benefit greatly from attracting lead users to their innovation collectives.

The results of the three empirical studies and the integrated literature review in this thesis also contribute to finding answers to important questions regarding the use of crowdsourcing at the FEI. As pointed out above, the insights gained in this thesis can be useful for improving the pre-selection of crowdsourced ideas and for enhancing the design and management of the ideation process in the early stages of the innovation process. However, as one of the major problems of the FEI is its fuzziness, an assessment still needs to be made of the extent to which the use of crowdsourcing within the FEI has the potential to help remove some of this fuzziness. What can be stated at this stage is that the use of crowdsourcing during the ideation phase naturally generates large amounts of data on this process. The studies in Chapters 2 to 4 show that this not only includes data on all the ideas that have been suggested and the comments made upon them, but also large amounts of digital traces that can accurately document the entire online ideation process. Although the empirical studies in this thesis were limited to using only data that were publicly available, the results already indicate that useful insights can be gained from analysing these data, and that this data can eventually contribute to gaining a clearer understanding of the idea-generation phase at the FEI.

Another question that arises from this thesis in this context is whether and how people's online ideation behaviour differs from their offline ideation behaviour, and therefore to what extent the insights gained can also be useful in understanding and managing other, possibly face-to-face, creative processes at the FEI. The findings in Chapter 3 indicate that some factors that have been found to influence creativity and idea-generation in other (offline) contexts, might not apply in the context of online idea crowdsourcing. This leaves space for a broader discussion that will have to be addressed in the coming years. As we are spending more time online and an increasing amount of work and knowledge production is taking place in new, fluid forms of organising, we need to know whether our established knowledge and existing theory will also apply here or whether our online behaviour in these fluid environments differs so substantially that we need new ways to explain this. The insights gained in Chapter 4, showing that knowledge from different sources can be accumulated in an environment that lacks many of the typical conditions or incentives

which are beneficial to the sharing and production of knowledge, should therefore also be seen within this broader research context. Researching the phenomenon of innovation crowdsourcing in fluid forms of organising can therefore be one way of adding valuable insights to important questions regarding the future of work and knowledge production.

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APPENDIX

Table containing further details on the papers used in the literature review in Chapter 5

Source	Type of crowdsourced knowledge	Methodology	Crowdsourcing attempt(s) analysed	Dataset used
Area A				
Acar & van den Ende (2016)	Concrete solution to a scientific R&D-related problem	Quantitative study	Science/R&D contests held on InnoCentive	Survey data of 230 of contest participants
Boudreau, Lacetera, & Lakhani (2011)	Concrete solutions (working software code) to different (algorithm) problems	Quantitative study	Software algorithm contests held on TopCoder among advanced participants with previous/ regular experience	Platform data related to 9, 661 virtual competition rooms in 645 contests
Boudreau, Lakhani, & Menietti (2016)	Development of a concrete solution (software algorithm) to problem	Quantitative study	Software algorithm contests held on TopCoder offering a cash prize for each virtual competition room	Platform data related to 2,775 contestants
Garavelli, Petruzzelli, Natalicchio, & Vanhaverbeke (2013)	Concrete solution to a well-defined (e.g. scientific or R&D-related) problem	Qualitative study (case studies)	Crowdsourcing platforms InnoCentive and PG Connect (plus two other not open platforms)	N/A
Garcia Martinez (2015)	Concrete solution (accurate predictive data-modelling) to a well-defined problem	Quantitative study	Data-modelling competitions held on Kaggle	Survey data of 259 competition participants
Garcia Martinez (2017)	Concrete solution (accurate predictive data-modelling) to a well-defined problem	Quantitative study	Data-modelling competitions held on Kaggle	Survey data of 222 of competition participants
Garcia Martinez & Walton (2014)	Concrete solution (accurate predictive data-modelling) to a well-defined problem	Qualitative study (case study)	Contest run by Dunnhumby on Kaggle (2,029 different solutions submitted by 537 participants)	N/A
Khasraghi & Aghaie (2014)	Concrete solution (software algorithm) to a well-defined problem	Quantitative study	Contests held on TopCoder	Platform data related to 950 competitors
Lopez-Vega, Tell, & Vanhaverbeke (2016)	Concrete solutions to scientific/ technical problems	Qualitative study (interviews, observation)	18 (scientific/ technical) problem-solving contests (for profit sector) managed by NineSigma	N/A

Pellizzoni, Buganza, & Colombo (2015)	Concrete technical solutions, e.g. new, digital learning environments or new energy management system, for business development	Qualitative study (interviews)	Innovation contest for students at a university in Italy	N/A
Poetz & Schreier (2012)	Concrete new product solutions to a problem in the consumer goods market for baby products	Quantitative study	Crowdsourcing project organised by the Austrian-based Bamed/ MAM Group	Evaluations of 52 crowdsourced user ideas and 51 ideas from company professionals
Area B				
Alexy & Leitner (2011)	Cooperative production of a new software solution within a sponsored OSS project	Quantitative study	Scenario experiment inviting programmers to a fictional sponsored OSS project	Survey data based on 201 respondents
Balka, Raasch, & Herstatt (2014)	Collaborative development of a new product (i.e. consumer electronics and IT-hardware & software designs)	Quantitative study	20 sponsored (open) IT-hardware/ software design communities	Survey data of 309 participants in different communities
Dahlander & Magnusson (2005)	Collaborative production of IT solutions, i.e. software code	Qualitative study (case studies)	Four communities of Nordic open source software firms: MySQL, Cendio, Roxen and SOT	N/A
Hess, Randall, Pipek, & Wulf (2012)	Collaborative product improvement and development (software for an Internet TV service)	Qualitative study (e.g. interviews, observation of the online tool)	Online community to collaboratively (co-)design and further improve new software	N/A
Jeppesen & Frederiksen (2006)	Collaborative production of IT solutions, i.e. software for computer-controlled music instruments	Qualitative and quantitative study (incl. netnography, interviews and a survey)	User community of the Propellerhead computer-controlled music instruments company	Survey data of 345 community members
Langner & Seidel (2015)	Collaborative development of (design, technical, etc.) solutions for complex problems or new products	Qualitative study (case study)	Local Motors online community for collaborative development of e.g. specialised cars, mobility solutions	N/A
Schlagwein & Bjørn-Andersen (2014)	Development of concrete new products (design) based on a collaborative decision-making process	Qualitative study (case study)	Product development and design platform LEGO Cuusoo (now LEGO Ideas)	N/A

Seidel & Langner (2015)	Collaborative development of (design, technical, etc.) solutions for complex problems or new products	Qualitative study (observations, interviews)	Local Motors online community for collaborative development of e.g. specialised cars, mobility solutions	N/A
Shah (2006)	Cooperative production of a new-software solution within a gated open source software community	Qualitative study (case study)	Gated open source software community	N/A
Spaeth, von Krogh, & He (2015)	Collaborative production of an IT solution, i.e. new operating system or a new smartphone	Quantitative study	Two sponsored open source software projects: Maemo (sponsored by Nokia) and OpenMoko (sponsored by the Taiwanese mobile phone manufacturer FIC)	Survey data of 368 volunteer members from Maemo and 783 from OpenMoko
Villarroel, Taylor, & Tucci (2013)	(Collaborative) production of solution to improve existing recommendation algorithm *(started as area A but became area B)*	Qualitative and quantitative study (interviews, survey)	Long-term Netflix prize competition and community	Survey data of 211 participants
West & O'Mahony (2008)	Collaborative production of IT solutions, i.e. software code	Qualitative study (interviews)	Twelve sponsored open source software communities	N/A
Area C				
Aitamurto, Landemore, & Saldivar Galli (2017)	Broad generation of ideas and input to improve an existing law	Qualitative study (interviews)	Crowdsourcing project to generate ideas and input for the reform of an off-road traffic law in Finland	N/A
Bayus (2013)	Broad generation of ideas for new (IT-related) products, services, processes	Quantitative study	Long-term idea call of a company in the IT sector: IdeaStorm by Dell	Platform data related to 4,285 participants
Blohm, Bretschneider, Leimeister, & Krcmar (2011)	Broad generation of ideas for new/ improved software products	Quantitative study	14-week idea call on SAPiens organised by the software company SAP	Platform data related to 57 ideas
Boons, Stam, & Barkema (2015)	Broad idea generation for a fairly ill-defined problem/ task not requiring specialised knowledge	Quantitative study	Several idea calls held on the same intermediary platform	Survey data of 153 ideators

Bretschneider, Leimeister, & Mathiassen (2015)	Broad generation of ideas for new/ improved software products	Quantitative study	SAPiens idea crowdsourcing platform organised by the software company SAP	Survey data of 87 SAPiens ideators
Chan, Li, & Zhu (2015b)	Broad generation of ideas for new (IT-related) products, services, processes	Quantitative study	Long-term idea call of a company in the IT-sector: IdeaStorm by Dell	Platform data related to 5,603 ideators
Chen, Marsden, & Zhang (2012)	Broad generation of ideas for new (IT-related) products, services, processes	Quantitative study	Long-term idea call of a company in the IT-sector: IdeaStorm by Dell	Platform data related to 6,142 ideators
Dahlander & Piezunka (2014)	Broad idea generation for new/ improved products, services, processes	Quantitative study	23,809 idea-seeking organisations that used online tool to external generate ideas and that received at least one idea	Platform data from 23,809 idea calls
Di Gangi & Wasko (2009b)	Broad generation of ideas for new (IT-related) products, services, processes	Quantitative and qualitative study (case study)	Long-term idea call of a company in the IT-sector: IdeaStorm by Dell	Expert evaluations and platform data related to 21 crowdsourced ideas
Ebner, Leimeister, & Krcmar (2009)	Broad generation of ideas for new/ improved software products	Quantitative study	SAPiens idea crowdsourcing platform organised by the software company SAP	Survey data of 73 SAPiens ideators
Filieri (2013)	Broad generation ideas for new/ improved products or processes of a food manufacturer	Qualitative study (case study)	Idea crowdsourcing attempt by an Italian food manufacturer	N/A
Fombelle, Bone, & Lemon (2016)	Broad generation of ideas for new/ improved services and processes	Quantitative study	Four online experiments simulating an idea community to improve online banking services, and an experiment to generate ideas for improved/ new services for a real Deli restaurant	Evaluations and actions of the 195 / 111 / 200 / 330 / 103 participants in the different on-line experiments
Fredberg & Piller (2011)	Broad idea generation for new/ improved sporting shoes	Qualitative study (case study)	Idea contest for new and improved sports shoes organised by Adidas	N/A
Füller (2010)	Broad idea generation for new/ improved products	Quantitative and qualitative study (survey, interviews)	Ten virtual co-creation projects, e.g. development of a pram, an innovative snowboard backpack, modular and adjustable running shoes, a mobile phone for kids, or furniture	Survey data of 727 participants in co-creation projects

Füller, Faullant, & Matzler (2010)	Broad idea generation for new/ improved medical technology products	Quantitative study	Potential idea crowdsourcing attempts for new/improved medical technology products	Survey data of 105 users of medical technology (i.e. doctors, hospital staff, etc.)
Füller, Mühlbacher, Matzler, & Jawecki (2009)	Broad idea generation for new/ improved products	Quantitative study	Ten virtual co-creation projects, e.g. development of a pram, snowboard backpack, modular and adjustable running shoes, a mobile phone for kids, or furniture	Survey data of 727 participants in co-creation projects
Huang, Singh, & Srinivasan (2014)	Broad generation of ideas for new/ improved (IT-related) products, services, processes	Quantitative study	Long-term idea call of a company in the IT-sector: IdeaStorm by Dell	Platform data related to 490 ideators who posted two or more ideas
Hutter, Füller, Hautz, Bilgram, & Matzler (2015)	Broad idea generation for new interior designs in trains	Quantitative study	Idea contest YouRail in the public transportation industry organised by Bombardier	Survey data of 107 YouRail participants and platform data regarding 2,233 comments submitted during contest
Jensen, Hienerth, & Lettl (2014)	Broad idea generation for new products (designs)	Quantitative study	LEGO Factory user-design platform	Platform data and expert ratings regarding 1,799 ideas
Kathan, Hutter, Füller, & Hautz (2015)	Broad idea generation for new interior designs in trains	Quantitative study	Idea contest YouRail in the public transportation industry organised by Bombardier	Platform data related to 695 contributors
Leimeister, Huber, Bretschneider, & Krcmar (2009)	Broad generation of ideas for new/ improved software products	Quantitative study	14-week idea call on SAPiens organised by the software company SAP	Survey data of all 32 ideators in the idea call
Li, Kankanhalli, & Kim (2016)	Broad generation of ideas for new (IT-related) products, services, processes	Quantitative study	Two long-term idea calls of two companies in the IT sector: IdeaStorm by Dell and IdeaExchange by the CRM software company Salesforce.com	Platform data related to 19,964 ideas (9,984 ideas from IdeaStorm and 9,980 ideas from IdeaExchange)
Mack & Landau (2015)	Broad idea generation for future innovative products, i.e. mobile web applications for cars	Quantitative study	Idea call involving management students to suggest ideas for future mobile web applications in Porsche cars	Platform data and survey data of 234 participants in the the idea call

Mahr & Lievens (2012)	Broad idea generation for new mobile service products	Quantitative study	Six finished idea calls from the Nokia BetaLabs community	Platform data related to 676 ideas
Martínez-Torres, Rodriguez-Piñero, & Toral (2015)	Broad idea generation for new/ improved food and beverage products, services, processes	Quantitative study	Long-term idea call of a company in the food and beverage sector: My Starbucks Idea	Platform data related to 99,528 ideas
Martini, Massa, & Testa (2012 and 2014)	Broad idea generation for new/ improved or food products	Qualitative study (case study)	Idea crowdsourcing efforts by the Italian food manufacturer Barilla	N/A
Mortara, Ford, & Jaeger (2013)	Broad idea generation for ill-defined tasks, e.g. new business models or technology solutions	Qualitative study (interviews)	Crowdsourcing attempts of five companies that intended to generate ideas from professionals for a range of ill-defined innovation areas.	N/A
Muhdi, Daiber, Friesike, & Boutellier (2011)	Broad idea generation for new/ improved products, services or processes in different consumer industries	Qualitative study (interviews)	Twelve idea crowdsourcing calls from nine companies four industries (banking, tourism, energy, insurance) run on the intermediary Atizo	N/A
Parjanen, Hennala, & Konsti-Laakso (2012)	Broad idea generation for new/ improved services for elderly people	Qualitative study (interviews)	Idea crowdsourcing call for new/ improved services for ageing people in a welfare centre in Finland	N/A
Piezunka & Dahlander (2015)	Broad idea generation for new/ improved products, services, processes	Quantitative study	922 idea-seeking organisations that used online tool to external generate ideas	Platform data regarding 922 idea calls
Piller & Walcher (2006)	Broad idea generation for new/improved sporting shoes	Qualitative study (case study)	Idea competition organised by Adidas using an Internet-based toolkit to generate customer ideas for new sports shoes	N/A
Rossi (2011)	Broad idea generation for new/ improved or food products	Qualitative study (case study)	Idea crowdsourcing efforts by the Italian food manufacturer Barilla	N/A
Salgado & De Barnier (2016)	Broad idea generation for creative product innovation and improvement, i.e. scooter designs and functions	Quantitative study	Four-hour crowdsourcing creativity experiment involving engineering students to generate ideas for future scooters made by the manufacturer Piaggio	Survey data of 180 participants in the experiment and expert evaluations of their ideas

Schemmann, Herrmann, Chappin, & Heimeriks (2016)	Broad idea generation for new/ improved food and beverage products, services, processes	Quantitative study	Long-term idea call by an international food and beverage company	Platform data related to 1,456 ideas
Schuhmacher & Kuester (2012)	Broad idea generation for new online services for soccer clubs	Quantitative study	14-week idea crowdsourcing experiment involving soccer fans to generate ideas for new online services for soccer clubs	Survey data of 120 participants in the experiment and expert evaluations of their ideas
Schuurman, Baccarne, De Marez, & Mechant (2012)	Broad idea generation for new online services for citizens	Quantitative study	Crowdsourcing initiative in the City of Ghent in 2011 that asked citizens to suggest ideas for new digital services	Platform data and expert evaluations related to 128 ideas
von Briel & Recker (2017)	Broad idea generation for new/ improved electronics products or services	Qualitative study (case study)	Idea crowdsourcing attempt of an electronic manufacturing company in the B2B sector	N/A
Zhao, Renard, Elmoukhliss, & Balague (2016)	Broad idea generation for new iPad smart cases	Quantitative study	Idea crowdsourcing experiment involving undergraduate students who were asked to come up with product ideas for iPad smart cases	Platform data related to the 177 participants and expert evaluations of their ideas
Area D				
Armisen & Majchrzak (2015)	Collaborative development of new ideas/ perspectives on a grand challenge through a threaded discussion	Quantitative study	72-hour idea jam organised by the USAID on a not-for-profit grand challenge	Platform data and expert evaluations of the 591 posts submitted in the discussion threads
Brunswicker, Bilgram, & Fueller (2017)	Novel, integrated, co-created solution paths to a complex/ wicked problem, i.e. future urban mobility	Qualitative study (case study)	Firm-sponsored civic innovation crowdsourcing initiative (Bombardier YouCity Challenge) to find new solutions for the future of urban transportation and mobility	N/A
Chan, Dow, & Schunn (2015a)	Collaborative and interactive collection of inspirations and development of conceptual solutions to tackle societal problems/ challenges	Quantitative study	Twelve completed challenges held on the platform OpenIDEO	Content of 2,341 concepts posted on the platform

Majchrzak & Malhotra (2016)	Collaborative development of ideas/ input to solve a complex and ill-defined problem through a threaded discussion	Quantitative study	Five commercial collaborative innovation challenges broadcasted by the intermediary Brightidea	Content of 107 post sequences in the discussion threads
Scheiner (2015)	Generating new ways to tackle the world's grand challenges	Qualitative study (case study)	Multiplayer online game EVOKE initiated by the World Bank Initiative to work on issues like food security, water crisis, the future of money, etc.	N/A

SUMMARY

Successful idea generation, selection and management are crucial in the early stages of any innovation process. The use of crowdsourcing during this phase can be beneficial and can lead to product ideas and solutions that are novel, show customer benefit and are likely to be more successful in the market than products based on the ideas generated by professionals. However, the underlying mechanisms of innovation crowdsourcing are not yet properly understood and there are open questions regarding the ideation and knowledge production capacities that can be gained using crowdsourcing. This thesis advances our understanding of crowdsourced idea generation and knowledge production and sheds light on different characteristics of successful innovation crowdsourcing.

As ideas are useless unless used, Chapter 2 of this thesis focuses on the characteristics of those ideas that the idea-seeker has chosen to put into practice. A growing number of organisations now use the crowd – made up of (potential) users – to generate a broad variety of ideas for new goods or services that they could offer. These open idea calls can lead to large numbers of ideas, not all of which will be perceived by the seeker as being equally useful or suitable. Thus, detecting the ideas that a company wants to implement can be problematic and require a lot of effort. One way to address this issue and to gain first insights into the successful generation of ideas from the crowd is to find out more about the characteristics of the ideas that are implemented. Our results reveal that ideators paying major attention to the crowdsourced ideas of others, the popularity of the idea, and its potential innovativeness positively influence whether an idea is implemented by the crowdsourcing company. Contrary to our initial expectations, the motivation of an ideator (reflected in the number of ideas suggested) does not influence the likelihood of an idea being implemented.

Research on user innovation in particular suggests that not all ideators will be equally capable of coming up with an innovative or good idea – ideas that the idea-seeker would like to implement. Some support for this is also found in the empirical study in Chapter 2 of this thesis, which shows that implemented ideas are more likely to come from ideators who pay a lot of attention to other ideas in the open idea call. Moreover, we know from research focusing on creativity at the front end of innovation that creative people are likely to possess certain behavioural characteristics, such as openness to experience, curiosity and support of other ideas. A better understanding of how successful ideators (i.e. those who come up with ideas that are perceived as useful by the idea-seeker and thus implemented) are likely to behave online is not only valuable for the (pre-)selection of ideas, it is also useful to improve the design and management of idea calls in ways which attract ideators with certain behavioural characteristics and encourage them to submit

ideas. The results gained in Chapter 3 reveal that displaying solution-oriented behaviour and showing openness and appreciation towards other ideas are key characteristics of successful ideators' online behaviour. When looking at these behaviours in more detail, the former is found to be characteristic of ideators who are likely to suggest an idea that is implemented but is only an improvement of an existing (service) product, and the latter is found to be characteristic of ideators who are likely to suggest an idea that is implemented as well as being novel to the unit of adoption. Paying attention to other ideas before suggesting one's own or showing collaborative behaviour by providing constructive input to other ideas are not found to be characteristic of the online behaviour of successful ideators.

Online idea calls not only ask the crowd to suggest ideas, they often also allow the crowd to discuss, elaborate or refine the ideas that have been suggested. This is interesting as idea-seeking efforts, in particular those that invite a diverse crowd consisting of (potential) users with no specific expertise to individually come up with a wide range of ideas on fairly broad topics (e.g. ideas for new products), tend to lead to a wide variety of ideas that are not very well elaborated, lack detail or are even incomplete. Keeping in mind the fluid conditions in these online innovation collectives, it does not seem very likely that relevant idea-related knowledge will be accumulated through the comments of the crowd. However, first insights gained from research analysing the content of such comments indicate that the crowd's comments should be considered and that relevant knowledge can be gained from these comments and online discussions. This can eventually improve the chances of an idea being perceived as useful and being implemented by the idea-seeker. Consequently, comments made by the crowd could be very valuable for the idea-seeker wanting to better understand the ideas suggested in such a call, and subsequently to successfully source ideas from the crowd. Understanding the mechanisms that help or hinder knowledge accumulation taking place in this environment is therefore important to making better use of the idea crowdsourcing potential. The results gained in Chapter 4 show that different factors influence the accumulation of idea-related knowledge in a commenting thread. Factors related to the relative advantage of the initial idea, i.e. idea novelty and idea popularity, and factors related to the interaction in the commenting thread are both found to be important for the amount of knowledge being accumulated. Regarding the interaction taking place in the commenting thread, it is important that the first comment is not a negative one and that commenters directly interact with each other. Comments that try to activate other commenters' input are not important for the amount of idea-related knowledge accumulation in the thread.

The insights gained in the three empirical studies undertaken for this thesis, as well as through the fast-growing number of empirical research papers that address the different

underlying mechanisms of innovation crowdsourcing, clearly show the need for an analytical framework defining the different areas of knowledge production within the innovation crowdsourcing space. The framework developed in Chapter 5 of this thesis allows us to synthesise the different empirical findings in a meaningful way and to spell out how new ideas and solutions can successfully be sourced from the crowd. The framework takes into account the fact that innovation crowdsourcing attempts can differ substantially in their cognitive and social dimensions of knowledge production. It defines four different areas of knowledge production within the innovation crowdsourcing space depending on the level of uncertainty of the innovation task assigned to the crowd and on the mutual dependency among the crowd to produce the ideas or solutions needed. The results of an integrated literature review show that the mechanisms that are important in making crowdsourcing work differ depending on the area of knowledge production. Consequently, there is no single approach or strategy that will be equally useful for all innovation crowdsourcing attempts. Instead, the ways in which the task is formulated and presented to the crowd, the incentives offered to the crowd and the ways in which the idea- or knowledge-seeking organisation interacts with the crowd will have to differ depending on the area of knowledge production within the innovation crowdsourcing space.

SAMENVATTING

Het succesvol genereren, selecteren en beheren van ideeën is cruciaal in de eerste stadia van een innovatieproces. Het gebruik van crowdsourcing tijdens deze fase kan nuttig zijn en kan leiden tot productideeën en -oplossingen die origineel zijn, voordelen hebben voor de cliënt, en meer succes op de markt hebben dan producten die zijn gebaseerd op ideeën die door professionals gegenereerd zijn. Er is echter nog onvoldoende inzicht in de mechanismen die ten grondslag liggen aan crowdsourcing ten behoeve van innovatie; ook zijn er nog onbeantwoorde vragen met betrekking tot de mogelijkheden tot het verkrijgen van ideeën en kennis met behulp van crowdsourcing. Dit proefschrift heeft als doel het inzicht te vergroten in het genereren van ideeën en kennis door middel van crowdsourcing, en duidelijk te maken wat de kenmerken zijn van het succesvol gebruik van crowdsourcing voor innovatie.

Ideeën zijn nutteloos totdat er iets mee wordt gedaan; daarom richt het eerste empirische onderzoek van dit proefschrift (hoofdstuk 2) zich op ideeën die zijn uitgekozen om in de praktijk te worden gebracht. Een groeiend aantal organisaties gebruikt nu de *crowd* – die bestaat uit potentiële gebruikers – om een breed scala aan ideeën te genereren voor nieuwe goederen of diensten die ze kunnen aanbieden. Een open ideeën-oproep kan leiden tot grote aantallen ideeën die de zoeker niet allemaal even nuttig of geschikt zal vinden. Het opsporen van ideeën die een bedrijf wil implementeren kan op deze wijze problematisch zijn en veel inspanning kosten. Om dit probleem aan te pakken en om eerste inzichten te verwerven in het succesvol genereren van ideeën uit de *crowd*, is het nuttig om meer te weten te komen over de kenmerken van de ideeën die worden geïmplementeerd. Onze resultaten tonen aan dat het implementeren van een idee door een bedrijf positief wordt beïnvloed door de populariteit van een idee, door de potentiële innovativiteit van het idee, en als het idee komt van een idee-generator die veel aandacht besteedt aan de ideeën van anderen. Anders dan wij aanvankelijk verwachtten, hangt de kans dat een idee wordt geïmplementeerd er niet vanaf of een idee afkomstig is van een idee-generator die veel ideeën heeft voorgesteld.

Onderzoek naar gebruikersinnovatie stelt dat niet alle idee-generatoren in gelijke mate in staat zijn om met een innovatief of goed idee te komen – ideeën die de idee-zoeker zou willen implementeren. Een eerste aanwijzing hiervoor is gevonden in de eerste studie van dit proefschrift, waaruit blijkt dat ideeën eerder worden uitgevoerd als zij afkomstig zijn van een idee-generator die veel aandacht besteedt aan de ideeën van anderen. Bovendien weten we uit onderzoek dat gericht is op creativiteit in het begin van het innovatieproces dat het waarschijnlijk is dat creatieve mensen bepaalde gedragskenmerken hebben, zoals open staan voor ervaringen, nieuwsgierigheid en de ondersteuning door andere ideeën.

Beter inzicht in hoe succesvolle idee-generatoren (d.w.z. degenen die komen met ideeën die door de idee-zoeker als nuttig worden beschouwd en dus worden geïmplementeerd) zich online gedragen is niet alleen waardevol voor de (pre-)selectie van ideeën maar ook nuttig om het ontwerp en het beheer van ideeën-oproepen te verbeteren, zodat idee-generatoren met bepaalde gedragskenmerken worden aangetrokken en aangemoedigd om met ideeën te komen. De tweede studie van dit proefschrift (hoofdstuk 3) toont aan dat niet alleen oplossingsgerichtheid, maar ook het open staan en waardering hebben voor andere ideeën belangrijke kenmerken zijn van het onlinegedrag van succesvolle idee-generatoren. Als deze gedragingen meer in detail worden beschouwd, blijkt oplossingsgerichtheid kenmerkend te zijn voor idee-generatoren die geneigd zijn te komen met een idee dat geïmplementeerd is maar slechts een verbetering is van een bestaand (service-)product, terwijl het open staan en waardering hebben voor andere ideeën kenmerkend is voor idee-generatoren die geneigd zijn met een idee te komen dat geïmplementeerd is en dat nieuw is voor de degene die de innovatie implementeert. Succesvolle idee-generatoren zijn niet geneigd om online aandacht te besteden aan andere ideeën voordat zij met hun eigen idee komen, of om constructieve input te verstrekken voor andere ideeën en zo samenwerkingsgedrag te vertonen.

Online oproepen vragen niet alleen de *crowd* om met ideeën te komen, maar ze geven de *crowd* vaak ook de mogelijkheid om de geopperde ideeën te bespreken, uit te werken of te verfijnen. Dit is interessant omdat zulke oproepen leiden tot uiteenlopende ideeën die vaak niet erg goed uitgewerkt, te weinig gedetailleerd, of zelfs onvolledig zijn – vooral als de oproepen gericht zijn op een divers publiek bestaande uit (potentiële) gebruikers die geen specifieke expertise hebben om apart met een breed scala aan ideeën te komen over vrij brede onderwerpen (zoals ideeën voor nieuwe producten). Door de steeds wijzigende omstandigheden in deze online innovatie-collectieven, lijkt het onwaarschijnlijk dat relevante idee-gerelateerde kennis zal worden opgebouwd met behulp van de opmerkingen vanuit de *crowd*. De eerste inzichten vanuit onderzoek dat de inhoud van dergelijke opmerkingen heeft geanalyseerd, wijzen er echter op dat deze opmerkingen juist wel belangrijk zijn en dat relevante kennis kan worden verkregen uit deze opmerkingen en online discussies. Dit kan uiteindelijk de kans vergroten dat een idee als nuttig wordt gezien en wordt geïmplementeerd door de idee-zoeker. Daarom zouden de opmerkingen van de *crowd* zeer waardevol voor de idee-zoeker kunnen zijn om beter begrip te krijgen van de ideeën die worden voorgesteld, en om later succesvol gebruik te kunnen maken van de *crowd* om nieuwe ideeën te genereren. Inzicht in de mechanismen die kennisvorming op dit gebied helpen of belemmeren is daarom belangrijk om beter gebruik te maken van het potentieel van crowdsourcing. De resultaten van de derde studie van dit proefschrift (hoofdstuk 4) geven aan dat verschillende factoren de opbouw van idee-gerelateerde kennis in een online discussie beïnvloeden. Zowel factoren die verband

houden met het relatieve voordeel van het oorspronkelijke idee, namelijk de nieuwheid en de populariteit van het idee, als factoren die verband houden met de interactie in de online discussie zijn belangrijk voor de hoeveelheid kennis die wordt opgebouwd. Voor de interactie tijdens de online discussie is het belangrijk dat de eerste opmerking niet negatief is en dat er directe interactie is tussen de deelnemers aan de discussie. Reacties die input van anderen proberen te stimuleren, zijn niet belangrijk voor de hoeveelheid idee-gerelateerde kennisopbouw in de discussie.

Niet alleen de inzichten als gevolg van de drie empirische studies van dit proefschrift maar ook het snelgroeiende aantal empirische onderzoeken naar de verschillende onderliggende mechanismen van innovatie-crowdsourcing laten duidelijk zien dat er behoefte is aan een analytisch kader dat de verschillende gebieden van de kennisproductie definieert binnen het gebied van innovatie-crowdsourcing. Het kader ontwikkeld in hoofdstuk 5 van dit proefschrift helpt om de verschillende empirische bevindingen op een zinvolle manier samen te brengen en om duidelijk te maken hoe nieuwe ideeën en oplossingen met succes kunnen worden verkregen uit de *crowd*. Dit kader houdt er rekening mee dat de cognitieve en sociale dimensie van kennisproductie wezenlijk kan verschillen bij verschillende manieren van innovatie-crowdsourcing. Het definieert vier verschillende gebieden van kennisproductie binnen innovatie-crowdsourcing, die afhangen van het niveau van de onzekerheid van de innovatietaak en van de onderlinge afhankelijkheid binnen de *crowd* om de benodigde ideeën of oplossingen te genereren. De resultaten van het geïntegreerde literatuuronderzoek tonen aan dat er verschillen zijn in de mechanismen die belangrijk zijn om crowdsourcing te laten werken, en dat die verschillen afhangen van het gebied van kennisproductie. Daarom is er niet één enkele aanpak of strategie die voor alle innovatie-crowdsourcing even nuttig zal zijn. Afhankelijk van het gebied van kennisproductie binnen de innovatie-crowdsourcing, zullen er juist verschillen moeten zijn in de wijze waarop de taak wordt geformuleerd en gepresenteerd, in de manier waarop de *crowd* wordt gestimuleerd, en in de interactie tussen de idee- of kennis-zoekende organisatie en de *crowd*.

ACKNOWLEDGEMENTS

An African proverb states that it takes an entire village to raise a child. Looking back at the eight years of my PhD trajectory I can say that this somehow also holds true for the development of a PhD candidate. This PhD thesis would not have been possible without the wise guidance, intensive support and unconditional friendship of many people.

I would like to thank my promoter Koen Frenken for taking me on board, always keeping a good eye on my PhD process, and for providing very valuable and ever so prompt feedback. I am also very grateful for the supervision I received from my three co-promoters: Gaston Heimeriks, for his enthusiasm and 'out-of-the-box' thoughts; Andrea Herrmann, for introducing me to the Innovation Studies Group, for taking on the doubtful and often very time-consuming pleasure of re-introducing me to the world of research design and methodology after my many years of work outside academia, and for the many pleasant, constructive and ever so nutritious stop-overs I had at her home in Düsseldorf (which often also involved receiving thoughtful feedback from her husband Marcus); and Maryse Chappin, for joining my supervision team at the end of the year 2013. Ever since, Maryse has been a tower of strength: she has spent hours listening to all my worries and struggles, and then suggested different paths to solve them. Not only did I benefit from her research interest in crowdsourcing but also from her vast knowledge regarding research methods and statistics and her ever so patient and empathic supervision style. Moreover, she kindly introduced me to Dutch culture, language and cuisine, which I thoroughly enjoyed. I would also like to say special thanks to Marko Hekkert for letting me to join the Innovation Studies Group as an external PhD student, despite my fairly diverse background.

As an external PhD candidate I am also very grateful to what I consider to be my external supervision team, especially Bettina, Petra, Marita and Hartmut. I got to know my dear friend Bettina early on during my PhD trajectory when I recruited her to be a freelance lecturer at the University of Applied Sciences Bremerhaven. Ever since we have been in this process together, and it soon became 'our' PhD project. I am so happy that she will be one of my paranymphs during my defence, as she has always been on my side with great advice (I really admire her marvellous *Überblickskompetenz*!) and a lot of mental support during rough patches in my private life. I will also never forget the many laughs we had in our endless telephone conversations! Petra, my dear *'Doktormutti'*, was first brave enough to offer me a job as a freelance lecturer and then encouraged me to do my PhD. I am very thankful to her for providing me with the necessary foundation for this fairly risky career change by offering me a job in Bremerhaven, for her great advice in all areas of life, for making me go to yoga classes (and dinner afterwards), and for becoming such a good

friend. When I moved to Karlsruhe in 2015, it was time to expand this external supervision team by bringing in some 'local players' in the more southern part of Germany: Marita and Hartmut, my good friends and former colleagues from IUB times. They saw straightaway what was needed to keep me going in this process and made sure that I stayed sane by spending time on agricultural and other hands-on tasks at their lovely little farmyard, providing feedback on papers and presentations and never losing faith in my capabilities.

A big thank you also goes to all my colleagues in Bremerhaven and at the University of Applied Sciences in Karlsruhe. They ever so patiently listened to all the stories related to my PhD and offered help where needed. Moreover, my supervisors at both institutions assisted me by creating a flexible work environment – very much needed when writing a thesis alongside a job. As I spent the last few months of my PhD trajectory starting work at Utrecht University School of Economics, I would also like to thank Jeroen de Jong and Erik Stam for providing me with a teaching-free start in the first few months which allowed me to complete the work on this thesis, and my many new colleagues for helping me get started in my new job.

I am also very grateful for the help that I received from the managerial team of the Innovations Studies Group. They always made sure that there was a desk available for me whenever I was in Utrecht and assisted me when I had all sorts of strange questions. I am very glad and honoured to be the last candidate that Ineke guided so skilfully through the entire PhD process before handing this job over to another colleague.

Having been a PhD student for quite some time, I had the pleasure of getting to know a number of fellow PhD candidates in the Innovation Studies Group. I shared an office with quite a few of them over time but, as the '10th floor' has this great tradition of open doors, I had the chance to interact not only with many other PhD candidates but also with most of the academic staff. Thank you very much to everybody for the many interesting discussions during the lunch breaks and the encouraging chats at the coffee machine. And very special thanks to Kevin for being one of my paranymphs.

Looking back at the last eight years I am also very grateful that friendships lasted despite my many time constraints and my absence from social life. A big thank you therefore goes to my old friends Doris, Kirsten and Andrea – I truly hope that I can make up for that in the coming years. I am also very happy to have developed new friendships with my dear swim-ladies, Maria and Carmen, in Karlsruhe. Carmen especially has helped me a lot by making sure that I swim regularly, introducing me to Badish culture and with her down-to-earth wisdom. *Außerdem möchte ich mich ganz herzlich bei meinen Vermietern in Karlsruhe bedanken: Giesela und Roland Margrander haben sich in den letzten Jahren nicht*

nur hervorragend um meine Wohnung, sondern sich auch sehr nett um mich gekümmert. And many thanks to Annika for being such a great housemate during our time in Houten. I will never forget the many late nights we spent sitting in the living room both preparing our lectures.

Finally, I would like to thank my family. *Meiner Schwester Desta und meiner Nichte Amelie, die in dem Jahr geboren wurde, in dem die Arbeit an meiner Doktorarbeit begann. Leider sehen wir uns nicht häufig, aber ich bin froh, dass Desta mich immer über alle Neuigkeiten in meiner alten Heimat auf dem Laufenden hält und sie vor allem trotz aller Widrigkeiten stets einen so positive Blick auf die Dinge des Lebens behält.* I am very grateful to my parents who ensured that I got the education needed to do a PhD. Sadly, my dear mother is no longer here to witness the end of this PhD process, but I am sure she would be very happy, as she was always so interested in my studies and my personal development. For my dear father the last few years must have been very stressful, seeing me deal with all this uncertainty. I am therefore extremely thankful for his enduring moral support – and sometimes unconventional ideas! – and for eventually becoming probably the greatest fan of my research.

CURRICULUM VITAE

After a vocational training in equine management at an agricultural college in the south of England, Brita Schemmann studied communications, politics and sociology at the University of Münster. In the year 1997/98 she was awarded a scholarship from the German Academic Exchange Service (DAAD) and completed her studies with a Master of Arts in mass communications at the University of Leicester in England. In the following years, Brita worked in corporate communications and marketing for a number of different organisations in Germany: first for the start-up of a private, international university in Bremen, then at the Goethe University in Frankfurt, followed by a position at the Hamburg Port Authority and later at a communications agency in Bremen. In 2010, she returned to higher education to work towards her PhD. During her time as an external PhD candidate in the Innovation Studies Group at Utrecht University, Brita first worked as a lecturer and in academic management at the University of Applied Sciences Bremerhaven and later as a researcher at the Institute for Learning and Innovation in Networks (ILIN) at Karlsruhe University of Applied Sciences. Since October 2017, Brita has been working in teaching and research as an assistant professor at Utrecht University School of Economics (U.S.E.).

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