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Exploring Open Innovation in Small and Medium-Sized Enterprises

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7.1 INTRODUCTION

Over the past years, research in open innovation has flourished and the analysis of open innovation has been extended to various topics. However, a large proportion of open innovation research of the last decade concentrates on large and multinational firms while innovation has become a more level playing field. Therefore, one would assume open innovation to be beneficial for large firms as well as for small and medium-sized enterprises (SMEs) (Chesbrough, 2006c). Prior work on innovation and SMEs emphasizes the role of inter-organizational relationships and external sources of innovation, and indicates that innovation in SMEs “by nature” has an external focus (Baum et al., 2000; Edwards et al., 2005). Nevertheless, SMEs have been excluded from the mainstream discussion in open innovation research (Lee et al., 2010; Wynarczyk et al., 2013).

Only recently, researchers have started to investigate the relevance and the specific nature of open innovation in SMEs (Lee et al., 2010; van de Vrande et al., 2009b; Vanhaverbeke, 2012; van der Meer, 2007; Spithoven et al., 2013). These studies confirm that small firms do engage in different types of open innovation practices and that openness drives innovation performance in SMEs (van de Vrande et al., 2009b; Parida et al., 2012; Brunswicker, 2011). Moreover, recent work provides a clear indication of the specific nature of how SMEs can benefit from opening their business models and using inflows and outflows of knowledge (Lee et al., 2010), suggesting that existing findings on open innovation in large firms cannot be directly transferred towards the SME sector. These first lessons learned provide the argument for studying open innovation in the SME sector in more detail. In addition, the economic relevance of SMEs further emphasizes the importance of research on open innovation strategies in SMEs. In Europe, for example, more than 60%

of private sector jobs are in the SME sector and more than 90% of all businesses are SMEs (European Commission, 2005; Organisation for Economic Co-operation and Development (OECD), 2009; Acs & Audretsch, 1987). As discussed next, it is the specific nature of open innovation in SMEs that opens up new research avenues.

7.2 THE SPECIFICS OF OPEN INNOVATION IN THE SME SECTOR

7.2.1 The SME Sector and the Nature of Innovation in SMEs

As the term suggests, small and medium-sized enterprises (SMEs) are organizations that are characterized by their “smallness,” which is usually measured with an upper ceiling for number of full-time employees, yearly turnover, and/or annual balance sheet total.¹ In practice, the term SME is regularly associated with high-tech start-ups, new small firms, and entrepreneurial firms. However, there are different “subpopulations” of SMEs (de Jong & Marsili, 2006; Leiponen & Byma, 2009), and SMEs subsume more than just young technology entrepreneurs and science-based ventures from high-tech sectors (Gans & Stern, 2003), and also include established SMEs that are at a later organizational lifecycle stage (Koberg et al., 1996). However, studies on SMEs and entrepreneurship literature in particular have a bias towards young and small firms (de Jong & Marsili, 2006; Macpherson & Holt, 2007).

It is widely recognized that SMEs make a significant contribution to our economies and that SMEs, compared to large firms, also have the capacity for innovation (Acs & Audretsch, 1988). It can even be observed that SMEs have been increasing their expenditures for R&D (National Science Foundation, 2006). However, it is not just high-tech start-ups that innovate. Low-tech SMEs, as well as established SMEs that have successfully passed the critical lifecycle stage of 8 to 15 years, also play an important role in today's innovation landscape (Koberg et al., 1996; Santamaría et al., 2009). While some may continue to engage in radical innovation, and eventually become market leaders, others remain “small” and compete in market niches (de Jong & Marsili, 2006). However, despite the considerable amount of literature on SMEs at the aggregated level, research on the firm-level innovation activities in SMEs is limited. Prior studies suggest that innovation processes and models in SMEs are quite different compared to large firms (Edwards et al., 2005): They are usually flexible, fast decision makers, and quicker in reacting to changing market demands (Vossen, 1988). At the same time, they face limitations in terms of material, human, and resource factors (Acs & Audretsch, 1987; Vossen, 1988; Harryson, 2008). Further, an

owner-manager, a group of partners, or the members of a family dynasty dominate most small businesses (Roper, 1999). Moreover, they generally have less formalized R&D procedures.

Due to the liability of smallness, SMEs cannot cover all innovation activities required to successfully realize an innovation. Thus, innovation in SMEs regularly has an external and boundary-spanning component. Indeed, there has been a long tradition of research on the role of external relationships and networks in SMEs (Birley, 1985; Edwards et al., 2005; Macpherson & Holt, 2007). Prior work on young biotechnology SMEs indicates that strategic alliances enable them to innovate. Dyadic partnerships and multi-actor alliances help them to get access to critical resources, to extend their technological competencies, and also to build legitimacy and reputation. SMEs that are involved in multiple ties are also more innovative than those that use only one type of tie (Baum et al., 2000). Further, existing literature on SMEs and social capital emphasizes the preference of entrepreneurs and their systems towards informal and social contacts that may provide opportunities and at the same time shape the development of a firm (Macpherson & Holt, 2007). In fact, SMEs that belong to formal and informal networks are more innovative than others. One factor driving this positive association is the presence of a large variety of relationships among network members; *personal networks* support the diffusion of innovation within networks of SMEs (Ceci & Iubatti, 2012). Social and personal relationships are often strongly embedded in the economic actions of SMEs and are therefore not “used” in a purposive manner. Thus, SMEs may regularly lack the capability to proactively articulate their needs for external knowledge (Bessant, 1999). Even though they could build upon strong external relationships and interpersonal networks, SMEs often don’t have the internal capabilities required to do so (Bougrain & Haudeville, 2002). Further, organizational and social relationships can act as a barrier to innovation as such ties may close opportunities (Macpherson & Holt, 2007). SMEs even run the risk of becoming too dependent upon their relationships.

Overall, literature indicates that inter-organizational linkages and networks are important drivers of innovation in SMEs. However, existing studies reveal a “paradox”. Even though SMEs regularly have strong inter-organizational ties, they struggle with making the best use of these ties. Studying open innovation in SMEs should provide insights in “how” SMEs can use network relationships and social capital by purposively using inflows and outflows of knowledge. If SMEs become proficient in applying and managing open innovation, they can use their relationships in a positive manner rather than becoming dependent upon them. As the locus of innovation regularly resides at the network level, open innovation in SMEs naturally is quite specific and different from large firms; it postulates researchers to explore the unique challenges in leveraging and managing open innovation in SMEs.

7.2.2 Mapping the Field of Research on Open Innovation in SMEs

Prior studies have addressed open innovation in SMEs from different angles² (an overview of selected studies published since 2003 can be found in Table 7.1). Some studies empirically investigate the role and the performance impact of open innovation in SMEs, providing a high-level insight into open innovation in SMEs (e.g. Laursen & Salter, 2006; van de Vrande et al., 2009b; Drechsler & Natter, 2012; Parida et al., 2012), while others take a more in-depth perspective and provide insights into the specifics of open innovation in SMEs (Vanhaverbeke & Cloudt, 2006; Lee et al., 2010; Vanhaverbeke, 2012). In the following chapters, we provide a brief overview of the existing literature.

Table 7.1 Overview of empirical studies on open innovation in SMEs

Author(s)	Year	Objective and focus of the study	Type of study
Barge-Gil	2010	Empirical examination of the role of the degree of openness in small and large firms	Quantitative study based on PITEC database (2004–2006) of Spanish firms
Bianchi et al.	2010	Investigation outbound open innovation (out-licensing) in SMEs with a focus on a managerial instrument for the identification of out-licensing opportunities and alternative application areas of a technology	Qualitative study (design science); single case study on an Italian SME
Brunswicker & Vanhaverbeke	2010	Exploration of different inbound sourcing strategies and internal managerial facilitators of open innovation in SMEs	Quantitative study based on firm-level data on European SMEs
Christensen et al.	2005	Analysis of the strategic mode of open innovation from an industrial dynamics perspective based on an in-depth study of the transformation of sound amplification within the consumer electronics system of innovation	Qualitative study based on primary and secondary on firms and R&D pioneers in the class D amplification around the Technical University of Denmark

Author(s)	Year	Objective and focus of the study	Type of study
Classen et al.	2012	Investigation of the differences in the diversity of cooperation partners used for innovation-related activities (i.e., search breadth) between family and nonfamily SMEs	Quantitative study based on SMEs from Belgium and Netherlands (Belgium Belfast database and the Dutch Chamber of Commerce database)
Cosh et al.	2011	Investigation of the nature of open innovation in British large and small firms from different sectors	Quantitative study based on survey among more than 12000 UK firms from 15 sectors performed in 2010
Drechsler & Natter	2012	Investigation of the underlying drivers of openness in small and large firms	Quantitative study based on the German Community Innovation Survey 2005 (CIS IV)
Gardet & Fraiha	2012	Exploration of the coordination modes used by an SME project bearer in a network	Longitudinal single case study on a SME in a network in France
Gruber & Henkel	2006	Investigation of how three key challenges of venture management—the liabilities of newness and smallness of start-ups and market entry barriers—affect new ventures in OSS	Empirical study on large scale survey of 268 embedded Linux developers and 30 personal interviews with industry experts
Huang & Rice	2006	Empirical investigation of the interaction between open innovation strategies and absorptive capacity	Quantitative study based on the Australian Bureau of Statistics' Business Longitudinal Survey; 292 manufacturing Australian SMEs
Laursen & Salter	2006	Empirical explanation of the impact of search strategy on innovative performance in small and large firms	Quantitative study based on the UK innovation survey 2001 with 2707 manufacturing small and large firms
Lee et al.	2010	Conceptualization of the role of an intermediary in open innovation and descriptive analysis of the success of Korean SMEs working with an intermediary	Qualitative study on Korean SMEs based on the report of Survey Science and Technology Policy Institute (STEPI) published in 2005

(continued)

Author(s)	Year	Objective and focus of the study	Type of study
Parida et al.	2012	Investigation of the effects of four inbound open innovation practices (both monetary and non-monetary) on innovation performance of high-tech SMEs	Quantitative study based on survey data of 252 high-tech SMEs; survey performed in Sweden in 2009
Spithoven et al.	2013	Investigation of the importance of four open innovation practices (focus inbound) and estimation of their performance effect with a focus on the differences between large and small firms	Quantitative study based on the Community Innovation Survey 2006 in Belgium
Theyel & Cosh	2012	Investigation of the differences in the importance and performance effect of different inbound and outbound open innovation activities in young versus established firms	Quantitative study based on survey data from 1202 firms from the UK; survey was performed in 2010
van de Vrande et al.	2009b	Exploration of the incidence of and apparent trend towards open innovation among Dutch SMEs addressing eight different practices for inbound and outbound open innovation	Quantitative study based on survey data of 605 SMEs in the Netherlands performed in 2005
van der Meer	2007	Descriptive analysis of the adoption of open innovation in Dutch firms (including small and large firms)	Empirical analysis of survey-data of 814 SMEs in Dutch firms based on the Dutch National Innovation Survey 2003 and 28 interviews with highly innovative Dutch firms
Vanhaverbeke & Cloudt	2006	Exploration of open innovation from a value network perspective focusing on the role of interorganizational networks in the commercialization of new product offerings based on technology breakthroughs in the agriculture biotech	Qualitative case study example of the role of value networks for open innovation in SMEs in the agriculture biotech sector

Author(s)	Year	Objective and focus of the study	Type of study
Vanhaverbeke	2012	Inductive investigation of the strategic role of open innovation in SMEs considering the interdependences between the firm strategy, business model, and open innovation	Qualitative study based on ten inductive case studies on Belgium SMEs

7.2.2.1 The Adoption and Prevalence Open Innovation in SMEs

As argued before, the adoption of open innovation in large firms and SMEs differs significantly. Survey-based studies indeed suggest that firm size positively influences a firm's openness (Drechsler & Natter, 2012), while others find an inverted U-shaped relationship between firm size and search breadth (e.g. Barge-Gil, 2010) or indicate that although large firms appear to be more open, SMEs have in fact a higher open innovation intensity (Spithoven et al., 2013). Moreover, SMEs have increased their open innovation activities over the last years (e.g. van de Vrande et al., 2009b), with inbound open innovation practices being far more diffused than outbound open innovation. Regarding inbound open innovation activities research indicates that SMEs have a preference for non-monetary activities such as networking, over complex transaction-based ones, such as acquisitions and in-licensing (van de Vrande et al., 2009). There are different open innovation types among SMEs. While some SMEs engage in a large variety of different practices, others tend to use a subset of potential practices only. Moreover, SMEs also differ in how they combine different types of sources of external knowledge. Some open up only along the value chain while others heavily draw upon universities and research organizations (Cosh & Zhang, 2011; van de Vrande et al., 2009b; Brunswicker & Vanhaverbeke, 2010).

Outbound open innovation, on the other hand, is hardly adopted in the SME sector (van de Vrande et al., 2009b) even though prior literature on the "market for ideas" indicates that technology-driven and venture-capital backed entrepreneurial firms do consider out-licensing of know-how and technologies as an alternative to developing a product and selling it on the market (Gans & Stern, 2003). Apparently, the identification of potential opportunities for out-licensing is challenging for SMEs. The role of non-monetary outbound innovation activities also receives little attention in existing literature on open innovation in SMEs. A notable exception is a study by Gruber and

Henkel (2006) who indicate that free revealing—a non-monetary form of out-bound innovation—may enable SMEs to overcome the liability of smallness.

Finally, prior studies have pointed to a number of factors that influence SME's open innovation decisions and activities, such as the firm's need for funding, and the characteristics of the innovation system. (Christensen et al., 2005) Indeed, market-related motives are a primary reason for SMEs to engage in open innovation (van de Vrande et al., 2009b). However, a firm's knowledge gap (market and technological knowledge) and ineffective IP protection mechanisms prevent firms from being open (Drechsler & Natter, 2012). A closer look into the SME-specific organizational and leadership characteristics reveals that the ownership structure also shapes the adoption of inbound open innovation in SMEs. Family-owned SMEs have a lower search breadth than their non-family counterparts. Furthermore, the level of education of the CEO and nature of the top management team affect the openness of SMEs (Classen et al., 2012).

7.2.2.2 *The Performance Impact of Open Innovation in SMEs*

First evidence on the performance impact of open innovation in SMEs suggests that sourcing positively affects innovation performance, both in developed and developing countries (Laursen & Salter, 2006; Chen et al., 2011). In addition, Spithoven et al. (2013) found that besides search, innovation collaboration and external R&D contracts also have a positive effect on SME's innovation performance. There are also differences between young and established firms with regards to openness and the performance impact of open innovation. Firm age and a firm's stage in the organizational life cycle affect its openness and the performance impact of open innovation—open innovation has greater benefits for young firms than for established firms (Theyel & Cosh, 2012). Moreover, the impact of openness on innovation performance also depends on the SME's sourcing strategy and how they combine different external knowledge sources. Some combinations have a negative effect on innovation performance and thus represent a potential risk (Brunswicker & Vanhaverbeke, 2010; Brunswicker, 2011). Interestingly, different open innovation practices have a differential impact on incremental and radical innovation. While technology scanning is more important for incremental innovation, sourcing (accessing technology via licensing) is of higher relevance for radical innovation. Somewhat counterintuitive, vertical collaborations along the supply chain with customers and end-users positively affect radical innovation in high-tech industries (Parida et al., 2012).

7.2.2.3 *The Network Dimension of Open Innovation in SMEs*

Prior research has provided extensive evidence that networks play an important role in explaining the performance of start-ups and SMEs (e.g. Baum et

al., 2000; Bruderl & Preisendorfer, 1998; Rogers, 2004). In addition, SMEs also frequently participate in more informal knowledge networks (Buchel & Raub, 2002). These knowledge networks are often regional initiatives aimed at knowledge sharing and networking among a broad range of parties, such as start-ups, incubators, venture capitalists, experts, etc. (Collinson & Gregson, 2003). Indeed, network relationships shape performance of SMEs and influence their strategic actions. The strategic role of networks in SMEs has also implications on the nature of open innovation in SMEs. Open innovation in SMEs is directly linked to the business strategy and the firm's overall strategic objectives (Vanhaverbeke, 2012). While large firms can implement open innovation without a strategic change, the shift towards open innovation in SMEs goes hand in hand with a strategic change (Vanhaverbeke, 2012).

As open innovation in SMEs is embedded in and directly linked to strategy, it also directly links to the SME's position in the value chain and its value creation relationships with partners. When SMEs engage in innovation, they regularly lack complementary assets and resources to commercialize a new product or service. For example, SMEs working on new technologies face the challenge to commercialize it and involve new value creation partners to access complementary assets (Vanhaverbeke & Cloudt, 2006; Lee et al., 2010). Thus, open innovation and boundary-spanning innovation activities are not just important in the "front-end"—that is in R&D—but also in the commercialization phase. For SMEs, interorganizational ties relate to the value network (Nalebuff & Brandenburger, 1996) as well as to the "front-end" innovation network (Vanhaverbeke, 2012).

Due to the importance of networks in open innovation, existing work also touches upon the intermediation and management of such networks. Lee et al. (2010) study possible models for SMEs to profit from networks and discuss the role of intermediation to support the commercialization phase and to establish different types of network relationships. In addition, the network dimension of open innovation also has implications for the managerial capabilities of SMEs. Coordination capabilities are required to benefit from innovation and value creation networks and to access the required resources and capabilities, especially if they play the role of a "hub" firm (Gardet & Fraiha, 2012). SMEs need to diligently implement different coordination tools through elaborating on their implementation mode, and consider their interaction to act as a "hub." For example, they need to decide on whether they rely on informal, semi-formal, or formal communication, whether they can rely on trust, how they divide the benefits, and how conflicts are resolved. Further, the project evolution (phase) and the dependency on the partners seem to be important antecedents of the coordination mode (Gardet & Fraiha, 2012; Harryson, 2008).

At the network level, there are also new managerial capabilities required, especially if the network is large and there is no "hub" firm managing it. Novel, less centralized organizational arrangements for open innovation, such as SME

innovation networks, employ boards to effectively manage joint research and development activities. The network board of such SME innovation networks holds a central role as it is responsible for motivating the participants, fostering collaboration, and ensuring that R&D activities are implemented in the best interest of the network's members. Gronum et al. (2012) find a U-shaped relationship between the network board continuity, describing the rate of renewal of network board members, and the innovation performance within large networks (but not in small networks). Under certain circumstances the renewal of network board officers may be an important determinant of the innovation performance of members in the network; even though this may be at odds with SME's preference for trusted and long-term relationships (Gronum et al., 2012). In other words, the composition and the managerial capabilities of network boards of SME network arrangements for open innovation requires careful consideration; it is worthwhile studying the managerial dimension of open innovation at the network level.

7.3 PROPOSITIONS FOR FUTURE RESEARCH

Overall, existing literature on open innovation is emerging and shows that open innovation in SMEs is a fascinating research topic. SMEs do engage in open innovation and also seem to benefit from doing so. However, existing studies often do not capture the full picture as they address only a subset of potential open innovation practices and do not provide sufficient insights into why and how SMEs make use of inflow and outflows of knowledge. Further, they only marginally address the specific nature of open innovation in SMEs.

As a consequence, there is a range of topics that either haven't been explored sufficiently or that require more detailed investigation. Out of those, we consider four topics of high priority for future research: First, existing literature stresses the importance of inbound open innovation in SMEs to overcome their liability of smallness. However, new open innovation practices such as IT-enabled crowdsourcing for involving a large number of unknown "outsiders" have not been explored in the context of the SME sector. Second, the importance of networks—both R&D and value networks—is highlighted in existing discussions on open innovation in SMEs. Prior literature on SMEs also points to the importance of social capital and dependency of SMEs on network relationships. So far, it is not fully understood how SMEs can make use and manage different kinds of relationships and networks, also personal ones, when engaging in open innovation (Birley, 1985; Macpherson & Holt, 2007; Ceci & Iubatti, 2012). Third, the interplay of IP management and open innovation is hardly addressed in existing work. Prior studies show that the lack of appropriate IP protection

mechanisms prevents SMEs from engaging in open innovation (Drechsler & Natter, 2012). While IP management is important in open innovation activities both in large firms and in SMEs, IP management in SMEs is subject to its own set of issues. Finally, existing literature clearly indicates that open innovation requires SMEs to build new internal capabilities when engaging in open innovation, particularly since open innovation is often directly linked to a strategic change in a firm's overall business model. Thus, the internal dimensions and the change process when engaging in open innovation provide an interesting avenue for future research. In the following sections, we will elaborate on these four themes in more detail and discuss the particular nature of open innovation in SMEs with regards to these four themes.

7.3.1 Theme 1: Beyond “Traditional” Search: Crowdsourcing in SMEs

Over the last years, open innovation scholars and practitioners have become increasingly interested in the potential of internet-enabled inbound open innovation practices such as online innovation contests, online idea competitions, and other practices which fall in the category of crowdsourcing or broadcast search (Lampel et al., 2012). Crowdsourcing and broadcasted search are similar concepts and describe the act of outsourcing as allocating a task in the problem solving process to a “crowd,” rather than to a designated “agent” (an organization, informal or formal team, or individual), such as a contractor, in the form of an open call (Howe, 2008; Afuah & Tucci, 2012; Jeppesen & Lakhani, 2010). The diffusion of the Internet and social networking technologies has opened many opportunities for implementing these sourcing strategies which go beyond the “traditional” sourcing strategies of a firm and tap into the power of many unknown agents. Prominent case studies such as the Netflix competition, in which the company crowdsourced the task to develop an algorithm to further improve its recommender system via an open call to the world, depict how crowdsourcing enables firms to overcome the problem of “local search” and to identify solutions that are much superior to the internal ones (Afuah & Tucci, 2012; Lakhani et al., 2006). In some cases Internet-enabled crowdsourcing maybe a better search strategy than more common alternatives (such as a club of well-known partners or internal resources), in some cases it won't. Recent theoretical contributions argue that the success of crowdsourcing is influenced by various factors such as the characteristics of the problem, the knowledge required for the solution, the characteristics of the crowd, and characteristics of the solutions to be evaluated (Afuah & Tucci, 2012). Indeed, observations of existing practices indicate that not all crowdsourcing activities provide satisfying results. For example, some crowdsourcing activities lack

participation. Further, practitioners proclaim that they receive only incremental solutions for the “problems” or “challenges” distributed via an open call to the crowd which raises new questions about the design and management of crowdsourcing activities from a socio-technical perspective, particularly for SMEs.

While firms may organize crowdsourcing activities on their own, they can also organize them through new Internet-enabled intermediary services for open innovation in order to overcome the difficulties in accessing the market for ideas (Hossain, 2012; Chesbrough, 2006a). Open innovation intermediaries such as Innocentive.com, yet2.com, Ninesigma, YourEncore, and IdeaConnection have received high interest in open innovation discussions (Lakhani et al., 2006; Hossain, 2012). These providers offer open innovation services to their clients—mostly large firms—and help them design and implement sourcing strategies. For example, they design the challenge, help to communicate it widely among the potential solvers, and play a brokering role in the technology transfer process. SMEs may rather rarely engage with those global service intermediaries which provide a sophisticated IT infrastructure and hold a large service portfolio due to the relatively high service fee. However, more “traditional” intermediary organizations that facilitate innovation at the regional or network level, such as Technology Transfer organizations (TTOs), can also act as broker and connector between multiple parties (Howells, 2006; Lee et al., 2010; Spithoven et al., 2010). Some of those organizations have already expanded their service portfolios and integrated Internet-enabled crowdsourcing activities in their traditional brokering activities.

Despite the interest in crowdsourcing and IT-enabled open innovation practices, existing literature on SMEs has not explored whether and when Internet-enabled crowdsourcing practices make sense for SMEs and help them to overcome the liability of smallness. As highlighted in the case of the small photonics firm Ocean Optics (see Case example 1), they provide instant access to a greater “innovation workforce” without having to put them on the payroll. However, they also have their own unique managerial challenges, especially for SMEs, as they regularly lack the reputation and brand value of a large firm needed to attract external actors, have difficulties in articulating and defining the problem, and may lack the capabilities and resources to manage the process and evaluate ideas appropriately. In particular, it raises the question whether and when crowdsourcing is superior to alternative sourcing strategies in SMEs. How can SMEs attract external solvers and achieve high quality submissions? How should they manage the inflow of ideas and how should they deal with IP issues in crowdsourcing? How should they design and use information systems to benefit from crowdsourcing? Do IT-enabled open innovation intermediaries really work for SMEs, and if so which ones and under which conditions?

CASE EXAMPLE 1

Ocean Optics is a 25-year-old US-based photonics technology SME, with about 200 employees and more than 50 million dollars in sales.³ They invented the first miniature spectrometer, a disruptive technology that enables field analysis of samples. Over time, Ocean Optics' R&D focus has switched from breakthrough to incremental innovations. Its intensive and long-term R&D partnerships with universities were not creating really new growth opportunities. To strengthen its R&D breakthrough capacity, CTO Jason Eichenholz implemented a significant shift in the firm's open innovation strategy. They designed a "Blue Ocean Grant" program to create breakthrough innovation opportunities. The Internet-enabled crowdsourcing program was implemented in two-stages: Phase 1 represented an open call to the "world" for submissions to provide support funding of \$10,000 for about 10 teams to work on a 6-months proof-of-concept project. In phase 2, Ocean Optics planned to fund one R&D project with \$100,000. The program exceeded their objectives in terms of participation and innovativeness of the results. Overall, it increased their R&D capacity by at least four times within the first year, made a positive impact on the firm's brand value, and drove the firm's strategic change. The unique IP management approach, the strong engagement with the teams throughout the program combined with a strong engagement internally, and social and personal relationships of the open innovation team externally within the photonics research community and internally with other functions were undeniable key enablers of the program. Motivated by the success, Jason Eichenholz initiated a larger open innovation membership-based initiative, called Open Photonics (www.open-photonics.com).

Source: Brunswicker, (2013)

7.3.2 Theme 2: Network Relationships and Coordination

As indicated earlier, SMEs are by nature embedded in a variety of formal and informal interorganizational networks which can be a driver of innovation performance (Ceci & Iubatti, 2012; Edwards et al., 2005). Network relationships play an important role in open innovation in SMEs: SMEs can use interorganizational networks to create value in the earlier stages of the new business development process to extend their technological competences (Edwards et al., 2005; Vanhaverbeke, 2012), while SMEs can also team up with downstream partners to get access to marketing and sales channels (Lee et al., 2010). As such, network relationships serve to accommodate the two sides of the open innovation coin: SMEs collaborate with other firms to enhance their innovation processes and to create value, while they may also need external partners to capture part of that value as they often lack complementary assets to commercialize a new product or service (Gans & Stern, 2003). Open

commercialization, where SMEs collaborate with other companies for the commercialization of their technologies, ideas, products, or services, is therefore an important topic. It implies value constellations (Norman & Namirez, 1993) linking firms with different assets and competencies together in response to or in anticipation of new market opportunities (Vanhaverbeke & Cloudt, 2006, p. 259). As such, open commercialization is central to high-tech and venture capital backed SMEs that form ties with partners to commercialize their technologies (Gans & Stern, 2003). However, open innovation researchers remain relatively quiet about the role of open commercialization in other sectors, other “subpopulations of SMEs,” and more collaborative rather than purely market-driven relationships between SMEs and their partners.

Despite the abundant literature on the importance of networks for SMEs, little is known about the process that underlies the formation and coordination of these networks (Gardet & Fraiha, 2012). In particular, the management of different types of innovation networks is a crucial factor in extracting value from these networks (Nambisan & Sawhney, 2011). So, how can SMEs act as “hub” firm and “orchestrate” their innovation network relationships? Given their limited resources and the dominance of “informal and personal relationships,” what role can SMEs play in the management of innovation leverage, innovation coherence, and innovation appropriability? Finally, many authors have stressed the interplay between small SMEs and large MNEs as a driver behind achieving superior innovation performance (e.g. Rothwell & Dodgson,

CASE EXAMPLE 2

Isobionics is a Dutch biotechnology company, active in the flavor and fragrance industry. The basis for their products is a technology developed by DSM, a large Dutch company active in the Life Sciences and Performance Materials industry. Using this technology, it is possible to produce flavors and fragrances synthesized by micro-organisms, which is considerably cheaper than using traditional methods. DSM, however, had decided not to pursue this technology, but instead was open to external partners to commercialize the technology. In 2008, Isobionics was established and in 2010 the first product, BioValencene, was introduced in the market. In developing this product, Isobionics worked closely together with DSM and other innovation partners. The collaboration between Isobionics and DSM is a good example of a development and commercializing partnership, in which a start-up works together with a large, established firm. Through this collaboration, Isobionics is able to build a successful company through the licensing of this product and tapping into the resources of DSM, while DSM benefits not only from the licensing revenues, but also has first-hand access to potential new discoveries and applications of the technology.

Source: Vanhaverbeke, 2012.

1991). Also in the commercialization phase, large firms play a prominent role. However, we know less about the role of specific characteristics of these large MNEs. For example, how important are market power, prominence, reputation, etc. in the innovation and commercialization phase of these collaborative efforts? And what is the key to successful collaboration between the two? Evidently, small and large firms are different in the way they operate and in their motivations for the collaboration (e.g. Blomqvist et al., 2005). Therefore, as highlighted in our case on the Dutch SME Isobionics (see Case example 2) these asymmetric partnerships are challenging for both parties and require both contracts and trust to foster successful collaboration. This raises an additional question: what role can SMEs play in the successful attraction of and collaboration with, larger multinational partners?

7.3.3 Theme 3: Open Innovation and Intellectual Property (IP) Management in SMEs

Intellectual property (IP) protection is of major concern for firms engaging in open innovation. Common methods for IP protection include formal mechanisms such as patents and trademarks, as well as more informal mechanisms such as trade secrets and lead-time. However, while large firms may have many possibilities for both formal and informal means of IP protection, SMEs appear to be more limited in this respect.

Prior studies have indicated that most SMEs find patents to be less efficient than more informal IP protection mechanisms (e.g. Kitching & Blackburn, 1998). Obtaining and maintaining a patent is usually a costly and complex process, with many regulations and procedures. Moreover, given the limited power and resources of SMEs, the costs associated with patent enforcement make patents less attractive for small firms (Lanjouw & Schankerman, 2004; Penin, 2005). Hence, it is no surprise that small firms tend to prefer more informal IP protection mechanisms, such as speed to market or secrecy (Arundel, 2001; Leiponen & Byma, 2009).

Nevertheless, formal means of IP protection play an important role in open innovation and may actually facilitate knowledge flows in open innovation. For example, if knowledge is protected by means of a patent, the transfer of the underlying knowledge becomes much easier as patents help to define the intellectual property rights explicitly (Alexy et al., 2009; Leiponen & Byma, 2009). As such, patents enable technology and IP trading and help to modularize knowledge. Firms engaging in cooperative R&D are therefore also more likely to favour patents over secrecy (Arundel, 2001). In addition, formal IP protection may also serve as a signalling device, demonstrating their technological capability. Particularly for small, start-up firms, having a patent is almost a prerequisite to receive

any kind of VC funding or for larger firms to be willing to cooperate (Gans & Stern, 2003). In this case, formal IP protection not only facilitates knowledge sharing, it may actually be a precondition to engage in open innovation and can form the basis of negotiations with VCs and potential alliance partners (Alexy et al., 2009). Particularly in horizontal or vertical cooperation efforts, informal means such as secrecy appear to be not very effective, mostly because secrecy is more difficult to maintain in joint projects (Leiponen & Byrna, 2009).

However, despite the importance of formal IP protection in open innovation, some authors argue that free revealing enables small firms to overcome the liability of smallness (Gruber & Henkel, 2006). Free revealing relies on the idea that firms may benefit from selectively revealing some part of their intellectual assets for free usage by others (Harhoff et al., 2003). This is a common practice in open source software development, but has also been adopted by large organizations in other sectors. For example, pharmaceutical companies such as Novartis and GlaxoSmithKline freely reveal some of their patents in an effort to embrace the larger research community to further understand particular diseases, such as diabetes and tropical diseases. It would be interesting to study whether selective free revealing offers specific benefits to SMEs, as it may reduce entry barriers and sunk costs for SMEs.

Consequently, there is no one-size-fits-all approach towards IP management in open innovation. Rather, open innovation requires effective IP management where different strategies may prevail in different situations. However, the conditions that favor particular types of knowledge protection mechanisms differ substantially among industries and types of firms. In particular, firms active in the service industry are much more likely to rely on speed to market, while SMEs from R&D intensive sectors more regularly engage in patenting. Thus, it is important to recognize that the role of IP management in open innovation is dependent on contingency factors such as the technological environment and the knowledge distribution therein (Alexy et al., 2009). According to these authors, patents are particularly useful in calm environments where knowledge resides with a few players, whereas turbulent environments with distributed knowledge may benefit more from free revealing.

To conclude, IP management plays an important role for SMEs engaged in open innovation, not in the first place to avoid unintended knowledge spillovers, but much more as an accelerator and facilitator of knowledge exchange and partnership formation. However, prior research has been inconclusive on many aspects of the interface between legal IP management and open innovation. Given the preference of informal IP management in SMEs, what is the role of informal means of IP management in open innovation in SMEs? Moreover, do formal and informal means of IP protection perhaps play

different roles for different open innovation practices and in relation to different sources of external knowledge? And if so, when is legal IP protection hindering or enabling value creation and capture? In addition, legal IP protection, secrecy, and free revealing are not mutually exclusive (Arundel, 2001). The case of Collabra Software Inc. depicts that in some cases it may be beneficial to selectively reveal IP (see Case example 3). This raises the question as to what are appropriate IP management practices throughout the innovation process? And how do these affect the open innovation practices? In other words, do SMEs indeed rely on secrecy in the early stages of the R&D process and how does that affect their willingness to engage in open innovation in that stage? Or are there alternative informal mechanisms of appropriation, such as trust and social norms, which allow IP protection and utilization at the interorganizational level even without patenting? Finally, although most of the IP protection debate has focused on manufacturing firms, many SMEs are in fact service firms. Future studies may investigate the specifics of IP management in services SMEs. IP management in open innovation in SMEs is a great area for research with manifold and exciting research questions that haven't been explored yet.

CASE EXAMPLE 3

Collabra Software Inc. was a US based software company, founded in 1993 and acquired by Netscape in 1995. Collabra's main product, CollabraShare, allowed users to organize and share information in electronic forums, and thereby to jointly create and edit documents. During the first year after the company was formally founded, Collabra primarily used NDAs as a way to protect its intellectual property. The advantage of doing so is that it was able to operate low profile until the release of its first product. Moreover, while Collabra was particularly open to its customers and third-party developers, it was much more reluctant to share information with analysts and competitors. Having customer to buy the product and third party developers that created products that were complementary to Collabra's offerings is of course essential to enhance to value of the company. On the other hand, sharing information with Lotus Notes (their main competitor) and Microsoft was less straightforward as they didn't want to reveal their product just yet. However, in order to compete successfully with Lotus Notes, Collabra needed an ally and therefore decided to approach Microsoft, again using an NDA to protect its IP. Collaborating with Microsoft allowed Collabra to gain marketing presence and publicity, and three months later they introduced their first product, CollabraShare to the market. In the case of Collabra, they decided to selectively reveal their knowledge to attract partners that were needed to successfully compete against Lotus Notes.

Source: Chesbrough, 2006a.

7.3.4 Theme 4: The Internal Dimension: Managing Open Innovation in SMEs

Open innovation poses new managerial challenges—not just for large firms but also for SMEs. Indeed, firms that shift from closed towards open innovation experience several difficulties in actively managing the open innovation processes (Lichtenthaler, 2011). Today many firms, including SMEs, still rely more on a trial and error process rather than established organizational practices to manage open innovation internally (Gassmann et al., 2010). Both scholars and practitioners agree that open innovation requires new internal capabilities (Chiaroni et al., 2011; Laursen & Salter, 2006; Spithoven et al., 2010). Existing discussions highlight two facets of such internal organizational capabilities. On the one hand, it is crucial to understand the internal organizational practices, systems and routines for managing open innovation and related knowledge flows in SMEs. On the other hand, the transition from closed towards open innovation implies some kind of organizational change which usually spans different phases (Chiaroni et al., 2011; Teece et al., 1997). It is also important to understand how SMEs can manage the transition from closed towards open innovation, which we assume is quite different from that of large firms. As we discussed above, open innovation in SMEs is regularly directly linked to the business model and implies a strategy change.

The first perspective links back to the seminal work of Cohen and Levinthal (1990) on absorptive capacity. Firms require the ability to absorb external knowledge in order to benefit from it (Cohen & Levinthal, 1990). Absorptive capacity is a pre-requisite for inbound open innovation and is built through formal R&D. In line with this argument a range of studies on inbound open innovation, and especially on sourcing of external knowledge, indicate that inbound open innovation activities do not substitute internal R&D; rather they are complementary (Dahlander & Gann, 2010; Laursen & Salter, 2006); In SMEs, R&D is usually not a formal process; however, formal R&D seems to impact the SME's ability to profit from open innovation (Huang & Rice, 2009; Spithoven et al., forthcoming). Given their limited resources, SMEs may also call upon third parties to support them in building absorptive capacity, such as collective research centres (Spithoven et al., 2010).

Even though absorptive capacity is important for open innovation, it concentrates on using external knowledge internally only and neglects other important organizational capabilities which are required in open innovation; neither does it address all dimensions of managing knowledge flows in open innovation, nor does it acknowledge the distributed character of knowledge in open innovation. For example, absorptive capacity does not capture the specifics of outbound open innovation. It also does not address the question of how to apply innovative knowledge and means to turn it into successful outcomes (Bianchi et al., 2010; Robertson et al., 2012). Recent theoretical contributions

propose additional capacities (groups of capabilities) for managing different knowledge processes in open innovation, which complement the construct of absorptive capacity (Lichtenthaler & Lichtenthaler, 2009; Robertson et al., 2012). While there are new knowledge capacities required for managing the acquisition and retention of knowledge at the intrafirm and interfirm level, open innovation also implies new capacities for applying knowledge, and turning external and internal knowledge into successful outcomes. Examples of such knowledge capacities for managing open innovation are accessive, adaptive, and integrative capacities (Robertson et al., 2012). Further, these knowledge capacities do not function “automatically” and therefore firms need some sort of a higher order capacity to guide these capacities; thus, *knowledge management* and *innovation management* capacities represent relevant “facilitators” for open innovation in SMEs; however, they are regularly lacking in SMEs (Brunswick & Vanhaverbeke, 2010; Robertson et al., 2012; van der Meer, 2007).

To establish such knowledge and managerial capacities, SMEs require new systems, processes, and routines (Huizingh, 2011; Pavitt, 2002). For example, SMEs may establish new processes for inbound open innovation to manage knowledge integration as proposed by Wallin and von Krogh (2010) in their five-step model, namely (1) define the innovation process, (2) identify innovation-relevant knowledge, (3) select an appropriate integration mechanism, (4) create effective governance mechanisms, and (5) balance incentives and controls (Wallin & von Krogh, 2010).

However, innovation is organizationally pervasive and therefore the required innovation management capacity relates to different managerial levels such as the strategic, the operational, the cultural and the network level (Adams et al., 2006; Müller-Stewens & Lechner, 2005). Particularly the network level is an important one in open innovation in SMEs (Gardet & Fraiha, 2012; Vanhaverbeke, 2012).

In addition, capacities are usually perceived as organizational and collective-level constructs. To shed light on those, it is inevitable to study their microfoundations and the underlying intentional actions, experiences and preferences of *individuals* (Felin & Foss, 2009). Open innovation may require new individual skills and may be supported by preferences and interests of different individuals and groups within and outside the organization.

Given the importance of internal knowledge and managerial capacities in open innovation, a range of questions emerge related to the SME sector. Besides absorptive capacity, what organizational capacities—including knowledge and managerial capacities—are required in open innovation? What kinds of capacities are required for open innovation in low-tech and process innovation in SMEs? What managerial systems, processes and routines support these capacities? Given the resource constraints of SMEs, how can SMEs embed organizational routines and practices for open innovation

within their existing organization routines? What are the microfoundations of such organizational capabilities and what individual skills and interactions build required capacities?

The second perspective of managing open innovation in SMEs is about the transition from closed towards open innovation over time. As highlighted in prominent case studies on large firms, such as the case study on Procter & Gamble, this transition implies significant organizational change and transformation (Huston & Sakkab, 2006; Dodgson et al., 2006). Regularly, a first open innovation project triggers a more fundamental and strategic change (Gassmann et al., 2010). Chiaroni et al. (2011) describe the change process from closed towards open innovation, highlighting the important role of the top management in enabling the change and the need for a champion promoting the change along different managerial levels. Further, they show that in large firms the starting point of the transition is a change at the organizational structure level. The establishment of a new independent open innovation unit (or role) represents an important trigger for change and sends signals to other organisational units (Chiaroni et al., 2011). In SMEs there might be different triggers. For example, in the small software firm CAS, a strategic engagement

CASE EXAMPLE 4

CAS is market-leader in the field of customer relations management (CRM) software for SMEs in Germany. The company was founded in 1986 and employs approximately 430 people today. In recent years it has won numerous innovation awards and has shown a constant and double-digit growth in sales over the last years. Recently, the company has successfully transformed itself from a closed towards an open innovator. Along this journey it went through five different phases of change in open innovation: In the first phase they established R&D partnerships with universities and research organizations. In the second phase, management started to strengthen collaboration with other partners including firms offering complementary products and services, sales partners, and also competitors. The third phase was about formalization of routines and managerial systems supporting open innovation. They established structures for managing open innovation and related knowledge flows including new roles and functions such as “network promoters,” and implemented an information system structure for open innovation. Today, CAS can be described as a “platform player” which builds upon a modular organizational design to best align its business model with the business model of their innovation and value chain partners. The case highlights the role of innovation management capacity in integrating different knowledge flows in open innovation and turning them into a successful outcome. It also underlines that the transition is directly linked to the changes in the business model.

Source: Brunswicker and Ehrenmann, (2013).

in R&D partnerships with universities represented a starting point of the transformation which was linked to a business model change (see Case example 4). This provokes research questions for studying SMEs in particular: What triggers the change towards open innovation in SMEs? What managerial levels are affected by that change and in which sequence? What internal factors enable the various change phases and what is the role of entrepreneurship in enabling change? And how are the change and transformation activities different from those in large firms? How does the change process interplay with the changes of the SME's business model?

7.4 CONCLUDING REMARKS

Open innovation in SMEs is an exciting and promising area of research. The sector is of high economic relevance and SMEs increasingly adopt different types of open innovation practices. However, utilizing and managing open innovation in SMEs is quite specific in nature. For example, in open innovation in SMEs different kinds of network relationships play an important role. Thus, SMEs require capabilities for managing these network relationships, which they regularly don't have and which are different from those of large firms. However, this is just one facet of the specific nature of open innovation in SMEs.

Today, we have only marginal insights into the specific nature of open innovation in SMEs and there are manifold research questions to be explored. We proposed four research topics with manifold research questions to stimulate future open innovation research. At this stage it is too early to draw any conclusions related to potential outcomes of research in these four research areas. Further, we don't proclaim that they address all relevant research topics and questions on open innovation in SMEs. For example, we did only marginally touch upon specifics of open innovation in subpopulations of the SME sector such as SMEs in the services sector, venture capital backed growth-oriented start-ups, SMEs in the emerging markets, or export-oriented SMEs (Wynarczyk et al., 2013). There are great opportunities for exploring the specifics of open innovation in these subpopulations. Thus, we invite future research to build upon and extend our proposed research questions within our four research topics, or even propose an additional one.

We would like to see both theoretical and empirical research to address open innovation in SMEs. Empirical research, in particular, will help us to gain a deeper understanding of open innovation in SMEs. However, implementing empirical research comes with significant challenges, especially quantitative ones. Firm-level data on SMEs are difficult to access, and survey-based research methods are not easily implemented. Further, cross-sectional data

will not allow researchers to answer questions related to the change and transition processes within open innovation. For some questions, only longitudinal analyses of SME case studies may allow a “deep dive” into the specific nature of open innovation in SMEs. Overall, we are convinced that research on open innovation in SME will benefit open innovation scholars as well as researchers from adjacent domains such as entrepreneurship, small business, and innovation policy research.

NOTES

1. Referring to the official definition of SMEs laid down in the European Commission Recommendations 2003/361/EC, they employ fewer than 250 employees. In addition to the headcount ceiling, an enterprise “officially” qualifies as SME if it meets either the turnover ceiling of less than € 50 million or the annual balance sheet ceiling € 43 million but not necessarily both (European Commission, 2003).
2. We performed a literature review by searching scientific database on publications relevant to this chapter. Further, we also added working papers, book chapters, and reports which considered as relevant
3. <http://www.tampabay.com/news/business/workinglife/article1163254.ece>