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Drivers of and barriers to networked commercialization: A business model perspective

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Abstract: The purpose of this study is to adopt a business model lens to identify and analyze key drivers of and barriers to the networked commercialization of technology (NCT). The study contributes to commercialization literature by illustrating the usefulness of the business model lens for analyzing networked commercialization. The results of the empirical case study of a company developing disruptive nanotechnological solutions for mass production identify key drivers of and barriers to business model decisions in the NCT. The results show that the tasks and activities involved in the NCT and business model development are connected to others operating in the business network.

Keywords: technology commercialization; network; business model; resource; value proposition; value creation; value capture; venture; qualitative case study.
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Technology commercialization (Chesbrough, 2003; Medlin and Törnroos, 2015) is an activity that often transcends the boundaries between corporate clusters and industries and, thus, has the potential for promoting the emergence of new and successful businesses (Hamel, 2002; Kim and Mauborgne, 2005; Zahra and Nielsen, 2002). Technology commercialization is challenging, particularly in the early phases of technological innovation (Gans and Stern, 2003; Hellman and van den Hoed, 2007). The absence of market orientation (Lo et al., 2012), non-spiral product development, inability to attract and retain partners and high risks (Belcher et al., 2013) may impede commercialization efforts. Scholars have called for research on how external opportunities and sources can be fitted with internal technologies and competence (Chesbrough, 2010; Zahra and Nielsen, 2002).

This study addresses technology commercialization from a business network perspective. Previous studies on business networks and commercialization have focused on the main external contributors to commercialization (Aarikka-Stenroos et al., 2014), the exploration and exploitation of network relationships (Medlin and Törnroos, 2015), resources (Aarikka-Stenroos and Sandberg, 2012), actors’ disalignment processes (Mattila, 2017) and interests and sensemaking among managers (Medlin and Törnroos, 2014). Networked commercialization emphasizes the complexity of the technology commercialization process (Kirchberger and Pohl, 2016; Pellikka and Virtanen, 2009; Zahra and Nielsen, 2002) and the heterogeneity of business networks (Aarikka-Stenroos et al., 2014; Mattila, 2017; Medlin and Törnroos, 2015). This study contributes to this line of research by examining the networked commercialization of technology (NCT) from the business model perspective. This perspective examines the ways by which value for customers (and network partners) and value for the enterprise (Amit and Zott, 2001; Casadesus-Masanell and Ricart, 2010; Day and Moorman, 2010; Teece, 2009; 2010) are created in the NCT.

This study presents a longitudinal qualitative case study of a Finnish technology venture firm, Avantone Ltd., that was seeking to create mass-produced printed nanotechnology solutions (for a definition of nanomaterials, see European Commission Recommendation 2011/696/EU, OJ L275/39). Business model decisions were examined over a period of four years from 2004 to 2007, the lifespan of the enterprise. The results of the analysis identify key drivers of and barriers to business model decisions in the NCT.

The paper is structured as follows. In the next section, literature on the NCT is reviewed, and a business model perspective on the NCT is introduced. Then, the case study methodology used in
this study is described, business model decisions made in the case firm are outlined and the analysis of the drivers and barriers related to the decisions is presented. The paper concludes with a discussion on inside-out and outside-in thinking in creating business models.

2 Theoretical framework

2.1 The networked commercialization of technology

The NCT as a concept refers to a set of actors and the relationships that connect the actors (Fombrun, 1982), and to the process during which an idea (of a new technology) is advanced into a commercial (exploitable) application (Chiesa and Frattini, 2011; Pellikka and Virtanen, 2009). The concept suggests that the NCT, or ‘a network for commercialization’ (Aarikka-Stenroos et al., 2014), involves an extensive group of actors whose ongoing interaction and network relationships contribute to the commercialization of an invention. The actors participating in an NCT include those who create a market for a new technology and facilitate its further adoption (e.g. universities, government bodies, intermediary companies and policymakers), those who provide funding (investors), those who make the innovation available to users (distributors), those who increase its use through licensing (suppliers and manufacturers), those who build awareness (media) and those who use or consume the developed advances (users and customers) (Aarikka-Stenroos et al., 2014). Thus, the networked commercialization encompasses circumstances and activities that shape both the hardware and the people involved in the process (Baraldi et al., 2011; Garud and Karnøe, 2003; Garud and Rappa, 1994; Sydow et al., 2012). This contrasts the more simplistic views on innovation (for a detailed discussion on linear models of innovation, see Balconi et al., 2010) and the view of technology evolving on predetermined paths irrespective of human action (Dosi, 1982).

In the NCT, inter-organizational links provide cost savings through increased productivity or technical efficiency (Håkansson, 1987), access to resources (Aarikka-Stenroos and Sandberg, 2012; Medlin and Törnroos, 2015), the improvement of position in the market by pooling complementary skills (Eisenhardt and Schoonhoven, 1996), and learning new skills (Powell et al., 1996). In inter-firm interaction, many kinds of resources can be combined in ways that create value for key actors during innovation and commercialization (Håkansson and Waluszewski, 2007). Simultaneously, firms may face many managerial (inter-firm relationships are difficult to manage), organizational
opportunistic behavior, asymmetric power relationships and loss of flexibility), financial (lack of venture capital support) and technology-specific challenges (immaturity and application diversity), during technology commercialization (Hellman and van den Hoed, 2007; Pellikka and Virtanen, 2009; for a review of the potential disadvantages of inter-firm networks, see Barringer and Harrison, 2000). For instance, a study of small technology-based firms showed that commercialization challenges, such as lack of support and development services provided by local institutions, a failure to acquire and allocate marketing resources and a failure to mobilize financial resources, resulted in inadequate inter-firm relationships (Pellikka and Virtanen, 2009).

2.2 The business model concept in understanding the NCT

Business models have populated strategic management literature. The business model concept has been used to denote, for instance, the way companies create business (Chesbrough and Rosenbloom, 2002; Magretta, 2002), a reflection of a firm’s realized strategy (Casadesus-Masanell and Ricart, 2010) and a company’s core logics and strategic choices for creating and capturing value (Shafer et al., 2005). In technology innovation/commercialization and management literature, the business model concept has been described as a means for a firm to commercialize innovative ideas and technologies, or as a new way of engaging in innovation activity (Lubik and Garnsey, 2016; Zott et al., 2011). For example, Chesbrough and Rosenbloom (2002) and Chesbrough (2010) demonstrated that business models have an important mediating role between the value potential embedded in new technologies and the economic value created in the market. Interestingly, the literature on (nano)technology commercialization has provided contradictory results on whether technology commercialization should follow the product market or a collaboration strategy (Fielder and Welpe, 2010; Gans and Stern, 2003; Maine, 2013; Maine and Garnsey, 2006). There is evidence that a licensing business model provides value potential in terms of increased productivity of research and innovation processes (increased technological opportunities), but it simultaneously delays the processes of innovation and commercialization because firms are compelled to test how their licensed ideas work in practice (Gambardella and McGahan, 2010).

Despite years of research, scholars have continually argued that the business model concept lacks generally accepted terminology, theoretical grounding and clear boundaries (e.g. Chesbrough and Rosenbloom, 2002; DaSilva and Trkman, 2014; Ritter and Lettl, forthcoming; Zott et al., 2011). In addition, business network researchers have criticized the concept for its emphasis on a firm-centric view over that of a business network view (Bankvall et al., 2017; Palo and Tähtinen, 2013).
Researchers have also called for more investigations into frameworks that fundamentally link business models with technological innovation, but allow for creative managerial action (Baden-Fuller and Haefliger, 2013).

In this study, we adopt an instrumental perspective on business models (Doganova and Eyquem-Renault, 2009). This means that we utilize the business model concept as an analytical tool to examine value creation and capture aspects within the NCT, especially regarding the identification of the key drivers of and barriers to it. We apply Johnson et al.’s (2008) well-established work, where a business model is defined as a combination of the following: (1) value-creating resources, (2) value-creating processes, (3) the customer value proposition and (4) the profit model. Resources refer to key ‘assets such as the people, technology, products, facilities, equipment, channels, and brand required to deliver the value proposition to the targeted customer’ (Johnson et al., 2008, p.53). Processes, on the other hand, include ‘operational and managerial processes that allow [the company] to deliver value in a way they can successfully repeat and increase in scale’ (Johnson et al., 2008, p.53). Examples of such processes are product development, manufacturing and sales, as well as abstract elements, such as the company’s rules, metrics and norms. The development of a customer value proposition involves deciding on a target customer segment, defining the key benefit delivered to the customer (the customer’s ‘job to be done’) and providing the concrete offering (Day and Moorman, 2010; Johnson et al., 2008). Finally, the profit model reflects the chosen value capture logic: the planned revenues, margins, cost structure, the timing of cash flows and asset utilization (Johnson et al., 2008). These four elements reflect the dual purposes of not only creating and capturing customer value but also matching internal resources to external opportunities (Amit and Zott, 2001). This latter perspective emphasizes the concept’s underlying networked and boundary-spanning nature (Nenonen and Storbacka, 2010; Shafer et al., 2005; Zott et al., 2011) and the close relationship to technology commercialization (Baden-Fuller and Haefliger, 2013; Chesbrough, 2010; Gambardella and McGahan, 2010; Lubik and Garnsey, 2016).

Previous research has shown that not only the internal aspects, such as cost structure, but also executives’ observations, assumptions and intuition regarding market opportunities, customer and competitor behavior, as well as internal aspects (cost structure), are all reflected in the selected business model (Amit and Zott, 2001; Casadesus-Masanell and Ricart, 2010; Teece, 2009). Further, executive thinking (evaluating and choosing the company’s business model) can be characterized as either inside-out or outside-in oriented (Day and Moorman, 2010; Saeed et al., 2015). Inside-out thinking dominates contemporary thinking in business and academia. The focus of this approach is
on resources, products, strengths and capabilities, leveraging company-owned assets, improving productivity and maximizing market share as the most important goals of a firm.

In contrast, the outside-in orientation places the markets as the starting point for strategy. What is considered as important is the capability to interpret how customer needs are changing, how competitors are behaving and how customers perceive the firm’s value propositions. With this information, the company can anticipate trends in the market and develop new capabilities and value propositions (Day and Moorman, 2010). The elements of a business model can be analyzed in terms of whether they reflect inside-out (internal resources, processes and cost structure) or outside-in (customer value, strategic partners and networks) thinking (Hacklin and Wallnöfer, 2012). However, a successful business model requires a balance between inside-out and outside-in elements. For instance, in the well-documented case of the camera manufacturer Kodak, the company’s management first overemphasized the internal development of film technology over external signals favoring the rise of digital imaging (an inside-out focus). Later, the management failed to align the business model with the digital trend due to an insufficiently low emphasis on internal rigidities, such as corporate culture, hierarchical organizational structure and high levels of bureaucracy (an outside-in focus) (Lucas and Goh, 2009).

3 Methodology

This study uses a single case study approach (Eriksson and Kovalainen, 2016). This methodology was chosen because it enables generating issue-related data at a specific site and developing theory through the utilization of insights into an empirical network phenomenon and its context (Halinen and Törnroos, 2005). Case-based approaches have been used in business/industrial network-oriented innovation/commercialization research, including the development of radical innovations (Story et al., 2011), networks for commercializing technological innovation (Medlin and Törnroos, 2015) and innovation processes in a technology-based new venture (La Rocca and Snehota, 2014).

The primary data consisted of 11 semi-structured interviews conducted at Avantone Ltd. from 2004 to 2007, and one in 2009. All interviews were conducted in Finnish and were recorded and transcribed verbatim (approximately 222 pages). As the study focus was on the decision-making contents and rationales, filler words such as ‘um’ and ‘you know’ were omitted to improve readability. The first interviews conducted in 2004 focused on the informants’ background and the innovation project, the company’s current state and future prospects and the challenges the informants and company faced during the study period. These interviews were conducted as open-
ended to elicit the actors’ own interpretations of the situation. Subsequent interviews in late 2005
and early 2006, as well as in 2009, were semi-structured to investigate certain themes more
carefully. Such themes were the growth of the activities and company, the informants’ experiences
of acting in and through the network and the company’s future prospects and development ideas.
The secondary data, approximately 100 pages, include the web pages of Avantone and the parent
companies, company presentations downloaded from the Internet, databases related to Avantone’s
activities and reports related to the hybrid media industry. These data were used to contextualize the
interview data.

Four researchers participated in collecting and analyzing the data. A qualitative content analysis
was used to analyze the data (Eriksson and Kovalainen, 2016). The data analysis process was
characterized by inductive and deductive reasoning. First, the researchers individually and
inductively identified key strategic decisions forming the firm’s business model, and then
collectively discussed the findings. The process of analysis resulted in the identification of six key
decisions. Secondly, a deductive orientation guided the analysis. The researchers adopted the
business model lens to analyze the drivers and the barriers to networked commercialization. Finally,
investigator triangulation (Stake, 1995) was used to assess the reliability of the data analysis.

4 The case: Business model decisions in nanotechnology commercialization

Avantone’s business model was formed around six decisions: setting up a corporate spin-off,
defining core competence, creating a networked mode of operation, seeking global brand owners as
the primary customers, engaging in gradual technology development and commercialization and
setting up a dispersed organization (for a more detailed description, see Mattila and Lehtimäki,
2016). These decisions are described next.

4.1 Business model decision 1: A corporate spin-off

The first business decision, which created Avantone Ltd., was to set up a joint venture owned by
three leading companies in three industries: pulp and paper, printing and telecom. After approval
from national and European Union (EU) competitive authorities in the autumn of 2004, 11 experts
mainly from the owner-investor companies and a national technology research center started to
work in the company. All hired experts had a long history of working in the fields of electronics, optics or printing. The owners provided operating resources for 20 months.

4.2 Business model decision 2: Avantone’s core competence

The core competence involved superior technological competence. The firm developed innovative technological solutions to be sold or licensed to other parties. Intellectual property rights (IPRs) were identified as a key strategic element, and several patents were applied for and obtained with partners. The ‘Friends and Partners’ concept was launched to emphasize collaborative technological development with partners and customers. Avantone wanted to demonstrate a core competence of executing development projects for its primary customers.

4.3 Business model decision 3: Networked mode of operations

The strategic plan was to create one large hub (connecting specialists, customers, partners and subcontractors) in Finland and one in Italy. Large hubs in the United States and Japan were also envisioned. Components, knowledge and skills that were not available internally were to be acquired from cooperating parties. Cooperation with external actors was promoted to utilize different resources and competence bases (expertise, tools, machines and various apparatuses) possessed by other companies and firms. Avantone had several cooperative relationships with actors who worked in research institutes and universities and with suppliers and other companies involved in developing core technologies. Some were described as partners, a few as suppliers and some as cooperating organizations.

4.4 Business model decision 4: Global brand owners as primary customers

The global consumer brand owners were targeted as primary customers, not only to pursue profitability through an increased volume of sales but also because these global brands were expected to have the resources to invest in technology development and technology mobilization. The global consumer brands were to be accessed in two ways: directly and indirectly through brand owners’ value chains.
4.5 Business model decision 5: Gradual technology development and commercialization

A competitive advantage was pursued by engaging customers in the final product development phases. Instead of offering ready-to-use products to potential customers, as the company’s potential competitors did, Avantone’s management chose to approach potential customers with unfinished technological solutions to be further developed in close collaboration between Avantone and the customer. The developed technologies were to be embedded in the customers’ products to serve the customers’ value creation.

4.6 Business model decision 6: A dispersed organization

Avantone’s management acknowledged that the need to combine and integrate cutting-edge expertise was difficult if not impossible to achieve in one physical location in Finland. Therefore, the hired specialists were permitted to choose a preferred location in which to work, and additional expertise was subcontracted. Everyone in the company was also encouraged to establish strong links with other specialists with the skills that were needed.

5 Analysis and discussion

The business model decisions made within the case company concerned financing and resources, core competence, the networked mode of operations, customers, offerings and organization. The rationale behind the business model decisions was closely linked to the strategic goal of engaging in the NCT. Figure 1 illustrates the identified business model decisions (boxes), key drivers of and barriers to the NCT and their links to the adopted business model framework (arrows).
Avantone can be described as a prime mover (Normann, 2001) or a ‘blue ocean strategist’ (Kim and Mauborgne, 2005). The company did not operate according to the rules provided by the business model frameworks built previously, but, instead, intentionally aimed at breaking the industrial boundaries and building a new innovation-based business field emerging from relationships and distinct competence acquired through inter-organizational networking. Capabilities in investment and business planning, together with technological resources, supported the NCT. Despite having large multinational companies as owners and being able to provide business, financial and technical know-how, as a small start-up company, Avantone needed to pool resources from several parties and orchestrate the activities of various contributors. Network partners helped to arrange and coordinate business operations into a novel business model and to achieve a more efficient and broader assembly of resources in providing radical solutions to a wide range of markets.

Thus, the capabilities in managing networked relationships and the strategic management of networks were identified as drivers for the NCT. Medlin and Törnroos (2015) argued that networking relationships are crucial for technology commercialization, as they enable exploiting the current relationships and exploring new ones. Throughout the company’s existence, Avantone’s experts utilized other companies’ resources, tools and manufacturing equipment. The continuous

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**Figure 1** An illustration of strategic business decisions and business model aspects (for more detail, refer to Table 1). *Source:* Research conducted by the authors
need for various resources (e.g. market insight, marketing capabilities, technology resources and financial resources) led to investments in creating and maintaining relationship-specific assets and social capital (Adler and Kwon, 2002). The relationships were mainly grounded in Avantone’s employees’ connections to other specialists in relevant fields. The heavy focus on maintaining the established relationships and the continuous search for new ones provided access to the needed resources and expertise. In addition, relationships enabled agility in decision-making, building cutting-edge expertise, envisioning IPRs and patenting. Finally, the heavy investment in relationships supported the effort to build a strategic mediator position in the field.

Although this case demonstrates a novel type of business model, no business occurs in a vacuum. As Johnson et al. (2008) argued, developing a business model requires a deep understanding of one’s business. This understanding includes a comprehension of the interdependencies amongst different actors, activities and resources, as well as the processes and structures that provide the possibilities, strengths and limitations to develop the business model. Thus, one barrier involves the difficulty of identifying and gaining access to the supplier, partner and customer resources. Further, the network relationships of Avantone’s experts eroded the coordination of parallel resources, the transfer and integration of dispersed and highly technical knowledge and the efforts to build a cohesive culture around the firm with shared norms and rules, as well as overall network management (keeping track of whether the network relationships were formed, maintained and utilized in a proper and efficient manner). The internal and external dispersiveness of the firm made it possible for its members to develop technologies in multiple directions. The generic nature of these technologies also assisted in these efforts. Avantone employed engineering experts who had been induced to join the firm by the offers of opportunities for career development. Consequently, the experts pursued their own interests instead of the firm’s interests, which, in turn, potentially delayed the commercialization of the chosen technological solutions. Thus, another barrier involves the difficulty of building a cohesive culture.

At Avantone, the rationale behind business model decisions involved resource pooling, core competence, manufacturing and profitability. First, the firm was established to spur value from (disruptive) technological innovations. The spin-off provided a complementary resource pool through split ownership. For Avantone, this meant internalizing financial and technical resources, which enabled the firm to advance the core technologies to the commercial end. Second, they also assisted in acquiring superiority in certain technological competences, which were further utilized to establish a key mediator position between technological innovations and the papermaking business. Third, to shorten the timeline between the company establishment and revenue streams,
Avantone overcame its size limitations to attract and retain the needed technical and knowledge resources. The decisions to operate in a networked mode, to build a dispersed organization and to gradually develop and commercialize the technology opened up access to resources and expertise that the firm did not possess internally. These decisions also made it possible to avoid overhead and operating costs and to generate a small cash flow. In some decisions, the existence of capabilities in utilizing distinct and complementary competences and resources owned by other organizations and the willingness of the key resource holders to split ownership were identified as critical drivers.

In relation to competence and business model development, Johnson et al. (2008) emphasized the role of understanding the customers. Brettel et al. (2012) also argued that venture firms can enhance performance by making relationship-specific investments in key customers. However, in the case of Avantone, the established business networking relationships and the search for new ones focused heavily on the technology end rather than on the customer end. The continual investments made in these network relationships thus eroded the functioning of the customer end and limited the understanding of customer value. Nevertheless, efforts were made to get access to customers. These efforts included contacting potential customers early in the process (access to customer needs and resources), recruiting personnel with design capabilities and rearranging the organization to clarify the roles and tasks on the customer end. Despite these efforts, customers remained largely unsegmented and the value propositions continued to be unspecified throughout the study period. These challenges resulted partly from the generic nature of the developed technologies, which were considered suitable for many products and purposes, ranging from product authentication to the means for global brands to invigorate interaction between the brands and their users. The technologies provided such a large number of business opportunities that it was difficult for the engineering experts to effectively envision all the possible purposes of customer use.

Furthermore, Payne et al. (2008) emphasized that every customer segment needs its own value proposition and that it should be developed through interaction and dialogue. In Avantone, the mechanisms for supporting these acts seemed to be unclear or incomplete, blurring the efforts to build customer understanding and marketing capabilities. Avantone’s experts had difficulty envisioning how their upcoming offerings would actually benefit customers and what price would best reflect those benefits. Nonetheless, the Avantone experts tried to generate market and customer insight, including continually contacting potential customers and strengthening established customer relationships. In addition, unlike the initial vision of Avantone’s managers, potential key customers wanted ready-to-use solutions and were not interested in investing in joint technology commercialization. Thus, the critical drivers for the NCT include the marketing capabilities used to
identify and segment potential customers, pricing the offerings and formulating value propositions, while the key barrier is the difficulty of generating market insight.

Table 1 summarizes the business model decisions and the rationale behind each decision, as well as the drivers of and barriers to the NCT linked with each business model decision.

Table 1 Drivers and barriers in a business model for the networked commercialization of technology.

<table>
<thead>
<tr>
<th>Key business model decisions and their rationales</th>
<th>Drivers of and barriers to the NCT</th>
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<tbody>
<tr>
<td><strong>A corporate spin-off</strong></td>
<td>Driver: Willingness of the key resource holders to split the ownership</td>
</tr>
<tr>
<td>To pool complementary resources from multiple parties; to focus only on core competence areas</td>
<td></td>
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<tr>
<td><strong>Defining core competence</strong></td>
<td>Drivers: The use of IPRs and patenting as a profit model; capabilities in managing networked business relationships</td>
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<tr>
<td>Owning the core technology; being a mediator between (disruptive) technological innovations and paper-making business</td>
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<tr>
<td><strong>Networked mode of operations</strong></td>
<td>Driver: Capabilities in utilizing distinct and complementary competences and resources owned by other instances</td>
</tr>
<tr>
<td>Not investing in own manufacturing</td>
<td>Barrier: Difficulty of identifying and getting access to supplier, partner and customer resources</td>
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<tr>
<td><strong>Global brand owners as primary customers</strong></td>
<td></td>
</tr>
<tr>
<td>Economies of scale/profitability; large customers willing to invest in the relationship</td>
<td>Driver: Marketing capabilities to help identify and segment potential customers, price the offerings and formulate value propositions</td>
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<tr>
<td><strong>Gradual technology development and commercialization</strong></td>
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<tr>
<td>Need to prioritize revenue sources; differentiation from competitors</td>
<td>Drivers: Capabilities in investment and business planning; technological resources</td>
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<tr>
<td><strong>A dispersed organization</strong></td>
<td></td>
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<tr>
<td>A need to acquire the best talent and organize distance work instead of recruiting only in one location</td>
<td>Driver: Strategic network management capabilities (including flexibility and commitment)</td>
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<td><strong>Source:</strong> Research conducted by the authors</td>
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</table>
6 Conclusions

This study demonstrates how the business model lens can be used to identify key drivers of and barriers to the NCT. Previous research combining commercialization and business network thinking in the innovation process has largely focused on research and development (R&D) activities (Heikkinen et al., 2007; Möller and Svahn, 2009), with some exceptions (Arikka-Stenroos and Sandberg, 2012; Arikka-Stenroos et al., 2014; Medlin and Törnroos, 2015). This study shows that the tasks and activities involved in the NCT and business model development are closely connected to other parties operating in the business network.

In the case firm, the cooperative relationships and strategy development involved multiple levels. On the one hand, actors in the business network were even-handed, and, on the other, the firm was part of a larger configuration comprising several different networks. In such a setting, the ability to capture and combine several different perspectives in the business model became crucial. In the networked business model design, the roles of the network actors are considered as important as those of the internal members.

This study identifies the key drivers of and barriers to the NCT. The drivers include the existence of distinct and complementary resources owned by collaborators, the willingness of these key resource holders to split ownership in new business, the use of IPRs and patenting as a profit model, capabilities in managing business relationships, managing and envisioning strategic networks, business planning and marketing capabilities. The barriers include the difficulty in identifying and getting access to key resources, generating market insights, balancing cash flows and building a cohesive culture.

The business model was fueled by both inside-out and outside-in thinking (Day and Moorman, 2010). However, the outside-in thinking entered the business model at a later stage, which resulted in an underdeveloped understanding of the value of the technological invention to the potential customers, the difficulties in selecting the target customer segments, pricing the offering and defining the value propositions. In the case firm, the prevalence of inside-out thinking may have been due to the generic nature of the developed technologies in question and the inability of the specialists to anticipate the direction of technology development. The technologies under development and their commercialization were viewed as suitable for several products and purposes, which blurred the understanding of the knowledge and skills needed in the effective NCT.
To conclude, the inside-out and outside-in distinction helps in understanding the need to balance these two orientations. Rather than focusing solely on the internal competences and technologies, an outside-in effort helps to understand and envision the potential partners and customers, their roles and positions in the network and the content of the relationships with them. The benefit is that this way the company can develop value propositions that are relevant to the different network members. However, there is a threat of the ‘Janusian effect’, which means that, although the NCT highlights the importance of engaging in interaction with relevant parties involved in the NCT, the actor diversity and dissimilarity may also simultaneously complicate the management of the NCT (for a similar perspective, see Aarikka-Stenroos and Sandberg, 2012). In the case firm, this was visible in the difficulty of understanding what competences were needed to create, maintain and boost the business network relationships to create value. The strong connections established with the relevant parties (technology developers, customers and suppliers) enabled the firm to maintain and renew its technological superiority and establish an expert (mediating) network position in the target markets. In addition, the firm was able to organize internal and external network-based processes and structures for a networked business model. In parallel with these actions, nevertheless, the management of the case firm reported continual difficulty in assessing whether these networking relationships were properly utilized to develop and commercialize the chosen technologies.

6.1 Managerial implications

Based on the findings, the first recommendation is that technology venture firms should focus on developing abilities to envision and orchestrate efficient business networking relationships. These efforts could include creating a portfolio of inter-organization relationships (Aarikka-Stenroos and Sandberg, 2012), which could also be useful when scouting and enrolling potential newcomers (e.g. customers, suppliers, subcontractors and venture capitalists) in the emerging business network. Also, an assessment of the connections to external parties could promote the firm’s long-term endurance.

Technology venture firms should put more effort into acquiring the capabilities needed to generate market and customer insight. More specifically, they should focus on effectively defining customer value propositions when developing a business model. Avantone failed to efficiently envision and create business networking relationships that would have enabled it to develop a thorough customer understanding to support a continuous creation of new technological solutions.
As a result, customers were not properly segmented, and customer value propositions remained largely unspecified.

6.2 Evaluation and future research

The chosen methodology prevents generalizing the findings. One case is not sufficient to represent all firms and companies operating in the field of nanotechnology. However, the study provides three areas for future research. The first area of investigation is in relation to materiality in the NCT. An important contribution would involve scrutinizing the role of materials in business model creation during the NCT. The work of Akrich et al. (2002a; 2002b) and Williams-Jones and Graham (2010) could be a suitable starting point in these efforts. The second area relates to the cultural dimension of business models that has been neglected in business model research in favor of structure (Amit and Zott, 2001) and processes (Johnson et al., 2008). The third area relates to the adopted inside-out and outside-in thinking. More research is needed to understand the specific inside-out and outside-in capabilities relevant to the NCT. Greenley et al.’s (2005) study could be a useful starting point.

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References


