Chapter 4

R&D-related Capabilities
of Technology Born Globals

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Abstract

R&D-related capabilities are the cornerstone of existence and competitive advantage of a large number of born globals. However, we know very little about the composition and functioning of these capabilities in international SMEs, considering their resource limitations and international competition. This article investigates R&D-related capabilities of technology-based born globals in order to find out the aspects that contribute to their competitive advantage in the long term. A longitudinal case study of a successful Danish technology born global is conducted to address this purpose. Among the findings are the importance of introducing R&D planning and implementation structures, as well as knowledge sharing processes in the organization, the difficulty of sustaining ambidextrous processes, the importance of extensive environmental scanning, as well as ongoing collaboration among different managerial levels and functions.
4.1 Introduction

Rapidly internationalizing SMEs have appeared on markets worldwide and have caused a wave of academic literature in the last decade. Many of these firms are founded on unique technologies and successful products that have resulted from these technologies, as they find application in markets across countries. Differentiation and continuous development of innovative and technologically competitive products for specific market segments is the most viable strategy for international and other SMEs, as they do not have the advantage of scale and scope economies that the bigger firms can have (Aspelund et al 2007; Shrader et al 2000). In the first years of operations, the novelty of their technologies may allow born globals to enter numerous markets and find demand for their products. However, eventually, other players enter the market, and if they happen to be larger companies with bigger R&D and other resource endowments, it becomes very difficult for the born globals to sustain their technological lead. Furthermore, finding the best application fields for a new technology and developing a potentially commercializable business model that is sustainable over a reasonably long time, is difficult. It takes an extensive period of time, and some start-ups never overcome this challenge (Bruno & Leidecker, 1988). Therefore, understanding the aspects that are important to effective functioning of R&D-related capabilities of technology-based born globals is critical for our understanding of the mechanisms that enable long-term competitive advantage of such ventures.

While the importance of R&D and innovation for born globals is widely understood, the academia is only beginning to investigate R&D and innovation capabilities of such firms. ‘International technological competence’ and innovativeness have been found to be among the cornerstones of competitive advantage of born globals (Knight & Kim, 2009). And a ‘global technological competence’ is highlighted as one of the strategies used by them to achieve superior performance in the international markets (Knight & Cavusgil, 2004). However, I was able to locate only one study (Gassmann & Keupp, 2007a) that actually investigates what technological capabilities of born globals might consist of and how they operate. The literature on R&D in SMEs is very useful, however the amount of this literature is also limited, as most of the R&D literature’s legacy written for over half a century has focused on the issues faced by large organisations.
Seeing the need and importance of exploring this aspect of born globals’ operations, the purpose of this article is to investigate the R&D-related capabilities of technology born globals and explain the aspects that are critical to sustaining the firms’ competitive advantage in the long term.

This study is expected to contribute to the R&D literature where I have not found studies dedicated to born globals, and relatively few studies on SMEs. The study also contributes to the born global / international entrepreneurship literature, which has mainly focused on the organizational factors that enable rapid internationalization of SMEs, but is only now beginning to look into specific organizational capabilities that enable long-term competitive advantages of such ventures.

4.2 Conceptual foundations

4.2.1 Born globals

Based on an extensive literature review and in line with the widely accepted definitions (Knight & Cavusgil 2004; Oviatt & McDougall 1994; Gabrielsson & Kirpalani, 2004; Di Gregorio et al 2008; Kuivalainen et al, 2007), I define a born global as a business organization that has achieved international operations within a few years after its establishment through the application of knowledge-based resources to the sale of outputs in and the combination of input resources from multiple countries, including those located beyond the firm’s domestic continent.

Research shows that most born globals are knowledge-intensive or knowledge-based firms – characterised by high value added to scientific knowledge in both products and processes (Bell et al, 2003). They are often based on unique or innovative technologies and/or capabilities. Born globals often operate in B2B markets (Knight et al, 2004; Moen, 2002) and utilize a differentiation strategy aimed at specific market niches, as this approach is more viable for SMEs than aiming for a mass consumer market (Aspelund et al, 2007; Shrader et al, 2000). In some instances, born globals take valuable positions in innovation / R&D value chains of larger organizations by providing highly specialized services and/or technologies to them (Gassmann & Keupp, 2007). The competitive advantage of born globals lies, among other things, in their strong innovative and international entrepreneurial culture (Dimitratos & Plakoyiannaki, 2003;
Knight & Kim, 2009; Knight & Cavusgil, 2004), flexibility and closeness to their customers (Knight & Cavusgil, 2004). Faced with the lack of resources (financial and knowledge) and the lack of economies of scale, born globals develop unique bundles of knowledge-based capabilities, which are derived from the knowledge, innovativeness, skills and experience of individual employees. These organizational capabilities enable effective knowledge and resource integration and create the foundation of competitive advantage of these firms (Knight & Cavusgil, 2004; Solberg et al, 2008).

International technological competence and innovativeness have been found to be among the cornerstones of competitive advantage of born globals. International innovativeness, which is “the capacity to develop and introduce new processes, products, services or ideas to international markets” (Knight & Kim, 2009:261), is one of the composite factors of Knight’s and Kim’s concept of international business competence, which engenders superior international performance of born globals. Global technological competence is a firm’s “technological ability relative to cohort firms in its industry. It facilitates the creation of superior products and the improvements of existing products, as well as greater effectiveness and efficiency in production processes” (Knight & Cavusgil, 2004:130). It is highlighted by the authors as one of the strategies used by born globals to achieve superior performance in international markets. However, in spite of the acknowledgement of the macro-importance of innovation and technological competences, I have only been able to locate one study that investigates R&D-related capabilities of born globals in detail (Gassmann & Keupp, 2007a).

4.2.2 Organizational capabilities

Although the literature is still debating, which organisational components comprise capabilities, studies point to the conclusion that in dynamic market environments, capabilities consist of adaptive semi-structured processes guided by managerial heuristics (Binghman et al, 2007, 2007a). The heuristics develop through the manager’s experience and the learning capability of the organization. Following the argument of Stalk et al that “A capability is a process strategically understood” (1992:62) and building on the work of Grant (1996), Bingham et al (2007; 2007a) and my own research, I define a capability as integration of individual specialized knowledge through dynamic and adaptive organizational processes, guided by a firm’s strategic objectives, in order to repeatedly perform a discrete productive task, which relates either
directly or indirectly to the firm's capacity for creating value through effecting the transformation of inputs into outputs.

4.2.3 The research-and-development related capabilities

An R&D capability is referred to in the literature as “the processes that enable firms to invent new technology and convert existing technology to develop new products and services. Therefore, R&D capability depends on the routines that help a firm develop new technical knowledge, combine it with existing technology, and design superior products and services.” (Krasnikov & Jayachandran, 2008:2) Following Lefebvre et al (1999; 1998), R&D-related capabilities of organizations can be divided into five groups, namely technological knowledge intensity, R&D strategies, R&D collaboration, acquisition of knowledge from various sources of information and management of technology practices. I also add the category of IP management to this list, based on other literature (Gassmann & Keupp, 2007; Pisano & Teece, 2007; Kitching & Blackburn, 1998).

*Technological knowledge intensity:* normally, the percentage of employees with technical and scientific backgrounds represents a good indicator of technological knowledge intensity and is viewed as a crucial R&D-related capability (Lefebvre et al, 1999). Technology-based SMEs direct specific efforts to hiring and retaining engineers and scientists with the skills critical to the firm’s business. A lack of resources to hire a sufficient number of qualified specialists often inhibits an SME’s ability to identify, use and assimilate external technical information (Rothwell & Dodgson, 1991).

*R&D strategies:* R&D is clearly firm-specific, and R&D investment is only one and a non-comprehensive determinant of success of a firm’s R&D efforts. Even if SMEs make similar levels of investments in R&D, they still differ in the extent, to which they are able to respond effectively to technological change (Nicholls-Nixon, 1995). The way a firm chooses to invest its R&D funds corresponds to its R&D strategies, the broad classic ones being basic research, applied research, product development, process development and improvement of existing products and processes. Improvement of existing scientific and technological assets can be considered a sixth broad strategy, as discussed in the literature on technological change, which emphasizes the cumulativeness of technology, knowledge and competences (Lefebvre et al, 1999).
**R&D collaboration:** collaboration with various network players is said to be one of the cornerstones of R&D-related capabilities of technology-based SMEs and born globals, as they suffer from resource limitations and need support in product development and application of their technologies into finished products (Freeman et al, 2006; Mort & Weerawardena, 2006). The choice of R&D partnerships varies substantially, and the following types of partnerships are defined in the literature: business to business - with customers, competitors and/or subcontractors (Kleinknecht and Reijnen, 1991); university to business – with academic and research institutions (Acs and Audretsch, 1992); and government agency to business (Roessner and Bean, 1994).

**Acquisition of knowledge from different sources of information:** according to Lefebvre et al (1999), the extent of use of R&D information from various sources corresponds a critical capability and reflects the absorptive capacity of the firm (Cohen & Levinthal, 1990). This is the ability to evaluate, assimilate and apply external and internal knowledge to commercial ends. The literature (Caloghirou et al, 2004) highlights the importance of a firm’s ability to acquire knowledge from external sources and its absorptive capacity to the firm’s innovation capability. Innovation can be understood as a process, in which an organisation creates and defines problems and then actively develops new knowledge to solve them. In this context, individuals and firms may need external sources of cognition and competence to complement their own. Firms also need inter-organisational linkages in order to convert both external and internal knowledge into new types of knowledge and develop new products, processes or services (Caloghirou et al, 2004; Nonaka, 1994; Nonaka and Takeushi, 1995). According to Cohen and Levinthal (1990), a firm’s internal R&D expertise and investment into the qualifications of its R&D personnel have a considerable positive effect on developing the firm’s absorptive capacity and being able to assimilate and convert external knowledge and information into new products, processes and services.

In a study of British SMEs (Lambert & Barber, 2000), most firms stated their internal competences as the main source of innovativeness and performance. Internal organizational sources of knowledge mainly comprise various functional groups, namely R&D, marketing, production and finance (Lefebvre et al, 1999). Nevertheless, the SMEs also actively used the following external sources of innovation (listed here as ranked by the SMEs): 1) vertically linked firms – suppliers and customers, 2) knowledge pools: patents, trade fairs, exhibitions, trade associations and legislation, and 3) the science and
engineering technology base comprised of universities, research councils, research associations and technology intermediaries. A study of Norwegian small knowledge-intense firms (Jenssen & Nybakk, 2009) has shown similar sources to be important.

Management of technology capabilities can be grouped into six separate, but complementary dimensions (Lefebvre et al, 1999; based on Burgelman et al, 1988 and Lefebvre et al, 1997). These represent dynamic capabilities, which reflect an organization’s ability to continuously innovate, renew its operational capabilities, learn, adapt and change over time (Teece et al, 1997). The six dimensions are: a) technological scanning: assessing the technological environment through a capacity to identify, analyse and predict competitors’ technological strategies, and a capacity to conduct technological forecasting. b) Integrating technology within the firm through the capacities to integrate new technology, share technological competencies among different functional groups (marketing, R&D, production, etc.), and develop concurrent engineering. c) Intrapreneurship: dealing with entrepreneurial behaviour inside the firm through a capacity to identify and evaluate entrepreneurial initiatives in the business unit and a capacity to fund unplanned but potentially profitable activities. d) Planning technological development, through a capacity to elaborate a long-term strategic technology plan. e) Implementing and managing change through a capacity to involve all hierarchical levels in the organization, a capacity to direct R&D efforts towards the strategic orientations of the firm, a capacity to develop new technological capabilities, and a capacity to manage change imposed by new technologies. Finally, f) commercialization: profiting from innovation through a capacity to commercialize products/services.

IP protection and management is the sixth R&D-related capability. It is not included into the discussion by Lefebvre et al (1999), but is discussed elsewhere (Pisano & Teece, 2007; Kitching & Blackburn, 1998) as critical to a firm’s R&D strategy and activities. Gassmann & Keupp (2007) have stressed the importance of IPR protection to internationalization of born globals. The unique technologies that born globals and other new technology-based firms (NTBFs) are based on require protection. In their collaborative product development with larger partners, born globals must disclose their technologies, which opens a way to the possibility of opportunism and appropriation of the technologies by the partners. Nevertheless, studies of SMEs (Kitching & Blackburn, 2003; Blackburn, 2003) show that SME managers often do not protect the firms’ innovations through legal mechanisms due to the lack of
expertise and resources (both financial and human) to file patent applications and conducting other IP protecting activities, scepticism about the possibility of enforcing litigation in case of infringement due to the lack of financial resources, preferences to direct their resources to other purposes, i.e. R&D work instead of patent writing, and unwillingness to disclose the content of their technologies in formal patent applications. SMEs with higher R&D intensity are more likely to apply legal IP protection mechanisms. Many SMEs prefer to protect their intellectual capital with ‘informal’ means: by using ‘factual’ means, i.e. secrecy, or high complexity of developments (Gassmann & Keupp, 2007), maintaining the lead time ahead of competition by bringing new products/technologies to the market faster (Blackburn, 2003; Matthews et al, 2003), developing high trust with network partners (Blackburn, 2003), or through contractual agreements.

The empirical study in this article is guided by the above dimensions of the R&D-related capabilities found in the literature. The article is structured as follows: methodology is discussed next, followed by the empirical study, where the various aspects of R&D-related capabilities of the case born global venture are discussed. The main findings are deliberated upon in the Discussion and Conclusions section.

4.3 Methodology

In order to closely study specific organizational capabilities, I have conducted a longitudinal process case study of one successful Danish technology-based born global. I spent 20-70 percent of my working time at the company’s premises as an Industrial PhD student and a marketing communications trainee over the period of 3 years (2007-2010). I had an opportunity to closely observe nearly all aspects of the firm’s operations, participate in strategic meetings, discuss various issues with the firm’s managers and engineers. The overarching philosophy of science in this study has been critical realism, and the analytical approach has been iterative (Easton, 2010; Langley, 1999): I conducted the study following the theoretical framework and then used the insights from the empirical findings to enrich the framework and make it specific for technology born globals. The main source of data has been participant observation and a series of semi-structured interviews that have focused on specific aspects of the firm’s operations. In total, 20 interviews have been conducted with 11 firm members including top managers, R&D project managers and specialists,
technology marketing- and regional development managers. The interviews lasted 1-2 hours each. Additional sources of data were the company literature and industry- and mass media publications. These various methods of data collection allowed for data triangulation (Yin, 2003). The data were analyzed using narrative analysis (Bryman & Bell, 2003; Langley, 1999), time lines, content-analytic summary tables (Miles & Huberman, 1994) and explanation building techniques (Yin, 2003).

4.4 The empirical study

4.4.1 DBG, the case company

The case firm is a Danish technology born global, here code-named DBG. The firm was founded based on innovative technologies in switching / Class D audio amplification. It was established jointly by the founder – the author of the technologies, and an established Danish electronics manufacturing firm (further – ‘mother firm’), while becoming its independent subsidiary. DBG develops B2B audio amplification solutions: the electronics core of audio devices, which consists of an amplifier, power supply and (in some cases) digital signal processing. The firm operates in B2B markets of consumer and professional audio, mobile and automotive audio applications. The nature of DBG’s customers defines the firm’s geographic markets, which are mainly North America, Western Europe, Japan and Korea. In the 1990s, DBG was one of the companies that started a radical shift in the audio industry from the traditional analogue amplification techniques (used since 1930s) to the much more efficient Class D/switching technologies. DBG currently employs ca. 30 people, has its HQ in the Greater Copenhagen area and regional offices in Tokyo and Chicago.

4.4.2 Technological knowledge intensity

DBG’s business is technology, hence its critical production resource are highly educated and specialized engineers. DBG was founded by engineers, and the percentage of engineers in its staff has always been 70 percent or above. While having its original home at the mother firm’s facilities, after one year, the founder moved DBG into the Greater Copenhagen area, closer to the country’s business centre and into the immediate proximity of the Danish Technical
University in order to have access to some of the country’s brightest minds in the scientific and technological fields that DBG operates in. The university’s department of power acoustics is one of the leading in the world. Most of the firm’s engineers are true enthusiasts of their profession and have a great interest in audio. Many of them first joined DBG as students and conducted their degree projects with the firm.

Since its early days, DBG has been closely involved in academic collaboration with the university and has had a number of Bachelor, Master and PhD students writing their degrees and taking courses with the firm. In the early days of the firm, its R&D strategy was more explorative and students were welcome to explore the application of the switching technologies in new fields. As a result of one such Master thesis, an audio chip for mobile applications was developed. Currently, the firm follows a leaner strategy, where students’ projects are brought into correspondence with the firm’s R&D needs, and they typically work to enhance the firm’s existing technologies. DBG’s engineers supervise the projects.

As for personnel development, the engineers are welcome to write (and have published a number of) scientific papers and participate in conferences, although the recent economic recession has put a strain on the firm’s resources, including the engineers’ time.

4.4.3 R&D strategies

DBG’s founder had a very big vision for the firm: “Becoming the Intel of audio applications”. In its early years, DBG went through an exploration process where the original engineering team was looking for viable application of its technologies. The first products were high-power amplifiers. The product range eventually expanded to include a number of “Plug&Play” designs. They carry a significant benefit for consumer audio manufacturers due to the general difficulty of incorporating switching technologies into end products. DBG’s solutions help to solve this challenge. The original R&D strategies were very much exploratory, the direction was grasped through numerous meetings with customers, visiting trade fairs and finding out, where the firm’s technologies could have the largest impact and where the products could be profitable. Often, a decision to expand into a specific market was based on a large customer collaboration or contract. After developing a customized solution, the firm
developed another, independent version of the product for its own independent sale.

However in 2008, after a critical change in the firm’s ownership and the founder leaving the firm, the updated management team has changed the firm’s approach to strategic and R&D planning. R&D planning has become structured, following specific selection procedures. It is discussed in section 4.4.6 “Management of technology practices”.

4.4.4 R&D collaboration

DBG has always actively pursued collaborative R&D strategies in order to reach specific product markets where it did not have enough resources to develop a product or compete on its own. In the pursuit of various semiconductor application markets (consumer audio, automotive audio, mobile audio), DBG looked for MNE partners with enough engineering, equipment and manufacturing resources and a good standing in the specific market to collaboratively develop a product, which would have strategic and financial benefits for both firms. From its side, DBG offered its unique, patented technologies and engineering services. Due to the novelty and high performance of its technologies and intelligent marketing on part of the management (discussed further down), DBG was able to obtain very beneficial collaborations with some of the largest players in the mobile phone, consumer audio and automotive audio industries and was able to successfully enter two of those markets by developing innovative products together with the MNEs. The collaboration with the automotive audio MNE did not go successfully due to inadequate project management from both sides. A lot of credit must be given to the founder and the CEO of DBG, who were able to develop appealing business cases to each of the MNEs and ‘sell’ them the idea of these collaborations, which were extremely beneficial for DBG both in financial and strategic terms.

4.4.5 Acquisition of knowledge from various sources of information

The firm continuously scans its markets and the wider technological environment through reviewing the following sources: 1) patent databases, 2) specialized industry publications and relevant mass media, 3) visiting key trade fairs in the markets of interest, 4) attending professional and scientific conferences, 5) discussions with existing and potential customers, 6) being in
dialogue with the world’s leading electronics manufacturers and technology trend setters, i.e. Apple. These companies have a strong influence on future development of global technology and product applications. According to the interviewees, being in contact with them provides DBG with very valuable information. An important aspect of this process is that the top managers, sales & marketing managers, and senior engineers often visit trade fairs and customers together. So they are exposed to the same scope of information and develop a common vision of the ongoing international technological development. The small size of the firm and a single location of most of the employees provide a forum for an ongoing discussion, and the collaboration between the R&D, marketing personnel and top management is continuous.

4.4.6 Management of technology practices

In an SME, some of the separate dimensions of managing technology practices discussed in the literature happen through the same processes and are difficult to separate in reality. In this way,

a) *Technological scanning* in the case firm happens through the sources discussed in section 4.4.5.

b) *Technology integration* happens through the continuous common marketing activities and an ongoing dialogue between the top management, R&D, marketing and sales personnel. There are no separate business divisions in DBG, and all the departments and project teams seat on the same floor. Information exchange happens continuously. Besides the informal, there are formal forums for information exchange: whenever a new product is developed, a new project is initiated or an engineering error is encountered, a general company meeting is called and the information is shared. All of the engineering developments since the firm’s establishment are kept in an online database, to which each engineer has access at any time.

c) *Planning technological development*. DBG’s top management (consisting of a CEO, CTO (Chief Technical Officer) and COO (Chef Operations Officer)), and with participation from the technology marketing manager and regional sales & marketing managers develop the firm’s R&D roadmap based on: 1) general industry information collected through the environmental sources listed above. Individual customers are highly specialized and knowledgeable in their own
markets, but often do not see a larger picture of the global technological development, i.e. a merger of various media and an emergence of new technologies and standards, i.e. Wi-Fi for audio and video products. Therefore, continuous scanning of the wider environment and being in contact with the largest technology trend-setters is very important. 2) Being in close dialogue with customers. Due to a long-lasting collaboration and trust developed between DBG and its customers, some of them perceive DBG as a strategic partner and disclose their product development roadmaps to the firm. Thereafter, DBG can come up with technological developments and product proposals to suit the customers’ roadmaps. 3) Considerations based on DBG’s existing products. Nonetheless, the key source of knowledge and product ideas is the firm’s own engineers and managers. They are highly qualified specialists, have the detailed knowledge of the firm’s technology and products and, considering the environmental information, know how the firm’s technologies and products can be improved and which new products can be developed.

A quote from DBG’s CTO:

We follow what is going on with patents related to what we do, and we read technical magazines. Then we, of course, get new ideas from what is going on in the world, from what we see at the exhibitions... All of these you can combine, and then you have to do a lot of thinking. Because it’s not enough just to see what the others are doing, you really have to think yourself, to be better. So you cannot rely on somebody else to tell you what to do. Most of it will have to come from yourself. (Interview 16.12.2010)

DBG applies a structured process where new R&D project ideas are assessed along three parameters: business case, project fitness and strategic importance. Business case evaluates the costs and revenue potential of a project. Project fitness assesses whether a product/project fits the current manpower availability and feasibility of time requirements. Strategic importance evaluates whether and how the project and/or potential customer are of strategic importance to the firm, whether it will lead to development of a platform and/or entering of a new market. The results are evaluated on a weighed scale.

DBG utilizes a structured R&D implementation process using a stage-gate model. A project must be approved or can be stopped at any of the ‘gates’, depending on whether it still meets all of the criteria discussed above. DBG’s EMS (electronic manufacturing services)
partner in China is involved in the product development process from the early stage of product specification in order to ensure the product’s manufacturability and readiness of the manufacturing tools in time for production.

d) *Intrapreneurship.* Anyone at DBG can initiate a project/product idea and submit a project proposal, where the business case, and the customer and market projections are presented. The project is then evaluated by the Product Development Council, consisting of the top management following the structured evaluation process discussed above.

e) *Implementing and managing change.* As discussed, all layers of the firm’s management participate in strategic and tactical discussions in an ongoing manner. Until 2008, however, the firm faced challenges related to the differences in the management styles and strategic priorities between the founder, who had a strongly entrepreneurial personality and business style; and the CEO (who joined in 2005), who is a more professional and experienced manager. The founder’s entrepreneurial management style was strongly driven by the continuously emerging business opportunities, which did not always fit the firm’s planned resource allocation. This sometimes led to sub-standard delivery on promises to existing customers and focusing more on obtaining new leads. The tension was eventually solved by the mother firm purchasing the founder’s shares and the founder leaving the firm. After this, the new management team (consisting of the long-term executives, some of whom changed their titles), which is much more uniform in their approach to managing the firm, took the lead. They began applying the structured management rules and processes, which had been present ‘on paper’ since 2-3 years after the firm’s founding, but have not been followed closely due to the founder’s entrepreneurial style. The founder’s leave coincided with the ensuring financial crisis and recession, which made the need for lean and efficient operations ever more apparent.

The new management has focused the firm’s R&D efforts on the markets where DBG had earned a strong standing and a brand name (professional and consumer audio), and has downsized R&D efforts in the markets where it could not compete on its own without support of an MNE (mobile, by then the collaboration with the original MNE partner had finished). For the same reason, the automotive operations
became committed to the mother venture, where the two firms develop complete automotive audio systems together. DBG’s research and development have become very focused, with resources allocated only to the projects included into the firm’s technology roadmap. Purely explorative research, including explorative academic projects, have stopped, as the firm did not have enough resources for it any longer. In general, the firm’s strategic and R&D management has changed from unstructured and highly entrepreneurial, typical for a start-up, to the more formal and structured management principles practiced by more established organizations. Hence, the firm’s capacity to incorporate change, adapt and remain focused on its strategic objectives is embedded in its structured R&D planning and implementation processes. The controlling body that helped to resolve a serious management conflict in the organization was the Board of Directors, which consists of executives of the mother company. At a specific time in the born global’s history, it decided in favour of the professional management practices, instead of the purely unstructured entrepreneurial approach to business. On the other hand, the structured processes for R&D planning are flexible enough, as they allow for intrapreneurial activity on part of employees, and for incorporating suggested projects into the firm’s strategic roadmap. Short communication lines allow for flexibility and responsiveness to customer needs and changes in the environment.

f) Commercialization. DBG was fortunate to receive early help with maturing its technologies into a first product series from the mother company. However, ever since, DBG has been operating and developing its products independently (unless the mother firm was its customer for a project). The firm’s early engineering team rather quickly figured out the product configuration, which enabled the best application of the technologies into customer-friendly integrated Plug & Play solutions (a strong advantage considering the difficulties of incorporating Class D technologies into consumer products). Marketing plays a crucial role in formulating new products: the marketing & sales managers, top managers and senior engineers discover through their marketing trips specific customer needs, and new product development (NPD) projects are planned and specified accordingly. In this way, integration of the market research and marketing activities happens.
When approaching strategic partner projects (i.e. R&D alliances), DBG’s senior managers create a wholesome business proposal that contains strategic interests for all the parties. This requires studying the customer’s existing product line, identifying where DBG’s technologies can contribute to improving it, making a sample product prototype and allowing the customer to appreciate the value added by a DBG solution.

Besides, DBG has paid close attention to building its brand since its early days (following the ‘Intel of Audio vision’). The firm has promoted the brand to its B2B customers using the means at hand, considering that the marketing communications budget was very small. DBG has also pursued promoting its brand to the B2C audience as a component brand using marketing channels of its customers. In some cases, MNE customers, seeing the significant value added by the component product, offered to communicate DBG’s brand on their products and/or in marketing materials. Overall, DBG’s brand has been built mostly through the innovativeness and technical qualities of the products and engineering professionalism of the firm, earning DBG a respected name in the industry. DBG has been considered the reference brand in its technological field for some years now. Furthermore, the firm began receiving revenues for the use of its brand on the customers’ consumer products as a symbol of high audio quality and energy efficiency. The brand has eventually become an important factor in helping to commercialize DBG’s products and technologies.

4.4.7 IP protection and management

DBG has always had an explicit IP management strategy and processes and paid a lot of attention to this area. In the early years, the founder’s strategy was to patent both major and minor inventions in an effort to protect the firm’s innovative technologies from being copied. However, due to the rising costs of sustaining patents, DBG changed the strategy to a more focused one: to sustaining only the core patents and only in strategically selected markets. Other methods of IP protection are also used, i.e. securing the freedom to operate, and sharing the less core inventions at academic conferences, which then become public knowledge and thus cannot be patented by others. The careful IP management strategy has served DBG well throughout its multiple
R&D collaborations, where its proprietary technologies had to be disclosed to the partners. Only one case of IP infringement has been encountered – by a Chinese firm illegally copying DBG’s products. DBG was prepared to go to court, but pre-empted it by talking to the Chinese firm’s customer (also a Chinese manufacturer), who aimed for the premium market and refused to buy the copied products. The copied products have not been seen otherwise.

1.5 Discussion and conclusions

Following the findings from the empirical study, below I compare them to the discussions found in the literature on SMEs and discuss, which aspects are specific to born globals, and which specific practices related to the R&D-related capabilities could be a source of their competitive advantage in the long term.

*Technological knowledge intensity.* The study has shown the importance of getting the right engineering competences into the firm since its early years. Besides the research specialists, the firm should have development specialists and people with manufacturing coordination experience. Developing a raw product prototype, even a highly innovative one, requires one set of skills, but making a product robust and manufacturable in large amounts and in accordance with all the international standards requires a different set of skills and a lot of experience, as stressed numerous times by the interviewees. Organising effective and smoothly running R&D processes in a firm also requires a lot of knowledge and experience. The findings therefore confirm the discussions of Lefebvre (1999) and Rothwell and Dodgson (1991) about the importance of having the right competences on board of a technology start-up in order to give it a chance for survival and long-term operations.

*R&D strategies.* This study has shown the importance for a born global of understanding its core competencies and the need to preserve, develop and protect them early in its history. Active entrepreneurial activities and the continuous search for new markets may lead the born global into too many markets, where it cannot simultaneously sustain technological leadership and continuous innovation in the face of competition. Previous research has shown that small firms may outsource both core and non-core competencies, which may be detrimental to their business (Sen & Haq, 2011).

The study has also confirmed that a niche differentiation strategy is the most viable one for born globals that develop knowledge-intense physical products or
services. It is very difficult for an technology-based SME with limited R&D resources to sustain innovation leadership in more than one (or a couple of closely related) markets simultaneously on an ongoing basis.

*R&D collaboration* have shown to be a vital and an integral part of the R&D strategies of born globals, confirming the extant literature (Mort & Weerawardena, 2006; Freeman et al, 2006; Coviello & Munro, 1995; 1997). Strategic and well-planned collaborations with MNEs can help a born global to develop its technologies into marketable products, enter into new markets, build a brand, and secure revenue inflow in the first critical years of the firm’s operations. In this way, they can secure the firm’s survival and fund its further R&D.

However, the study has also shown that in the long run, collaborations with MNEs may lead a born global into the markets where it cannot compete on its own once the collaboration with the MNE is over. It is therefore, critical for born globals to make well-considered decisions based on the competitive situation on the market and own resource availability relative to that of competitors, on whether to remain and compete in such a market, or quit it altogether before large investments into independent products are made. MNEs have a different level of R&D resource availability and libraries of existing technological developments that they can build on. Therefore, their time-to-market will be multiple times shorter than those that a born global can offer; and the flexibility of product features offered by the MNEs would be incomparably larger. A born global could compete with MNEs in one or a few related market niches, but in this case, the born global would have to focus its R&D spending on those markets and not spread them broadly.

*Acquiring knowledge from different sources of information:* the study has revealed the high importance of continuous and widely reaching environmental scanning processes for sustaining a born global’s technological competences. External source of information are extremely important for informing internal R&D about the market- and wider technological developments. The sources that can be important are patent databases, specialized industry publications and relevant mass media, the key trade fairs in the markets of interest, professional and scientific conferences, and close contact with the customers. The findings thus confirm those of Lefebvre et al (1999), Lambert & Barber (2000), and Jenssen & Nybakk (2009) as for the importance of external sources of information for knowledge-intensive SMEs. An interesting additional finding is
the importance of being in dialogue with the world’s leading electronics manufacturers and technology trend setters, since they, to a large degree, decide the direction of the future global technological development.

**In managing technology capabilities:**

*Technological scanning and technology integration within the firm.* Besides the aspects discussed above, an important learning that runs throughout the study is the critical importance of the close and continuous collaboration and knowledge sharing between engineering and marketing managers and the top management in marketing processes, environmental scanning, technology strategy development and product planning to the effectiveness of the firm’s R&D-related capabilities. The continuous collaboration leads to a well-informed and unified perspective on the development of international technology markets among all the key decision makers. The ongoing contact with existing and potential customers through marketing visits create a well-rounded knowledge of the international technological environment, leads to a unified decision making and to creating timely and well-specified products demanded by the customers. It also helps to estimate potential demand for planned products and calculate their commercial potential. Such integrated approach enables a coherent worldview and strategic and technology planning inside the venture, thus overcoming possible communication problems between the marketing & sales and R&D departments.

The findings support the argument for the importance of effective internal communication and knowledge sharing throughout the organization to enable knowledge sharing and technological learning (Trott, 2008; van den Bosch & van Wijk, 2001). The study shows the importance of both formal and informal ways of communication, and the advantages of a single location of a firm’s employees. It has become apparent from the study that even a very small firm can suffer from internal division, and knowledge and information sharing may be interrupted. The findings highlight the importance of active managerial action in introducing regular formal forums for discussion, i.e. regular all-company status meetings, or meetings for specific purposes. The coherence of general management of the organization, which will be discussed in the next session, contributes to the free flow of informal communication and knowledge sharing, which is also very important for creating a collaborative atmosphere inside a firm.
Planning technological development and intrapreneurship have shown to be closely related. While international entrepreneurial practices of born globals are one of their defining characteristics (Knight & Cavusgil, 2004; Autio et al, 2000), the study has shown the importance of introducing structured management principles into the organizations. Continuous unstructured entrepreneurial practices, where the firm reacts to the many market opportunities without considering the consequences to the overall R&D roadmap and resource allocation may lead to ineffective and inefficient use of resources, spreading them too broadly, and a failure to deliver on obligations to existing customers. If a firm is to be sustainable in the long run, there is a need to replace the chaotic entrepreneurial behaviour with more structured strategy and resource planning processes. This finding supports the findings of Bingham et al (2007a) about the fundamental value of implementing structure into young entrepreneurial ventures in order to organize the firm’s experiences, learn from them, and develop effective organizational capabilities. The findings also support those of Lefebvre et al (1999) in that a firm’s ability for long-term strategic technology planning is one of the significant determinants of its export performance.

Meanwhile, it is also important to leave a window for exploration and intrapreneurship for the organization’s employees to take initiative and ownership of the projects they initiate (Drucker, 1985; Stevenson & Jarillo, 1990; Teece, 2007). This leads to the firm retaining flexibility and being able to react to newly arising market opportunities. The central finding of this study is the actual mechanisms of structured processes for R&D planning and implementation, which have shown to be effective in organizing the firm’s resources, while allowing for intrapreneurial initiative at the same time. The structured approach also helps to discover profitable and sustainable business models and markets for the organization and make investment decisions based on this information.

A related important finding form this study is that ambidexterity – sustaining simultaneous and ongoing explorative and exploitative processes in a firm (Tushman & O'Reilly 1996; He, Wong, 2004) is not necessarily possible for SMEs. Being able to fund ongoing explorative research is a commitment that very few SMEs would be able to uphold. A more viable approach is a careful crafting of an R&D roadmap, considering the numerous inputs from the firm’s environmental scanning, customer contact and the firm’s own internal sources of knowledge, followed by committing resources to the research and
development projects that are included into the roadmap based on the potential demand and profit considerations.

**Implementing and managing change.** This aspect touches upon dynamic capabilities of organizations. These are meta-level capabilities, which deserve a dedicated study of their own. The ability to implement and manage change involves a combination of a number of organizational processes. They involve consistent decision making by the top management team, ongoing internal communication, collaboration among the different managerial levels and organizational functions, as well as the implementation of the structured R&D planning processes, discussed above. The dynamic capabilities highlight the importance of *managerial capabilities* of born globals, where the top managers introduce business processes and principles that enable all of the above processes to happen. Internal division in the top management team negatively affects the managerial capability. An external supervisory body, such as a board of directors, is helpful in solving deep divisions in the firm’s management and other high-level misalignments, as seen from this study.

*Commercialization* is closely related to the processes of environmental scanning, marketing, and technological planning in born globals. This study has shown the importance of integrated marketing and technological scanning activities, and of keeping close contact with the customers and technology trend setters. In B2B markets, where many technology born globals operate, the amount of customers is limited, and keeping a close contact with them and developing products according to their specific demands is a viable strategy for the smaller suppliers. Scientific approach to strategic planning: market assessment and applying formal strategic planning models enables a born global to define markets with the most potential and the most viable business models, considering the firms’ core competences and resource availability.

This study has uncovered a separate important aspect of product commercialization for technology born globals: understanding the product line-up of potential customers and being able to develop a product and a commercial offer that would be interesting for the customers to collaborate on. Strategic alliances and other long-term collaborations are not obtained based purely on a unique technology. A born global needs to show potential customers how this technology can benefit their product offerings from the technological and customer value perspectives, both in the short and the long run. The other
commercialisation aspect is being able to develop a business offer – possibly, a strategic, long-term collaboration, that a customer would be interested in.

**IP protection and management.** A clear IP management strategy and implementation processes have shown to be of critical importance for born globals and other technology-based SMEs. This is an important point, considering the evidence of reluctance of some SMEs to undertake patenting practices (Kitching & Blackburn, 2003; Blackburn, 2003). The findings from this study confirm the suggestion of Gassmann & Keupp (2007) that the scope of IPR protection of SMEs indirectly affects their early and rapid internationalization. Today’s technological capabilities enable rapid advances in all fields of science and technology. Competitors may hire other talented engineers and can ‘catch up’ on a born global’s technologies and develop equally valid ones of their own. Therefore, a well-considered strategy for IPR protection is critical for defending the firms’ basis for existence. The study has also shown that due to costliness of patenting practices, it is important for a born global to find a suitable mix of IPR protection mechanisms that it is willing and able to carry out in the long term. A set of alternative preventive IP protection mechanisms can be used, i.e. notes of invention signed with a notary, and sharing of non-core developments at academic conferences.

4.6 Managerial implications

This study has revealed a number of managerial practices related to R&D-related capabilities of a successful technology born global, which can be very valuable for managers of similar companies. The detailed learnings about defining a firm’s strategy, implementing R&D resource planning and management processes, streamlining internal operations, organizing international knowledge sharing processes, as well as external marketing and technology scanning processes are expected to be particularly useful.

4.7 Avenues for further research

This study has generated a number of insights about the functioning of the R&D-related capabilities in a technology born global. More case studies of born globals to investigate deeper or add other aspects of the R&D-related capabilities would be beneficial. To enhance our knowledge in this field, further
research avenues would be to convert the findings into testable propositions and hypotheses and test their statistical generalizability on a sample of technology-based born globals.
References


