

**Absorptive and adaptive capacity as a key to successful
commercialization process. A case study of SMEs in the Norwegian
petroleum sector**

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Abstract

When studies have identified different types of dynamic capabilities, scholars agree that the field lacks empirical studies of new firms and the role of dynamic capabilities in their survival and development (Zahra et al., 2006). Following this call, we aim to answer the following research question: *How absorptive and adaptive capacity of the firm enhances its ability to commercialize?* A longitudinal comparative case study of three new innovative firms operating within drilling and exploration activities in the Norwegian petroleum industry was chosen. The findings reveal that for small innovative firms in the early-stage, absorptive capacity may be especially crucial for development of innovative product, while adaptive capability is necessary for successful commercialisation process and firm survival.

Key Words: absorptive capability, adaptive capability, commercialization, SME, oil industry

1. Introduction

A central concern of a firm's overall strategy and the management of its innovations is how to maintain a dynamic fit between what the firm has to offer and what the environment demands or dictates (Learned et al., 1965; Miles and Snow, 1978). As such, a firm must possess the essential capabilities to constantly reconfigure, renew, and redeploy its resources and capabilities to better capture and exploit the changing opportunities (Teece et al., 1997). Given the smallness and newness of entrepreneurial firms, the need for dynamic capabilities and the leveraging of resources and capabilities in overcoming challenges and introducing new innovations within an industry environment, can prove an extremely daunting task.

As highlighted by Lee and Kelley (2008), the dynamic capabilities perspective can provide a useful theoretical lens for investigating innovation at the organizational level. Dynamic capabilities can be defined as the capacity of an organization to create, extend, or modify its resource base (Helfat et al., 2007: 4). Recent research suggests that dynamic capabilities are determined in a variety of forms, involving a diversity of functions, including product development innovations, process development, as well as idea generating improvements (Easterby-Smith et al. 2009). Finally, and one common theme that aligns well with the nature of innovation, dynamic capabilities are more specifically associated with change (Zollo and Winter, 2002; Winter, 2003; Zahra et al., 2006).

Whereas the issue of dynamic capabilities has been researched in mostly established firms, which already have a product, customers, employees

and some kind of organizational structure, this paper takes as a starting point that newly established firms have fewer resources to meet challenges related to handle these four mentioned questions. Scholars agree that the field lacks empirical studies of new firms and the role of dynamic capabilities in their survival and development (Zahra et al., 2006).

In our study, we focus on the early phase of the commercialization process of highly innovative firms. This phase is characterized by familiarizing potential customers with the product idea, preparing the market by building firms' legitimacy and increasing the visibility of the business, building relationships with potential customers and suppliers. Especially for small new firms, firm's ability to acquire external, new knowledge, assimilate it with existing internal knowledge and ability to create new knowledge, or absorptive capability (George, 2005; Salvato, 2003; Lim, 2009), as well as a firm's ability to identify and capitalize on emerging market opportunities, is essential for survival and prosperity (Chakrovarthy, 1982; Hooley et al., 1992).

Hence, in the present research we are going to focus on the following research question: *How absorptive and adaptive capacity of the firm enhances its ability to commercialize?*

2. Absorptive and adaptive capacity and commercialization

There has been a considerable amount of recent research focusing on dynamic capabilities. Dynamic capabilities are viewed as drivers behind the creation, evolution, and recombination of other resources into a new source of competitive advantage (Henderson and Cockburn, 1994; Teece et al., 1997). Barney (1991) describes resources as all assets, capabilities, organizational processes, firm attributes, information and knowledge controlled by the firm which enable it to conceive of and implement strategies that improve its efficiency and effectiveness. However, resources alone are not enough to explain a firm's competitive advantage; they need to be intelligently employed in order to be useful (Penrose, 1959; Grant, 1991). As a response to this critique, the dynamic capability approach has been developed, and defined as the ability to coordinate and deploy resources in order to achieve the firm's goals (Amit and Schoemaker, 1993). The capabilities approach thus eliminates the question of whether the possession or the actual use of resources is the primary concern (Wiklund and Shepherd, 2003). Further, as they are not simply inputs into a productive process, capabilities cannot be purchased on the market (Makadok, 2001).

The resource-based approach has recently been extended by viewing the firm as a stock as well as a dynamic flow of resources (McKelvie and Davidsson, 2009). The constantly changing circumstances of a new firm call for

immediate restructuring and transformation of resources (Eisenhardt and Martin, 2000). Dynamic capabilities are now seen as the firm's ability to integrate and change its resource base in order to manage changing environments (McKelvie and Davidsson, 2009). The role of dynamic capabilities is to strengthen the firm's extant resource base and transform it in such a way that a new configuration of resources is created so that the firm can sustain or enhance its competitive advantage (Ambrosini and Bowman, 2009). Dynamic capabilities also require the artful orchestration of highly specialized and co-specialized assets. For example, an organization must sense and seize the external opportunity by proactively reorganizing and recombining resources if needed (Teece 1997, 2006). Within the entrepreneurship literature, the prevailing view is one of organizational actors as agents mobilizing the recombination and alignment of resources and capabilities along with the promotion of knowledge transfer and learning.

Thus, the dynamic capability perspective is an attempt to explain *how* entrepreneurial firms can leverage their strategies and change their valuable resources to enable them to confront and overcome multiple challenges over time.

Examples of dynamic capabilities having been identified and described in the literature include R&D (Helfat, 1997), acquisition process (Karim and Mitchell, 2000), product innovation process (Danneels, 2002), absorptive capacity (Zahra and George, 2002), organizational structure reconfiguration (Karim, 2006). This demonstrates how dynamic capabilities are used in managing large-scale firm processes or changes. However, recently dynamic capabilities approach have also been applied to study small and medium enterprises (Madson, 2010) and new emerging businesses (Foss et al., 2011).

The common characteristics of dynamic capabilities across firms are identifiable and demonstrate the nature of "commonalities in key features" (Eisenhardt and Martin, 2000). Wang and Ahmed (2007) argue that it is possible to identify three main components of dynamic capabilities across studies, namely adaptive capability, absorptive capability and innovative capability. In the present study we aim to focus on adaptive and absorptive capabilities as the objective to study the innovative firms that are commercializing their products to the market, thus innovativeness is an initial and main feature of such firms.

Adaptive Capabilities

Adaptive capability is defined as a firm's ability to identify and capitalize on emerging market opportunities (Chakrovarthy, 1982; Hooley et al., 1992). We therefore view them as essential for commercializing new products in early-stage firms. Adaptive capability focuses on effective search and on balancing exploration and exploitation strategies (Staber and Sydow, 2002). This type of

“balancing” act is brought to a strategic level and linked to the resource perspective. The development of adaptive capability is often accompanied by the evolution of organizational forms. According to Rindova and Kotha (2001) firms undergo comprehensive, continuous changes in products, services, resources, capabilities and modes of organizing. Other empirical studies (e.g., Alvarez and Merino, 2003; Camuffo and Volpato, 1996; Forrant and Flynn, 1999) also reveal that the ability to adapt to the environment and align internal resources with external demand is critical to firm evolution and survival in several industries. Adaptive capabilities often refer to the firm’s ability to adapt their product-market scope to external opportunities, to scan the market, monitor customers and competitors and allocate resources to marketing activities, and to respond rapidly to changing markets (Oktemgil and Gordon, 1997). According to Gibson and Brikshaw (2004) adaptive capability refers to the ability of management to encourage people to challenge outmoded traditions, practices and sacred cows, which allows the firm to respond quickly to changes in the market and evolve rapidly in response to shifts in its business priorities. In the context of newly established firms this concept refers to their ability to position themselves in the market space.

Absorptive Capabilities

Cohen and Levinthal (1990: 128) refer to absorptive capability as: *“the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends... the ability to evaluate and utilize outside knowledge is largely a function of the level of prior knowledge”*. A firm’s ability to acquire external, new knowledge, integrate this with existing internal knowledge and to create new knowledge, are important elements of dynamic capabilities in several industries (George, 2005; Salvato, 2003; Verona and Ravasi, 2003). For innovative firms in the early-stage, absorptive capacity may be especially crucial for development processes where the firm learns from external actors and integrates this knowledge within the firm.

There is an ongoing debate in the literature on whether dynamic capabilities results directly in a superior firm performance, or they related to the firm performance in more indirect ways. So far, this question is still an open topic for discussion as there is a lack of studies testing such relationships in a quantitative way (Zahra et al., 2006). In our study, we focus on the early phase of the commercialization process of highly innovative firms. This phase is characterized by familiarizing potential customers with the product idea, preparing the market by building firms’ legitimacy and increasing the visibility of the business, building relationships with potential customers and suppliers. These processes often occur in parallel with developing the product itself; thus early commercialization work becomes intertwined with making the product ready for the market. As we apply a longitudinal design, it makes possible to observe whether the usage of the dynamic capabilities is actually related to successful commercialization of the products, and in which way it

happens. Since our cases are not yet robust enough to measure their performance, the first crucial test for the new firms is their ability to make a first sale and to commercialize a product, alternatively to perform some activities that results in profits on the firm level.

Research Method

Case Study Design

In order to grasp the embedded, processual and contextual nature of the absorptive and adaptive dynamic capabilities, a case study design was chosen. Following the theoretical sampling of cases, we build on the suggestive arguments that multiple cases create more robust theory grounded in varied empirical evidence (Eisenhardt and Graebner, 2007). The cases vary in organizational size, somewhat in technology and market niche. We controlled for industry, type of company and type of innovation. The three companies selected are all within the exploration and drilling segment of the Norwegian petroleum industry, established to commercialize an innovation about 5-6 years ago and had reached a stage in their technological development where commercialization activities had begun.

Data collection strategy

Following longitudinal design, data were collected through a series of interviews. The first wave was organized between October 2008 - September 2009, and second wave was done in June 2011. Respondents were members of the management teams and CEOs of the companies. Our informants were selected to provide a balance of opinions from different professional areas, and different levels of responsibility and seniority in an attempt to gather and integrate a variety of perspectives. Following Eisenhardt and Graebner (2007) it is unlikely that such a varied group of informants engage in retrospective sense-making or impression management. We also interviewed external experts and possible partners. Semi-structured interviews were chosen since they allow for richer data and leave room for adjustments during the interview. Furthermore, some secondary information was gathered, such as information from business registries, websites, firm presentations, and press clippings.

Altogether, 18 interviews were conducted, 15 during three rounds between October 2008 and September 2009: four within each company, two within two different oil companies and one with a board member/business adviser. And, 3 follow-up interviews with companies in June 2011.

The interviews lasted one hour on average and varied from 10 to 22 pages in length when transcribed. Based on the research question as guidance, authors independently read the transcripts, sorted and coded the data. This process was performed within each case. The process of coding was executed through

finding significant statements related to theoretical themes: that is, the adaptive and absorptive capabilities within each firm. Comparison and selection of statements were performed across the cases. Finally, we used intuitive and critical reflection in interpreting the data. This was performed within as well as across cases (cf Ayres *et al*, 2003).

Description of Cases

The three companies, Alpha, Beta and Gamma are developing products that can be characterized as innovative. By innovation, we refer to any kind of innovation that will induce change, associated with new knowledge or technology (radical innovations) or incremental innovations which result in radical or discontinuous innovations (i.e., small changes having large effects and the input of new knowledge can push through into radical new direction; Rice et al., 2002). All firms are at a stage where the technology is mature enough to start the commercialization process, or they have already started. The characteristics of the three companies are summarized in Table 1.

Alpha was founded in 2005 by a team of four, and based on a technology foresight process where several ideas were assessed. One of the technologies were of particular interest for the National Oil Company and on their request, a project was initiated. The business idea is based on a radical new automated solution within the drilling and exploration sector that is integrating cutting edge technologies. The idea was chosen based on an explicit market need, an enhanced technology to face the increasingly challenging environments in the Arctic and deep sea. The market targeted by Alpha is currently being developed and there are thus few direct competitors..

Beta was founded in 2003, but the idea was “born” and patented in 1999 by a researcher having worked in this specific field. The idea behind the company is described as a radical new solution that will position itself as a “game –changer” in the market. The existing market is characterized by high-cost, high-risk solutions which are also damaging to the environment. Therefore, with increasing pressures on costs and on the environment, the market is disposed for new solutions. A company with professional structure (board, management team, etc.) was set up early on. The inventor quickly became a minor shareholder, and a team of different people worked with the idea. The company raised substantial funds for the technology development through an initial public offering (IPO) early on.

Gamma was founded in 2003. The product idea originated from the entrepreneur’s own experience from a technology development project that was shelved after the company could not make the technology work. The entrepreneur subsequently developed a simple solution that worked from the

start. In terms of technology development the company has developed a first and second generation pilot technology.

Absorptive capacity

In all three companies absorptive capacity is easily and clearly observable in relation to technological development of their products or services. This ability to apply ideas from other industries to enhance or develop their own products' seems to be a necessary condition for our cases to produce innovative products. We have identified several sub-dimensions of absorptive capacity

Absorbing technology from other industries

The ability to learn from partners, to integrate external information and to transform it into firm-embedded knowledge has been found to be positively associated with performance, especially in the petroleum industry (Woiceshyn and Daellenbach, 2005). We found that two of the companies are constantly searching for new technology from other industries, to implement in their production.

Alpha has been searching for new technologies in several other industries, including the robotics, space and car industries. The company adopts technologies from other industries, integrates, modifies and develops it with petroleum technology for application in drilling and exploration activities. Thus, Alpha exploits technology gaps between petroleum and other industries. The company uses suppliers ranging from local industries to international universities to help develop and produce the individual components, which is then assembled.

Beta searches for new technologies in universities doing cutting-edge research, and implement technology from other industries. In order to handle technological challenges Beta outsources certain aspects of the search, and is thus almost constantly searching for new technologies to be applied in its own production:

"You need to be curious, search and make use of knowledge from other industries.." (CEO, Beta)

This search and learning process clearly serves to enhance the absorptive capability of the company. The formal or codified knowledge is assimilated by the employees and a new, tacit knowledge is developed. Beta has even developed a routine to translate the tacit knowledge obtained into formal rules and procedures with the help of the technical notes, thus completing the knowledge loop (cf. Nonaka, 1999).

To develop his initial innovative product, the founder of Gamma has absorbed technology from other fields. Thus, knowledge from seismic field helped him to develop innovation that he patented for the oil industry. At the second interview round we found, however, he was not able to develop his product further due to the absence of partners. When moving his firm development into another field - providing services for big oil companies, he again used his knowledge from seismic and robotic to develop a unique service. Thus, once again he demonstrated the absorption of knowledge from industries other than oil industry to create value.

There are differences between the three companies with regard to involving partners. Whereas Alpha uses partners actively for developing the technology, Beta seems to use partners less actively. Finally, Gamma outsourced all of the building and assembly of the technology. Alpha seems more open in their technology searches and in its interactions with partners. The CEO in Beta told us that the company is careful in protecting IP. Names of employees are not on the web site and the suppliers are not allowed to use the company as reference. Gamma seems to have used well qualified sub-suppliers for building and assembling the technology and our informants expressed no concern over losing technological know-how to them. However, in dealing with potential business partners, our informants in Gamma expressed much more concern for retaining IPR within the company. All three companies search their environments for new technological solutions, thus underlying adaptive capabilities. The quotes illustrate that the search for technology and the selection of suppliers underpin the absorptive dynamic capability of these two companies.

Involving Potential Customers to Participate in Product Development

The oil industry is dominated big companies with specific and often differing requirements to sub-suppliers. In the interviews, the respondents of Alpha and Beta stressed the importance of involving potential customers in the development of the product. This may improve the product and increase the chances for a first sale to these customers. Interestingly, these potential customers are also partners in technology development.

In case of Alpha, the Norwegian Oil Company has invested money in the product development. This increases the chances for a first sale.

“One advantage is that we work together with the industrial development department of Norwegian Oil Company, having a program committing the use of technology. They can commit to use the first part, and after that it will be a commercial transaction. When being involved in this program, the product is tested as a pilot, without competition from anybody else. When the pilot is tested then you are on commercial terms and have to compete.” (CEO, Alpha)

Thus, involving potential customers in product development seem to enable adaptive capability in terms of obtaining knowledge of customers' needs. In this case the customer is also a partner in a project funded by the research council. They have invested in the company and they are making their internal expertise available for Alpha.

According to our informants, getting approval from potential customers is an important factor for pre-appraisal of the innovative product, and can stimulate innovative processes. An informant in Beta describes the challenges of getting potential customers committed to the product idea:

“The challenge is to find a partner who senses the idea, understands the needs, and who is willing to develop the idea with the owner. Call it customer based, or industry based innovation development. It's crucial.” (CFO, Beta)

Gamma also described how the industrial development department of Norwegian Oil Company facilitated contact with a potential partner company:

“Because this company had been demonstrating something for the Norwegian Oil Company, one in the department came to me and said ‘get in touch with Potential Partner Company’ because we think you can collaborate, without giving me much more info than that.” (CEO, Gamma)

All three companies have succeeded in involving potential customers to invest in product development projects. Alpha has one whereas Beta has three petroleum companies involved. The CEO of Gamma benefitted from his personal network and the oil company's positive interest in this innovation. Close relations with potential customers also give access to important resources, such as technical know-how and funding.

Adaptability

We found during our longitudinal study that ability to adapt to the demands of the economic environment seems to be crucial to achieve success in terms of commercialization. Speaking about adaptability, the firms demonstrated four types of adaptability. The first one is technical product adaptability; the second one is adapting to the existing economic environment through networking, thirdly, adapting organizational structure to the life cycle of the firm, and finally, adaptability in terms of firm's vision, either in terms of strategy or even products.

Technical product adaptability

The ability of the firm to adapt to the existing technology can be crucial for its performance and prospects. In some circumstances the ability to integrate new technology with the existing one can enhance survival and success chances of commercialisation process.

Alpha's product will be integrated with existing technological solutions. Therefore, the firm's product needs to be adapted to the existing norms and systems, and accordingly, its technological strategy is to develop each module as a closed system.

"If we go to another supplier and look at a drilling system, everything is integrated. We have a strict philosophy that every single machine shall be its' own individual which will handle everything itself: all closed-loops, control loops all will be inside the machine." (CTO, Alpha)

Thus, adapting the product to the existing technology seems to be a vital success factor, i.e. of the ability to "fine-tune" the product to the demands of the market.

The data from Beta do not support similar conclusions regarding the process of integrating new technology to existing solutions. This is because Beta's product is intended to replace existing technology, hence the company does not need to focus on this kind of adaptability. However, they have created a steering committee with three potential customers who monitor their technology development.

The initial technology of Gamma was equipment to be used in combination with ROVs (remote operated vehicle, or unmanned submarines). This product cannot be used on his own and need to be integrated with existing technology. Thus, adapting this product to existing equipment is essential for Gamma. While the commercialisation of this product was postponed during our research period, another firm activity that is performed quite successfully during the second interview period was based on integration of different technologies to the needs of Oil Company. Thus, adaptation of seismic and robotic technologies for the needs of oil industry was in place.

Comparatively, the companies' choices illustrate different strategies, where Alpha and Gamma are more clearly in the process of integrating their products with the dominant technology. Beta does not need to integrate its product to the same extent, but wants to ensure that it will satisfy the customers' needs and current safety regulations in the oil industry. Therefore, under several conditions, we can conclude that the ability to integrate the future product with existing technology can be an important part of the adaptive dynamic capability.

Adapting through networking

Communication addresses the challenge of successfully transferring the knowledge of new innovative products to the market. Given the smallness and newness of entrepreneurial firms, collaboration with larger organizations, like oil companies, may prove difficult.

Our informants have a similar understanding of how a large industrial bureaucracy like the Norwegian Oil Company works. Both Alpha and Beta have developed a special capability to meet the challenge of working with a large organization.

“Norwegian Oil Company is a large organization. Often one person doesn’t talk to another person because he doesn’t know that he is sitting there. So therefore we have to be very active ourselves and use our network... Basically we try to use the network, use the people in Norwegian Oil Company we are working with, and also other resource persons and former employees. We use them to find the right people.” (CEO, Alpha)

Beta has hired people who know the industry from inside, which enables the company to build a dialogue with potential customers. The ability to negotiate with large petroleum companies is based on knowledge of the system and contact with individual employees, and the CEO even hints at the importance of industry culture and the ability to read and play the cultural codes.

The CEO in Gamma has also a long industry record. However, he has never worked in an oil company, only as a supplier or consultant. Nevertheless, in his negotiations with potential industry partners he has benefited from his relations to an industry adviser with background as an oil company executive.

Our companies use their networks, either personal or through third parties, as support in these negotiations. This indicates that interpersonal skills (networking) and personal competence are important adaptive capability.

Adapting organizational structure

Alpha has been following a very flexible organisational structure from the beginning. Their concept always was to keep core competence in the firm, while extensively outsourcing what can be outsourced.

“We’re very much based on consultants. Because it takes a long time to build a staff..” (CEO, Alpha, 1st round)

With times passes they have hired one more employee to take care of increasing demand to market their products and as they are approaching the commercialization stage there is a need to concentrate more on future sales. This example illustrates that firm is adapting it’s’ organizational structure to their needs very carefully. As a result, a seven-man team was able to develop an impressive package of products to offer to the market.

Beta had a different policy in terms of human capital. From the beginning they hired highly competent technical staff as well as some administrative people and employees working with marketing and promoting commercialization process:

"And since that we decides to employ people because the idea should be developed, and because competencies should be generated inside the company as become our main value. If you use too much consultants, then they come, learn something, and leave the company, and they take away the valuable competence. Therefore, our idea was to employ as much people as possible (CEO, Beta, 3d interview, 1 round)

Firms organizational structure has not therefore changed much from the beginning. According to our respondents, the costs of working with radical innovation is quite high and expenses for human capital could have been a problem, if only firm have not squired itself with by the equity capital they acquired through the stock exchange. At the same time, the firm loose a great degree of flexibility as in exchange to funding they were constrained by the contract with initial partners:

"The contract we are steel working with was written in 2005. At that time everything was actually "blue sky"... So we have run after the money and the criteria for tests that were predefined without any real basis (CEO, Beta, 2nd round)

Firm Gamma has to change the product, and as a consequence, during our second interview round, it was in the process of changing from one-man firm to a few employees firm structure. Thus, adaptation is also naturally happening in this firm.

Adaptability in terms of firm's vision

Alpha demonstrated adaptability in terms of product or service development. During the second interview round our respondents told us about the interest from the potential customers to one of their products. The firm immediately reacted by splitting their activities, so that part of the team was continually working with original idea of product development, while a part of the team began to work extensively in developing the particular product the customers showed interest in.

"quote" (CEO Alpha, 2nd round interview)(interviews are not yet transcribed, to be added)

Because the firm has a board of directors that were very helpful and were caring about current situation, this decision was supported and resulted in a successful pre-sale contract for Alpha for this particular product. The CEO commented that sale of this product will be helpful for promoting the whole concept. However, the company is evaluating the spin-off from its main

activity to hold focused in the future if the product will began to be settled to the production line. This example demonstrated the flexibility and immediate adaptability to the demands from the economic environment that showed to be a smart and successful strategy for the firm.

Firm Beta found itself in a different situation. Speaking about product adaptation, firm Beta product is not a module based like Alpha product, but rather a solution that should be done as a whole. It was not possible or feasible to develop only a part of the product. At the same time, several spin-off ideas firm came across during development of its main product have not been supported by the board of directors. This is because Beta is on the Oslo stock exchange, has obligation to report on for their investors and does not have the same flexibility as Alpha. Facing difficulties on product development, the firm has adapted in different way. If their original concept was “brand new technology” that can drill to 1000 m dept (3000 m if one count with water), now firm has changed this message to potential customer and investors. The new concept is more modest but at the same time more realistic, promising to drill on to 100-300 m, which is enough to get customers interested in the equipment.

“If we can drill on 100, 200 meters(above water), then we start generating value for oil companies, a great value.”(CEO Beta, 2nd round interview)

Changing this concept was not easy as they already have reported for the customer their desire to drill for 3000m. However, changing the concept was necessary as the technology to drill for 3000m is not developed yet, and the market needs technology that will allow using more oil and gas in the nearest future. It seems that company has changed their vision without changing much the product itself, adapting to the market needs.

Gamma has also shown a strong adaptability towards markets demands during the duration of our research. Founder was not able to find industrial partner to continue implement the commercialization of the initial product. Therefore, he decided to postpone the commercialization of his initial idea in favour of responding on the market needs. Today he offers services of equipping the oil companies with robot-based equipment that allow performing certain search operations more effective and easy. This new activity is based on his earlier expertise and experience and is novel in terms of applying robots from seismic fields to perform operations. At the same time he hopes that this new activity will allow him to get necessary access to the resources in order to continue with initial product commercialisation. Thus, adaptability to real market demands seems to be the main capability firm Gamma needs to survive. In the long run, this adaptability may also help to commercialize the initial product.

5. Discussion and conclusions

The perspective and approach of our research are based on the need to understand development of absorptive and adaptive dynamic capabilities in the context of commercialising innovations in new entrepreneurial firms. Our work differs from previous research examining capabilities within existing firms (e.g., McKelvie and Davidsson, 2009), in that we have studied the links between different type of dynamic capabilities within early-stage firms where these capabilities have yet to fully materialize..

Recently, Ambrosini and Bowman (2009) have argued that additional research should improve our understanding of the underlying antecedents and consequences of dynamic capabilities. Additionally, Helfat et al. (2007) assert that “prior literature has placed less emphasis on the underlying processes that an organization requires in order to move from its starting position to a new or adjusted path.” This means that there is a need to understand processes of capability development and their role in the firm survival and performance. We have explored how managers and their teams develop dynamic capabilities conditioned by the processes they are engaged in. Our research reveals that new firms need to conduct a multitude of activities simultaneously. While these activities may be firm-specific, they resemble each other across firms. Moreover, while the current practices are dependent on, and have been developed by, the founder or the manager, they have become institutionalized within the firm. These companies are, on the other hand, in constant development. Few procedures are formalized, they are often “designed” to fit current circumstances.

In addition to identifying dynamic capabilities, previous research advise to focus on how and when capabilities develop. We have seen that absorptive capability, in its many sides, has emerged very early during the commercialization process, and even first interviews round demonstrates that for innovative-oriented firms absorption of external knowledge and making them to work inside the organisation is a crucial condition for the development of innovative products. All three cases, in different degree, absorb ideas from other industries or other fields of application. The managers of Alpha, Beta and Gamma described how they, among other things, conduct technology searches and incorporate technology from other industries into their products, work with universities and research institutes (nationally, regionally, and internationally), gain knowledge from customers, use customers to open doors to enable them to learn from existing players, acquire funding, and recruit personnel with the right background. What makes product highly innovative is exactly technologies that have never been applied in oil drilling before, but that were known and used in another industries (car construction, space technologies, seismic). Common for Alpha and Beta were the search for new technology; however due to Beta’s innovation being more research based, its search was directed towards research-based knowledge. Alpha seems to exhibit a wider range of partnership involvement, including those with

suppliers and potential customers in addition to research institutes and universities. The data reveal a rich collection of the firm-specific activities associated with both involving potential customers in the development of the product, collaborating with large organizations, gaining legitimacy through being visible and repositioning their organization for commercialization. We also showed how the CEO in Gamma, struggled more because he did not have the organization and the capabilities to support him.

Ability to apply this knowledge, using contacts with suppliers, partner and future customers is a main feature of our entrepreneurial firms. As the aim of our research is to make theory contribution above the findings from our cases, subject to future analysis and research, we conclude with the following proposition:

Proposition 1: High level of absorptive capability in the firm leads to the high degree of product or service innovativeness

Commercializaion of the product for new firms means survival. In order to make this last important stage happen – to succeed with the first sale and to start gaining profits, firm should carefully respond for the market signals. Due to the longitudinal design of our research we were able to observe how our cases were flexible and responsive to the changes in the external economic environment. Firms differs in the degree and ability to quickly respond to changes, however, they all demonstrated adaptation in greater or lower degree. The most flexible case was Alpha, due to its organizational structure and careful hiring strategy. We observed very clearly how this firm responded on the external demand and how this process helped them to achieve their goals quite successfully. Beta also changed their positioning and adapted to the market needs, setting more observable goals for their product development and possible application of the product. For Gamma adaptability equals survival, since the initial product was not commercialized but due to adapting and responding on the market needs firm was able to survive and even started to develop quite rapidly.

We may conclude that this study add to existing research by shedding some light on the complex processes of adaptation when firms face changes in technology and market conditions (Verona and Ravasi, 2003). We therefore suggest the following proposition:

Proposition 1: High level of adaptive capability in the firm leads to the higher survival rate and more successful commercialization process

Managerial Implications

As our research is a study of what managers in new firms actually do and how dynamic capabilities in practice are created and developed, a strategy-as-practice lens (Jarzabkowski et al., 2007; Johnson et al., 2003) was employed. The interview material provided rich narrative quotes revealing how the several processes seem to be decisive for developing adaptive and absorptive dynamic capabilities in the process of commercializing innovations. These were: absorption of new technologies, involving potential customers and suppliers to participate in product development, adaptability in firm products, adaptability of the firm organisational structure, adaptability in terms of firm's vision. We also pointed out some of the additional challenges faced by a firm that did not acquire these capabilities itself. This is important in order to explain why dynamic capabilities must be well targeted and deployed towards achieving strategic goals (cf. Zahra et al., 2006). When it comes to the basics of production, our firms use a number of novel approaches that can be adopted and employed by other firms as they adapt their technology, price/value their innovation, and minimize the risk for their customers. Flexibility, quick decisions and responsiveness to the changes in the real market demand are found to be crucial for firm survival during the commercialization process. For the firms to be able to introduce novel and exiting technical solutions or services, it is also important to develop and maintain absorptive capability to be on the frontiers of the knowledge development in the field.

The managerial “take-away” of this paper is that entrepreneurial firms may develop stronger capabilities by paying attention to their specific foundations. By allowing potential customers to participate in the development of new products, and by collaborating and networking with larger organizations, managers can adapt more quickly to changes in the environment and align their internal resources to handle the challenges of commercialization. Taking stock of internal resources may prove an important managerial task in developing specific strategies for a successful commercialization of the product. This study points to networking skills, customer orientation, and adapting to the changing economic environment as important foundations in this process. Thus, this study is our first attempt at addressing the question of how entrepreneurial firms should manage capabilities in order to gain performance-related benefits (cf. Zahra et al., 2006).

This study adds to existing theories of dynamic capabilities by clarifying the significance of firm specific processes that characterise dynamic capabilities in new firms (Wang and Ahmed 2007; Zahra et al. 2006). Close cooperation with practitioners in this study enabled us to identify the processes in the firms studied, what they looked like and how they were deployed (c.f., Ambrosini and Bowman 2009). Our study is one of the first to investigate the role of the adaptive and absorptive capabilities of nascent yet emerging entrepreneurial

firms. However, as this study is case-based, the generalizability of results are limited. Suggesting propositions in our research, we open the road for future research to investigate the role of adaptive and absorptive capabilities in relation to innovativeness and overall firm success. For the new entrepreneurial firms that also mean relationships to firm survival. Future research should test these propositions implying more quantitative methods in combination with longitudinal design, so that the effects can be seen and analysed.

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Table 1. Firm's characteristics.

	Alpha	Beta	Gamma
<i>Founded</i>	2005	2003	2003
<i>Idea</i>	Industry based (from technology foresight)	Research based	Industry based (from practical experience)
<i>Technology</i>	Patented	Patented	Patented
<i>Competence of CEO</i>	CEO with engineering and business degrees, 10 year experience in innovation/technology development.	CEO with background from petroleum company and supplier industry.	CEO civil engineer.
<i>Competence of Team</i>	Team with different industrial backgrounds and experienced in technology development.	Seniors with long industry backgrounds, combined with "fresh" PhD's	
<i>Market niche</i>	Drilling and exploration technology	Exploration technology	Installation of equipment on seabed.
<i>Number of employees</i>	6(7)* employees, 6 consultants	17 employees	0(4). CEO and industry adviser working as consultants.
<i>Ownership structure</i>	Venture fund: 28% Founders: 14% each Others: 15% (this has changed during our project)	On Oslo stock exchange	Founder: 89%, technology park 8%, chair of the board 3%.

