DYNAMIC CAPABILITIES IN NEW PRODUCT DEVELOPMENT PROCESS. THE CASE OF SMALL SOFTWARE DEVELOPING COMPANIES

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Abstract. This study investigates the product development process of two small firms in the Norwegian software industry. A firm's ability to mobilize its capabilities and align them dynamically with the changing environment is of vital importance as the firm constantly innovates to survive and create its own competitive advantage. While literature has addressed new product development process and challengers it cope with, a limited focus has been taken on what capabilities are necessary to successfully overcome them. In the present paper we discuss the challengers that SME's meet while introducing new product development process in software industry and dynamic capabilities they utilize to overcome these challengers. Our findings reveal two main challenges – the need to continuously competence improvement and the need to enhance the efficiency of product development process. We found that to cope with these challenge both firms extensively developed open innovation mode through knowledge generative capabilities as well as certain integrative capabilities.

Keywords: dynamic capabilities, new product development, software, case studies.

1 INTRODUCTION

The process of new product development of SME's in software industry has received scant attention in the literature. The empirical measures are often limited to the stages of which new product development consists, and even these findings are rarely depict the context in which small enterprise act. This approach is not very appropriate to explain *how* firms are developing new software products. Rather, one needs to look at the complex picture of knowledge creation and utilisation to get into insides and to access the cohesive whole of the problem (King, 2007). We will investigate deeply the ways of dealing with these challengers on the example of two Norwegian small firms operating in the software industry.

Developing new products is a difficult process in any industry, but the software industry is particularly demanding in regard to time and quality constraints (Blackburn, 1996; Sheremata, 2002). These conditions are especially critical for small and medium-sized enterprises (SMEs) developing computer software (Ambrosini and Bowman, 2009). SMEs often are limited in their resource base, suffer from small scale disadvantages, have small strategic apex and risk being locked into the present strategy (Kuratko and Audretsch, 2009, Schindehutte and Morris, 2009). At the same time SMEs has initial advantage in the form of flexibility and capacity to adapt to a changing environment. To survive and successfully compete with larger companies, SMEs imply the entrepreneurial behavior that is characterized by innovation (technological development, new products, new services, and improved product lines), proactiveness and risk-taking (Miller, 1983; Zahra et al., 2006).

Because of resource limitation, small companies often apply open innovation approach to keep themselves competitive. Open innovation can be defined as the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and to expand the markets for external use of innovation (Chesbrough et al., 2006). At the heart of the open innovation model is the recognition that today, competitive advantage often comes from inbound as well as from outbound connections. Inbound connections is the practice of leveraging the discoveries of others: companies need not and indeed should not rely exclusively on their own R&D. Outbound open innovation suggests that rather than relying entirely on internal paths to market, companies can look for external organizations with business models that are better suited to commercialize a given technology (Chesbrough, 2002). Open innovation has received increasingly attention in scientific research, but so far it has mainly been analyzed in larger enterprises drawn on in-depth interviews and case studies (Chesbrough, 2003; Kirschbaum, 2005; Vrande et al., 2009).

In the present study we will address the issues of *how* small firms do actually build capabilities to forester open innovation and entrepreneurial mindset of the firm with limited resources in hands.

We will approach this main research question by utilizing the dynamic capabilities approach. The dynamic capability approach elaborate on the characteristics of resources that increase the pace of change towards new, original, strategic adaptation patterns in future (Teece et al., 1997, Poulis et al. 2010). In order to employ open innovation model, SME's need to build some certain capabilities that might facilitate this process. So far dynamic capabilities to firm long-term competitive advantage is considered in the large organizations, including such DC as 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). However, recently these approach shown to be useful also for SMEs (Madsen et al, 2006; Foss et al., 2011). However, there is an absence of studies highlighting and specifying dynamic capabilities that constitute the core of open innovation in SME's during that new product development process. The present study is aimed to fill up this gap and to explore critical dynamic capabilities in the product development process of computer software developing in SMEs.

2 DYNAMIC CAPABILITIES IN SOFTWARE INDUSTRY

2.1 OPEN INNOVATION AS ROADMAP

Due to labor mobility, abundant venture capital and widely dispersed knowledge across multiple public and private organizations, entrepreneurs can no longer afford to innovate on their own, but rather need to engage in alternative innovation practices (Vrande et al., 2009; Chesbrough, 2003; Gassmann, 2006). Recent finding confirms that innovation in SMEs is becoming more open, and many SMEs attempt to benefit from the initiatives and knowledge of their employees. In addition, most SMEs try to involve their customers in innovation process by tracing their modifications in products, proactively involving them in market research, etc. (Vrande et al., 2009; Von Hippel, 2005). One may claim that open innovation in SMEs is mainly motivated by market-related targets, since the main problem for small enterprises is not so much invention but commercialization (Gans and Stern, 2003).

Open innovation comprises both outside-in and inside-out movements of technological ideas (Lichtenthaler, 2008). We may expect SMEs to rely on both inbound and outbound open innovation simultaneously (van de Vrande et al, 2009). Examples are cross-licensing agreements, in which firms transfer some of their own technology to get access to external knowledge (Grindley and Teece, 1997). The adoption of open innovation may be sequential, starting with customer involvement, following with employee involvement and external networking, and ending with more "advances" practices like IP licensing, R&D outsourcing, venturing and external participations (Johannisson, 1997; Vrande et al., 2009). As SMEs may struggle with a limited strategic apex, the organizational features may be of vital importance.

One important challenge facing a going company is that the innovative processes of the firm have to run in parallel with implementation of the present strategies. The balancing of exploitation and exploration activities is a risk-provoking task and needs an adapted business configuration (Chesbrough, et al. 2006; Roaldsen & Borch, 2011).

How this balancing can be achieved is the main research we aim to address in this paper. As any company bases its activities on resources it disposes as well as on opportunities it sized, it seems that that is ability to recombine resources in order to achieve necessary level of innovativeness is the key capabilities SMEs needs.

2.2 DYNAMIC CAPABILITIES FOR OPEN INNOVATION

As Teece (1998) writes, in an economy where the only certainty is uncertainty, the one sure source of the competitive advantage is knowledge. Continuous product development process requires the simultaneous presence of the fundamental knowledge-based dynamic capabilities at the organizational level: knowledge creation and absorption, knowledge integration and knowledge reconfiguration (Verona and Ravasi, 2003; Wang and Ahmed, 2007, Ambrosini and Bowman, 2009). According to Sheremata (2002), software development projects of SMEs need the dynamic capability to access a large quantity of creative ideas, in-depth knowledge, and accurate information and these projects need to build integrative dynamic capability providing the project managers with structural sources of influence. Sheremata (2002) pointed out knowledge generating and integrative dynamic capabilities in new software development process.

Firms developing new software act in uncertain and dynamic environments and to succeed they tend to use an iterative process, which emphasizes learning and adaptation (MacCormack and Verganti, 2003). Studies of software development stress the importance of information about customer needs and new technologies. These studies indicate that increasing the quantity and quality of ideas, knowledge, and information a software development project can access both improves product quality and speeds development (Blackburn, 1996; Iansiti and MacCormac, 1997).

The team factors such as personnel capability and experience, personnel motivation, coordination and communication among team members are critical for project success in software development (Sheremata, 2002; Krishnan, 1998; Carmel and Sawyer, 1998). Integration can also improve product quality (Cusumano and Selby, 1997). According to Sheremata (2002), new product development is a task that consists of interdependent components. Software development is characterized by a need to coordinate the work of individuals on a day-to-day basis.

Summarizing, the following research model is suggested for the present study:

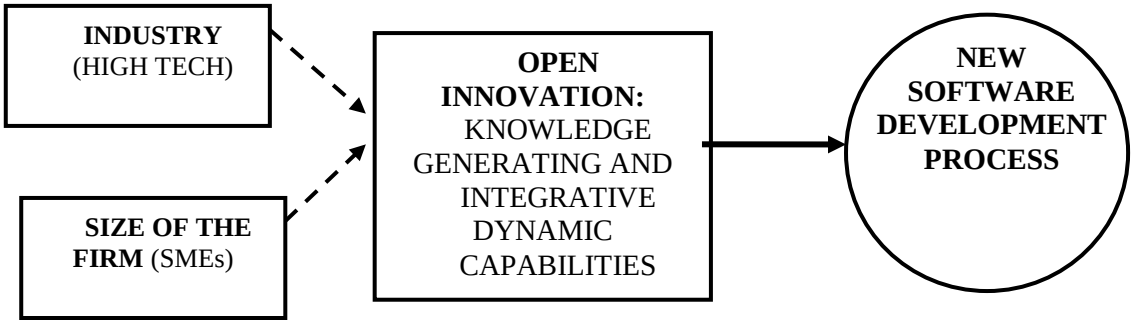

Figure 1. The research model.

3 METHODS USED

3.1 RESEARCH METHODOLOGY

In order to grasp the embedded, processual and contextual nature of the 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).

Similar with other studies (Heaton 1998, Tuunanen and Vainio, 2005), our case selection was based on the theoretical sampling to obtain information from comparable cases (Glasser and Strauss, 1967, Orlikowski, 1993). A list of relevant firms was obtained from Confederation of Norwegian Enterprise (NHO) which satisfied following selection criteria : (1) Companies working within software development industry , 2) Small companies, less than 100 employees 3) Companies that showed good financial results over the last few years 4) Companies operating on roughly similar business-to-business markets 5) Companies that constantly introduce new products into the market. Those firms were further scanned with the help of information available thought their web-pages. Because of money and time constraint we choose those firms from the ones that satisfied initial criteria that were physically situated close to us. We ended up with two firms operating in software development industry, operating on the business-to-business market. Data were collected through a series of interviews organized between October 2003 and May 2004. We conducted in-depth individual, semi-structured interviews with the CEOs, development managers, and other managers of two small Norwegian firms developing computer software. Each interview lasted about 1 hour and was tape-recorded and transcribed. Overall, we conducted 9 interviews.

After having identified dynamic capabilities influencing the software development process in both firms, we applied to them Sheremata (2002) classification and divided them into two groups – knowledge generating and integrative dynamic capabilities.

3.2 DESCRIPTION OF CASES

Company Alpha is one of the leading suppliers of ticket system in Nordic cinema industry, and is represented in five countries. Company Betta is a dominant player in the Norwegian health-care sector, selling patient software systems for hospitals in Norway and represented in five regions in Norway. It accounts for 35% of the total Norwegian market of somatic hospitals. Betta experiences almost 80% increase in turnover during one year period prior to research was carried on. Both firms have less than 100 employees, with firm Alpha having 19 employees and firm Betta having 40 employees. Both firms were constantly introducing new products or services to the market and exhibiting growth in turnover and marked share. At the same time, firms differs somewhat in size, services they provide and market niche, leaving opportuni-

ties to explore a verity of new product development challenges and ways to overcome these challenges in software industry

4 FINDINGS

4.1 PRODUCT DEVELOPMENT PROCESS IN HIGH-TECH SME'S – CONTEXTUAL INFLUENCE

Interviewees from both firms agree that high tech industry and small size of their firms dramatically affect the product development process. Different industries are characterized by different extent of dynamism. In this study we elaborate on the software industry. Firms acting in this industry find themselves in a situation of rapid and unpredictable change that craves from dynamic capabilities, according to Eisenhardt and Martin (2000), to be simple, experiential, and unstable processes relying on quickly created new knowledge. At the same time SME's often have limited resources, both financial, human capital and other types of resources. We have identified several challengers firms meet during the product development process.

Technology in the software industry changes very fast. Due to small size, it is impossible for SMEs in software industry to achieve comprehensive competence within software. The development manager of Alpha said that in the software industry it is impossible to have comprehensive knowledge. It leads to lacking competence in the development department. "The field of programming is enormously large. With seven developers it is impossible to cope with the whole field. However we cope with it. In general, we have the competence we need, but I am sure that we could have more competence". Developers of company Alpha are in continuous learning process. According to the development manager "new versions of programming tools are coming very often. Our developers must learn all the time." Because of complexity of software systems that company Alpha develops, it takes, according to the managing director, 1-2 years before a developer understands what the firm is really doing. The professional development of software developers goes on during the work.

The same problem was outlined by company Betta. Due to its size, it is impossible for company Betta to have comprehensive competence within software. The firm collaborates with other companies within the industry that have experience in areas Betta lacks competence. For example another firm creates mobile solutions for Betta. According to the development manager, "this firm has competence not only about the mobile solutions, but about how to create it, about the concept". There is very much dialoging with partners about how the best possible system is going to be realized. Summarizing, there is a need for continues competence improvement.

Because the firm has limited human resources each employee have to deal with lots of different task, which results in low efficiency. The development manager of company Alpha said: "Due we are a little firm each developer should have wide knowledge in the programming field to perform very different tasks. It affects negatively efficiency, because each developer has too much tasks simultaneously." In the

same time the development manager of company Betta noted that "when the firm was smaller, – eight persons, it was easier to react in time to market changes. Now it goes more slowly. We have more people and we are doing more, but I am not satisfied with the level we have today." The company needs more teams of developers to cope with increased demand on its product. The development manager said: "we have few teams of developers now." We can conclude that companies experience a need to enhance the efficiency of product development process.

4.2 KNOWLEGDE GENERATING CAPABILITIES OF NEW PRODUCT DEVELOPMENT PROCESS: CASE ILLUSTRATIONS.

Both companies considered in the study developed and successfully implement knowledge generating dynamic capabilities. Following capabilities were identified: decentralization, reaching for information from customers, reaching information about technologies and free flow of information as well as monitoring of competitor competences. We describe below these capabilities, illustrated by the case examples.

The first capability identified was *decentralization.* Because knowledge is often tacit, software development projects must cross organizational boundaries to gain access to it (Dougherty, 1996). Developers in company Alpha often have informal meetings, they self decides whom they want to meet. "We go away from PCs. We go to the meeting room and discuss projects and tasks we are working with. Everybody can go there, independently of groups". In company Betta developers work with formally delegated nurse from customer service department, which allows to create cross-discipline teams. While both companies have developed decentralization routines, they perform it in different ways. Developers in Alpha discuss the development work with everybody they want, while developers in B work with formally delegated nurse from customer service department that can reduce positive influence of decentralization on new software development.

The second capability was named *reaching for information from customers*. Reaching for information from customers and about technologies and markets increases the probability of successful development (Ancona and Caldwell, 1992) Both, Alpha and Betta, involve customers in process of new software development. Customers actively participate in all stages of development that dramatically increases reaching for information from them and allows immediately react on market changes. In company Alpha customers often work together with developers and participate in technology tests: "Customers may say: we have a need for something new. Also, we collaborate with customers during testing of the ready product." In Betta, customers are also active and advise on the product. "A lot of demand and ideas are coming from customers".

Next, a capability that we called *Reaching for information about technologies* was found. Alpha extended its knowledge base by acquiring new highly competent human resources: "We had usual experience of database programming and we worked with usual internet information server. We employed one DOT Net specialist and one Java specialist. Thanks to these persons we have improved our knowledge dramatically".

Company Betta shares technological competence with partners through common projects and courses. The firm collaborates with many firms in the industry.

Further, companies performed *free flow of information*. Removing obstacles such as differences in social status, and physical distances between individuals increases the quantity and quality of knowledge available for problem solving, which then helps organizations innovate successfully (Jelinek and Schoonhoven, 1990). In company Alpha all de-velopers are sitting together in the common room. Company tends to remove such obstacle as physical distance between software developers "There is a group that is responsible for the product. And their knowledge is divided to everybody in the group." Company Betta had changed its organizational culture to increase the free flow of information: "We change culture from the situation when each developer develops his own system to the situation when it will be just a part of the whole sys-tem."

Last, but not least, we observed *monitoring of competitors' competence*. The company's Betta leadership has regular meetings with competitors. It helps the organization to innovate successfully. "We monitor competitors' competence, we meet them and discuss with them." Betta considers competitors as a source of expertise. Ancona and Caldwell (1992) point out that effective product development processes have extensive external communication as dynamic capability that is applicable for regular meetings of Betta's leadership with its competitors.

4.3 INTEGRATIVE CAPABILITIES OF NEW PRODUCT DEVELOPMENT PROCESS: CASE ILLUSTRATIONS

Both companies developed several integrative dynamic capabilities to improve their product development process, including direct contact, project management influence, cross-functional team influence and temporal pacing, as well as inter-team collaboration and prioritizing.

First integrative capability executed by companies was *direct contact.* Increasing interaction among individuals in the project through direct contact appears to speed development, by increasing feedback, error correction, and the synthesis of different points of view (Clark and Fujimoto, 1990). In company Alpha, developers who work logically with the same theme are sitting around one table. According to the development manager the firm faced higher dynamism of the product development process when the development work was organized as a team work around one table. "We experienced very high rise of job satisfaction between employees when they moved to one room. Developers are talking together and we noted that the system became more coordinated". Thus, eliminating a physical distance is one way of enhancing direct contact between the team members. In Betta, team leaders collect their teams in once a week. During these meetings team leaders make priority of task fulfillment and discuss different tasks with employees. Therefore, this established order of team meetings also enhances the direct contact between the team members. Team work in Alpha and Betta differs in high extent, and although direct contact is present in both cases, it is performed in slightly lower degree in Betta.

Next capability was *project manager influence*. A project manager needs power – the ability to change another's attitudes, beliefs, or behaviors in an independent direction – to be an effective integration mechanism. Sources of this power include formal position authority, control over critical scarce resources, expertise, and a central position in the flow of information (Sheremata, 2002; Haefliger and von Krogh, 2004). Formal and informal authority of team leaders are of high importance in Betta. As it comes from interviews, powerful project leader influences positively on new software development process. The personal characteristics of team leaders are of high importance in Betta, because, according to the managing director, they influence dramatically on product development process. The team leader should be in stand to place him in the work situation of hospital specialists that will work with the product. It is important to understand the customer's weekday. He should lead a group of people in work and simultaneously run the process in the systematic way. In the same time, there are no leaders in development teams in company Alpha. The development manager points out that there are only informal leaders because they worked longer in the firm. The development manager doesn't point out a person that will be a team leader. In one project it is one person that is natural leader, while in another project it will be another person. Therefore, project management influence cannot be named an important antecedent of the product development process in Alpha. This fact can be partly explained by the smaller size and less formal structure of the company Alpha in relation to Betta, and partly by the differences in the product characteristics between two companies.

Further, an important integrative capability is *cross-functional team influence* and *temporal pacing.* A cross functional team usually includes representatives from functions who provide function-level leadership to the project, and a project manager who supervises the work of functions through these representatives (Clark and Wheelwright, 1992). Representatives must actively and regularly participate in cross-functional teams for them to wield any influence and therefore any integrative capability (Dougherty and Hardy, 1996). There is organized the product board in company Alpha to improve the product development process. This product board acts as a cross-functional team with active participation of representatives from all departments. The product board consists of development manager, project manager, sales manager, support manager, and director. At the same time the product development process is built as team work in Alpha. That means that employees actively and regularly participate in cross-functional teams. Betta is under the organizational changes today. The firm is growing very fast and the organizational structure does not manage to adapt these changes. Interviewees noticed that the firm lacks knowledge in project management. That is why such useful structures as cross-functional teams are under construction in B at the moment

Next, *inter-team collaboration* is an important capability. In company Alpha two team of developers were moved to one room. According to the development manager of Alpha, "these teams began to collaborate. As a result the firm improves quality of new software." According to Eisenhardt and Martin (2000), effective product development processes involve routines that ensure that concrete and joint experiences among team members, such as working together to fix specific problems or participat-

ing in brainstorming sessions occur. This definition clearly reflects the capability developed by Alpha that united two teams in one room to increase inter-team collaboration

Finally, last capability we observed was labeled *prioritizing***.** Thanks to priorities in better quality and better quality control Betta dramatically improved the product development process. "Our priorities are better quality and better quality control. We use more time to create even better product. That dramatically improved product development process of the company." The need to coordinate tasks (Helfat and Peteraf, 2003) implies that a capability involves coordinated effort by individuals. The Betta's leadership performs tasks coordination prioritizing better quality and better quality control that dramatically improved product development process. Danneels (2002) names quality assurance tools as dynamic capability affecting product development process.

5 DISCUSSION

The empirical findings of this study show that that knowledge generating and integrative dynamic capabilities are critical for new product development process of new software producing SMEs. In addition to the dynamic capabilities previously identified in the software development process, we found several new dynamic capabilities – one knowledge generating dynamic capability that we named "monitoring competitors", and two integrative dynamic capabilities that we named "prioritizing" and "inter-team collaboration".

The firms also underlined the importance of all capabilities to achieve competitive advantage. Generation of knowledge is crucial to the process of new product development. Small firms do not possess all necessary resources, and opening up for collaboration with customers, sometimes even with potential competitors can turn weaknesses into strengthens. Our cases stress that there is a conflict of archiving efficiency and implementing new ideas, and through decentralization, free flows of information, reaching information from customers and new technologies, monitoring competitors firms can overcome the challenge of newlines.

However, it is also important integrate new knowledge in effective way. This task is achieved in our cases by practicing direct contact, cross-functional teams, inter-team collaboration, prioritizing, in some cases project management influence.

6 CONCLUSION

6.1 CONTRIBUTION

Finding of critical dynamic capabilities in software development process gives guidance as to the best suited management approaches in software industry. Managers can increase their probability of meeting their product quality goals. They can encourage groups and individuals to find problems through search, or they can design their

organizations so they can both access and integrate knowledge as they solve problems.

Software development projects that combine all of these dynamic capabilities have the highest probability of attaining their schedule and product quality goals. Unfortunately, reaching outward for ideas, knowledge, and information while turning inward to integrate them is inherently difficult, and searching for problems is not intuitive or comfortable for many. However, projects that rise to this challenge and successfully develop these dynamic capabilities may be far more likely to realize their goals – to see their visions embodied as products in market

6.2 LIMITATIONS AND FUTURE RESEARCH

This study's findings might not generalize beyond the computer software industry. Future research should determine whether these findings apply to other industries. The fast pace of competition in the computer software industry may change the dynamics of schedule attainment in a way that precludes generalization. Moreover, the abstract character of the product may change the dynamics of attaining schedule and product quality goals – by putting more of a premium on access to ideas, knowledge, and information, for example.

The difficulty of obtaining data from firms developing software products limited this study in other way. It quickly became obvious that trying to gather data from software developers was a difficult task. Pervasive time pressure in this industry works as a barrier in conducting the research. A larger sample as well as a longitudinal study might reveal more findings on the topic. A more in-depth study of problem identification might provide even greater insights.

Nevertheless, we believe that present study has added to the growing body of knowledge by exploring important processes leading to the successful new product development through application of a open innovation approach when we studied those processes as embedded into the small firm context and to the environmental industrial context.

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