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Absorbing is not Enough

Revisiting the Assumptions of R&D Processes and Introducing Generative Capacity as an Integral Part of Innovative Capabilities

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ABSORBING IS NOT ENOUGH:
REVISITING THE ASSUMPTIONS OF R&D PROCESSES AND INTRODUCING
GENERATIVE CAPACITY AS AN INTEGRAL PART OF INNOVATIVE CAPABILITIES

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ABSTRACT

The relation between competitiveness and innovation has become indisputable in large firms. As customers get used to rapid technology development, they demand more frequent introductions of new products and updates. This trend is forcing all companies to develop more innovative products to remain competitive. However, in many large firms, the simultaneous demands for cost efficiency and risk reduction have resulted in highly structured development processes with very little room for creative activities and experimentation with new knowledge. Previous research on innovation has underlined the need to develop firm's absorptive capacity to be innovative, still large firms continue to have difficulties in developing innovative products within their R&D processes. This paper aims at exploring how large firms deal with innovative concepts in practice. It is based on empirical studies from the automotive and pharmaceutical industries, exploring conceptual work and concept car development at Volvo Cars and the early phases of drug development in a pharmaceutical firm. Based on the results from these studies, this paper contributes to an increased understanding of how large established firms develop innovative products. It also contributes to the literature on innovative capabilities through proposing that it is dual in nature, consisting not only of a firm's absorptive capacity, but also of a generative capacity.

Key words: innovation, NPD, innovative capabilities, absorptive capacity, knowledge generation

1. INTRODUCTION

Intense technology development has made products such as cars and telecom systems more complex and knowledge-intensive (e.g. Mikaelsson, 2004). The competitive situation is also described as fiercer than ever before (Kummerle, 1997), and firms must succeed in launching new products on new markets at an increasing pace while satisfying local differences in market demand and implementing best-practice engineering and manufacturing practices – all in parallel. In this era of constant change, increasing cost pressure has led to a consolidation of many industries where companies are trying to reach economies of scale and lower costs for both New Product Development (NPD) and manufacturing. In this context, globalization of Research and Development (R&D) is considered the overarching mega-trend (Anderson, 2001). In the same time, the increasingly informed customers are getting used to rapid arrivals of new product versions, and they seem to favour products that offer individual choices, i.e. demand product diversity. To systematically launch innovative products has thus become inevitable to survive. But the highly structured development processes required to achieve cost efficiency and risk reduction provide very little room for creative activities and experimentation with new knowledge.

Product development processes are often sketched as a funnel with a large entrance where many ideas enter and an evaluation process selects the best ideas to develop further so that only a limited number comes out in the other end – as products (e.g. Wheelwright and Clark, 1992). Another way of representing it is the stage gate model as defined by Cooper (1988) where product development is organized in phases with predefined checkpoints in terms of time, cost and specifications. Innovation processes are often described generically as consisting of four steps: to search, select, implement and learn (e.g. Tidd et al, 2005). Previously successful large firms often have difficulties in developing more radical innovations (Henderson and Clark, 1990; Dougherty and Heller, 1994; Christensen, 1997; Tushman and O' Reilly, 1997; Leifer *et al.*, 2001) and there is a clear call in research for an increased understanding of their innovation processes (e.g. Cheng and Van de Ven, 1986; Dodgson, 1993; Sharma, 1999). Previous research on innovation has underlined the need to develop firm's absorptive capacity (AC) to be innovative (Cohen and Levinthal, 1990; Lane et al., 2006). Absorptive capacity contains three steps – to recognize and understand new external knowledge, to internalise valuable knowledge and to apply it internally. But how do firms know what to absorb?

This paper aims at exploring how large firms deal with innovative concepts in practice. It is based on empirical studies from the automotive and pharmaceutical industries, exploring conceptual work and concept car development at Volvo Cars and the early phases of drug development in a pharmaceutical firm. The automotive and the pharmaceutical industries are both under strong pressure for simultaneous efficiency and innovation. Based on results from these studies, this paper contributes to an increased understanding of how large established firms develop innovative products through exploring the prerequisites for innovative concepts in large firm's R&D structures. It also contributes to the literature on innovative capabilities through proposing that it is dual in nature, consisting not only of a firm's absorptive capacity, but also of its generative capacity.

This paper is structured as follows: first, a brief summary of previous research on NPD and innovation is presented as well as the notion of absorptive capacity. Then the empirical studies and the results are put forward and their implications for theory are

discussed. Finally, a new model for innovative capabilities is suggested where absorptive capacity is complemented by “generative capacity”. This paper is based on a dissertation presented at Chalmers University of Technology in Sweden (Elmquist, 2007a).

2. THEORETICAL FRAMEWORK

2.1 R&D processes and Innovation

New product development (NPD) processes in large firms are often complex structures with many interdependencies, implying that even small changes may have an important impact on other parts of the process. Research on R&D has mostly focused on how to make these processes more efficient. During the eighties and nineties, focus lay on efficient manufacturing and lean production (Womack, 1991), while the turn of the century brought an increased focus on the preceding development work through stage-gate systems (Cooper, 1988), lean product development (Karlsson and Åhlström, 1996) and modularization (Baldwin and Clark, 1997). In this work, efficient product development is defined as the acceleration of execution and the shortening of lead times, reducing uncertainties as early as possible to minimize costs (e.g. Cooper, 1997; Wheelwright and Clark, 1992; Gupta and Wilemon, 1990).

However, research has also shown that as the NPD processes get more efficient, the ability to absorb new and innovative technology concepts diminishes (Christensen, 1997; Sharma, 1999). Research on innovation in NPD processes has focused either on how to enable late changes within planned product structures, such as working with modules within a product architecture (Baldwin and Clark, 1997) or keeping a “planned flexibility” in the process (Verganti, 1999, Bhattacharya *et al.*, 1998), or on the early phases of NPD, the Front End (FE) of innovation (Reinertsen and Smith, 1991; Khurana and Rosentahl, 1997; Khurana and Rosentahl, 1998; Reid and de Brentani, 2004; Nobelius and Trygg, 2002). In those early phases, the costs of introducing innovative concepts and product changes are still relatively low (Reinertson and Smith, 1991) which makes it an important phase for companies that aspire to develop innovative products. Despite intensive research activity, most of the effort has been put into how to structure these early phases as well how to make them more efficient (e.g. Khurana and Rosenthal, 1997; Koen *et al.*, 2001; Burchill and Fine, 1997). Others have proposed the need for a context that fosters innovation, focusing on the roles of individuals (e.g. gatekeepers) or various organizational mechanisms (Van de Ven, 1986; Iansiti and West, 1997; Sharma, 1999; Colarelli O’Connor and Rice, 2001).

The model of an innovation funnel is often used to describe the complete R&D process consisting of four activities: input, feasibility, implementation and launch (Clark and Wheelwright, 1992). The authors claim that an efficient funnel has a wide opening and then rapidly narrows down as the viable solutions are selected. The search for and selection of new ideas is often described as the central parts of the innovation process (e.g. Laursen & Salter, 2006; Fetterhoff & Voelkel, 2006). Despite some authors claiming that NPD is centred around knowledge creation (e.g. Nonaka, 1991; Nonaka and Takeuchi, 1995; Madhavan and Grover, 1998), empirical studies have shown that there is little room for experimenting and learning in industries where product cycles are long and costly and NPD projects are very complex (Bartezzaghi *et al.*, 1997; Aggeri and Segrestin, 2007).

Unlike the NPD process, innovation is recognized to be a nonlinear process (Cheng and Van de Ven, 1996). Many researchers agree that innovation is an incontestable source of competitive advantage (e.g. Tushman and Nadler, 1986; Cooper and Kleinschmidt, 1987; Utterback, 1994) but to manage the innovation process is described as problematic since it is inherently linked to risk and uncertainty (Birchall and Tovstiga, 2005). Several authors stress that while the NPD process is appropriate for incremental innovation projects, it is quite inadequate for developing innovative products that are radically different from previous products (Veryzer, 1998; Eisenhart and Tabrizi, 1995; McDermott and Colarelli O'Connor, 2002; Rice *et al.*, 1998). The management of innovation is instead described as a balancing act between planning and chaos (Quinn 1985) and some researchers have argued that too much formalization can even be detrimental for innovation (Benner and Tushman, 2002; Murray and Blackman, 2006). It is well known that large, established firms have difficulties managing a more radical innovation process (Henderson and Clark, 1990; Dougherty and Heller, 1994; Christensen, 1997; Tushman and O'Reilly, 1997; Leifer *et al.*, 2001).

In their work on innovation processes, Le Masson, Weil and Hatchuel (2006) argue that it is not possible to work according to the logics of traditional R&D processes when the aim is to develop innovative products (Le Masson *et al.*, 2006). The authors define Research as “a controlled process for producing knowledge, answering previously formulated questions” and Development as “a controlled process that activates existing competencies and knowledge in order to specify a system (product, process, or organization...) that reaches well clarified criteria (quality, delay, cost) and for which the value for the company has been clearly conceptualized and more or less evaluated” (Hatchuel *et al.*, 2001:9). The authors further argue that in an innovation process, the value of future offers is not given: performances criteria and evaluation criteria are not known but needs to be designed and the competencies needed to develop new technologies or new solutions are even not identified (Hatchuel *et al.*, 2001; Le Masson *et al.*, 2006).

The NPD process is designed to be a rational process of stages that can be planned and made more efficient, enabling companies to reduce uncertainties and eliminate risks. However, aiming for innovative concepts implies a certain degree of experimentation and risk taking. The underlying rationales of NPD processes described in literature seem to fit badly with the underlying rationales of innovation that implies uncertainty. It is also noteworthy that there is an abundance of literature on the barriers to innovation (e.g. Assink, 2006; Moss-Kanter, 2006) and the difficulties of previously successful firms to succeed again (e.g. Henderson and Clark, 1990; Dougherty and Heller, 1994), but very little research on how to enable innovation and build efficient organizations that can support the development of innovative products. This weakness of the research field motivates the need for an increased understanding of how large companies work with innovation.

2.2 Absorptive capacity and innovative capabilities

The sources of innovation can be both internal and external (Drucker, 1985). Ideas for innovative products often stem from external actors (von Hippel, 1988; Von Hippel 2005), which is also accentuated in more recent research on open innovation and the management of activities outside the boundaries of the firm (e.g. Chesbrough, 2003; Dahlander, 2006). To be able to exploit any new idea, firms first need to identify and assimilate it. Already in the eighties, Daft and Weick (1984) described the firm as an

interpretation system where learning is the result of scanning and interpretation of data. According to the authors, the scanning process involves monitoring the environment and collecting data, formally or informally. Then follow the interpretation of data, when the data is put into the context of the organization and is given a meaning. Only then, organizations can learn and act on the new information. This interpretation is governed by two variables; “(1) management’s beliefs about the analyzability of the external environment and (2) the extent to which the organization intrudes into the environment to understand it” (Daft and Weick, 1984:287).

The term *absorptive capacity* (AC) of the firm (Cohen and Levinthal, 1990; Van den Bosch *et al.*, 1999; Lane *et al.*, 2006), was first coined by Cohen and Levinthal who defined it as “the ability of the firm to recognize the value of new external information and apply it to commercial ends” (Cohen and Levinthal, 1990:128). They argue that a firm’s absorptive capacity 1) build on prior investments in the absorptive capacity of individuals in the organization, 2) is path dependent and cumulative and 3) depend on the ability of the organization to share knowledge internally. Therefore they suggest that investments in R&D not only expand the knowledge of the firm, but also enhance the absorptive capacity of the firm. The authors further argue that the greater the absorptive capacity of a firm, the greater the ability to recognize emerging technological opportunities (Cohen and Levinthal, 1990). Van den Bosch *et al.* (1999) argue that the level of absorptive capacity of the firm depend on the organizational structure and the combinative capabilities of the firm.

In a review of the literature on the absorptive capacity construct, Zahra and George (2002) develop a generic model based on four organizational capabilities that they claim contribute to an enhanced absorptive capacity: acquisition, assimilation, transformation and exploitation of knowledge. Based on this framework they introduce the notions of *potential absorptive capacity*, (for the first two capabilities) and *realized absorptive capacity* (for the last two). The authors underline that developing the potential absorptive capacity is not enough to enhance performance - that necessitates also the realization of the absorptive capacity (Zahra and George, 2002). These notions have been criticised for omitting some of the fundamentals of the original concept, such as the differences between individual and organizational learning (Todorova and Durisin, 2007).

In a recent literature review, Lane, Koka and Pathak (2006) build on Cohen and Levinthal and propose a process model based on an extended definition for AC, with antecedents and outcomes. They introduce an elaborated definition: “Absorptive capacity is a firm's ability to utilize externally held knowledge through three sequential processes: (1) recognizing and understanding potentially valuable new knowledge outside the firm through exploratory learning, (2) assimilating valuable new knowledge through transformative learning and (3) using the assimilated knowledge to create new knowledge and commercial outputs through exploitative learning.” (Lane *et al.*, 2006:856). They define transformative learning as linking explorative and exploitative learning, allowing existing knowledge to be used in new ways (through the combination of existing and new knowledge). Their model is presented in Figure 1 below.

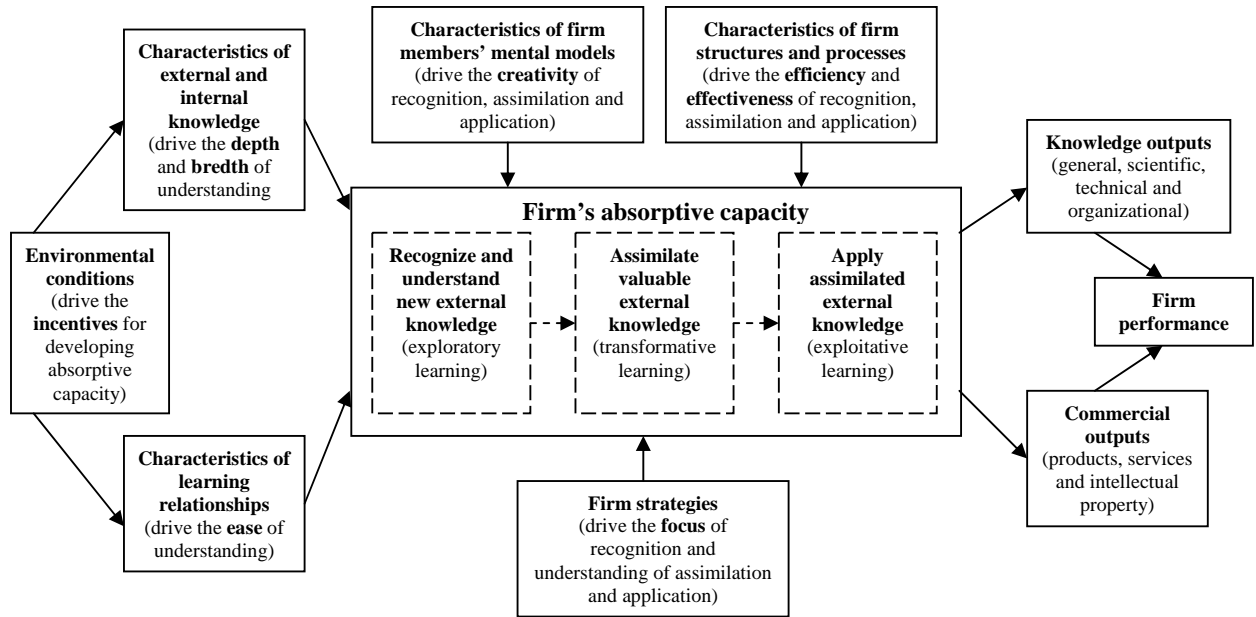


Figure 1. A process model of Absorptive Capacity, its antecedents and outcomes. (Source: Lane *et al.*, 2006)

Further, Szulanski has also shown that a weak absorption capacity in an organization is one of the main barriers to knowledge transfer and he stresses the need to develop learning capacities in the organizational units, to foster closer relationships and a systematic understanding of different practices (Szulanski, 1996). Also other authors have stressed the link between absorptive capacity and the firm's capability to learn (Todorova and Durisin, 2007) and to enable innovation (e.g. Williander, 2006). Assink (2006) also underlines the necessity to continuously develop the absorptive capacity of firms as a way of improving their overall *innovative capabilities*, a term often used interchangeably with absorptive capacity. Assink (2006) defines innovative capabilities as: "the internal driving energy to generate and explore radical, new ideas and concepts, to experiment with solutions for potential opportunity patterns detected in the market's whitespace and to develop them into marketable and effective innovations, leveraging internal and external resources and competencies" (Assink, 2006:219). An alternative definition is "a collective capacity to permanently and simultaneously recreate new sources of value (products, concepts, patents, environmental values etc.) and competences (knowledge, know-how, professions etc.)" (Le Masson *et al.*, 2006:21).

3. METHOD

3.1 Research approach

This paper aims at exploring how large firms deal with innovative concepts in practice and discuss the notion of absorptive capacity in the context of innovation. It builds on results from two collaborative research studies. Collaborative research is defined as "an emergent and systematic inquiry process, embedded in a true partnership between researchers and members of a living system for the purpose of generating actionable scientific knowledge" (Shani *et al.*, 2004:84). The problems addressed are emergent and

developed in collaboration with the industrial partner as the mutual understanding of the knowledge area increases. A combination of academic problem definitions and an industrial perspective on relevant challenges, leads to intermediary theories that can be tested and further developed in an iterative manner (Adler and Shani, 2001). Using an abductive approach, revisiting relevant literature as the understanding of the subject grows, enables a joint knowledge generation process, where both academics and practicing managers take part. A key notion of collaborative research is the generation of *actionable scientific knowledge*, that is knowledge that is as relevant to the research community as it is to managers (Starkey and Madan, 2001) and can be acted upon (Argyris, 1995).

Since the aim of this paper is to understand actual practices, the companies have been studied in real time and the results of those studies have not been known on beforehand, the research approach has been of an exploratory nature. Studying product development in experimental settings is always challenge in itself as the organization often does not know what the outcome will be (Thomke, 2001). The included studies are qualitative and build on the creation of in depth knowledge of a limited number of case companies, enabled by the collaborative research approach. The concept of a case in itself is not easily defined (Ragin and Becker, 1992), but it has been argued that there is no need for numerous cases to justify knowledge generated in case studies (Easton, 1995; Siggelkow, 2007). Eisenhart (1989) suggests that a number of research methodologies should be used for case studies, in order to “triangulate” the results. In the two studies that this paper builds on, several methods have been used such as ethnographic data collection, interviews, documentation studies and discussion seminars. Both studies are described in more detail in previous publications (for study I see Backman et al., 2007; Elmquist, 2007b and for study II see Elmquist and Segrestin, 2007).

3.2 Study I: Concept work and concept cars at Volvo Cars

The first study was conducted at Volvo Cars where a long term collaborative partnership on the practices of innovation and early phases of R&D enabled both a broad interview study on concept work and an in-depth study of a concept car project. The interview study was based on 16 semi-structured interviews designed to capture how different players viewed and worked with innovative concepts and the integration of such concepts with the NPD process. Interlocutors were selected on the basis of their key roles in the interplay between Product Planning, Design and R&D. The interviews were made in pairs, with a varying constellation of researchers. Notes from the interviews were made by one of the interviewees and then completed by the second. An abductive approach for interpretation of the data was applied, where the empirical data was viewed against an intermediate conceptual models and understanding was continuously developed, referred to as systematic combining (Dubois and Gadde, 2002). Interview results were combined with contextual knowledge from a number of other studies of conceptual work at Volvo Cars as well as with the pre-understanding and continuous data collection of insider researchers in the team (Bartunek and Louis, 1996).

Also, a longitudinal study of a concept car project was conducted (see Backman, 2005), following both the development phase (2003-2004) and the absorption of innovative concepts into the NPD process. During the project, data was mostly collected through the observation of project management meetings in an ethnographic approach. After each encounter, detailed field notes (van Maanen, 1988) were written where the activities of each meeting were systematically reflected upon. A total of 130 formal

meetings, mounting to a total of 170 hours, and numerous informal meetings and lunches were attended to. In addition to this, 18 interviews were made with project members and key stakeholders during the project and internal documentation was studied. Two discussion seminars were also organized with the project members. Two years after the project, another 24 interviews were conducted on how the innovative concepts developed in the project had been absorbed into the organization. In total, 42 interviews were conducted on the concept car project, they were recorded and transcribed and the data was analyzed and interpreted based on sub themes. The analysis followed a systematic combining model (Dubois and Gadde, 2002), working with the creation of intermediate models and the iterative collection of data. The results have also been discussed with managers at Volvo Cars to strengthen the validity of the analysis.

3.3 Study II: Drug design in PharmaCorp

In 2003, a collaborative research project was launched with PharmaCorp with the objective of increasing the understanding of how to organize early phases of discovery work. A joint interest in understanding the managerial processes used by the discovery department of PharmaCorp at that time led to the design of an exploratory study. It had an explicit action orientation where our results would serve as input for the company in their creation of a new Biopharma Asset Team in the discovery organization. Data was collected through a combination of interviews, discussion seminars and analysis of documents¹. The first part of the study focused on an ongoing process for identifying and evaluating drug candidates outside the traditional therapeutic areas, known as the scouting process. In a second part, it was decided that the study would investigate two internal but exploratory projects (subsequently called “the resting project”, and the “unmasking project”) two projects that lay outside the established areas of expertise. A total of 39 interviews were conducted at PharmaCorp, and two discussion seminars were organized to validate the results. The interviews were all open-ended, semi-structured, and always undertaken in pairs. All interviews were summarized and reflected upon in a structured way by both interviewers. In addition to and in parallel with the interviews, internal documentation was studied.

The data analysis was made on an ad hoc basis. First, the material was studied and then comparisons were made between the projects, their phases, initiation, knowledge acquisition etc. Patterns and links were searched for and intermediary models were developed, tested and refined. The analysis was thus abductive (Alvesson and Sköldbberg, 1994) and another example of systematic combining (Dubois and Gadde, 2002). Also, managers and project champions at PharmaCorp were involved in testing and questioning our evolving results and the results were tested in the discussion seminars.

4. THE PREREQUISITES FOR INNOVATIVE CONCEPTS – SOME FINDINGS

4.1 Findings from Volvo Cars

The study of concept work at Volvo Cars revealed that different types of concepts seem to have different inherent driving forces which influence their ability to impact the NPD

¹ This study was supposed to lead to a third study based on the results, but unfortunately the study was terminated in 2004, due to a lack of further funding.

processes (Backman et al., 2007). Two main categories of concepts could be distinguished: on the one hand, technology driven concepts (including design driven concepts), and on the other hand, customer and market driven concepts (including service and value driven concepts). It was shown that technology driven concepts are more likely to successfully be integrated in the NPD process since they can be processed, calculated and evaluated with familiar metrics. Looking at the formal processes, such as the business evaluation process, the advanced engineering process and the stage gate process, they were all designed to accommodate technology driven concepts using its inherent language and norms. Design driven concepts are included in this category since they were related to those processes in a natural way and fit well with the evaluation models. However, customer and market driven concepts experienced certain difficulties since they often came in a different shape. They also had a lower status in the organization and several examples showed that they had to find alternative ways to actually make their way into the processes, failing in the regular evaluation processes. The customer and market driven concepts that did succeed had extraordinary support, for example from strong individuals with high credentials in the organization, or from external attention that created external pressure on R&D to prioritize those ideas.

The study of the concept car confirmed the difficulty of the organization to exploit innovative concepts created in the project (Elmquist, 2007b). Based on the framework developed by Szulanski (1996) some barriers to learning could be identified. First, the *knowledge created was of a different character*, not necessarily directly linked to the product itself – much of it was related to norms and values. The project was also dependant on a strong support from the CEO, by-passing the regular processes for launching a concept car project. This was necessary to keep the project alive, but it also created barriers to learning through the *NIH effects of building a strong group on the side*. To learn from the project, resulting knowledge needs to be integrated into the established processes, and the fact that the group was constituted by an all-female team made the distance to the organization dominated by men even greater. The *lack of integration* resulted in communication problems. Finally, a strong barrier to learning lay in *the organizational context*. Since there were no processes, no support and no evaluation in the routines of organizing concept car projects; it was based on ad hoc activities and individual capabilities. On an organizational level, there was no clear strategy, no responsibility nor even a clear role for this type of project. The study showed that despite abundant knowledge production in the project, there was no guarantee for organizational learning.

Even though many strong ideas continuously emerge at Volvo Cars, they often fail to enter the NPD process or fail in early evaluations. It is easier to evaluate a technology driven concept that fits with the formal evaluation tools and methods, but this leaves little room for untested innovative concepts with revenues that are future-based and therefore difficult to pinpoint – which is often characteristic for market and customer based concepts. The structured process seems to easily suffocate concepts that deviate from the more easily recognizable concepts, instead of investigating their potential opportunities. The more innovative concepts will not be recognized as viable and thus not selected for further development.

4.2 Findings from PharmaCorp

In the pharmaceutical industry, decreasing productivity is an important concern (e.g. DiMase et al, 2003). As drug development becomes more risky and more costly,

discovery departments of pharmaceutical companies are increasingly compelled to provide strong drug candidates for efficient development processes and quick market launches. The study at PharmaCorp explored the actual practices of a discovery department (Elmqvist and Segrestin, 2007). Through modelling both a scouting (screening) process initiative and two exploratory projects from a design reasoning perspective, much contrasted FE activities were highlighted. The analysis suggested that the screening logic is insufficient when entering new fields where the knowledge base is weak. When PharmaCorp actively tried to develop a new therapeutic area through screening the market for sustainable ideas to internalise and develop further, they failed completely despite an important investment. Actually, they did not have enough knowledge internally to evaluate what ideas were the viable ones. The analysis of the two exploratory projects suggested instead that a more successful way of entering the therapeutic area was to begin in an area where they already had some knowledge and then actively work on developing it further. The discovery process in this case was actually more of a *design process* where the iterative generation of new concepts and new knowledge led the work; the product concept was not selected and narrowed down to one optimal candidate, but concept generation was rather about the expansion of the attributes into a range of concepts.

4.3 Innovation and the limits of the selection logic

The studies show that innovative concepts, especially if based on customer and market knowledge, have difficulties impacting the NPD processes, they are not selected. The results also indicate that screening concepts is not a successful way of entering new areas since the knowledge needed to evaluate innovative ideas is missing. Instead, a more successful approach turned out to be to begin where some knowledge existed and then actively work on developing it further, developing new concepts in a generative process. The results from both studies indicate that traditionally used selection logic is not efficient when aiming at innovation.

Innovation processes are often described generically as consisting of four steps: to search, select, implement and learn (e.g Tidd et al., 2005). But as highlighted by the two studies, this approach is built on two important assumptions:

- That the knowledge exist, i.e. that the company has enough knowledge internally to recognize good opportunities (it knows what to look for)
- That the opportunities exist, i.e. that there are a number of “available opportunities” to chose from (there is something to find)

But when companies want to develop innovative products, companies do not always have the relevant knowledge to recognize a good idea. There is also a risk that opportunities that are difficult to evaluate in traditional decision models are not chosen. The studies show that in the development of more innovative products and services, these assumptions are not necessarily true (Backman et al., 2007; Elmqvist and Segrestin, 2007). Therefore, to develop more innovative products, the prevailing selection logic is not enough – and these assumptions need to be revisited.

If assuming that in an innovative situation a company does not have all the necessary knowledge, nor can rely on the availability of opportunities, an alternative approach to developing innovative capabilities is needed. It is thus proposed that the notion of absorptive capacity should be complemented with a notion of *generative capacity* signifying the firm’s ability to develop new knowledge, internalise valuable knowledge

and apply it internally. To enable an efficient R&D process and the development of more innovative products, both these capacities seem equally important.

5. ABSORBING IS NOT ENOUGH TO BE INNOVATIVE – INTRODUCING GENERATIVE CAPACITY

5.1 Revisiting absorptive capacity from an innovation perspective

The literature on learning seemingly offers a more dynamic view of the firm than R&D literature in general, as it describes how an organization can change through expanding its knowledge base. Yet, when looking at the model of the firm as an interpretative system as proposed by Daft and Weick (1984), it is based on the same prevailing assumptions. Although the authors discuss the environment in terms of analyzability they do not question how the strategy is influenced by the existing knowledge base of the firm that interprets the signals (the ability of the firm to identify what to scan), nor does it worry that the opportunities/knowledge may not be there to find. This reactive approach is linked to the prevailing selection logic of the NPD processes.

Absorptive capacity is also defined as a quite passive construct– to *recognize knowledge and to apply it* (Cohen and Levinthal, 1990). In more recent literature the dimension of internalizing the knowledge (combining old and new knowledge to see how it is valuable to the organization) has been added to the notion. Absorptive capacity is then described as a capability based on three activities, to *recognize, assimilate and apply new knowledge* (Lane *et al.*, 2006). However, it still builds on the same assumptions – that there is enough knowledge available to identify signals in the environment and that the signals are there to be identified. Further, in Cohen and Levinthal’s (1990) discussion on enhancing absorptive capacity, the result is defined as recognition of *technological* opportunities, ignoring that not all opportunities may be of a technological character.

The outcome of absorptive capacity is described as both knowledge and commercial output, as shown in Figure 2 below (partial figure from Lane *et al.*, 2006:856).

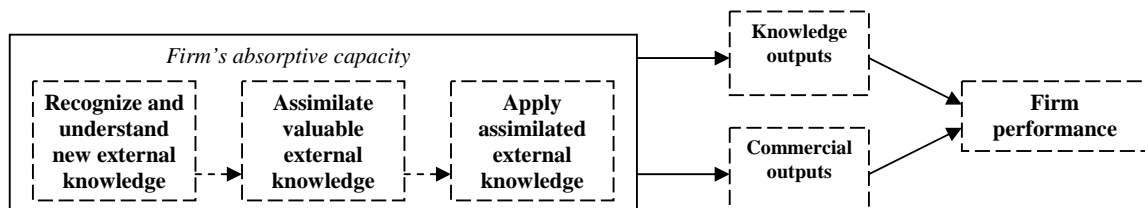


Figure 2. Absorptive capacity and its outcomes (Lane *et al.*, 2006)

Despite this elaborated wording, the absorptive capacity notion is still reactive, and based on the same assumptions - that the opportunities exist and can be recognized with the available knowledge. This is mirrored in the potential and realized absorptive capacity notions introduced by Zahra and George (2002). They claim that acquisition and assimilation is activated by a trigger and that social integration mechanisms govern whether the absorptive capacity is realized (Zahra and George, 2002). Despite describing absorptive capacity as a dynamic capability, this model does not encourage firms to more actively generate new concepts and search for new knowledge (initiate the signals). Other authors have suggested the addition of feedback loops to enable

learning (Todorova and Durisin, 2007) but without addressing the underlying assumptions.

5.2 Towards a dual model for developing innovative capabilities

Assink defines innovative capabilities as “the internal driving energy to generate and explore radical, new ideas and concepts, to experiment with solutions for potential opportunity patterns detected in the market’s whitespace and to develop them into marketable and effective innovations, leveraging internal and external resources and competencies” (Assink, 2006:219). Stressing more on the collective aspect, Le Masson, Hatchuel and Weil define innovative capabilities as “a collective capacity to permanently and simultaneously recreate new sources of value (products, concepts, patents, environmental values etc.) and competences (knowledge, know-how, professions etc.)”(Le Masson *et al.*, 2006:21). In contrast to the absorptive capacity construct, both Assink (2006) and Le Masson *et al.* (2006) thus see innovative capabilities as the capacity to actively and iteratively both explore and generate knowledge, an aspect not covered by the absorptive capacity construct. In line with these definitions, the notion of a firm’s *generative capacity* or the ability to actively generate new knowledge and new opportunities is proposed. Although literature on innovative capabilities underlines the need to explore and recreate, NPD models seem to theoretically build exclusively on the selection logic, which is not in line with the ability to be innovative. The empirical results also show that this logic is insufficient when aiming at developing more innovative products. Selecting is important, but not enough.

Combining the well known notion of absorptive capacity with a generative capacity is thus a way of re-conceptualizing the innovative capabilities and complementing the hitherto prevailing selection logic. Such generative logic would imply that decision and evaluation processes would value not only knowledge and commercial output as suggested in Lane, Koka and Pathak’s model (2006), but also the identification of knowledge gaps and the new ideas and concepts generated in such design process (c.f. Le Masson *et al.*, 2006). To enable managers to work with the strengthening of the innovative capabilities of the firm, a new conceptual model for innovative capabilities is suggested, based not only on a firm’s ability to absorb new knowledge, but also on its ability to work with the generation of new concepts and knowledge. Innovative capabilities are thus considered: *a firm's ability to (1) absorb new knowledge through recognizing and understanding potentially valuable new knowledge and (2) generate new knowledge through actively experimenting and creating potentially valuable new knowledge. This new knowledge is then assimilated and applied to create commercial outputs and to develop new knowledge and new concepts as well as to identify relevant competence gaps.* In Figure 3 below, this tentative model for describing a firm’s innovative capability, entailing both absorptive and generative capacities, is proposed.

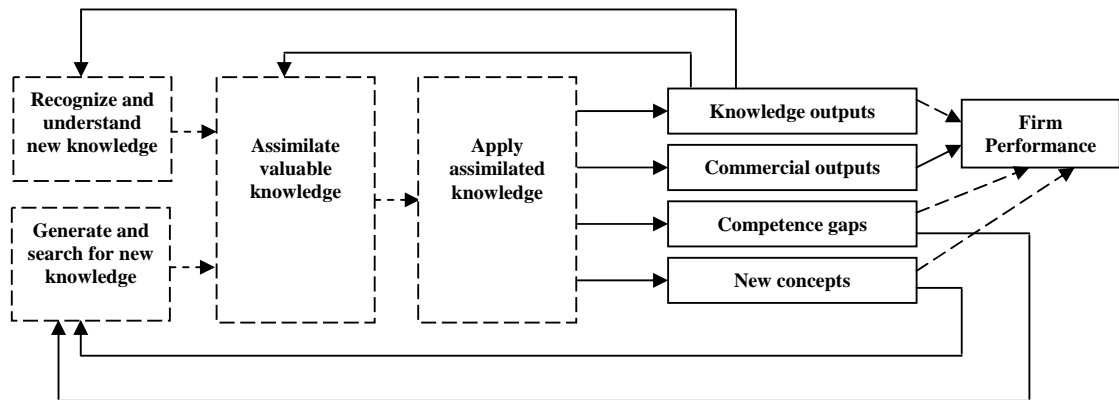


Figure 3. A conceptual model for a firm's innovative capability.

Building on previous research on absorptive capacity, this model is based on the assumption that the processes for absorbing internally produced knowledge (internal to the firm or even from within R&D) present as much of a challenge as absorbing external knowledge, which is why knowledge in this model refers to both internal and external knowledge. The model describes an iterative process where both the absorptive capacity and the generative capacity induce knowledge that lead to four types of output. The commercial output is the revenue coming from the products and services that result from the application of knowledge. The knowledge outcome is looped back into the process, but also used in the assimilation of new knowledge. These outcomes were described by Lane et al (2006) as related to absorptive capacity. This model also recognizes the identification of competence gaps, used to develop new knowledge and skills, and the generation of new concepts to launch new exploratory projects. These outputs may not lead to short term firm performance but they do contribute to the future competitiveness of the firm, and the long term firm performance.

This model can be used on multiple layers; it is applicable on individuals as well as on a process level or a company level, as was suggested for AC by Cohen and Levinthal (1990). This model also has some links to the hypertext organization proposed by Nonaka and Takeuchi (1995) in that it considers knowledge creation as a key to innovative capabilities, and in that it argues that the knowledge created in the NPD process must be looped back into the wider organization to find its application. It is also related to the RID structure and the design-oriented organization (Hatchuel *et al.*, 2001; Hatchuel et al., 2003; le Masson *et al.*, 2006) where Innovation is seen as a set of structures and processes that generate relevant knowledge as input to R&D.

The suggested model underlines that the NPD process also play an important role as a generative process where multiple types of value are created. The product-centred image of R&D as a sequential process that needs to be optimized and efficient (e.g. Wheelwright and Clark, 1992) has led to the image of a trade-off between efficiency and innovation. In the model proposed here, the integration between generative and absorptive processes is a fundamental dimension and managerial challenge to enable both an efficient NPD process and the development of more innovative products. This integration is achieved through the explicit management of the interface between knowledge generation activities and the NPD processes - sometimes referred to as a duality perspective (Janssens and Steyaert, 1999). The tentative model presented here provides a starting point for a better understanding of a firm's innovative capabilities but further research is needed to validate its actionability and provide managerial tools.

6. CONCLUSION

In the academic field, it is indisputable that innovation contributes to the long term competitiveness of the firm (e.g. Tushman and Nadler, 1986; Cooper and Kleinschmidt, 1987; Drucker, 1988; Utterback, 1994; Thomke, 2001). Although the urgency to innovate is often present in management discourse, managerial actions tend to focus on achieving short term development efficiency. However, innovation is not a rational process that can be optimized as such. What needs to be managed is rather the development of innovative capabilities to be able to develop innovative products in an efficient way. In NPD theory, it is argued that innovative capability is based on a firm's ability to recognize and exploit external opportunities, or the absorptive capacity of the firm. However, efficient R&D processes do not necessarily lead to innovative products.

This paper set out to explore how large firms deal with innovative concepts in practice. It was shown that innovative concepts, based on other knowledge than the knowledge base of the prevailing business had difficulties entering the NPD processes in the firms. It was argued that NPD processes are insufficient when aiming at developing innovative products. This is in line with previous research (Veryzer, 1998; Eisenhart and Tabrizi, 1995; McDermott and Colarelli O'Connor, 2002; Rice *et al.*, 1998) arguing that NPD processes are designed mainly for developing well-defined products in an efficient way. Further it was argued that NPD processes are based on two basic assumptions, that the existing knowledge is sufficient (that the actors in the process possess enough knowledge to respond to the right signals) and that the opportunities already exist (that there are a number of existing potential opportunities to select among). A modification of these assumptions was suggested in innovative situations. As a consequence, it was argued that the innovative capabilities of a firm can be described and managed as a dual capability consisting of both a firm's ability to absorb new knowledge and its ability to generate new knowledge. It was further argued that a close integration between generative and absorptive processes is a fundamental dimension to enable both an efficient R&D process and the development of more innovative products.

Finally, a conceptual model of such innovative capabilities was proposed as an integrative model between AC and GC. The model highlights that while investments in R&D build the AC of a firm few firms invest in the generative processes of learning and knowledge generation that build long term competitiveness. This does not mean that the absorptive capacity of a firm is any less important for innovations than previously argued – only that, for companies that want to develop their innovative capabilities, a single focus on absorbing is not sufficient.

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² The author changed her family name from Backman to Elmquist in Nov 2006.

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