



Paper to be presented at the  
35th DRUID Celebration Conference 2013, Barcelona, Spain, June 17-19

## **The role of operational and dynamic capabilities in ambidextrous innovation: A longitudinal analysis**

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### **Abstract**

The benefits of simultaneous exploration and exploitation, generally referred to as ambidexterity, are well documented in the literature. However, there is scarce knowledge about how firms are able to achieve ambidexterity. This paper addresses this issue in the context of the innovation process. Drawing on the capability approach in the evolutionary theory of the firm we examine the relative roles of operational capabilities and dynamic capabilities in firms' ability to simultaneously develop explorative and exploitative product innovations using a longitudinal quantitative research design. Results show direct and indirect relationships between capabilities (dynamic and operational) and product innovation.

# The role of operational and dynamic capabilities in ambidextrous innovation: A longitudinal analysis

## ABSTRACT

The benefits of simultaneous exploration and exploitation, generally referred to as ambidexterity, are well documented in the literature. However, there is scarce knowledge about how firms are able to achieve ambidexterity. This paper addresses this issue in the context of the innovation process. Drawing on the capability approach in the evolutionary theory of the firm we examine the relative roles of operational capabilities and dynamic capabilities in firms' ability to simultaneously develop explorative and exploitative product innovations using a longitudinal quantitative research design. Results show direct and indirect relationships between capabilities (dynamic and operational) and product innovation.

## 1. INTRODUCTION

According to managers of top-performing firms, product innovation is a key antecedent to competitiveness and economic performance (Carden, 2005). This practitioner statement is consistent with the evolutionary theory of the firm which argues that the evolutionary fit between the firm and the environment is the key measure of organizational performance. Firms with good fit are rewarded with growth and profits while firm with poor fit shrink and face exit. It further argues that innovation, especially product innovation, is the key mean through which firms can secure or improve their evolutionary fitness (Nelson & Winter, 1982).

The extent to which firms can purposefully adapt, change and introduce new innovations to secure their evolutionary fitness is however debated. Some argue that firms are inert and eventually will be replaced by new firms in the evolutionary process of variation-selection and retention (e.g. Barnett & Carroll, 1995). Other theorists argue that firms can purposefully adapt and change (e.g. Eisenhardt & Martin, 2000). Empirical research offer support for both the "selection" argument and the "adaption" argument, which leads to the

following key issue which lies underneath much debate in the management sciences: “Can organizations adapt and change – and if so how does this occur?” (O’Reiley & Tushman, 2007, p.3).

Research has argued that firms need to conduct both exploration and exploitation in order to successfully change and to secure or even improve their current and long-term evolutionary fitness (March, 1991). While the benefits of ambidexterity are now well understood, there is much scarcer knowledge about why and how some firms are better able to achieve ambidexterity. The research in this paper is motivated by the scarce knowledge surrounding this issue. Framed within the context of the innovation process, we seek to examine how and why some firms are better able to develop exploitative and explorative product innovations simultaneously.

The capability approach in the evolutionary theory of the firm suggests that capabilities within the firm and their evolution over time may have the potential to help explain why firms differ (Nelson & Winter, 1982; Nelson, 1991; Teece et al, 1997). The paper thus aims to analyze to what extent this theoretical framework can be used to understand why firms differ in their ability to achieve ambidexterity in the product innovation process.

Evolutionary theory argues that capabilities (sometimes also referred to as routines) comprise the firm’s fundamental structure and that a capability hierarchy exists within the firm. The capability hierarchy distinguishes between operating capabilities (OC) and dynamic capabilities (DC) (Dosi, Nelson & Winter, 2000; Nelson & Winter 1982, Schumpeter 1934, Winter 2003). Operating capabilities govern in this framework the firms’ day-to-day activities, reflecting the firm’s selectively retained experience and current capacity for innovation, while the role of dynamic capabilities is to alter the firm’s operating capabilities in order to enable future spells of innovation. With this theoretical insight as a guide, the paper asks the following research question: What is the relative role of ordinary and dynamic capabilities in firms’ ability to develop both exploitative and explorative product innovations? Our rather broad research question is elaborated into six hypotheses to be tested in a longitudinal quantitative research design which tracks firms over time.

This paper makes the following contributions to the literature. First, we use the capability approach in the evolutionary theory of the firm as a theoretical frame of reference for

understanding how and why some firms achieve ambidexterity in the product innovation process. Although this has previously been recommended (Tushman & O'Reiley, 2007), few prior studies have used this theory to study ambidexterity in the innovation process, in particular over time. Second, this paper helps to test and clarify how dynamic and operational capabilities affect the firm's ability to introduce new product innovations, both exploitative and explorative, and therefore increases our knowledge on the organizational factors and mechanisms that enable product innovation within firms, an issue which has been called for in the literature (Connor, 2009; Perez-Luño et al., 2010). Third, we empirically test the relationship between capabilities (OC, DC) and innovation outcomes, thereby extending previous evolutionary theorizing on this issue which has been mainly conceptually discussed the relationship between OCs and DCs and how they influence innovation performance over time (e.g. Danneels 2011, Ellonen et al. 2009, Lee & Kelley 2008, Lichtenthaler & Lichtenthaler 2009, Newey & Zahra 2009, Verona & Ravasi 2003). As argued by others, the empirical analysis of the potential for an organization to actually invoke changes on its operational capabilities via dynamic capabilities is still scarce in the literature (Zahra et al., 2006; McKelvie and Davidson, 2009). Fourth, by introducing a longitudinal setting we are able to empirically study the evolution of operational capabilities and its relationship with dynamic capabilities. Thus, the paper is able to advance our knowledge on the dynamic aspects of capabilities - an important yet neglected element of DC literature (Arend & Bromiley, 2009, Lichtenthaler & Ernst, 2012). In previous literature, the empirical research on the central function of which DCs, i.e. changing operational capabilities, has been is missing.

The remainder of this article is organized into four sections. In the next section we discuss and review the literature on DCs and its relationship with a firm's capability base and innovation. This is followed by a section presenting the research methodology and the empirical data used to test the hypotheses. The analysis is conducted in section four. Finally, the research findings are discussed and theoretical and managerial implications are pointed out.

## 2. THEORETICAL FRAMEWORK AND HYPOTHESES

### 2.1. The capability hierarchy and the relationship between dynamic and operational capabilities

The theoretical point of departure in this paper is the evolutionary theory of the firm (Nelson & Winter 1982, Schumpeter 1934, Winter 2006). Two central tenets of the evolutionary theory are that capabilities are considered as the building blocks of firms and that the presence of path dependency is important in evolution of organizations (Nelson & Winter, 1982; Hodgson & Knudsen 2010). Capabilities are in this perspective the know-how that enables firms to perform their characteristic output activities, i.e. creating product or providing services (Dosi, Nelson and Winter 2000).

In the literature on capabilities, stemming from the evolutionary and behavioural theories of the firm, a dominant view is that they can be ordered hierarchically into operational capabilities and dynamic capabilities (Ambrosini et al., 2009; Collis, 1994; Helfat & Peteraf 2003, Helfat et al., 2007; Winter, 2003; Zahra et al., 2006).<sup>1</sup> Operational capabilities are used to perform the everyday activities and operations of the firm on an on-going basis, while dynamic capabilities on the other hand modify and extend the ordinary capabilities.

Dynamic capabilities have been defined as: *“the capacity of an organization to purposefully create, extend or modify its resource base”* (Helfat et al. (2007, p. 1). DCs thus refer to the capabilities by which managers influence their ordinary day-to-day activities (i.e. their operational capabilities) needed to pursue new market and product opportunities

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<sup>1</sup> Ordinary capabilities have been called by various names: Substantive capabilities in Zahra et al. (2006), Operating capabilities in Newey & Zahra (2009), Operational capabilities Cepeda & Vera (2007) and Helfat & Winter (2011).

(Eisenhardt and Martin, 2000; Lichtenthaler & Ernst, 2012; Marsh & Stock, 2003; Newey & Zahra, 2009; Pisano, 1994; Winter, 2003; Zahra et al., 2006).

As population ecologists point out, firms are prone to inertia, which is a prevalent and even necessary characteristic of operational capabilities (Nelson & Winter 1982; Newey & Zahra, 2009). Inertia may be detrimental to strategic change and thus lead to the failure of the firm. Operational capabilities may become what Schreyogg & Liesch-Eberl (2007) call rigidities. This is where dynamic capabilities enter the picture - they allow the firm to change and adapt purposefully.<sup>2</sup> The main function of dynamic capabilities is to govern the rate of change of operational capabilities (Collis 1994, Winter 2003, Zahra et al. 2006), and thus enable the firm to evolve in a sustainable manner, to overcome inertia, and to adapt to changing circumstances, whether environmental or internal (Helfat et al. 2007; Newey & Zahra 2009; Eisenhardt & Martin, 2000) without having to resort to ad hoc problem solving.

DCs thereby constitute the means for changing and renewing current processes, providing a basis on which to achieve innovation and a better fit with the environment (see Helfat, et al., 2007; Eisenhardt and Martin, 2000; Zollo and Winter, 2002; Winter, 2003; Zahra et al., 2006).

Within the context of product innovation, the role of DCs is to influence the firms' operational capabilities in relation to technology and marketing, henceforth technological OC and marketing OC, in creating new products (Acur et al. 2010; Danneels 2002; Ngo & O'Cass 2012). Technology and marketing OCs may be understood as the firm's expertise, know-how and difficult to imitate, often tacit, knowledge about technology/new product

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<sup>2</sup> Some researchers suggest that there exists a paradox in defining dynamic capabilities as routines: they are supposed to create change in the firm, while at the same time routine is by definition stable. However, in this study it is acknowledged that capabilities are routines as portrayed in the evolutionary theory of the firm and the change they create focuses on the lower order capabilities (e.g. Dosi et al. 2001; Winter 2000, 2003). Hence, dynamic capabilities themselves may be inert. To understand the nature and role of routines in organizations see e.g. Hodgson & Knudsen (2010).

development and about the needs and wants of the market and the customer. Because product innovation is the market introduction of new products, it is argued that firms may benefit from having superior operational technological OC in order to create a novel technological product, and superior market OC to identify a product innovation that the market wants.

It is further argued in the literature that firms need to change their operational capabilities. The reason is that innovation is considered to be an outcome of a search process where firms recombine new and old knowledge into new products and services (Nelson & Winter, 1982; Schumpeter, 1934). Theorizing and empirical studies has on the other hand shown that many firms find it difficult to develop new knowledge. Left on their own, firms have a clear tendency in the innovation process to conduct local search where the focus is on the exploitation of knowledge that the firm already knows and have access to (Stuart & Podolny, 1996; March, 1991). The disadvantage of using familiar knowledge in the innovation process is that it seldom brings in new pieces of knowledge that firms can recombine into new innovations. Thus, the capability approach in the evolutionary theory of the firm argues that firms need to alter their operational capabilities over time in order to be able to adapt to new environmental changes and conditions in order to secure their evolutionary fitness (Newey & Zahra, 2009).

We recognize that there are a range of different DCs that are important for firms, which thrive to change (see e.g. Ambrosini & Bowman 2003, Danneels 2010, Mckelvie & Davidson 2009, Teece 2007, Verona & Ravasi 2003). Recent literature on dynamic capabilities has identified a number of these different types of dynamic capabilities (e.g. Bowman & Ambrosini 2003; Madsen 2010; Teece 2007). In this paper we focus on the core element of dynamic capabilities, which is the reconfiguration and renewal of the organizational capabilities. Within the context of product innovation, DCs that reconfigure the resource and capability base of the firm is particularly important. Consistent with this argument we

specifically address the *resource reconfiguration* capability, which expresses firms' capacity to create, extend or modify its capability base.<sup>3</sup>

Figure 1 illustrates a simplified version of our conceptual model. The core assumption in our model is that dynamic capabilities affect innovation output indirectly by enabling purposeful change in the technological and market capabilities over time (Benner, 2009; Danneels, 2002, Verona & Ravasi, 2003). The model will be elaborated in the next section where specific hypotheses about the interplay between DC, OC and innovation over time are formulated on the basis of theory and prior research.

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## 2.2. The evolution of organizational capabilities

Especially in the so called population ecology literature it is heavily emphasized that the pre-existing and even initial capabilities are practically unchangeable and thus organizations are inert by nature (Hannan & Freeman 1989). The strategic management literature has, on the other hand, claimed that firms are able to actively create capabilities which lead to competitive advantage and improved evolutionary fitness. Research offers support to both views (O'Reiley & Tushman, 2007). Thus it seems that firms are able to change although organizational capabilities are subject to powerful inertial forces (Cockburn et al. 2000, Nelson 1991). Research on organizational capabilities suggests that they evolve over time

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<sup>3</sup> Although operationalized in a slightly different manner, this is similar to what Lichtenthaler & Ernst (2012) in their very recent paper describe as the transforming capacity.



through the learning mechanisms of firms (Winter 2000, Zollo & Winter, 2002). The function of dynamic capabilities is to change the operational capabilities when perceived necessary by the management (Winter, 2000). However, as argued above, path dependency and inertia are inherent features of organizational capabilities. Firms build on their previous capability and learning base, which may lead to a virtuous cycle where firms become better at the capability they have previously acquired, but equally likely capabilities can become a burden if the fit to the operational environment is lost (Newey & Zahra 2009). As routines are by definition inert, managing change in capabilities is not an easy task. Previous literature suggests that while firms can and do change, change, and especially radical departure from pre-existing capabilities, is difficult if not impossible (Helfat 2000; Nelson & Winter 1982). However, whether and to what extent dynamic capabilities are able to change operational capabilities is seldom addressed in the literature. There exist a number of reasons why change in operational capabilities is hard and may end in failure. Change can be constrained by the initial capabilities, path dependency, and the satisficing nature of learning (e.g. Cockburn, Henderson & Stern 2000; Langlois & Steinmueller 2000; Tripsas & Gavetti 2000; Winter 2000). When creating capabilities organizations must typically make a set of specific and highly complementary investments in tangible assets, in process development, and in the establishment of relationships (Winter 2000). The path dependency in the initial or pre-existing capabilities may lead to cognitive myopia, where the managers become too narrow sighted when embedded in their value networks (Christensen 1997; Tripsas & Gavetti 2000). In addition, the investments in capability creation are costly (Winter 2003).

Organizational capabilities are path dependent and therefore the role of prior experience is important in their evolution (Helfat 2000). Prior experience cumulates within the organization through, especially, learning-by-doing mechanisms (Dierickx & Cool 1989).

These mechanisms also are likely to make the firm to narrow its capability focus leading to relative overemphasis of the capabilities the firm has succeeded in. Based on the above discussion we put forth the following set of hypotheses:

*Dynamic capabilities and the evolution of operational capabilities*

*Hypothesis 1a:* There is a positive relationship between dynamic capabilities at  $t_1$  and technology capabilities at  $t_2$ .

*Hypothesis 1b:* There is a positive relationship between dynamic capabilities at  $t_1$  and market capabilities at  $t_2$ .

*Path dependency of operational capabilities*

*Hypothesis 2a:* There is a positive relationship between technology capabilities at  $t_1$  and technology capabilities at  $t_2$ .

*Hypothesis 2b:* There is a positive relationship between market capabilities at  $t_1$  and market capabilities at  $t_2$ .

*Dynamic capabilities and the inertia of operational capabilities*

*Hypothesis 3a:* The influence of technology capabilities at  $t_1$  on technology capabilities at  $t_2$  is stronger than the influence of dynamic capabilities at  $t_1$  on technology capabilities at  $t_2$

*Hypothesis 3b:* The influence of market capabilities at  $t_1$  on market resources at  $t_2$  is stronger than the influence of dynamic capabilities at  $t_1$  on market capabilities at  $t_2$

*Hypothesis 4a:* There is a positive relationship between DCs at T1 and technological capabilities at T2, even when controlling for technological capabilities at t1.

*Hypothesis 4b:* There is a positive relationship between DCs at T1 and market OC at T2, even when controlling for market OC at t1.

### **2.3. Organizational capabilities and product innovation output**

The capabilities to introduce new products continuously over time are widely recognized to be vital for the success of firms (e.g. Alegre & Chiva 2008, Henderson & Cockburn 1994, Nerkar & Roberts 2004). In this study we focus on two central capabilities related to innovation output, namely technological and market capabilities. These have been

recognized as vital for the successful introduction of innovations (Danneels 2002, Nerkar & Roberts 2004). Technological capabilities consist of the technological knowledge and resources within the firm, reflecting its ability to combine disparate elements of technological knowledge (Nerkar & Roberts 2004; Kogut & Zander 1992; Teece 1982).

In addition to technological capabilities, successful introduction of product innovations requires sufficient understanding of the potential consumer and client population. In order to create demand pull for the technological innovation firms need to possess an appropriate set of market capabilities (Teece 1986). Market capabilities enable the firm to better determine the market value of new inventions and technological discoveries. These capabilities increase the knowledge of user needs making it easier to connect with the potential customers to take advantage of the innovative potential of the consumers and users of their technology (Wiklund & Shepard 2003, von Hippel 1994). New product development requires linking together the market and technological capabilities (Danneels 2002).

Prior research has suggested that one important function of dynamic capabilities is help the firm to succeed in effective short run competition in existing market and help the firm to adapt to, and even create, new markets (O'Reiley & Tushman, 2007), generally referred to as exploration and exploitation (March, 1991). In line with this, we focus in this paper on two different types of product innovations that reflect the exploitative and explorative character of organizational learning and innovation (Pérez-luño, Wiklund & Valle Cabrera 2011), namely "new to the firm" and "new to the market" product innovations: While the first type refers to innovations that are new relative to existing products on the market, the latter category refers to products that are completely new for the market (Damanpour &

Wischnevsky, 2006, Pérez-luño, Wiklund & Valle Cabrera 2011). Both types are important for evolutionary fitness. While product innovations “new to the firm” can secure and even increase revenues from existing markets (e.g. exploitation), firms can achieve revenues from entirely new markets and/or products not already on the market from the introduction of product innovations “new to the market” (e.g. exploration). Having previously hypothesized that DCs positively influence the evolution of OCs (technological and market), the next set of hypotheses below deals with the role of OCs in the promotion of “new to the firm” and “new to the market” product innovation.

*Operational capabilities and innovation output*

*Hypothesis 5a:* There is a positive relationship between technology capabilities at  $t_2$  and new to the firm product innovation at  $t_2$ .

*Hypothesis 5b:* There is a positive relationship between technology capabilities at  $t_2$  and new to the market product innovation at  $t_2$ .

*Hypothesis 6a:* There is a positive relationship between market capabilities at  $t_2$  and new to the firm product innovation at  $t_2$ .

*Hypothesis 6b:* There is a positive relationship between market capabilities at  $t_2$  and new to the market product innovation at  $t_2$ .

Studies addressing the capabilities firms require in their innovation processes have shown that dynamic capabilities are essentially important antecedent in creating new products (Danneels 2002, Danneels 2010, Ellonen et al. 2009, Hill & Rothaermel 2003, Iansiti & Clark 1994, Lee & Kelley 2008, Lichtenthaler & Lichtenthaler 2009, Pavlou & El Sawy 2006, Rothaermel & Hess 2007, Verona & Ravasi 2003). The central argument in this strand of literature is that since innovations require search for new knowledge, new processes, and new organizational skills, dynamic capabilities, which enable firms to change according to

these needs, are vital. Dynamic capabilities are intertwined with the organizational processes of product innovation (Verona & Ravasi 2003). Successful innovation often requires the development of new capabilities and *reconfiguration* allows firms to be flexible regarding the roles and relational patterns in creating new products (Danneels 2002; Verona & Ravasi 2003).

The literature argues that the influence of DCs on product innovation “*must be measured through their effects on the firm’s resource configuration*” (He and Wong, 2004, p. 486.)

Dynamic capabilities focus on changing the operational capabilities and therefore they indirectly influence the probability of a firm successfully adopt and generate product innovations. Reconfiguration and renewal capabilities are required to combine and recombine the two operational capabilities when generating or adopting new product innovations (Henderson & Cockburn 1994). In addition, dynamic capabilities increase the knowledge capacities of the firm leading to more commercialization of new products (Lichtenthaler & Lichtenthaler 2009, Rothaermal & Hess 2007). In other words, market and technological capabilities mediate the relationship between dynamic capabilities and product innovation (both new to the firm and new to the market). Based on the above we put forth the following hypotheses. Figure 2. below represents our hypothesized conceptual model.

### *Dynamic capabilities and innovation output*

*Hypotheses 7a:* There is a positive indirect relationship between dynamic capabilities at  $t_1$  and new to the firm product innovation at  $t_2$ . Technology and market capabilities at  $t_2$  mediate the effect of dynamic capabilities at  $t_1$ .

*Hypotheses 7b:* There is a positive indirect relationship between dynamic capabilities at  $t_1$  and new to the market product innovation at  $t_2$ . Technology and market capabilities at  $t_2$  mediate the effect of dynamic capabilities at  $t_1$ .

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Insert Figure 2. approx. here

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## **3. METHOD**

### ***3.1 Research design and sample***

In order to examine the above hypotheses we have collected survey data from R&D active firms in Norway at two points in time. The population was all businesses registered to a scheme for tax deduction of R&D costs (called SkatteFUNN). We focus on these companies as innovation is important for their performance i.e. the hypothesized relationships are arguably more explicit in these firms.

All enterprises which registered R&D activities during May to December 2005 were approached, in all 1721 enterprises. A web-based questionnaire was developed containing the measures of dynamic and operational capabilities, and innovation among other measures. A link to the questionnaire was e-mailed to the enterprises within a month after they registered R&D activities. The initial mailing was followed by two e-mail reminders. Of

the enterprises approached, 1199 (70 %) returned filled-in questionnaires. The 1199 companies that filled out the questionnaire were contacted again 1.5 - 2 years later. 754 of the enterprises returned filled-in questionnaires containing the same items as before.

### **3.1 Measurement**

#### *3.1.1 Dependent variables: New to the firm and new to the market product innovation*

Our definition of product innovation is adopted from the OSLO manual (OECD, 2005). Two questions are used to measure two related but still different types of product innovation. Product innovation “new to the firm” was measured through the following questions: “During the last year, did your enterprise introduce onto the market any new or significantly improved products (goods or services) relative to the firms previously developed products”? Product innovation “new to the market” was measured through the following question: “During the last year, did your enterprise introduce new or significantly improved products (goods or services) not only new relative to earlier products developed by the firm, but also new for your enterprise's market?” Respondents could tick their degree of agreement on a 7 point likert scale where: 1 = no extent and 7 = to a very large extent. Our definition of innovation has been used by a range of prior studies (see Smith, 2005 for a review).

#### *3.1.2 Dynamic and operational capabilities.*

There are no established measurement models of dynamic capabilities (McKelvie and Davidson, 2009). Therefore this study builds on a mixture of qualitative case study methodology, literature review and statistical techniques to develop and refine measures of

DCs. First, exploratory qualitative interviews, using a semistructured interview guide, were conducted with management representatives from 10 R&D/innovative firms. The aim of the interviews was to get an overview of each firm's innovation and development processes, in particular the processes related to its dynamic capabilities and the management of its resources. Themes raised in the interviews were about network, co-operation with external R&D-institutions, learning in the firm, adaptation and changes in the firm. We interviewed SMEs and larger firms, and the industries varied from high-tech and ICT to publishing. Based on the interviews and an extensive literature review, statements identified as descriptions of dynamic capabilities and resources were developed and included in a questionnaire.

Second, the informants from the 10 firms were subsequently asked to take part in a pretest of the questionnaire, including the preliminary items developed to measure dynamic capabilities and resources, by responding to the questionnaire and giving comments on the individual questions. This was followed up by a telephone call to the interviewees where they were asked to report their views on the various questions/items.

Third, the face validity of the items was further examined by pre-testing the measurements among experts. Researchers with knowledge of business strategy within firms were asked to evaluate the questionnaire. Based on the results from the pilot study, the items were adjusted and refined.

Although we recognize at the outset that the concept of dynamic capabilities and their underlying resource components are very challenging to research in a systematic and econometric fashion (McKelvie and Davidson, 2009), we follow the argument in the literature that more empirical work is necessary to test and refine the dynamic capabilities concept and how it is related to the evolutionary economic theory (Arend & Bromiley 2009;



Rosenblom, 2000; Verona and Ravasi, 2003; McKelvie and Davidson, 2009). It is in this spirit that the research reported in this paper has been undertaken.

Items measuring DC and OCs were developed as statements for which the respondents were asked to indicate to what extent each statement fitted a description of their business. We adopted one-sided seven point Likert scale where: 1 = strongly disagree and 7 = strongly agree. We built on prior studies where items measuring OCs have been measured relative to competitors (McKelvie and Davidson, 2009).

The *resource reconfiguration* construct includes three items, describing processes related the firm's ability to renew, reconfigure and change its resource base. The items are: "*we systematically identify what types of resources our firm can benefit from*", "*In our firm there is an systematic transfer of resources to the development of new business areas*" and "*we have developed routines that enables us to reconfigure our old resources into new resource constellations*". A principal components factor analysis was used to check that the items loaded on the same factor. The factor analysis (shown in the appendix) extracted 1 factor. Cronbachs alpha is 0.72.

Technological capabilities include four items and describe the firm's technical resources. Items are: "Our firm has a competence which is difficult to copy", "Compared to our competitors the firm has a better technical expertise", "Compared to our competitors the firm has a better expertise regarding development of products or services", and "Compared to competitors employees at our firm are better at coming up with ideas for new products". Items are adopted from Wiklund and Shepherd (2003) and Madsen et al., (2007). Two principal components factor analysis were used to check that the items loaded on the same

factor at two different points in time ( $t_1$  and  $t_2$ ). The factor analysis (shown in the appendix) extracted 1 factor in both time periods. The overall Cronbachs alpha is 0.86.

Market capabilities include two items and describe the firm's market/marketing resources. Items are: "Compared to our competitors the firm has a better expertise in marketing", and "Compared to our competitors the firm has a better special expertise regarding customer service". Items are adopted from Wiklund and Shepherd (2003). Two principal components factor analysis were used to check that the items loaded on the same factor at two different points in time ( $t_1$  and  $t_2$ ). The factor analysis (shown in the appendix) extracted 1 factor in both time periods. The overall Cronbachs alpha is 0,70.

### 3.1.3 Control variables

We control for firm size, firm age, market turbulence and industry. First, inspired by Schumpeter seminal work, prior research has suggested that larger and older firms may be more innovative (see Acs & Audretsch, 2003 for a review and Leiblein & Madsen, 2009 for a more nuanced view). Firm size is measured as the (log of) number of employees while firm age is measured as (the log of) number of years since the firms inception in the Norwegian business register. Prior research has also suggested that firms' industry environment will influence their innovativeness (see Malerba, 2005). Industry dummies, based on the NACE classification, are therefore entered to control for differences among firms in their industry context. Data on firm age, size and industry comes from the Norwegian business register that was merged with the survey data. We control in addition for managers subjective perception of their firms market context. The variable market turbulence was measured with the following three items: "The rate at which products/services are becoming obsolete in the industry is very high", "actions of competitors are unpredictable" and "demand and tastes

are almost unpredictable". Items are adopted from Khandwalla (1977). Cronbachs alpha is 0.6.

As discussed above we also control for the type of respondents using dummy variables for the five different types of respondents, namely, project leader, R&D director, CEO, CFO, and other.

### 3.2 Self-reported data and survivor bias

The research in this paper draws on self-reported data to a large extent.

To control for the possibility that different types of respondents perceive the same issue differently, such as how their firms should score on items measuring DCs and resources (Lyon, Lumpkin & Dess, 2000), we will control for "respondent effects" in our empirical analysis. Our questionnaire included yes/no questions to whether or not respondents had any of the following positions within the firm: CEO, project leader for the SkatteFUNN project, CFO, R&D manager, or other. These binary variables (1=yes) are entered as controls.

As already described, not all firms that participated in the survey at T1 participated in the follow-up survey at T2, due to either bankruptcy, other types of exit, non-response, loss of interest etc. To explicitly take this into account we use Heckman regression which helps to control for selection / survivor bias.

## 4. ANALYSIS

### 4.1. Descriptive statistics

Table 1. provides the descriptive statistics for the variables in the estimated models. Table 2. provides the correlation matrix. Values of the dependent variables are highly correlated due to the nature of the questionnaire, as suggested above. Also operational capabilities at  $t_2$  are positively correlated with their counterparts at  $t_1$ , suggesting a path dependent relationship as hypothesized.

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Insert Table 2. approx. here

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### 4.2 Estimation strategy

Seemingly unrelated regression technique (SUR) is used to examine the hypotheses. SUR is used because the error terms from the different equations that we will estimate may be correlated to each other. There are several reasons why there may be correlated error terms across the equations. First, both technological and market capabilities at  $t_2$  may be correlated to each other as they both address the firm's operational capabilities (as seen in

table 2). Because market OC and technological OC at  $t_2$  are used as dependent variables, the error terms from these equations may be correlated to each other as well. Further, there is a natural correlation between our items measuring “new to the firm” and “new to the market” product innovation. The reason is that innovations that are “new to the market” are also “new to the firm” (their correlation is strong as shown in table 2). As will be further discussed below, a Breusch-Pagan test of independence clearly suggests that the error terms across the estimated equations are significantly correlated to each other. Hence, SUR is the preferred estimation method.

#### **4.3. Estimation results**

To test our hypothesized conceptual model we estimated four different empirical models for the two different dependent variables. First, we estimated the models testing the relationship between dynamic capabilities (resource reconfiguration) at  $t_1$  and operational capabilities at  $t_2$ . The first specifications (Models 1a & 1b in Table 3.) include only the dynamic capability variable measured at  $t_1$ . The results show a positive and significant relationship between resource reconfiguration and both technological OC and market OC. We then extend this model by adding technological OC and market OC at  $t_1$  as predictors of market and technological OCs at  $t_2$  to test the path dependency hypotheses (Models 2a & 2b). The purpose of these specifications of testing hypotheses 2a and 2b as well as 3a and 3b.

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Insert Table 3. approx. here  
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Table 3 above shows that the dynamic capability (resource reconfiguration) has a positive and significant influence on technological and market OCs at  $t_2$ . This influence is reduced, but is still positive and significant when we added technological and market OCs at  $t_1$  as predictors. This result supports both hypothesis 1a and 1b. Table 3 (Models 2a & 2b) further show that the market OC at  $t_1$  has a significant and positive relationship with the market OC at  $t_2$ . It can further be seen that technological OC at  $t_1$  has a strong positive and significant relationship with technological OC at  $t_2$ . These results support hypotheses 2a and 2b. Interestingly, we see that the cross-over effects of the operational capabilities at  $t_1$  on the operational capabilities at  $t_2$  are insignificant. In other words, market capabilities do not positively influence technological capabilities and vice versa.

Hypotheses 3a and 3b posit that the influence of operational capabilities at  $t_1$  is stronger than the effect of dynamic capability on the operational capabilities at  $t_2$ . From Table 3. (Model 2a) we see that the effect of technological capability is far stronger than the effect of DC at  $t_1$ . Similarly, we see that for market capability the effect of market OC at  $t_1$  is far stronger than the effect of DC. To confirm that the coefficient of the DC variable is significantly different from the coefficients of the market and technology OC variables we tested for equality of regression coefficients using the “test” command in Stata. Two such tests are performed. The first test tests the null hypothesis that the coefficient of the variable technology OC at  $t_1$  is equal to the coefficient of the resource reconfiguration dynamic capability at  $t_1$  in a regression where the technological OC at  $t_2$  is the dependent variable. The test returned a p-value of less than 0.0000. We can thus reject this null hypothesis. The second test tests the null hypothesis that the coefficient of the variable

market OC at  $t_1$  is equal to the coefficient of the resource reconfiguration dynamic capability at  $t_1$  in a regression where market OC at  $t_2$  is the dependent variable. The test also returned a p-value of less than 0.0000. We can thus reject also this null hypothesis. Thus, operational capabilities at  $t_1$  have a stronger positive effect on the operational capabilities at  $t_2$  than the resource reconfiguration DC. This supports hypotheses H3a and H3b.

However, results also show that the resource reconfiguration DC at  $t_1$  has a significant and positive influence on market and technological OCs at  $T_2$ , even when controlling for market and technological OCs at  $t_1$ . Thus, DCs is able to make a significant change and influence on the firms operational capabilities even in the short run, a sign that DCs is able to overcome the inert nature and past-dependent character of the evolution of operational capabilities. This support hypothesis 4a and 4b.

-----  
 Insert Table 4. approx. here  
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Second, we estimated the effect of dynamic and organizational capabilities on product innovation output to test hypotheses 4 through 7. Models 3a and 3b include the explanatory variables from the period  $t_1$ . The specifications labelled as models 4a and 4b also include operational capabilities from  $t_2$ . The results show that market and technological OCs and the resource reconfiguration DC at  $t_1$  have a positive and significant influence on product innovation (both new to the market and new to the firm) at  $t_2$ .

When market and technological OCs at  $t_2$  are added as predictors of product innovation in  $t_2$ , we see that they have a positive and significant influence on the product innovation. The results support the hypothesized relationships between both operational and dynamic capabilities and product innovation. Especially, it should be emphasized that the positive effect of dynamic capabilities is mediated by the operational capabilities at  $t_2$  and in other words they have an indirect effect on product innovation.

Further, a Breusch and Pagan test of independence was conducted to test whether the SUR estimator used in our regression analyses is appropriate. The test statistic is chi square distributed under the null hypothesis of cross-sectional independence. P-values less than 0.0000 were obtained. Hence, the null hypothesis of cross-sectional independence can be rejected, indicating that SUR estimation is indeed appropriate in our case.

## **5. DISCUSSION AND CONCLUSION**

### *Discussion of results*

The present paper was motivated by the ongoing discussion in the literature about the relative role of operating and dynamic capabilities in product innovation. The aim of this study was to address this topical issue by focusing on the firms' ability to achieve ambidextrous innovation performance, which is considered to be a key mechanism that can enhance firms' evolutionary fitness. Although previous literature has proposed that DCs may have an important role in this (Tushman & O'Reiley, 2007), past studies have not explicitly addressed the relationship between the different levels of capabilities. The following research question was thus posed: What is the relative role of ordinary and dynamic



capabilities in firms' ability to develop both exploitative and explorative product innovations? To answer this question, six hypotheses were put forth. Table 5. summarizes our research hypotheses and results accordingly.

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Insert Table 5. approx. here

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In essence, our results show that there is considerable scope for purposeful change through dynamic capabilities as shown by the influence of the resource reconfiguration DC on the firms technological and market OCs. Thus, dynamic capabilities have a significant influence on the evolution of operating capabilities over time. Further, the influence of dynamic capabilities on product innovation is mainly indirect and reflected in its ability to influence technology and market OCs positively over time, which have subsequent positive and significant direct relationships with product innovation. Overall, results show that DCs can help firms to achieve ambidexterity, success in both exploration and exploitation, in the innovation process through its positive influence on the evolution of market and technological OCs over time.

Our analysis, which has focused on the evolution of operating capabilities and their relationship with product innovation over a two year period, also sheds interesting light over the relationship between DCs and OCs *in the short run*. As may be expected in the short run, we find that previously developed operating capabilities continues to exert a strong influence on the evolution of operating capabilities. However, even in the short run we see that dynamic capabilities have a positive and significant influence on market and

technological OCs two years later (T2), even when controlling for firms previously developed market and technological OCs.

Thus, even though our results show that the influence of inertial forces on evolution of operating capabilities is stronger than the influence of purposeful change through dynamic capabilities, the scope for change through dynamic capabilities is considerable, even in the short run.

### *Theoretical implications*

This study contributes to the research on organizational capabilities in three significant ways. First, the paper has helped to clarify the relative roles of OCs and DC for the ability of firms to develop both explorative and exploitative product innovations, thus achieving ambidexterity. While the advantages of ambidexterity are well documented (e.g. March, 1991), there has been little research on how firms can achieve it, especially in the innovation process, and even fewer studies have examined the relative roles of operational and dynamic capabilities (Tushman & O'Reiley, 2007). Responding to this gap in our knowledge, this paper has developed new knowledge on how resource reconfiguration promotes firms ability to develop both exploitative and explorative product innovation through its influence on the evolution of the firms technological and market OCs. Thus, this paper has helped to develop and extend the theoretical relevance of the dynamic capability approach in the evolutionary theory of the firm for understanding how firms can achieve ambidexterity, particularly in the innovation process.

Second, by introducing a longitudinal setting we are able to empirically study the evolution of operational capabilities through the deployment of dynamic capabilities. Thus, the paper is able to advance our knowledge on the dynamic aspects of capabilities - an important yet

neglected element of DC literature (Arend & Bromiley, 2009, Lichtenthaler & Ernst, 2012). In previous literature, the empirical research on the central function of which DCs, i.e. changing operational capabilities, has been missing. The study further supports the view that organizational capabilities should be analysed as hierarchy, dynamic capabilities working through operational capabilities, and in a longitudinal setting (Helfat et al. 2007; Winter, 2003). Third, by explicitly framing our study on the evolutionary theory of the firm we are able to strengthen the theoretical foundations of dynamic capabilities, while at the same time contribute back to the evolutionary theory of the firm by shedding light on one of the central questions in the literature, i.e. whether and to what extent are firms able to adapt.

Overall, our results shed new light on whether organizations can adapt and change, and if so, how this occur – which is a key question underlying much debate in the management sciences (O'Reiley & Tushman, 2007, p.3). Pressed to offer a stylized response to this question, at least our results support the argument that organizations can change to a considerable extent through the execution of dynamic capabilities, *even in the short run*. Thus, we find considerable support for an adaptation perspective. Further, our results help to show “how adaptation occurs” through the deployment of resource reconfiguration capabilities that influence the evolution of market and technological OCs which has a direct effect on firms’ ability to develop exploitative and explorative product innovations, a finding which has important implications for how firms can improve their evolutionary fitness.

Based on the results and contributions made suggestion on future research topics to enhance our understanding of the complexities of organizational capabilities can be made. In this paper we have focus on only one type of a dynamic capability, and because the

literature recognizes different types with different roles, considering the effects of these and their interplay with operational capabilities is a promising research area. From the perspective the literature on organizational capabilities, especially as research on organizational capabilities is naturally founded on the evolutionary theory of the firm, the final performance measure of interested in studies of dynamic capabilities should be the evolutionary fitness of the firm (Baretto 2010; Leiblein 2011).

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## TABLES

Table 1. Descriptive statistics

Variables	Mean	Std.dev	Min	Max
New to the firm product inno. (t <sub>2</sub> )	5.1	1.7	1	7
New to the market innovation (t <sub>2</sub> )	4.9	1.6	1	7
Market capability (t <sub>1</sub> )	4.2	1.3	1	7
Technological capability (t <sub>1</sub> )	5.3	1.1	1	7
DC	4.4	1.2	1	7
Firm size (log)	2.6	1.5	0	9.2
Firm age (log)	2.2	.87	0	5.2
Market capability (t <sub>2</sub> )	4.1	1.2	1	7
Technological capability (t <sub>2</sub> )	5.2	1.1	1	7
Technological turbulence	3.9	1.2	1	7

Table 2. Correlations between main variables

Variables	1	2	3	4	5	6	7	8	9	10
1.New to the firm inno.(t <sub>2</sub> )	1									
2.New to the market (t <sub>2</sub> )	0.73	1								
3.Market cap. (t <sub>1</sub> )	0.11	0.14	1							
4.Technological cap. (t <sub>1</sub> )	0.2	0.21	0.25	1						



5.DC	0.16	0.17	0.21	0.30	1					
6.Firm size (log)	-0.02	-0.06	0.19	-0.13	-0.11	1				
7.Firm age (log)	-0.03	-0.03	0.07	-0.11	-0.16	0.46	1			
8.Market cap. (t <sub>2</sub> )	0.20	0.22	0.54	0.09	0.17	0.17	0.04	1		
9.Technological cap. (t <sub>2</sub> )	0.31	0.35	0.15	0.56	0.27	-0.1	-0.1	0.26	1	
10. Tech. turbulence	0.11	0.08	-0.0	0.14	0.17	-0.1	-0.1	-0.0	0.1	1

Table 3. Examining the relationship between initial capabilities and resource reconfiguration on current market and technological capability

	Model 1a	Model 1b	Model 2a	Model 2b
	Technological capability (t <sub>2</sub> )	Market capability (t <sub>2</sub> )	Technological capability (t <sub>2</sub> )	Market capability (t <sub>2</sub> )
DC - resource reconfiguration	.235***	.202***	.117***	.094***
Market capability (t <sub>1</sub> )			-.010	.477***
Technology capability (t <sub>1</sub> )			.532***	-.060
Firm size (log)	-.031	.174***	-.007	.086**
Firm age (log)	-.001	-.036	.001	-.053
Technological turbulence	-.027	-.025	-.040	-.023
Mills ratio	-1.790	-4.03	-1.61	-1.83
Industry dummies	Included	Included	Included	Included
Respondent dummies	Included	Included	Included	Included
Constant	5.23	5.37	2.97	3.21
R2	17 %	13 %	38 %	35 %
N	620	620	620	620

\* Sig at the 0.1 level \*\* sig at the 0.05 level

\*\*\*Sig at the 0.01 level

Table 4. Examining the role of resource reconfiguration in product innovation

	Model 3a	Model 3b	Model 4a	Model 4b
	New to the firm innovation (t <sub>2</sub> )	New to the market inno. (t <sub>2</sub> )	New to the firm inno. (t <sub>2</sub> )	New to the market inno. (t <sub>2</sub> )
Market capability (t <sub>1</sub> )	.088*	.126***	.006	.057
Technological capability (t <sub>1</sub> )	.173***	.197***	-.001	-.017
Market capability (t <sub>2</sub> )			.180***	.153***
Technological capability (t <sub>2</sub> )			.347***	.420***
DC – resource reconfiguration (t <sub>1</sub> )	.135***	.138***	.077	.074
Firm size (log)	.105*	.041	.092*	.030
Age (log)	.033	.043	.043	.051
Technological turbulence (t <sub>1</sub> )	.037	-.010	.055	.010
Mills ratio	-3.52	-4.49*	-2.63	-3.54
Industry dummies	Included	Included	Included	Included
Respondent dummies	Included	Included	Included	Included
Constant	4.61	5.22	3.0	3.5
R2	18 %	18 %	23 %	25 %
N	620	620	620	620

\* Sig at the 0.1 level \*\* sig at the 0.05 level

\*\*\*Sig at the 0.01 level

Table 5. Summary of the hypothesized relationships

Theme	Hypothesis	Result
<i>Dynamic capabilities and the evolution of operational capabilities</i>		
	H1a: There is a positive relationship between dynamic capabilities at t1 and technology capabilities at t2.	<i>supported</i>
	H1b: There is a positive relationship between dynamic capabilities at t1 and market capabilities at t2.	<i>supported</i>
<i>Path dependency of operational capabilities</i>		
	H2a: There is a positive relationship between technology capabilities at t1 and technology capabilities at t2.	<i>supported</i>
	H2b: There is a positive relationship between market capabilities at t1 and market capabilities at t2.	<i>supported</i>
<i>Dynamic capabilities and the inertia of operational capabilities</i>		
	H3a: The influence of technology capabilities at t1 on technology capabilities at t2 is stronger than the influence of dynamic capabilities at t1 on technology capabilities at t2	<i>supported</i>
	H3b: The influence of market capabilities at t1 on market resources at t2 is stronger than the influence of dynamic capabilities at t1 on market capabilities at t2	<i>supported</i>
	H4a: There is a positive relationship between dynamic capabilities at t1 and technological capabilities at t2, even when controlling for technological capabilities at t1	<i>supported</i>
	H4B: There is a positive relationship between dynamic capabilities at t1 and market capabilities at t2, even when controlling for market capabilities at t1	<i>supported</i>
<i>Operational capabilities and innovation output</i>		
	H5a: There is a positive relationship between technology capabilities at t2 and new to the firm product innovation at t2.	<i>supported</i>
	H5b: There is a positive relationship between technology capabilities at t2 and new to the market product innovation at t2.	<i>supported</i>
	H6a: There is a positive relationship between market capabilities at t2 and new to the firm product innovation at t2.	<i>supported</i>
	H6b: There is a positive relationship between market capabilities at t2 and new to the market innovation at t2.	<i>supported</i>
<i>Dynamic capabilities and innovation output</i>		
	H7a: There is a positive indirect relationship between dynamic capabilities at t1 and new to the firm product innovation at t2.	<i>supported</i>
	H6b: There is a positive indirect relationship between dynamic capabilities at t1 and new to the market product innovation at t2.	<i>supported</i>

## FIGURES

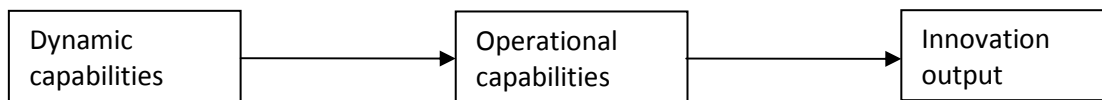


Figure 1. The conceptual model of the organizational capability and innovation relationship

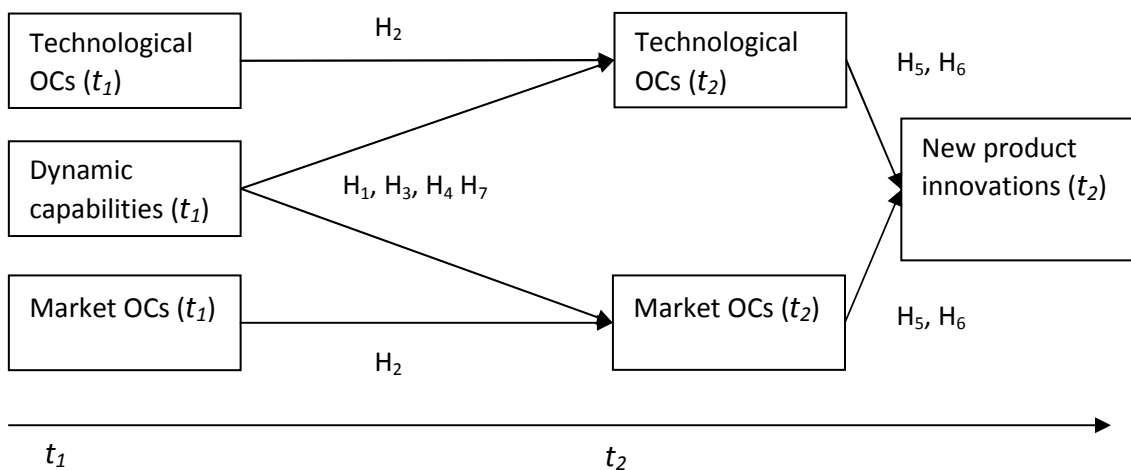


Figure 2. Hypothesized conceptual model

## Appendix

Table A1. Factor analysis – items measuring “resource reconfiguration”

	Factor loadings
	T1
We systematically identify what types of resources that our firm can benefit from	0.773
In our firm there is an systematic transfer of resources to the development of new business areas	0.809
We have developed routines that enables us to reconfigure our old resources into new resource constellations	0.817
N	625
Explained variance	63 %

Table A2. Factor analysis – items measuring technological capability

	Factor loadings	Factor loadings
	T1	T2
Compared to our competitors the firm has a better technical expertise	.716	.642
Compared to our competitors the firm has a better expertise regarding development of products or services	.710	.762
Our firm has a competence which is difficult to copy	.627	.685
Compared to competitors employees at our firm are better at coming up with ideas for new products	.467	.459
N	625	625
Explained variance	63 %	64 %

Table A3. Factor analysis – items measuring market capability

	Factor loadings	Factor loadings
	T1	T2
Compared to our competitors the firm has a better expertise in marketing	.836	.819
Compared to our competitors the firm has a better special expertise regarding customer service	.836	.819
N	625	625
Explained variance	70 %	67 %