Adapting to Change

On the Mechanisms of Dynamic Capabilities

Lars Hovdan Molden

NORD UNIVERSITY BUSINESS SCHOOL

NORD University

www.nord.no

Adapting to Change
- On the Mechanisms of Dynamic Capabilities

Lars Hovdan Molden

PhD dissertation submitted to
Nord University Business School
for the degree of PhD

Lars Hovdan Molden

Adapting to Change - On the Mechanisms of Dynamic Capabilities

Acknowledgments

And of course there are the **Shrinks** and helpers when things went bad
Cathrine Kvaran, Ingvild Aarbakken and Steinar Krokstad
For them it was their job and plight
for me it meant everything, it kept me in the fight

A doctoral dissertation has been a hazardous stunt
and my **Family** are the ones who bore the brunt
My mom and dad (you are the best) who brought me up to be me
who relentlessly believed and supported my curiosity
My siblings who grew up with a nerd
despite my quirkiness their backing never deterred
Then of course my parents in-law for backing and show
who brought to life the best person I know

Cause the largest foundation, my rock and my very best friend
is my perfect wife Birgitte whom I so solidly depend.
Thank you for sticking with me and almost never loosing it
from now on I promise more time to tend the garden and to knit.
And to my two girls, Ida and Ingrid you have also played your parts
keeping it real by being stubborn, feisty and utter sweethearts.

So my flock of jolly folks, I thank you all and I admit
I don't expect you to read it all, just skim it a bit

Oh, I almost forgot two important sources for both recognition and dollar
I am forever grateful for being accepted as both a NORAM and a Fulbright Scholar
And finally some words to material factors which have been paramount:
Coffee and Beer, my Bose and My Mac, and my Spotify Account

Lars H Molden, Steinkjer, January 31st 2020

To my very own dynamic capabilities, Ingrid and Ida, who constantly force me to change my routines and adapt my capabilities,

to Billie for maintaining a highly stochastic environment,

and to Birgitte for being the most beloved constant in my life.

Abstract

Gaining competitiveness and staying competitive over time, seems increasingly difficult. However, some firms manage to thrive and evolve. This dissertation uses dynamic capabilities theory to investigate how firms adapt to change through creating, extending and modifying their resource base. By placing dynamic capabilities as a core explanatory model for how firms manages to change strategically (i.e intentionally), I look into various ways in which this happens. I place a particular emphasis on various types of mechanisms at work in dynamic capabilities theory and their effort to enable strategic change. Particularly, I lean on an emergent stream of literature in making a distinction between *behavioral* and *cognitive* mechanisms (or objects of change), through which dynamic capabilities work to enable strategic change. By using a set of various surveys and registry data, I provide quantitative analysis of core mechanisms, as well as outcomes, of dynamic capabilities in various settings.

This dissertation comprises an introductory part and four independent research papers. All papers are quantitative and empirical, but makes conceptual and theoretical contributions as well. Paper 1 deals with the particular functioning of innovation capabilities as a functional domain of dynamic capabilities in influencing the innovation process under different levels of complexity. Paper 2 looks into two different expressions of dynamic capabilities (capabilities alignment and development) and find them to be separately and distinctly related to competitive advantage. Paper 3 opens up the evolution of dynamic capabilities and it's relationship with deliberate learning, and argue for a second, hitherto understudied, effect of dynamic capabilities. Finally, paper 4 takes an explicit look at cognitive and behavioral objects of change as separate, yet complementary constructs, and identify their relationship with competitive advantage.

Overall the findings of this dissertation suggests that both behavioral and cognitive mechanisms/objects of change matter in enabling firms to change strategically. Several practical and theoretical implications are derived, and future research possibilities are presented

CONTENTS

List of Figures

List of Tables

Introduction

It's not the strongest that survives, nor the most intelligent, but the ones that are most responsive to change - Leon Megginson[1].

There are two numbers that should concern any scholar of organization, strategy, management and economics, or any business executive. These are **18** and **2008**. The first one, from (Barton et al., 2016), shows the average life span of an S&P 500 company. Currently they survive an average of 18 years. This is down from 60 years in 1950, a drop of 68%. For a larger sample of firms across the developed world the probability of falling out of a position as market leader increased from 2% in 1960 to 8% in 2013 (Reeves et al., 2015). Also the probability of being both the market leader and the most profitable company decreased from 35% in 1955 to 7% in 2013 (ibid). The second one represents the year when the number of firm exits surpassed the number of firm entries into the economy (Hathaway & Litan, 2014). In other words, firms are struggling to establish and to stay profitable. Combined, these numbers tell a story of a carnage in the business world where old established firms perish and the overall dynamism of the economy stagnates. When asked about the future, CEOs from over 1400 companies told the consultancy PWC that they fear the rapid rate of change in technology, markets, societies and the climate (PWC, 2018).

---

[1]Leon C. Megginson summed up his interpretation of Darwin's ideas, as they related to economics, at the Southwestern Social Science Association

Still, a considerable fraction of CEOs have a positive outlook on the future (ibid). This must mean that they believe in ways to cope with the rapid change they are facing.

And rapid change in business environments it is. A large number of publications has documented the change in technology (McAfee & Brynjolfsson, 2016; Ross, 2016), society and institutions (Frey & Osborne, 2017; Schwab, 2017), politics (Collier, 2018), digitization (Agrawal et al., 2017, 2018), and the climate (Friedman, 2016) to name a few. Taken together the rapid change facing many firms, and the increasing challenge of staying competitive has tempted the coining of adaptability as the new competitive advantage (Reeves & Deimler, 2011; Reeves et al., 2015).

And some firms do face the sharp teeth of time in a manner fit to make them remain competitive and profitable over decades despite rapid change. The British Aerospace company GKN was founded in 1759 and is still in business (O'Reilly & Tushman, 2016). It has gone from a steel manufacturer by ways of a drive train and automotive company, into an aerospace business, and has managed to maneuver economic, political and social shifts in the UK and the world for nearly 260 years. Storebrand Life Insurance can trace their roots back to 1789, and Stora Enso in Sweden was founded in 1229 (Enders & Haggstrom, 2018). Perhaps the most explicit example is two firms most people know from experience. Most of us know Fujifilm as a leading provider of photographic films (Gavetti et al., 2007). Following the digital transformation of the photo industry, Fuji is still very much in business, but not in photography. When the markets and industries shifted into digital images, Fujifilm realized that in order to stay profitable (let alone alive) it had to adapt. Building on its key capabilities, e.g. coloring of surfaces and chemical processing, it ventured into cosmetics, regenerative medicine, diagnostics and biological manufac-

turing. Its American arch rival, Eastman Kodak, did not make similar strategic choices and forever redefined the idea of a 'Kodak moment' by going from dominant market player to bankruptcy in a little over a decade and becoming an idiom for failure to adapt to change [2] (O'Reilly & Tushman, 2016; Anthony, 2016).

And precisely this distinction between firms that manage to flourish and those who does not, is the focal interest of this dissertation. What is behind these differences? This question becomes even more relevant when uncertainty and rapid change increasingly is infiltrating a majority of industries and sectors of the society. So, it seems, that all firms, to varying extent, faces changes they have to adapt to, be it technological, societal, political, digital or climate. Those who are able to strategically change their business, i.e. creating *strategic change* to adapt to their business environment are those who are able to flourish in the long run. Consequently, *understanding how firms are able to achieve strategic change* is of pivotal importance in business research and the larger tradition within which this dissertation aims to contribute.

1.1 Research topic: Strategic change and dynamic capabilities

As most have experienced, change can occur without us changing any aspect of our behavior or thinking. It simply happens. This is also highly relevant to organizations like firms which are prone to changing business environments such as markets, industries or regulatory. It can occur inconsistent or consistent, continuous or discrete, randomly or deterministic. Hence, the pivotal question for any organization is to what extent it can engage with the change so to create deliberate and intentional changes for

---

[2]The painful irony is that just like Fuji later would pan into chemicals, Kodak tried the same in 1988, but did not manage to adapt the venture to its core business. It later had numerous opportunities to adapt to the digital revolution and probably even take a leading position

the organization. This is what I mean by *strategic change*[3]: a planned response to realign the firm to its business environment.[4] Putting it into a more practical context, when firms manage this planned response to realign the themselves to their business environment, they stay competitive or gain an increased competitiveness. This is observed, for instance, in the form of out-performance relative to peer firms in their industry. Strategic change as a concept warrant a more detailed discussion. I will hence return to this in more detail shortly by clarifying the concept of strategic change as well as its relations with firm performance, competitive advantage, resources and *dynamic capabilities (DC)*. For now I provide a telling example to establish a preliminary understanding of strategic change. The mid-Norway property developer Boligbyggerlaget Midt (BM) was faced with a new business environment when their main supplier of core software services suddenly went out of business. This change in the environment was exogenous to the company and thus outside its control. A long term strategic partner pulled a core business system on which BM and their customers were heavily reliant. Rather than accept the high switching costs related to finding a new supplier, the firm sensed and seized an opportunity to develop their own applications for selling to their own customers meanwhile providing a new service to similar companies. Through a strategic partnership with a local consultancy, Smart Media, BM was able to leverage the situation and develop even new sources of revenue going forward. In

---

[3]The more formal definition is 'a planned intervention by (senior) management arising under certain environmental and organizational conditions which attempts to guide emergent reactions toward making major changes in a strategy and/or organization, resulting in a realignment between the firm and its environment' (Greiner & Bhambri, 1989, p. 68)

[4]Strategic change is a unique subset of the broader 'change'. *Change* is a fundamental concept in the philosophy of time yielding a range of definitions valid. My simplistic understanding builds on the mathematical concept of Δ where $\Delta x = \frac{x_t - x_{t-1}}{x_{t-1}}$, where x represent a state. Change is thus the difference between two states over time. Philosophical understanding include 'difference or nonidentity in the features of things' Mortensen (2016) and 'the actualization of what is potentially' (Kostman, 1987, p. 3).

this situation BM managed a planned response to realign the form to its business environment; rather than taking the change as exogenous they internalized its consequence and adapted. This is strategic change

And the business history is full of examples of firm's being able to adapt by changing strategically. Consequently, I assume that intention and deliberation can make the organization able to adapt to change in accordance with its goal and objectives (i.e. strategically).

This is by all means an uncontroversial assumption in the management literature. Certain perspectives see limits to the adaptability of firms in relations to changes in the environment and argues that path dependency and structural inertia hinders firm adaptation to environmental change (Hannan & Freeman, 1989). Consequently, change happens randomly and strategic change is thus futile and impossible.

In juxtaposition to these views a range of established work in strategic management assumes, and demonstrates, that strategic change can occur (i.e. that it represents the outcome of a deliberate and purposeful process (Helfat et al., 2007)). Prominent among these is the *dynamic capabilities theory (DCT)* that aims to explain how, why and when strategic change happen. The theory holds that firms can stay competitive through continually adapting the set of resources available to the firm [5]. Upon accepting the premise introduced at the beginning of this chapter about change being a constant to an increasing number of firms, DCT seems increasingly relevant.

---

[5]A more precise description holds that competitive advantage can endure when firms are able to continuously creating, modifying and extending the resource base of a company:'a dynamic capability enables the repeated and reliable performance of an activity directed toward strategic change, as distinct from entirely ad hoc problem solving (Schilke et al., 2018, p.392)

In brief, the core tenant of DCT is that firms are able to achieve strategic change to stay competitive over time by 'purposefully create, extend, or modify its resource base' (Helfat et al., 2007, p.1) which is also the definition of DC applied in this dissertation. Although I elaborate on the different concepts constituting this proposition in chapter 2.2 of this dissertation, a brief explanation is warranted. The resource base can be thought of as all the levers available to a firm to create value.[6]. In the case described above, Fujifilm had a rich resource base consisting of tangible assets such as chemical production facilities, research and development (R&D) labs, and vast amounts of input factors such as plastic, paper and chemicals to name a few. Intangible assets included in their resource base, and perhaps most interesting, included know-how on how to put color to paper, process chemicals and market products.

A very important subset of the resource base is ordinary or *operational capabilities* that are geared toward maintaining daily functions and enabling the firm to make a living[7]. In the case of Fujifilm these capabilities included those ways capitalize on the know-how described above. Through a series of capabilities they were able to produce, market and sell products with considerable customer value for many decades (Gavetti et al., 2007). But more importantly, in the face of change, Fujifilm was able to reconfigure the use of these operational capabilities to capture value in a new market. This change, is the core of the workings of DC. Figure 1.1 illustrate how DC work to achieve strategic change through changing the resource base.

---

[6]It is more precisely defined as 'tangible, intangible, and human assets (or resources) as well as capabilities which the organization owns, controls, or has access to on a preferential basis' (Helfat et al., 2007, p. 4). Examples include everything from hardware, input factors, routines and so forth.

[7]More precisely: Those capabilities that 'permit a firm to make a living in the short term' (Winter, 2003, p. 991)

Figure 1.1: Dynamic capabilities and its relation to strategic change

DCT offers an answer to how strategic change occurs and what it takes to stay competitive over time. The partial answer is through capacity to adapt the composition of firm resources when needed (e.g. when the business environment such as markets, technology or similar around the firm changes).

This makes DCT especially suited to pursue this broad topic of how firms are able to achieve strategic change. Consequently, the purpose of this thesis is to explore the role of dynamic capabilities in explaining **how** and **why** firms achieve strategic change. Questions of how and why can be studied through contemplating mechanisms between two constructs of interests, e.g. DC and operational capabilities. Such questions can also be answered using qualitative research methods, but, for reasons I will get back to, I have relied on a quantitative design in my research. This is in part due to the DC literature arguing such mechanisms to be quasi-synonymous to mediation in the empirical domain (Schilke et al., 2018). Put simply, when an effect from A to B runs through C, C is mediating the relationship between A and B. Thus, it is possible to explore mechanisms, and by extensions how and why, through studying empirical mediation. In figure 1.1 this mediation is depicted with the effect of DC on strategic change goes through the resource base, a mechanism that is prominent in theoretical and empirical work on DC (Eriksson, 2014; Helfat et al., 2007). This is the core of my dissertation leading tho the following overarching research question:

Overall research question

RQ: What is the role of dynamic capabilities in enabling strategic change in firms?

The growing consensus hold that the purpose and workings of DC is to change the underlying resource base of an organization to better stay competitive over time (Helfat et al., 2007; Schilke et al., 2018; Peteraf et al., 2013). However, the particular nature and workings of these mechanisms remains in need of further elaboration, and state of the art contributions holds that there is a need to 'explore additional mechanisms (i.e., mediators) that explain proposed relationships of dynamic capabilities with other variables, which is an area of weakness in the current literature' (Schilke et al., 2018, p. 392). In other words this means that we need to understand what exactly are the mechanisms that enables DC to work in accordance with its purpose. One particular promising avenue for pursuing this understanding is to look at two broad, but distinct types of mechanisms: *behavioral* and *cognitive*. Although these concepts often are found to be traits of individuals, in the domain of DC and my dissertation these are to be regarded as organizational constructs.

1.2   Sub research questions: Behavioral and cognitive mechanisms

The components of DCT and their relationships are somewhat complex and although I will get back to them all in more detail in chapter 6.3, a brief, structured introduction is warranted. The table below shows the elements in DCT and its relation to strategic change relevant to my dissertation.

> **Simple definitions of core elements in this dissertation**
>
> **Routines:** 'a behavior that is learned, highly patterned (and) repetitious' (Winter 2003) - The building block of activities in the firm
>
> **Capabilities:** 'the know-how that enables organizations to perform' (Dosi et.al 2001) - Often composed of several routines in interplay
>
> **Resource base:** 'tangible, intangible, and human assets [available to the firm]' (Helfat 2007) - Everything the firm needs to operate daily
>
> **Performance:** The degree to which the firm achieves its intended outcome (e.g return on equity)
>
> **Competitive advantage:** The ability of a firm to perform better than its competitors
>
> **Strategic change:** A planned response to realign the firm to its business environment - to gain or maintain competitive advantage

In this context routines and capabilities are the building blocks of the firm, the resources available that enables the firm to make a living in the short term. These routines and capabilities can, if they are valuable, rare, inimitable and non-substitutable generate better performance than competitors (Barney, 1991a). Thus, they can, according to the resource based view, generate competitive advantage (Barney, 1996). However, in order to stay competitive over time or in the face of changing business environment (which is the case in most industries of today), the firm will have to adapt and change these routines and capabilities. And the main way they can do this is through their DC. This process of changing the routines and capabilities to enable or maintain competitive advantage, is the process of strategic change as understood in this dissertation. Figure 1.2 depicts this relationship between DC, strategic change, competitiveness and performance the way I understand it.
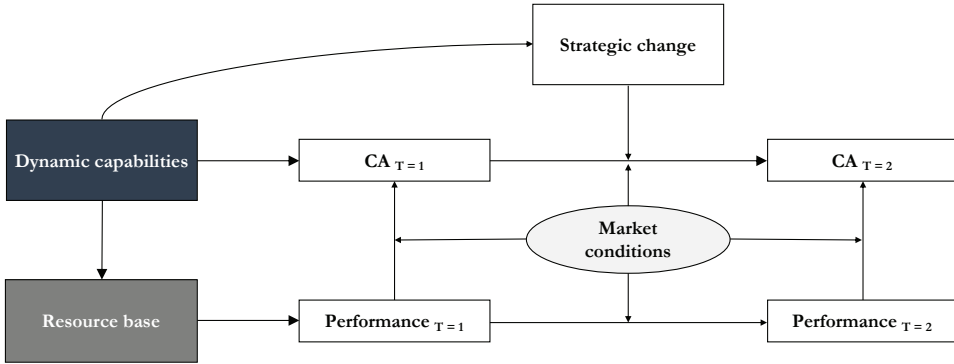
Figure 1.2: Dynamic capabilities, competitive advantage and strategic change

The figure places strategic change as a process of enabling or maintaining competitive advantage over time. Strategic change itself is enabled by the firm's DC. Similarly, market conditions (or even more general; the business environment) also influences the firm's ability to create CA and maintain it over time. DC is working to enable strategic change by changing the resource base of the firm. However, this resource base, defined as 'tangible, intangible, and human assets (or resources) as well as capabilities which the organization owns, controls, or has access to on a preferential basis' (Helfat et al., 2007, p. 4), must contain a range of different 'objects' on which DC can work to change, i.e. they are 'objects of change'. In simple words, the objects of change are those elements DC changes to generate strategic change. These can be routines, capabilities, mindsets, emotions or other types of organizational characteristics. This meta-notion of 'objects of change' transcends the existing categorization (e.g. capabilities, routines etc) and brings in a taxonomy to shed light on common characteristics with objects constituting the resource base, rather than considering the resource base simply a collection of objects with the same functioning.

Consider the example of the industrial giant General Electric's venture into data analytics. The decision to pursue analytics was based on the increasing amount of data being generated on the back of the company's growing number of sensors placed in jet engines. The data was initially considered a nuisance but GE also saw a huge opportunity in capitalizing on the data. This would, however, require them to become a more capable software company (Black, 2017). On the one hand this meant investing heavily in new capabilities and developing routines to handle a new business vertical. This amounted to changing operational capabilities of the firm and thus enabling it to operate in another way, and DC is a way of understanding how GE was able to change these operational capabilities. Building new and enhancing capabilities and routines means enabling a certain change in the behavior of the people; if you want to change the way things are done you need to create change in behavior (i.e. *behavioral change*). To this effect GE invested in a new software division stacked with talent from inside and outside the company. Existing software capabilities were included and enhanced (Black, 2017).

Simultaneously, however, GE had to change its perception of data from a nuisance to an enormous opportunity. Moreover, the movement into software also meant taking on layers of complexity hitherto unknown to the company. This meant that not only did GE need to change the behavior of the organization, but also its mindset and way of thinking. CEO Jeff Immelt have later coined this new way of thinking as a 'culture of simplification' (Kirkland, 2015). This change of mindset and thinking is not directly related to changing behavior, but rather the acceptance and motivation for the necessity of change. It is a change in the cognitive frames of the organization; the way it perceive its mission and objectives and change to it is what is coined *cognitive change* (Zollo et al., 2016). This is often

popularized by stating that 'culture eats strategy for breakfast' [8] indicating that strategic change without a certain cultural alignment is likely to fail

The example of GE illustrates the importance of understanding different types of mechanisms. By considering mechanisms as quasi-synonymous with 'mediator' (Baron & Kenny, 1986; Schilke et al., 2018) studying different objects of change (i.e. mediators through which DC work to enable strategic change) is a way of contributing to the DC theory. I aim to address the particular gap in the literature related to the investigation of various mechanisms. And key to these mechanisms is the objects which DC changes in order to enable strategic change (i.e. the objects of change). I will now discuss each of these in some detail.

The first group is *behavioral objects of change* that are geared towards 'how things are done within the firm'. In other words, this object influence the **doing** of the firm. Most of the existing work have explored how this function plays out in influencing the behavior of agents in the organization as well as the organization as a whole (Schilke et al., 2018; Teece, 2007; Helfat & Winter, 2011). In order to enable strategic change, DC triggers these behavioral objects to change the behavior of the organization, e.g. in the form of new routines. In other words, this includes the conventional understanding of the firm's resource base as consisting of resources and capabilities, a point I will get back to in detail in chapter 6.3. This is very much the traditional understanding of how DC work and is illustrated in figure 1.1 where the resource base is a mediator between DC and strategic change (Verona & Zollo, 2011).

---

[8]The quote is of course attributed to Peter Drucker and made famous by Ford President and CEO Mark Field

Although the extant literature has explored a multitude of behavioral objects of change as mechanisms in DCT, a point which I will get back to in chapter 6.3, pursuing a better understanding of how different 'behavioral objects of change' works in creating strategic change is a pivotal part of this dissertation and the source of the first sub research question.

Sub research question 1

SRQ1: What is the role of behavioral objects of change as mechanisms of dynamic capabilities?

The second group contains those objects of change not related to behavioral elements of the organization. Rather it deals with 'why things are done within the firm' and hence influencing the **understanding** within the firm. I coin this *cognitive objects of change* building on recent work in the cognitive turn in strategic management (Tripsas & Gavetti, 2000; Gavetti, 2012), organizational cognition in DC (Zollo et al., 2016), and the human side of DC (Verona & Zollo, 2011). When geared towards *cognitive objects of change* DC adapt the more tacit and subtle aspect of human interactions (motivation, emotions and identity, in particular) to environmental or contextual requirements (Verona & Zollo, 2011, p. 538). For example, in the process of implementing change in behavior 'firms will have to adapt cognitive frames and managerial mind-sets related to a new formulation of purpose and identity' (Zollo et al., 2016, p. 226). Motivation and identity (Verona & Zollo, 2011), cognitive frame/processes, and mindsets (Zollo et al., 2016) are all concepts or part of the subset of cognitive objects of change. In the case of GE's transition into a software company the management sought to bring about strategic change through changing the mindset and ways of thinking within the organization. In a

similar transformation Microsoft emphasized instilling a 'growth mindset' in the organization to make it fit the strategic direction into a full fledged cloud business (Nadella et al., 2017).

Sub research question 2

SRQ2: What is the role of cognitive objects of change as mechanisms of dynamic capabilities?

These sub research questions are both dealing with 'mechanisms' through which DC instill strategic change, but differ in the nature of the intermediary factors (i.e. if they are behavioral or cognitive in nature). By addressing these questions the research on DCT is likely to make headway in terms of a better understanding of **how** and **why** DC leads to strategic change, as I will get back in the subsequent chapter of this thesis in more detail. I once again find it prudent to point out that it is useful to study the how and why, often explored qualitatively, through the use of mediating factors (mediators), Especially since mediators can be regarded as quasi-analogous to mechanisms (Schilke et al., 2018). Figure 1.3 presents the research questions and relate them to each other and the papers in the dissertation. Although all my papers in varying degree addresses the different sub research question, they are all linked to both and to the overall research question. The indicators at the end of the figure suggests the relevance of each paper to each sub reserach question.

15
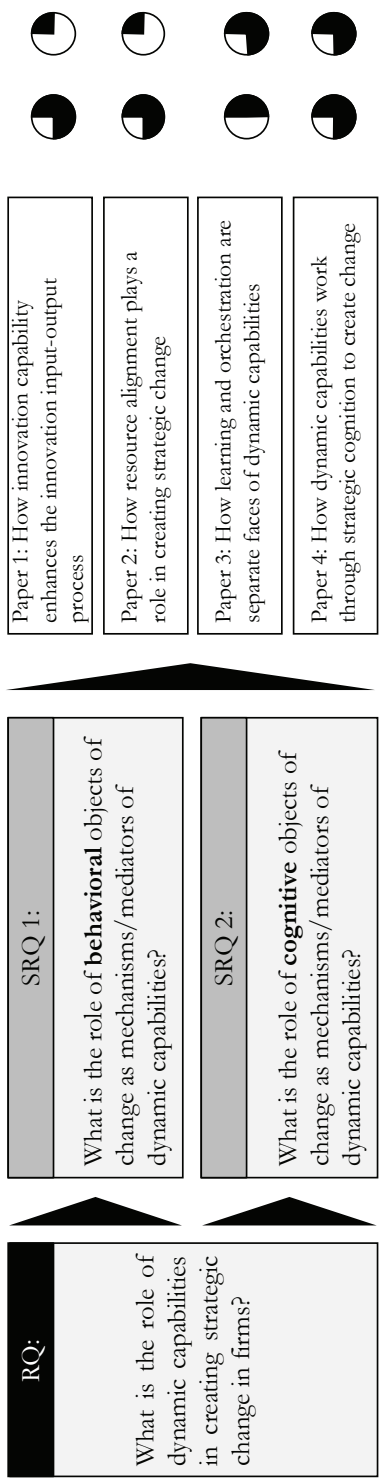
Figure 1.3: The structure of the dissertation

RQ:

What is the role of dynamic capabilities in creating strategic change in firms?

SRQ 1:

What is the role of **behavioral** objects of change as mechanisms/mediators of dynamic capabilities?

SRQ 2:

What is the role of **cognitive** objects of change as mechanisms/mediators of dynamic capabilities?

Paper 1: How innovation capability enhances the innovation input-output process

Paper 2: How resource alignment plays a role in creating strategic change

Paper 3: How learning and orchestration are separate faces of dynamic capabilities

Paper 4: How dynamic capabilities work through strategic cognition to create change

Relevance for
SRQ 1   SRQ 2

Underpinning DCT is an assumption that changing behavioral and cognitive objects is possible. Indeed, as I get back to in chapter 6.3, this makes up for a large body of empirical literature demonstrating that they can be changed. To the more specific question if such change is practically doable for all firms, the answer is a bit more complicated. As in most theories there are contingencies that shape the opportunities firms have in terms of achieving strategic change. Developing and enhancing routines and capabilities are costly Pisano (2017) and many types of capabilities are not readily available through acquisitions (Coen & Maritan, 2011; Maritan, 2001). Another contingency relates to overcoming resistance to change (Tripsas & Gavetti, 2000) and organizational inertia (Schreyögg & Kliesch-Eberl, 2007; Kaplan & Henderson, 2005) often present in organizations in need for change Thus, lack of access to financial and human resources, as well as resistance and inertia, could severely limit a firm's ability to achieve strategic change. A more detailed discussion on the limitations and main criticisms of DCT follows in section 2.5. Still, contributions to the field of DCT holds that change is possible (Schilke et al., 2018).

1.3   Proposed research papers and implications

The overall research question concerns the role of DC in enabling strategic change. DCT holds that a dynamic capability is the capacity to modify the resource base of the organization and consequently influencing a certain outcome such as strategic change. Thus, there are several important roles DC can play in enabling strategic change. However, the extant literature points to a lack of understanding *how* DC achieves this (Schilke et al., 2018). In other words, in what ways DC can enable strategic change and what is the mechanism at play? This is the crux of both sub research questions but each with a different group of such mechanisms (different

objects of change), namely *behavioral* and *cognitive.* Exploring each of these mechanisms individually as well as in combination, brings us new insights into the role DC has in enabling strategic change.

Papers emphasizing behavioral objects of change

First, although the extant literature has explored a multitude of behavioral objects of change as mechanisms in DCT, a point which I will get back to in chapter 6.3, some important gaps remain. One particular and important gap relates to the distinction between DC working to change existing resources (operating routines and capabilities) and creating new ones (through innovation) (Di Stefano et al., 2014). It is unclear, however, to what extent, if any, DC work differently in these different outcomes, and explicit modeling of these DC-mediator-performance chain is largely lacking in the literature (Schilke et al., 2018). Thus, pursuing a better understanding of how different 'behavioral objects of change' works in creating strategic change is a pivotal part of this dissertation and the source of the first sub research question. When firms alter parts of their resource base in order to instill behavioral change (e.g. changing a routine) when executing DC, they do this purposefully to make their resources more aligned with the needs of the firm.

In paper 1 and 2, I explore two different behavioral objects of change. The distinction between the papers is between DC contributing to creating new resources (through innovation) and change existing resources (through operating capabilities), thus addressing a gap in the extant literature (Di Stefano et al., 2014).

Paper 1 will theorize and analyze the role DC plays as a mediator through which innovation input transforms into innovation output, as well as how this relationship is contingent on the complexity of the external environ-

ment. I plan to do this by using a pan-European firm-level data set on innovation activities and construct measures of the innovation process and external conditions, as well as a particular functional form of DC, namely innovation capability. Various functional domains of DC is present in the literature ranging from the very general to the very specific, a point I will get back to in detail in chapter 6.3.

In paper 2 I suggest a second function of DC beyond orchestrating existing resources, namely aligning resources to gain better strategic fit. Here I aim to use an international data set of management practices from firms all over the world. The idea is to build different empirical constructs capturing alignment and capabilities orchestration and study their individual and joint impact on firm performance. Taken together these papers aims to explicitly model the mechanism through which DC works (investigating mediators) and hence contribute to sub reserach question 1 and the overall research question. Moreover, although these papers are emphasizing behavioral objects of change and is hence aiming to contribute to sub research question 1, some important cognitive elements in them are relevant for sub research question 2.

Paper 1 will deal with innovation and how innovation capabilities matter. Such capabilities are mainly behavioral in nature (i.e. they aim at getting the firm to create new things), but the process of seeing the need for new innovations and investments in such capabilities are indeed cognitive. Likewise in paper 2, the awareness of the combination of which capabilities to pursue and the options they entail is very much related to the cognitive frames of the management. Hence, although they are not directly addressing both sub reserach questions, interesting implications can probably still be drawn to both.

Papers emphasizing cognitive objects of change

Second, the less studied way firms execute DC to enable strategic change is through changing *cognitive object* of the organization and/or its agents. Such cognitive frames includes mindset, motivation and identity among others and will be discussed in more detail in the theory chapter as well as in each paper. The extant literature has conceptualized this idea, but little empirical inquiry currently exists and several gaps are present. One example is to what extent cognitive objects of change work differently in enabling strategic change compared to the more commonly studied behavioral objects. Another gap is related to how cognitive frames and mind-sets can be triggered by DC in a more complex process than simply increasing motivation for strategic change. Thus, pursuing a more nuanced insight into the particularities of cognitive objects of change comprise the second sub research question of this dissertation. The papers will make a distinction between a cognitive object as an outcome of DC leading to competitive advantage (paper 4), and as an outcome of DC leading to learning (paper 3). Both deals with strategic change, however.

Paper 3 will theorize about how DC have two faces in creating strategic change, and how these faces delivers different but complementary effects on change of an organization. It will build on a seminal model of DC evolution (Zollo & Winter, 2002) and the cognitive nature of learning as a result of DC execution. The paper uses longitudinal data from Norwegian technology firms and will try to capture the dynamics of how cognitive objects of change and how they play out DC evolution.

In paper 4, I plan to make a clear distinction between behavioral and cognitive objects of change and analyses how they work individually and in tandem to create strategic change. I plan to do this by using a longitudinal survey that captures these dimensions and merge it to performance

data to measure both competitive advantage (i.e. the firm's ability to do better then their competitors) and sustained competitive advantage (i.e. the firm's ability to beat their competitors over time). Moreover, although these papers are emphasizing behavioral objects of change and is hence aiming to contribute to sub research question 2, some important cognitive elements in them are relevant for sub research question 1. Paper 3, in dealing with learning, conceptualize deliberate learning with both behavioral and cognitive elements. The ideal model in the paper also incorporates both behavioral and cognitive effects of DC. Still, the cognitive objects are likely to be most prominent. In paper 4, I plan to model both cognitive and behavioral objects of change to study their individual and collective role in DC theory.

Implications and intended contributions

Through the papers outlined above, I aim to contribute to a more nuanced understanding of how these two typologies of change objects manifest themselves as mechanisms in DCT. This kind of research is called on in recent literature (Schilke et al., 2018) and investigations into different mediating mechanisms will contribute in pushing the theory forward in three ways. First, I aim to clarify the different workings, nature and outcome of behavioral and cognitive objects of change and thus contributing to the "cognitive turn in strategic management" in generally (Gavetti, 2012) and the "human side" of DCT in particular (Verona & Zollo, 2011). Second, I aim to look into various functional domains of DC from the more general (e.g ability to sense, seize and transform Teece (2007)), to the more particular (e.g innovation capability (Breznik & D. Hisrich, 2014) or routine alignment (Pisano, 2017; Hung et al., 2007)). This brings a partial answer to the call for studying a range of various forms of DC (Eriksson, 2014). Finally, I strive to contribute to a better understanding of the evolution of DC itself and the role of a capability hierarchy in this regard (Zollo &

Winter, 2002; Schilke, 2014b). In this work I try to clarify how different levels of capabilities relate to each other in the formation and function of DC.

Seen together, I believe my four papers will bring some novel insights into the field of DCT and how DC through behavioral and cognitive mechanisms enables strategic change. The findings in my work will thus bring certain practical and academic implications. The academic implications relate to how DC is seen and understood. By elucidate two different types of change objects through which DC enables strategic change I aim to bring a better understanding of the distinctiveness and relatedness of these separate mechanisms. This should encourage further research into other types of mechanisms either in a similar typology or in others. Moreover, by identifying sources for DC evolution within the hierarchy of capabilities I hope to open new avenues of research bringing new second-order DC into the light. By extension, such research would benefit our insight into how DC evolve over time and helps enable strategic change.

From a more practical point of view, I hope my research can help managers better prioritize their resources. Three take-aways for practitioners is worth mentioning. First, strategy formation and implementation should pay close attention to cognitive objects of change such as emotions, mindsets and understanding. In other words, these objects relates to ho things are understood within the company. These factors are interlinked with those behavioral objects of change geared towards changing the way things are done within the company. Second, investments and enhancement of deliberate learning through knowledge articulation and codification is an important factor in determining long term strategic change of the firm. Not only does it act as a source for DC, but it also probably captures experiences gained from execution of DC in the first place. In other words,

firms that goes through changes constantly will over time generate experiences that need to be understood and translated to new actionable insights. These will in turn inform the strategic choices facing the firm. Managers should thus emphasize deliberate learning in their strategic planning and implementation. Finally, alignment of capabilities can be a complementary, and possibly more cost efficient, approach to capabilities improvement for many firms. Thus, being aware of opportunities in reconfiguration and alignment of capabilities, can bring increased value to the firm.

The rest of this dissertation is organized as follows. The next chapter deals with the emergence and status quo of research on DCT. It concludes by some important research gaps related to the research question in this dissertation. I then move onto methodological discussion in chapter 3 where ontological and epistemological considerations are discussed before describing a suitable research design for my research question. Chapter 4 presents a brief summary of all papers including their findings and relation to the dissertation's research questions, before conclusions and avenues for future research is explored in chapter 5. The final chapter contains all four research papers.

Dynamic capabilities theory

Although it is not yet fully elaborated as a theory of the firm, the dynamic capabilities framework brings Williamsonian transaction costs, Penrosean resources, Knightian uncertainty, and Schumpeterian (knowledge) combinations together in a way that can potentially explain not only why firms exist, but also their scope and potential for growth and sustained profitability in highly competitive markets - David E. Teece[1]

In a brown bag seminar at an American university I was asked the simple question: 'What are dynamic capabilities?'. I went on with the usual explanation about how they are capacities of a firm to change the resource base and so on. The person asking the question was not satisfied and pressed on. 'Give me an everyday example' she pressed on. Since this day I have been pondering this question and found it extremely hard to answer. However, being a fan of American football I have found some inspiration in my favorite team, but also the firm and multi-billion dollar franchise: The Green Bay Packers.

At December 3, 2015 the Packers took on the Detroit Lions in Detroit Ford Field Stadium. By halftime my beloved Packers were trailing the Lions 20-0. After the break, the exact same team came out of the locker room with their captain, quarterback Aaron Rodgers, and won the game 27-23. It was the exact same team (resources used to make plays), but they were

---

[1]Teece (2019)

directed and orchestrated by the great Aaron Rodgers who managed to adapt to the effective Lions defense and win the game. Rodgers did this by reconfiguring the ways he used the resources on the field to adapt to how the game was evolving. He exhibited dynamic capabilities in this way by changing the way his resources were deployed. It was only possible for Rodgers to do so because the resources were up to task and adaptable in themselves, and because he was able to 'sell' the idea that it was possible. And this is actually the core of DCT at its very simple level and also very much present in any NFL game, as well as many other team sports around the globe. Aaron Rodgers executed dynamic capabilities through leadership, but also through the routines and capabilities already present in the team at large. So it was not only an effect of the leader (the CEO of a firm) but the effect of a changeable and adaptable resource base as well.[2]

The fundamental questions of this dissertation are linked to what role DC plays in enabling strategic change, and what are the mechanism at play. The core tenant is that this is achieved through DC which enables firms to develop different resource bases over time and hence stay competitive. DC offers an explanation for why some firms are better at performing over time than others. In order to shed light on the reserach questions, a literature review and understanding the state of the art of the research front on DC, is imperative. Figure 2.1 sketches out the process I follow to elucidate the role DC plays in enabling strategic change. The first step is to understand how strategic management theory has considered strategic change throughout its history and how DCT is a culmination of several streams of research being concerned with change over time. Next, and paramount due to a lacking consensus on the definition of DC, I present a

---

[2]I would be amiss not to mention that Rodgers himself placed the final points with a 61 yard 'Hail Mary pass' exactly when the time ran out. Henceforth this game was simply referred to as the 'Miracle in Motown'

range of definitions of the core constructs of DCT. Third, I lay out the 'nuts and bolts' of DCT and what we currently know, before finally laying out some gaps in the literature surrounding the mechanisms of DCT related to strategic change - the focal point of this dissertation.
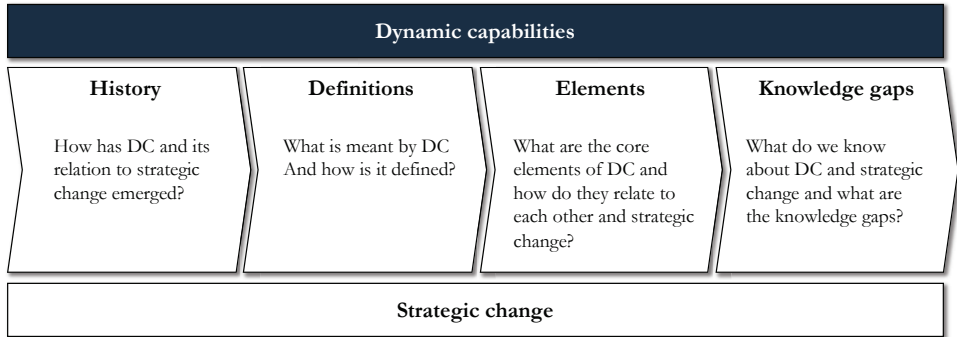
Figure 2.1: The process of theory inquiry

2.1 A brief history of dynamic capabilities theory

Early theories of the firm adopted a certain 'black box' view of the firm and hence assuming considerable homogeneity among firms (Bain, 1956; Coase, 1937; Demsetz, 1988). In this view firms were rather considered price takers from the market and simply acting on the market price system. Responding critically to the 'black box' view claiming it inadequate to explain the growth of the firm, (Penrose, 1959) argued that firm's capability to utilize its resources is a way to innovation profit and a source of considerable heterogeneity among firms. Firms are, she argued, simply not the same. Albeit, very much focused on operational aspects of the firm and not directly prescribing strategic adaptation per se (Rugman & Verbeke, 2002), she contributed a rigorous analysis of the growth process of the firm. Penrose saw firm's capability to utilize its resources as a way to innovation profit by depicting 'the direction of corporate learning and growth as a path-dependent resource-constrained process' (Cantwell,

2001, p 16). This became the foundations for the view that firm resources and capabilities creates heterogeneity among firms and matter for firm performance (Wernerfelt, 1984) and as a source of competitive advantage (CA) (Barney, 1996). Competitive advantage means a firm's ability to outperform its competitors in an industry. Simply put, firms developed assets within its boundaries that were 'asset specific' and yielded reduced transaction costs (Williamson, 1975) as well as asset heterogeneity. This theoretical view centering around the firm itself is known as the *resource based view (RBV)*. However, really lifting the resource based view into the realm of strategic management, Barney (1991a) argued that the right composition of firm resources and capabilities would, under a set of strict conditions, even lead to a sustained competitive advantage (SCA), i.e. the ability to continue to outperform your competitors over time. Under his famous VRIN conditions (when resources and capabilities are valuable, rare, inimitable and non-substitutable) firms could deliver SCA and hence stay competitive over time.

And to some sense one could argue that the RBV theory provides a useful framework for enlightening the change of firms over time in that the VRIN concept is sufficient to understand SCA. Moreover, Penrose's view on the resource learning process can be reconciled with the Schumpeterian view that incumbent firms drive innovation and growth[3]. Here the role of existing firms in innovation is not in the form of market power, but as an organizational device for learning beyond simple price and quantity decision taking (Cantwell, 2001). Consequently, RBV can, within these conceptions, to a certain degree explain the survival and thriving of firms over time.

---

[3]What is known as Schumpeter Mark II and juxtaposed to his earlier Mark I argument that it is the entrepreneur who takes on this role

However, RBV has, rightly, been subject to criticism in this regard (Teece & Pisano, 1994; Helfat & Peteraf, 2003). Most notably, that the perspective is static in that it 'recognizes but does not attempt to explain the nature of the isolating mechanisms that enable entrepreneurial rents and competitive advantage to be sustained' (Teece et al., 1997, p 510). Specifically, RBV does not account for the way resources and capabilities may be reconfigured to fit changing business environments. Thus, dynamism entered theorizing around how firms through their resources can maintain a competitive advantage over time. Dynamism in business environments are sources for considerable uncertainty that the firms are forced to cope with, leaving less room for immobility and inertia, but also more opportunities for capturing value from entrepreneurial opportunities (Knight, 1921).

In their seminal paper Teece et al. (1997) laid the ground work for what was to become the *dynamic capabilities theory (DCT)*. DCT sets out to explain the sources of competitive advantage as the ways organizations create, extend and modify their resource and capabilities to adapt to changing environments. DCT builds on evolutionary economics concept of routines (Nelson & Winter, 1982) in resource formation as a source of CA. Path-dependency is intimately linked to the idea of creating unique sets of routines to the firm, and hence is regarded as a source of heterogeneity among firms; firms evolve in their own path. However, this path-dependency can also be an obstacle to change and leave the firm inert to adapt (Cyert & March, 1963; Nelson & Winter, 1982).

DCT distinguishes between operational capabilities and routines as first-order constructs on one hand, and dynamic capabilities as higher-order constructs (Winter, 2003) on the other. The idea is that routines and capabilities are changeable and adaptable through dynamic capabilities (such as depicted in figure 1.1). In other words: DC is set to reconfigure

the first-order constructs such as routines and operational capabilities. [4].
More generally, the evolutionary theory lends its idea of path dependency
as a source of firm heterogeneity, and that this heterogeneity manifest itself
through the resource base of the firm. Thus, firms do vary in their abilities
to change strategically.

Another important antecedent more prevalent in later contributions to
DCT (Eisenhardt & Martin, 2000; Teece, 2007) is the behavioral theory
of the firm (Cyert & March, 1963). The behavioral theory emphasizes im-
portant sources of firm heterogeneity in other ways than explained by the
evolutionary tradition. Central to this is the role of what Cyert & March
(1963) coins 'standard operating procedures' that are the unique ways in
which the firm handles its tasks, meaning that it produces a consistent
outcome. Moreover, when actors within an organization acts 'boundedly
rational' the outcome of such standard operating procedures and how they
react to new opportunities will vary (Simon, 1957). Moreover, to the point
of change, organizational adaptation will itself also exhibit considerably
heterogeneity due to the way the boundedly rational agents draws expec-
tations from the environment, chooses between opportunities, and controls
the implementation of such change (Arndt & Pierce, 2018).

These theoretical developments have all invariably explained how firms
change over time. Bringing strategic change to the forefront of the the-
ory, however, Helfat et al. (2007) framed DC as a way of understanding
strategic change in organizations:

> 'Strategy matters most during times of change. Businesses and people find it
> far easier to do more of the same than to do something different. But the
> world does not stand still. As markets become more globally integrated and
> new forms of technology and competition arise, companies cannot rest on their
> laurels. Firms must adapt to and exploit changes in their business environment,

---

[4]A detailed discussion on these distinctions are presented in the next section

while seeking opportunities to create change through technological, organizational, or strategic innovation. Creating, adapting to, and exploiting change is inherently entrepreneurial, for large firms and small, for old firms and new. But entrepreneurial activity of this sort does not imply a lack of strategy or organization. Indeed, effective change often requires both. To survive and prosper under conditions of change, firms must develop the "dynamic capabilities" to create, extend, and modify the ways in which they make their living' - (Helfat et al., 2007, p. 1)

This quote from the opening paragraph of the book clearly states the role of DC in enabling strategic change. They clarify that 'concept of dynamic capability includes the capacity with which to identify the need or opportunity for change, formulate a response to such a need or opportunity, and implement a course of action' (ibid p.7), and conclude that 'because dynamic capabilities concern strategic change, virtually any research topic that involves strategic change has links to dynamic capabilities, and vice versa' (ibid p. 120).

In sum I conclude that the historical evolution of DCT has been intimately linked to the pursuit of strategic change, and that this is increasingly important given the changing environments firms increasingly face (as discussed in the introduction to this dissertation). The next step in the theoretical inquiry process is to clarify definitions of core concepts of DCT. In many ways I have already forestalled parts of this discussion by subscribing extensively to the perspectives of Helfat et al. (2007), but the definition of DC is by no means consensus driven.

Albeit still a certain friction around definitions, elements and outcomes of DCT (Peteraf et al., 2013), a certain consensus on the definition of the concept has emerged whereas other gaps remain. I will thus now turn to the formal definition of the core concepts of DCT.

2.2 Definitions of core concepts in dynamic capabilities theory

This dissertation concerns itself with the role of DC in enabling strategic change. Thus, both DC and strategic change needs some elaborate discussion. Starting with the latter *strategic change* is a common term in the DC literature, but not particularly clearly defined. A common understanding seems to be that it entails deliberation and intention in the change process as opposed to random changes. The more formal definition is 'a planned intervention by (senior) management arising under certain environmental and organizational conditions which attempts to guide emergent reactions toward making major changes in a strategy and/or organization, resulting in a realignment between the firm and its environment' (Greiner & Bhambri, 1989, p. 68). I adhere to a simpler definition, namely a planned response to realign the firm to its environment. Consequently, the firm execute a planned response when the environment changes, which it invariably will in one form or the other over time.

As briefly discussed in chapter 1, strategic change relates to how firm's are able to stay competitive over time, i.e maintain competitive advantage. Figure 1.2 places these concepts in relation to each other. Central to the ability to enable strategic change to happen is the core concept, *dynamic capabilities (DC)*. The point of departure for RBV and resource-based theories, including DCT, is that firms and organizations can be seen as bundles of resources available at their discretion. As such this **resource base** can be defined as 'tangible, intangible, and human assets (or resources) as well as capabilities which the organization owns, controls, or

has access to on a preferential basis' (Helfat et al., 2007, p. 4). I think of this resource base as all the levers available to a firm to create value and such including everything from hardware, input factors, routines and so forth. Thus, resources as traditionally understood in RBV (Barney, 1991a; Amit & Schoemaker, 1993; Wernerfelt, 1984) and its antecedents (Penrose, 1959), namely 'as stocks of available factors that are owned or controlled by the firm' (Amit & Schoemaker, 1993, p. 35) are a subset of the resource base.

I subscribe to the definitions put forth by Helfat et al. (2007) and build this dissertation on the distinction between tangible *resources* on the one hand, and intangible and human *capabilities* on the other. Resources in this context is the stocks of available factors as suggested by Amit & Schoemaker (1993). Capabilities comes with a far less clear understanding and definitions vary.

In-depth discussions on capabilities are well established in the literature (Dosi et al., 2001; Amit & Schoemaker, 1993; Helfat & Peteraf, 2003), and a comprehensive definition of capabilities varies (Helfat & Winter, 2011). A few common factors do, however, exist (ibid). First, a capability has an intended use for a specific purpose. Second, a capability entails 'to do' and to 'carry out' a certain set of tasks. And third, a capability means that the performance follows a repeatable and reliable pattern and is hence closely tied to routines as I will discuss in more detail below. From this list of characteristics from Helfat & Winter (2011) I suggest the following definition of a capability in general as 'the know-how that enables organizations to perform (..) and extend its characteristic "output" actions - particularly, the creation of a tangible product or the provision of a service, and the development of new products and services (Dosi et al., 2001,

p.1). Dosi et al. (2001) makes a case for coining the overarching capabilities term *organizational capabilities* which makes for a crisper distinction between groups and levels of capabilities within an organization.

The core concepts of DC theory are best understood in the context of the **capabilities hierarchy**. This organizing framework has been suggested and elaborated by several seminal contributors to the DC field (Winter, 2003; Schilke, 2014b; Helfat et al., 2007). Figure 2.2 depict the relationship between the key constructs in DC theory including a possible definition and an example. From the figure it is reasonably clear that resources and capabilities are both a subset of the resource base of the firm, the key concept upon which DC operate.

Concept	Definition	Example
Resource base	'tangible, intangible, and human assets (or resources) as well as capabilities which the organization owns, controls, or has access to on a preferential basis' (Helfat, 2007)	Commodities, capital, know-how of a firm needed to produce
Resources	'stocks of available factors that are owned or controlled by the firm' (Amit & Schoemaker, 1993)	Factors that goes into production such commodities like aluminum
Capabilities	'the know-how that enables organizations to perform (..) and extend its characteristic "output" actions - particularly, the creation of a tangible product or the provision of a service, and the development of new products and services' (Dosi at.al, 2001)	The ability to produce a car
Operating capabilities	'a set of high-level routines that 'confers upon an organization's management a set of decision options for producing significant outputs of a particular type' (Winter, 2003)	The routines needed to convert resources like aluminum and create a car
Dynamic capabilities (1st)	'the capacity of an organization to purposefully create, extend, or modify its resource base' (Helfat, 2007)	Ability to renew car production through product development
Dynamic capabilities (2nd)	'(capabilities) that can be used to develop first-order dynamic capabilities' (Collis, 1994)	Ability to deliberately learn and adapt through experience
...		
Dynamic capabilities (nth)	'(capabilities) that can be used to develop (n-1) order dynamic capabilities' (Adapted from Collis, 1994)	

Capabilities hierarchy

Figure 2.2: The relationship between key constructs of DC theory

At this point it is useful to place routines as the lowest level of building blocks in the capabilities hierarchy. A routine is defined as a 'behavior that is learned, highly patterned, repetitious, or quasi-repetitious, founded in part in tacit knowledge' (Winter, 2003, p. 991). A collection of routines can form *operational capabilities* which emerges as those high-level routines that 'confers upon an organization's management a set of decision options for producing significant outputs of a particular type' (Winter, 2003, p. 991). Or more commonly, those capabilities that enables a firm to make a living in the short run (ibid). The linkage between capabilities and routines are prominent in the literature and sometimes confusing to the reader. However, a certain distinction is warranted. A routine is simply a 'regular and predictable behavioral patterns of firms' (Nelson & Winter, 1982, p. 14) or similar to 'basic functional activities of the firm' (Collis, 1994, p. 145). Juxtaposed to a capability, however, a routine imply no particular size or scope, no deliberation, and no presumption of the particular purpose (Dosi et al., 2001). In fact, routines are often so void of deliberation and particular purpose that people being a part of them do not know their antecedents or rationale (ibid). Thus, certain routines are an embedded part of the genes of the company (Nelson & Winter, 1982) and simply a product of the 'way we do things here' (Vince & Gabriel, 2011).

In contrast, an operating capability is also repetitious in nature, but in a larger scale, more deliberate and with presumption of a particular purpose (Dosi et al., 2001). Moreover, capabilities 'enables repeated and reliable performance of an activity, in contrast to ad hoc activity that does not reflect practiced or patterned behavior' (Helfat & Winter, 2011, p. 1244) which is the hallmark of routines. Capabilities and routines are linked, however, through a certain hierarchical structure as well tempting promi-

nent contributors to conclude that 'routines are the building blocks of capabilities' (Dosi et al., 2001, p. 4). Yet others have argued that routines form bundles into capabilities (Winter, 2003).

Moving to the next level of the capabilities hierarchy depicted in figure 2.2, the focal concept of this dissertation comes into view. *Dynamic capabilities* are in brief capabilities geared towards changing the resource base (e.g. resources and capabilities) to cope with environmental change. Definitions of dynamic capabilities varies considerably and a number of variations exist in the literature (Barreto, 2010; Eriksson, 2014). Table 2.1 presents a synthesis of the most common definitions found in the literature.

Definition	Reference	Theoretical origin
The subset of the competences and capabilities that allow the firm to create new products and processes and respond to changing market circumstances	Teece & Pisano (1994)	Evolutionary Economics
The firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments	Teece et al. (1997)	Evolutionary Economics
Dynamic capabilities are higher-level competences that determine the firm's ability to integrate, build, and recongure internal and external resources/competences to address, and possibly shape, rapidly changing business environments	Teece (2012)	Evolutionary Economics
The firm's processes that use resources—specifically the processes to integrate, reconfigure, gain, and release resources—to match and even create market change; dynamic capabilities thus are the organizational and strategic routines by which firms achieve new resource configurations as markets emerge, collide, split, evolve, and die	Eisenhardt & Martin (2000)	Behavioral Theory
The ability to sense and then seize opportunities quickly and proficiently	Teece (2000)	Behavioral Theory

A dynamic capability is a learned and stable pattern of collective activity through which the organization systematically generates and modifies its operating routines in pursuit of improved effectiveness	Zollo & Winter (2002)	Behavioral Theory
Those (capabilities) that operate to extend, modify, or create ordinary capabilities	Winter (2003)	Evolutionary Economics
The abilities to reconfigure a firm's resources and routines in the manner envisioned and deemed appropriate by its principal decision maker(s)	Zahra et al. (2006)	Behavioral Theory
The capacity of an organization to purposefully create, extend, or modify its resource base	Helfat et al. (2007)	Evolutionary Economics
Dynamic capabilities concern an organization's ability to reallocate or reconfigure resources to adapt to changes in the future	Helfat et al. (2007)	Evolutionary Economics
Dynamic capabilities can be disaggregated into the capacity (a) to sense and shape opportunities and threats,(b) to seize opportunities, and (c) to maintain competitiveness through enhancing,combining, protecting, and, when necessary, reconfiguring the business enterprise's intangible and tangible assets	Teece (2007)	Evolutionary Economics
Dynamic capabilities can usefully be thought of as falling into three clusters of activities and adjustments: (1) identication and assessment of an opportunity (sensing); (2) mobilization of resources to address an opportunity and to capture value from doing so (seizing); and (3) continued renewal (transforming)	Teece (2012)	Evolutionary Economics
A set of specific and identifiable processes such as product development, strategic decision making, and alliancing	Eisenhardt & Martin (2000)	Behavioral Theory

Table 2.1: Definitions and theoretical origins of dynamic capabilities

The work to find a common definition of dynamic capabilities has seen several challenges, the pinnacle of which is tied to a conceptual disagreement between schools of dynamic capabilities thinking (Peteraf et al., 2013).

36

Arguably, this discrepancy can be traced, at least partly, back to the theoretical roots of the author proposing the definition (Arndt & Pierce, 2018). Some common traits do, however, exists between all the definitions put forth in table 2.1 that are relevant to my focal topic. The bulk of the definitions contain elements pointing to a focus on change and the role of DC in fostering adaptability to change. Phrasings such as 'changing market circumstances', 'changing environments', 'as markets emerge, collide, split, evolve and die' and 'adapt to changes in the future' are all pointing to the centrality of change in DCT. Some other definitions, like the one I subscribe to in this dissertation, is not explicitly stating this relationship, but implicitly points to change as a driver through holding that purposeful modification is important to the concept.

Moving from definitions, I now turn to the core elements of DC theory and how they play out in enabling strategic change.

2.3   Elements of dynamic capabilities theory

Any theory can best be analyzed and understood through studying its constituent parts. Specifically, 'a theory may be viewed as a system of constructs and variables in which the constructs are related to each other by propositions and the variables are related to each other by hypotheses between units observed or approximated in the empirical world' (Bacharach, 1989, p. 498). The theory must hence answer **how, when** and **why** some (what) A leads to B. Thus mechanisms plays a prominent in any theory and theory development and helps us think about causal relationships and thus propositions of the theory. Mechanisms represents causal explanations that must be true causation: 'to cite the cause is not enough: the causal mechanism must also be provided, or at least suggested' (Elster, 1989, p. 4). And it is notoriously hard to establish true causality, whereas causal explanations is possible, albeit often empirically challenging. Thus

it is useful to 'work on partial mechanisms rather than general theories' (Williamson, 2000). Consequently, the study of mechanisms is particularly important in any theory development, and the need to clarify them is of pivotal importance.

Figure 2.4 presents the theoretical elements of Bacharach (1989) in the context of DCT. DC impacts some outcome such as performance (e.g. competitive advantage or strategic change) through some intermediary outcome (a mediator) or directly. The mediator thus becomes quasi-equivalent to a mechanism (how and when) in theoretical sense.
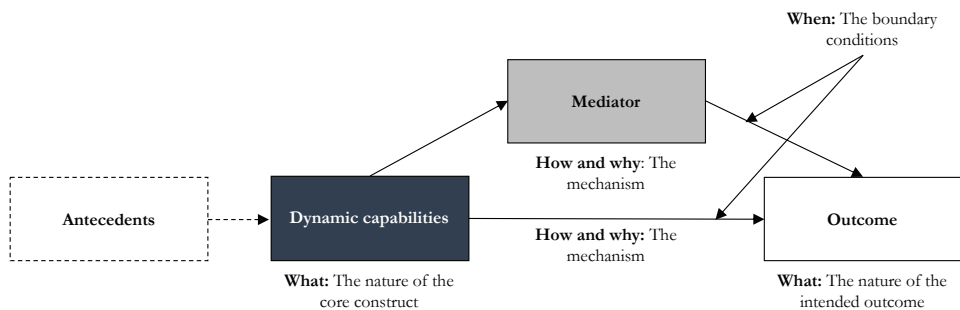
Figure 2.3: The constituent elements of dynamic capabilities theory

Along the dimensions in figure 5.1 a range of research gaps are identified in the current literature, most notably by Schilke et al. (2018). Some overarching questions are still unanswered and new empirical and theoretical work is needed. The last decades have seen considerable progress in DCT. A number of *antecedents* have been identified and studied grouped in either internal such as organizational structure (Eisenhardt et al., 2010; Felin & Powell, 2016), information technology (Pavlou & El Sawy, 2006; Macher & Mowery, 2009), human capital (Blyler & Coff, 2003), cognition (Dunning & Lundan, 2010), or external such as the external technological environment (Fawcett et al., 2011; Killen et al., 2012; Benner, 2009), or

---

[4]Figure is based on Di Stefano et al. (2014), Eriksson (2014) and Bacharach (1989)

the market specifically (Koolen et al., 2005; Chung & Beamish, 2005). Indeed a certain level of environmental dynamism is consider an important antecedent as well (Wang & Ahmed, 2007).

Thus, a useful way of considering the current research agenda on dynamic capabilities is to distinguish between the different constituent elements of DCT in order to see how it answers the how, when and why strategic change occurs and generates competitive advantage. Various categorizations of such elements exist in the literature (see for example Ambrosini & Bowman (2009), Eriksson (2014) and Schilke et al. (2018)). Certain elements are, however, common. The nature and antecedents of the core construct (dynamic capabilities), mechanisms and process, and the outcome is a useful list of constituent parts. Figure 5.1 depicts these dimensions.
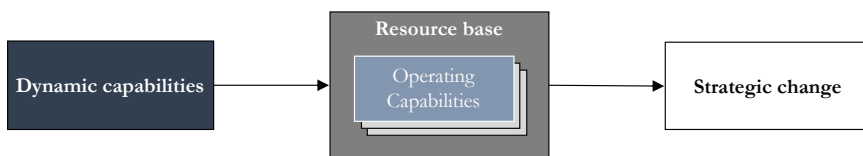
Figure 2.4: The workings of dynamic capabilities

Considerable progress has also been made with respect to understanding the very *nature* of the construct itself (Ambrosini & Bowman, 2009; Teece, 2007; Helfat et al., 2007) (the **what** of the theory). This includes inquiry into the hierarchy of various capabilities (Winter, 2003; Collis, 1994; Schilke, 2014b), as well as various functional domains. This notion that DC takes different forms in different functional domains is important for how we operationalize and understand. All these functional domains can be placed on a continuum from very specific (post-acquisition integration) to very generic (capacity to sense and seize opportunities). Examples product development (Danneels, 2008, 2010), marketing capabilities (Bruni & Verona, 2009), innovation capabilities (Breznik & D. Hisrich, 2014), alliance formation (Kale et al., 2002; Kale & Singh, 2007; Schilke,

2014b), acquisition targeting (Bingham et al., 2015), technological capabilities (Mikalef & Pateli, 2017; Wamba et al., 2017) and internationalization (Efrat et al., 2018; Dunning & Lundan, 2010). I will get back to this under the methodology chapter to clarify how I have used various functional domains in my research.

Moreover, also exploring the **what** of the theory, a range of various *outcomes* have been theorized and analyzed. The most obvious and persistent outcome is related both objective and subjective measures. Objective measures include firm-level performance (Desyllas & Sako, 2013; Shamsie et al., 2009), domain-/process-specific performance such as acquisition integration product quality, and supply chain management (Zollo & Singh, 2004) and external fitness (Helfat & Peteraf, 2009). However, a common underlying outcome implicit in all of the above relates to strategic change (Helfat et al., 2007). Strategic change is the focal outcome of DC because the theory aims to explain how firm's survives and thrives over time. This is never as clear as in Helfat et al. (2007): 'Because dynamic capabilities concern strategic change, virtually any research topic that involves strategic change has links to dynamic capabilities, and vice versa' (p. 120).

A myriad of various *contingent factors* exploring the boundary conditions of the theory (the **when**) has been presented in extant literature (Piening, 2013a; Teece et al., 1997; Schilke et al., 2018). The most important one is tied to the notion of environmental dynamism and goes to the core of the initial work on DCT (Teece et al., 1997). The most prominent discussion on this contingency holds that various early contributions forked into two camps regarding the boundary condition represented by environmental dynamism where one side held that DC 'is especially relevant in a Schumpeterian (high environmental dynamism) world' (Teece et al., 1997, p. 509), while the other claims that DC 'encounters a boundary condition

in high-velocity markets' (Eisenhardt & Martin, 2000, p. 1118). The consequences of this discrepancy is thoroughly debated in the literature from both theoretical (Di Stefano et al., 2014; Arndt & Pierce, 2018; Peteraf et al., 2013) and empirical angles (yuan Li & Liu, 2014; Schilke, 2014a; Romme et al., 2010). Other contingent factors related to the external environment such as industrial sector (Piening, 2013b) and competitive intensity (Arrfelt et al., 2015), as well as internal factors including organizational size (Arend, 2015), structure (Fang & Zou, 2009), social capital (Blyler & Coff, 2003), and culture (Ambrosini et al., 2009).

Still, a range of research gaps have been identified. First, investigating the *antecedents* of DC still garner needed attention as a range of antecedents, as well as their interplay is largely unexplored (Schilke et al., 2018). Understanding the antecedents of a pivotal unit of a theory, is similarly useful in extending the theory itself, as well as a useful tool for strategic decision makers in the quest for dynamic capabilities. One particular aspect of these antecedents discussed in the literature, is the role of organizational learning as an antecedent for dynamic capabilities (Zollo & Winter, 2002).

Second, understanding the *nature* of DC is an ongoing research endeavor. A rich literature building on Winter (2003) has developed a number of hierarchical models for analyzing the interaction between lower-order and higher-order routines and capabilities (Collis, 1994; Ambrosini & Bowman, 2009). Furthermore, the degree of routinization exhibited in DC is also subject to a considerable debate (Peteraf et al., 2013) and integration is needed and in demand (Di Stefano et al., 2014). Shedding light on the role of resource hierarchy and routinization in DC is thus in demand (Schilke et al., 2018).

Third, the ultimate dependent variable of DC have been related to some measure of performance such as financial return, innovation, or general competitive advantage (Barreto, 2010). Interest in the final outcome of organizational change from DC is of course important for any theory development. Its validity as a construct will rely on the theory's ability to explain the ultimate objective of the unit of analysis, i.e. the firm.

Finally, one particular theoretical problem with the DC theory is the lack pf understanding of the *mechanisms* that play into the effect of DC on any outcome (Schilke et al., 2018). Specifically, the role of different mediators in the link between DC and outcome should be explored. One aspect garnering interest among strategy scholars is the role of mediators such as tangible and intangible resources (Schilke et al., 2018), cognitive factors (Verona & Zollo, 2011), options from general purpose capabilities (Pisano, 2017), and innovation capabilities (Breznik & D. Hisrich, 2014). And although all parts of DCT, as depicted in figure 2.4, to a certain extent will have to be part of efforts to move the theory forward, I have chosen to put particular emphasis on the **how** and **why**, i.e. the mechanisms, in this dissertation. .

2.4 Knowledge gaps in dynamic capabilities literature

The current state of the literature on mechanisms in DC theory is, as discussed above, progressing. Still, extant DC research is lacking in exploring the role of different types of mediators as mechanisms through which DC work to yield a certain outcome such as strategic change. In order to shed light on the research question of 'the role of dynamic capabilities in enabling strategic change in firms' the mechanisms through which DC works is of pivotal importance. Current literature has explored and explicated a range of different mechanisms, but more work remains. Reverting back to the notion of what constitutes a theory, namely the **how, when** and

why (Bacharach, 1989, p. 498), a particular emphasis on the **how** and **why** seems warranted as any insight into the mechanisms at play is an important characteristic of proper theory building (Elster, 1989) and hence a crucial gap to fill. This is also stressed in a recent state-of-the-art literature review holding that 'we see opportunities for researchers to explore additional mechanisms (i.e mediators) that explain proposed relationships of dynamic capabilities with other variables, which is an area of weakness in the current literature' (Schilke et al., 2018, p. 406).

One particular interesting avenue for further research is the distinction between *behavioral* and *cognitive* objects of change (Verona & Zollo, 2011; Zollo et al., 2016). These are both to be considered as organizational level concepts. This view holds that conventional understanding entails DC working to change behavior of organizations, e.g. changing operating routines. *Behavioral objects of change* are geared towards 'how things are done within the firm'. Extant literature has explored how this plays out in influencing the behavior of agents in the organization as well as the organization as a whole (Schilke et al., 2018; Teece, 2007; Helfat & Winter, 2011). In order to enable strategic change, DC triggers these behavioral objects to change the behavior of the organization, e.g. in the form of new routines. This is very much the core mediator in most extant DC literature (Verona & Zollo, 2011). Many such *behavioral* mechanisms have been explored, but still more of them needs to be investigated. Especially, this goes for the distinction between DC working to create new capabilities, or enhance old one (Di Stefano et al., 2014), innovation say (Breznik & D. Hisrich, 2014), as well as how general purpose capabilities can be enhanced as well as reconfigured and aligned in new bundles (Pisano, 2017). I therefore aim to contribute to each of these gaps in papers 1 and 2 with a special eye on sub research question 1.

The novelty of (Verona & Zollo, 2011) through leveraging the increasing focus on cognition in strategic management (Gavetti et al., 2007; Gavetti, 2012). *Cognitive objects of change* deals with 'why things are done within the firm'. When geared towards *cognitive objects of change* DC 'adapt the more tacit and subtle aspect of human interactions (motivation, emotions, and identity, in particular) to environmental or contextual requirements (Verona & Zollo, 2011, p. 538). For example, in the process of implementing change in behavior 'firms will have to adapt cognitive frames and managerial mind-sets related to a new formulation of purpose and identity' (Zollo et al., 2016, p. 226). Motivation and identity (Verona & Zollo, 2011), cognitive frame/processes, and mindsets (Zollo et al., 2016) are all concepts or part of the subset of cognitive objects of change. Consequently, such objects represents a different mechanism than ones geared toward behavioral change and should be analyzed as separate constructs. To particular cognitive frames that are important in being able to enable strategic change are the ability to learn (Zollo & Winter, 2002), and the adoption of certain mindsets (Verona & Zollo, 2011). I attempt to contribute to these particular streams of insight through papers 3 and 4 with a special eye on sub research question 2.

2.5 Limitations and criticisms of dynamic capabilities theory

There are several important and interesting limitations with DCT that warrant a certain attention. First, seminal contributors to the field have found it hard to reconcile their conceptualization of DC Peteraf et al. (2013) leading to diverging opinions to the nature and outcome of DC. One stream of this debate holds DC to be simple routines akin to best practices, and that they are more imitable than commonly held (Eisenhardt & Martin, 2000). Consequently, DC will not satisfy the VRIO condition for competitive advantage. Another stream argues that DC are more complex and path-dependent, and hence more heterogeneous between firms (Teece

et al., 1997). According to this conceptualization, DC can lead to competitive advantage. In an effort to reconcile these differences, a newer stream of literature argues for a conceptualization combining, stating that DC can be both and hence forming a more dynamic system (Di Stefano et al., 2014; Arndt & Pierce, 2018). This dissertation attempts to contribute to a more nuanced understanding of this dynamic system proposed by (Di Stefano et al., 2014).

Another challenge is related to the definition of DC. Currently, as I get back to in chapter 6.3, a multitude of definitions are used interchangeably (Barreto, 2010; Ambrosini & Bowman, 2009). These definitions vary with respect to their focus on the environment (Teece et al., 1997), degree of routinization (Wohlgemuth & Wenzel, 2016; Eisenhardt & Martin, 2000), and actors enacting them (e.g top managers or organization) (Zahra et al., 2006). To partly remedy this limitation, I allocate a full section of this dissertation to discussing various definitions in order to get a better grasp of the core idea of DC.

One other challenge in the extant literature is the general lack of operationalization of DC as a construct (Easterby-Smith et al., 2009). DC is in many ways a latent construct (although extant literature differs somewhat on this notion as well (Di Stefano et al., 2014)). And as it is invariably seen as higher-order routines (Winter, 2003) or processes (Teece, 2007) depending on the point of view, empirical measurements vary (Kump et al., 2018; Laaksonen & Peltoniemi, 2018). Indeed, even routines and capabilities hard to measure due, in part, to their idiosyncrasies (Penrose, 1959), although efforts have been made (Bloom & Reenen, 2007). In this dissertation, I attempt to contribute to both better measurements of DC using repeated cross sectional data, but also proposing novel ways of thinking about DC through the idea of capabilities alignment (Pisano, 2017).

One particularly challenging critique relates to the causal argument posed in the theory. This holds that effects from DC simply is a response to the firm being a good firm (Arend & Bromiley, 2009). Consequently, DC is equated to firm performance, making for a tautological argument (Priem & Butler, 2001). This tautology makes it hard to distinguish the direction of the effects the performance implications of dynamic capabilities (Wang & Ahmed, 2007) and it is amplified due to the lack of ex-ante identification of DC (Eriksson, 2014). Simply put both firm performance and dynamic capabilities can be due to some unobserved factor of the firm simply being a "good firm". In such cases we would simply regress one on the other and get positive results without the exact mechanism being pointed out. Albeit later rebuffed by arguing that 'because organizations vary in how well they perform an activity, the definition of dynamic capability does not constitute a tautology with respect to superior performance' (Stadler et al., 2013, p. 1784), the criticism is warranted and should be taken seriously. thus I have placed considerable emphasis on this in my papers by adding proxies for the quality of the firm as a control variable. Such controls, alas far from perfect, serves to partially control for parts of the possible cofounding factors of firm quality. However, the lack of ex-ante identification of DC due to its latent nature, still looms large (Eriksson, 2014).

Methodology

*'I reaffirm with emphasis (..) that the sun is real, and also that it is hot —
in fact as hot as Hell, and that if the metaphysicians doubt it they should
go there and see'* - Winston Churchill

This chapter elaborates on the methodological approach I have used to
investigate the research question of this dissertation. From the onset I
discuss the philosophical foundations of my research and the ontological
and epistemological preconditions I have chosen as guiding principles of
my research. Second, I describe the research design of the dissertation and
how my methods apply to the research I pursue. Finally, I describe the
data and methods, construct operationalization and the quality assessment
techniques applied.

3.1 Epistemological and ontological positioning

Let me be the first to admit that my philosophical position in my work
with this dissertation has been a journey rather than a fixed point. This
is also reflected in an ongoing philosophical debate of the ontology and
epistemology of the business and strategy sciences (Foss, 2012) where con-
siderable movement from logical positivism to inclusion of more interpre-
tivst ideals have been observed (Mir & Watson, 2000; McCloskey, 1991).
Consequently, a debate also plays out in the tension between inductive and
deductive logic (Montgomery et al., 1989; Shiller, 2017). Hence, it is of

increasing importance to make ones fundamental assumptions about the world and how it works when embarking on a project like I have in this dissertation.

From a *realist ontology* general laws and principles could exist and the *objectivist epistemology* holds that such universalities can indeed be observed. A *nominalist ontological* position, on the contrary, would oppose this notion of generality on the grounds of a *constructionist epistemology* claiming that a socially constructed world can only be understood through the relative view of the beholder. This has also traditionally been the focal point of economic research (Crotty, 1998).

Dynamic capabilities is a complicated phenomenon to study and clarity surrounding the researchers ontological and epistemological position is paramount for the pursuit of high quality research. DC is comprised of a 'capacity' (Helfat et al., 2007) that imply human actions, based on agent behavior, in social systems. This capacity is not directly observable in the strictest sense and one is forced to make certain assumptions about the objective existence of DC as well as its subjective interpretation in order for it to become a meaningful object of study. **Ontologically** this poses a fundamental question: Do the concept of dynamic capability really exist? One is hard pressed to truly falsify the existence of a dynamic capability, making it an unscientific claim in a strict Popperian sense (Popper, 1972). Neither can it be truly verified as its predictions often calls for measuring outcomes that could be the result of other factors (e.g. strategic change could be a result of unobservable, random, exogenous shocks) thus making it hard to verify in a Kuhnian sense (Kuhn, 1962). In some sense this leads dynamic capabilities theory to a nominalist ontology where the core construct is considered non-existent in the real sense. The individuals exercising DC, on the other hand, would indeed be assumed real (Foss,

2012). So one is able to accept both a *realist ontology* and *nominalist ontology* contingent on how we consider the agents making up the construct itself. However, even the ardent constructivist tends to stick with a realist ontology because one can leave the search for the truth to the imperfect observations of reality; 'I reject ontological relativity (because) evolutionary epistemology has in it an unproven assumption of an (external) real world' (Campbell, 1988, p. 507). And this is indeed conducive to my own ontological realist position. I find that both considering DC as set of higher-order routines or complex processes they still exist in the sense that they are able enact change to reach a (moving) objective. In other words, they exist because of agents being enabled by and executing them, agents that are real (Foss, 2012).

The **epistemological** presents another challenge where clear assumptions must be made. Core to the DC construct the implied role of human actions, based on agent behavior, in social systems (Adner & Helfat, 2003; Arndt & Pierce, 2018; Helfat & Peteraf, 2015; Eisenhardt & Martin, 2000). One fundamental question arose while I was grappling with the DC theory. DC is comprised of rules and processes for human actions the 'agents' in the theory will be the unit that will execute DC and moving it from a latent to an actionable construct (Di Stefano et al., 2014). If so, can we really observe latent human action, and, if so, to what extent would these observations be objective in the truest sense? I coin this the *problem of observability.*

The problem of observability is a central trait of DC theory. DC as routines and processes are arguably unobservable (Nelson & Winter, 1982). According to the bearing principle of inimitability, resources that are unobserved are also harder to imitate, and hence more valuable and intrinsically linked to the competitive advantage of the firm (Barney, 1991a). This

would, by extension, be especially relevant to more complex, higher-order routines that are even harder to imitate, such as DC (Winter, 2003). A strictly logical positivist approach, the point of departure for much work in economics and management, would hold that DC as a concept would only be valuable if, and only if, it can be empirically verifiable. Consequently, purely theoretical elements of a theory has reduced value unless they can be verified empirically. A partial refutation of this position holds a more instrumental understanding of the world arguing that a theoretical elements usefulness relates to its ability to explain empirical phenomena (Nagel, 1961). In a more practical sense an instrumentalist would argue that value of a theoretical element can only be assessed by the extend to which 'it yields sufficiently accurate predictions' (Friedman, 1953, p. 15). This position fits rather neatly with empirical ambitions for DC theory, or indeed any theory of strategic management due to its pragmatic antecedents (Foss, 2012).

However, in order to test accuracy of predictions the mere measurement would be problematic when adopting an instrumentalist approach. The measurements itself could be based on unobservable factors and consequently prone to rejection by an instrumentalist researcher (Godfrey & Hill, 1995). Rather, the researcher would have to accept some level of 'faith' (Chalmers, 1999) which opens up to severe criticisms for simply being a part of the metaphysics (Popper, 1972) or theology (Feyerabend, 1978). By accepting a certain 'belief' the researcher is a realist (Crotty, 1998) and can remedy parts of the meta-physical critique by adopting a strict regime of falsification as a device to safeguard scientific relevance. Additionally, accepting that epistemological certainty is impossible due to the points raised above, Putnam (1990) argues for combining ontological realism and relativistic epistemology in 'critical realism' (Crotty, 1998; Bhaskar, 1998). And many strategy researchers subscribe to critical real-

ism and its methodological sibling - abductive reasoning (Mingers, 2006). Through abductive reasoning 'take some unexplained phenomenon and propose hypothetical mechanisms that, if they existed, would generate or cause that which is to be explained' (ibid p. 23).

The problem of unobservability, however, still looms large in DC theory. Especially when we introduce the ultimate outcome of strategic management theories in general, and DC in particular; competitive advantage (Schilke et al., 2018). The link between DC and CA is by itself subject to criticism for being tautological in the sense that one observes CA and finds DC in retrospect and 'it would not be surprising if the researcher located such factors' (Powell, 2001, p. 882). Thus, the problem of unobservability becomes a severe epistemological challenge in lieu of a certain 'leap of faith' as described above. I pondered this predicament for quite a while until finally settling on a justification for a constituted belief of the value of pursuing research on the unobservable DC concept.

All scientific endeavor should at some point be judged against its ability to make sense of observed phenomena. Making sense, in its respect, will be subject to certain judgments that are in turn related to interpretation of what constitutes desirable outcomes. For the purpose of strategic management scientific progress should be judge on its ability make for practical applications and actionable. Consequently, I follow Peirce's view of 'doubt' as a catalyst for knowledge creation asserting that no inquiry is possible when the mind is fixated in any one belief system (Shields, 1998). Pierce contend that any cognition is path dependent on previous cognitions and that 'possibility of scientific truth does not derive from indubitable foundations, but by the self-correcting process of interpretation' (Halton, 2004, p. 650). Furthermore, a certain level of 'belief' is consistent with a lion share of scientific progress as 'all good theories, even the most esteemed theories

of the physical and biological sciences, have metaphysical qualities' (Powell, 2001, p. 883). Taken together the judgment of science on the basis of practical utility (pragmatism) and the proposition that metaphysical qualities of theory is almost inevitable in scientific progress, constitutes a rational argument for accepting a certain level of belief in the concept of DC without it being observable. Consequently, DC theory can and should progress to increasingly capture the unobservability of the concept and its outcomes simply because it serves a practical purpose of understanding the source of competitive advantage, and because it has proved to be able to explain the phenomenon that certain firms do better than others over time. The value of science and thought, in other words, is a function of the problems it solves. Thus the mode of knowledge production is subjugated the research objective (Hickey, 2009).

Adhering to a critical realist perspective with a pragmatist justification for coping with the unobservability of the core concept of DC theory has certain methodological implications. First, it follows that DC in most cases would be a latent construct only *directly* observable through its execution (i.e. when used). This is not to say that measures of formative observable traits can be measured to capture the concept 'ex ante', but rather that the impact of DC can only directly be measured 'ex post'. Second, the relationship between DC and outcome (such as strategic change) is complex and often works with a time lag. Third, sources of strategic change and competitive advantage can be several factors outside the extant theory of DC. This could be other competing paradigms or simply randomness or other characteristics of the industry, the firm or the business cycle that is not a part of the DC theory. Consequently my methodological approach is designed to cope, to the best possible degree, with the latent nature, the time dynamics and the confounding effects on the DC final outcome. In practice this means that I do my utmost to provide latent measurements

of DC, introduce time wherever possible, and strive to include as many confounding factors as possible in my empirical research design. I will now turn to methodological considerations in more detail.

3.2 Research design

An elaborate research design helps the researcher explain and justify their approach to data collection and analysis, as well as the operationalization of core constructs. The following research design is aligned with the philosophical position elaborated above in that it puts considerable emphasis on capturing the latent nature of the core concept of DC and aim to shed light on how mechanisms in DC theory is at work in explaining the observed outcome of strategic change. Figure 3.2 presents a synposis of the data and methods used in the research papers. I will now consider these as a whole and relate them to the process of answering my overall research question.
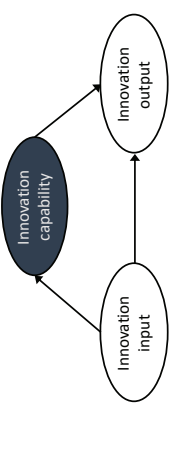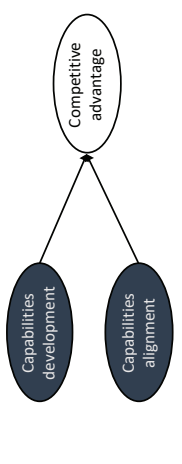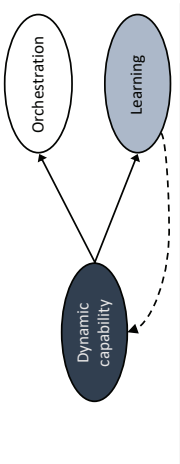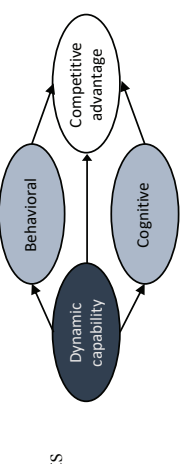
Paper	Operationalization	Key constructs	Relationships
Paper 1	Innovation capabilities as a specific functional domain of DC. Measured as a latent construct with items from survey indicating both internal and external capabilities for innovation	DC as *innovation capability* as mediator of innovation process.	
Paper 2	Constructs of 'expressions' of DC measured through underlying management routines. Both mean and the kurtosis of the distribution of routines used	DC as expressed through *capabilities development* and *alignment*. Leading to *competitive advantage* and *sustained CA*	
Paper 3	Generic DC measured latently using customized survey items. Similarly with the other focal constructs of the paper such as deliberate learning and operational capabilities.	DC working through orchestration of *capabilities*, and *learning* (mediator). Enabling learning enhances DC at later stage	
Paper 4	Generic DC measured latently using customized survey items. Similar measure of latent objects of change.	DC working through *behavioral* and *cognitive* objects (mediators). Impact on *competitive advantage*	

Figure 3.1: Overview of methods in the research papers - 1

Paper	Data source	Example items	Statistical method
Paper 1	**Innobarometer:** Pan-European survey on innovation activity from EU. Broad coverage and multilevel structure. Sample of 4900 firms	Has your company started or increased any of the following initiatives: - Knowledge management systems - Internal mechanisms for employees to submit innovative ideas	Constructs estimated using Item Response Theory. Fixed Effects- and Bayesian Causal Mediation estimation
Paper 2	**World Management Survey:** International survey capturing management practices across several dimensions in the firm. Sample of 2000 firms	- Production practices - Hiring and firing practices - Rewards and evaluation practices - Goal setting and monitoring practices	Fixed Effects estimation
Paper 3	**DC survey:** Survey of Norwegian R&D active firms particularly designed to capture DC. Longitudinal. Sample of 283 firms	- We systematically identify which resources we can utilize - We have developed routines that enable us to recombine existing resources in novel way	Heckman selection model estimation and Bayesian Causal Mediation estimation
Paper 4	**DC survey:** Survey of Norwegian R&D active firms particularly designed to capture DC. Longitudinal. Sample of 240 firms	- We systematically identify which resources we can utilize - We have developed routines that enable us to recombine existing resources in novel way	Partial Least Square Structural Equation Model (PLS-SEM)

Figure 3.2: Overview of methods in the research papers - 2

Level and unit of observation and analysis

Strategy research has moved from industry-level analysis (Schmalensee, 1985; Bain, 1956; Porter, 2008) to firm-level (Rumelt, 1991; Barney, 1991a; McGahan & Porter, 1997) and business-level (Hough, 2006; Misangyi et al., 2006). Particularly, within the DCT the bulk of the extant empirical literature focuses on the firm level (Schilke et al., 2018; Eriksson, 2014; Fainshmidt et al., 2016). This, of course, partly stems from increased effort to understand performance differentials between firms as a function of firm heterogeneity (Helfat et al., 2007). Furthermore, increasingly the use of time series data in conjunction with large cross sectional samples have been called for in the literature (Schilke et al., 2018) in order to progress towards a better understanding of dynamics.

All the data in my dissertation are observed at the firm level, with some control and indicator variables (used for grouping) measured at the industry, regional or country level. This means that the focal variables are observed at the firm level, but that certain data sources had firms nested in higher order groupings (e.g. industry, region or country). In certain of the data sets I was also able to extract several observations of each firm over time which made for an extra dimension of analysis. The analytical levels are also mainly at the firm level. However, as I in certain papers had panel-data, and even hierarchical data structures, I was able to take multiple levels into consideration.

In answering the overall research question, firm-level analysis over time seems to be a suitable approach. This includes firm level covariates to capture confounding effects and control for other firm characteristics likely to influence the strategic change of the firm.

Samples and population

Research on strategy focusing on the firm level uses a range of populations for their studies. A prominent high-level set of empirical research uses full populations of listed firms (Erkan et al., 2015; Hough, 2006; van Essen et al., 2015). More specific samples are found in various industries and geographies (Kump et al., 2018; Jantunen et al., 2005), as well as special types of firms like family owned firms (Duran et al., 2015), and technology firms (Alsos et al., 2007).

To capture various mechanisms of DC it is also useful to use different samples from different populations throughout the research papers. This safeguards a more representative total sample, although measures and estimations may differ. In this thesis, as indicated in figure 3.2, I use three different samples from three different populations. Common for all these are that they largely are firms in the developed world and they are for the most part manufacturing or technology oriented firms with a certain exposure to innovation and R&D. By including these similarities in the overall sampling, I aim to make for better cross validation of my findings across contexts.

Despite certain commonalities, however, the samples and populations are also diverging in other characteristics. On the one hand I analyze large samples from international firms with a certain opportunity for a higher external validity of the findings. The large data set also gives me opportunities to control for context specific factors in play at the country or the industry level. It also enables me to explicitly measure the rate of change facing the firms by estimating the time effect of industry changes in sales and profitability, as well as measure market out performance at the firm level over time due to the availability of financial reporting data from these populations and the sample size itself. On the other hand I dig deeper by

analyzing a smaller set of R&D active Norwegian firms. This enables me to even more explicitly model the mechanisms because the level of detail in the data is considerably high. Moreover, because the sample is drawn from a universal tax credit scheme, the firms are required to report extensively on their activities bringing more relevant firm level controls into view.

A detailed description of the sampling and population is readily available in the research papers as well as in European Commission (2009), Bloom & Van Reenen (2010) and Alsos et al. (2007) for the Innobarometer, WMS and DC data set respectively.

Operationalization of measures and questionnaire design

The focal constructs of this dissertation, specifically DC, is complex and often represents latent traits and characteristics not readily observable empirically (Helfat et al., 2007; Kump et al., 2018). Several different approaches of operationalization exist in the literature (see Laaksonen & Peltoniemi (2018) for an overview), but a common characteristic is that DC is captured as a latent variable rather then directly measured through simple or few items.

The advantages of using multi-item measures of latent constructs are thoroughly documented in the literature (Williams et al., 2009; Hair, 2014) and applications are wide (Hair et al., 2012). When attempting to measure a complex construct such as DC we want to capture underlying indicators that reflect it. Although it may be tempting to utilize single-item proxies due to simplicity and easy of analysis, it comes with some severe drawbacks (Diamantopoulos et al., 2012). First, the single item, even if sufficiently related to the construct of interest, it is not likely that it captures the full content of the construct simply because of its complexity. This is related to the content validity of the construct that is obfuscated when only one

dimension is present. Second, simple items are hard pressed to produce sufficient scale for discrimination between respondents in a survey. Finally, establishing reliability in one item is impossible and multiple items will help secure a more reliable scale to capture the focal construct. In capturing the latent nature of DC, as well as other focal constructs relevant to explore the mechanisms of DC, multi-item constructs needs to be developed. This means applying some sort of dimensionality reducing technique where focal constructs are build on several items and aggregated. This aggregation process is described in more detail in the next section, but briefly I apply a range of techniques from simple additive indexes, confirmatory factor analysis and item response theory, depending on the measurement scale of the underlying items.

The dissertation uses a combination of existing and novel approaches to operationalization. I put a particular emphasis on using established scales to safeguard the best possible validity. The core challenge with DC,however, is the lack of clear standard for operationalization. Thus, I had to rely on several different sources of prior research to build my construct. This varies from utilizing a survey specially designed to capture the DC construct and tested in earlier research (Alsos et al., 2007), but also more experimental approaches. One particular way is to take the definition of DC as the point of departure and constructing factors based on similar previous research and theory. In the interest of clarifying the operationalization of my key constructs, all papers include more detailed discussions as well as tables describing how the constructs are measured.

Data collection of secondary data

This dissertation relies on survey data for its operationalization of DC. I use a combination of well established and much cited data sources, the Innobarometer data (European Commission, 2009) and World Management

Survey (Bloom & Reenen, 2007) on the one hand, and more specialized sources on the other. The latter include the use of a less established data set designed for the specific purpose developing a particular measure of dynamic capabilities (Alsos et al., 2007). Table 3.2 depicts the main data sources of my dissertation. The three sources are indicated with the total number of cases in the whole data base. Some of these have been reduced as a result of matching with other sources due to firms that were not present in both sets.

Data set	Abbr.	Size	Panel	Multi-level
European Commission Innobarometer	IBD	N=4600	NO	YES
World Management Survey	WMS	N=10000	YES	YES
Nordland Research Institute Survey with additional follow-up	NRI	N=283	YES	NO

All data used in this dissertation are based on secondary sources. This is a potential weakness of my overall research because I have not been able to personally validate data, or design data capture in a way that is fully conducive to the epistemological nature of my core constructs and research questions. However, the upside to using secondary data is related to their external validity and their proven relevance for previous research. It also brings the possibility of replication, a concern raised frequently in the strategic management research (Bettis et al., 2016a,b).

Moreover, I combine data from several secondary sources throught my dissertation. This includes combining firm data like the Innobarometer (European Commission, 2009) and WMS (Bloom & Van Reenen, 2010) with country and industry level data on, for example, external complexity and industrial dynamism respectively. Matching such data is pretty straight forward given that my main data sources maintain meta data on the typical matching keys such as geographical and industrial location of

the firms in the sample. Similarly, these secondary sources are also rather conducive to be matched with to financial data in Norway and abroad. This also applies to the Norwegian Company registry and the financial reporting data base they maintain, enabling me to enrich the data structures with several sources simultaneously.

The greatest advantage with this approach is that I am able to avoid common method bias and other problems linked to simply using one data set on its own merit. The results will hence be more robust. Before I move on to data analysis I briefly describe all data sources that are included in this dissertation.

Innobarometer The first data set used in this dissertation is the Eurobarometer 2009 "Innovation" (European Commission, 2009) which is a survey of 4466 companies from 30 countries all over the EU. This particular version of the barometer contains a set of questions appropriate for building empirical constructs related to innovation input and output, as well as dynamic capabilities. The data is cross-sectional and hierarchical.

Most of the Innobarometer contains questions with binary answers. Typically the respondents are asked to answer yes or no to a range of different efforts they have made or results they have achieved. One example is the question of what different types of measures are put into work to help the innovation of the firm. The respondents are given five different measures to which they respond yes or no depending on if they are implemented in the company.

Innobarometer contains self-reported scores that I do not attempt to validate in my dissertation. However, the same data has been used for other research papers (Arundel et al., 2019) and a similar survey (Community Innovation Survey) has been used extensively (Laursen & Salter, 2006,

2004; Keupp et al., 2012; Blind, 2012). This lends a certain face validity to the data. The general limitations related to secondary data sources is discussed in more detail later in this chapter.

World Management Survey Being the workhorse of the *New Economics of Management* (Bloom et al., 2014) the World Management Survey (WMS) was developed to explain variations in management practices across geographies and industries (Bloom & Reenen, 2007). The WMS asks approximately 10000 companies in over 20 countries a range of questions asking the respondents to describe different aspects of the organization (e.g. how processes are organized), and about management practices (e.g. how performance is tracked and rewarded). The interviewer (a graduate student) rates the response on a 5-point scale indicating the quality of the response. All interviews are done by at least two students to control for interviewer variability. The questions are in turn merged into four categories: Operations Management (operation), Performance Monitoring (monitor), Target Setting (target), and Talent Management (people). A detailed outline can be found in Bloom & Reenen (2007).

In relation to dynamic capabilities, the WMS data offers a unique composition of zero-level or ordinary capabilities as collections of routines (Winter, 2003; Collis, 1994). Thus, by building a measure of dynamic capabilities from the ordinary capabilities underpinning a firms ability to make a living (Helfat et al., 2007) I am able to provide insights into different expressions of dynamic capabilities work to create strategic change. This is elaborated in detail in paper 2 and in the measurement section of this chapter.

WMS has been extensively used to study differences in management practices (Bloom et al., 2009; Bloom & Reenen, 2010; Bloom et al., 2014), firm performance (Van Reenen, 2010), productivity (Bloom et al., 2012), innovation (Agarwal et al., 2014) and dynamic capabilities (Pisano, 2017).

Nordland Research Institute Firm Survey The work with this dataset started in 2005 by researchers at the Nordland Research Institute (NRI) and was subsequently the source for measuring dynamic capabilities among a sample of Norwegian firms (Alsos et al., 2007). A later extension in 2014 by Tommy H. Clausen at Nord University Business School added another time point of the sample.

The data set comprise of survey data from R&D active firms in Norway at two points in time (2005 and 2014). The population is all businesses registered to a scheme for tax deduction of R&D costs (called SkatteFUNN). As all enterprises which are eligible for taxation could register their R&D activities to receive a tax refund, the registered enterprises include close to all enterprises which are involved in such activities at the time of the survey.

This particular data set is unique in its character because it attempts to measure the latent construct of dynamic capabilities (as well as other constructs relevant to the DC theory such as operating capabilities, deliberate learning and competitive advantage). It has, however, not been used extensively in the extant literature (with Alsos et al. (2007) as a notable exception). The relevance of the data increased, however, when Clausen added a second time point to the data. This enabled estimation of dynamic models more suited for studying dynamic capabilities.

Other data used in the dissertation A set of other data sources have also been crucial in this dissertation. These are mainly related to firm financial performance and other firm level characteristics such as size, age, balance sheet and profit and loss statements. The source of such firm level data has varied with the sample applied. For the WMS data I used the international ORBIS database from Bureau Van Dijk to capture financial data.

For paper 1 I also needed to introduce measures of complexity defined by Economic Complexity Observatory (Simoes & Hidalgo, 2011) from the MIT Media Lab. This dataset has a well-tested metric for country level complexity. Similarly, to capture environmental dynamism I used a well known technique developed by (Dess & Beard, 1984) and explained in some detail later in this chapter. In short this required vast number of firms in each industry and country I included in my papers. In the context of paper 2 this meant drawing on Bureau Van Dijk to estimate environmental dynamism as a control variable.

Data analysis and statistical inference

The selection of analytical tools was contingent on the data structure and focal reserach of each paper. All data analysis were done using the R-statistical software with a range of its packages. In some of the SEM analysis I cross validated my results by running them through the Mplus software and STATA.

All papers have a similar analysis strategy employed in them. First, I reduced the dimensionality of the data into factors or indexes capturing the focal construct. This ranges from the use of simple additive indexes, to more modern approaches. Particularly, certain data in the dissertation lends itself very good to *Item Response Theory* (IRT). The idea behind IRT is to determine to what extent a series of true/false statements are able to discriminate between respondents that are good or bad (de Boeck & Wilson, 2004). Its main application areas have traditionally been psychometric and education science, but recent contributions to management science have elevated its position and applicability for strategic management research as well Carroll et al. (2016).

The bulk of the survey data used in this dissertation, however, is of ordinal response character, most commonly using Likert scales where the respondents are agreeing to certain statements about their firm. These items are in turn assumed to be related to a latent construct relevant for my research such as dynamic capabilities, deliberate learning, operating capabilities and so on. To reduce the dimensionality of the observable data and capturing the latent nature of some key concepts, I have applied two different techniques contingent on the estimation strategy chosen for the analysis in the individual paper. These are *additive index* and *confirmatory factor analysis* and are very common in strategy research (Hair, 2014; Greene, 2003). All the papers include more details on the dimension reducing techniques applied and measures for their validity.

The second part of all my estimation strategies was the estimation of relationships between my core constructs. Most of my data had a certain nesting structure varying from firms, industries and countries, to firms and years. In other words, all data had a certain hierarchical and panel structure, albeit in to varying degrees. This had, of course, implications for choice of estimation method.

These techniques are chosen on the basis of the data structure and the focal relationship to be explored. Hence, the methods ranges from sequential regression model with regular OLS (Ordinary Least Square), fixed effects estimations and logistic regression to Casual Mediation Model (CMM) with Bootstrapped standard errors using a quasi-Bayesian estimation (Hicks & Tingley, 2011) and Heckman selection models (Heckman, 1979; Certo et al., 2016). Of course standard OLS and logistic regressions are a simple choice in the presence of assumed linearity or the binary dependent respec-

tively. Fixed effects estimations are useful for controlling for factors that are fixed between firms, e.g. industry or country level factors (Greene, 2003; Sharp et al., 2013).

As the focus of this dissertation is *mechanisms* in DCT, the use of mediation analysis is useful. Thus I use CMM and PLS-SEM models to distinguish between direct and mediated effects. The upside of using the CMM versus a SEM model relates to the structure of the data and mix of various statistical estimators in the model. The CMM approach opens for using non-linear estimators in a very computationally efficient way compared to traditional SEM. Still, in small sample sizes, a SEM approach like PLS-SEM is likely to be a more efficient estimator (Hair et al., 2012). Particularly when testing mediation effects of two simultaneous factors a PLS-SEM approach with multiple mediators is useful to determine separate effects.

Ethical issues

My data collection did, in general, not involve individual identification of people. The unit of analysis is the firm and most firms are identified using a alphanumerical identifier (such as firm ID in Norway, and ISIN and similar for international data). The Innobarometer data was, on their end, fully anonymized also at the firm level. One exception is the NRI data set where respondent emails were present. As described below, I took particular care to safeguard this particular information.

As a researcher and doctoral student I set a high ethical standards for my conduct. For the purpose of ethical guidance, however, I find Ringdal (2013) and his three guidelines concerning research ethics for quantitative

methods to be particularly useful. Ringdal holds that that an ethical conduct must encompass *a responsible research process*, *privacy concerns* and a *responsible research motivation.*

My research process did not contain any human subjects for the purpose of data collection. All my sources are quantitative datasets from external entities. Privacy concerns are mainly relevant when accessing identifiable data on firm level. When working with such data I took particular care to secure the dataset in accordance with Norwegian Social Science Database privacy guidelines. Data was stored on encrypted hard drives and commercial grade cloud services provided by the university. In the case of the NRI data with individual manager's email addresses, I kept a separate record of the ID key and left the identifiable information out of my data. The key was kept on my encrypted home server with two stage identification login. Source code for the data handling and analysis, as well as the latex files for the manuscripts, were kept in a version control system using encrypted communication. I never uploaded data sets to these repositories, but rather data frames with non-identifiable subjects. In the case of matching various data sources I made sure to review the original intention behind the different sources to safeguard GDPR compliance of data legacy.

Finally, I hold my motivation for doing research to be a quest for new and improved insights. I am a champion for open source and open access of information and have sought to make all my data publicly available without infringing on privacy and confidentiality.

Considerations when employing secondary data

The distinct advantage with using established data sources is that it makes for replicable research which is very much in demand in strategic management research (Ethiraj et al., 2016; Makadok et al., 2018) in general and

dynamic capabilities in particular (Schilke et al., 2018). The use of commonly available data hence brings a further opportunity for delivering both narrow replication (e.g. same data on same research design) and quasi-replication (e.g. same data for new design) (Bettis et al., 2016b)

Another distinct advantage with secondary data sources is that it can rather easily be matched with other sources. Particularly, by using unique company identifiers (ISIN number and Norwegian firm ID respectively), it is possible to bring new dimensions into new research based on data applied in previous contributions. Within the scope of a PhD dissertation, both gathering and matching data from several sources while maintaining a certain sample size, severely limits the range of the research questions one is able to answer. In this dissertation, the use of existing data has made it possible to expand the theoretical and empirical inquiry into a more novel areas due to the combination of different data sets.

Finally, using secondary data is also fruitful from a quality perspective. The Innobarometer data (European Commission, 2009) and the World Management Survey (Bloom & Reenen, 2007) are both conducted by well established researchers as well as public statistical agencies (in the case of Innobarometer). The resources put into making sure the quality of the data is up to the standards required for precise empirical research makes for a good reliability claim. Moreover, the use of these data in previous research (e.g. Bloom et al. (2016, 2012); Bloom & Van Reenen (2010); Pisano (2017)), also imply a considerable face validity of the data. DC data from Norway is based on previous work that has been subject to peer review using the same data (Alsos et al., 2007) and extend previous analysis by including new observations over time, as well as other data sources such as financial performance data.

The use of secondary, open data sources do, however, come with certain limitations. The core challenges relate to the *trustworthiness* of the data as well as how they are *related to the topic* I am tackling. In terms of trustworthiness it is related to the quality perspective described above. WMS and Innobarometer data are both gathered and organized by highly proficient entities. The former is maintained by world renowned institutions like the London School of Economics and the latter by the European Commission and Eurostat. Furthermore, these data are also used in numerous studies with similar constructs. Taken together these suggest a considerable face validity and hence I find them trustworthy. The NRI dataset is smaller and administered by a smaller entity. However, the data was gathered and organized by a professional entity with the purpose of measuring constructs similar to mine. The results have also been presented at high quality conferences.

Relatedness is always a key challenge with secondary data. In brief, this means that the data were gathered for other purposes than I use them for. This is of smaller concern in paper 3 and 4 where I use the NRI data set particularly constructed to capture my core constructs. WMS and Innobarometer, however, was not customized for the purpose of measuring DC. However, recent empirical and conceptual research in good journals have pointed to the role such data can play in exactly the field of DC (Pisano, 2017).

A more general note on the data is also that over time survivor bias may be a problem. The longitudinal survey data from WMS and collected by NRI is potentially subject to survivor bias. I attempt to remedy this shortcoming by using Heckman two-step selection model (Certo et al., 2016) which is a useful, but by no means perfect tool for such problems.

The cross-sectional data from the Innobarometer is potentially subject to common method bias. I have tried to remedy these challenges by using Confirmatory Factor Analysis and SEM (Richardson et al., 2009).

Quality of the research

To safeguard the quality of research I have taken particularly care to obtain the best possible validity and reliability of my measures and constructs. Validity is the 'degree to which a measure accurately represents what it is supposed to' (Hair, 2014, p. 7). Hereof internal validity refers to 'the confidence that can be placed in causal inferences' (Somekh & Lewin, 2005, p. 216). In the context of my research using correlational analytical methods internal validity is generally weaker than in experimental designs. The most useful remedies for the lack of clear causal claims is to control for as many confounding effects as possible. Throughout all my papers I have striven to include controls in the form of covariates and fixed effects. Moreover, in terms of the operationalization of DC I have, to the best of my abilities and the availability of data, worked to include all possible items in the latent constructs I have constructed.

External validity, or generalizability, refers to the 'possibility of expanding any claims of causality from the group or sample being studied to the population that the group represents' (Somekh & Lewin, 2005, p. 216). In correlational research the external validity decreases with the inclusion of confounding effects to the extent that including all relevant factors outside the model makes the results highly context dependent. One obvious remedy is to include large samples. Two of my data sets are large (between 5000 and 10000 firms). They are also designed and tested by well renowned entities providing them with a certain face validity. The sample size reduces the likelihood of severe sampling bias. On the other hand, I use a smaller data set drawn from a Norwegian population. This is prone

to be less generalizable than the cross national samples. I thus make sure to let this limitation be reflected in the conclusion I draw in those papers. In terms of hypothesis testing I have employed a range of statistical techniques for cross validation and robustness checks. All empirical models I have used are based on state of the art techniques, and I have taken particular care to relate all results stringently to theoretical expectations and previous similar models.

Moreover, and particularly relevant to the domain of measuring unobservables such as DC, I have strived to address construct validity throughout my papers when dealing with latent variables. Establishing a certain construct validity can be seen as embodying two separate sub-categories of validity. First, convergent validity refers to the correspondence between items in the proposed construct (Hair, 2014). Operationally, this has been addressed by studying the correlations between items included in the latent variable construction. Most of my papers include correlation based metrics for the items although not a full correlation matrix due to space constraints. Second, discriminant validity refers to the ability of the research to discriminate between similar constructs (ibid). I have added measures of correlations between focal constructs in the papers where these have been relevant. For instance, when addressing two paths of DC change in paper 4, I show by means of correlation analysis, that these are indeed separate constructs.

Reliability measure of the 'degree to which a set of indicators of a latent construct is internally consistent in their measurements' (Hair, 2014, p. 7). With respect to the reliability I have aimed to consider the theoretical internal consistency among the statements included in the summed scales and component scores. I have to a large extent relied on previously tested measurement methods, either in theory or in empirical papers. The chal-

lenge has been that consensus of one measure of DC does not exist in the research community, so several approaches has been used. Where previous empirical measures were not available directly in the DC literature, I tried to find similar constructs in related fields and considered my own in their light. I also conferred with leading experts of DC theory and read extensively in related fields. Moreover, from a more statistical point of view, all scales and factors are assessed by means of the relevant statistical measure for consistency such as Cronbach's α, Dillon-Goldstein's ρ and Items Characteristics measures. All the papers includes more details on the calculation and consideration of reliability.

A final comment on common method bias is warranted due to my general reliance on survey data. When surveying people we might end up just capturing some unobserved systematic error that exist between all the respondents so that the results of the survey reveal those rather than the characteristics we aim to measure. There are several ways to control for common method bias including CFA tests and Harman tests (Greene, 2003). Throughout my research I have squinted toward these statistical tests without them indicating common method bias to be a problem in my work. Moreover, the best remedies against common method bias is using several data sources at once to control for as much unobservable heterogeneity as possible, use large scale surveys with a range of respondents from many different contexts, and use repeated measures over time. All my papers uses a mix of these remedies as a part of the research design. Taken together, they do not suggest common method bias to be a problem in my work. However, survey data in general have these inherent limitations and future research should definitely attempt to move beyond using single sources of data.

Summary of research papers

This chapter presents summaries of the research papers in this dissertation. I will briefly describe high level theoretical and methodological considerations in the papers, as well as their findings and contribution to the field in general and this dissertation in particular. A detailed discussion on how these papers together and individually contributes to answering my research questions, follows in the next chapter.

4.1 Paper 1: Playing 3D chess - Firms thriving under complexity

Author: *Lars Hovdan Molden*
Status: *Revise and resubmit - Journal of Business Research*

Introduction

This paper sets out to elucidate how a particular DC, innovation capability, works in the process of generating innovation output from innovation input. Innovation is in itself a core tenant of strategic change as it concerns the process of capturing value from new products, services, processes or others. Therefore, innovative firms are able to change and utilize their innovation process to stay competitive. Much of the literature on innovation processes focuses on the role innovation input (most commonly R&D) plays in generating output (Adams, R., Bessant, J., & Phelps, 2006; Gwynne, 2015). Specifically, it does not seem to recognize the complexities of the processes, the external environment, or the role management can play in remedying these (Keupp et al., 2012). Moreover, on their end, strategic management scholars seem to agree that there exists a positive relationship between input and output in the innovation process, but that 'the "slope" of this relationship likely differs among organizations because of the complexity of innovation management' (Duran et al., 2015, p 1227). In other word, firms are heterogeneous not only in their level of innovation input (e.g. R&D), but also in the utilization of said input into output, as well as their ability to handle the inherent complexities of innovation.

Innovation is often the result of complex processes involving a multitude of parameters simultaneously (Dias et al., 2014) (i.e. *procedural complexity* (Vasconcelos & Ramirez, 2011)). Moreover, innovation often takes place in responses to complex and dynamic market- and business environments (i.e.

contextual complexity (ibid)). Still, recognition of these complexities has been scarce in the innovation management research (Keupp et al., 2012; Tidd, 2001; Dias et al., 2014).

This paper brings innovation capabilities into the innovation process and analyze their role in converting innovation input into innovation output, and, ultimately, value creation, as well as the contingencies stemming from external and internal complexities.

The paper raises the following research question:
RQ: To what extent does innovation capability influence the relationship between (a) innovation input and innovation output, and between (b) innovation input and commercialization, and how is this process contingent on external and internal complexity of the firm

Theory

The paper builds on conventional research of the innovation process as an input-output model (Adams, R., Bessant, J., & Phelps, 2006) meanwhile arguing that this model is insufficient to understand variations i innovation between firms. Thus, building on dynamic capabilities theory I argue that the microfoundations underpinning dynamic capabilities would be relevant to innovation capabilities (Breznik & D. Hisrich, 2014). Innovation capabilities are characterized by some factors such as the ability to *sense, seize* and *transform* opportunities into outcomes (Teece, 2007), and it's idiosyncratic nature is argued by several earlier contributions (Duran et al., 2015; Klein, 2016).

Furthermore, the concept of innovation capabilities can be thought of as both external (Laursen & Salter, 2006) and internal (Breznik & D. Hisrich, 2014) to the firm with emphasis on search and resource orchestration

respectively. Thus, the paper suggest, innovation capabilities represents two distinct concepts (internal and external) and should be an important factor in creating innovation, as well as enabling the firm to move from innovation to commercialization. I move on to study the role innovation capabilities plays as a mediator and mechanism to enhance innovation input into output, the focal mechanism in the paper. Moreover, the working of any dynamic capability is uncoupled to the external business environment of the firm as well as the complexity of the organization itself. Specifically, these factors outside of the innovation process sets boundary conditions for the effect of innovation capabilities expecting them to be more efficient in very complex environments.

Methods

Using data from EU Innobarometer (European Commission, 2009) with survey data on 4693 firms from all EU countries the paper constructs latent variables for innovation input, output, commercialization and innovation capabilities using *items response theory*. The variables and their proposed relationships are investigated using a mixed-model of linear and logistic regressions, as well as estimating causal mediation by means of a Bayesian Causal Mediation Model (Hicks & Tingley, 2011).

Findings

I find support for innovation capabilities, both internal and external, being mediators of the input-output relationship. This suggests that DC as innovation capability are indeed important mediators between innovation input and output thus working to enhance the effect of the innovation process. Moreover, this effect is stronger under high degrees of internal complexity with less effect from external complexity. This suggests that innovation capability as a DC makes even more sense in high complexity, in line with the expectations in DC theory.

Contributions to dissertation

Innovation is a driver for change and is, in accordance with my definition, strategic in nature. The purpose of innovation is to generate new products and services to stay competitive in the long run. This paper demonstrates that one particular set of DC, innovation capabilities, can work as a mechanism itself through which innovation input is enhanced into output. Studying innovation capabilities as a particular functional domain of DC is in itself a contribution to extant literature where various types (functions) of DC are in demand (Schilke et al., 2018). The way the concept is measured entails that it is behavioral, i.e. geared towards generating behavioral change in the innovation process. But there are obvious elements of the cognitive side of innovation capabilities as well. One example here is that creativity and culture is a part of the construct. In conclusion, this paper brings insight into *how* DC works in the innovation process - a harbinger of strategic change.

4.2 Paper 2: Let's stick together: The role of resource alignment in dynamic capabilities

Author: *Lars Hovdan Molden*
Status: *In review - Industrial and Corporate Change*

Introduction

An important debate in DCT relates to the sources of competitive advantage (CA) and the ability to maintain it over time. The discourse surrounds the notion that general purpose capabilities such as best practices are imitable and thus no source of CA. In this paper I have laid out the foundations of two separate expressions of how DC can create CA and maintain it over time. One promising avenue of research is the idea that DC can combine simple and complex processes in a more fully dynamic system that is hard to imitate (Di Stefano et al., 2014). Building on this debate the main argument of this paper is that that DC can act on operating capabilities (OC) simultaneously by two different expressions of DC, capability development and alignment. Through these two expressions, DC forms a completely dynamic system that is hard to imitate and hence a source of sustained CA. Thus it contributes to a richer understanding of how DC works to generate change to stay competitive. This leads to the following research question:

RQ: What is the role of capabilities alignment as a dynamic capabilities mechanism for creating (sustained) competitive advantage?

Theory

Extant theory suggests a multi-dimensional role of DC as a capacity (Di Stefano et al., 2014). On the one hand they enhance existing operational capabilities (Teece et al., 1997; Helfat et al., 2007). On the other hand they help reconfigure how capabilities are put together (Pisano, 2017) to better align them to take advantage of complementarities (Teece, 2007; Brynjolfsson & Milgrom, 2013). The theory suggests that this process of alignment is more unique and harder to copy because of its complex process (Teece, 2007). Although they play a distinct role, combined they form a more dynamic system of complex and simple routines that, taken together, is a source of CA and sustained CA (SCA) over time.

Methods

I leverage a well known data set on firm management routines, namely the World Management Survey (Bloom & Van Reenen, 2010; Pisano, 2017) to construct bundles of routines into capabilities. The novel construct, however, is capabilities alignment measured as the kurtosis of the underlying distribution of the routines. This metric indicates the extent to which routines are aligned and captures the cospecialization element highlighted in the literature, but void of current empirical testing (Teece, 2007). CA is operationalized using an indicator dummy in each period the firm outperforms the market, and SCA is the number of years the firm achieved this. The model is estimated using logistic- and poisson regressions respectively.

Findings

The empirical models indicate that the alignment and development are indeed two separate constructs with differing effects on CA. Moreover, I find that only capabilities alignment is a source of sustained competitive

advantage. The findings supports the notion of a more complex dynamic system forming from DC execution and that alignemnt and development play distinctly different roles.

Contributions to dissertation

Firms that are able to generate sustained competitive advantage are almost by definition successful in strategic change given that the business environment is not entirely static. The ways in which this happens, however, has been less clear, even contentious (Peteraf et al., 2013; Arndt & Pierce, 2018). By conceptualizing different expressions of how DC works and with distinct effects on CA and SCA this paper contributes to understanding how both development and alignment of routines and capabilities are sources for successful strategic change. My conceptualization and empirical model contribute an approach to better understand DC as a more complex process than often found in the literature (Di Stefano et al., 2014).

4.3 Paper 3: Orchestration and Learning: The Two Faces of Dynamic Capabilities

Author: *Lars Hovdan Molden and Tommy Hoyvarde Clausen*
Status: *In review - Strategic Management Journal*

Introduction

Extant DC literature has been lacking a consistent theory on how DC themselves evolve over time, and several critics have argued that DC needs an ever higher level of DC (higher order DCs) to alter lower order ones (Winter, 2003). One interesting approach is considering the role of learning as a way of achieving evolution in DC (Zollo & Winter, 2002). This paper identifies two faces of first-order dynamic capabilities (DC). The first face manifests in an influence on firms' operating capabilities (OC), and portrays the conventional role of DC in the literature. The second face manifests in an influence on deliberate learning (DL), whose key function is to change first-order DC. We develop a conceptual model which situates this dual role of first-order DC in evolution of organizational capabilities. This conceptualization brings a partial solution to the larger question of how DC evolve over time. This leads to the following research question:

RQ: What is the dual role of first-order dynamic capabilities in evolution of organizational capabilities?

Theory

In understanding how DC themselves are subject to change Zollo & Winter (2002) conceptualized the linkage between DC and DL where the latter contained accumulation of experience (behavioral element) and knowledge articulation and codification (cognitive element). This DL enhances DC

and, consequently, OC. Two issues remained in this important conceptualization however. First, the propositions have not received extensive empirical testing, and, second, it is unclear how DL relates to the hierarchy of capabilities constituting the resource base of a company and how it self came into being. Early contributions suggested that higher order constructs such as DL needed an even higher level construct to change it, leading to an infinite number of levels in a capabilities hierarchy. We suggest that these issues are partially solvable by placing DL into the capabilities hierarchy and studying feedback loops from execution of DC. Our model implies that through executing DC the firm changes OC, but also generates a bi product of learning opportunities that captures the need for more DL. This insight is quite analogous to the two faces of R&D (Cohen & Levinthal, 1989).

Methods

We use a longitudinal (repeated cross section) survey data set with Norwegian R&D active firms and construct latent variables from the core concepts in the paper such as DL, DC and OC. The time lag in the data makes us able to test dynamic effects, i.e. how the variables of interest relates to each other over time. We build a simple linear model and test the mediation effects using a Causal Mediation Model. To remedy the possible selection effects from the survey repeated over time, we employ a Heckman Selection model.

Findings

Largely, we find support for our hypotheses. We demonstrate that these two faces have empirical validity and that the two levels in capabilities hierarchy contains much of the necessary elements to explain the way DC

works to foster strategic change. This particular result indicates the presence of a feedback loop that is hitherto understudied in the literature (Schilke et al., 2018).

Contributions to dissertation

The first and second face of DC simultaneously opens up for a better understanding of the DC theory as a more fully dynamic system that contains the seeds to its evolution. A fully evolutionary understanding of DC through the capabilities hierarchy is highly conducive to the study of strategic change because it entails change stemming from a purposeful process within the hierarchy. The foundations of the linkages between DC and DL contains both behavioral and cognitive objects. It seems, however, that the cognitive awareness of the importance of DL that stems from the execution of DC, is the most salient character of the mechanisms at play.

4.4 Paper 4: One goal, two paths: How dynamic capabilities enable competitive advantage through behavioral and non-behavioral objects of change

Author: *Lars Hovdan Molden and Tommy Hoyvarde Clausen*
Status: *Submitted - Journal of Business Research*

Introduction

Conventional DCT has emphasized how DC changes objects/elements of the organization to adapt the behavior (e.g. enhancing or creating new routines). Indeed, the extant conceptualization of the DC-CA link leaves out a considerable part of a firm's 'resource base' that are non-behavioral, such as resources that are tied to how the employees of the firm sees their mission, internalize information and effectuates change. Following the 'cognitive turn' in management (Gavetti, 2012, 2005) increased focus has been directed towards cognitive elements (e.g. mind sets, culture, emotion, learning) of the organization and how DC can change these (di Stefano et al., 2010). This paper analyzes to what extent DCs influence competitive advantage through two paths - one old, and one new - namely behavioral and non-behavioral (cognitive) objects of change. This leads to the following research question:

RQ: What is the role of non-behavioral objects of change as a mechanism through which dynamic capabilities can influence competitive advantage?

Theory

To be able to stay competitive (i.e. enable strategic), a firm need, in addition to modifying, extending and creating capabilities, also some kind of alignment with the organization as a whole. This is often referred to as

'how we do things here' (Nelson & Winter, 1982), and how an organization think and act (Nadella et al., 2017). This alignment is possible only if the employees share a common cognitive frame related to the strategic direction of the company enabling them to make sense of the changes ahead. Concepts related to such cognitive frames include sensemaking (Weick, 2001), culture and attitude (Verona & Ravasi, 2003), and mindset (Dweck, 2016). The extent to which individuals in an organization is enabled to allocate attention to effortful mental activities related to understanding needs for strategic change instead of relying on automatic reasoning (Tversky & Kahneman, 1983) or rules of thumb (Kahneman & Tversky, 1979), can be a forceful remedy against organizational inertia (Adriaenssen & Johannessen, 2016). Taken together with behaviroal objects, the more conventional approach, a cognitive (non-behavioral) object of change can provide a very important insight into the mechanisms of DCT.

Methods

We use a longitudinal (repeated cross section) survey data set with Norwegian R&D active firms and construct latent variables from the core concepts in the paper such as DC, and behavioral and non-behavioral mediators. The behavioral objects are operationalized as capabilities and routines, whereas the non-behavioral objects are operationalized as a mindset of proactiveness. The time lag in the data makes us able to test dynamic effects, i.e. how the variables of interest relates to each other over time. As we are simultaneously looking at two mediators (behavioral and non-behavioral) we employed a SEM baser, multiple mediation technique implemented as a partial least square model (PLS-SEM).

Findings

Our empirical results support the idea that behavioral and non-behavioral objects of change represent distinctly different mechanisms through which dynamic capabilities influence competitive advantage. This suggests that dynamic capabilities have two roles working in tandem. They work in tandem in that you are not able create strategic change without adapting your capabilities for the change, meanwhile exercising the right interpretation, understanding and attitude towards change. We also find that cognition in tandem with relevant and strong capabilities reinforce each other, meaning that they are complementary resources to the firm.

Contributions to dissertation

This paper is very much placed in the intersection between my sub research questions because it deals with both behavioral and cognitive objects of change. The most interesting finding in this paper is that cognition and behavioral traits are distinctly different and mutually reinforcing in the quest for competitive advantage. Holding that competitive advantage is preceded by strategic change (unless we assume a totally static environment), finding that firms who manages both capabilities orchestration while enhancing the cognitive frames and mindsets of the organization, are much more likely to generate strategic change. Thus, they are able to stay competitive over time.

Conclusions and implications

This chapter draws on the findings in the research papers to make some concluding remarks on the research questions put forth in this dissertation. I do this by rolling backwards from the papers, through the sub research questions and end up by demonstrating how my work has contributed to answering the main question posed: What is the role of dynamic capabilities in enabling strategic change in firms? Next, I draw some academic and practical implications of my findings, before finally venturing into some limitations and avenues for further research.

5.1 Discussion of the sub research questions

On the back of recent debate on the mechanisms of DC in the literature (Schilke et al., 2018; Peteraf et al., 2013; Verona & Zollo, 2011; Helfat & Winter, 2011) I started this thesis by asking two different sub research questions. Each of these were tied to streams of literature concerning the various ways in which DC could work to enable firms to manage strategic change (Helfat et al., 2007). The overarching mechanisms of DC is enable strategic change by changing the resource base of the firm. This resource base, defined as 'tangible, intangible, and human assets (or resources) as well as capabilities which the organization owns, controls, or has access to on a preferential basis' (Helfat et al., 2007, p. 4), must contain a range of different 'objects' on which DC can work to change, i.e. they are 'objects of change'. I suggested that two distinct meta-groups of mechanisms through which DC works, are at play and further research into these mechanisms

is needed to understand **how** and **why** DC is working. In this pursuit I view mechanisms as quasi-synonymous with mediators in the empirical domain (Schilke et al., 2018). Thus, mediation analysis is an important part of my results.

The role of behavioral objects

Starting with the conventional understanding of how DC works, namely through purposefully creating, extending, or modifying the resource base, I coined the first group as *behavioral objects of change* that are geared towards 'how things are done within the firm'. In order to enable strategic change, DC triggers these behavioral objects to change the behavior of the organization, e.g. in the form of new routines. In the empirical sphere this mechanism places behavioral objects of change such as operational capabilities (OC) a mediator between DC and strategic change (Verona & Zollo, 2011; Helfat et al., 2007).

> **Sub research question 1**
>
> SRQ1: What is the role of behavioral objects of change as mechanisms of dynamic capabilities?

In my research I set out to understand the role such objects play. I started by looking at the role of a particular functional domain of DC, namely innovation capability (Breznik & D. Hisrich, 2014). The concept brings insight into how DC can enable a particular component of strategic change, namely innovation, through enhancing the innovation process. My research into innovation capabilities as an enhancer of the innovation process shows that firms not only differ in terms of their innovation input and output. They also differ with respect to their ability to make use of the innovation resources they have such as R&D. Innovation capability thus becomes a mechanism to make the innovation process more

efficient. Moreover, the same capability also influences the likelihood that innovation output gets commercialized. As commercialization will not always follow innovation, the ability to sell new services is a crucial part of strategic change. One typical example of this is Microsoft's innovative but failed attempt at removing the iconic start button[1] to allow for seamless integration between tablets and desktops. Another is the Apple Newton[2] which was a very early handheld personal assistant. Both were great innovations but failed to commercialize. These examples emphasizes the need for capabilities also to commercialize. My findings supports the importance of innovation capabilities in the whole innovation process form input to output and commercialization.

Especially related to strategic change, I also find that the complexity surrounding the innovation process matters to the efficacy of the innovation capability. My results suggest that innovation capabilities are more efficient in highly complex environments and processes. This is perhaps not that surprising given that DC is a construct firmly rooted in the idea of dynamic environments, but the results are still confirming this important boundary condition of the theory. Moreover, the effect of innovation capabilities are also present when complexity is low, albeit with a smaller impact.

In the extension of the specific functional form of DC, I also brought in a more generic form. In paper 2, I abstracted away from the concept itself and theorized about the expressions a proper DC would yield. I laid out the foundations of two separate expressions of how DC can create CA and maintain it over time. In the paper I demonstrated that DC can act on operating capabilities (OC) simultaneously by (1) enhancing the quality and efficiency of OC (development), and (2) aligning the compositions of OC

---

[1]'Don't believe the Windows 8 "failure" hype' in Forbes Magazine, 28.March 2014
[2]'When Apple Failed' in Forbes Magazine, 30.October 2008

(alignment). The former yields performance effects simply through providing OC with higher quality (improved technical fitness) (Helfat et al., 2007). The implications from this paper is strongly related to the idea that mechanisms in DC can take a combination of simpler and more complex processes simultaneously (Di Stefano et al., 2014).

In combination these expressions opens up a more nuanced understanding of how mechanisms work in DCT. In particular, in conjunction alignment and development forms a more dynamic system that is very hard to imitate and hence much more likely to generate strategic change and maintain competitive advantage over time. This finding also fits nicely into the debate on the ability of DC to generate competitive advantage over time and lend support to those who argue that this is possible (Peteraf et al., 2013).

The final two papers, 3 and 4, are mainly contributing to answering second sub research question, but some insights from these are also warranted at this point. Both papers include theorizing and empirical operationalization of behavioral objects in addition to their focal alignment towards cognitive ones. In paper 3 I find support for a dynamic role of DC as both affecting the behavioral objects (such as operational capabilities) meanwhile generating opportunities for more cognitive elements. These results suggest that DC takes center stage in its own evolution and that behavioral objects of change contributes to DC evolution and hence strategic change over time. Similarly, the results from paper 4 hold that both behavioral and cognitive objects for change matters for a firm's ability to generate CA.

The main contribution of this part of the dissertation is the investigation of conventional mechanisms often emphasised in extant literature (Schilke et al., 2018; Protogerou et al., 2012). These mechanisms are behavioral

in the sense that DC changes them in order to achieve a change in the behavior of the firm (Verona & Zollo, 2011). I have looked into a particular functional domain of DC - innovation capability (Breznik & D. Hisrich, 2014) and established now it relates to the innovation process in general and under conditions of complexity in particular. Moreover, in this work I have also explored DC in a more generic form such as ability to sense, seize and transform operating capabilities (Teece, 2007). Studying various functional form of DC contributes to a richer insight into the many facets of the construct itself and the theory.

I have also placed the role of capabilities alignment (Pisano, 2017; Hung et al., 2007) as an expression of DC distinct and separate from the conventional understanding of capabilities development (Helfat et al., 2007). By starting the theoretical integration of resource complementarity into the functioning of DC, I believe I have contributed to a more complete understanding of how DC can be seen to enact change. Specifically, this reasoning brings interesting questions to the relative efficacy of alignment vs development of capabilities, and suggest that DC operates as a dynamic system of complex and simple processes simultaneously (Di Stefano et al., 2014). This notion contributes to a better understanding of the important dichotomy found in the literature regarding the nature of DC (Peteraf et al., 2013; Arndt & Pierce, 2018).

The role of cognitive objects

The second sub research question concerns a particular set of non-behavioral objects of change, namely cognitive frames of the organization. These deal with 'why things are done within the firm' are named *cognitive objects of change*, and build on recent work in the cognitive turn in strategic management (Tripsas & Gavetti, 2000; Gavetti, 2012), organizational cognition in DC (Zollo et al., 2016), and the human side of DC (Verona &

Zollo, 2011). Recall that DC works through such objects by adapting the more 'tacit and subtle aspect of human interactions (motivation, emotions, and identity, in particular) to environmental or contextual requirements' (Verona & Zollo, 2011, p. 538). Motivation and identity (Verona & Zollo, 2011), cognitive frame/processes, and mindsets (Zollo et al., 2016; Dweck, 2016) are all concepts or part of the subset of cognitive objects of change.

Sub research question 2

SRQ2: What is the role of cognitive objects of change as mechanisms of dynamic capabilities?

In pursuing the role these objects play as mechanisms in DCT I dug into to detailed data at the firm level and attempted to build novel constructs based on extant literature. Particularly, I adopted a more general functional form of DC more attune to the microfoundational approach to DC (Teece, 2007; Meyer-Doyle et al., 2019) namely capturing sensing, seizing and reconfiguring capabilities.

Through my research I find that cognitive objects of change such as mindsets and learning constitutes important mechanisms for dynamic capabilities to enable strategic change. Moreover, the effects are differing across the levels of the resource base of the firm. Through my work with paper 3 I disentangled the role of deliberate learning into the behavioral part ('experience accumulation') and the cognitive parts ('knowledge articulation and codification') (Zollo & Winter, 2002). The cognitive elements of learning is a crucial component in an organization's ability to develop its DC over time and this paper places this ability as a higher order dynamic capability which function is to change first-order (regular) dynamic capabilities (Schilke, 2014b). However, and most interestingly, my research also uncover the mechanism through which deliberate learning itself is triggered. Based on the empirical results in paper 3 I suggest that firms, when

executing DC (e.g. through sensing an opportunity to be seized), yields two effects (two faces). The first is the more conventional idea of DC as orchestrating capabilities (behavioral). The second face stems from DC execution generating opportunities for learning and experiencing. the behavioral element of accumulating experiences makes the firm more aware of the need to take advantage of these opportunities for learning. Hence, experiences from DC execution 'feeds back' into the cognitive realization of the need for more deliberate learning to take place. Subsequently this also influences DC in turn. The most interesting implication of this paper with respect to cognitive objects is that the cognitive awareness for learning creates a feedback loop that works as a mechanism to enhance DC over time. In other words, the cognitive object of learning enhances the feedback from DC execution and emerges as a very important mechanism for understanding the evolution of DC and operational capabilities, and consequently strategic change.

Furthermore, my work with paper 4 leveraged an explicit linkage between DC and CA mediated by a behavioral and a cognitive object simultaneously. The paper demonstrated that these two constructs exist and have separate and joint effects on firms CA. Particularly, my results suggests a certain causal (albeit weak) claim about how cognitive capabilities mediates the effect from DC to CA. When firms need to generate strategic change they can do that through both changing behavioral (capabilities) or cognitive (frames such as proactiveness) to make it happen. Improved capabilities means changing routines and capabilities so to enable the firm to produce, sell, innovate and operate more efficiently (Helfat et al., 2007). On the other hand DC can also enable a stronger proactiveness in the firm, and hence creating buy-in into the notion that change has to be implemented (Marchand et al., 2004; Verona & Zollo, 2011). Moreover, increased proactiveness can also enhance the efficiency of how operational

capabilities are being used and hence itself exhibit impact on behavioral traits of the organization (Simsek et al., 2009). The paper uses Microsoft's transformation into a cloud business as an illustrating case study. The experiences from this case was that you actually need to do both and that they are mutually reinforcing. My results also supports this suggesting that firms that are able to combine behavioral and cognitive objects of change are more likely to enable strategic change. This leads me to my overall research question.

My research into this sub-research question has sought to bring more clarity into two areas of interest, and I believe I have brought important contributions. First, I have explicitly modeled and studied cognitive objects of change (specifically proactiveness) and related them to competitive advantage over time. This brings a new, and more formal conceptualization of the 'human side of dynamic capabilities' (Verona & Zollo, 2011). I have demonstrated that cognitive and behavioral objects of change act separately and uniquely as change objects from DC in creating competitive advantage. Second, by separating learning into a behavioral element of experience accumulation, and a cognitive element of knowledge articulation and codification, I have placed learning as a higher-order dynamic capability. In conjunction with the conceptualization of the feedback loop and the early theorizing on the mechanism of this loop, I would argue that my work has brought more insight into the role of learning and the capability hierarchy (Schilke, 2014a).

5.2 Discussion of the main research question

This dissertation started with an overarching interest in firm's ability to adapt over time. Several examples of firms that have managed to thrive over decades and even centuries made me curios about the prospect of understanding the mechanisms behind this phenomena. Obviously, these

firms had faced changing business environments. With a clear focus on strategic change in firm's dynamic capabilities theory (DCT) has garnered increasing attention from the strategic management community with hundreds of research articles being published on the topic (Schilke et al., 2018; Eriksson, 2014; Barreto, 2010). Thus it was an obvious point of departure to study strategic change in firms.

Overall research question

RQ: What is the role of dynamic capabilities in enabling strategic change in firms?

I have put mechanisms at the center of my analysis because it holds the key to understanding the **how** and **why** something leads to another. In my case this 'something' is DC leading to strategic change.Thus mechanisms plays a prominent in any theory and theory development and helps us think about causal relationships and thus propositions of the theory. Through studying a range of various mechanisms in two distinct meta groupings - behavioral and cognitive - I have been able to bring insights into how DC can enable strategic change in firms.
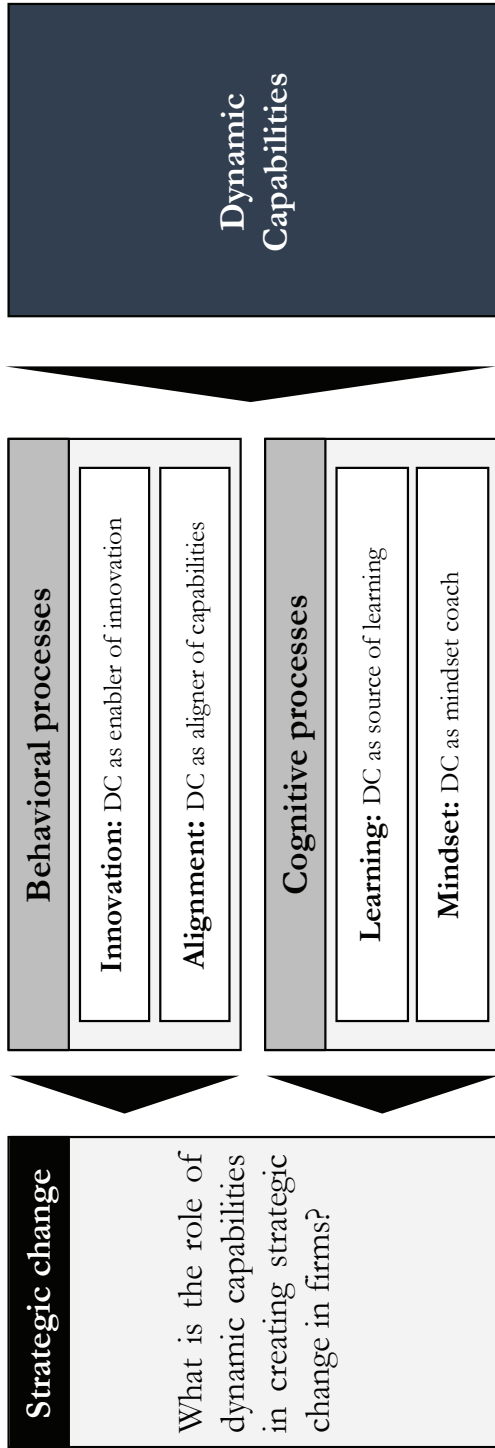
Figure 5.1: Summary of research findings

Dynamic Capabilities

Behavioral processes

Innovation: DC as enabler of innovation

Alignment: DC as aligner of capabilities

Cognitive processes

Learning: DC as source of learning

Mindset: DC as mindset coach

Strategic change

What is the role of dynamic capabilities in creating strategic change in firms?

First, behavioral patterns of firms can be enhanced and developed by DC. When firms are in need to adapt to their business environment, they tend to invest in new-, or create or modify existing capabilities to create a better fit. One way firms do this is through *innovation* capabilities that are a special functional domain of DC (Breznik & D. Hisrich, 2014). By enhancing the efficiency of the innovation process innovation capabilities are enabling firms to create and commercialize new products, services or processes that enables them to stay competitive over time (Duran et al., 2015). The more they are able to reinvent themselves through execution of dynamic capabilities, the more able they are to enable strategic change.

Second, through the process of capabilities *alignment*, meaning changing the composition and configuration in underlying capabilities and routines, DC enables firms to take advantage of their cospecialization (Teece, 2007) and generate options alas the underlying capabilities themselves are neither rare nor unique (Pisano, 2017). In conjunction with developing the fitness of existing capabilities, the alignment enables the firm to achieve consistent competitive advantage over time. Taken together these processes form a more fully dynamic system that is better geared towards enabling strategic change (Di Stefano et al., 2014).

Third, cognitive processes are the hitherto understudied side of dynamic capabilities (Verona & Zollo, 2011), but has very important implications for firm's ability to enable strategic change. Moreover, I find that DC can work on cognitive processes just as well as behavioral ones. One such example is how DC creates opportunities for learning when executed. My research into the role of learning in DCT finds that firms with functioning DC enables strategic change through the conventional understanding of capabilities orchestration, but also through learning opportunities. My results suggest that when firms execute DC they accumulate experiences

that calls for a cognitive process of articulation and codification (Zollo & Winter, 2002). Increased experience accumulation triggers awareness for the need for more articulation and codification. This leads, in turn to increased efforts of deliberate learning (Zollo & Winter, 2002; Romme et al., 2010). Thus, through cognitive process of learning DC enables evolution in the capabilities hierarchy and, consequently, to strategic change.

Finally, DC can work to enable strategic change through changing and activating *mindsets* such as proactiveness into the organization. Instilling mindsets of change (e.g. a growth mind set (Dweck, 2016)) works to activate an understanding for change being necessary and thus creating a 'buy in' or alignment into the necessary steps to be taken. Such alignment is possible only if the employees share a common cognitive frame related to the strategic direction of the company enabling them to make sense of the changes ahead. When people are on board with change in this manner it renders formal governance mechanisms less important (Simsek et al., 2009) and the change process more efficient (Marchand et al., 2004).

In sum my research has uncovered several mechanisms through which dynamic capabilities can work to enable strategic change. This has practical and academic implications which I will discuss in this final section of the dissertation.

5.3 Implications and further research

Any theory can best be analyzed and understood through studying its constituent parts. Specifically, 'a theory may be viewed as a system of constructs and variables in which the constructs are related to each other by propositions and the variables are related to each other by hypotheses between units observed or approximated in the empirical world' (Bacharach, 1989, p. 498). The theory must hence answer **how, when** and **why** some

(what) A leads to B. Thus mechanisms play a prominent in any theory and theory development and helps us think about causal relationships and thus propositions of the theory. Mechanisms represents causal explanations that must be true causation: 'to cite the cause is not enough: the causal mechanism must also be provided, or at least suggested' (Elster, 1989, p. 4). And it is notoriously hard to establish true causality, whereas causal explanations is possible, albeit often empirically challenging. Thus it is useful to 'work on partial mechanisms rather than general theories' (Williamson, 2000). Consequently, the study of mechanisms is particularly important in any theory development, and the need to clarify them is of pivotal importance.

Future research into DC should continue the incremental study of mechanisms. Empirical studies could benefit from exploring even more various functional forms of DC (Schilke et al., 2018). Various types of both cognitive and behavioral objects of change should also be explored. I took a particular look at proactiveness, but emotional attributes, frames for sensemaking and competitive attitudes (Gavetti, 2012) would all be interesting future objects of study. Empirical studies should also aim for longer time series of capabilities, performance such as competitive advantage, and DC. A combination of survey- and registry data would most likely continue to add value to the field of DC. Finally, a number of studies aiming at testing the explicit mechanisms discussed in this dissertation (e.g. the feedback loop in paper 3) would be particularly important.

On the more theoretical side I see several promising avenues. First, I was only able to scratch the surface of the microfoundations of the feedback loop between DC execution and deliberate learning. Future research focusing on building a more complete theoretical understanding of this mechanism, would vastly benefit the debate around the capability hierar-

chy and its implications. Second, the nature of capability alignment vs. capability development deserves future attention. Particularly taken as separate parts of a more complete dynamic system of DC as suggested by Di Stefano et al. (2014), these parts should be studied in more detail to determine the extent to which they constitute more or less complex processes, and to what extent this relates to their ability to enable sustained competitive advantage or not. Third, future research should continue to explore cognitive objects such as mindsets (Dweck, 2016; Weick, 2001) and their theoretical underpinnings. For instance, in depth case studies into growth mindset in firms like Microsoft, could prove valuable. Fourth, the effort to push for more ex-ante identification of DC, should continue (Eriksson, 2014). This is particularly important in the debate of unobservables in the strategic management literature (Godfrey & Hill, 1995) and continue to be a core challenge in DCT as well. Perhaps the idea of capabilities alignment can provide some interesting opportunities going forward. Finally, many of the contributions in this dissertation has only included measures of environmental dynamism and complexity as a control (with paper 1 being an exception). Future research would benefit largely from bringing industry-level variations in dynamism as contingency for DCT.

From a more practical point of view, I believe my findings can help managers better prioritize their resources. Overall managers should not be to hung up on resources. By including a better understanding of the capabilities (behavioral) and cognitive elements of the organization, and particularly their complementarity, managers could reap rewards in the form of a more adaptable and agile organization.

My overall findings suggest three concrete sets of advise for manager. First, managers should pay particular attention to cognitive objects at work in their organization. This includes a better grasp with how emotions, mind-

sets, perceptions and attitudes matter for their strategy formation and implementation. Specifically, it seems to pay off for managers to divide their attention between such cognitive objects on the one hand, and behavioral objects such as routines and capabilities on the other.

Second, investments and enhancement of deliberate learning as a part of their core strategy process, seems a valuable effort to pursue. Being able to codify and articulate knowledge from experiences in the organization could potentially be vastly undervalued in a firm. My research indicates that articulation and codification is an important factor in determining long term strategic change of the firm. Specifically, I have shown that deliberate learning act as a source for DC, as well as a measure for capturing experiences gained from execution of DC in the first place. In other words, firms that goes through changes constantly will over time generate experiences that need to be understood and translated to new actionable insights. These will in turn inform the strategic choices facing the firm.

Finally, alignment of capabilities can be a complementary, and possibly more cost efficient, approach to capabilities improvement for many firms. Managers should thus make alignment of capabilities a key priority in their strategy formulation and implementation. My research indicates a clear complementarity between these different expressions of DC. Thus, being aware of opportunities in reconfiguration and alignment of capabilities, can bring increased value to the firm.

Dissertation papers

6.1 Paper 1

Playing 3D chess - How firms can thrive under complexity: The mediating role of innovation capabilities in utilization of innovation input

Abstract:

Firms differ not only in their investments in input for innovation, but also in their innovation capabilities - i.e. their ability to utilize innovation input into output and commercial gain. This paper brings together the dimensions of process and management oriented factors determining innovation outcomes. Specifically, we attempt to bring innovation capabilities into the innovation process and analyze their role in converting innovation input into innovation output, and, ultimately, value creation. We also hypothesize some contingencies facing these relationships, most notably the role of procedural and contextual complexity. By utilizing a cross national data set of over 4500 firms and dynamic capabilities theory, we find that innovation capabilities contributes to enhancing the innovation process by making firms better at utilizing innovation input into output. We also find support for our hypothesized role of complexity.

`Dynamic Capabilities, innovation, innovation capabilities, complexity`

Introduction

Innovation is often the result of complex processes involving a multitude of parameters simultaneously (Dias et al., 2014) (i.e. *procedural complexity* (Vasconcelos & Ramirez, 2011)). Moreover, innovation often takes place

in responses to complex and dynamic market- and business environments (i.e. *contextual complexity* (ibid)). Still, recognition of these complexities has been scarce in the innovation management research (Keupp et al., 2012; Tidd, 2001; Dias et al., 2014). Much of the literature on innovation processes focuses on the role innovation input (most commonly R&D) plays in generating output. Specifically, it does not seem to recognize the complexities of the processes, the external environment, or the role management can play in remedying these (Keupp et al., 2012). Moreover, on their end, strategic management scholars seem to agree that there exist a positive relationship between input and output in the innovation process, but that "the "slope" of this relationship likely differs among organizations because of the complexity of innovation management" (Duran et al., 2015, p 1227). In other word, firms are heterogeneous not only in their level of innovation input (e.g. R&D), but also in the utilization of said input into output, as well as their ability to handle the inherent complexities of innovation.

These heterogeneities have, to our knowledge, not previously been integrated into the same analysis. A considerable literature concerns itself with the role of the innovation' process, how it varies and its efficacy (Meissner & Kotsemir, 2016; Rothwell, 1994). This *process oriented* stream of literature stems mainly from the field of innovation economics and tend to disregard how other firm capabilities (e.g. innovation capabilities) act in the process of changing input into output. On the other hand an equally ample literature deals with the capabilities of firms working to deliver innovation (i.e. their innovation capabilities) (Lawson & Samson, 2001; Breznik & D. Hisrich, 2014). Through management decisions firms invest in such innovation capabilities designed to enhance innovation outcome (Lawson & Samson, 2001). Typically, these innovation capabilities can enable the firm to be looking outwards for new opportunities (i.e. sensing

(Teece, 2007) and open search (Laursen & Salter, 2006)). But they can also be internal of scope (i.e. seizing (Teece, 2007), personal skills and expertise (McKelvie & Davidsson, 2009), ability to learn systematically (Zollo & Winter, 2002) and experimentation and learning (Eisenhardt & Martin, 2000)). These *management oriented* contributions are mainly found in the strategy and innovation management literature.

This paper brings together the dimensions of process and management oriented factors determining innovation outcomes. Specifically, we attempt to bring innovation capabilities into the innovation process and analyze their role in converting innovation input into innovation output, and, ultimately, value creation, as well as the contingencies stemming from external and internal complexities. By doing this we answer the call of contributions such as Keupp et al. (2012) asking for a more integrated approach 'since many questions pertaining to the strategic management of innovation are still little understood' (ibid 368). The research question is:

To what extent does innovation capability influence the relationship between (a) innovation input and innovation output, and between (b) innovation input and commercialization, and how is this process contingent on external and internal complexity of the firm?

This is important to our understanding of how innovation is generated as innovation increasingly is seen as the path to long term competitive advantage of the firm. And as we know that firm resources and capabilities contributes to the heterogeneity in firm performance (Schilke et al., 2018; Barney, 1991a), insight into the interplay between firm resources and capabilities, and the way in which their innovation takes place, seems crucial.

Moreover, in the face of growing complexity our analysis bring additional insights into how the efficacy of strategic management is contingent on complexity.

This paper makes three contribution to extant literature. First, is a theoretical contribution. We theorize on the role of innovation capabilities in the innovation process, and how different types of such capabilities work in tandem to enhance the innovation outcome of the firm. Second, as a contingency contribution, we theorize about the role of complexity and how innovation capabilities as dynamic capabilities works better under conditions of high complexity. Finally, we utilize an empirical technique not commonly used in management research (Carroll et al., 2016) (item response theory) to capture the dimensions of the concepts in the theorizing. This is a methodological contribution in its own right.

The rest of this paper is organized as follows. First we present some working definitions of our main constructs before theorizing about their relationships. We then go on to test our hypotheses item response theory and linear and logistic regression, and a mediation analysis under various conditions. We discuss the results and propose future directions for research.

Innovation process and innovation capabilities

Idiosyncrasies in firm innovation seems largely to stem from two factors. First, the ability to invest in R&D, patents,license, software, staff training, and design capabilities matters. These are core assets and resources of the firm and may be utilized for the purpose of creating innovative solutions in a myriad ways. The second source of heterogeneity stems from the ability of the firm to "create, extend and modify it's resource base" (Helfat et al., 2007), i.e. their *dynamic capabilities*. Dynamic capabilities can work in

several processes within an organization also in generating innovation. We will in this section explicate the role of each of these factors - *innovation resources* and *innovation capabilities.*

Definitions

The innovation process is thoroughly debated in the literature (Adams, R., Bessant, J., & Phelps, 2006) where a variety of perspectives are presented (Eveleens, 2010).The overall development in innovation process research has been a movement from firm-level analysis to horizontally and vertically integrated models. Rothwell (1994) and Kline & Rosenberg (1986) present synopses of the development of innovation from processes at the firm level of "market pull" and "technological push" through a "coupling model" with interaction between firm functions, to a 'chain linked' model with supplier integration. The shift outside the firm organization itself continued into the systems integration of the "networking-model" (Meissner & Kotsemir, 2016) and later the seminal paradigm of "open innovation" (Chesbrough, 2003). This evolution imply that external relationships are increasingly important for the innovation process. Specifically, innovation processes within the firm needs to adhere more to the surroundings and shifting conditions, enhancing the importance of adapting existing resources to changes. Consequently, the relationship between strategic management and innovation process becomes increasingly a focal point for research (Keupp et al., 2012) as "decades of research on the management of technology and innovation (..) failed to provide a comprehensive framework to guide innovation research or management practice" (Tidd, 2001, p 173).

In tying these two streams of research together, we suggest a simple input-output model of innovation where input is transformed into output which in turn generates some gain from innovation through commercialization.

By *innovation input* we mean the resources and routines put into the effort creating innovation which composition is dealt with in a large literature (see Becheikh et al. (2006) for a review). *Innovation output* means new products, processes, business models, and organizational traits as the results of a purposeful enactment of resources (Van de Ven 1995). *Innovation gain and commercialization* refer to the business model development and utilization of innovation into actual value added.

Innovation capability is the main independent variable of our analysis and is defined as the ability to continuously transform knowledge and ideas into new products, processes and systems for the benefit of the firm and its stakeholders (Lawson & Samson, 2001). We go with the term *innovation capability (IC)* defined as the "ability to continuously transform knowledge and ideas into new products, processes and systems for the benefit of the firm and its stakeholders"(Lawson & Samson, 2001, p. 384).

Although a comprehensive and agreed upon definition remains illusive (Jacobs, 2013), we accept a working definition of *complexity* as "state manifested by the multiplicity, diversity, and functional interrelatedness of elements" (Jacobs & Swink, 2011, p 677). Complexity has many sources and facets, but for the purpose of studying the innovation process and the role of innovation capabilities two separate types of complexity is pressing. Vasconcelos & Ramirez (2011) distinguishes between *procedural complexity* concerns "the difficulty to solve a given, well-defined problem" (ibid p 237) and *contextual complexity*. The former entails the resources put into a process (e.g. the innovation process) and the variety of these resources. In innovation this would amount to the resources put into generating a certain innovative output, i.e. the input of the innovation process itself. In this regard, diversity (Jacobs, 2013) becomes a driver of procedural complexity. Contextual complexity, on the other hand, relates to "situations in

which finality is not a priori known, or knowable, by the actor in question" (Vasconcelos & Ramirez, 2011, p 237). Moreover, it relates to ambiguous and dynamic environments where information is not easy to acquire and the environment is volatile with high variability (Jacobs, 2013).

Innovation process

The accessibility of resources for input into the innovation process is crucial. Increased access to resources leads to higher levels of innovation output. At its most fundamental level innovation research concerns itself with a simple input-output model (Adams, R., Bessant, J., & Phelps, 2006) where innovation output is seen as a function of efforts put into the innovation process. However, firms vary with respect to their ability to utilize input and transform it into innovation output. This transformation of input into output has been studied with different perspectives and conceptualizations such as productivity of R&D (Gwynne, 2015) and innovation conversions rate (Duran et al., 2015). As for the relationship between innovation input and output, there seems to be a consensus of a strong positive one. Consequently we propose a simple and well established hypothesis of this relationship:

H1: Innovation input has a positive relationship with innovation output.

The input-output model is also easily extended to include the commercialization of innovation into in demand products or services, or cost savings due to improved organizational routines and processes (Meissner & Kotsemir, 2016; Adams, R., Bessant, J., & Phelps, 2006).This extension is tested and demonstrated in several empirical contributions (Rajapathirana & Hui, 2017). Firms do not only differ in their ability to generate innovation output from innovation input, but also in their utilization of output of the innovation process into commercial offerings or cost reductions with

performance gains. A firm with strong outcomes from the innovation process would not necessarily be able to utilize this into commercial gains, but a link between innovation output and commercialization seems rather trivial. As innovation output itself is, however, a function of innovation input and some of the input resources are relevant to the process of commercialization as well, we expect a positive direct relationship between innovation input and commercialization. Thus, we propose the following hypothesis:

H2: Innovation input has a positive relationship with the firm's ability to commercialize.

Innovation capabilities

Duran et al. (2015) argue that "while most researcher's assume that a positive correlation exists between innovation input and innovation output, the "slope" of this relationship likely differs among organizations because of the complexity of innovation management (ibid p 1212). This suggests differences in the way resources are managed into output, which has also been empirically suggested (Lin et al., 2006). Hence, we will argue that the microfoundations underpinning managerial dynamic capabilities would be relevant to innovation capabilities as defined in our case, a view commonly held in the literature (Breznik & D. Hisrich, 2014). Innovation capabilities are characterized by some factors such as the ability to *sense, seize* and *transform* opportunities into outcomes (Teece, 2007), and it's idiosyncratic nature is argued by several earlier contributions (Duran et al., 2015; Klein, 2016). Sensing is a function of perception and attention (Helfat & Peteraf, 2015) and is related to alertness and a discovery process (Gaglio & Katz, 2001; Kirzner, 1997). An organization's attention to the environment yields more opportunities for discovery and could hence more precisely direct resources into valuable opportunities.

Seizing is in turn a function of the problem solving abilities of the firm (Helfat & Peteraf, 2015). Upon sensing an opportunity in the environment, the firm has to commit resources to generate actual innovation as well as a valuable business model. This often means making investment decisions involving senior managers, and the potential pay off is highly uncertain (Maritan, 2001). One example here is that design of proper business models call for a highly integrated set of resources and complementarities (Peteraf & Reed, 2007) that goes beyond the mere input of resources itself.

Transforming is driven by the ability of the organization, and more specifically its management, to create legitimacy for the strategic direction needed to change and innovate (Eggers & Kaplan, 2009). Helfat & Peteraf (2015) suggest that communicative skills plays an important role in an organization's ability to conduct the necessary "resource orchestration" to generate innovation. Furthermore, organizations must overcome their own resistance to change to successfully be able to engage in innovative activities. Such resistance can only be overcome by breaking down rigid cognitive frames of the organization (Kaplan & Henderson, 2005)

Due to the novel nature of innovation in itself it follows that it requires some change of routines and competencies to generate successful outcomes. This fits neatly with the concept of a dynamic capability in that it is working through the orchestration of resources (Helfat et al., 2007). Thus, the sensing, seizing and transforming abilities of a firm's innovation capability would be expected to work in tandem with resources such as innovation input. Considering the discussion above, we would expect a higher level of innovation capability to yield better innovation outcome and improved

ability to commercialize from innovation. Moreover, to be a functioning capability it not only impacts the innovation output directly, but also mediates the relationship between innovation input and output(Wu, 2007).

H3a: Innovation capabilities partially mediates the relationship between input and output
H3b: Innovation capabilities partially mediates the relationship between output and commercialization

The antecedents of dynamic capabilities originate from a firm's internal resource base and its external inter-organizational relationships (Ambrosini & Bowman, 2009; Eriksson, 2014). In other words, certain capabilities are related to processes within the firm such as team-work, multidisciplinarity, openness to new ideas, internal communication and so on. We coin these *internal capabilities*. On the other hand *external capabilities* refer to cooperation, alliances and relations with actors and processes outside the firm. The internal/external distinction is related to the focus of the capabilities, and not the their sensing, seizing and transforming abilities. '

Internal human capital and technological know-how are demonstrably related to innovation outcomes. Specifically, studies of new product development offer valuable insight (e.g. Evanschitzky et al. (2012)). Internal capabilities as such will work to enhance other resources put into the innovation process. At the individual level this entails personal skills and expertise in creating novel solutions from existing or new resources (McKelvie & Davidsson, 2009). At the organizational level this means an organization's ability to learn systematically (Zollo & Winter, 2002; Cepeda & Vera, 2007) and to utilize past experience unto new knowledge creation. Other mechanisms at play with internal capabilities include entrepreneurial leadership (Augier & Teece, 2009), experimentation and learning (Eisenhardt & Mar-

tin, 2000), cross-organizational teams designed to coordinate and integrate resources (Ambrosini & Bowman, 2009), and organizational structure reconfiguration through acquiring business units (Karim, 2006).

Internal capabilities alone, however, might be insufficient as sources of renewal (Chesbrough, 2003). Capabilities are hence now increasingly being found outside the organization (Laursen & Salter, 2006). These capabilities to leverage networks, customers, suppliers and other relations and resource exogenous to the firm (Houghton et al., 2009) are our notion of external capabilities and they are arguably of increasing importance (Jung et al., 2018). Other central mechanisms discussed in the literature include environmental scanning (Danneels, 2008), finding alliance or acquisition target (Helfat et al., 2007), technology-based partnerships (Ettlie & Pavlou, 2006), the formation of R&D cooperation ties (Kudic et al., 2016), and inter-firm collaborations to enhance core competencies (Lorenzoni & Lipparini, 1999).

Based on the above discussion and prior work, we would argue that internal and external innovation capabilities are both at work in enhancing the use of innovation input resources and the transformation of innovation output into commercialization.Like with other capabilities internal and external innovation capabilities are likely to work in tandem (Laursen & Salter, 2006). A well established approach argues that internal resources are a necessary condition for such absorption (Cohen & Levinthal, 1990). Generally, scholars tend to contend that resources embedded in business networks complement internal resources and enhance their effectiveness and efficiency in new product development activities (e.g. Cassiman and Veugelers, 2006). This leads us to our final hypothesis:

H4: External and internal innovation capabilities are complements in enhancing innovation output

Complexity as contingency

Originally the core idea of dynamic capabilities related to its working in dynamic and fast moving environments (Teece et al., 1997). Moreover, the literature on complexity highlights environmental dynamism as an important dimension of complexity as "an increasing number of changing elements, interrelationships, and exchange processes also increase in complexity" (Braun & Hadwich, 2016, p 3512). Moreover, this particular dimension is very much at the core of the debate on the role of dynamic capabilities (Peteraf et al., 2013; Schilke et al., 2018; Schilke, 2014a), and the link to complexity theory is highlighted in recent contributions (Teece, 2018). Hence, we investigate the role of complexity, found in the literature on dynamic capabilities and thus relevant for innovation capabilities as a type of dynamic capabilities (Breznik & D. Hisrich, 2014).

With respect to firm performance in general, the role of complexity is found to an important moderator of strategy-performance relationship (McArthur & Nystrom, 1991), and exhibit a curve linear relationship with performance (Davis et al., 2009). Moreover, the environmental context matters for innovation (zahra 1996), the product development process (Revilla et al., 2010), and the way opportunities are captured (Hsieh et al., 2007).

From the definition of innovation capabilities as "ability to continuously transform knowledge and ideas into new products, processes and systems for the benefit of the firm and its stakeholder" (Lawson & Samson, 2001, p. 384) it follows that a continuous awareness of, i.e. sensing (Teece,

2007), the environment is a pivotal part of the concept. If a firm exhibit superior capacity "to purposefully create, extend, or modify its resource base" relative to it's competitors, we would expect the firm to be doing fairly better in more complex environments. This is also supported in the empirical literature (Schilke, 2014a).

H5a: The mediating effect of innovation capabilities is stronger in more complex external environments

How is complexity affecting the function of innovation capability Complexity in the processes of the firm would also be expected to act as a contingency on the role of innovation capabilities. Again, the role of continuously transforming and seizing (Teece, 2007) opportunities is given more prominence when the underlying processes are more complex. Contrast two cases. The first includes a set of fairly straight forward inputs into a innovation process. Actually creating innovation from these require less advanced dynamic capabilities as the number of possible configurations and combinations are limited. Hence, firms with the same resources and different innovation capabilities would appear more similar. Contrast this with a case of complex resources. The number of combinations increases and the difference between a high and low levels of innovation capability becomes clearer. The firm with the highest innovation capability is enabled to seize and reconfigure a higher number of combinations and hence more likely to succeed (Vasconcelos & Ramirez, 2011).

H5b: The mediating effect of innovation capabilities is stronger in more complex internal processes

In continuation of the proceeding complementarity discussion, complementarities between internal and external innovation capabilities is relevant under varying levels of complexity as well. Two arguments stands out with respect to how complexity would influence the interaction between internal and external innovation capabilities. First, contextual complexity might foster an exploration orientation (Sidhu et al., 2004) in that firms are pioneering new use of capabilities (Sirmon et al., 2007). In complex environments (i.e. dynamic environments), firms will consider a broader range of alternatives, resources,capabilities, and information sources, as well as efforts to integrate different approaches (Eisenhardt & Martin, 2000; Eisenhardt, 1989). Second, when facing the uncertainty that stems from increasing contextual as well as procedural complexity, managers are more likely to search for information more broadly and comprehensively in order to mitigate the uncertainty (Daft & Weick, 1984). Consequently, we would expect complexity to enhance the effect of complementarities between internal and external innovation capabilities.

H5c: The mediating effect of complementarities between internal and external innovation capabilities increases under any type of complexity.

Figure 6.1 depicts a summary of the different hypotheses. We will, in the following, test the different relationships separately by adding variables one by one, and sequentially testing the paths from input to output and then output to commercialization. This takes the form of regular regression analysis (OLS and logistic regression). We will also take special care to test the mediating relationship using Baron-Kenny mediation analysis with a quasi-bayesian estimator. Both analysis, however, support the same findings.
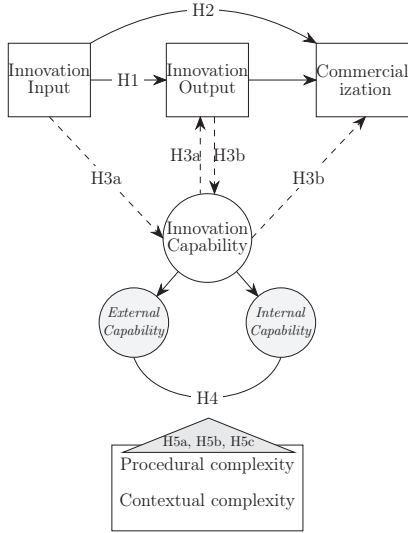
Figure 6.1: Conceptual figure with prescribed hypotheses

Data and methods

To test our hypotheses we utilize Eurobarometer 2009 "Innovation" (European Commission, 2009) which is a survey of $N = 4466$ companies ($i \in [1, N]$) from $C = 30$ countries all over the EU ($c \in [1, C]$). This particular version of the barometer contains a set of questions appropriate for building empirical constructs of all the concepts in our conceptual model (see figure 6.1). The variables are described in table 6.4. We use two dependent variables, *innovation output* for (Y_i) and *commercialization* (G_i). Our main independent variables are *innovation input* (X_i) and *innovation capabilities* (internal (ξ_i) and external (ϕ_i)). Additionally we use three (Z) firm level controls (C_i^z); Firm size, firm age and if the firm is an export firm. These are all empirically found to have a significant impact on innovation (Duran et al., 2015). The export variable warrant a particular treatment. Empirical studies have found that firms competing

globally across a multitude of regions, face more demanding and diverse needs from their customers (Penner-Hahn & Shaver, 2005). This leads to an increasing need for innovation (Aniruddha & Mital, 2016).

Most of the Innobarometer contains questions with binary answers. Typically the respondents are asked to answer yes or no to a range of different efforts they have made or results they have achieved. One example is the question of what different types of measures are put into work to help the innovation of the firm. The respondents are given five different measures to which they respond yes or no depending on if they are implemented in the company. The binary structure of the data lends itself very good to *Item Response Theory* (IRT). The idea behind IRT is to determine to what extent a series of true/false statements are able to discriminate between respondents that are good or bad (de Boeck & Wilson, 2004). Its main application areas have traditionally been psychometric and education science, but recent contributions to management science have elevated its position and applicability for strategic management research as well (Carroll et al., 2016).

Whereas a full describtion of the empirical method is beyond the scope of this paper, a brief explanation seems warranted. The statistical technique enables us to measure latent traits of individual observations based on how they respond to true/false questions. Using Markov-chain Monte Carlo (MCMC) models we are able to solve the complex problem of identifying discriminatory behavior underpinning the respondent's answers (see de Boeck & Wilson (2004) for an introduction).

To test for the focal contingencies we added a measure of external complexity by data from the Economic Complexity Observatory (Simoes & Hidalgo, 2011) from the MIT Media Lab. This dataset has a well-tested metric for country level complexity. Ideally, we wanted to add complexity

at the industry level, but the existing data allowed for only product level analysis and could not easily be transformed to industry aggregated. We then used the contextual complexity variable as a filter to draw a subsample of firms in contexts with high degree of complexity (above one standard deviation from the mean). Analogously, for procedural complexity we employ a metric for the number of different resources put into the innovation process. Similarly, we draw a subsample of firms with high number of different resources in the innovation process (above one standard deviation from the mean).

Dependent variables

The first dependent variable, *innovation output* is measured by the items described in table 6.4. The respondents were asked to a answer which offerings they had been able to achieve from their innovation activities. These offerings included new products, new services, improvements in existing products, organizational improvements and new business models. Using IRT I extracted a corresponding Z-value representing the level of output for each individual firm. Figure 6.3 depicts two important diagnostic tools in determining the suitability of the scale created by IRT (the latent trait). The first is the *item characteristics curve (ICC)* which shows the relationship between the individual items in the scale, and the latent trait (the scale) itself. A good scale would be monotonously increasing and gathered around the mean of the latent trait. The second diagnostic is the *test information function (TIF)* which shows for what part of the population the latent trait provides the most information. If these curves exhibit a normal distribution, they are a proper representation of the mean (de Boeck & Wilson, 2004). From figure 6.3 it is clear that the latent trait of output is a proper representation of our innovation output variable.

The second dependent variable is the business outcomes of innovation, *commercialization* or innovation gain. We use commercialization as short hand in this paper. This metric is binary measure where respondents get 1 if half or more of their revenue stems from innovative products or services.

Independent variables

We use IRT to extract three independent variables in accordance with our research model. First, *innovation input* represents resources and activities put into the innovation process such as R&D, license purchasing, training to support innovation, and design. Second, *external innovation capability* includes measures that captures the firm's ability to search for- and utilize innovation opportunities outside of the firm and hence put innovation output to use. Typically, these innovation capabilities can enable the firm to be looking outwards for new opportunities (i.e. sensing (Teece, 2007) and open search (Laursen & Salter, 2006)). Such abilities include strategic relationships with customers, suppliers, other companies and research institutions. Finally, *internal innovation capability* captures the firms strategically developed competencies (i.e. seizing (Teece, 2007), personal skills and expertise (McKelvie & Davidsson, 2009), ability to learn systematically (Zollo & Winter, 2002) and experimentation and learning (Eisenhardt & Martin, 2000)). This includes items such as abilities to work in team, negotiation skills, and creativity. Table 6.4 in the appendix offers more details on the construction of these variables. All the variables in this study is using are scaled from zero for the purpose of interpretation. It does not at all affect the empirical results.

Descriptive statistics

Table 6.1 presents the pairwise correlations and the simple mean and standard deviation of each variable. Not surprisingly, innovation input and output is rather highly correlated with a coefficient of 0.514. Furthermore,

our two separate constructs are somewhat highly correlated with a coefficient of 0.377. This suggests that they represent different constructs, but are related. In the empirical modeling we take particular care to test for problems of multicolinearity without finding any particular issues that affect the results.

	Mean	SD	1	2	3	4	5	6	7	8
1) Input	1.20	0.75	1							
2) Output	1.11	0.73	0.513	1						
3) Internal IC	0.87	0.69	0.34	0.415	1					
4) External IC	0.78	0.69	0.445	0.434	0.375	1				
5) Total IC	1.12	0.77	0.431	0.486	0.949	0.63	1			
6) Firm size	1.94	0.97	0.277	0.174	0.19	0.156	0.216	1		
7) Firm age	0.08	0.28	0.01	0.038	0.016	0.04	0.023	-0.04	1	
8) Exporting firm	0.47	0.50	0.259	0.165	0.108	0.18	0.146	0.178	0.006	1

Notes: Pairwise correlations between variables in the study including controls

Table 6.1: Descriptive statistics and correlations for variables in this paper

Empirical estimations and results

The main analysis in this paper is a two-step regression model where the first step estimates

$$Y_i = \beta_0 + \beta_1 X_i + \beta_2 \phi_i + \beta_3 \xi_i + \beta_4(\xi_i \times \phi_i) + \Gamma C_i^Z + \epsilon_i \tag{6.1}$$

$$G_i = \gamma_0 + \gamma_1 X_i + \gamma_2 \phi_i + \gamma_3 \xi_i + \gamma_4 Y_i + \Lambda C_i^Z + \mu_i \tag{6.2}$$

where Y_i is *innovation output*, and G_i is *commercialization*. Our main independent variables are *innovation input* (X_i) and *innovation capabilities* (internal (ξ_i) and external (ϕ_i)). Additionally we use three (Z) firm level controls (C_i^z); Firm size, firm age and if the firm is an export firm. These are all estimated in two vectors of coefficients named Γ and Λ.

Regression results

As described above we estimate this system separately using OLS for the first, and logistic regression for the second. This results are found in table 6.11. To keep control of the individual effects we add internal and external capabilities in sequence, as well as their interaction. In the second step we

	Dependent variable:						
	Innovation Output					Commercialization	
	OLS					logistic	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Innovation Input	0.474***	0.389***	0.368***	0.324***	0.330***	0.383***	0.290***
	(0.013)	(0.013)	(0.014)	(0.014)	(0.014)	(0.086)	(0.089)
Innovation Output						0.300***	0.174*
						(0.098)	(0.103)
Internal IC		0.284***		0.238***	0.249***		0.214**
		(0.014)		(0.014)	(0.020)		(0.093)
External IC			0.258***	0.194***	0.215***		0.263***
			(0.014)	(0.014)	(0.023)		(0.090)
Firm Size	0.028***	0.008	0.022**	0.007	0.008	−0.138**	−0.158***
	(0.010)	(0.009)	(0.009)	(0.009)	(0.009)	(0.056)	(0.057)
Firm Age	0.070**	0.060*	0.051	0.047	0.046	0.224	0.208
	(0.033)	(0.031)	(0.032)	(0.031)	(0.031)	(0.172)	(0.173)
Export Firm	0.062***	0.048**	0.031*	0.033*	0.033*	0.189	0.164
	(0.020)	(0.019)	(0.018)	(0.018)	(0.019)	(0.117)	(0.117)
Internal IC x External IC					−0.022		
					(0.019)		
Constant	0.364***	0.351***	0.362***	0.316***	0.289***	−2.596***	−2.668***
	(0.091)	(0.087)	(0.048)	(0.047)	(0.086)	(0.481)	(0.484)
Country Fixed Effects	YES	YES	YES	YES	YES	YES	YES
Industry Fixed Effects	YES	YES	YES	YES	YES	YES	YES
Firms included	All	All	All	All	All	All	All
Pseudo R^2						0.053	0.02
Observations	4,688	4,688	4,693	4,693	4,688	3,592	3,592
R^2	0.306	0.362	0.345	0.382	0.386		
Adjusted R^2	0.300	0.356	0.340	0.378	0.380		

Note: *p<0.1; **p<0.05; ***p<0.01

Table 6.2: Regression results for relationships between input,output and commercialization

regress equation 2 by means of a logistic regression while $G_i \in [0, 1]$. These first models lends support to all hypotheses except H4b concerning complementarity between internal and external innovation capabilities. We also see that the coefficients of innovation input and innovation output in equation 1 and 2 respectively, declines when adding our innovation capabilities variables. This suggests support for the mediation hypotheses.

In table 6.11 model 1 lends support to our first hypothesis about the positive relationship between input and output. This is not surprising given that these two are highly correlated. When adding internal and external

innovation capabilities the coefficient of innovation input (β_1) drops from 0.474 to 0.389. Albeit still significant, this supports a partial mediation of innovation input on output by innovation capabilities. This lends support to H3a. Furthermore, we observe a similar characteristic when studying changes in the coefficient of innovation output on commercialization (γ_4). This drops considerably from 0.300 to 0.174. This provides support to H3b. We pursue this further when formally testing for mediation in the next section.

The coefficient of innovation input on commercialization is also positively significant and robust to inclusion of industry and country dummies, as well as controls and innovation capabilities. This lends support to H2.

One surprising result, however, is that internal and external capabilities does not exhibit complementaritiy as evident from their insignificant interaction (β_4). Consequently, we find no support for H4. However, findings in the mediation analysis sheds some light on this finding.

Mediation analysis under levels of complexity

To formally test the mediation effects and investigate their contingency conditions (i.e. under contextual and procedural complexity) we employ a quasi-bayesian estimation of the Baron-Kenny method for mediation analysis (Baron & Kenny, 1986; Hicks & Tingley, 2011). We estimate the mediating effect of internal, external and total innovation capabilities, as well as the interaction between internal and external. The equation system can be written as follows:

$$Y_i = \beta_0 + \beta_1 X_i + \beta_2 M_i^R + \Gamma C_i^Z + \epsilon_i \tag{6.3}$$
$$M_i^R = \gamma_0 + \gamma_1 X_i + \gamma_4 \Lambda C_i^Z + \mu_i \tag{6.4}$$

where Y_i is *innovation output*, and M_i^R is a vector of our four mediators (internal, external and total innovation capabilities, as well as the interaction between internal and external). Our main independent variables remain *innovation input* (X_i). Additionally we use three (Z) firm level controls (C_i^z); Firm size, firm age and if the firm is an export firm. These are all estimated in two vectors of coefficients named Γ and Λ. In total this yields four models who are run under three different conditions (represented by different samples of firms): base case with full sample (i.e. average for all firms with respect to complexity), subsample of firms with high levels of procedural complexity, and subsample of firms with high levels of contextual complexity. That in the special case of interaction between internal and external innovation capabilities, we add the total innovation capability as a control (not shown in the equation system).

The results from this analysis is presented in figure 6.2. All effects are significant. All mediation effects are stronger (i.e. they account for a larger share of the total effect of innovation input on output) for firms facing contextual and procedural complexity. Generally, the firms leverage high levels of procedural complexity better than contextual complexity. This is evident by the larger slope of the blue dotted lines in all the mediators. There are differences between the mediators however, Internal innovation capabilities (the model up to the left) works better at mediating innovation input to output under conditions of high procedural complexity, whereas contextual complexity plays a rather insignificant role. Looking at external innovation capabilities (upper right) we see a different pattern. This supports H5a.
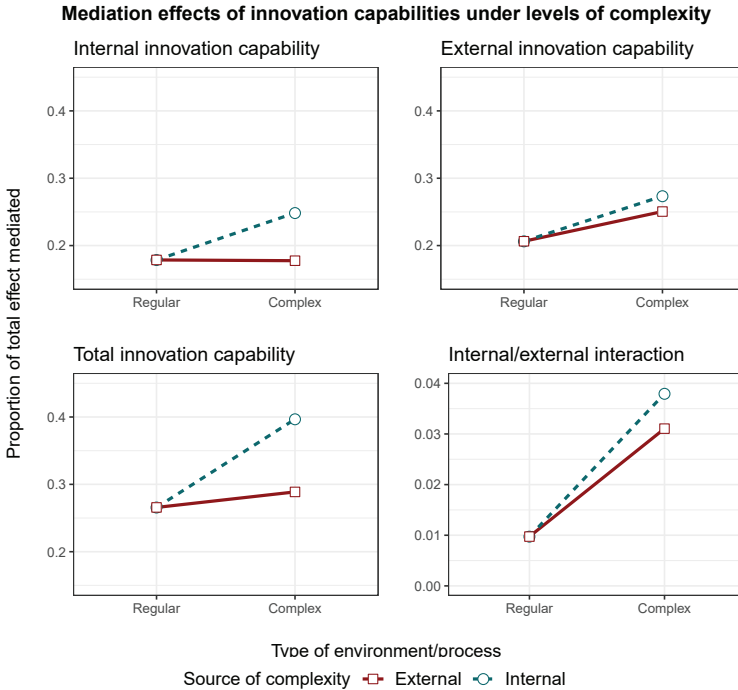
Figure 6.2: Mediation analysis under different levels of complexity

External innovation capabilities works better as a mediator under both types of complexity and even slightly better under contextual complexity. The difference is, however, so small that it is hard to conclude firmly. Hence, we contend that this lend weak support to H5b.

Not surprisingly, we find that the total innovation capabilities (as a function of both internal and external) exhibit an average pattern where both contextual and procedural complexity enhances its mediating effect.

Finally, looking at the lower right model the complementarities between internal and external innovation capabilities exhibit a similar pattern. Recall that this model controls for the total innovation capability so the

Hypothesis	Finding
H1	Support
H2	Support
H3a	Support
H3b	Support
H4	No support
H5a	Support
H5b	Weak support
H5c	Partial support

Table 6.3: Hypotheses and findings summarized

observed effect is much lower than the other models as it only accounts for a residual effect above and beyond the effect of total innovation capability (evident from the small scales on the y-axis). Note that only the contextual complexity significantly enhances the mediation of the complementarities. The effect of procedural complexity is insignificant. This thus lends only partial support to our hypothesis H5c.

Table 6.3 summarizes the findings in this analysis. We find support for most of our hypotheses except from H4b. Together with the partial support of H3a this is puzzling and warrant some afterthought.

Discussion and future research

In this paper we include the strategic management concept of innovation capabilities as "ability to continuously transform knowledge and ideas into new products, processes and systems for the benefit of the firm and its stakeholders"(Lawson & Samson, 2001, p. 384) into the innovation process. We theorize how firms not only differ in respect to their investments in innovation input, but also in their abilities to utilize these inputs into output and, ultimately, value creation in the form of commercialization. The most interesting part of this paper is the development of a mediation model to test how innovation capabilities work to "purposefully create, extend, or modify [a firm's]" (Helfat et al., 2007) innovation input into out-

put, and how these effects are contingent on the procedural and contextual complexity facing the firm. Firms that have developed such innovation capabilities are better at creating innovation output *et ceteris paribus* and at least partially able to enhance the effect of innovation input. We find partial support for this hypothesis.

Similarly we find support for a full mediation between innovation output and commercialization. One interesting take away is, however, that internal innovation capabilities seem to be more robust to model specification suggesting that they may play a more important role in commercialization than external innovation capabilities. This finding fits with the literature suggesting that seizing capability (a certain dynamic capability design to capture value from opportunities by generating proper business models) is related to internal structures of the firm (Teece, 2017, 2007). Looking into the microfoundations of dynamic capabilities business model development is tied to internal capabilities such as designing product and market architecture, communicating internally, and demonstrating leadership (Teece, 2007). Furthermore, the same process of business model development, the core in value capture, is found to be related to problem solving abilities and reasoning within the organization (Helfat & Peteraf, 2015).

We theorized over a distinction between internal and external innovation capabilities and suggested that they are separate constructs. However, they did not act as compliments as we expected. The interaction effect in the empirical model was non significant lending no support to our hypothesis.

Our theoretical discussion on the contingencies of the mediation relationships suggested that innovation capabilities in general would work better under higher level of complexity. We distinguished between contextual and procedural complexity and tested, using subsamples, shifts in the medi-

ating relationships of innovation capabilities (internal, external, total and their interaction). In line with previous empirical findings on environmental dynamism (Schilke, 2014a) we find empirical support for complexity impacting the theorized relationships. This also makes intuitive sense. If a firm is good at utilizing opportunities relative to its competitors, we would expect it to do relatively better than their peers when complexity increases.

Future papers could try to study the business model generation practice of firms more finely grained than our data made possible. Specifically, we would suggest measuring more of the microfoundations found in the literature directly (see for example Helfat & Peteraf (2015)). Second, other known contingencies in the dynamic capabilities literature should be explored. The role of environmental dynamism and complexity is still up for debate in the dynamic capabilities literature (Peteraf et al., 2013) with one side claiming they only work in high velocity environments (Eisenhardt & Martin, 2000) while others find them useful in normal environments as well (Teece et al., 1997; Helfat et al., 2007). Finally, similar studies using longitudinal data should be conducted to investigate the dynamism at the core of dynamic capabilities theory (Zollo & Winter, 2002; Helfat & Martin, 2015) and to evaluate the impact on strategic change over time.

Concluding remarks and limitations

We started this paper with a fitting quote: "Strategic management scholars seem to agree that there exist a positive relationship between input and output in the innovation process,'the "slope" of this relationship likely differs among organizations because of the complexity of innovation management" (Duran et al., 2015, p 1227). In other word, firms differ not only in their level of innovation input (e.g. R&D), but also in the utiliza-

tion of said input into output. We wanted to investigate this relationship by introducing innovation capabilities into the analysis of firm innovation process.

We theorized about how innovation capabilities, internal and external oriented, as dynamic capabilities, are designed to orchestrate resources for innovation and hence influence the innovation outcome. Innovation capabilities are thus theoretically related to dynamic capabilities in that they work to modify other resources for a strategic end. We found partial support for a mediating effect of innovation capabilities between innovation input and output, but less clear evidence between output and commercialization.

However, our results suggest that firms are able to utilize innovation capabilities to generate innovation output and that the effect is partially undetermined by the level of input into the innovation process. Specifically, innovation capabilities can provide a partial answer to how innovation input becomes innovation output, and, consequently, value creation.

Drawing too broad conclusions is, however, problematic. We have built our empirical analysis on one single source of data which is prone to common method bias. Furthermore, the Innobarometer is self reported scores that are not validated in this paper. It is a large, cross sectional sample that yields robust results. However, the same data has been used for other research papers (Arundel et al., 2019) and a similar survey (Community Innovation Survey) has been used extensively (Laursen & Salter, 2006, 2004; Keupp et al., 2012; Blind, 2012). This lends a certain face validity to the data, but one should abstain from making broad generalizations. Finally, it only captures a moment in time so robust techniques including instrumentation for causal investigations are impossible on the current data set and should be emphasized in future research.

Limitations aside, we argue that this paper has contributed to our understanding of how dynamic capabilities can tell a partial story about how firms are able to innovate. We show that innovation output is a function of innovation input, which is prescribed from theory, but that this relationship is mediated by innovation capabilities. This leads us to suggest that firms can indeed obtain better innovation results by doing more of what matters, rather than just doing more.

Appendix
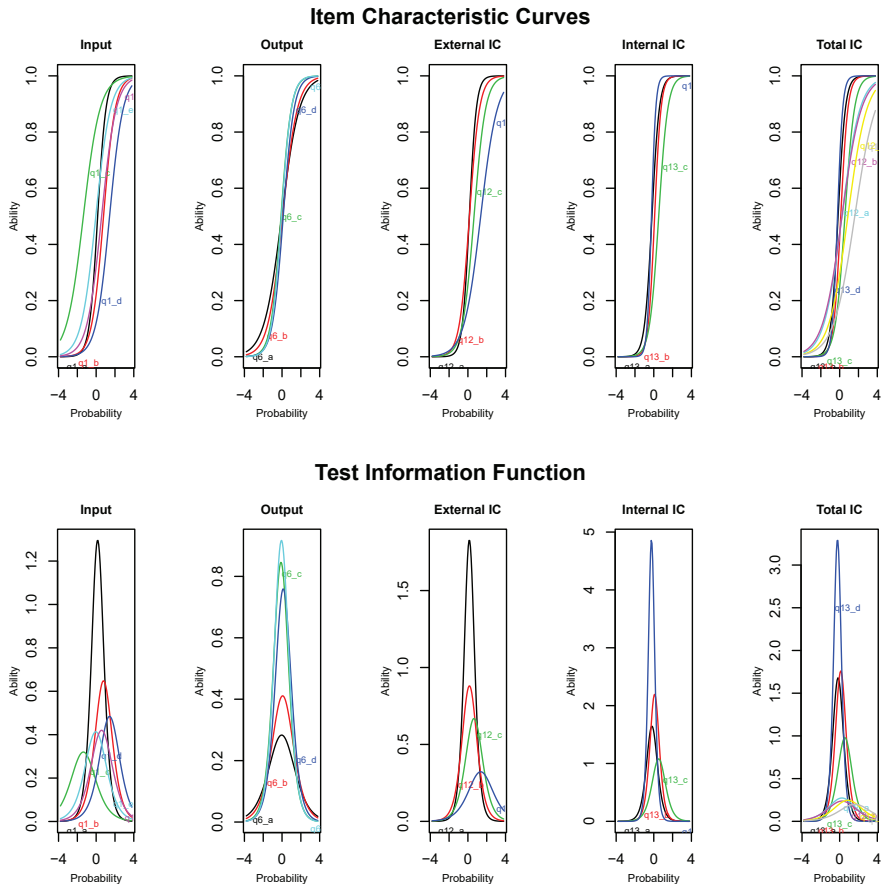
Figure 6.3: Characteristics and Information evaluations from latent traits

Type	Variable name	Measurement	Content
Dependent	Innovation Output (Y_i)	Continuous	Item Response Z-scores
			– New or improved products
			– New or improved services
			– New or improved processes
			– New or improved marketing strategies
			– New or improved organizational structure
Dependent	Commercialization (G_i)	Binary	Indicating if main share of sales attributed to innovation
			– Most sales came from innovative products or services ($G_i = 1$)
Independent	Innovation Input (X_i)	Continuous	Item Response Z-scores
			Has your company had expenditures on any of the following activities to support innovation since 2006?
			– R&D within your company
			– R&D performed for your company by other enterprises or by research organizations
			– Acquisition of new or significantly improved machinery, equipment and software
			– Purchase or licensing of patents, inventions, knowhow, and other types of knowledge
			– Training to support innovative activities
			– Design (graphic, process, product, service or industrial design)
			– Application for a patent or registration of a design

Table 6.4: Variable description - part 1

Type	Variable name	Measurement	Content
Independent	External Capabilities (ξ_i)	Continuous	Item Response Z-scores
			Since 2006, has your company developed any strategic relationships in support of your innovation activities with (any of the following):
			– Some specific customers or clients
			– Suppliers
			– Other companies active in your field
			– Research institutes
			– Educational institutions
Independent	Internal Capabilities (ϕ_i)	Continuous	Item Response Z-score
			Since 2006, has your company started or increased any of the following initiatives to integrate different company activities in support of innovation:
			– Knowledge management systems
			– Internal mechanisms for employees to submit innovative ideas
			– Staff rotations or secondments between different functions
			– Creation of cross-functional or cross-departmental teams on innovation projects
			– Team working capacity
			– Negotiation skills
			– Ability of successful communication with people of other culture
			– General communication skills
			– Creativity (e.g. problem-solving, originality of thought)

Table 6.5: Variable description - part 2

Type	Variable name	Measurement	Content
Independent	Innovation Capabilities ($f(\xi_i, \phi_i)$)	Continuous	Item Response Z-score of all items under ξ_i and ϕ_i
Control	Firm Size (C_i^S)	Ordinal	Scale of size from 20 to >500 in 4 steps
Control	Firm Age (C_i^A)	Binary	Indicate if firm is established before 2001 ($C_i^A = 1$)
Control	Export Firm (C_i^E)	Binary	Indicate if firm produce or sell products outside own country ($C_i^E = 1$)
Filter	Contextual Complexity (F_1)	Binary	Indicate if firm is located in a high complexity country environment
Filter	Procedural Complexity (F_2)	Binary	Indicate if firm has complex innovation input

Table 6.6: Variable description - part 3

6.2 Paper 2

Lets stick together - the role of capabilities alignment in dynamic capabilities

Abstract:

In this paper we have laid out the foundations of two separate expressions of how dynamic capabilities (DC) can create competitive advantage (CA) and maintain it over time. This is in response to criticism of DC suffering from unclear understanding on how this is achieved and under what conditions (Di Stefano et al., 2014). Using insights from recent contributions to DC theory we hypothesize on two different expressions of how DC shapes CA. Using data on firm level management practice we find support for our theorizing. Our results suggests the presence of a more complex, interdependent system of DC expressions and future research directions are discussed.

```
Dynamic capabilities, alignment, competitive advantage
```

Introduction

One of the most important tenants of the theory of dynamic capabilities (DC) is that it presumably can generate strategic change through 'creating, extending and modifying' firm resources and capabilities (Helfat et al., 2007, p. 1). Indeed DC has been found to have considerable implications for development of firm capabilities Helfat et al. (2007), routines (Dunning & Lundan, 2010; Romme et al., 2010; Zollo & Winter, 2002), and conse-

quently, firm performance (Protogerou et al., 2012; Pezeshkan et al., 2016). DC theory is also hailed to explain variations in competitive advantage (CA), and even competitive advantage sustained over time (Teece, 2007).

Specifically, a recent study by Pisano (2017) argues that 'general-purpose management capabilities rooted in such things as control and incentive systems, hiring and promotion practices, quality management systems, and corporate governance may contribute to performance differences across firms' (Pisano, 2017, p. 758). This is because such general-purpose capabilities (i.e. best practices) themselves can create options for further exploitation. Through this perspective Pisano contributes with a partial answer to the ongoing debate on the DC can form CA (Peteraf et al., 2013). Still, no clear conceptualization and empirical modeling exist to explain *how* and under what circumstances DC leads to CA. Moreover, although a certain consensus exist with respect to the opportunities DC can create for *temporary CA*, the wider debate is still very much up with respect to the linkages between DC and *sustained competitive advantage (SCA)* (Peteraf et al., 2013; Arndt & Pierce, 2018). A partial answer to gap question suggests that DC work in a combination of routinized and more complex functions and hence forming a more complex dynamic system that is inimitable and valuable (Di Stefano et al., 2014). However, a clear conceptualization and empirical testing of the workings of such a complex system is, to our knowledge, not present in the extant literature.

To bridge this gap we suggest a novel conceptualization of the *expression DC* exhibit when executed. By expression we mean the observable result of DC, a concept often latent in nature (Di Stefano et al., 2014). Specifically, building on the concept of cospecialization (Teece, 2007, 1986) and dynamic bundle (Di Stefano et al., 2014), we suggest that DC has at least two distinctly different expressions: *'capabilities development'* and

'capabilities alignment'. The former is very much tied to the conventional understanding of how DC work (i.e. through 'creating, extending and modifying' firm resources and capabilities (Helfat et al., 2007, p. 1). The latter is the novel insight that capabilities and routines are bundled together matters for performance as well.

The main argument of this paper is that that DC can act on operating capabilities (OC) simultanously by (1) enhancing the quality and efficiency of OC (*development*), and (2) aligning the compositions of OC (*alignment*). The former yields performance effects simply through providing OC with higher quality (improved technical fitness) (Helfat et al., 2007). The latter enhances performance by aligning the composition of OC in a way to better take advantage of the diversification effect of improving several areas at ones, as well as utilizing complementarities between them. Specifically, we attempt to contribute to a better understanding of different ways in which DC impact OC by putting forth the following research question:

RQ: What is the role of capabilities alignment as a dynamic capabilties mechanism for creating (sustained) competitive advantage?

To answer this question we build on a central tenant of the theory of dynamic capabilities (DC), namely that 'management matters' and can explain performance differences across firms (Helfat & Martin, 2014; Helfat et al., 2007; Teece, 2007; Pisano, 2017). This central aspect of the DC framework has recently received empirical support in research using the World Management Survey (WMS) (Bloom & Reenen, 2010, 2007; Bloom et al., 2014, 2012) where one key conclusion is that 'one important explanation for the large differences in productivity between firms and countries – differences that cannot be readily explained by other factors – is vari-

ation in management practices'. This insight has led Pisano (2017) to conclude that general purpose management capabilities are crucial determinants of performance differentials between firms. Placing management routines as the atomic building blocks of firm performance makes for particularly useful context in which to study general purpose capabilities, the focal construct of this paper.

The main contribution of this paper is twofold. First, we conceptualize a second expression of DC as a form of 'capability alignment' and suggests a measure to capture this. This places DC as a function of how underlying routines are organized above and beyond simply improving their quality and efficiency. Second, we utilize repeated measurements of firm performance to capture both CA and SCA and demonstrates empirically that the two expressions of DC have different effects on this focal outcomes of DC theory.

The rest of this paper is organized as follows. First, we go into the two differing expressions in detail to argue that they are distinctly different constructs with varying implications. We then move into describing the data and suggesting a measure for capturing alignment in particular, before presenting simple descriptive statistics. Next, we present the estimations before discussing the results and concluding with suggestions for future research.

Differing mechanisms

The focal claim of this paper is that DC has two distinctly differing expressions or mechanisms that work in different ways to create temporary and sustained competitive advantage. Particularly, we coin the effort to combine different routines and levels of routines into capabilities, *capabilities alignment*, and suggest that it constitutes a hitherto understudied

expression of DC. It must, however, be seen against the backdrop of a more conventional understanding. By the term *expression* we here mean the observable result of DC, a concept often latent in nature and often making direct observations of it difficult (Di Stefano et al., 2014).

The conventional understanding of how firm resources contribute to CA is based on the notion of value, inimitablity and rareness (e.g. the well known VRIO condition (Barney, 1991a)). Hence, by 'creating, extending and modifying firm resources' (Helfat et al., 2007, p. 1), DC will, by extension, generate CA. This reasoning, however, is contested and argued to be contingent on the nature of the underlying operating capabilities (OC) and operating routines (OR) (Peteraf et al., 2013; Arndt & Pierce, 2018). On the one hand, seminal contributions have seen these underlying OC as a certain commonality between firms (Eisenhardt & Martin, 2000) and argued that DC takes on a similar shape of 'best practices and simple rules as decision-making heuristics' (Arndt & Pierce, 2018, p. 414). Following this, these OC as well as DC are imitable and hardly rare or valuable, thus violating the VRIO condition. Consequently, they cannot lead to CA.

On the other hand, another stream of contributions consider that CA can stem not from the OC themselves, but through a higher-order capabilitiy geared towards *changing* the underlying OC (Teece et al., 1997) through a combination of 'Schumpeterian innovation, higher-order routines, and a progressive application of problemistic search' (ibid). Consequently, DC can, through its functioning, contribute to CA. Moreover, Teece (2007) argues that microfoundations of DC encompasses various expressions where the notion of cospecialization is separate from other forms of reconfiguration stemming from DC. Most notably, the microfoundations of dynamic capabilities suggest that firms with DC *sense* and *seize* new opportunities (and avoid treats) through *reconfiguring* its capabilities and resources

(Teece, 2007). This framework suggests that the capacity to manage reconfiguration, meaning the 'continuous alignment and realignment of specific tangible and intangible assets' (ibid p. 1340) is a function of several management structures and tools. This suggests a multi-dimensional role of DC as a capacity. On the one hand improving the technical fitness of the underlying routines and capabilities (i.e. their operational efficiency), and on the other hand aligning capabilities to fit the strategic landscape of the firm. In the latter, cospecialization, meaning managing complementary assets more valuable in joint use than in separate use, remains separate from the acquisition and development of individual capabilities.

In an effort to reconcile these differing views on DC and its ability to generate CA, Di Stefano et al. (2014) suggests that DC work in a more dynamic system comprised of a combination of simple routines and more complex processes which contribute simultanously to the firms outcome, specifically its competitiveness. Such interactions create a bundle of capabilities and routines that are 'socially complex and hard to imitate' (Di Stefano et al., 2014, p. 320). In their understanding DC can create CA even though the underlying OC are not VRIO themselves. This mechanism is also suggested by Pisano (2017) who brings the idea of 'capabilities choice' as an important tenant of DC theory, and one that is inherently tied to the prescriptive problem of 'how to choose among alternative capability creating investments' (Pisano, 2017, p. 748).

In the interplay between these recent contributions, we argue that this notion of 'capabilities choice' (Pisano, 2017) is an expression of the dyanmic system of DC (Di Stefano et al., 2014). Thus we contend the existence of a distinction between two expressions of DC as a dynamic system. The first expression is the conventional understanding of DC as a higher-order routine for identifying the resosurces needed to stay competitive in the

face of change. This makes for investing in new- and improving existing capabilities. We coin this expression the *capabilities development.* This mechanism entails that changes in the resource base, especially its quality, is an important mediator between DC and CA. Most of the recent work has, naturally, focused on the quality of OC when assessing changes over time. Thus, the core mechanism between DC and CA is mainly centered on the individual capability and less to the way they are composed. This opens up for a second expression of DC, *capabilities alignment.* Albeit definitely discussed and reflected in previous literature (Sirmon et al., 2011; Helfat et al., 2007) and included in the conceptualisation of the causal mechanism between DC and CA in recent 'state of the art' reviews (e.g. Schilke et al. (2018)), its distinction from *capabilities development* is not clear. We will, in the following section, lay out the differences between these to expressions of DC and how they act differently through OC. We use the context of management routines to make the argument and empirical modeling.

In the following subsections we will first briefly lay out the insight behind *capabilities development* which is the established and well known expression of DC. We then go more into detail on *capabilities alignment.*

Capabilities development

The ability to acquire and improve underlying capabilities such as OC is at the core of the DC theory. Specifically, it has been argued that OC 'are directed toward maintaining and leveraging the status quo in terms of the scale and scope of activities, businesses, product lines and customer segments' (Schilke et al., 2018, p. 393). In other words these capabilities are the ones that 'permit a firm to "make a living" in the short term' (Winter, 2003, p. 991).

Previous research has indeed argued and found that DC work by changing the resource base, e.g. OC, to generate CA (Protogerou et al., 2012; Karimi & Walter, 2015; Jantunen et al., 2018; Klarner & Raisch, 2013). Thus, from a conceptual argument and based on previous empirical findings we suggest the following hypotheses for the purpose of establishing a base line for comparison between the two expressions of DC that is the focal point of this paper:

H1a: Fit management capabilities leads to competitive advantage
H1b: Improvements in the fitness of management capabilities leads to competitive advantage

From the onset DC theory was concerned with 'how firms achieve and sustain competitive advantage' (Teece et al., 1997, p. 509). This has, in turn, been refuted by other seminal contributions holding that DC takes the form of 'best-practices' and are violating the VRIO condition (Eisenhardt & Martin, 2000). Moreover, wheter or not DC itself is VRIO is subordinated to how DC is able to change OC in a way that generates CA. If the underlying capabilities (i.e. the OC) are themselves general purpose and best practices they will not fully satisfy the VRIO condition and hence not being able to sustain any CA over time. They may be valuable and rare, but hardly inimitable. In other words, alas high quality OC, as a result of DC or not, can lead to a temporary CA, sustaining it over time simply by increasing its quality seems unlikely to maintain CA over time. This relates to the notion that high-quality best-pracitces are still homogenous and imitable over time. Hence, DC working through capabilities improvement and acquisitions are unlikely to maintain a sustained CA.

H1c: High fitness management capabilities do not lead to sustained competitive advantage

Capabilities alignment

As pointed out in the introduction, the notion of DC working mainly through *capabilities development* is underplaying the role of DC plays in organizing and composing combinations of OC. By selecting and combining capabilities and routines, firms are able to generate options from general-purpose capabilities (Pisano, 2017). We coin this effort to combine different routines and levels of routines into capabilities *capabilities alignment*. Even though each individual building block of the capabilities as well as combination of capabilities themselves are general purpose and best-practices, and thus not VRIO, the composition and combination of them can turn into a more unique set of OC that are much harder to imitate. Such an interaction can form a 'dynamic bundle' of different routines operate in conjunction with each other (Peteraf et al., 2013) to create CA. Similar idea have been promoted as 'internal fit', i.e. 'alignment among things internal to the firm' (Peteraf & Reed, 2007, p. 1089), and as 'organizational process (e.g. routines) alignment' arrange the various parts of a company so that they work together harmoniously to pursue common organizational goals, to enhance performance and sustain competitive advantage' (Hung et al., 2007, p. 1025), as well as the process of cospecialization (Teece, 1986, 2007). All these contribution relates the notion of 'alignment' to DC which in turn traditionally has been emphasizing related concepts such as 'co-specialized assets' (Teece et al., 1997), and 'complementary assets' (Carmeli & Tishler, 2004). Moreover, these contributions have, through focusing on the resources of the firm, demonstrated that alignment matters for firm performance. This suggests a perhaps understudied expression of DC beyond *capabilities development*. Albeit suggested in certain definitions and exemplification of DC (e.g. as 'resource orchestration' (Sirmon et al., 2011; Helfat et al., 2007) a clear distinction between a narrow focus on the development of capabilities (i.e. quality,

fitness and function), implicit in much work on DC, and the alignment (e.g. composition, selection and orchestration) of capabilities has not been brought forth. However, there are at least two important mechanisms suggesting that *capabilities alignment* is a plausible and important expression of DC separate from the conventional *capabilities development.*

The first relates to the cost of developing and enhancing capabilities. Development of new and enhancement of old capabilities are increasingly demanding of resources up until a certain point where the capability matures and its level of functionality flattens out (Helfat & Peteraf, 2003). This suggests increasing cost to improvement ratio over the existing level of capability. This is partly because the general law of diminishing return of investments in resources, but also because investments follows learning in capability development, and that learning stops when the capability is performing satisfactory rather than optimal (Winter, 2000). Consequently, firms have an incentive to invest more broadly in enhancing more mediocre or bad capabilities rather than bringing about a marginal improvement of a small set of very good ones.

The second relates to uncertainty. Pursuing capability development comes with a considerable uncertainty for the firm. This uncertainty can stem from a 'supply effect', namely a difficulty in predicting the outcome of such endeavours and hence creating a gap between intended and realized capability enhancement. Uncertainty can also stem from uncertainty of the economic value of capabilities projected to be developed or acquired (Pisano, 2017). Similarly to the cost argument above, a risk diversification argument applies: Firms have incentives to spread their risk in capabilities investments due to the inherent uncertainty in the effect of such investments on the functioning of the capabilities.

This search for capabilities and the inherent uncertainty makes for a persuasive case for pursuing diversification strategies in capability composition. As capabilities are seen as a collection of routines (Winter, 2000; Helfat & Winter, 2011) the composition of these capabilities can be seen as a separate decision from that of enhancing functioning of the individual capability. Through diversification and composition firm's can be able to generate outcomes that are beneficial above and beyond fitness enhancement. Through such a separate process, options are generated for the firm to exploit (Pisano, 2017). This discussion leads us to the following hypothesis:

H2a: Capability alignment is a separate determinant of competitive advantage than that of capability development

Moreover, capabilities alignment helps enhance the performance of a set of routines. Here we turn to the New Economics of Management and their long standing insights from *complementaritites* og organizational *practices* (Milgrom & Roberts, 1995; Brynjolfsson & Milgrom, 2013). Organizational practices has their counterpart in the strategy literature and their concept of routines (Winter, 2003; Schilke, 2014a). The link is less straight forward between complementarities and alignment. Whereas complementarities occurs when 'doing more of one thing increases the returns to doing (more of) the others' (Milgrom & Roberts, 1995, p. 181), alignment is the process of exploiting complementarities. Thus, in the face of complementary routines aligning them is likely to yield net positive performance effects whereas 'changing only one practice, or a small set of them, is likely to reduce overall performance' (Brynjolfsson & Milgrom, 2013, p. 14). The intuition behind this informal proposition is that the impact of one practice is linked to the outcome of another. Thus, increasing the fitness of just one of them attempting to optimize that particular routine, will not yield

the desired effect as long as its complementary routine is not enhacned. A particularly stellar routine of identifiyng excellent experts are of no use if the routines of hiring, incentiveation and organizational assimmilation is not following along. The firm will then end up with a costly routine for identification and not being able to utilize it properly. Actually, the disproportionate efficiency and quality of the identification routine may get the other routines less efficient due to, for example, information overload (i.e. identifying too many good candidates) (see Brynjolfsson & Milgrom (2013) for a thorough formal analysis). Consequnetly, we propose the following hypothesis:

H2b: Capability alignment has a positive relation with competitive advantage

Seeing both 'development' and 'alignment' as separate expressions of DC also makes for an analysis of the difference. For a capability to lead to CA it will need to satisfy the VRIO condition. Considering general purpose capabilities (e.g. management best-practices) these are, at best, a source of temporary CA because their homogeneous nature makes them prone for imitation (Eisenhardt & Martin, 2000). Hence they can, by being high-quality and through continuous enhancement, lead to CA by themselves (as posited in the first hypothesis in this paper). The alignment of capabilities, however, can be seen as more of an evolutionary process and is the outcome of a more complex, path dependent and thus heterogeneous process (Di Stefano et al., 2014). These are not easily imitated and they stay valuable because they are able to quickly adapt to changes. Consequently, we posit the final hypothesis:

*H2c: Capability alignment has a positive relation with sustained competitive advantage*

Figure 1 illustrates the expressions of DC proposed in this paper. *Capabilities development* is illustrated by differing sizes of the white circular objects within the gray circle. This indicates varying fitness of capabilities and routines and how DC can work to change them. In the other gray circle *capabilities alignment* is illustrated by the same type of capabilities being aligned in accordance with each other. Both expressions have hypothesized relationships with the outcome - CA.

Figure 6.4: Conceptual figure of the two expressions of dynamic capabilities
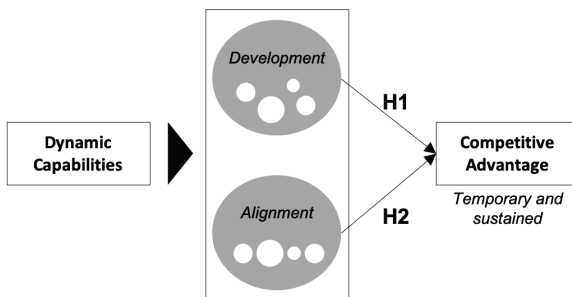
Data, measurement and methods

The empirical investigation into routines, capabilities and dynamic capabilities poses some potential challenges. First, is the obvious problem of operationalization on all levels of analysis from routines and OC to DC. In our approach we attempt to remedy this by building on established methods for measuring management routines in the form of management practices (Bloom & Reenen, 2007) and the subsequent method for aggregation (Bloom et al., 2014). Second, the DC literature is often criticized for being tautological in the sense that the construct is both seen as impact performance and being analogous to firm performance at the same time (Zollo & Winter, 2002). Thus, a fruitful empirical approach should

separate the *process* of DC from its outcome (Helfat et al., 2007) by first tracing its impact on some intermediate variable (e.g. change of underlying routines) and subsequently on some sort of performance variable.

We operationalize management routines captured as management practices in the World Management Survey (Bloom & Reenen, 2007) and aggregate these into four types of management capabilites (OC) in line with earlier research (Bloom & Van Reenen, 2010). These constructs are observed at two different points in time so we run a simple index construction based on Cronbach's alpha to capture the bundling of routines into capabilites OC at times $t = 0$ and $t = 1$.

Data

The World Management Survey (WMS) captures four dimensions of managerial practices (*operations, people, talent* and *monitoring*) in a battery of 25 survey questions for 7738 companies in 21 countries. Some of these are measured at several time intervals yielding a total of 10299 observations at the firm level. The efficacy and relevance of WMS for capturing management practices, have been documented thoroughly (Bloom & Van Reenen, 2010; Bloom & Reenen, 2010; Waldman et al., 2012) and a detailed description of the methodology is readily available (e.g. Bloom & Reenen (2007)). Recently, it has also been introduced into the DC research (Pisano, 2017). Thus, we find it to be a fitting measure for management routines and readily aggregated into OC. 2249 firms are interviewed at two or more different time periods providing us with a total sample of 2249 firms for our model. When adding a third point in time we reduce the sample to 285 firms. The rest of the firms are only measured once and is thus not suitable for our purpose. Our sample is drawn from 23 industries and 18 countries.

Independent variables

In this paper we are not directly measuring DC, but rather observing the effects of DC over time. In other words, we are indirectly observing the effects of a latent dynamic capability that comes into observation through one of two expressions. These effects or expressions are what we have coined *capabilties development* (i.e. the conventional expression of creating, extending and modifying opertional capabilities), and *capabilities alignment* (i.e. the process of utilizing complementarities and diversification effects by the way capabilities are constructed).

To capture *capabilties development* we lean on the extensive work of WMS Bloom & Reenen (2007) arguing that the practices observed are management routines, and bundled into OC (leaning on Pisano (2017)). These bundles of routines are ultimately summarized in a variable capturing management capabilities quality (as an example of an OC). We coin this varible MCD and it is simply constructed as the mean of all 18 practices (routines) in the survey so that:

$$MCD_c = \sum_{i=1}^{P} r_{i,c} \tag{6.5}$$

where r is routine i of a total of $P = 18$.

To capture *capabilties alignment* we utilize the distribution of $r_i...r_P \in [0,5]$ to measure the alignment of these routines. Specifically, we measure the kurtosis under the assumption that routines of similar quality and efficiency will be better aligned to take advantage of the diversification and complementarities argued in this paper. Specifically we define management capability alignment MCA as $\frac{\mu_c^4}{\sigma_c^4}$:

$$MCA_c = \frac{E[(x_{i,c} - \mu_c)^4]}{(E[(x_{i,c} - \mu_c)^2])^2} \qquad (6.6)$$

Table 1 shows the reliability measures of the main constructs. Most notably, a range of routines form four different capabilities (OC) which in turn form the overall construct for managerial capabilities development as captured by MCD. The reported Cronbach's alphas indicate strong internal validity. This lends support to an important assumption in our and others work, namely that routines can indeed form capabilities with high internal consistency. Furthermore, when capabilities (operations, monitor, target and people) in turn forms MCD to capture the overall managerial capability of the firm, we see a similar solid internal consistency.

	Capabilitiy	Brief description of underlying routines	Items	α
1	Operations	Lean manufacturing, and processes and systems for improvements	2	0.86
2	Monitoring	Tracking of performance of individuals, reviewing performance	4	0.87
3	Target	Realism, transparency and interconnection of targets	6	0.85
4	People	Promotion criteria, pay, and handling of bad performers	6	0.78
5	Management	Firm's managerial capabilitiy as index of capabilites above	4	0.89

Table 6.7 Capabilities constructs and validity

Dependent variable: Firm performance and competitive advantage

We utilize two different measures of firm performance based on return on equity (ROE) and profit margin (PM). The reason for including both is that they capture different aspects of the firm's performance. First, we compare the ROE and PM to the industry average for a focal firm i in a certain period t. If both metrics are higher than the average, the resulting dependent variable at this time t will be coded as 1. If one of the two metrics outperforms the industry the variable is given the value 0.5. This measure will hence be a relative measure and is hence a proxy for firm c *competitive advantage* at time t. We thus call this variable *competitive advantage (CA)*.

The final dependent variable in our analysis is the sum of the CA variable. Over the period of our analysis (10 years) we count the number of times a focal firm c manages to beat the industry average as captured in CA. Hence, we are given a measure of the firm's ability to win over time. The resulting count variable is thus a measure of *sustained competitive advantage (SCA)*.

Control variables and moderators

Several control variables are used in the previous literature on management practices, routines and capabilities to account for the observed heterogeneity among firms. We add firm level- and industry level controls. At the firm level we control for *firm size* measured as the number of employees, *ownership structure* (i.e. a dummy if ownership is dispersed), *part of multi national corporation* (a dummy if the firm is controlled by a corporate entity with a multi national structure), and *competition* as self reported indicator of the number of competitors facing the firm. We have coded this to mean 'high competition' if the firm faces more than 10 competitors in their industry. All proposed controls are controls employed in earlier research on management routines (Bloom & Reenen, 2007, 2010). We add dummies for each industry as well as for each country and year in the sample.

To capture the contested element of the role of environmental dynamism (Peteraf et al., 2013) we build a measure capturing the changes of industry revenues, sales, and assets over time. We use a common method proposed by Dess & Beard (1984) and operationalized in recent work on dynamic capabilities (Schilke, 2014a). We use data from the whole sample of industries found in WMS and match these with financial data from Bureau Van Dijk Orbis data base and Compustat. This gave us 50 000 firms from the 20 (2 digit NACE codes) industries in the sample of 15 countries. We

	Mean	SD	1	2	3	4	5	6	7	8	9	10
1) Competitive Advantage	0.49	0.44	1									
2) Sustained CA	4.42	2.95	0.63	1								
3) Management Capability Quality	3.00	0.67	0.05	0.07	1							
4) Management Capability Alignment	2.60	0.98	0.03	0.05	0.07	1						
5) Environmental dynamism.	3.52	2.32	-0.02	-0.06	0.02	0.05	1					
6) Competitive environment	0.49	0.44	-0.03	-0.05	0.05	0	-0.02	1				
7) Size (ln employees)	5.73	1.00	0.03	0.04	0.29	0.04	0.06	-0.07	1			
8) Activity (ln revenue)	10.66	1.53	0.1	0.14	0.35	0.06	0.05	-0.04	0.54	1		
9) Dispersed ownership	0.32	0.47	0.02	0.04	0.23	0.03	0.03	-0.08	0.14	0.21	1	
10) Part of MNC	0.60	0.49	0.04	0.08	0.33	0.02	0.03	-0.08	0.3	0.36	0.36	1

Table 6.8: Correlation matrix for performance effect of DC

then regressed all the firms in a focal industry s in country k with time as the only covariate. We then extracted the standard error of the estimated coefficient of time as the proxy for environmental dynamism for each metric (sales, revenue and total assets) and averaged them. This gave us a measure of *environmental dynamism (ENV)* for each industry s in each country k. As this variable reduces the total sample size somehow, we ran both with and without including it without the results changing materially for the other variables.

Modeling

We provide analytical insight into our focal relationship between MCD and MCA in two steps. The first model deals with their relationship with temporary competitive advantage (CA) (i.e. to what extent the firm is able to beat its market in one particular time period. The second model deals with how MCD and MCA relates to competitive advantage sustained over time (SCA).

The first model deals with the explanation of the competitive advantage of a firm and how capabilities building and alignment plays into this. The following model is estimated using logistic regression.

$$CA_{c,t} = \alpha_0 + \alpha_1 MCD_c + \alpha_2 MCA_c + \alpha_3 ENV + \alpha_4 ENV_{s,k} + \overrightarrow{\gamma}\mathbf{C} + \overrightarrow{\lambda}\mathbf{IND} + \overrightarrow{\mu}\mathbf{CTY} + \overrightarrow{\omega}\mathbf{YR}\epsilon_c$$

Note that this has the subscript s, k indicating that it is measured uniquely at each industry s within each country k of the sample. $\overrightarrow{\gamma}$ is a vector of coefficients for each control variable in the matrix $\mathbf{C}$. Similarly vectors $\overrightarrow{\lambda}$, $\overrightarrow{\mu}$ and $\overrightarrow{\omega}$ represents a set of coefficients for industry dummies ($\mathbf{IND}$), country dummies ($\mathbf{CTY}$), and time dummies ($\mathbf{YR}$) respectively. This simple model has the advantage of controlling for some unobserved heterogeneity through the industry, country and year fixed effects, and by including some control variables at the firm level.

The second empirical test is to what extent the analysis to include competitive advantage sustained over time. The following model is run using poisson regression.

$$SCA_c = \delta_0 + \delta_1 MCD_c + \delta_2 MCD_c + \delta_3 ENV_{s,k} + \overrightarrow{\gamma}\mathbf{C} + \overrightarrow{\lambda}\mathbf{IND} + \overrightarrow{\mu}\mathbf{CTY} + \\ + \overrightarrow{\omega}\mathbf{YR} + \epsilon_c$$

Here the dependent is a count variable capturing the number of times each focal firm has performed above average in the time period of our study. In estimating the models we include heteroskedasticity robust standard errors and control for multicolinearity by running variance inflation tests after each model. None of these remedies changed the overall effect of our findings.

Results

The results from the first regression model is presented in tables 3. Our focal constructs MCD and MCA are both significant predictors of CA at any time t controlled for firm level and industry level controls and firm, year and country fixed effects. The results are depicted in models 1 through 3. In conjunction with the correlations between MCD and MCA the results indicate that *capabilities improvement and acquisition*

and *capabilities alignment* are indeed different constructs with separate effects on CA. We also observe that higher revenue is positively related to CA while firm size, competition and dynamism has a negative effect. The overall explanatory effect of the models are around 4.5% which is not deemed particularly strong. We measure this by means of Nagelkerke R^2 which captures the explanatory power of a logistic model. However, the low explanatory power is not uncommon when modeling competitive advantage for a particular firm. Overall, the results from models 1 through 3 is in line with the expectations put forth in our hypotheses.

Moving onto analysing SCA we observe that MCD is insignificant and very weak compared to MCA. This is also in line with the hypotheses. This suggests that capabilities themselves are unable to provide sustained CA where as alignment can.

Discussion

Our empirical results suggests that both *capabilities development* and *capabilities alignment* matter for the creation and maintenance of CA. We hypothesized that these two effects are distinct and different expressions of DC and find support for these. We argue that these are different expressions of DC and plays distinctly separate roles in creating competitive advantage. This finding is in line with our hypotheses based on the individual mechanisms at play under both expressions. The interesting question remains how this plays into the larger theory of DC. If indeed DC can come to expression in two distinctly different ways, this suggests a richer and more nuanced insight into *how* DC work to create competitive advantage.

	Dependent variable:					
	Competitive Advantage (CA)			Sustained Competitive Advantage (SCA)		
	logistic			Poisson		
	(1)	(2)	(3)	(4)	(5)	(6)
Capability Development (MCD)	0.039**		0.037*	0.009		0.007
	(0.019)		(0.019)	(0.014)		(0.014)
Capability Alignment (MCA)		0.038**	0.036**		0.023*	0.022*
		(0.017)	(0.017)		(0.012)	(0.012)
Activity (ln Revenue)	0.317***	0.323***	0.315***	0.221***	0.221***	0.220***
	(0.026)	(0.025)	(0.026)	(0.017)	(0.017)	(0.017)
Size (ln employee)	−0.097***	−0.093***	−0.097***	−0.078***	−0.077***	−0.078***
	(0.021)	(0.021)	(0.021)	(0.015)	(0.014)	(0.015)
High competition	−0.101***	−0.094***	−0.100***	−0.069***	−0.067***	−0.068***
	(0.034)	(0.034)	(0.034)	(0.025)	(0.025)	(0.025)
Dispersed ownership	0.045	0.050	0.044	0.059**	0.059**	0.057**
	(0.039)	(0.039)	(0.039)	(0.028)	(0.028)	(0.028)
Part of MNC	0.015	0.030	0.018	0.050*	0.053*	0.051*
	(0.041)	(0.040)	(0.041)	(0.029)	(0.029)	(0.029)
Environmental Dynamism	−0.052**	−0.054**	−0.053**	−0.042***	−0.043***	−0.043***
	(0.022)	(0.022)	(0.022)	(0.015)	(0.016)	(0.016)
Constant	0.225	0.186	0.224	1.414***	1.406***	1.414***
	(0.156)	(0.155)	(0.156)	(0.102)	(0.101)	(0.102)
Country Fixed Effects	YES	YES	YES	YES	YES	YES
Industry Fixed Effects	YES	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	NO	NO	NO
Pseudo R^2	0.044	0.045	0.045	0.261	0.263	0.263
Observations	14,885	14,885	14,885	1,689	1,689	1,689

Note: *p<0.1; **p<0.05; ***p<0.01

Table 6.9: Regression analysis - How development and alignment impacts competitive advantage

The larger theoretical implications for DC theory is perhaps related to three separate issues raised in the extant literature. First, our operationalization of capabilities alignment as a second expression of DC captures much if the idea of *cospecialization* put forth by Teece (2007) and Teece (1986). We demonstrate empirically that the concepts are negatively correlated and still offers distinct effects on CA. This is also inline with the suggestions of Teece (2007). The conventional understanding of DC is tied to the common definition of the concept, namely as 'the capacity to create, extend and modify the resource base of the firm' (Helfat et al., 2007, p. 1). How this capacity works, however, is a little unclear. Some

theoretical insights have been gained, however. Most notably, the micro-foundations of dynamic capabilities suggest that firms with *DC sense* and *seize* new opportunities (and avoid treats) through *reconfiguring* its capabilities and resources (Teece, 2007). This framework suggests that the capacity to manage reconfiguration, meaning the 'continuous alignment and realignment of specific tangible and intangible assets' (ibid p. 1340) is a function of several management structures and tools. This suggests a multi-dimensional role of *DC* as a capacity. On the one hand improving the technical fitness of the underlying routines and capabilities (i.e. their operational efficiency). Simply put, *DC* improves the function of operational capabilities by making them better and more fit to the environment. On the other hand, the reconfiguration process are also driven by a desire to achieve fit in bundles of routines (as typically bundled into a capability) and argues that such complementarities from aligned routines and resources are important for firms to achieve competitiveness: 'In environments of rapid change, there is a need for continuous or at least semi-continuous realignment' (Teece, 2007, p. 1337). Consequently, our conceptualization of *capabilities alignment* fits empirically and conceptually neatly with the idea of cospecialization (Teece, 1986), but adds to the extant literature with a clearer insight into how this distinct effect works.

Second, our paper contributes with empirical findings and deeper theoretical argument about how general purpose capabilities can contribute to *CA* by means of aligning resources. It relates to the notion of 'capabilities choice' as an important tenant of *DC* theory, and one that is inherently tied to the prescriptive problem of 'how to choose among alternative capability creating investments' (Pisano, 2017, p. 748). We have argued and empirically suggested that 'capabilities choice' (Pisano, 2017) is an expression of the dyanmic system of *DC* (Di Stefano et al., 2014).

Third, and perhaps most interestingly, is how our distinction between *capabilities development* and *capabilities alignment* relates to debate about the linkage between DC and CA in the extant literature, most notably the juxtaposition between the seminal papers of DC theory on the nature and outcome of DC (Peteraf et al., 2013). We suggest conceptually, and show empirically that the concepts are distinct with separate and distinct effects on CA. Moreover, we also demonstrate that these concepts are complimentary to each other and reinforces the overall impact on CA. This is very much in line with the notion that DC is not working either as simple rule (Eisenhardt & Martin, 2000) or more complex processes (Teece et al., 1997), but rather in tandem forming a more fully dynamic system (Di Stefano et al., 2014). They argue that competitive advantage is indeed achieved due to to the 'socially complex and hard-to-imitate dynamic bundle of resources and capabilities (Di Stefano et al., 2014, p. 320). Through finding a positive interaction between the key concepts that are statistically unrelated meanwhile making conceptually sense, we have showed that this dynamic bundle combining different expressions of DC is a partial determinant of CA.

Conclusion and future directions

We set out this paper to explore a key tenant of DC theory, namely that it can be a source of CA. Moreover, we wanted to uncover the mechanisms underpinning *how* DC is able to generate CA. One of the most important tenants of the theory of dynamic capabilities (DC) is that it presumably can generate strategic change through 'creating, extending and modifying' firm resources and capabilities (Helfat et al., 2007). Indeed DC has been found to have considerable implications for development of firm capabilities Helfat et al. (2007), routines (Dunning & Lundan, 2010; Romme et al., 2010; Zollo & Winter, 2002), and consequently, firm performance

Protogerou et al. (2012); Pezeshkan et al. (2016). DC theory is also hailed to explain variations in competitive advantage CA, and even competitive advantage sustained over time (SCA) (Teece, 2007).

In this paper we have laid out the foundations of two separate expressions of how DC can create CA and maintain it over time. The extant literature on DC has been routinely challenged with respect to *how* and under what circumstances DC leads to CA, as well as CA maintained over time. Extant literature has suggested that various expressions and functions of DC may exist simultaneously in the form of a combination of routinized and more complex functions and hence forming a more complex dynamic system that is inimitable and valuable (Di Stefano et al., 2014). A clear conceptualization and empirical testing of this system is, however, not currently readily available in the literature. Our paper is an attempt to remedy this by providing a conceptualization of two different expressions of DC as well as an empirical operationalization. Our hypotheses find general support in data using management routines as building blocks for capabilities, as well as a measure of capabilities alignment.

The main contribution of this paper is twofold. First, we conceptualize a second expression of DC as a form of 'capability alignment' and suggests a measure to capture this. This places DC as a function of how underlying routines are organized above and beyond simply improving their fitness and efficiency. Second, we utilize repeated measurements of firm performance to capture both CA and SCA and demonstrates empirically that the two expressions of DC have different effects on this focal outcomes of DC theory.

Our paper does, however, suffer from certain limitations that should be addressed and expanded upon in subsequent research. First, although we suggest the underlying mechanisms at work in *capabilities alignment*, our

most novel conceptualization of DC expression, we are not able to directly test it empirically. Both the cost and risk underpinning development of capabilities should be explored explicitly using microlevel data measuring risk and return of investments in capabilities over time. For example, future research could garner inspiration from financial economics to measure risk and reward in portfolios of capabilities investments. Second, the WMS data captures only a subset of the larger set of organizational capabilities, namely management routines, and it does so only in a very limited subset of industries and countries. Future research should focus on testing the construct of *capabilities alignment* on other bundles of routines, and from a larger population of firms and industries. Finally, the dynamic bundle suggested by the combination of *capabilities development* and *capabilities alignment* should be explored empirically and theoretically in more detail. On the empirical side future research should study their co-evolution over time in a more dynamic empirical model. Theoretical progress should be made along the paths laid out by Di Stefano et al. (2014) tying the level of routinization and complexity to the workings of each expression. One particular meritorious endeavor, in our opinion, would be to provide a better analysis on how *development* and *alignment* differ in terms of the level of routinization and complexity each of them exhibit, and how these characteristics vary between firms and industries.

These limitations aside, the core idea of DC as well as the notion of distinct, but complementary expressions, is worth pursuing in the quest to understand how firms achieve competitive advantage.

6.3   Paper 3

Orchestration and Learning: The two faces of dynamic capabilities

Abstract:

This paper identifies two faces of first-order dynamic capabilities (DC). The first face manifests as an influence on firms' operating capabilities (OC), and describes the conventional role of DC in the literature. The second face manifests as an influence on deliberate learning (DL), whose key function is to change first-order DC. We develop a conceptual model that situates this dual role of first-order DC in the context of evolution of organizational capabilities. A set of hypotheses is derived from the model and tested against survey data with a 10-year time lag. Empirical results support the conjecture that first-order DC have a dual role in capability evolution by influencing OC and DL. Theoretical and practical implications of this conceptualization of first-order DC in the capability hierarchy are discussed.

First- and second-order dynamic capabilities, deliberate learning, dynamics

Introduction

There is ongoing interest in dynamic capabilities (DC) and how they influence firm performance (Fainshmidt et al., 2016; Teece, 2014; Wibbens, 2019; Meyer-Doyle et al., 2019; Ringov, 2017). Indeed, DC theory, and its antecedent, the resource-based view (Barney, 1991b; Helfat et al., 2007), is now considered one of the major theories in strategic management (Schilke

et al., 2018; Argyres et al., 2019). Arguably, a key reason is that this theory clearly articulates how firms can undertake strategic change by altering their operating capabilities (OC) through DC (Helfat et al., 2007). While it is now widely agreed that a central role of DC is to rejuvenate OC, a fundamental question that has emerged as a consequence of this insight is whether firms can change their DC, and if so, how (Wibbens, 2019; Schilke et al., 2018; Schilke, 2014b; Eriksson, 2014). The reason is, perhaps, obvious. If execution of DC can improve firms' competitive advantage by rejuvenating their resources and operating routines, then purposeful change in DC's represent a source of long-term competitive advantage (Wibbens, 2019; Zollo & Winter, 2002; Schilke, 2014b).

Scholarly thinking about this important issue has been greatly influenced by Zollo and Winter's (2002) frequently cited conceptual model of how deliberate learning (DL) constitutes a key antecedent of DC as well as of OC. Thus, in this model, DL is set as a central construct affecting the evolution of DC. However, despite being frequently cited, there has been surprisingly little subsequent theoretical and empirical research on the role of DL in the DC literature. A consequence of this is that the Zollo and Winter's model has not often been tested empirically. This is a shortcoming in the DC literature because DC is a theory that strives to offer practical advice to managers. But more fundamentally, we lack an understanding of the role of DL in recent DC theorizing, and we lack insight into how DL is triggered as a process. In other words: Where does DL come from? We believe that these two issues are intertwined. First, there is a need to situate DL in terms of conceptualization of the capability hierarchy that introduces second-order dynamic capabilities as those capabilities that change DC (Schilke, 2014b; Winter, 2003; Collis, 1994). Simply put, it is unclear how second-order DC relate to DL, and the notion of a capability hierarchy can help in conceptualizing this rela-

tionship. Second, DL is not "manna from heaven" (i.e emerging out of nowhere). Without an understanding of how DL processes are triggered and from where they originate, we have an incomplete understanding of DC as the key entity enabling strategic change in DC theory and the field of strategic management.

We suggest that these two issues/challenges can, at least in part, be reconciled by drawing on the notion of "feedback loops" whose role in DC theory has recently been questioned. There have been specific requests asking for more research on how this may work (Schilke et al., 2018). Heeding this call, and as a starting point, we are theoretically inspired by Cohen and Levinthal's (1989; 1990) groundbreaking theorizing about the two faces of research and development (R&D). Importantly, they argued that R&D has two faces, generating **both** innovation and learning at the firm level. When we adapt this thinking to the theory of DC, we see that first-order DC may have two faces, and an analogous dual role that has hitherto not been conceptualized in the theory of DC. To learn more about this we ask the following research question.

What is the dual role of first-order dynamic capabilities in the evolution of organizational capabilities?

To answer the RQ, we build a conceptual model in which we map our understanding of DC and their two faces on the model of evolution of organizational capabilities (Zollo & Winter, 2002). In line with extant theory, our model proposes that first-order DC operate to change underlying OC (i.e. *orchestrating* capabilities Sirmon2011,Helfat2007). This is, to use the language of Cohen and Levinthal (1989; 1990), the first face of first-order DC. However, first-order DC also generate a byproduct when executed that are analogous to the byproduct generated in the model by Cohen & Levinthal (1989). In our model, this byproduct triggers deliber-

ate learning, whose key function is to change first-order DC. This is the second face of first-order DC. We then situate this dual role of first-order DC in evolution of organizational capabilities within the capability hierarchy. A set of hypotheses is derived from the model and tested against survey data with a 10-year time lag between observations, in a design similar to that used by Schilke (2014b). The empirical results support the conjecture that first-order DC have a dual role in capability evolution by influencing OC and DL.

Our paper contributes to the scholarly thinking about dynamic capabilities by conceptualizing the two faces of first-order DC, a new conceptualization with important implications for the evolution of organizational capabilities and our understanding of the inner workings of the capability hierarchy. We test key propositions from Zollo and Winter's largely untested model, and extend it by identifying a new feedback mechanism between first-order DC and DL, i.e the second face of DC, using the theoretical language of Cohen & Levinthal (1989, 1990). This also adds to the literature by proposing how DL is triggered as a process, which has received scant attention (Schilke et al., 2018). Furthermore, our theorizing extends the work of Schilke et al. (2018) and predecessors (Zollo & Winter, 2002; Collis, 1994; Winter, 2003), as we conceptualize DL as a key functional domain of second-order DC. This aids in the theoretical integration of DL and second-order DC into the capability hierarchy Schilke (2014b); Wibbens (2019). Overall, our conceptualization suggests a (partial) solution to the "ad infinitum" critique often raised against DC theory (i.e the critique that one will always need a higher-order capability to explain changes in lower-level capabilities, and that this logic extends ad infinitum) (Schilke et al., 2018; Arend, 2015; Ambrosini & Bowman, 2009; Winter, 2003). In contrast, and using the theoretical language of Cohen and Levinthal, we propose that DL, as a key type of learning process, is triggered by

experiences generated as a byproduct of the execution of a DC at a lever level of the hierarchy (i.e. first-order DC). Therefore, the roots of DL as a higher-order domain of DC are generated at a lower level in the capability hierarchy. Our model therefore allocates theoretical primacy to first-order DC and its two faces in enabling the evolution of organizational capabilities and strategic change.

The rest of this paper is organized as follows: First, we discuss theoretical implications of the Zollo and Winter (2002) model in light of the capability hierarchy and derive hypotheses related to the first face of DC (the "orchestration face"). We then move on to argue for the second face (i.e. the "learning" face) using Cohen and Levinthal (1989; 1990) as a point of departure. Second, we set forth the methods and data used to test our hypotheses. Third, we present the estimation results as well as a discussion. Finally, we conclude with some avenues for future research.

Theory

Organizational capabilities can roughly be divided into two categories. First, operational capabilities (OC) "are directed toward maintaining and leveraging the status quo in terms of the scale and scope of activities, businesses, product lines, customer segments" (Schilke et al., 2018, p. 393). In other words these capabilities are the ones who "permit a firm to "make a living" in the short term" (Winter, 2003, p. 991). On the other hand, dynamic capabilities (DC) are "those that operate to extend, modify or create ordinary capabilities" (ibid). An important addition to this definition, however, is found in Helfat et al. (2007) where DC is defined as the ability to "**purposefully** create, extend and modify its resource base" (Helfat et al., 2007, p. 1).

Moreover, the DC themselves are evolutionary in their definition (Arndt & Pierce, 2018) as well as their empirical characteristics (Schilke, 2014b), meaning that they are both perceived and observed as changing over time. This calls for the notion of a higher-order dynamic capability geared towards changing lower-order DC (i.e those dynamic capabilities we defined above which are the focal construct of DC theory). Thus, several earlier contributions have discussed the idea of a *capability hierarchy* where OC are influenced by first-order DC that are influenced by second-order DC (Collis, 1994; Winter, 2003; Schilke et al., 2018). However, this hierarchy has no apparent logical ending suggesting that the second-order DC need even higher-order capabilities for them to change, bringing up the notion of an infinite regress (Schilke, 2014b; Arend, 2015). As Winter (2003) puts it, the chain of increasingly higher order capabilities suggests that this "explicitly makes the extension 'ad infinitum'" (ibid p 992). Of course, the idea of an infinitely tall hierarchy with N levels is not particularly useful in explaining firm dynamics, as such a system will never reach a convergent state. Nor is it clear how management actions can provide fertile grounds for development of capabilities at increasingly higher levels in the capability hierarchy. This brings up the image of "turtles all the way down" and the notion of there being a shaky theoretical foundation for the whole theory of DC. Consequently, a theory of how DC evolve, beyond simply stating the idea of an increasingly taller capability hierarchy, is needed.

Recently, Schilke (2014b) reintroduced second-order DC as an important type of higher-order DC whose function is to influence first-order DC, the latter being the traditional type of DC portrayed in the literature (e.g. Teece1997 and Helfat2007). This contribution echoes earlier work that has discussed the concept of the capability hierarchy (Winter, 2003;

Collis, 1994; Zahra et al., 2006) where OC are influenced by first-order DC that are, in turn, influenced by second-order DC (Schilke, 2014b; Winter, 2003; Schilke et al., 2018).

While the idea of the capability hierarchy is an intriguing one, DC theory is somewhat unclear about how organizational capabilities evolve in the context of the capability hierarchy. However, evolution of organizational capabilities, first- and second-order DC, as well as OC, take place within the capability hierarchy and in potential relation to each other. Thus, while prior studies have adopted an understanding of higher- order DC as influencing organizational capabilities of lower levels (Schilke, 2014b; Winter, 2003), scholars have recently argued for the need to examine feedback-loops in DC theory (Schilke et al., 2018). The idea of feedback loops implies that different types of organizational capabilities, at different levels of the capability hierarchy, may co-evolve through their interplay in ways that we currently have less insight about. This issue has recently been highlighted by Schilke's (2014b) distinction between first- and second-order DC, a distinction that is seeing increasing attention in the literature (Schilke et al., 2018). Reflecting this, it seems to be necessary to clarify how organizational capabilities, DC in particular, evolve in the context of the capability hierarchy. which now consists of types of (empirically measured) DC at different levels (i.e first- and second-order DC), and while doing this, take into account that there may be feedback loops between types of organizational capabilities across hierarchical levels.

Arguably, the single most influential contribution to our understanding of how dynamic capabilities evolve within the capability hierarchy is Zollo and Winter's frequently cited conceptual model on the role of deliberate learning (DL) in influencing the evolution of operating capabilities as well as DC. However, despite it being frequently cited, there has been sur-

prisingly little empirical research on the role of DL in the evolution of organizational capabilities. Moreover, how DL relates to the capability hierarchy (Collis, 1994; Winter, 2003) is unclear, a point also raised by Zollo2002a. This issue has recently been highlighted by Schilke's (2014b) suggestion that DL could be an example of second-order DC (a point also raised in Zollo & Winter (2002)). A theoretical challenge in this regard is to better understand and clarify how DL relates to recent conceptualizations and theorization which distinguish between first- and second-order DC in the context of the capability hierarchy and the evolution of organizational capabilities. The interplay between these two types of DC is less than clear, particularly when accounting for the existence of feedback loops between them. There is, therefore, no clear answer to what triggers DL. Without an understanding of how DL processes are triggered and originate, we have an incomplete grasp of how organizational capabilities evolve through the interplay between DC and DL.

To better understand evolution of organizational capabilities and the role of DL in the capability hierarchy, we integrate existing theorizing about DL (Zollo & Winter, 2002) and first-/second-order DC with the foundational theorizing of Cohen and Levinthal on the two faces of research and development (R&D) (Cohen & Levinthal, 1989, 1990). These researchers show that R&D fills two functions within a firm: (1) production of new information: and (2) opportunities for learning, as further elaborated below. While the capability hierarchy and first-/second- order DC have been discussed, we now devote attention to how Cohen and Levinthal's insights may be applied to and illuminate hitherto undiscovered, but important mechanisms in the theory of DC.

Cohen and Levinthal introduced a paradigm shift in our understanding of R&D in (evolutionary) economics and strategy research. Compared to the classical economics understanding of R&D as producing information, Cohen and Levinthal conceptualized R&D as having the role of creating new products, while simultaneously creating opportunities for learning. These opportunities, in turn, increase "the firm's ability to identify, assimilate, and exploit knowledge from the environment" (Cohen & Levinthal, 1989, p. 549). In other words, from this residual process the firm develops what is known as 'absorptive capacity' (Cohen & Levinthal, 1990). In this model the degree of absorptive capacity is determined by the learning taking place as a result from execution of R&D. Similarly, in the context of DC, opportunities for learning can stem from the execution of DC making Cohen & Levinthal (1989) an interesting analogy in this paper.

Subsequent research has confirmed and detailed the importance of absorptive capacity (Bertrand & Mol, 2013; Yao & Chang, 2017; Volberda et al., 2010; Apriliyanti & Alon, 2017), and *DC* scholars have even referred to absorptive capacity as an important type of dynamic capability (Apriliyanti & Alon, 2017; Zahra & George, 2002). However, while theorization on absorptive capacity has evolved in tandem with *DC* theorizing, the (potentially) deeper utility of Cohen and Levinthal's theoretical propositions for understanding (the evolution of) dynamic capabilities has not been explored in depth.

When we adapt Cohen and Levinthal's thinking to the theory of DC, we see that first-order *DC* may have an analogous, dual role: They influence both ordinary capabilities (i.e. the first face) and deliberate learning (i.e the second face). Thus, decisions to invest in the development of dynamic capabilities are enabled and enhanced by the learning ability of a firm (Zollo & Winter, 2002) thus enabling the firm to utilize learning for

changing operating routines through dynamic capabilities. This is analogous to the first face of R&D. The byproduct of these decisions, however, is that they enable opportunities for learning. Thus, opportunities for learning can stem from the execution of first-order DC that may trigger deliberate learning through an important feedback loop.

In the following sections, we will explore these two faces of *DC*: (1) as "resource orchestration" (i.e. the conventional understanding of *DC*) as the *first face*; and (2) "learning" (i.e. analogous to the idea of learning in Cohen1989) as the *second face*.

The first face: dynamic capabilities as orchestration

Arguably, Zollo & Winter (2002) coined the very concept of deliberate learning in their influential paper. According to these authors, deliberate learning mainly works by orchestrating dynamic and operational capabilities. Key to Zollo and Winter (2002) model is that through processes of experience accumulation, knowledge codification and articulation, *DC* as well as *OC* are shaped and evolved over time. This is also shown in Figure 6.10. This places firm learning at the core of how firms evolve and develop organizational capabilities (Grant, 1996; Prencipe & Tell, 2001). Like Argyris and Schön (1978), Zollo and Winter see firm learning as taking place when "new knowledge is translated into meaningful action and different behaviors that are replaceable" (Heimeriks et al., 2007, p. 374).

In their model, deliberate learning is contrasted with "learning by doing" (Zollo & Winter, 2002; Arrow, 1962) based on repetitive actions by employees in firms and organizations, and instead defined as learning that takes the form of a planned and deliberate process (Arthur & Huntley,

2005). With this in mind, a key aspect of the model by Zollo & Winter (2002) is that DL has a direct effect on the evolution of OC, a shown in Figure 6.10. Reflecting this, we propose the following hypothesis:

H1: Deliberate learning has a direct, positive influence on the development of operating capabilities in firms

Importantly, Zollo and Winter's model has also been instrumental for understanding how DC evolve, and learning has also had a central place in subsequent DC contributions (Bingham et al., 2015; Romme et al., 2010; Heimeriks et al., 2012). Inasmuch as deliberate learning constitutes an antecedent to DC, it also fits the concept of a second-order dynamic capability in that it can be defined as "the ability to purposefully create, extend and modify" (Helfat et al., 2007, p. 1) dynamic capabilities. Both the *deliberation* underpinning deliberate learning, and the *purposefulness* defining DC relates to the notion of intent. In conjunction with the mechanisms explored in (Zollo & Winter, 2002) this idea of intent makes it clear to us that DL can be seen as a functional domain of second-order DC. Extending this, we argue, in line with Schilke et al. (2018), that DC, also second order DC, have different functional domains. Functional domain is taken to mean the area in which DC are applied. Reflecting this, we conceptualize DL as a key functional domain of second-order DC.

The main function of deliberate learning is to accumulate knowledge and experience about the operation of the organization and its environment (Argyris & Schon, 1978; Kale et al., 2002; Heimeriks et al., 2007). Through this process, DL generates insights into what should be changed or not in order to achieve improved organizational performance. Central to the concept of DC is the deliberation underpinning its function, DC consists of a certain learned and stable pattern revealing that "dynamic capabilities are structured and persistent" (Zollo & Winter, 2002, p. 340). Thus,

ad-hoc or random and unstructured adaptation to change is not conducive to exhibiting proper DC (Helfat et al., 2007), and in order to change their DC consistently, organizations need to absorb knowledge and information in a structured and systematic manner. This is why Zollo and Winter identify DL, through its process of experience accumulation, knowledge codification and articulation, as precisely the systematic approach needed to generate the stable pattern of collective activity (ibid p 340) that defines DC. This is also shown in Figure 6.10. This understanding of DC is coherent with the definition the DC literature to which DC scholars increasingly subscribe, and that enhances the importance of the purposefulness of DC. Consequently, following Zollo and Winter (2002), we contend that DL is an important antecedent to dynamic capabilities.

H2: Deliberate learning has a direct, positive effect on changes in dynamic capabilities

When enacting the core function of DC, a firm senses and seizes opportunities, and reconfigures it's intangible and tangible assets (Teece, 2007). Thus, upon facing changes in it's environment, a firm with well-developed DC is able to stay competitive through changing operational capabilities and other firm resources - such as resource orchestration. Additionally, DC themselves influence operational capabilities. Our previous hypotheses have proposed relationships between DL and DC. By logical extension, DC would act as a mediator between DL and OC.

H3: Deliberate learning has an indirect effect on changes in operational capabilities through changes in dynamic capabilities

These three hypotheses are, to a considerable extent, derived directly from Zollo and Winter (2002), but with a clearer conceptualization of DL as a functional form of a second-order DC, extending Schilke (2014b). A

schematic visualization of this model is found in Figure 6.10 where the relationships between key constructs are depicted. This first face of DC is thus very much known in the existing literature, but we argue that it also contains, important insights into how to understand the evolution of DL itself. We now turn to the second face: learning.
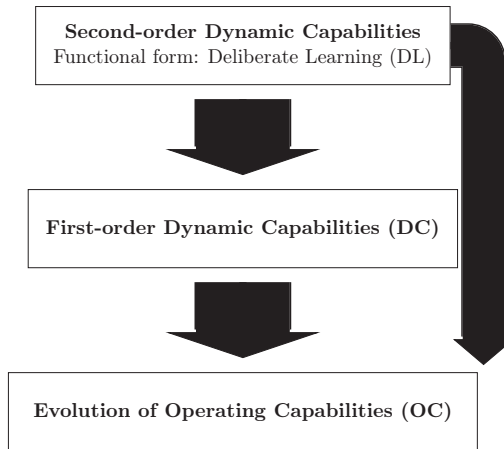
```
┌─────────────────────────────────────────┐
│    Second-order Dynamic Capabilities     │
│ Functional form: Deliberate Learning (DL)│
└─────────────────────────────────────────┘
                    ⬇
┌─────────────────────────────────────────┐
│   First-order Dynamic Capabilities (DC)  │
└─────────────────────────────────────────┘
                    ⬇
┌─────────────────────────────────────────┐
│  Evolution of Operating Capabilities (OC)│
└─────────────────────────────────────────┘
```

Figure 6.5: Resource Orchestration - the first face of dynamic capabilities

The second face: dynamic capabilities as learning

In Zollo and Winter learning is a key source of evolution in organizational capabilities. It is, however, unclear in extant DC theory how DL is triggered as a key antecedent to DC and OC. Building on what Schilke et al. (2018) see as an "opportunity to investigate feedback loops from dynamic capabilities to organizational and individual-level antecedents through an impact on consequences such as learning" (p. 419).

To investigate how execution of DC can create such a feedback loop back to DL, we consider one general mechanism as postulated by the microfoundations of DC. When enacting the core function of DC, a firm senses and seizes opportunities, and reconfigures it's intangible and tangible assets (Teece, 2007). When new experience accumulation from the processes of resource orchestration occurs (i.e the byproduct of the first face), the

firm is able to sense opportunities and threats from this new information generated *from DC* itself, and seize these opportunities through a reconfiguration process. This effort leads to strategic investments and asset alignment (Helfat & Peteraf, 2015) in the pursuit of strategic change, in this case through acquiring and enhancing experience articulation and codification capabilities; the core tenants of DL. Recent contributions have specifically highlighted how experience accumulation alone is insufficient for developing capabilities such as those for acquisition integration (Heimeriks et al., 2012; Zollo & Singh, 2004) and alliance formation (Kale & Singh, 2007). Thus, the complete set of deliberate learning components (i.e experience accumulation and knowledge codification and articulation) is needed to cope with strategic change.

In other words, execution of DC creates the byproduct of experiences that are accumulated, and the firm, due to its DC, is able to sense opportunities, and seize them by reconfiguring. This creates a demand for more investments and development of experience articulation and codification capabilities. Figure 6.6 depicts this relationship. Importantly, the relationship and feedback loop between first-order DC and DL, can be seen as introducing how organizations "learn to learn" how to change their organizational capabilities, and that the largely cognitive mechanisms of knowledge articulation and knowledge codification may play a key role in this process.

The microfoundations of this feedback loop could possibly be extended in several directions. On possible path is to consider a simple principal-agent model. The agent is the workers and functionary implementing changes in operational capabilities as materialized through the organization's DC. In the process of executing changes as prescribed by DC the agent learns and accumulates experiences. Provided that the agent is a wage recipient
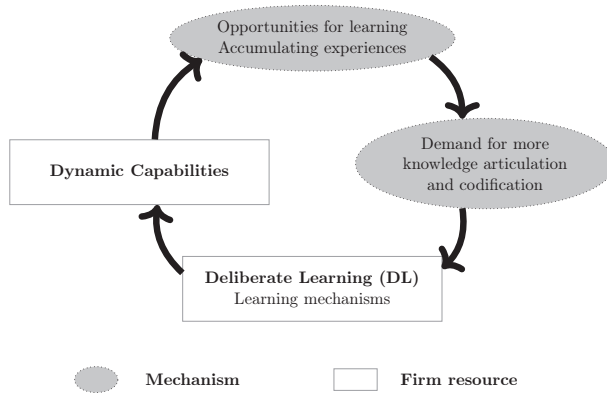
Figure 6.6: Learning - the second face of dynamic capabilities

and has no capital stock in the firm, they have no incentive to share these experiences. To the contrary, they have an incentive to obtain information from these experiences for themselves. If unchecked or incentivized, this creates an agency problem for the company (Arthur & Huntley, 2005). The principal has no way of knowing for sure whether the agent supports the firm's objective function. Facing this potential information asymmetry and agency problem, the principal has a strong incentive to invest in capacities for knowledge articulation and codification, as well as to incentivize agents to share their experiences. Consequently, we would expect to see increased demand for systems of deliberate learning in instances were opportunities for learning are high. The more potential for knowledge accumulation through learning, the more potential for misaligned incentives between workers keeping information back for fear of not being sufficiently compensated, and management. Hence, the incentive for the firm to invest in deliberate learning to better align these incentives, increases (ibid). This mechanism is illustrated in Figure 6.10. In sum, these arguments shape an interesting hypothesis about the feedback loop between deliberate learning and dynamic capabilities and how deliberate learning could be an outcome as well as an antecedent of dynamic capabilities (Schilke et al., 2018).
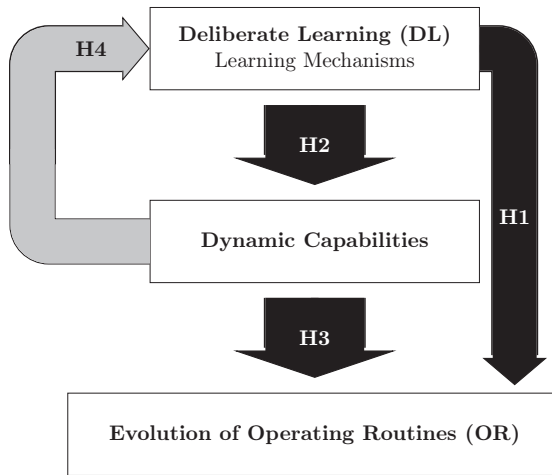
Figure 6.7: The two faces of dynamic capabilities and hypothesized relationships

H4: Dynamic capabilities creates opportunities for learning thus increases demand for systematic learning so deliberate learning will increase.

Figure 6.7 sums up the hypothesis proposed in this section of our paper. The white boxes and black arrows represent the first face of DC, those mechanisms that were originally proposed by Zollo and Winter (2002). The gray parts represent the second face, an extension based on more recent contributions to the field of dynamic capabilities and on our theorization.

Data and methods

An empirical test of the Zollo and Winter model and a feedback loop necessitates a certain length of observation in order to enable the study of dynamics over time. The lack of such longitudinal studies to investigate dynamics has been a obstacle to moving the DC literature forward empirically and theoretically (Schilke et al., 2018). To remedy this gap in the literature and to investigate the empirical characteristics of two faces of DC we utilized a database where Norwegian technology firms were admin-

istered a survey at two points in time ($T_0 = 2005$ and $T_2 = 2014$). The data is a combination of secondary data and data collected by the authors. The initial survey was to 1721 technology firms in Norway in 2005 where the intent was to measure dynamic capabilities (Alsos et al., 2007). Of the firms approached, 1199 (70 percent) returned filled-in questionnaires. Importantly, items measuring DC were developed based on an extensive literature review and qualitative interviews, and were tested in the field. The face validity of the items was further examined by testing the items on experts. We did not participate in this data collection. However, we have been given access to the raw data collected in 2005. The second author of this paper decided to do a follow-up survey with the companies that participated in the first round. The second round of data collection was done in spring/summer of 2014, nine years after the first round. All respondents received a web-based questionnaire containing the same measures of DC, CA, and OC. However, some new concepts and their measurements, such as DL were introduced, and the respondents were asked to answer retrospectively. Specifically, they were asked about items related to DL and to what extent the statements presented to them rang true for their firms five years prior to the time of the survey. This means that the firms were asked about their DC activities about five years prior to 2014. Hence, we have a proxy for measurement of DL at time T_1, whereas the other focal constructs are measured at times T_0 and T_2.

Two hundred and eighty-three of the firms returned filled-in questionnaire. Our operational construct of DC captures dynamic capabilities in a broad, non-functional, sense (e.g. as a broad-purpose capability rather than one for a particular purpose) (Schilke et al., 2018), and will hence capture the collective orientation of an organization rather than a narrow set of learned capabilities. This makes our conclusions more general, albeit maybe less precise in predicting what investments in DL would mean for important

capacities such as new product development and innovation. All the firms in the sample were identifiable by means of an official firm identifier. This enabled us to attach financial data from the annual accounts of the firms despite none of the firms in the sample being publicly traded companies. We obtained the financial accounts from the National Firm Registry (BR-REG) for all years between 2007 and 2014 (information collected prior to 2007 was not accessible through our database).

To control for survivor and non-response among our firms over time due to exogenous factors such as exit, bankruptcy, and so on, we estimated a Heckman correction model (Hair, 2014). In the context of this paper, Heckman regression is a method that in the first step analyzes the probability that a firm at T_1 will answer the survey at T_2 depending on observables at T_1. This is modeled as a probit regression. Based on the probit regression in T_1, the inverse Mills ratio (sometimes called lambda) is added to the analysis in the second step, where the goal is to analyze the relationship between our focal constructs (using regular OLS regression). The inverse Mills ratio is a control factor that controls for unobserved heterogeneity. More concretely, the inverse Mills ratio will control for unobserved factors related to firms' probability of answering the survey at T_2 (Certo et al., 2016). The combined data set gives us one distinct advantage. The time lag of the variables makes it possible to test a very simple dynamic. By controlling for previous period, we can argue a certain weak-causal (we see it as a sort of quasi-Granger-causality) relationship. It is more likely that a variable at time t affects a variable at time $t+1$ than the same variables at the same point in time or in the opposite direction.

Variable construction

The focal constructs of this paper were deliberate learning (DL), dynamic capabilities (DC), and operational capabilities (OC). These are all operationalized using the survey data described above. Table 6.13, below, describes the items used to operationalize the focal constructs and their internal validity in forming an additive index (Cronbach's alpha). The results show that our key constructs can be represented by the items in the survey.

Items measuring DC and OC 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 a one-sided seven point Likert scale where: $1 =$ strongly disagree and $7 =$ strongly agree. We built on prior studies in which items measuring OC have been measured relative to competitors (McKelvie & Davidsson, 2009). DL was operationalized using a similar questionnaire built on the previous work of Prencipe and Tell (2001). We developed questions based on their classification of learning into experience accumulation, knowledge articulation and knowledge codification. All the items from the questionnaire, as well as the internal validity of the constructs based on these items, are presented in Table 6.13 in the appendix.

Control variables

We added a set of control variables expected to explain parts of the variation in our focal constructs. From the survey, we added firm size, firm age, and the level of dynamism facing the firm. Size is the reported number of employees in the firm at T2, and age is the number of years since establishment. Dynamism is captured by asking a number of questions about the competitive environment facing the firm. A full list of items and their internal validity is available in the appendix.

To partly remedy the problem of common method bias, we added controls of financial data from the firm's profit and loss statements, and balance sheet. Specifically, we added the natural logarithm of the assets to capture the capital intensity of the firm.

One core critique of the DC literature is that it simply is a response to the firm being a good firm (Arend & Bromiley, 2009). This tautology makes it hard to distinguish the direction of the effects from the performance implications of DC. Simply put, both firm performance and dynamic capabilities can be due to some unobserved factor. In such cases we would simply regress one on the other and get positive results without the exact mechanism being pointed out. To partly control for this, we added a proxy for the quality of the firm as a control variable. In this paper we use the profit margin of the firm as this type of control. It is not perfect, as profit margins can be due to many factors outside our model, but it serves to control for parts of the possible confounding factors of firm quality.

These extra control variables are not observed in all the firms, so adding them reduce the sample size somewhat. Thus, we added them as robustness checks and reran all our models with those included. This did not materially change the results.

The focal variables in this study are presented with descriptive statistics and bivariate correlations in Table 6.10.

	Mean	SD	1	2	3	4	5	6	7	8
1) DL_{T_1}	4.86	1.12	1							
2) OR_{T_0}	4.77	1.03	0.11	1						
3) OR_{T_2}	4.66	0.82	0.43	0.29	1					
4) DC_{T_0}	4.87	0.95	0.28	0.47	0.13	1				
5) DC_{T_2}	4.60	0.96	0.66	0.11	0.56	0.36	1			
6) Dynamism	4.04	1.14	0.01	0.1	-0.01	0.37	0.08	1		
7) Firm Size	4.21	1.94	-0.13	0.08	0.11	0.03	0.19	-0.12	1	
8) Firm Age	24.74	14.06	-0.09	-0.01	0.05	-0.08	0.09	-0.1	0.52	1

Notes: Pairwise correlations between variables in the study excluding controls

Table 6.10: Descriptive statistics and correlations for variables in this paper

Estimation and empirical model

To test our hypotheses, we ran a sequential linear regression with heteroskedastic robust standard errors and Heckmann two-step correction to control for attrition and survival bias (Hair, 2014). We tested the mediation hypotheses within this framework using a causal mediation (Baron & Kenny, 1986; MacKinnon, 2008) with quasi-Bayesian confidence intervals over a million simulations (Imai et al., 2010). The sequential regression model is presented chronologically in accordance with Figure 6.10. This entails that the dependent variable in one model is the independent in the next to study the evolution of the proposed model sufficiently. The following models were estimated:

$$OR_{2,i} = \beta_0 + \beta_1 OC_{0,i} + \beta_2 DL_{1,i} + \mathbf{\Gamma C_i} + \epsilon_i \tag{6.7}$$

$$OR_{2,i} = \beta_0 + \beta_1 OC_{0,i} + \beta_2 DL_{1,i} + \beta_3 DC_{0,i} + \beta_3 \Delta DC_i + \mathbf{\Gamma C_i} + \epsilon_i \tag{6.8}$$

$$DC_{2,i} = \gamma_0 + \gamma_1 DL_{1,i} + \gamma_2 DC_{0,i} + \mathbf{\Gamma C_i} + \upsilon_i \tag{6.9}$$

$$DL_{1,i} = \xi_0 + \xi_1 DC_{1,i} + \mathbf{\Gamma C_i} + \nu_i \tag{6.10}$$

Here $\mathbf{\Gamma C_i}$ represents a vector of control variables including size, age, dynamism, financial assets and profit margin. ΔDC_i is the change in DC from T_0 to T_2.

In addition, we estimated mediating models and test for mediation using the Baron and Kenny method (Baron & Kenny, 1986; MacKinnon, 2008). We estimated a mediating model to test if DC mediates the effect of DL on OC. The mediation equation for dynamic capabilities is stated below:

$$\Delta DC_i = \alpha_0 + \alpha_1 OC_{1,i} + \alpha_2 DL_i + \mathbf{\Gamma C_i} + u_i \tag{6.11}$$

The Heckman selection model with the probability of selecting in to the sample at time T_2 is determined by the following model:

$$P(R = 1) = \eta_0 + \eta_1 L_i + \eta_2 DC_{0,i} + \eta_3 DY N_{0,i} + m_i \qquad (6.12)$$

OC is an indicator variable equal to 1 if the firm has responded at T_2 and 0 if not. L_i is an indicator set to 1 if the person answering the survey was the managing director or CEO. This acts as an instrument for considering the probability of the firm selection into the sample, but without having any theorized relationship with the main outcome variables DC and OC. It is reasonable to assume that if the CEO was involved in answering the survey at T_1, would increase the probability of the firm answering at T_2 as well.

Results

The focal variables of our study are presented with pairwise correlation, mean, and standard deviation in Table 6.10. It is worth noting that the mean values of OR and DC are declining over time, suggesting that the average firm experienced a negative development in core resources. We observe a certain correlation in the development in DC over time suggesting that prior-period DC is a strong predictor of future DC. Furthermore, we see a strong correlation between DL and DC, which indicates that these two constructs are indeed related.

Table 6.11 shows a summary of the regression models proposed in the previous section. Models 1,2 and 3 are designed to test relationships between DL, OR and DC. In model 1, we observe that DL is influencing the level of OR within the firm ($\beta_2 = 0.084$) supporting H1. However, the effect

decreases when we add ΔDC in model 2, suggesting a mediating effect. In other words, we see that firms with initial high DC ($\beta_3 = 0.182$) and increasing DC over time ($\beta_4 = 0.467$) also have better OR.

	Dependent variable:				
	OR_{T_2}		DC_{T_2}	ΔDC	DL_{T_1}
	(1)	(2)	(3)	(4)	(5)
OR_{T_0}	0.229***	0.331***			
	(0.055)	(0.054)			
DC_{T_0}		0.182**	0.239***		0.634***
		(0.078)	(0.060)		(0.091)
ΔDC		0.467***			
		(0.062)			
DL_{T_1}	0.312***	0.084*	0.547***	0.399***	
	(0.040)	(0.051)	(0.039)	(0.147)	
Firm size	0.053*	−0.006	0.130***	0.166**	−0.086**
	(0.028)	(0.026)	(0.025)	(0.080)	(0.037)
Firm age	0.001	−0.0005	0.003	0.004	−0.001
	(0.004)	(0.003)	(0.003)	(0.017)	(0.005)
Environmental Dynamism	−0.026	−0.022	0.095*	0.139	0.015
	(0.052)	(0.046)	(0.049)	(0.100)	(0.084)
Constant	1.704***	1.454***	0.809**	1.593	4.404***
	(0.439)	(0.364)	(0.350)	(1.011)	(0.398)
R^2	0.27	0.42	0.55	0.39	0.14
Adjusted R^2	0.25	0.4	0.53	0.38	0.12
Observations	1,188	1,188	1,189	1,189	1,189
ρ	0.168 (0.460)	0.560** (0.239)	−0.828*** (0.088)	−0.996	−0.942*** (0.023)

Note: *p<0.1; **p<0.05; ***p<0.01

Table 6.11: Regression models using Heckman 2-step correction

To control for the mediating effect suggested by the change in coefficients for DL between models 1 and 2, we performed a causal mediation analysis, as reported in Figure 6.10. This analysis confirms the indications from models 1 and 2, showing that the direct effect from DL on OR is smaller in the face of mediation, suggesting that ΔDC is partially mediating the effect of DL on OR (ADE = 0.09). Meanwhile, the indirect effect running through changes in DC over time is significant, yielding a positive and significant indirect effect of 0.19. The proportion of the effect that is mediated amounts to 0.674. These results suggest that H1 is supported, but that the bulk of the effect is indirect, running through DC, in line with
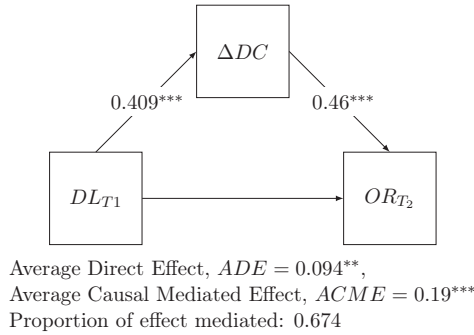
Average Direct Effect, $ADE = 0.094^{**}$,
Average Causal Mediated Effect, $ACME = 0.19^{***}$
Proportion of effect mediated: 0.674

Figure 6.8: Mediation analysis: Orchestration - the first face of dynamic capabilities

Average Direct Effect, $ADE = 0.179^{**}$,
Average Causal Mediated Effect, $ACME = 0.354^{***}$
Proportion of effect mediated: 0.662
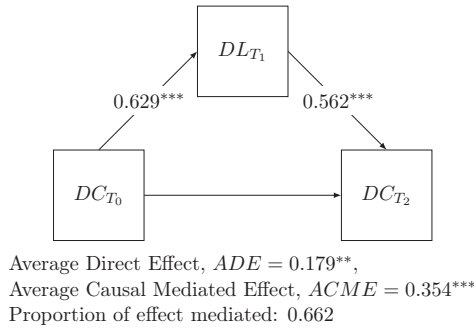
Figure 6.9: Mediation analysis: Learning - the second face of dynamic capabilities

the expectations in H3. Similarly, we see from model 3 that DC is indeed influenced by DL above and beyond its own evolutionary trajectory. This is in line with our expectations, and lends support to H2.

A brief note on the model fit is warranted. Our main models control for firm size and age, and environmental dynamism, whereas we added controls for assets and profit margin by including variables from another data source as a robustness check. In general, bringing correlated independent variables such as DC_{T_0} and ΔDC into a model suggests multicollinearity problems. However, VIF testing indicates no severe multicollinearity issues. The advantage of still bringing both in is to capture how much of the change in OR_{T_2} can be attributed to initial DC levels and how much stems from how DC evolves. Given the limitation of the data (survey data with

fixed scales with which to capture our constructs) it makes sense to control for both, because a low ΔDC may very well stem from a high initial DC_{T_0}, which should indicate that the firm is able to change OR nonetheless.

To evaluate H4, proposing a feedback effect from DC to DL, we turn to model 5 in Table 6.11. Controlling for the usual firm-level controls, we find a positive effect ($\xi_1 = 0.634$) from DC_{T_0} on DL_{T_1}. This supports H4, suggesting that firms with more DC are more likely to generate opportunities for which more learning will need to take place. It is also worth noting that models 2, 4, and 5 have significant λ from the Heckman selection model indicating that selection is leading to biased estimates. By running a Heckman correction we, avoid this potential problem.

Discussion

We set out to better understand the **the dual role of first-order dynamic capabilities in evolution of organizational capabilities**. Our theorizing and empirical results sugests that DC has two distinct faces, orchestration and learning, and that the latter triggers a second order DC (deliberate learning) through a feedback loop. Table6.12 depicts the hypotheses and to what extent they have been supported.

Our first three hypotheses are closely tied to the Zollo and Winter (2002) model and the propositions put forth there. Our core contribution in this regard is an empirical test of a frequently cited theoretical model in DC theory, which has made a substantial contribution to our understanding of DC antecedents and outcomes (Schilke et al., 2018; Eriksson, 2014). Our estimations support these hypotheses, lending added empirical validity to the Zollo and Winter model. Moreover, this also supports our notion of the *first face* of DC as a conductor of lower-level capabilities. Through execut-

	Hypothesis	Finding
H1	Deliberate learning has a direct, positive influence on development of operating capabilities of a firm	Support
H2	Deliberate learning has a direct, positive effect on changes in dynamic capabilities	Support
H3	Deliberate learning has an indirect effect on changes in operational capabilities through changes in dynamic capabilities	Support
H4	Dynamic capabilities creates opportunities for learning, thus increasing demand for systematic learning so deliberate learning will increase	Support

Table 6.12: Hypotheses and findings summarized

ing DC as a response to sensing and seizing opportunities, DC changes OC above and beyond the path dependency of OC itself. These mechanisms are in line with the theoretical claims in Zollo & Winter (2002).

The final hypotheses results from our theorization of opportunities for learning as a byproduct of executing DC. Firms with well-functioning dynamic capabilities would be able to utilize and create more instances of strategic change and thus more opportunities for learning. We propose that co-evolution of first- and second-order DC can be understood without resorting to an infinite regress argument (Winter, 2003; Schilke, 2014b; Arend, 2015). Experience accumulation alone has been found to be insufficient to fully generate proper routines for changing routines (Heimeriks et al., 2007; Zollo & Singh, 2004). Consequently, it is not the byproduct of accumulated experience itself that enables firms to learn and hence to develop DC. But DC, through sensing, seizing and reconfiguring (Teece, 2007), may enable the those firms to *acknowledge* the need to "engage in more deliberate efforts to learn by codifying its experience" (Heimeriks et al., 2012, p. 704). This finding highlights the importance of cognitive sides of how firm resources and capabilities evolve (Verona & Zollo, 2011;

Zollo et al., 2016) and is conducive to the "cognitive turn" in strategic management where focus on such factors are of increasing interest (Gavetti, 2012). This is the core idea behind our hypothesis on the *second face* of DC, which we find initial empirical support. This is an important finding, because it provides a partial answer to the one question in DC theory of how DC evolve, as well as to the "ad infinitum" criticism so prominent in the literature (Ambrosini & Bowman, 2009; Barreto, 2010).

This paper helps to integrate DL within the capability hierarchy (Winter, 2003). In the current conceptualization, it has been somewhat unclear whether DL is a capability or an antecedent. Our conceptualization of DL as a key functional domain of second-order DC has made it clear that DL is both, a key functional domain of a important type of higher-level capability, and an antecedent that is triggered by the byproduct of the execution of first-order DC. Our paper adds to the understanding of how DL is triggered, thus partly remedying what we believe is an area of neglect in the extant literature. However, by drawing on the notion of feedback loops (Schilke et al., 2018), this paper has helped to answer this important issue. We find that the execution of first-order DC creates a byproduct that trigger learning, in particular through the mechanisms of knowledge articulation and knowledge codification (Zollo & Winter, 2002), which is cognitive based mechanisms. Importantly, this suggests that the cognitive turn (Gavetti, 2012; Verona & Zollo, 2011) has relevance for understanding a core issue in the theory of DC, namely how DL originates and is triggered as a key mechanism in the evolution of organizational capabilities.

This paper helps to facilitate the theoretical integration of DC theory and theories of organizational learning, which has recently been called for (Schilke et al., 2018). However, we have only scratched the surface of the benefits of the integration between DC and organizational learning

theory for understanding evolution of organizational capabilities within the capability hierarchy. In particular, deep qualitative studies need to be undertaken to uncover the processes that lie underneath the mechanisms and empirical relationships we have identified in this paper. Our paper also shows how Cohen and Levinthal's (1989) insights may be used as a theoretical point of departure for examining and exploring feedback loops in DC theory. Thus, instead of just thinking that their theorizing can be used for identifying a type of DC, absorptive capacity, we have shown that it may in fact illuminate feedback loops which ave recently come to prominence in the theory of DC (Schilke, 2018). It is mainly from Cohen and Levinthal that we have the insight that the feedback loop between first-order DC and DL stems from the execution of first-order DC. In addition, we have helped to clarify the relationship between DL and DC within recent conceptualizations of the capability hierarchy which now clearly distinguish between first and second order DC.

Concluding remarks

This paper starts from the established theory that dynamic capabilities (DC) develop as a result of deliberate learning (DL) within the firm. This places DL as a second-order DC, a notion that is supported by extant literature (Schilke, 2014b). DL, as a functional form of a second-order DC, works to change both first-order DC and OC directly. It also changes the OC through changing DC. This expression of DC changing OC is what we, inspired by (Cohen & Levin, 1989), call the *first face* of DC. This *first face* is characterized by DC orchestrating underlying capabilities and resources, and is itself subject to influence from a second-order DC such as DL. This places DL as an antecedent to DC, in line with the definition of a second-order DC and as highlighted in the extant literature (Zollo & Winter, 2002; Schilke, 2014b; Schilke et al., 2018).

However, this mechanism opens the whole DC literature up for criticism that one would need an ever taller capability hierarchy (increased orders of DC) to be able to explain changes over time (i.e the problem of infinite regress (Winter, 2003)). Therefore, in this paper we propose, again inspired by Cohen and Levinthal (1989), that the execution of first-order DC creates a byproduct in addition to directing change in OC. This byproduct takes the form of experience accumulation and is the condition needed for knowledge articulation and codification to make sense (Zollo & Winter, 2002). Hence, accumulated experience is understood as an opportunity (or threat) by the sensing abilities of the firm's DC and , consequently, demand for knowledge articulation and codification is enhanced. This then leads to more investments and development of DL. We term this feedback loop the *second face* of dynamic capabilities.

Through an empirical model based on repeated cross-section and causal mediation estimations, we show that these two faces have empirical validity. Moreover, seeing the first and second faces of DC simultaneously enables a better understanding of the DC theory as a more fully dynamic system (Di Stefano et al., 2014) that contains the seeds of its evolution. This has several implications for strategic management research. First, it starts to illuminate the mechanism of feedback loop from executing DC and how this relates to the capability hierarchy (Winter, 2003) in general, and the criticism of infinite regress in particular. Second, it provides empirical support for the long standing model of Zollo & Winter (2002), and hence should inspire further insights into the core mechanisms underpinning this model.

This paper has several limitations. First, it builds on a sample of 257 firms with focal constructs, measured with a 10 year time lag (with the observation of DL being retrospective and thus placing it between the points in

time indicated). This limits our ability to study dynamics over time and further studies should strive to develop more longitudinal studies. Examining more firms from more industries would also enrich the analysis and enable studies of boundary conditions and contingencies. Second, the constructs are operationalized using a 10-year lag, which opens up for a number of factors affecting the focal constructs. Third, we use profit margin to take into account the criticism that there is a capabilities-outcome tautology in the field of DC research. However, profit margin is an imperfect measure.

Our findings also generated some ideas for future research. First, the incentives and motivations of agents in the organization should be explored. As suggested in previous literature the role of social capital (Blyler & Coff, 2003), cognitive frames (Verona & Zollo, 2011), and unchecked agency problems (Arthur & Huntley, 2005) can have significant implications for organizational outcomes. Hence, agents and their motivation are important moderators of our proposed *second face.* Second, the cognitive underpinnings of the managerial role would be an important part of our future understanding. This could be related to managerial cognitive capabilities such as attention, reasoning and social cognition that in turn impacts the sensing, seizing and reconfiguring abilities of DC (Helfat & Peteraf, 2015). This role of management is demonstrably important for strategic change (Helfat & Martin, 2015). Hence we would expect management to influence the *second face.* One particular question of interest to both organizational agents and management is how demand for more knowledge articulation and codification results from increasing experience accumulation from execution of DC or not. This is a third important field for future analysis; as in any dynamic system contingencies should be explored. Under which conditions will the feedback loop really trigger improved DL and when will it rather lead to outcomes hindering this improvement such

as organizational inertia (Romme et al., 2010)? We believe that pursuing contingencies of this type is important for the future of building theory in general (Makadok et al., 2018) and *DC* in particular (Schilke et al., 2018).

The most pressing practical implication of our paper is that the effect of dynamic capabilities, and thus its value, may be underestimated in models where the feedback loop is not implemented. This has two potential implications for managers. On the one hand, it may lead to under-investments in DC because the expected value is underestimated. On the other hand, investments in DC may lead to legacy investments in more deliberate learning, and thus increase the overall cost of the total investment in capabilities.

Appendix

Construct	Alpha	Items
Deliberate Learning (DL)	$T_1 = 0.9$	Management receive frequent information about the employee's newly gained experiences Knowledge and experiences are shared across teams in the firm Positive and negative experiences are shared between employees The employees are involved in discussions where the way of doing business is questioned The employees are encouraged to engage in critical discussions about how the company is conducting its business We conduct evaluations of "what has worked and what has not worked" in regards to larger projects etc
Dynamic Capabilities (DC)	$T_0 = 0.86$ $T_2 = 0.91$	Management and employees of the firm are strongly encouraged to front new visions, objectives, and ideas The firm systematically benchmarks itself against the best competitors in the business The firm has a high tolerance for trial and error in relation to development of new ideas We systematically identify which resources we can utilize (economic, competencies, political and organizational) We systematically search for new business concepts through observing what happens in our environment We systematically bring creative and knowledgeable people in the firm together to develop new business concepts We work continuously to realize efficiency gains in our business Systematic transfer of resources for development of new business areas is common in our firm We have developed routines that enable us to recombine existing resources in novel ways The firm puts strong emphasis on increasing employees' competence The firm uses resources to increase employees' competence The employees are, to a large extent, encouraged to learn from their experience The firm has routines for systematically compiling employee experiences
Operating capabilities (OC)	$T_0 = 0.78$ $T_2 = 0.76$	The firm has a competence that is hard to copy The firm has better technical competencies than competitors The firm has better competence in product/service development than competitors The firm has better marketing competence than competitors Compared to our competitors our firm is particularly skilled in customer service Compared to our competitors our firm is particularly skilled in management and operations Our employees contribute new ideas for products/services compared to our competitors' employees
Environmental dynamism	$T_0 = 0.72$	The firm is in an industry with high growth rates Products and services in our industry are rapidly falling out of fashion It is hard to predict the behavior of our competitors It is hard to predict customer preferences and the market demand New businesses are constantly entering our industry We frequently have to change our market strategies to keep up with our competitors

Table 6.13: Overview of constructs and questionnaire items including internal validity

6.4 Paper 4

One goal, two paths: How dynamic capabilities enable competitive advantage through behavioral and non-behavioral objects of change

Abstract:

The ultimate goal in the theory of dynamic capabilities (DCs) is competitive advantage. This paper analyzes to what extent DCs influence competitive advantage through two paths - one old, and one new - namely behavioral and non-behavioral objects of change. In addition to emergent theorizing and real world examples, we use the metaphor of "DC as coach" and DC as conductor" to build a conceptual model and derive hypotheses. Using longitudinal survey data with a 10 year time lag we find that DCs influence competitive advantage through both paths. Thus, the paper empirically validates emergent theorizing proposing non-behavioral objects of change as a new path between DC and competitive advantage. Moreover, the paper helps to broaden the conceptual basis for empirically investigating how DCs enable competitive advantage. This has implications for understanding how dynamic capabilities work, as well as practical implications for how strategic change is implemented in firms.

`Dynamic Capabilities, strategic cognition, operating capabilities,`
`mechanisms, competitive advantage`

Introduction

The ultimate goal in the theory of dynamic capabilities (DC) is competitive advantage (Schilke, 2014a; Helfat et al., 2007; Protogerou et al., 2012; yuan Li & Liu, 2014; Efrat et al., 2018; Mikalef & Pateli, 2017; Davcik & Sharma, 2016). Extant theory argues that competitive advantage (CA) stem from resources and routines that are well aligned to firms' competitive environment (Helfat et al., 2007; Peteraf et al., 2013; Teece et al., 1997; yuan Li & Liu, 2014; Jantunen et al., 2018; Makkonen et al., 2014). Dynamic capabilities are a source of longer-term competitive advantage in this perspective through its capacity to purposefully change these lower-level routines and capabilities (Winter, 2003; Helfat & Winter, 2011; Schilke et al., 2018; Pezeshkan et al., 2016; Lin & Wu, 2014), also referred to as ordinary, substantive, and zero-level routines and capabilities (Winter, 2003; Danneels, 2008; Collis, 1994). As a group, these lower level routines and capabilities are called 'behavioral objects of change' (Verona & Zollo, 2011; Zollo et al., 2016), and constitutes an important path through which DCs can enable competitive advantage (Verona & Zollo, 2011).

However, less emphasis has been placed on how other mechanisms can be work in shaping firm competitive advantage. Indeed, this gap in the literature is explicitly emphasized by (Schilke et al., 2018) where they 'see an interesting opportunity for future work to add greater richness to our understanding of the mechanism of resource-base change, given this mechanisms central role in many foundational works (..) and the diverse ways in which resource changes can potentially come the mechanism of resource-base change, given this mechanisms central role in many foundational works (..) and the diverse ways in which resource changes can potentially come about' (p. 419).

Indeed, the extant conceptualization of the $DC-CA$ link leaves out a considerable part of a firm's 'resource base' that are non-behavioral, such as resources that are tied to how the employees of the firm sees their mission, internalize information and effectuates change. These traits of the organization is very much related to concepts of 'mindset' (Dweck, 2016), 'employee cognition' (Lakoff, 1987; Gavetti, 2012) 'organizational genes' (Nelson & Winter, 1982) and 'sense-making' (Weick, 1995) to name but a few. However, in relations with dynamic capabilities, one promising avenue for exploring mechanisms, beyond the conventional behavioral objects of change is to examine the role of *non-behavioral* objects of change in the theory of DC (Verona & Zollo, 2011). These non-behavioral objects of change contain psychological objects such as cognitive frames, motivation and identity that are important for strategy formation and implementation (Vince & Gabriel, 2011; Gavetti, 2012) as they 'concern how decisions or actions are shaped, subverted and transformed by emotions, and (..) determine the "way we do things here"' (Vince & Gabriel, 2011, p. 338).

Moreover, these non-behavioral objects of change are themselves far from static and are found to change over time as responses to external change (Zollo et al., 2016) thus making them a natural part of the mechanisms underpinning how dynamic capabilities work (Schilke et al., 2018; Verona & Zollo, 2011). Still, far less is know about the non-behavioral objects of change and how they work as a mechanism in the dynamic capabilities theory.

We aim to contribute to bridging this gap by analyzing to what extent DCs influence competitive advantage through two paths - one old, and one new - namely behavioral and non-behavioral objects of change. Specifically, we ask the following research question:

What is the role of non-behavioral objects of change as a mechanism through which dynamic capabilities can influence competitive advantage?

To help answer this research question we build a conceptual model which illuminates the relationships between DC, behavioral and non-behavioral objects of change and CA. The model firmly integrates theorizing on organizational cognition (Lakoff, 1987), non-behavioral object of change (Verona & Zollo, 2011) and cognitive psychology (Tversky & Kahneman, 1983; Kahneman & Tversky, 2011) into the $DC - CA$ nexus. Specifically, we focus on a particular type of non-behavioral object of change, strategic cognition, and how it acts as a mediator between dynamic capabilities and firm competitive advantage and hence has a pivotal place in the literature. Reflecting this, we argue that DCs have two important functions, namely 'DC as **coach**' and 'DC as **conductor**':

Dynamic capabilities take the function of a **conductor** by orchestrating routines and capabilities, and the role of a **coach** in stimulating strategic cognition. We discuss this theoretical understanding of DC and use the case of Microsoft's transition into the cloud computing business as an illuminating case. Importantly, this case demonstrates how the roles of conductor and coach coexist and in generating strategic change and competitive advantage.

The conceptual model is used to derive a set of hypotheses which is tested against longitudinal survey data with a 10 year time lag. We find that DC influence competitive advantage through both behavioral and non-behavioral objects of change. Thus, the paper empirically validates emergent theorizing proposing non-behavioral objects of change as a new path between DC and competitive advantage. Moreover, the paper helps to broaden the conceptual basis for empirically investigating how DC enable

competitive advantage. This has implications for understanding how dynamic capabilities work, as well as practical implications for how strategic change is implemented in firms. Thus, the paper clarifies the theoretical role of non-behavioral objects of change as well as a possible operationalization through the concept of *strategic cognition*. Moreover, we conceptualize two different expressions of dynamic capabilities (i.e. conductor and coach) and theorize on how they work in the $DC - CA$ nexus. Finally, we develop and test an empirical model suited for analyzing mediating constructs on the dynamic capabilities-competitive advantage nexus. The time-lag of our data in conjunction with advances in empirical estimations of multiple simultaneous mediators makes for an interesting model to push our understanding of important mechanisms in the theory.

The rest of this paper is organized as follows: First, we present a brief discussion on the key definitions applied in this paper. We then move on to develop hypothesis of the focal relationships. Third, we present the data and empirical models used to test our hypothesis. A discussion follows the results from our model, before we conclude by offering some limitations to our study as well as future directions for study.

Theoretical background and hypotheses

Competitive advantage is considered the 'holy grail' of strategic management (Schilke et al., 2018) and is indeed the focal point of important antecedent theories of dynamic capabilities (Arndt & Pierce, 2018; Pezeshkan et al., 2016). Consequently, contributions to push the theory forward should enable a better understanding of how dynamic capabilities work to influence firms' competitive advantage.

The collective term for assets available for firms in their pursuit of their objectives are *resources* (Helfat & Winter, 2011; Helfat et al., 2007). This term entails tangible assets such as machines, capital, and labor, but also intangible assets such as procedures, practices, and intellectual property (Pisano, 2017). The process of using these resources in the pursuit of business objectives such as competitive advantage is a firm's *capabilities* which can be a set of routines and skills applied (Helfat et al., 2007; Helfat & Winter, 2011). Resources and capabilities are both tied organizational behavior and how the organization act in their operation. Hence, they are coined *behavioral objects of change* (Verona & Zollo, 2011): 'A pattern of action, a process, an operating routine, or any form of group activity characterized by some level of stability and predictability' (ibid. p.538). Such behavioral objects such as capabilities are the conventional understanding of how dynamic capabilities work; they 'purposefully create, extend and modify the resource base' (Helfat et al., 2007, p. 4). In the terminology proposed in this paper this process takes the shape as a **conductor** envisioning a conductor orchestrating firm capabilities. Extant literature on dynamic capabilities are increasingly focusing on how firm resources are changed by dynamic capabilities as a response to changes in the environment (Schilke et al., 2018; Eriksson, 2014), thus placing firm capabilities as a mediator between dynamic capabilities and competetive advantage (Helfat et al., 2007). This notion of 'orchestration' of firm resources, assets and capabilities has indeed been emphasized in the extant literature (Sirmon et al., 2011; Helfat & Peteraf, 2015). Thus the notion of a **conductor** captures a directional role played by DC in terms of its functioning to 'orchestrate' *behavioral* objects of changes such as *operational capabilities*.

However, as Verona & Zollo (2011) points out: 'This approach misses the fundamental aspect that organizational capabilities specific to managing change can hardly be reduced to the management of behavioral change'

(ibid p. 538). This opens for *non-behavioral objects of change* which are defined as 'behavioral antecedents, such as cognition (e.g. cognitive frames) and motivation' (ibid p. 539). This concept entails the 'how decisions or actions are shaped, subverted, and/or transformed by emotions; and it concerns how emotions become embedded in cultural and political practices that determine the "way we do things here"' (Vince and Gabriel 2011 . ch 15). One particular dimension of these non-behavioral objects of change particularly conducive to the context of generating strategic change is the *strategic cognition* of the organization. Strategic cognition can be defined as conceptual structures in the minds of the individuals that encapsulate a shared understanding of the reality the individuals face with respect to the strategic goal of the organization [1]. This strategic cognition is the result of a mental process that underlie internal audiences adoption of new strategic representation and identity code to move toward a new or existing goal (Gavetti, 2012). Although strategic cognition may lead to behavioral outcome, the nature of the concept itself is tied to cognition rather than actual latent action (Zollo et al., 2016). Thus, dynamic capabilities are not sufficiently creating strategic change through its role as **conductor**. Additionally they need to exercise a role to adapt the strategic cognition of the organization to create a shared understanding of the sense and necessity of the strategic goals of the orientation. We coin **coach** to capture the enabling role dynamic capabilities plays through *strategic cognition* as juxtaposed to the more directional role played as **conductor** of *operational capabilities*. According to the Cambridge dictionary the noun 'coach' means 'someone whose job is to teach people to improve' and 'someone whose job is to train and organize'. Albeit often used in relation to sports it is also increasingly used for any process of 'learning and development intervention that uses a collaborative, reflective, goal-

---

[1]This definition is based on the definition of Lakoff (1987) definition of the more generic 'cognitive representation' and is adapted to fit the pursuit of strategic goals such as competetive advantage which is the aim of this paper

focused relationship to achieve professional outcomes' (Jones et al., 2016, p. 253). We use the word as an analogous idiom for an organizational process focusing on the subject (e.g. the firm or an individual) to utilize own capacities as well as activating latent motivations. Thus it is juxtaposed to a **conductor** that creates results through directions and orchestration.

Conducting and coaching at Microsoft

When Satya Nadella took over as CEO of Microsoft in March 2014, he took over a company in big trouble. The share price was just north of 30 USD and the company had just launched a 7.2 billion USD acquisition of the failing Nokia company. The story about how Nadella turned Microsoft around to a valuation of 105 USD pr share and with successful mergers along the way is a story of excellent 'capabilities orchestration' as a response to exercising dynamic capabilites, specifically through sensing, seizing and transforming resources to adapt to changing market conditions (Teece, 2007). Nadella and his firm did a considerable reorientation towards the cloud and reconfigured firm capabilities to fit this objective - almost a school example of exercising dynamic capabilities.

Moreover, and to the point of this paper, through a series of talks, interviews and his own book Nadella put considerable emphasis on how Microsoft managed to change their 'mindset', that is their 'cognitive frames' (Nadella et al., 2017): 'I focused on what would be our grandest endeavor, the biggest hurdle - transforming the Microsoft culture' (p. 89). Drawing on the concept of a 'growth mindset' (Dweck, 2016) Nadella sees culture as a 'complex system of individual mindsets' and that it encompasses how 'an organization thinks and act' (ibid p.90).

Satya Nadella is very much on the same page as recent contributions on how cognitive frames of an organization (i.e. its non-behavioral object of action) is a pivotal part in how firm resources shape outcomes such as performance and competitive advantage (Barney, 1991b, 2001), and how it consequently plays a role in how dynamic capabilities work along these lines Verona & Zollo (2011). Microsoft under Nadella did transform the company by changing the behavioral objects of action (i.e. capabilities and routines), but also through changing the non-behavioral objects of action (i.e. the strategic cognition). In other words, the story of Microsoft's transformation suggest that dynamic capabilities worked through mediating factors to influence competetive advantage, but that these mediating factors exist as two distinctly different concepts working in tandem. Figure 6.10 presents a conceptual depiction of the paths running through these two concepts of *capabilities* and *strategic cognition* objects of action (Zollo et al., 2016). We use a familiar term for the conventional understanding of dynamic capabilities mechanism as 'orchestration' as a collective term to describe the behavioral objects of action (Verona & Zollo, 2011)(ref). In this process dynamic capabilities play the role of a **conductor** orchestrating capabilities of the firm, an understanding that is in line with a range of the most common definitions of dynamic capabilities (Schilke et al., 2018).

The non-behavioral objects of action has no similar agreed upon analogy, so for the purpose of our analysis we envision this mechanism to work more as a cognitive process enabling the organization to tear away from their current understanding and ways in which things are done (Vince & Gabriel, 2011). Whereas the analogy of a **conductor** suggests a function that composes an outcome based on the available capabilities, the notion of a **coach** refers to the function of enabling others to achieve their objectives. The process is all about getting employees on board, and by changing an

organization's thinking from the automated and well-known, to the more cognitively aware. We will now turn to the two functions of dynamic capabilities in turn.

Capabilities conductor

Satya Nadella set out to transform Microsoft by investing heavily in artificial intelligence and cloud computing capabilities. This entailed hiring new people, upgrading the skills and abilities of the current staff, and acquire infrastructure and hardware. Additionally, Microsoft was able to acquire and integrate a number of companies to support the strategic direction the company was on. Companies such as GitHub, LinkedIn and Citrus data became important platforms for developing new capabilities within the company Nadella et al. (2017).

This role of **conductor** is the conventional way of understanding dynamic capabilities. It stems from one of the most common definitions (Helfat et al., 2007) as well as the analogy of the process as 'resource orchestration' (Sirmon et al., 2011). It is also found in the empirical literature handling various functional forms of dynamic capabilities such as acquisition targeting (Bingham et al., 2015), alliancing (Schilke, 2014a), new product development (Danneels, 2008), innovation capabilities (Breznik & D. Hisrich, 2014), marketing capabilities (Bruni & Verona, 2009) and alliance capabilities (Kale et al., 2002; Kale & Singh, 2007).

The bulk of prior contributions study firm capabilities and resources as the mechanism through which dynamic capabilities influence an outcome (Pezeshkan et al., 2016; Fainshmidt et al., 2016; Protogerou et al., 2012; Schilke et al., 2018). Particularly, much of the extant literature concerns measures of accounting profitability and competitive advantage as the final outcome of dynamic capabilities Shamsie et al. (2009); Schilke (2014a,b);

Teece & Leih (2016). Thus, from these prior contributions we derive a fundamental hypotheses of the relationship between dynamic capabilities and competitive advantage:

H1: Firm capabilities mediates the relationship between dynamic capabilities and competetive advantage

However, this mechanism is solely related to behavioral objects of action while previous insights from the literature on organizational capabilities hold that this is only parts of the story Tripsas & Gavetti (2000); Gavetti (2012). Or as highlighted by Verona & Zollo (2011): Most 'conceptualizations of DCs have in common the often implicit assumption that the object upon which DCs produce their effects is fundamentally of a behavioral nature: that is a pattern of action, a process, an operating routine, or any form of group activity characterized by some level of stability and predictability. This approach misses the fundamental aspect that organizational capabilities specific to managing change can hardly be reduced to the management of *behavioral* change' (p. 538). Thus, they argue, a more holistic approach including cognition is needed (Zollo et al., 2016). This claim is also supported in the lessons from Microsoft's transition.

Cognitive coach

On February 4th 2014 an email appeared in the inbox of all Microsoft employees. It was from Nadella who had just begun his tenure as CEO of the company. In this email he lays out the framework for transforming Microsoft around changing the way the company jointly acted. He wanted to change the culture of the company from one of inviting new ideas and fostering creativity. This called for changes in the *cognition* of the individual employers as well as their capabilities and skills. Nadella made this abundantly clear in this email even paraphrasing Oscar Wilde in that 'we

need to believe in the impossible and remove the improbable'. Nadella's tool for achieving this change of cognition was to become the notion of the growth mindset (Dweck, 2016). This transformation of the cognition of the organization to better fit the strategy he was laying out, is a proper example of instilling a *strategic cognition* in the organization.

vJuxtaposed to the experiences from Microsoft, the case of Polaroid brings another set of experiences to our discussion on non-behavioral objects of action (see (Tripsas & Gavetti, 2000) for a detailed account). Cognitive inertia on the part of the organization played a pivotal part in the failing of the company's digital imaging effort (Verona & Zollo, 2011). In other words, Polaroid did not exercise dynamic capabilities to change the cognition of the organization. Similar patterns are found in Kodak and Anderson Consulting (Kaplan & Henderson, 2005), and Smith Corona (Danneels, 2010). These examples highlight the absence of 'dynamic capabilities specific to the adaptation of cognitive frames, first, and consequently of operating processes' (Verona & Zollo, 2011, p. 541). This is also highlighted at the core of the dynamic capabilities literature: 'Dynamic capabilities are about doing the right things, at the right time, based on new product (and process) development, unique managerial orchestration processes, a strong and **change-oriented organizational culture**' (our emphasis) (Teece, 2014, p).

When dynamic capabilities are executed it is as a response to changes in the environment in order to stay competitive. This processes relates to creating strategic change (Helfat et al., 2007) and entails changing strategic direction and objectives of the organization. This strategic change requires, in addition to modifying, extending and creating firm capabilities, also some kind of alignment with the organization as a whole - what is often referred to as 'how we do things here' (Nelson & Winter, 1982), and

how an organization think and act (Nadella et al., 2017). This alignment is possible only if the employees share a common cognitive frame related to the the strategic direction of the company enabling them to make sense of the changes ahead. This is what we have coined *strategic cognition* and has its expression in Microsoft's development of a growth mindset. Strategic cognition is needed to get employees on board as well as capture the efficiency of non-directed change. Getting on board refers to the general willingness of the organization to accept and value the importance of some decision or system 'without being prompted or required by formal governance mechanisms'(Simsek et al., 2009, p. 812). Moreover, When individuals of a firm buys into changes they will enhance the full organization's ability to not only act upon changes (Marchand et al., 2004), but also in 'timely responsiveness' (Kohli et al., 1993).

Seminal contributions in cognitive psychology describes this state of actively engaging in cognitive processes 'system 2 thinking' and define it as allocating 'attention to the effortful mental activities that demand it, including complex computations' (Kahneman & Tversky, 2011, p. 21). This is juxtaposed to the more automated 'system 1' which 'operates automatically and quickly, with little or no effort and no sense of voluntary control' (ibid). The process is all about changing an organization's thinking from the automated and well-known, to the more cognitively aware. The extent to which individuals in an organization is enabled to allocate attention to effortful mental activities related to understanding needs for strategic change instead of relying on automatic reasoning (Tversky & Kahneman, 1983) or rules of thumb (Kahneman & Tversky, 1979), can be a forceful remedy aganist organizational inertia (Adriaenssen & Johannessen, 2016).

Consequently, strategic cognition not only contributes to getting people on board, it also maintain a more efficient change process where the individuals take more responsibilities for the change itself and leverages their individual knowledge in the endeavor. For a firm to create real strategic change as enabled by their dynamic capabilities and hence stay competitive, is will need to act as a **coach** to instill a strategic cognition in the organization.

H2: Strategic cognition mediates the relationship between dynamic capabilities and competitive advantage

Coaching conductor

Although Satya Nadella and Microsoft put strong emphasis on the cognitive side of strategic change (the role as **coach**), acquisition and development of capabilities were also very much on their mind (the role as **conductor**). It was not about letting 'culture eat strategy for breakfast', but rather serving culture and strategy as complementary side-dishes. Nadella emphasized 'getting the right team in place', 'build new and surprising partnerships', 'be ready to catch next wave of innovation and platform shift' as things Microsoft needed to get right. These meant investing in new people as well as upgrading the capabilities of the existing staff Nadella et al. (2017). Meanwhile, he also stressed that they needed to 'drive cultural change from top to bottom' and 'reframe our opportunity for a mobile- and cloud-first world'. (ibid p 95-96). In Microsoft, it clearly seems, it was exactly by being both a **coach** and a **conductor** at the same time that results would come. In other words, the giant software company strongly emphasized that the two mechanisms were complementary.
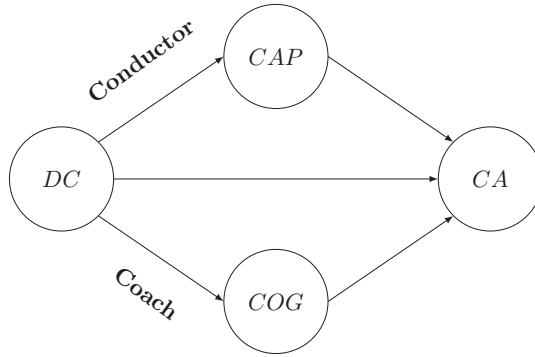
Figure 6.10: The resource and cognitive mechanisms of dynamic capability

When dynamic capabilities are executed in a firm being able to both adapt the capabilities and the cognitive frames simultaneously makes sense. A solid strategic cognition in tandem with relevant and strong capabilities would reinforce each other. This has also been supported in previous research where firm success has been shown to relate to the interconnection between resources and capabilities, and culture and attitude (Verona & Ravasi, 2003), and high levels of social capital (Blyler & Coff, 2003). Moreover, the lack of one (e.g. strategic cognition) can lead to unfavorable outcomes even though capabilites and resources are aligned for the needed strategic change (Tripsas & Gavetti, 2000). This leads us to our final hypothesis:

H3: Strategic cognition and operating capabilities are complementary and thus mutually reinforcing their individual effect on competitive advantage

Data and methods

To test the relationships between dynamic capabilities and competitive advantage, as well as the mediating effects on operational capabilities and strategic cognition, we need a proper metric of all. Particularly, it is useful

to consider changes over time to capture the dynamic in the relationships and make for a more plausible causal argument to be put forth. The lack of longitudinal studies to investigate dynamics over time and control for path dependency of organizational routines has been noted as permanent limitation for moving the dynamic capabilities literature forward empirically and theoretically (Schilke et al., 2018).

We use a unique data set where Norwegian technology firms were administered a survey at two points in time. ($T_0 = 2005$ and $T_2 = 2014$). The data combine the secondary data from an earlier survey with registry data and a follow-up survey conducted by the authors. The baseline survey was captured in 2005 when a web based survey was sent to 1721 technology firms in Norway intending to capture the concept of dynamic capabilities (Alsos et al., 2007). Approximatly 70% of the firms returned filled-in questionaires mouting to a total sample size of 1199 firms. Details of the data gathering process and the validation is available in Alsos et al. (2007), but a brief explanation is waranted. The authors used a mixed methods approach combining an extensive literature review with qualitative interviews and testing in the field. Face validity of the items was further examined by testing the items on experts. The authors of the present paper did take part in this data initial collection. However, we have been given access to the raw data collected in 2005. The second author of this paper followed up with a similar survey in the spring/summer of 2014, 9 years after the first round. All the same firms received a web-based questionnaire containing the same measures of the key constructs in this paper. Following htis second round we were left with a sample size of 283 representing the number of firms returning a filled-in second questionnaire.

The population was all businesses registered to a scheme for tax deduction of R&D costs (called SkatteFUNN). As all enterprises which are eligible for taxation could register their R&D activities to receive a tax refund, the registered enterprises include close to all enterprises which are involved in such activities at the time of our study. The context of R&D active firms is particularly relevant for studying dynamic capabilities because R&D activity is a signal of responsiveness to change and that the firms are located in industries with a certain level of dynamism.

All the firms in the sample were identifiable by means of the official firm identifier. This enabled us to attach financial data from the annual accounts of the firms despite none of the firms in the sample being publicly traded companies. We obtained the financial accounts from the National Firm Registry (BRREG) for all years between 2007 and 2014 (prior to 2007 was not accessible through our database). By including data from a second source, we aim to remedy to known short comings of similar contributions. See the section of control variables for short discussion.

Variable construction

The focal constructs of this paper are dynamic capabilities, operating capabilities, strategic cognition as measured by proactiveness, and competitive advantage. These are all operationalized using the survey data described above. To capture *operating capabilites* we look at the definition of these by (Winter, 2003) as those capabilities that enables the firm to 'make a living' in the short term, i.e. contributing to the technical fitness of the firm (Helfat et al., 2007). Thus we chose to survey a firm's ability to handle core functions of daily operations such as operational routines, operational management, customer service and marketing. To capture strategic cognition we apply the definition derived above. Of course such a concept can have many actual expressions, but in the context of studyin

competititve advantage the organization's attitude towards competition seems like a plausible starting point. In other word a shared cognitive frame of an overall competitive orientation is useful. Thus, we adopt the idea of measuring a strategic posture of the firm (Covin & Slevin, 1989) and particularly the notion of *proactiveness* (Covin & Slevin, 1991; Wales, 2016).

Table 6.13 in the appendix describes the items used to operationalize the focal constructs and their internal validity as measured by Dillon-Goldstein Rho which is the preferred metric for this purpose (Hair et al., 2019). The results show that our key constructs can be represented by the items in the survey, with a minor caveat. The measure of strategic cognition as proactiveness loads only partly on one item (item 3). Statsistically, a loading of 0.53 is on the weaker side of traditional 'rules of thumb' (Hair, 2014), but from a theoretical stand point the measure makes sense and is established in the literature Covin & Wales (2012).

There are no established measurement models of dynamic capabilities (McKelvie & Davidsson, 2009; Schilke et al., 2018).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 semi-structured 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, cooperation 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 & Davidsson, 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; McKelvie & Davidsson, 2009). It is in this spirit that the research reported in this paper has been undertaken.

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 operating capabilities have been measured relative to competitors (McKelvie & Davidsson, 2009).

The nine year lag between our points of measurement has its distinct advantages with respect to capturing long term trajectory of the firms. For example, the operating capabilities at time $t = 1$ is very likely a function of operating capabilities at time $t = 0$ as well as other factors such as dynamic capabilities. Indeed, extant literature argues for this path dependency of resources and routines (Helfat et al., 2007; Winter, 2003). These capabilities are said to be serial-correlated and path dependent. However, as dynamic capabilities and operating capabilities are distinctly different concepts, this kind of path dependency is also not equally clear in this regard. We could have firms with very high levels of dynamic capabilities at $t = 0$ and equally a poorer level at time $t = 1$. Because of the long time lag a lot of factors could have influenced this decline, and indeed a rather high number of over firms exhibit this characteristic of declining dynamic capabilities over time. As we regard dynamic capabilities as 'the first derivative' (Winter, 2003) (i.e. the rate of change of the operating capabilites) a large initial value (at time $t = 0$) could over estimate the expected change of the underlying capability at time $t = 1$. Moreover, based on the scale applied (Likert from 1 through 7) a high initial value leaves nowhere to move but downwards. This is not to say that those firms are likely to develop poorer operating routines. Nor is to say that those with low dynamic capabilities at time $t = 0$ are rendered useless in developing capabilities going forward towards $t = 1$. Rather it suggests that a long time span may include unnecessary noise in the model. Thus, we estimated an average of the dynamic capabilities of the firm between time $t = 0$ and $t = 1$ as a proxy for a more representative measure of the rate of change. Hence, our construct of DC_0 is actually a measure between times $t = 0$ and $t = 1$. As a robustness check we repeated the full analysis using 2005 measure as our DC_0. This did not severely alter the conclusions we draw in this paper, but had some minor effects on the significance of the path between DC_0 and COG_1.

Control variables

We add a set of control variables expected to explain parts of the variation in our focal constructs. From the survey we add firm size and firm age. Size is the reported number of employees in the firm at T_1, and age is the number of years since establishment.

To partly remedy the problem of common method bias, we add controls of financial data from the firm´s profit and loss statements, and balance sheet as robustness checks. Specifically, we add the natural logarithm of the assets to capture the capital intensity of the firm.

One core critique of the dynamic capabilities literature is that it simply is a response to the firm being a good firm (Arend & Bromiley, 2009). This tautology makes it hard to distinguish the direction of the effects the performance implications of dynamic capabilities. Simply put both firm performance and dynamic capabilities can be due to some unobserved factor of the firm simply being a 'good firm'. In such cases we would simply regress one on the other and get positive results without the exact mechanism being pointed out. To partly control for this we add a proxy for the quality of the firm as a control variable. In this paper we use the profit margin of the firm as this type of control. It is not perfect as profit margins can be due to many factors outside our model, but it serves to control for parts of the possible cofounding factors of firm quality.

All the constructs and the control variables are presented with descriptive statistics and pairwise correlations. The main estimation was tested for multicolinearity using the variance inflation test (VIF) with no severe multicolinearity detected. This is also suggested by the correlation matrix.

	Mean	SD	1	2	3	4	5	6	7	8	9	10	11
1) CA_1	3.89	1.39	1										
2) CA_0	3.88	1.47	0.38	1									
3) DC_0	4.66	0.84	0.3	0.06	1								
4) CAP_1	4.17	0.99	0.54	0.18	0.36	1							
5) CAP_0	4.23	1.17	0.32	0.41	0.21	0.36	1						
6) COG_1	4.63	1.15	0.45	0.06	0.39	0.46	0.25	1					
7) COG_0	4.71	1.26	0.19	0.27	0.24	0.15	0.37	0.34	1				
8) Size	4.33	1.90	0.36	0.29	0.06	0.31	0.29	0.11	0.13	1			
9) ln(Assets)	10.01	2.03	0.35	0.33	0.06	0.32	0.26	0.08	0.11	0.87	1		
11) Margin	-0.07	0.66	0.18	0.24	0	0.09	0.13	-0.06	-0.09	0.07	0.02	1	
12) Age	25.12	14.24	0.17	0.18	-0.05	0.19	0.17	-0.02	-0.05	0.52	0.51	0.04	1

Table 6.14: Descriptive statistics and correlation between key constructs and control variables.

Estimation and empirical model

Our empirical model is a mediation analysis where operational capabilities and proactiveness acts as mediators of the dynamic capabilities-competitive advantage relationship. Our data is for the larger part survey based with some controls gathered from registry data (particularly the Norwegian Company Registry). The total sample size of the paper is $N = 262$ which makes it very suited for a latent variable analysis using Partial Least Squares - Structural Equation Modeling (PLS-SEM) (Hair, 2014). Particularly, PLS-SEM is useful when studying theoretical extensions of established theories, when the sample size is small, when the structural model includes many constructs and indicators, and when distribution issues are a concern (Hair et al., 2019). Indeed, the use of PLS-SEM is increasingly taking hold in strategic management research (Hair et al., 2012).

As we work with latent constructs we needed to handle missing values in the measurement model. Each latent variable consists of several observable indicator variables and the latent variable will drop an observation if one of the indicators are missing. Thus, to reduce the number of missing observations we ran a two-step validation process when constructing the latent variables. First, we established a theoretical structure based on theory and tested the constructs accordingly by evaluating the internal validity using

Dillon-Goldstein Rho. In this first step we used only observations where all indicators were complete (i.e. no missing). Then we imputed the mean value of the other indicators when one indicator had a missing value. In the second step we reran the model and compared the reliability measures. None of the constructs changed materially, but the total sample size went from $N = 262$ to $N = 240$ because some of the constructs lacked more than one item, rendering the imputation challenging. In these cases we dropped the observation. As a robustness check we reran all the models using a Multivariate Imputation By Chained Equations (MICE) procedure which makes use of the whole sample to impute missing values where more than one underlying item is missing. This procedure did not change the results materially.

The complete data used in the measurement model then comprised of $N = 240$ observations. When adding the registry data from the Norwegian Company Registry, the sample sized declined somewhat to $N = 206$. We ran all the models with and without the registry data without the focal relationship changing materially.

To test our hypotheses we then built a path-model from the latent variables we constructed. This resulted in four models. The results from the structural model is reported in figure 6.11 and table 6.15. To estimate the standard errors we ran simulations using bootstrapping and reported the simulation number, standard errors and corresponding p-values. To evaluate the models we compared R^2 and Q^2 statistics for model comparison. All these are reported in table 6.15.

The estimated models are based on the following specification:

$$CA_{i,1} = \alpha_0 + \alpha_1 CA_{i,0} + \omega_1 \alpha_2 CAP_{i,1} + \tag{6.13}$$

$$\omega_2 \alpha_3 COG_{i,1} + \alpha_4 DC_{i,0} + \mathbf{\Gamma}_m \mathbf{C}_{i,1}^m + \epsilon_i \tag{6.14}$$

$$CAP_{i,1} = \beta_0 + \beta_1 CAP_{i,0} + \beta_2 DC_{i,0} + v_i \qquad (6.15)$$

$$COG_{i,1} = \eta_0 + \eta_1 COG_{i,0} + \eta_2 DC_{i,0} + u_i \qquad (6.16)$$

CA,CAP,COG and DC indicates the consctruct for competetive advantage, operational capabilities, strategic cognition (proactiveness) and dynamic capabilities respectively. Subscript i refers to the firm and the second subscript indicates the time $t = 0$ or $t = 1$. $\mathbf{\Gamma}_m$ is an $m \times 1$ vector of coefficients γ_1 to γ_m for the control variables included in the model captured in $\mathbf{C}_{i,1}^m$ which is a $i \times m$ matrix of controls. This generic model structure corresponds to four models by changing the parameters ω_1 and ω_2 which are indicator variables $\omega \in [0, 1]$. Our base case model is $\omega_1 = \omega_2 = 0$ where only the direct effects from DC including the controls is captured. Models 2 and 3 captures the mediation effect of CAP and COG respectively (ω_1 or $\omega_2 = 1$). Our final model captures the effect of both mediators ($\omega_1 = \omega_2 = 1$).

A final model includes an interaction term between CAP_t and COG_t to capture any complementarity or substitution-effects these two may exhibit:

$$\begin{aligned} CA_{i,1} =& \alpha_0 + \alpha_1 CA_{i,0} + \omega_1 \alpha_2 CAP_{i,1} + \omega_2 \alpha_3 COG_{i,1} + \alpha_4 DC_{i,0} + \quad (6.17) \\ & \alpha_5 CAP_{i,1} \times COG_{i,1} + \mathbf{\Gamma}_m \mathbf{C}_{i,1}^m + \epsilon_i \end{aligned}$$

Results

The main results of our analysis are depicted both in the graphical path diagrams (figure 6.11) and the regression table in table 6.15. The use of PLS-SEM has increased substantially in the realm of marketing (Hult et al., 2018) and strategic management (Hair et al., 2012; Valaei et al., 2017) and is the topic of special issues in leading journals (Hair et al., 2020) (e.g. Journal of Business Research call for papers in 2020). In this

tradition we aim to present thorough analysis of our models and largely follows the recommendations made in recent contributions (Hair et al., 2019).

The empirical models are presented from left to right starting with the direct model. The main effect from DC_0 to CA_1, controlled for CA_0, firm size, age, profit margin and assets, is positive and significant at the onset. Increasingly, by adding mediating variables as suggested by the theory, this effect diminishes to an extent suggesting that partial or full mediation is taking place. The effect decreases from 0.25 to 0.08 and turns insignificant when adding the two mediators. This suggests a full mediation. The mediating variables CAP_1 and COG_1 are both positive and significantly related to CA_1. This suggests that the effect between dynamic capabilities and competitive advantage is mediated by these two factors separately, as well as together. These findings both support H1 and H2. Moreover, the model becomes increasingly better both in terms if explanatory power (R^2) and predictive power (Q^2).

When adding the interaction term $CAP_1 \times COG_1$ we get a significant effect. this is compatible with the idea of behavioral (CAP_t) and non-behavioral (COG_t) objects of change being complementary. This lends support to H3.

Our results indicate that between 37% and 48% of the variation in CA_1 can be explained by our model, whereas 19% and 18% of the variation in our mediators CAP_1 and COG_t respectively is explained.

	(1)	(2)	(3)	(4)	(5)
	CA_t	CA_t	CA_t	CA_t	CA_t
DC_{t-1}	0.246	0.134	0.126	0.083	0.061
	(5.52)	(2.72)	(2.49)	(1.6)	(1.12)
CAP_t		0.382		0.324	0.331
		(7.65)		(6.38)	(7.24)
COG_t			0.301	0.188	0.225
			(5.27)	(3.11)	(3.66)
$CAP_t \times COG_t$					0.093
					(2.04)
		CAP_t		CAP_t	CAP_t
DC_{t-1}		0.237		0.224	0.206
		(4.12)		(3.38)	(3.17)
			COG_t	COG_t	COG_t
DC_{t-1}			0.325	0.331	0.329
			(5.23)	(5.29)	(5.31)
CA controls	YES	YES	YES	YES	YES
CAP controls		YES		YES	YES
COG controls			YES	YES	YES
R^2	0.3	0.44	0.37	0.47	0.48
Q^2	0.2	0.31	0.25	0.32	0.31
N	240	232	240	232	232

Standard-errors estimated using bootstrapping with 10 000 simulations.
Firm level control variables include firm size, firm age, profit margin, firm assets.

Table 6.15: PLS-SEM results for key constructs

Robustness and assumption validation

The results are subject to some robustness checks not directly reported in the paper, albeit a summary is available in the appendix. First, controlling for functional form using a Ramsay RESET test we find support for a linear relationship between our constructs. Second, we ran the a Variance Inflation Test (VIF) to control for multicolinearity. None of the VIF values exceeded the suggested level indicating multicolinearity problems. Third, we ran two separate models where we (1) included other measures of DC (using the original measure of DC_0), and (2) added more control variables to which decreased the sample size (from $N = 238$ to $N = 205$).
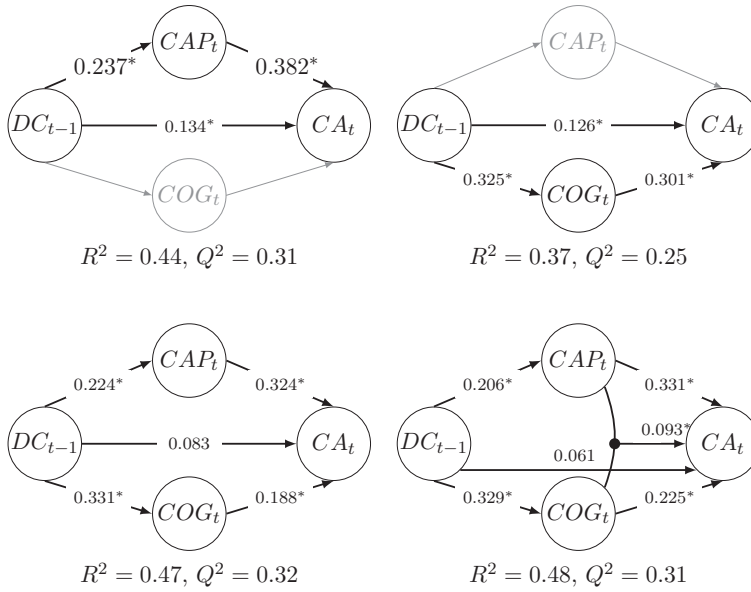
Figure 6.11: Mediation analysis - graphical representation

Discussion

The aim of this paper is to theorize about how non-behavioral objects of change work as a mechanism through which dynamic capabilities influence competitive advantage. Our results indicate that both behavioral (*operating capabilities*) and non-behavioral (*strategic cognition*) mediates the effect from dynamic capabilities on competitive advantage. The first mechanism, dubbed 'conducting' in reference to the well established terminology of 'resource orchestration' (Sirmon et al., 2011; Helfat et al., 2007), shows a robust and strong function as a mediator in line with our first hypothesis. When firms exhibit strong dynamic capabilities they are able to adapt their operating capabilites to stay competitive. We hypothesized that this relationship would be positive and significant. Our results indicated exactly this relationship and thus lending support to hour hypothesis. In our example context of Microsoft Nadella did several invest-

ments in capabilities and resources as a response to Microsofts dynamic capabilities execution. For example, he acquired important capabilities from M&A efforts, and upgraded the competencies regarding cloud business and big data (Nadella et al., 2017). This should not be surprising given the vast literature on indirect effects of dynamic capabilities (Schilke et al., 2018; Eriksson, 2014) supported by empirical and theoretical research (Pezeshkan et al., 2016; Fainshmidt et al., 2016; Protogerou et al., 2012; Karimi & Walter, 2015). However, it adds to this ongoing effort of investigating mechanisms through which dynamic capabilities work which is called for in the literature (Schilke et al., 2018).

In this vein, our second hypothesis, and the main contribution of this paper, is much more novel in its characteristics. Building on the important work of Verona & Zollo (2011) in what they call adding a 'human side to dynamic capabilities' we suggest that non-behavioral objects of action exists in parallel with behavioral ones. This view holds that cognition makes a difference in creating strategic change and should thus be a part of a more 'holistic' approach to dynamic capabilities theory (ibid). The notion of cognition in general plays an important role in determining 'the way we do things' (Vince & Gabriel, 2011). The idea of 'strategic cognition' seems to be a way of safeguarding that organization members buy into the needed strategic change identified by execution of dynamic capabilities. Indeed, this is also what we find in our results. Our operationalization of 'strategic cognition' as *proactiveness* makes for a proper mediator in the focal relationship between dynamic capabilities and competitive advantage. This is the path we have dubbed 'coaching' where dynamic capabilities rather than orchestrating resources enables the organization to fully grasp and adapt to the proposed strategic change. In our Microsoft example this was exactly where Nadella put the most emphasis. By instilling a growth

mindset Microsoft became a more proactive company, but the triggering mechanism was the execution of dynamic capabilities through sensing and seizing the opportunities they saw.

Our empirical results support the idea that *operating capabilities*) and *strategic cognition* being distinctly different mechanisms through which dynamic capabilities influence competitive advantage. This suggests that dynamic capabilities have two roles working in tandem, both being a 'conductor' of capabilities, and a 'coach' of cognition at the same time. Moreover, these two types of objects of change, as thoroughly discussed by Verona & Zollo (2011), are not independent. They work in tandem in that you are not able create strategic change without adapting your capabilities for the change, meanwhile exercising the right interpretation, understanding and attitude towards change. Our third hypothesis considers strategic cognition in tandem with relevant and strong capabilities and hold that they would reinforce each other. This has also been supported in previous research where firm success has been shown to relate to the interconnection between resources and capabilities, and culture and attitude (Verona & Ravasi, 2003), and high levels of social capital (Blyler & Coff, 2003). Moreover, the lack of one (e.g. strategic cognition) can lead to unfavorable outcomes even though capabilites and resources are aligned for the needed strategic change (Tripsas & Gavetti, 2000). This is also one of the key lessons from the Microsoft case. Our empirical results do indeed support this. *Operating capabilities*) and *strategic cognition* are complementary to each other in influencing competitive advantage meaning that businesses will not succeed properly without being conscious of both.

Concluding remarks

We started this inquire with the aim to shed light on non-behavioral objects of change as an alternative mechanism between dynamic capabilities and competitive advantage. Inspired by the novelty of insights into the 'human side of dynamic capabilities' (Verona & Zollo, 2011; Zollo et al., 2016), the forceful transformation of Microsoft (Nadella), and the call to investigate new mechanisms (mediators) in dynamic capabilities (Schilke et al., 2018), we set out to analyze the role of these non-behavioral objects of change. Indeed, both research and practical interest in dynamic capabilities largely stems from the promise of delivering competitive advantage - the 'holy grail' of strategic management (Helfat et al., 2007; Schilke et al., 2018; Peteraf et al., 2013). Thus, really understanding the mechanisms *through* which dynamic capabilities can influence competitive advantage, is of crucial importance.

Using recent contributions on the role of cognition in strategy (Gavetti, 2012; Zollo et al., 2016; Verona & Zollo, 2011) we hypothesized about the role strategic cognition, defined as 'conceptual structures in the minds of the individuals that encapsulate a shared understanding of the reality the individuals face with respect to the strategic goal of the organization'.

Using a survey of 262 Norwegian technology firms we constructed latent variables capturing the focal constructs of dynamic capabilities theory. Using PLS-SEM analysis we were able to analyze the relationships between these constructs, specifically the role of *operating capabilities* and *strategic cognition* as measured by capabilities for daily tasks, and proactiveness respectively. We found that these two are separate constructs both acting as mediators between dynamic capabilities and competitive advantage. Moreover, an interaction analysis also suggest that they are indeed complementary to each other.

We have aimed at using this holistic approach to dynamic capabilities theory to explain firm competitive advantage - the 'holy grail' of strategic management (Schilke et al., 2018). Specifically we have tried to push the theory forward in understanding of *how* dynamic capabilities work to influence firms' competitive advantage. Our contributions have been threefold. First, we clarified the theoretical role of non-behavioral objects of change and suggested a possible empirical operationalization through the concept of *proactiveness*. This has implications for how we operationalize important mediators in the $DC - CA$ nexus.

Second, we suggested and demonstrated two different expressions of dynamic capabilities (i.e. **conductor** and **coach**) as well as their workings in the dynamic capabilities-competitive advantage nexus. This insight adds to the nascent work of bringing cognition into broader strategic management field in general (Gavetti, 2012, 2005) and dynamic capabilities in particular (Helfat & Peteraf, 2015; Arndt & Pierce, 2018). In particular, the evolutionary and resource based roots of DC theory has to a large extent been dominating the field (Arndt & Pierce, 2018; Peteraf et al., 2013) leaving an important side of cognition (Verona & Zollo, 2011) and heuristics (Arndt & Bach, 2015) less explored. Particularly, the call for exploring new mediators of the $DC - CA$ nexus (Schilke et al., 2018) is particularly relevant to moving DC theory forward. Our conceptualization is thus an important contribution to this work. Bringing the notion of simultanously separate and interpendent expressions of DC has implications for strategizing and decisions to pursue capability aquisition and development. As with the case of Microsoft, our data shows that simultanously maintaining 'strategic cognition' adds to outcome of the strategic change. Thus, managers who underestimate these effects may very well end up delivering less value than they otherwise could.

Third, we utilized time-lagged data in conjunction with advances in empirical estimations of multiple simultaneous mediators. In doing these three we believe we have helped to push our understanding of important mechanisms in the dynamic capabilities theory.

This paper has several limitations however. First, it has been hard to capture the full extent of the focal constructs empirically. We have had to settle for few items to capture the full magnitude of the mechanisms. Future research should focus on establishing more comprehensive operationalization of key constructs in order to better test the theory. Second, we have leaned a lot on one case study to motivate our work. Although Microsoft is an interesting and important case, future research should include more case studies with more in-depth analysis to really get under the proposed mechanisms. Third, our sample size is on the smaller size. Granted, PLS-SEM is able to capture rather consistent estimates on small samples, larger samples would enable researchers to extend the analysis further. More industries and countries should also be included in the analysis, and more observations over time would be helpful in analyzing more causal claims in the theory. Forth, we have examined two particular types of behavioral and non-behavioral objects of change. Thus, future research should examine other types in order to develop e more elaborate and holistic understanding of how behavioral and nonbehavioral objects of change influence competitive advantage in the theory of DC.

These limitations aside, we believe that this paper has helped to push the theory in a more 'holistic' direction as suggested by Verona & Zollo (2011) and hence answering the call for investigating more mechanisms in the dynamic capabilities theory (Schilke et al., 2018).

Appendix

Construct	Rho	Items
Dynamic Capabilities	0.89	– Management receive frequent information about the employee's newly gained experiences (0.69) – Knowledge and experiences are shared a cross teams in the firm (0.77) – Knowledge and experiences are shared a cross teams in the firm (0.76) – Positive and negative experiences are shared between employees (0.82) – The employees are involved in discussions where the way of doing business is questioned (0.79) – The employees are encouraged to engage in critical discussions on how the company is conducting its business (0.62) – We conduct evaluations of "what has worked and what has not worked" in regards to larger projects etc (0.61)
Operating Capabilities	0.84	– The firm has better marketing competence than the competitors (0.78) – Compared to our competitors our firm is particularly skilled in customer service (0.71) to our competitors our firm is particularly skilled in management and operations (0.86)
Strategic Cognition	0.82	– Compared to our competitiors our firm typically refrain from action until competitors move, and then answer (0.89) – Compared to our competitors we are often first movers in introducing new products, services, administrative routines, production methods etc (0.87) – We relate to our competitors by adopting a "go get them" attitude. We are gonna win this (0.53)
Competitive Advantage	0.89	– The firm has better financial results than our competitors (0.85) – The firm has a stronger revenue growth than our competitors (0.87) – The firm has a larger market share than our competitors (0.87)

Dillon-Goldstein Rho is recommended as reliability measure for SEM-PLS (Hair et al., 2019).

Table 6.16: Core constructs and their measurement items. Factor loadings in parantheses

Bibliography

Adams, R., Bessant, J., & Phelps, R. (2006). Innovation management measurement: A review. *International Journal of Management Reviews*, *8*, 21–47.

Adner, R., & Helfat, C. E. (2003). Corporate effects and dynamic managerial capabilities. *Strategic Management Journal*, *24*, 1011–1025.

Adriaenssen, D. J., & Johannessen, J. A. (2016). Prospect theory as an explanation for resistance to organizational change: Some management implications. *Problems and Perspectives in Management*, *14*.

Agarwal, R., Brown, P. J., Green, R., Randhawa, K., & Tan, H. (2014). Management practices of Australian manufacturing firms: Why are some firms more innovative? *International Journal of Production Research*, *52*, 6496–6517.

Agrawal, A., Gans, J., & Goldfarb, A. (2018). *Prediction machines : the simple economics of artificial intelligence*.

Agrawal, A., Gans, J. S., & Goldfarb, A. (2017). What to Expect From Artificial Intelligence. *MIT Sloan Management Review*, (pp. 1–8).

Alsos, G., Borch, O., Ljungren, E., & Madsen, E. (2007). The Dynamic Capabilitiy Construct and its Operationalization. *Researchgate Working Paper*, .

Ambrosini, V., & Bowman, C. (2009). What are dynamic capabilities and are they a useful construct in strategic management? *International Journal of Management Reviews*, *11*, 29–49. arXiv:arXiv:1011.1669v3.

Ambrosini, V., Bowman, C., & Collier, N. (2009). Dynamic capabilities: An exploration of how firms renew their resource base. *British Journal of Management*, *20*.

Amit, R., & Schoemaker, P. J. (1993). Strategic Assets and Organizational Rent. *Strategic Management Journal*, *14*, 33–46.

Aniruddha, K., & Mital, A. (2016). Role of Dynamic Capabilities in Innovation Output of High-Technology Firms. *Strategic Change*, *25*, 401–425.

Anthony, S. (2016). Kodak's Downfall Wasn't About Technologye Digital Revolution. *Harvard Business Review*, .

Apriliyanti, I. D., & Alon, I. (2017). Bibliometric analysis of absorptive capacity. *International Business Review*, *26*, 896–907.

Arend, R. J. (2015). Mobius' edge: Infinite regress in the resource-based and dynamic capabilities views. *Strategic Organization*, *13*, 75–85.

Arend, R. J., & Bromiley, P. (2009). Assessing the dynamic capabilities view: spare change, everyone? *Strategic Organization*, *7*, 75–90.

Argyres, N., Mahoney, J. T., & Nickerson, J. (2019). Strategic responses to shocks: Comparative adjustment costs, transaction costs, and opportunity costs. *Strategic Management Journal*, *40*, 357–376.

Argyris, C., & Schon, D. (1978). *Organizational Learning: A Theory of Action Perspective*. Reading, MA: Addison-Wesley.

Argyris, C., & Schön, D. a. (1978). Organizational Learning: A Theory of Action Perspective. *The Journal of Applied Behavioral Science*, *15*, 542–548.

Arndt, F., & Bach, N. (2015). Evolutionary and Ecological conceptualization of dynamic capabilities: Identifying elements of the Teece and Eisenhardt schools. *Journal of Management and Organization*, *21*, 701–704.

Arndt, F., & Pierce, L. (2018). The behavioral and evolutionary roots of dynamic capabilities. *Industrial and Corporate Change*, *27*, 413–424.

Arrfelt, M., Wiseman, R. M., McNamara, G., & Hult, G. T. M. (2015). Examining a key corporate role: The influence of capital allocation competency on business unit performance. *Strategic Management Journal*, *36*, 1017–1034.

Arrow, K. J. (1962). The Economic Implications of Learning by Doing. *The Review of Economic Studies*, *29*, 155–173.

Arthur, J. B., & Huntley, C. L. (2005). Ramping up the organizational learning curve: Assessing the impact of deliberate learning on organizational performance under gainsharing. *Academy of Management Journal*, *48*, 1159–1170.

Arundel, A., Bloch, C., & Ferguson, B. (2019). Advancing innovation in the public sector: Aligning innovation measurement with policy goals. *Research Policy*, *48*, 789–798.

Augier, M., & Teece, D. J. (2009). Dynamic Capabilities and the Role of Managers in Business Strategy and Economic Performance. *Organization Science*, *20*, 410–421.

Bacharach, S. B. (1989). Organizational Theories: Some Criteria for Evaluation. *Academy of Management Review*, .

Bain, J. S. (1956). *Barriers to new competition: their character and consequences in manufacturing industries*.

Barney, J. (1991a). Firm Resources and Sustained Competitive Advantage. *Journal of Management*, *17*.

Barney, J. B. (1991b). Firm Resources and Sustained Competitive Advantage. `arXiv:z0037`.

Barney, J. B. (1996). The resource-based theory of the firm. *Organization Science*, *7*, 469.

Barney, J. B. (2001). Is the Resource-Based " View " a Useful Perspective for Strategic Management Research ? Yes. *Academy of Management Review*, *26*, 41–56. `arXiv:0149-2063`.

Baron, R., & Kenny, D. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, *51*.

Barreto, I. (2010). Dynamic Capabilities: A Review of Past Research and an Agenda for the Future. *Journal of Management*, *36*, 256–280.

Barton, D., Horvaty, D., & Kipping, M. (2016). *Re-imagining capitalism*. Oxford: Oxford University Press.

Becheikh, N., Landry, R., & Amara, N. (2006). Lessons from innovation empirical studies in the manufacturing sector: A systematic review of the literature from 1993 to 2003. *Technovation*, *26*, 644–664.

Benner, M. J. (2009). Dynamic or Static Capabilities? Process Management Practices and Response to Technological Change. *Journal of Product Innovation Management*, *26*, 473–486.

Bertrand, O., & Mol, M. J. (2013). The antecedents and innovation effects of domestic and offshore R&D outsourcing: The contingent impact of cognitive distance and absorptive capacity. *Strategic Management Journal*, *34*, 751–760.

Bettis, R. A., Ethiraj, S., Gambardella, A., Helfat, C., & Mitchell, W. (2016a). Creating repeatable cumulative knowledge in strategic management. *Strategic Management Journal*, *37*, 257–261.

Bettis, R. A., Helfat, C. E., & Shaver, J. M. (2016b). The Necessity, Logic and Forms of Replication. *Strategic Management Journal*, *37*, 2193–2203.

Bhaskar, R. (1998). Philosophy and scientific realism. In M. Archer (Ed.), *Critical Realism: Essential Readings* (pp. 16–47). Rougledge.

Bingham, C. B., Heimeriks, K. H., Schijven, M., & Gates, S. (2015). Concurrent learning: How firms develop multiple dynamic capabilities in parallel. *Strategic Management Journal*, *36*, 1802–1825.

Black, S. (2017). Digitization of an Industrial Giant: GE Takes on Industrial Analytics.

Blind, K. (2012). The influence of regulations on innovation : A quantitative assessment for OECD countries. *Research Policy*, *41*, 391–400.

Bloom, N., Christos, G., Sadun, R., & Reenen, J. V. (2012). Management Practices Across Firms and Countries. *Academy of Management Perspectives*, .

Bloom, N., Lemos, R., Sadun, R., Scur, D., & Van Reenen, J. (2014). The New Empirical Economics of Management. *Journal of the European Economic Association*, (pp. 1–65). arXiv:arXiv:1011.1669v3.

Bloom, N., & Reenen, J. V. (2007). Measuring and Explaining Management Practices Across Firms and Countries. *Quarterly Journal of Economics*, *122*.

Bloom, N., & Reenen, J. V. (2010). Why Do Management Practices Differ across Firms and Countries? *Journal of Economic Perspectives*, *24*, 203–224.

Bloom, N., Sadun, R., & Reenen, J. V. (2009). The Organization of Firms across Countries.

Bloom, N., Sadun, R., & Van Reenen, J. (2016). Management as a Technology? *NBER Working Paper*, *22327*. arXiv:arXiv:1011.1669v3.

Bloom, N., & Van Reenen, J. (2010). New approaches to surveying organizations. *American Economic Review*, *100*, 105–109.

Blyler, M., & Coff, R. W. (2003). Dynamic capabilities, social capital, and rent appropriation: Ties that split pies. *Strategic Management Journal*, *24*, 677–686.

de Boeck, P., & Wilson, M. (2004). *Explanatory Item Response Models: A Generalized Linear and Nonlinear Approach*. Statistics for Social and Behavioral Sciences. Springer.

Braun, C., & Hadwich, K. (2016). Complexity of internal services: Scale development and validation. *Journal of Business Research*, *69*, 3508–3522.

Breznik, L., & D. Hisrich, R. (2014). Dynamic capabilities vs. innovation capability: are they related? *Journal of Small Business and Enterprise Development*, *21*, 368–384. arXiv:dx.doi.org/10.1108/BIJ-10-2012-0068.

Bruni, D. S., & Verona, G. (2009). Dynamic Marketing Capabilities in Science-based Firms: an Exploratory Investigation of the Pharmaceutical Industry. *British Journal of Management*, *20*, S101–S117.

Brynjolfsson, E., & Milgrom, P. (2013). Complementarities in Organizations. In P. Milgrom, & J. Roberts (Eds.), *Handbook of Organizational Economics*. Princeton, N.J: Princeton University Press.

Campbell, D. T. (1988). *Methodology and epistemology for social science: Selected papers.*. Chicago, IL, US: University of Chicago Press.

Cantwell, J. (2001). Innovation , profits and growth : Schumpeter and Penrose. *Henley Business School University of Reading*, (pp. 1–28).

Carmeli, A., & Tishler, A. (2004). The relationships between intangible organizational elements and organizational performance. *Strategic Management Journal*, *25*, 1257–1278.

Carroll, R., Primo, D., & Richter, B. (2016). USING ITEM RESPONSE THEORY TO IMPROVE MEASUREMENT IN STRATEGIC MANAGEMENT RESEARCH: AN APPLICATION TO CORPORATE SOCIAL RESPONSIBILITY. *Strategic Management Journal*, *37*, 66–85.

Cepeda, G., & Vera, D. (2007). Dynamic capabilities and operational capabilities: A knowledge management perspective. *Journal of Business Research*, *60*, 426–437.

Certo, S., Busenbark, J. R., Woo, H.-S., & Semadeni, M. (2016). Sample Selection Bias and Heckman Models in Strategic Management Research. *Strategic Management Journal*, *37*, 2639–2657.

Chalmers, A. F. (1999). *What is this thing called science?*. indianapolis: Hackett Publishing Company.

Chesbrough, H. W. (2003). *Open innovation : the new imperative for creating and profiting from technology*. Harvard Business School Press.

Chung, C. C., & Beamish, P. W. (2005). Investment mode strategy and expatriate strategy during times of economic crisis. *Journal of International Management*, *11*, 331–355.

Coase, R. H. (1937). The Nature of the Firm. *Economica*, .

Coen, C. A., & Maritan, C. A. (2011). Investing in Capabilities: The Dynamics of Resource Allocation. *Organization Science*, *22*, 99–117.

Cohen, W. M., & Levin, R. C. (1989). Empirical Studies of Innovation and Market Structure. In R. Schmalensee, & R. Willig (Eds.), *Handbook of Industrial Organization II*. North-Holland.

Cohen, W. M., & Levinthal, D. A. (1989). Innovation and Learning : The Two Faces of R & D. *The Economic Journal*, *99*, 569–596.

Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: a new perspective on learning and innovation. (Technology, Organizations, and Innovation). *Administrative Science Quarterly*, *35*, 128.

Collier, P. (2018). *The Future of Capitalism: Facing the New Anxieties*. Harper.

Collis, D. J. (1994). Research Note : How Valuable Are Organizational Capabilities ? *Strategic Management Journal*, *15*, 143–152.

Covin, J. G., & Slevin, D. P. (1989). Strategic management of small firms in hostile and benign environments. *Strategic Management Journal*, *10*, 75–87.

Covin, J. G., & Slevin, D. P. (1991). A Conceptual Model of Entrepreneurship as Firm Behavior. *Entrepreneurship Theory and Practice*, *16*, 7–26.

Covin, J. G., & Wales, W. J. (2012). The Measurement of Entrepreneurial Orientation. *Entrepreneurship Theory and Practice*, *36*, 677–702.

Crotty, M. (1998). *The foundations of social research : meaning and perspective in the research process*. London ; Thousand Oaks, Calif. : Sage, 1998.

Cyert, R. M., & March, J. G. (1963). *A behavioral theory of the firm*. Prentice-Hall international series in management. Englewood Cliffs, N.J: Prentice-Hall.

Daft, R. L., & Weick, K. E. (1984). Toward a Model of Organizations as Interpretation Systems. *Academy of Management Review*, *9*, 284–295.

Danneels, E. (2008). Organizational Antecedents of Second-Order Competences. *Strategic Management Journal*, *29*, 315–334. `arXiv:1`.

Danneels, E. (2010). TRYING TO BECOME A DIFFERENT TYPE OF COMPANY: DYNAMIC CAPABILITY AT SMITH CORONA. *Strategic Management Journal*, *32*, 1–31. `arXiv:1`.

Davcik, N. S., & Sharma, P. (2016). Marketing resources, performance, and competitive advantage: A review and future research directions. *Journal of Business Research*, *69*, 5547–5552.

Davis, J. P., Eisenhardt, K. M., & Bingham, C. B. (2009). Optimal Structure, Market Dynamism, and the Strategy of Simple Rules. *Administrative Science Quarterly*, *54*, 413–452.

Demsetz, H. (1988). The Theory of the Firm Revisited. *Journal of Law, Economics, and Organization*, *4*, 141–161.

Dess, G. G., & Beard, D. W. (1984). Dimensions of Organizational Task Environments. *Administrative Science Quarterly*, *29*.

Desyllas, P., & Sako, M. (2013). Profiting from business model innovation: Evidence from Pay-As-You-Drive auto insurance. *Research Policy*, *42*, 101–116.

Di Stefano, G., Peteraf, M., & Verona, G. (2014). The Organizational Drivetrain: A Road To Integration of Dynamic Capabilities Research. *Academy of Management Perspectives*, *28*, 307–327. `arXiv:1103.1723`.

Diamantopoulos, A., Sarstedt, M., Fuchs, C., Wilczynski, P., & Kaiser, S. (2012). Guidelines for choosing between multi-item and single-item scales for construct measurement: A predictive validity perspective. *Journal of the Academy of Marketing Science*, *40*, 434–449.

Dias, M. F. P., Pedrozo, E. A., & da Silva, T. N. (2014). The innovation process as a complex structure with multilevel rules. *Journal of Evolutionary Economics*, *24*, 1067–1084.

Dosi, G., Nelson, R. R., & Winter, S. G. (2001). Introduction: The Nature and Dynamics of Organizational Capabilities. In *The Nature and Dynamics of Organizational Capabilities*. Oxford: Oxford University Press.

Dunning, J. H., & Lundan, S. M. (2010). The institutional origins of dynamic capabilities in multinational enterprises. *Industrial and Corporate Change*, *19*, 1225–1246. `arXiv:arXiv:1011.1669v3`.

Duran, P., Kammerlander, N., van Essen, M., & Zellweger, T. (2015). Doing More With Less: Innovation Input and Output in Family Firms. *Academy of Management Journal*, (pp. 1–5). `arXiv:arXiv:1011.1669v3`.

Dweck, C. (2016). What Having a " Growth Mindset " Actually Means. *Harvard Business Review*, (p. 4).

Easterby-Smith, M., Lyles, M. A., & Peteraf, M. A. (2009). Dynamic Capabilities: Current Debates and Future Directions. *British Journal of Management*, *20*, S1–S8.

Efrat, K., Hughes, P., Nemkova, E., Souchon, A. L., & Sy-Changco, J. (2018). Leveraging of Dynamic export capabilities for competitive advantage and performance consequences: Evidence from China. *Journal of Business Research*, *84*, 114–124.

Eggers, J. P., & Kaplan, S. (2009). Cognition and Renewal: Comparing CEO and Organizational Effects on Incumbent Adaptation to Technical Change. *Organization Science*, *20*, 461–477. `arXiv:arXiv:1011.1669v3`.

Eisenhardt, K. M. (1989). Making Fast Strategic Decisions in High-Velocity Environments. *Academy of Management Journal*, *32*, 543–576.

Eisenhardt, K. M., Furr, N. R., & Bingham, C. B. (2010). Microfoundations of Performance: Balancing Efficiency and Flexibility in Dynamic Environments. *Organization Science*, *21*, 1263–1273.

Eisenhardt, K. M., & Martin, J. A. (2000). Dynamic capabilities: what are they? *Strategic Management Journal*, *21*, 1105–1121. arXiv:z0022.

Elster, J. (1989). *Nuts and Bolts for the Social Sciences*. Cambridge: Cambridge University Press.

Enders, A., & Haggstrom, L. (2018). How the World's Oldest Company Reinvented Itself. *Harvard Business Review*, .

Eriksson, T. (2014). Processes, antecedents and outcomes of dynamic capabilities. *Scandinavian Journal of Management*, *30*, 65–82.

Erkan, A., Fainshmidt, S., & Judge, W. Q. (2015). Variance decomposition of the country, industry, firm, and firm-year effects on dividend policy. *International Business Review*, *25*, 1309–1320.

van Essen, M., Strike, V. M., Carney, M., & Sapp, S. (2015). The Resilient Family Firm: Stakeholder Outcomes and Institutional Effects. *Corporate Governance (Oxford)*, *23*, 167–183.

Ethiraj, S. K., Gambardella, A., & Helfat, C. E. (2016). Replication in Strategic Management. *Strategic Management Journal*, *37*, 2191–2192.

Ettlie, J. E., & Pavlou, P. A. (2006). Technology-based new product development partnerships. *Decision Sciences*, *37*, 117–147.

European Commission (2009). *Flash Eurobarometer 267 (Innobarometer 2009 – EU Business Innovation Trends)*. Technical Report GESIS Data Archive Cologne.

Evanschitzky, H., Eisend, M., Calantone, R. J., & Jiang, Y. (2012). Success factors of product innovation: An updated meta-analysis. *Journal of Product Innovation Management*, .

Eveleens, C. (2010). Innovation management; a literature review of innovation process models and their implications.

Fainshmidt, S., Pezeshkan, A., Lance Frazier, M., Nair, A., & Markowski, E. (2016). Dynamic Capabilities and Organizational Performance: A Meta-Analytic Evaluation and Extension. *Journal of Management Studies*, *53*, 1348–1380.

Fang, E. E., & Zou, S. (2009). Antecedents and consequences of marketing dynamic capabilities in international joint ventures. *Journal of International Business Studies*, *40*, 742–761.

Fawcett, S. E., Wallin, C., Allred, C., Fawcett, A. M., & Magnan, G. M. (2011). Information technology as an enabler of supply chain collaboration: A dynamiccapabilities perspective. *Journal of Supply Chain Management*, *47*, 38–59.

Felin, T., & Powell, T. C. (2016). Designing Organizations for Dynamic Capabilities. *California Management Review*, *58*, 78–96.

Feyerabend, P. (1978). *Against Method: Outline of an Anarchistic Theory of Knowledge*. London: Verso.

Foss, N. J. (2012). Theory of Science Perspectives on Strategic Management Research: Debates and a Novel View. In G. B. Dagino (Ed.), *Handbook of Research on Strategic Management*. Cheltenham: Edward Elgar.

Frey, C. B., & Osborne, M. A. (2017). Technological Forecasting & Social Change The future of employment : How susceptible are jobs to computerisation ? *Technological Forecasting & Social Change*, *114*, 254–280.

Friedman, M. (1953). *Essays in Positive Economics*. Chicago, IL: University of Chicago Press.

Friedman, T. L. (2016). *Thank you for being late : an optimist's guide to thriving in the age of accelerations*. (First edit ed.). Farrar, Straus and Giroux.

Gaglio, C. M., & Katz, J. A. (2001). The Psychological Basis of Opportunity Identification: Entrepreneurial Alertness. *Small Business Economics*, *16*, 95–111.

Gavetti, G. (2005). Cognition and hierarchy: Rethinking the microfoundations of capabilities' development. *Organization Science*, *16*, 599–617.

Gavetti, G. (2012). Perspective toward a behavioral theory of strategy. *Organization Science*, *23*, 267–285.

Gavetti, G., Aoshima, Y., & Tripsas, M. (2007). Fujifilm: A Second Foundation.

Godfrey, P. C., & Hill, C. W. (1995). The problem of unobservables in strategic management research. *Strategic Management Journal*, *16*, 519–533.

Grant, R. M. (1996). Towards a Knowledge-based Theory of Firm. *Strategic Management Journal*, *17*, 109–122.

Greene, W. H. (2003). *Econometric Analysis* volume 97. Prentice Hall.

Greiner, L. E., & Bhambri, A. (1989). New CEO intervention and dynamics of deliberate strategic change. *Strategic Management Journal*, *10*, 67–86.

Gwynne, P. (2015). Research Note: Measuring R&D Productivity. *Research-Technology Management*, *58*, 19–23.

Hair, J. F. (2014). *Multivariate data analysis*. (7th ed.). Upper Saddle River, NJ: Prentice Hall.

Hair, J. F., Howard, M. C., & Nitzl, C. (2020). Assessing measurement model quality in PLS-SEM using confirmatory composite analysis. *Journal of Business Research*, *109*, 101–110.

Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European Business Review*, *31*, 2–24.

Hair, J. F., Sarstedt, M., Pieper, T. M., & Ringle, C. M. (2012). The Use of Partial Least Squares Structural Equation Modeling in Strategic Management Research: A Review of Past Practices and Recommendations for Future Applications. *Long Range Planning*, *45*, 320–340.

Halton, E. (2004). Pragmatism. In G. Ritzer (Ed.), *Encyclopedia of Social Theory* 1907 (pp. 1–15). Thousand Oaks: Sage Publications.

Hannan, M. T., & Freeman, J. (1989). *Organizational ecology*. Harvard University Press.

Hathaway, I., & Litan, R. (2014). Declining Business Dynamism in the United States: A Look at States and Metros. *Economic Studies at Brookings*, .

Heckman, J. J. (1979). Sample Selection Bias as a Specification Error. *Econometrica*, *47*, 153–161.

Heimeriks, K. H., Duysters, G., & Vanhaverbeke, W. (2007). Learning mechanisms and differential performance in alliance portfolios. *Strategic Organization*, *5*, 373–408.

Heimeriks, K. H., Schijtven, M., & Gates, S. (2012). Manifestations of Higher-order Routines: The Underlying Mechanisms of Deliberate Learning in the Context of Postacquistion Integration. *The Academy of Management Journal*, *55*, 703–726.

Helfat, C., & Martin, J. (2015). Dynamic managerial capabilities: review and assessment of managerial impact on strategic change. *Journal of Management*, *41*.

Helfat, C. E., Finkelstein, S., Mitchell, W., Peteraf, M. A., Singh, H., Teece, D. J., & Winter, S. G. (2007). *Dynamic Capabilities : Understanding Strategic Change in Organizations*. Hoboken: Wiley.

Helfat, C. E., & Martin, J. A. (2014). Dynamic Managerial Capabilities. *Journal of Management*, *41*, 1281–1312.

Helfat, C. E., & Peteraf, M. A. (2003). The dynamic resource-based view: Capability lifecycles. *Strategic Management Journal*, *24*, 997–1010.

Helfat, C. E., & Peteraf, M. A. (2009). Understanding dynamic capabilities: progress along a developmental path. *Strategic Organization*, *7*, 91–102. `arXiv:ISSN: 0019-848X`.

Helfat, C. E., & Peteraf, M. A. (2015). Managerial cognitive capabilities and the microfoundations of dynamic capabilities. *Strategic Management Journal*, *36*, 831–850.

Helfat, C. E., & Winter, S. G. (2011). Untangling dynamic and operational capabilities: Strategy for the (N)ever-changing world. *Strategic Management Journal*, *32*, 1243–1250.

Hickey, L. P. (2009). *Hilary Putnam*. London: Continuum.

Hicks, R., & Tingley, D. (2011). Causal mediation analysis. *Stata Journal*, *11*, 605–619.

Hough, J. R. (2006). Business segment performance redux: a multilevel approach. *Strategic Management Journal*, *27*, 45–61.

Houghton, S. M., Smith, A. D., & Hood, J. N. (2009). The influence of social capital on strategic choice: An examination of the effects of external and internal network relationships on strategic complexity. *Journal of Business Research*, *62*, 1255–1261.

Hsieh, C., Nickerson, J. A., & Zenger, T. R. (2007). Opportunity Discovery, Problem Solving and the Entrepreneurial Theory of the Firm. *Journal of Management Studies*, *44*.

Hult, G. T. M., Joseph F. Hair, J., Proksch, D., Sarstedt, M., Pinkwart, A., & Ringle, C. M. (2018). Addressing Endogeneity in International Marketing Applications of Partial Least Squares Structural Equation Modeling. *Journal of International Marketing*, *26*, 1–21.

Hung, R. Y. Y., Chung, T., & Lien, B. Y. H. (2007). Organizational process alignment and dynamic capabilities in high-tech industry. *Total Quality Management and Business Excellence*, *18*, 1023–1034.

Imai, K., Keele, L., & Yamamoto, T. (2010). Identification, Inference and Sensitivity Analysis for Causal Mediation Effects. *Statistical Science*, *25*, 51–71.

Jacobs, M. A. (2013). Complexity: Toward an empirical measure. *Technovation*, *33*, 111–118.

Jacobs, M. A., & Swink, M. (2011). Product portfolio architectural complexity and operational performance: Incorporating the roles of learning and fixed assets. *Journal of Operations Management*, *29*, 677–691.

Jantunen, A., Puumalainen, K., Saarenketo, S., & Kyläheiko, K. (2005). Entrepreneurial Orientation, Dynamic Capabilities and International Performance. *Journal of International Entrepreneurship*, *3*, 223–243.

Jantunen, A., Tarkiainen, A., Chari, S., & Oghazi, P. (2018). Dynamic capabilities, operational changes, and performance outcomes in the media industry. *Journal of Business Research*, *89*, 251–257.

Jones, R. J., Woods, S. A., & Guillaume, Y. R. (2016). The effectiveness of workplace coaching: A meta-analysis of learning and performance outcomes from coaching. *Journal of Occupational and Organizational Psychology*, *89*, 249–277.

Jung, K., Kodama, F., Schiuma, G., Jeon, J., Park, H., Park, K., Zhao, X., Yan, M.-R., Pyka, A., Lee, M., Yun, J., Won, D., & Lee, S. (2018). How to Respond to the Fourth Industrial Revolution, or the Second Information Technology Revolution? Dynamic New Combinations between Technology, Market, and Society through Open Innovation. *Journal of Open Innovation: Technology, Market, and Complexity*, *4*, 21. arXiv:0605180.

Kahneman, D., & Tversky (2011). *Thinking, fast and slow*. New York: Farrar, Straus and Giroux.

Kahneman, D., & Tversky, A. (1979). Prospect theory: an analysis of decision under risk. *Econometrica*, *47*, 263–291.

Kale, P., Dyer, J. H., & Singh, H. (2002). Alliance capability, stock market response, and long-term alliance success: The role of the alliance function. *Strategic Management Journal*, *23*, 747–767.

Kale, P., & Singh, H. (2007). Building firm capabilities through learning: the role of the alliance learning process in alliance capability and firm-level alliance success. *Strategic Management Journal*, *28*, 981–1000.

Kaplan, S., & Henderson, R. (2005). Inertia and Incentives: Bridging Organizational Economics and Organizational Theory. *Organization Science*, *16*, 509–521.

Karim, S. (2006). MODULARITY IN ORGANIZATIONAL STRUCTURE: THE RECON-FIGURATION OF INTERNALLY DEVELOPED AND ACQUIRED BUSINESS UNITS. *Strategic Management Journal*, *27*, 799–823.

Karimi, J., & Walter, Z. (2015). The role of dynamic capabilities in responding to digital disruption: A factor-based study of the newspaper industry. *Journal of Management Information Systems*, *32*, 39–81.

Keupp, M. M., Palmié, M., & Gassmann, O. (2012). The Strategic Management of Innovation: A Systematic Review and Paths for Future Research. *International Journal of Management Reviews*, *14*, 367–390.

Killen, C. P., Jugdev, K., Drouin, N., & Petit, Y. (2012). Advancing project and portfolio management research: Applying strategic management theories. *International Journal of Project Management*, *30*, 525–538.

Kirkland, R. (2015). GE's Jeff IMmelt on Digitizing in the Industrial Space. *McKinsey Quarterly*, *October*.

Kirzner, I. M. (1997). Entrepreneurial Discovery and the Competitive Market Process : An Austrian Approach. *Journal of Economic Literature*, *XXXV*, 60–85.

Klarner, P., & Raisch, S. (2013). MOVE TO THE BEAT — RHYTHMS OF CHANGE AND FIRM PERFORMANCE University of Munich. *Academy of Management Journal*, *56*, 160–184.

Klein, P. G. (2016). Why entrepreneurs need firms, and the theory of the firm needs entrepreneurship theory. *Revista de Administração*, *51*, 323–326.

Kline, S. J., & Rosenberg, N. (1986). An Overview of Innovation. In R. Landau, & N. Rosenberg (Eds.), *The Positive sum strategy : harnessing technology for economic growth*.

Knight, F. (1921). *Risk, uncertainty and profit*. Ph.D. thesis.

Kohli, A. K., Jaworski, B. J., & Kumar, A. (1993). MARKOR: A Measure of Market Orientation. *Journal of Marketing Research*, *30*, 467–477.

Koolen, S., Taminiau, Y., & Faber, C. (2005). Monti and market dynamics: The strategy of a national car importer. *European Management Journal*, *23*, 413–425.

Kostman, J. (1987). Aristotle's Definition of Change. *History of Philosophy Quarterly*, *4*, 3–16.

Kudic, M., Pyka, A., & Sunder, M. (2016). The formation of R&D cooperation ties: An event history analysis for German laser source manufacturers. *Industrial and Corporate Change*, *25*, 649–670.

Kuhn, T. S. (1962). *The Structure of Scientific Revolutions*. Chicago, IL: University of Chicago Press.

Kump, B., Engelmann, A., Kessler, A., & Schweiger, C. (2018). Toward a dynamic capabilities scale: measuring organizational sensing, seizing, and transforming capacities. *Industrial and Corporate Change*, (pp. 1–24).

Laaksonen, O., & Peltoniemi, M. (2018). The Essence of Dynamic Capabilities and their Measurement. *International Journal of Management Reviews*, *20*, 184–205.

Lakoff, G. (1987). *Women, Fire, and Dangerous Things: What Categories Reveal about the Mind*. Chicago: Chicago University Press.

Laursen, K., & Salter, A. (2004). Searching high and low: what types of firms use universities as a source of innovation? *Research Policy*, *33*, 1201–1215.

Laursen, K., & Salter, A. (2006). Open for innovation: the role of openness in explaining innovation performance among U.K. manufacturing firms. *Strategic Management Journal*, *27*, 131–150.

Lawson, B., & Samson, D. (2001). Developing Innovation Capability in Organisations: a Dynamic Capabilities Approach. *International Journal of Innovation Management*, *05*, 377–400.

yuan Li, D., & Liu, J. (2014). Dynamic capabilities, environmental dynamism, and competitive advantage: Evidence from China. *Journal of Business Research*, *67*, 2793–2799.

Lin, B. W., Lee, Y., & Hung, S. C. (2006). R&D intensity and commercialization orientation effects on financial performance. *Journal of Business Research*, *59*, 679–685.

Lin, Y., & Wu, L. Y. (2014). Exploring the role of dynamic capabilities in firm performance under the resource-based view framework. *Journal of Business Research*, *67*, 407–413.

Lorenzoni, G., & Lipparini, A. (1999). The leveraging of interfirm relationships as a distinctive organizational capability: A longitudinal study. *Strategic Management Journal*, *20*, 317–338.

Macher, J. T., & Mowery, D. C. (2009). Measuring dynamic capabilities: Practices and performance in semiconductor manufacturing. *British Journal of Management*, *20*, S41–S62.

MacKinnon, D. (2008). *Introduction to Statistical Mediation Analysis*. New York: Lawrence Erlbaum Associates.

Makadok, R., Burton, R., & Barney, J. (2018). A Practical Guide for Making Theory Contributions in Strategic Management. *Strategic Management Journal*, .

Makkonen, H., Pohjola, M., Olkkonen, R., & Koponen, A. (2014). Dynamic capabilities and firm performance in a financial crisis. *Journal of Business Research*, *67*, 2707–2719.

Marchand, D. A., Kettinger, W. J., & Rollins, J. D. (2004). *Information orientation : the link to business performance*. Oxford: Oxford University Press.

Maritan, C. A. (2001). Capital Investment as Investing in Organizational Capabilities : An Empirically Grounded Process Model. *Academy of Management Journal*, *44*, 513–531.

McAfee, A., & Brynjolfsson, E. (2016). *Machine, platform, crowd : harnessing our digital future*.

McArthur, A. W., & Nystrom, P. C. (1991). Environmental dynamism, complexity, and munificence as moderators of strategy-performance relationships. *Journal of Business Research*, *23*, 349–361.

McCloskey, D. N. (1991). Storytelling in economics.

McGahan, A. M., & Porter, M. E. (1997). How Much Does Industry Matter , Really? *Strategic Management Journal*, *18*, 15–30.

McKelvie, A., & Davidsson, P. (2009). From resource base to dynamic capabilities: An investigation of new firms. *British Journal of Management*, *20*.

Meissner, D., & Kotsemir, M. (2016). Conceptualizing the innovation process towards the 'active innovation paradigm'—trends and outlook. *Journal of Innovation and Entrepreneurship*, *5*, 14.

Meyer-Doyle, P., Lee, S., & Helfat, C. E. (2019). Disentangling the microfoundations of acquisition behavior and performance. *Strategic Management Journal*, *40*, 1733–1756.

Mikalef, P., & Pateli, A. (2017). Information technology-enabled dynamic capabilities and their indirect effect on competitive performance: Findings from PLS-SEM and fsQCA. *Journal of Business Research*, *70*.

Milgrom, P., & Roberts, J. (1995). Complementarities and fit strategy, structure, and organizational change in manufacturing. *Journal of Accounting and Economics*, *19*, 179–208.

Mingers, J. (2006). *Realising Systems Thinking: Knowledge and Action in Management Science*. Springer.

Mir, R., & Watson, A. (2000). Strategic Management and the Philosophy of Science: The Case for a Constructivist Methodology. *Strategic Management Journal*, *21*, 1–21.

Misangyi, V. F., Elms, H., Greckhamer, T., & Lepine, J. A. (2006). A new perspective on a fundamental debate: a multilevel approach to industry, corporate, and business unit effects. *Strategic Management Journal*, *27*, 571–590.

Montgomery, C. A., Wernfelt, B., & Balakrishnan, S. (1989). Strategy content and the research process: A critique and commentary. *Strategic Management Journal*, *10*, 189–197.

Mortensen, C. (2016). Change and Inconsistency. In E. N. Zalta (Ed.), *The Stanford Encyclopedia of Philosophy*. Metaphysics Research Lab, Stanford University. (Winter 201 ed.).

Nadella, S., Shaw, G., & Nichols, J. (2017). *Hit Refresh: The Quest to Rediscover Microsoft's Soul and Imagine a Better Future for Everyone*. New York: Harper Collins.

Nagel, E. (1961). The Structure of Science. *Les Etudes Philosophiques*, *17*, 275.

Nelson, R. R., & Winter, S. G. (1982). *An evolutionary theory of economic change*. Cambridge, Mass: Harvard University Press.

O'Reilly, C., & Tushman, M. (2016). Lead and disrupt: how to solve the innovator's dilemma.

Pavlou, P. A., & El Sawy, O. A. (2006). From IT leveraging competence to competitive advantage in turbulent environments: The case of new product development. *Information Systems Research*, *17*, 198–227.

Penner-Hahn, J., & Shaver, J. M. (2005). Does international research and development increase patent output? An analysis of Japanese pharmaceutical firms. *Strategic Management Journal*, *26*, 121–140.

Penrose, E. (1959). *Theory of the Growth of the Firm*.

Peteraf, M. A., & Reed, R. (2007). Managerial Discretion and Internal Alignment under Regulatory Constraints and Change. *Strategic Management Journal*, *28*, 1089–1112. `arXiv:1`.

Peteraf, M. A., di Stefano, G., & Verona, G. (2013). The elephant in the room of dynamic capabilities: bringing two diverging conversations together. *Strategic Management Journal*, *34*, 1389–1410.

Pezeshkan, A., Fainshmidt, S., Nair, A., Lance Frazier, M., & Markowski, E. (2016). An empirical assessment of the dynamic capabilities-performance relationship. *Journal of Business Research*, *69*, 2950–2956.

Piening, E. P. (2013a). Dynamic Capabilities in Public Organizations: A literature review and research agenda.

Piening, E. P. (2013b). Dynamic Capabilities in Public Organizations: A literature review and research agenda. *Public Management Review*, *15*, 209–245.

Pisano, G. (2017). Towards a Prescriptive Theory of Dynamic Capabilities : Connecting Strategic Choice , Learning , and Competition. *Industrial and Corporate Change*, *26*, 747–762. `arXiv:arXiv:1011.1669v3`.

Popper, K. (1972). *The Logic of Scientific Discovery*. London: Hutchinson of London.

Porter, M. E. (2008). *On competition*. (Updated an ed.). Boston, MA: Harvard Business School Pub.

Powell, T. C. (2001). Competitive advantage: Logical and philosophical considerations. *Strategic Management Journal*, *22*, 875–888.

Prencipe, A., & Tell, F. (2001). Inter-project learning: Processes and outcomes of knowledge codification in project-based firms. *Research Policy*, *30*, 1373–1394.

Priem, R., & Butler, J. (2001). Tautology in the Resource-Based View and the Implications of Externally Determined Resource Value : Further Comments Author (s): Richard L . Priem and John E . Butler Source : The Academy of Management Review , Vol . 26 , No . 1 (Jan ., 2001), pp . 57. *Academy of Management*, *26*, 57–66.

Protogerou, A., Caloghirou, Y., & Lioukas, S. (2012). Dynamic capabilities and their indirect impact on firm performance. *Industrial and Corporate Change*, *21*, 615–647. `arXiv:z0024`.

Putnam, H. (1990). *Realism with a human face*. Cambridge, Mass. : Harvard University Press, 1990.

PWC (2018). *PWC CEO Survey 2018*. Technical Report.

Rajapathirana, R. J., & Hui, Y. (2017). Relationship between innovation capability, innovation type, and firm performance. *Journal of Innovation & Knowledge*, *3*, 44–55.

Reeves, M., & Deimler, M. (2011). Adaptability: The New Competitive Advantage. *Harvard Business Review*, .

Reeves, M., Haanaes, K., & Sinha, J. (2015). *Your Strategy Needs a Strategy: How to Choose and Execute the Right Approach*. Harvard Business Review Press.

Revilla, E., Prieto, I., & Prado, B. (2010). Knowledge Strategy: Its Relationship to Environmental Dynamism and Complexity in Product Development. *Knowledge and Process Management*, *17*, 36–47.

Richardson, H. A., Simmering, M. J., & Sturman, M. C. (2009). A Tale of Three Perspectives: Examining Post Hoc Statistical Techniques for Detection and Correction of Common Method Variance. *Organizational Research Methods*, *12*, 762–800.

Ringdal, K. (2013). *Enhet og mangfold: samfunnsvitenskapelig forskning og kvantitativ metode*. Fagbokforlaget.

Ringov, D. (2017). Dynamic capabilities and firm performance. *Long Range Planning*, *50*, 653–664.

Romme, A. G. L., Zollo, M., & Berendsy, P. (2010). Dynamic capabilities, deliberate learning and environmental dynamism: A simulation model. *Industrial and Corporate Change*, *19*.

Ross, A. (2016). *The industries of the future*. Simon & Schuster.

Rothwell, R. (1994). *Towards the Fifth-generation Innovation Process* volume 11.

Rugman, A. M., & Verbeke, A. (2002). Edith Penrose's contribution to the resource-based view of strategic management. *Strategic Management Journal*, *23*, 769–780.

Rumelt, R. P. (1991). How Much Does Industry Matter? *Strategic Management Journal*, *12*, 167–185.

Schilke, O. (2014a). On the contingent value of dynamic capabilities for competitive advantage: The nonlinear moderating effect of environmental dynamism. *Strategic Management Journal*, *35*, 179–203.

Schilke, O. (2014b). Second-Order Dynamic Capabilities: How do they matter? *Academy of Management Perspectives*, *28*, 368–380.

Schilke, O. (2018). A Micro-institutional Inquiry into Resistance to Environmental Pressures. *Academy of Management Journal*, *61*, 1431(36).

Schilke, O., Hu, S., & Helfat, C. E. (2018). Quo Vadis, Dynamic Capabilities? A Content-Analytic Review of the Current State of Knowledge and Recommendations for Future Research. *The Academy of Management Annals*, *11*.

Schmalensee, R. (1985). Do Markets Differ Much? *American Economic Review*, *75*.

Schreyögg, G., & Kliesch-Eberl, M. (2007). How Dynamic can Organizational Capabilities be? Towards a Dual-process model of Capability Dynamization. *Strategic Management Journal*, *28*, 913–933. arXiv:1.

Schwab, K. (2017). *The fourth industrial revolution*.

Shamsie, J., Martin, X., & Miller, D. (2009). IN WITH THE OLD, IN WITH THE NEW: CAPABILITIES, STRATEGIES, AND PERFORMANCE AMONG THE HOLLYWOOD STUDIOS. *Strategic Management Journal*, *30*, 1440–1. `arXiv:1`.

Sharp, B. M., Bergh, D. D., & Li, M. (2013). Measuring and Testing Industry Effects in Strategic Management Research: An Update, Assessment, and Demonstration. *Organizational Research Methods*, *16*, 43–66.

Shields, P. M. (1998). Pragmatism as a Philosophy of Science: A Tool for Public Administration. *Research in Public Administration*, *4*, 195–225.

Shiller, R. J. (2017). Narrative Economics. *American Economic Review*, *107*, 967–1004.

Sidhu, J. S., Volberda, H. W., & Commandeur, H. R. (2004). Exploring exploration orientation and its determinants: Some empirical evidence. *Journal of Management Studies*, *41*, 913–932.

Simoes, A., & Hidalgo, C. (2011). The Economic Complexity Observatory: An Analytical Tool for Understanding the Dynamics of Economic Development. In *Workshops at the Twenty-Fifth AAAI Conference on Artificial Intelligence*.

Simon, H. A. (1957). *Models of man: social and rational; mathematical essays on rational human behavior in society setting*. New York: Wiley.

Simsek, Z., Lubatkin, M. H., Veiga, J. F., & Dino, R. N. (2009). The role of an entrepreneurially alert information system in promoting corporate entrepreneurship. *Journal of Business Research*, *62*, 810–817.

Sirmon, D. G., Hitt, M. A., & Ireland, R. D. (2007). Managing Firm Resources in Dynamic Environments to Create Value : Looking inside the black box. *Academy of Management Review*, *32*, 273–292.

Sirmon, D. G., Hitt, M. A., Ireland, R. D., & Gilbert, B. A. (2011). Resource orchestration to create competitive advantage: Breadth, depth, and life cycle effects. *Journal of Management*, *37*, 1390–1412.

Somekh, B., & Lewin, C. (2005). *Research methods in the social sciences*. London: Sage.

Stadler, C., Helfat, C. E., & Verona, G. (2013). and Development Resource Access and Development. *Organization Science*, *24*.

di Stefano, G., Peteraf, M., & Verona, G. (2010). Dynamic capabilities deconstructed: A bibliographic investigation into the origins, development, and future directions of the research domain. *Industrial and Corporate Change*, *19*, 1187–1204.

Teece, D. (1986). Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy. *Research Policy*, *15*, 285–305.

Teece, D., & Leih, S. (2016). Uncertainty, innovation, and dynamic capabilities: An introduction. *California Management Review*, *58*, 5–12.

Teece, D., & Pisano, G. (1994). The dynamic capabilities of firms: An introduction. *Industrial and Corporate Change*, *3*, 537–556.

Teece, D. J. (2000). Strategies for Managing Knowledge Assets: The Role of Firm Structure and Industrial Context. *Long Range Planning*, .

Teece, D. J. (2007). Explicationg Dynamic Capabilities: The Nature and Microfoundations of (Sustainable) Enterprise Performance. *Strategic Management Journal*, *28*, 1319–1350. arXiv:1.

Teece, D. J. (2012). Dynamic Capabilities: Routines versus Entrepreneurial Action. *Journal of Management Studies*, *49*, 1395–1401. arXiv:1.

Teece, D. J. (2014). The Foundations of Enterprise Performance: Dynamic and Ordinary Capabilities in an (Economic) Theory of Firms. *Academy of Management Perspectives*, *28*, 328–352. arXiv:z0024.

Teece, D. J. (2017). Business models and dynamic capabilities. *Long Range Planning*, *51*, 40–49.

Teece, D. J. (2018). Dynamic capabilities as (workable) management systems theory. *Journal of Management and Organization*, *24*, 359–368.

Teece, D. J. (2019). A capability theory of the firm: an economics and (Strategic) management perspective. *New Zealand Economic Papers*, *53*, 1–43.

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, *18*, 509–533.

Tidd, J. (2001). Innovation management in context: environment, organization and performance. *International Journal of Management Reviews*, *3*, 169–183.

Tripsas, M., & Gavetti, G. (2000). Capabilities, Cognition and Inertia: Evidence From Digital Imaging. *Strategic Management Journal*, *21*, 1147–1161.

Tversky, A., & Kahneman, D. (1983). Extensional versus intuitive reasoning: The conjunction fallacy in probability judgment. *Psychological Review*, .

Valaei, N., Rezaei, S., & Ismail, W. K. W. (2017). Examining learning strategies, creativity, and innovation at SMEs using fuzzy set Qualitative Comparative Analysis and PLS path modeling. *Journal of Business Research*, *70*, 224–233.

Van Reenen, J. (2010). Does competition raise productivity through improving management practice?

Vasconcelos, F. C., & Ramirez, R. (2011). Complexity in business environments. *Journal of Business Research*, *64*, 236–241.

Verona, G., & Ravasi, D. (2003). Unbundling dynamic capabilities: an exploratory study of continuous product innovation. *Industrial and Corporate Change*, *12*, 577–606.

Verona, G., & Zollo, M. (2011). The Human Side of Dynamic Capabilities: A Holistic Learning Model. In M. Easterby-Smith, & M. Lyles (Eds.), *Handbook of Organizational Learning and Knowledge Management* (pp. 535–550). Chicester: John Wiley & Sons.

Vince, R., & Gabriel, Y. (2011). Organizations, Learning and Emotion. In M. Easterby-Smith, & M. Lyles (Eds.), *Handbook of Organizational Learning and Knowledge Management*. Chicester: John Wiley & Sons.

Volberda, H. W., Foss, N. J., & Lyles, M. A. (2010). PERSPECTIVE—Absorbing the Concept of Absorptive Capacity: How to Realize Its Potential in the Organization Field. *Organization Science*, *21*, 931–951.

Waldman, D. A., Sully de Luque, M., & Wang, D. (2012). What Can We Really Learn About Management Practices Across Firms and Countries? *Academy of Management Perspectives*, *26*, 34–40.

Wales, W. J. (2016). Entrepreneurial orientation: A review and synthesis of promising research directions. *International Small Business Journal: Researching Entrepreneurship*, *34*, 3–15.

Wamba, S. F., Gunasekaran, A., Akter, S., fan Ren, S. J., Dubey, R., & Childe, S. J. (2017). Big data analytics and firm performance: Effects of dynamic capabilities. *Journal of Business Research*, *70*, 356–365. `arXiv:1`.

Wang, C. L., & Ahmed, P. K. (2007). Dynamic capabilities: A review and research agenda. *International Journal of Management Reviews*, *9*, 31–51. `arXiv:ISSN: 0019-848X`.

Weick, K. E. (1995). *Sensemaking in organizations*. Foundations for organizational science. Thousand Oaks, Calif: Sage.

Weick, K. E. (2001). *Making sense of the organization*. Oxford: Blackwell.

Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal*, *5*, 171–180. `arXiv:z0036`.

Wibbens, P. D. (2019). Performance persistence in the presence of higher-order resources. *Strategic Management Journal*, *40*, 181–202.

Williams, L. J., Vandenberg, R. J., & Edwards, J. R. (2009). Structural Equation Modeling in Management Research: A Guide for Improved Analysis. *The Academy of Management Annals*, *3*, 543–604.

Williamson, O. (2000). The New Institutional Economics: Taking Stock , Looking Ahead. *Journal of Economic Literature*, *XXXVIII*, 595–613.

Williamson, O. E. (1975). *Markets and hierarchies, analysis and antitrust implications : a study in the economics of internal organization*. New York: Free Press.

Winter, S. G. (2000). The satisficing principle in capability learning. *Strategic Management Journal*, *21*, 981–996.

Winter, S. G. (2003). Understanding dynamic capabilities. *Strategic Management Journal*, *24*, 991–995. `arXiv:z0023`.

Wohlgemuth, V., & Wenzel, M. (2016). Dynamic capabilities and routinization. *Journal of Business Research*, *69*, 1944–1948.

Wu, L. Y. (2007). Entrepreneurial resources, dynamic capabilities and start-up performance of Taiwan's high-tech firms. *Journal of Business Research*, *60*, 549–555.

Yao, F. K., & Chang, S. (2017). Do Individual Employees' Learning Goal Orientation and Civic Virtue Matter? A Micro-Foundations Perspective on Firm Absorptive Capacity. *Strategic Management Journal*, *38*, 2041–2060.

Zahra, A. S., Sapienza, J. H., & Davidsson, P. (2006). Entrepreneurship and Dynamic Capabilities: A Review, Model and Research Agenda. *Journal of Management Studies*, *43*, 917–955.

Zahra, S. A., & George, G. (2002). Absorptive Capacity: A Review, Reconceptualization, and Extension. *Academy of Management Review*, *27*, 185–203.

Zollo, M., Bettinazzi, E. L., Neumann, K., & Snoeren, P. (2016). Toward a Comprehensive Model of Organizational Evolution: Dynamic Capabilities for Innovation and Adaptation of the Enterprise Model. *Global Strategy Journal*, *6*, 225–244.

Zollo, M., & Singh, H. (2004). Deliberate learning in corporate acquisitions: Post-acquisition strategies and integration capability in U.S. bank mergers. `arXiv:0-387-31073-8`.

Zollo, M., & Winter, S. G. (2002). Deliberate Learning and the evolution of dynamic capabilities. *Organization Science*, *13*, 2002.

Utgitt i ph.d. serie ved Handelshøgskolen:

Nr. 1 – 2003   Lars Øystein Widding
Bygging av kunnskapsreservoarer i teknologibaserte nyetableringer

Nr. 2 – 2005   Pawan Adhikari
Government Accounting in Nepal: Tracing the Past and the Present

Nr. 3 – 2005   Tor Korneliussen
The Relationship between Initation, Barriers, Product Quality and Inter-
nationalization

Nr. 4 – 2005   Bjørn Willy Åmo
Employee innovation behavior

Nr. 5 – 2005   Odd Birger Hansen
Regnskap og entreprenørskap. En fortolkende studie av hvordan to en-
treprenører bruker regnskap

Nr. 6 – 2006   Espen John Isaksen
Early Business Performance
- Initial factors effecting new business outcomes

Nr. 7 – 2006   Konstantin Timoshenko
Russian Government Accounting:
Changes at the Central level and at a University

Nr. 8 – 2006   Einar Rasmussen
Facilitating university spin-off ventures
-an entrepreneurship process perspective

Nr. 9 – 2007   Gry Agnete Alsos
Portfolio Entrepreneurship - general and farm contexts

Nr. 10 – 2007   Elsa Solstad
Tre sykehus - to verdener - en fusjon.
En studie av reorganisering i et helseforetak

Nr. 11 – 2007   Levi Gårseth-Nesbakk
Experimentation with accrual accounting at the central government level
in Norway - how a global phenomenon becomes a local practice

Nr. 12 – 2007   Tatiana Iakovleva
Factors Associated with new venture performance:
The context of St. Petersburg

Nr. 13 – 2007   Einar Lier Madsen
                 Utvikling av dynamiske kapabiliteter i små og mellomstore bedrifter

Nr. 14 – 2008   Anne Haugen Gausdal
                 'Network Reflection' – a road to regional learning, trust and innovation

Nr. 15 – 2008   Lars Rønning
                 Social capital in farm-based entrepreneurship and rural development

Nr. 16 – 2008   Terje Andreas Mathisen
                 Public Passenger Transport in Norway – Regulation, Operators' Cost
                 Structure and Passengers' Travel Costs

Nr. 17 – 2008   Evgueni Vinogradov
                 Immigrant Entrepreneurship in Norway

Nr. 18 – 2008   Elin Oftedal
                 Legitimacy of Creative Destruction

Nr. 19 – 2009   Frode Kjærland
                 Valuation of Generation Assets – a Real Option Approach

Nr. 20 – 2009   Tatiana Maximova-Mentzoni
                 Marketization of the Russian University: Origins, Features and Outcomes

Nr. 21– 2009   Hugo Skålsvik
                 Studies of Market led Processes influencing Service Performance:
                 -Case Studies on the Norwegian Coastal Voyage

Nr. 22– 2009   Svein Oskar Lauvsnes
                 Determinants of a shifting effective demand equilibrium.
                 An explorative investigation of the interaction between
                 psychological, financial and real factors

Nr. 23– 2010   Frode Fjelldal-Soelberg
                 Entreprenøriell markedsføring. En studie av entreprenørskap og mar-
                 kedsføring som overlappende fenomen

Nr. 24– 2010   Heidi Rapp Nilsen
                 From Weak to Strong Sustainable Development
                 An analysis of Norwegian economic policy tools in mitigating climate
                 change

Nr. 49– 2014   Ingebjørg Vestrum
                The Resource Mobilisation Process of Community Ventures
                -The Case of Cultural Events in Rural Communities

Nr. 50– 2014   Ragnhild Johnson
                The Practice of Project Management
                - A qualitative analysis of complex project-based organizations

Nr. 51– 2014   Ann Heidi Hansen
                Memorable moments
                Consumer immersion in nature-based tourist experiences

Nr. 52– 2014   June Borge Doornich
                Entry modes and organizational learning during internationalization
                An analysis of Norwegian supply companies' entering and expanding in
                the Russian oil and gas sector

Nr. 53– 2014   Kjersti Karijord Smørvik
                Opplevelsesskaping i dynamiske opplevelsesrom:
                En studie av turisters opplevelser på Hurtigruten

Nr. 54– 2015   Marianne Terese Steinmo
                How Firms use University-Industry Collaboration to Innovate:
                The role and Development of Social Capital and Proximity Dimensions

Nr. 55– 2015   Eva J.B. Jørgensen
                Border Firms: Norway and Russia

Nr. 56– 2015   Krister Salamonsen
                Exogenous Shocks as Drivers of Growth in Peripheral Regions.
                - A Multilevel Approach to Regional Development

Nr. 57– 2015   Hindertje Hoarau Heemstra
                Practicing open innovation in experience-based tourism:
                the roles of knowledge, values and reflexivity

Nr. 58– 2015   Elena Zhurova
                Environmental Performance Reporting of Russian Oil and Gas Companies

Nr. 59– 2016   Siri Jakobsen
                Environmental innovation cooperation:
                The development of cooperative relationships between Norwegian firms

Nr. 60– 2016   Antonina Tsvetkova
                Supply Chain Management in the Russian Arctic:
                An institutional perspective

Gaining competitiveness and staying competitive over time, seems increasingly difficult. However, some firms manage to thrive and evolve. This dissertation uses dynamic capabilities theory to investigate how firms adapt to change through creating, extending and modifying their resource base. By placing dynamic capabilities as a core explanatory model for how firms manages to change strategically (i.e intentionally), I look into various ways in which this happens. I place a particular emphasis on various types of mechanisms at work in dynamic capabilities theory and their effort to enable strategic change. Particularly, I lean on an emergent stream of literature in making a distinction between behavioral and cognitive mechanisms (or objects of change), through which dynamic capabilities work to enable strategic change. By using a set of various surveys and registry data, I provide quantitative analysis of core mechanisms, as well as outcomes, of dynamic capabilities in various settings.

This dissertation comprises an introductory part and four independent research papers. All papers are quantitative and empirical, but makes conceptual and theoretical contributions as well. Through four papers, I delve into different mechanisms underpinning dynamic capabilities and their ability and role in creating change.

Overall the findings of this dissertation suggest that both behavioral and cognitive mechanisms/objects of change matter in enabling firms to change strategically. Several practical and theoretical implications are derived, and future research possibilities are presented