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1. INTRODUCTION

1.1. Explanatory Contribution of the Dynamic Capabilities Framework

The notion of dynamic capabilities (Teece & Pisano, 1994) indicated the outset of a new strategic framework that evolved through the realization that an expanded paradigm is needed to explain how firms may gain and sustain competitive advantage. It is based on the insight that especially in the presence of environmental change existing frameworks, such as the resource-based view (Barney, 1991; Penrose, 1995; Wernerfelt, 1984) or the competitive forces approach (Porter, 1980), are of limited value in explaining the occurrence and the sources of (sustainable) competitive advantage. Especially under conditions of changing external conditions, e.g. changing technologies and/or changing customer needs, a firm's ability to recognize and adapt to such changes by developing new capabilities and resource configurations is proposed to be the real source of sustained competitive advantage (Teece & Pisano, 1994).

The dynamic capabilities framework (Teece, Pisano & Shuen, 1997) lined up to explain how and why certain firms build competitive advantage under regimes of rapid change. Thereby, it aimed at filling the research gap of other frameworks that explain how a given competitive advantage may be safeguarded or maintained under stable conditions, but neglect to explain how such a competitive advantage was gained in the first place and can be sustained under changing conditions. The competitive forces approach postulates that competitive advantage stems from valuable positioning within an industry and further from protecting this valuable position against competitors and new entrants (Porter, 1980, 1985). The resource-based perspective postulates that competitive advantage stems from firm-level efficiency advantages based on different bundles of resources and capabilities, which are heterogeneously distributed among firms (Barney, 1991; Penrose, 1995; Wernerfelt, 1984). Thereby, firm specific resource and capability bundles also partly explain the firm's ability to capture valuable market positions (Spanos & Lioukas, 2001). The dynamic capabilities framework, however, attempts to explain how new capabilities can be developed and how novel resource and capability combinations help to attain or sustain competitive advantage under conditions of technological and market change (Teece et al., 1997). The dynamic capabilities framework thus attempts to provide an answer to the fundamental question, why some firms succeed in dynamic competitive environments while others fail (Arend & Bromiley, 2009). The outstanding importance to better understand firm-level sources of competitive advantage thereby is underpinned by realizing that performance differences among firms are

mainly attributable to their business units (McGahan & Porter, 1997; McGahan & Porter, 2002; Misangyi, Elms, Greckhamer & Lepine, 2006; Rumelt, 1991).

1.2. Dynamic Capabilities in Comparison with other Frameworks Explaining Adaptation and Change

Against the background of its desired explanatory contribution, the dynamic capabilities framework lines up with other theoretical approaches aiming at the explanation of successful adaptation and change. Lewin and Volberda (1999) describe several different approaches that focus on the challenge of adaptation to exogenous environmental change. Some of these approaches are *briefly* introduced in the following to show similarities and differences between the dynamic capabilities framework and other approaches referring to adaptation and change, and in order to show which frameworks provided insights that found consideration within the dynamic capabilities framework.

Population ecology (Hannan & Freeman, 1977) assumes that managerial intention and managerial action has little or no impact on adaptation and that successful organizations are selected by the environment based on resource scarcity and competition (Lewin & Volberda, 1999). Moreover, due to internal pressures and structural inertia, organizations suffer from an inability to actively adapt to changing conditions. *Institutional theories* explain the similarity and stability of organizational arrangements in a certain population, which is due to the perceived legitimacy of the specific arrangement in a given context (Greenwood & Hinings, 1996; Lewin & Volberda, 1999). While usually not being regarded as a theory explaining organizational change and being weak in explaining the internal dynamics of change, neo-institutional theory explains the occurrence of change and adaptation as stemming from the dissatisfaction of groups of organizations or sub-populations with the given arrangements and their respective actions in order to change these given arrangements (Greenwood & Hinings, 1996).

Within the *industrial organization framework* (Porter, 1980, 1985) adaption is based on managerial choice regarding profitable industries, the capturing of profitable positions within these industries, and the protection of these valuable positions. *Transaction cost theory* (Williamson, 1975, 1985) explains organizational adaptation mainly through balancing adequate institutional arrangements between market and hierarchy, seeking for the cost-minimizing institutional arrangement. The *behavioral theory of the firm* (Cyert & March, 1963) explains adaptation through managerial decision making regarding the allocation of resources and the engagement in innovation activity. The firms ability to adapt to changes is

thereby determined by the availability of slack resources and the strategic intent to allocate slack resources to innovation (Lewin & Volberda, 1999).

The *evolutionary theory of the firm* (Nelson & Winter, 1982) assumes that firms accumulate knowledge during their existence and command a repertoire of unique skills and know-how which is embedded in complex routines. Tacit knowledge and routines enable firms to search for novel solutions that allow adaptation to changing conditions (Lewin & Volberda, 1999). However, these routines are regarded as being relatively unreceptive towards change and suppress the attention span and the absorption of new knowledge as they direct the search focus on fields which are related to prior knowledge. As a consequence, organizational routines may become a major source of inertia and inflexibility (Hannan & Freeman, 1984). A recent reconceptualization of routines, however, argues that the interplay between ostensive (structure of the routine) and performative (specific actions by specific actors within the routine) aspects of a routine provide permanent opportunities for variation, selection, and retention of new practices, making routines to a potential source of flexibility and change (Feldman & Pentland, 2003).

Contingency theory (Burns & Stalker, 1961; Lawrence & Lorsch, 1967) assumes that firms have to achieve a "fit" with the conditions given by their environment. In this approach organizational forms vary between more static and more flexible organizational designs, while the former is better suited for more stable environments and the latter is more adequate in more dynamic environments. Organizational adaptation thereby refers to the ability of managers to adequately interpret external conditions and to implement appropriate organizational designs (Lewin & Volberda, 1999). The emphasis here is on reactive adaptation and the ability to actively influence the environmental conditions is largely ignored. The *strategic choice perspective* (Miles & Snow, 1978) expands this approach by taking into account the various ways in which organizations interact with their environment and how managerial strategic choices are also able to actively shape the environment.

Organizational learning theory (Argyris & Schön, 1978; Huber, 1991) assumes that organizations have some unique skills for learning, unlearning, or relearning based on past experience, which allow them to align with their environment. This learning process, which is both reactive and proactive, enables the development of insight and knowledge as well as the association of the appropriateness of past actions and the potential usefulness of future actions. In this framework organizations stay vital by balancing local and expanded search in order to accomplish their most fundamental functions and at the same time remain open for

continuous reflection and monitoring to meet the challenges of external change and internal inertia (Lewin & Volberda, 1999).

The *dynamic capabilities framework* is understood as an integrative framework that partly draws from insights of some of the theoretical perspectives outlined above while simultaneously integrating new facets into the consideration (Teece et al., 1997). The dynamic capabilities framework thereby builds on the fundamental understanding of the resource-based perspective in which competitive advantage stems from the exploitation of firm specific resource and capability bundles (Barney, 1991; Penrose, 1995; Wernerfelt, 1984), but expand this perspective to the question how firms first develop firm-specific resource and capability bundles and how they renew their resource and capability configurations in order to respond to shifts in their environment (Teece et al., 1997). Further, the dynamic capabilities framework borrows some insights from the behavioral theory of the firm, transaction cost theory, and evolutionary theory (Augier & Teece, 2009). The dynamic capabilities framework thereby incorporates managerial decisions regarding resource allocations for capability development or innovation activities. Further, the dynamic capabilities framework acknowledges the existence of transaction and switching costs in the case of resource or capability transfer and the advantages of certain coordination mechanisms under specific circumstances. Moreover, the dynamic capabilities framework recognizes the attempt of organizations to build and exploit valuable knowledge assets. The dynamic capabilities framework additionally incorporates the perspective of innovation-based competition and the 'creative destruction' of existing competences through 'entrepreneurial' actions (Schumpeter, 1934), and thus, does not solely focus on reactive adaptation and change, but also on the potential of organizations to actively shape their environments (Eisenhardt & Martin, 2000; Teece, 2007).

Dynamic capabilities can further be distinguished from the more practical approach of change management by denoting that dynamic capabilities focus on firm-level abilities and mechanisms that drive the development of novel resource and capability combinations and in consequence enable adaptation or market making, while change management is a structured organizational process aiming at shifting organizations from a current state to a desired future state by providing guidelines and tactics that encourage individuals and groups within the firm to contribute to the desired change by adjusting their behavior or the performance of work tasks.

1.3. Criticism of the Dynamic Capabilities Framework

Despite its growing popularity, the development of the dynamic capabilities framework has not gone unchallenged and received some criticism. Arend and Bromiley (2009, p. 75), for example, criticize the *"…(1) unclear value-added relative to existing concepts; (2) lack of a coherent theoretical foundation; (3) weak empirical support; and (4) unclear practical implications."* Williamson (1999, p. 1093) criticizes the capabilities perspective and especially the dynamic capabilities framework regarding *"…obscure and often tautological definitions of key terms; and failures of operationalization."* Other authors echo the critique of vague or confusing definitions that make it difficult to capture the construct (Danneels, 2008; Kraatz & Zajac, 2001; Winter, 2003). The lack of empirical research on dynamic capabilities is a reason for concern for several scholars (Newbert, 2007; Williamson, 1999). In this regard other authors note that the major part of empirical research on dynamic capabilities was conducted in qualitative case studies or concentrated on small sections of the concept (Wang & Ahmed, 2007) and that quantitative empirical tests of a comprehensive model of dynamic capabilities are underdeveloped. As the findings remain unconnected, there is no clear understanding about the antecedents and consequences of dynamic capabilities, and until to date the construct dynamic capabilities remains abstract and diffuse as there is no widely accepted operationalization available (Barreto, 2010; Prieto, Revilla & Rodríguez-Prado, 2009). Zahra, Sapienza and Davidsson (2006) further state that dynamic capabilities are often operationalized in a way that makes it difficult to differentiate between their existence and their effects. Another point of criticism regarding the capability perspective is that the field is lacking micro-foundations that explain how individual-level abilities are leveraged to collective organizational-level constucts like organizational capabilities or routines (Abell, Felin & Foss, 2008; Felin & Foss, 2005).

1.4. Conceptual Differences within the Dynamic Capabilities Framework

Due to a rather broad conceptual basis and vague definition of key terms at the outset, several distinct perspectives on the nature of dynamic capabilities evolved during recent years (Schreyögg & Kliesch-Eberl, 2007).

The first perspective, originating mainly from the resource-based view of the firm and most prominently represented by Teece et al. (1997), understands a capability in the most general way as the ability of an organization to perform a certain activity (Amit & Schoemaker, 1993; Helfat et al., 2007). In this perspective dynamic capabilities are under-

stood as a certain set of capabilities that aim at altering other capabilities, which are applied for conducting the regular business activities. Regular business activities include to develop, produce, and market the firms output (products or services) as well as several supporting activities, e.g. management, communication, coordination. Dynamic capabilities are thereby a set of distinct but related capabilities that conjointly enable the firm to identify the need for change, to formulate an appropriate response, and to implement a course of action (Helfat et al., 2007). This includes sensing changes in the business environment and seizing opportunities through the integration of knowledge and the reconfiguration of the existing capability configuration (Teece et al., 1997; Teece, 2007). As a further characteristic, dynamic capabilities do not affect the output of the firm (i.e. products or services) directly, but indirectly via their effect on other capabilities, which are applied for producing the firm's output (Helfat & Peteraf, 2003). This perspective regards environmental dynamism as a boundary condition that enhances the value of dynamic capabilities in terms of their contribution to competitive advantage, as under conditions of rapid change the alteration of existing capability configurations is more important.

The second perspective, also originating from the resource-based view, most prominently represented by Eisenhardt and Martin (2000), regards dynamic capabilities as specific identifiable processes, e.g. product development, strategic decision making, or alliancing, within the firm, which alter the resource configuration. In this perspective, dynamic capabilities are regarded as the organizational and strategic routines by which a firm alters its resource base. Further, they argue that these processes vary in their shape or pattern depending on the condition of the external environment. While in moderately dynamic environments they are detailed, analytic, and stable processes, producing predictable outcomes, in highly dynamic environments they represent simple, experimental, and fragile processes with unpredictable outcomes (Eisenhardt & Martin, 2000). In this perspective environmental dynamism is not regarded as boundary condition for the value of dynamic capabilities, as their value resides in the resources and capabilities they create and they are regarded as being effective in terms of creating new resources and capabilities in moderately dynamic and dynamic levels of environmental dynamism. However, the predictability of the outcome also varies with environmental dynamism. Further, high velocity markets or hypercompetitive environments threaten the firm's potential to adapt as they may devaluate the effectiveness of dynamic capabilities.

A third perspective, originating from the evolutionary theory of the firm and most prominently represented by Winter (2003) and Zollo and Winter (2002), builds on the definition of capabilities in terms of routines. Routines are thereby understood as stable patterns of collec-

tive interaction that are learned, highly patterned, and repetitious (Winter, 2003). Based on this understanding, dynamic capabilities are routines to change routines. Further, Winter (2003) distinguishes between 'zero-order' capabilities as the 'how we make a living now' and 'first-order' dynamic capabilities that change the products, processes, or customers based on which a firm 'makes its living'. In this perspective, dynamic capabilities are not automatically linked to competitive advantage as their (positive) value creation contribution is dependent on other boundary conditions, such as environmental dynamism. In occasions where there is less need to change, e.g. rather stable environments, dynamic capabilities may still be effective in terms of creating new capabilities, but are not efficient from a cost perspective, as other modes of capability development exist that are less costly in such settings.

While the three perspectives on dynamic capabilities clearly show differences regarding the nature of the focal construct, the links to competitive advantage, and the boundary conditions (i.e. environmental dynamism), they also show important commonalities. All three perspectives acknowledge the potential of dynamic capabilities to contribute to competitive advantage and all three perspectives acknowledge that dynamic capabilities operate on other resources and/or capabilities within the firm. During the recent years, these three perspectives influenced each other in the way that insights regarding the characteristics of dynamic capabilities gained from studies based on one of the perspectives have also been recognized within the other perspectives as long as they were not mutually exclusive, because being based on assumptions that violate the other perspective's foundations.

The most important conceptual difference between these perspectives is the understanding about what constitutes a capability in general and a dynamic capability in particular. Within the first perspective, a capability is defined as the ability to perform an activity (Amit & Schoemaker, 1993; Grant, 1991; Helfat & Peteraf, 2003; Penrose, 1995) in the sense that a firm can carry out a specific activity purposefully, repeatedly, reliable, and in an at least minimally satisfactory manner (Helfat et al., 2007; Helfat & Winter, 2011). Within the second and the third perspective, a capability is equated with a routine. Thus, within the second and the third perspective these constructs are treated as being congruent.

However, a review of the defining characteristics of a routine reveals important differences compared to the defining characteristics of a capability. Zollo and Winter (2002) define organizational routines as stable patterns of behavior. Winter (2003) defines a routine as a behavior that is learned, highly patterned, and repetitive. Cohen and Bacdayan (1994) regard organizational routines as multi-actor, interlocking, reciprocally-triggered sequences of ac-

tions. According to Feldman and Pentland, *"…routines can be defined as repetitive, recognizable patterns of interdependent actions, carried out by multiple actors"* (2003, p. 95). The sum of characteristics, attributed to routines within these definitions, create a significant difference compared to the defining characters of a capability. A capability may adopt the shape of a routine, when the underlying activity is conducted in that specific manner, but these routine-specific characteristics are not a necessary attribute of a capability. Thus, routines are an example of resources and capabilities (Barney, 2001), but routines and capabilities are not necessarily congruent. An important differentiation relates to Feldman and Pentland's (2003) reconceptualization of routines. Thereby a routine may also manifest in a recurring and stable structure (ostensive aspect) of activity domains without the necessity that the specific performance of tasks which build the content of that domain (performative aspect) is being conducted in a routinized fashion.

1.5. Dominant Research Questions Regarding the Dynamic Capabilities Framework

Some of the most fundamental research questions regarding the dynamic capabilities framework, which require ongoing attention, are directly or indirectly linked to the critique regarding weak definitions and insufficient operationalizations of the construct. As a first step towards a better understanding about the nature and the effects of dynamic capabilities, the development of a comprehensive measure of dynamic capabilities is necessary that conjointly covers the various facets of the concept (Barreto, 2010; Prieto et al., 2009; Wang & Ahmed, 2007). Thereby, rigorous attempts have to be made to operationalize the various dimensions of dynamic capabilities in a content-valid manner, avoiding the risk of tautological definitions (Kraatz & Zajac, 2001; Williamson, 1999), and operationalize the construct in a way that allows to explicitly differentiate between dynamic capabilities' existence and their effects (Zahra et al., 2006).

Based on a solid and comprehensive operationalization that allows measuring the level of dynamic capabilities explicitly and accurately, in a second step, their contribution to firm performance and competitive advantage can be examined and their framing conditions – such as their dependence on environmental dynamism – can be identified. To date these two questions belong to the most important unsolved research questions related to the dynamic capabilities framework. Regarding the question how and in which way dynamic capabilities contribute to firm performance and competitive advantage, there is an ongoing debate, whether dynamic capabilities unfold direct performance effects (Arend & Bromiley, 2009; Teece et al., 1997), indirect performance effects that are mediated by the firm's resources and capabilities

(Eisenhardt & Martin, 2000; Zahra et al., 2006), or both direct and indirect performance effects (Helfat & Peteraf, 2009). Further, the question is whether dynamic capabilities only unfold positive performance effects or whether there are costs associated with dynamic capabilities (Winter, 2003; Zott, 2003) that may also negatively contribute to firm performance (Drnevich & Kriauciunas, 2011). Even most recent research exploring the performance links of dynamic capabilities (Drnevich & Kriauciunas, 2011; Protogerou, Calothirou & Lioukas, 2011) provides inconsistent results, which is partly due to inadequate operationalization of the focal construct, again underscoring the call for a relentless commitment towards adequate operationalization.

The second question is whether and to what extent the effectiveness, the efficiency, or the value of dynamic capabilities depends on the level of dynamism in the business environment. While Teece et al. (1997) argue that dynamic capabilities are especially valuable in turbulent environment and explicitly link dynamic capabilities to regimes of rapid change, Eisenhardt and Martin (2000) argue that dynamic capabilities are also effective in terms of creating new capabilities in moderately dynamic environments, and thus, are also valuable under conditions of low environmental dynamism. Winter (2003) argues that, while potentially being effective in rather stable environments that require less capability reconfiguration, dynamic capabilities might not be efficient under such conditions as alternative modes of capability creation are likely to be superior from a cost perspective. Zahra et al. (2006) argue that the value of dynamic capabilities, which resides in their capacity to renew the organization's operational capabilities, is independent from the dynamism in the environment. In order to adequately examine the relation between dynamic capabilities' performance effects and the environmental conditions, the potentially complex performance links of dynamic capabilities as outlined above have to be better understood in the first place. Based on a deeper insight into the effect chain of dynamic capabilities, the influence of environmental dynamism on their performance effects can be examined.

Last but not least there is a dearth of knowledge whether dynamic capabilities require specific organizational settings. Dynamic capabilities, like any other capability, are embedded in organizational structures (Greenwood & Miller, 2010), and are influenced by organizational design characteristics. Therefore, it is potentially interesting to examine, whether certain design characteristics are favorable in order to foster dynamic capabilities within the organization. While there are some subtle hints towards certain design characteristics that might foster dynamic capabilities, there is no clear understanding about which organizational design or coordinating form best supports dynamic capabilities (Williamson, 1999).

1.6. Research Objective and Research Procedure

The aim of this dissertation thesis is to address some of the research questions outlined above. More specific, this thesis aims at providing answers to six main research questions, which are regarded as relevant within the dynamic capabilities framework:

(1) How to operationalize dynamic capabilities comprehensively in the sense of capturing the relevant facets and thereby operationalizing dynamic capabilities independently from their outcomes on organizational level?

(2) How are dynamic capabilities related to proposed organizational outcomes like capability development or the establishment of firm competence?

(3) What are the singular direct contributions and the conjoint contributions of the dynamic capabilities dimensions in producing organizational outcomes like capability development or firm competence?

(4) How are dynamic capabilities related to successful innovation? Can dynamic capabilities be identified as the internal mechanisms that enable large organizations to succeed in innovation-based competition?

(5) What are the performance links of dynamic capabilities? How are dynamic capabilities related to relative firm performance and to what extent do dynamic capabilities support superior firm performance?

(6) What are the organizational antecedents of dynamic capabilities? In which organizational design configurations are dynamic capabilities most likely to prosper?

To address these research questions, I conducted five empirical studies, which were combined to constitute this cumulative dissertation thesis. These five empirical studies are based on a large-scale cross-sectional survey, which was conducted during 2010, of independent business units of large companies operating in various industries in Germany. This thesis further builds on a conceptual study, conducted during 2009, developing a comprehensive research model of dynamic capabilities, which is currently in the status *Revise and Resubmit* at the *Strategic Management Journal*. Prior versions of the studies building Chapter 4, 5, and 6 have been presented or been accepted for presentation at leading international conferences, such as the *Academy of Management Meeting, 2011* and the *European Academy of Management Conference, 2011*. Further conceptual studies, in which the conceptual basis of this thesis was developed, have been presented at the *Tilburg Conference on Innovation, 2010* and the *Academy of Management Meeting, 2010*.

This thesis is structured as follows: In Chapter 2 a multi-dimensional measurement model of dynamic capabilities is developed and validated. To do so, I draw from a broad body of conceptual and empirical research on dynamic capabilities to derive the several distinct but related dimensions that conjointly reflect the existence of dynamic capabilities in a given organization. Then I establish construct validity by examining convergent and discriminant validity. In the next step, I examine nomological validity by analyzing the relations to theoretically expected outcomes, i.e. the development of operational capabilities and the establishment of operational capabilities of superior quality.

In Chapter 3, I examine the contribution of dynamic capabilities on core organizational outcomes in more detail. To provide a deeper insight into the nature and the effects of dynamic capabilities, I examine the simultaneous direct effects the several dimensions of dynamic capabilities unfold on the development of different operational capabilities, i.e. marketing capabilities, technological capabilities, and organizational/managerial capabilities. Further, I examine how the several dimensions of dynamic capabilities directly contribute to a superior quality in the capability domains mentioned before. Thus, I analyze their direct contributions to firm competence. Further, I examine whether and to what extent combinations of the several dynamic capabilities dimensions unfold complementary effects on firm competence within the different capability domains.

In Chapter 4, I begin to examine the 'performance' outcomes of dynamic capabilities in the more narrow sense of the word and the influence of environmental dynamism. To do so, I draw from the Schumpeterian perspective on innovation and first examine the potential of dynamic capabilities to foster successful innovation, i.e. innovation performance. Therefore, I examine the potential indirect effects of dynamic capabilities on innovation performance, which are mediated by the firm's operational capabilities, as well as potential direct effects. Further, I analyze whether and to what extent the direct and indirect effects of dynamic capabilities on innovation performance depend on the level of dynamism in the environment.

In Chapter 5, I continue to examine the performance outcomes of dynamic capabilities and focus – contrary to Chapter 4 – on dynamic capabilities' contribution to financial firm performance. Again, I examine the direct and indirect performance effects of dynamic capabilities, but provide a more detailed analysis of the influence of environmental dynamism. To do so, I separately analyze the influence of market and technological turbulence on the performance effects of dynamic capabilities.

In Chapter 6, I focus on the organizational antecedents of dynamic capabilities and examine how certain organizational design characteristics may support or hamper dynamic capabilities. Therefore, I analyze the impact of centralization, routinization, and formalization on dynamic capabilities and their several dimensions.

Chapter 7 provides an overall conclusion regarding the several studies building this dissertation thesis and provides an outlook on potentially promising future research questions regarding dynamic capabilities.

2. DYNAMIC CAPABILITIES: DIMENSIONS, MEASUREMENT, AND VALIDATION

2.1. Introduction

The dynamic capabilities framework (Teece et al., 1997) has attracted great attention in management and organizational research as it has great potential to explain how firms attain and sustain competitive advantage. A growing body of empirical research evolved around this complex framework. Dynamic capabilities' effects on competitive advantage on firm level (Wu, 2010) or process level (Pavlou & El Sawy, 2006) have been examined. A further study examined the differing effects of ordinary and dynamic capabilities on relative firm performance (Drnevich & Kriauciunas, 2011). Others found that the performance effects of dynamic capabilities are mediated by the firm's operational capabilities (Protogerou et al., 2011). The link between operational and dynamic capabilities has been examined (Cepeda & Vera, 2007) as well as the complementary effects of operational capabilities on joint venture performance (Song, Droge, Hanvanich & Calantone, 2005).

Further, it has been found that a selection capability between internal and external capability sourcing modes influences a firm's ability to renew their existing capabilities and as a result to survive (Capron & Mitchell, 2009). Other authors show that dynamic managerial decisions which relate to building, integrating, and reconfiguring organizational resources and competences affect the variance of business performance (Adner & Helfat, 2003). Further, it has been shown that a history of increased resource deployments in marketing leads to higher economic firm performance (Kor & Mahoney, 2005) and that willingness to cannibalize, constructive conflict, tolerance for failure, environmental scanning, and resource slack are antecedents of second-order marketing and R&D competences (Danneels, 2008). Other studies investigate how human capital and specialized expertise support the development of dynamic capabilities (McKelvie & Davidsson, 2009) or examine the role of experience and managerial choice for developing dynamic capabilities (King & Tucci, 2002).

Despite the commendable efforts that have been made in recent years, empirical research on the dynamic capabilities construct itself is still underdeveloped and there is still confusion regarding dynamic capabilities' nature and their effects (Barreto, 2010; Zahra et al., 2006). As a consequence we observe conflicting research findings, e.g. regarding the performance effects of dynamic capabilities. While Drnevich and Kriauciunas (2011) report negative di-

rect effects of dynamic capabilities on firm performance, Protogerou et al. (2011) report that there is no direct performance effect of dynamic capabilities and that the effects of dynamic capabilities on firm performance are fully mediated by operational capabilities.

The main issues empirical research on dynamic capabilities (and in consequence theory development) is suffering from are: (1) most often dynamic capabilities are not explicitly measured at all. Many empirical studies on the subject claiming to measure dynamic capabilities either measure expected antecedents or expected outcomes as proxies instead of dynamic capabilities itself, but neglect that the antecedents and the construct itself may only share a certain intersection of outcomes or that the outcomes might be due to alternative explanations. When dynamic capabilities are operationalized with measures that in fact measure the development of ordinary capabilities (e.g. Drnevich & Kriauciunas, 2011), which actually is an outcome of dynamic capabilities and not the construct itself, we risk to draw wrong theoretical conclusions. As alternative modes of capability development exist (Winter, 2003), it is not sure that we indeed observe the effects of dynamic capabilities, when just the outcome is measured, as the outcome could be due to alternative explanations. Furthermore, if proxies are applied to measure a construct of interest, it is at least questionable whether the proxy and the construct produce equal outcomes under any circumstances.

(2) Most often quantitative studies neglect the richness of the construct as outlined in prior conceptual research (e.g. Barreto, 2010; Helfat *et al.*, 2007; Teece *et al.*, 1997; Teece, 2007) and concentrate on rather narrow sections of the concept, which constrains the validity of the results on concept level as the conjoint effects of relevant facets are neglected (Wong et al. 2008). Often dynamic capabilities are conceptualized as individual capabilities that contain a dynamic character or aim at altering the resource base, like acquisition or alliance capabilities (Helfat et al., 2007). Such capabilities clearly contain a dynamic character and have the potential to modify or extend the resource base. Acquisition and alliancing are external reconfiguration modes that build a counterpart for other – internal – modes of capability reconfiguration (Capron & Mitchell, 2009; Lavie, 2006) and the appropriateness to engage in either internal or external modes of reconfiguration thereby depends on certain internal and external conditions. Capron and Mitchell (2009) conclude that a selection capability that enables to choose the appropriate sourcing mode under given circumstances has to be an additional facet of dynamic capabilities. These findings give a first hint that an individual capability – whatever its nature – is unlikely to constitute what Teece et al. (1997) termed dynamic capabili-

ties, which include to sense the need for reconfiguration and accomplish internal and external transformation.

Despite the fact that several scholars regularly formulate the need to develop and validate a comprehensive measurement model of dynamic capabilities that conjointly accounts for their various distinct but related dimensions (e.g. Barreto, 2010; Easterby-Smith, Lyles & Peteraf, 2009; Prieto et al., 2009; Wang & Ahmed, 2007), little effort has been made to develop a measure of dynamic capabilities that comprehensively covers the richness of the construct as outlined in prior conceptual research and enables to explicitly differentiate between the nature of the construct and its various outcomes on organizational level (Zahra et al., 2006).

The purpose of this study is to develop and validate a multi-dimensional measure of dynamic capabilities and thereby contributing to a better understanding of the nature of the construct. Based on a literature review I derive several distinct but related dimensions in which dynamic capabilities manifest and discuss their content as well as their purpose. Then I examine the construct validity and show that these distinct dimensions relate to one underlying overall construct of dynamic capabilities. In a next step, I examine the nomological validity of the measure by investigating its relations with theoretically expected outcomes. Thereby I show that the proposed measure of dynamic capabilities, while clearly discriminating from its expected outcomes, is positively related to the development of operational capabilities in different capability areas and to the establishment of firm competence in several competence dimensions.

2.2. Construct Definition of Dynamic Capabilities

2.2.1. The Nature of Dynamic Capabilities

Dynamic capabilities are defined as "…the capacity of an organization to purposefully create, extend, or modify its resource base" (Helfat et al., 2007, p. 4) and thus represent a dynamic extension of the resource-based view (Barreto, 2010). Dynamic capabilities thereby operate on other – operational – capabilities (Collis, 1994; Winter, 2003), which are resources themselves, and thus, are part of the resource base (Barney, 1991; Helfat et al., 2007). Thus, dynamic capabilities alter the resource base by building, integrating, or reconfiguring operational capabilities (Helfat & Peteraf, 2003).

A capability is defined as the ability to perform an activity (Amit & Schoemaker, 1993; Grant, 1991; Helfat & Peteraf, 2003; Penrose, 1995) in the sense that a firm can carry out a specific activity purposefully, repeatedly, reliable, and in an at least minimally satisfactory manner (Helfat et al., 2007; Helfat & Winter, 2011). Operational capabilities are those that enable an organization to perform the ordinary or regular business activities (Collis, 1994; Helfat & Winter, 2011; Winter, 2003). This relates to the ability to perform the activities necessary to design, produce, market, and deliver the product, as well as the necessary supporting activities (Collis, 1994; Porter, 1985). Accordingly, examples of operational capabilities are R&D, product development, marketing, organization, management, etc. (Amit & Schoemaker, 1993; Grant, 1991). Thus, I apply a functional perspective on capabilities, in which I differentiate between different kinds of capabilities by the function they fulfill. Operational capabilities conjointly 'produce' the products and services by which a firm *makes its living*. Dynamic capabilities, however, do not directly affect the output of the firm in terms of its products and services, but indirectly through the impact on operational capabilities (Helfat & Peteraf, 2003). To clearly distinguish dynamic capabilities from operational capabilities that might also contain a dynamic character, like R&D or product development, it is important to understand that the latter change the shape of the product or service, while the former changes the shape of the R&D and/or product development capabilities. Further, dynamic capabilities likewise operate on different types of operational capabilities. A better relative capability in comparison with competition is referred to as competence in this thesis, in the sense of a distinctive competence (Snow & Hrebiniak, 1980; Teece et al., 1997).

2.2.2. Dimensions of Dynamic Capabilities

Dynamic capabilities are a multidimensional construct of interrelated and complementary dimensions (Barreto, 2010; Pavlou & El Sawy, 2006; Teece, 2007). To derive dimensions that may capture the different facets of dynamic capabilities and may simultaneously cover the overall construct as completely as possible, I reviewed the relevant literature.

Dynamic capabilities include the ability to identify the need for change, to formulate a response, and to implement appropriate measures (Helfat *et al.*, 2007). They involve sensing the need for change, learning about how to respond to opportunities and threats, and accomplishing reconfiguration (Teece et al., 1997; Teece, 2007). Sensing may capture the first facet. Sensing capability comprises a firm's ability to recognize shifts in the environment that could impact the firm's business based on the current capability position (Teece, 2007). Thus,

sensing relates to the recognition of opportunities and threats and the monitoring of the current capability endowment (Barreto, 2010; Schreyögg & Kliesch-Eberl, 2007; Teece, 2007).

The second facet, the formulation of a response, may be based on learning. Teece et al. (1997) already propose learning as a core element of dynamic capabilities (Teece, 2007, p. 1341). The formulation of a response by shaping opportunities is also a learning function, as it involves learning about customer needs as well as technologies and/or business models to address them adequately (Teece, 2007). Learning in this context relates to knowledge creation, knowledge acquisition, and knowledge sharing (Eisenhardt & Martin, 2000; Verona & Ravasi, 2003).

The third facet may be captured by reconfiguration. Based on the understanding of the organization as a certain configuration of capabilities and resources, in this paper any type of alteration of this configuration is termed reconfiguration. Reconfiguration is the final chain in a procedural perspective on dynamic capabilities and is widely accepted as a core element of dynamic capabilities (Barreto, 2010; Eisenhardt & Martin, 2000; Pavlou & El Sawy, 2006; Teece, 2007). Reconfiguration relates to the internal creation of new capabilities and the integration of newly created or acquired capabilities (Capron & Mitchell, 2009; Lavie, 2006).

Sensing. Sensing capability comprises a firm's ability to recognize shifts in the environment that could impact the firm's business (Teece, 2007). Organizations constitute sensing capability by establishing processes to regularly scan their local and distant business environment (Danneels, 2008; Pavlou & El Sawy, 2006; Teece, 2007), to interpret the gathered information, and to filter the relevant parts (Teece, 2007). Sensing capability comprises the starting point within a procedural perspective on dynamic capabilities, as it is the point where a possible need or opportunity to change is identified based on changes in the business environment. However, the need or opportunity for change is not solely determined by changes in the external environment. It also depends on the current resource and capability position as this position determines if there is need to build, extend or modify existing capabilities, and in which way, or if the organization can cope with the arising challenges based on the current capability endowment (Capron & Mitchell, 2009; Lavie, 2006). Thus, it is not sufficient to scan the external environment. Furthermore, organizations also have to monitor the internal environment (Teece, 2007).

Monitoring is thereby seen as a separate function to continuously check whether and why the capability configuration has to be adjusted to cope with external challenges (Schreyögg &

Kliesch-Eberl, 2007). Sensing, thus, relates to both the ability to recognize shifts in the external environment that could affect the business model and the ability to identify to what extent the organization might respond with its current capability endowment, or to what extend the development of new capabilities is necessary (Barreto, 2010; Teece, 2007).

Learning. An organization's learning capability is reflected by the ability to create internal knowledge, to acquire external knowledge, and to assimilate internal and external knowledge through knowledge sharing (Kogut & Zander, 1992; Zahra & George, 2002). Knowledge creation and knowledge acquisition are very important as they build the fundament for capability creation (Kogut & Zander, 1992). New processes and products mainly result from new combinations of knowledge (Augier & Teece, 2009). Especially in turbulent environments, organizations should additionally possess knowledge acquisition capability as the capability to create knowledge internally may not be sufficient to cope with the challenges arising from changes in the environment (Lichtenthaler, 2009).

Prior studies regularly highlight the relevance of knowledge acquisition, knowledge creation, and knowledge transfer as elements of dynamic capabilities (Eisenhardt & Martin, 2000; Lichtenthaler, 2009; Verona & Ravasi, 2003; Zahra & George, 2002). The notion of learning that is relevant in the context discussed here is the ability of task specific learning in the sense of quickly acquiring or creating specific knowledge necessary to seize the identified opportunities (Eisenhardt & Martin, 2000). Such task specific learning undergirds the formulation of a response that can be implemented by reconfiguring the resource base.

To seize opportunities firms need to make interrelated strategic choices and investment decisions (Teece, 2007) and make timely as well as market-oriented decisions (Barreto, 2010). In order to make meaningful decisions about how to address opportunities and threats, it is necessary that firms reach a new state of knowledge in order to understand the alternatives at hand and the interrelatedness of the factors involved. Thus, the abilities to create and acquire new knowledge and to share it throughout the firm is very likely to be a necessary precondition for making informed decisions instead of just 'trying a shot in the dark'.

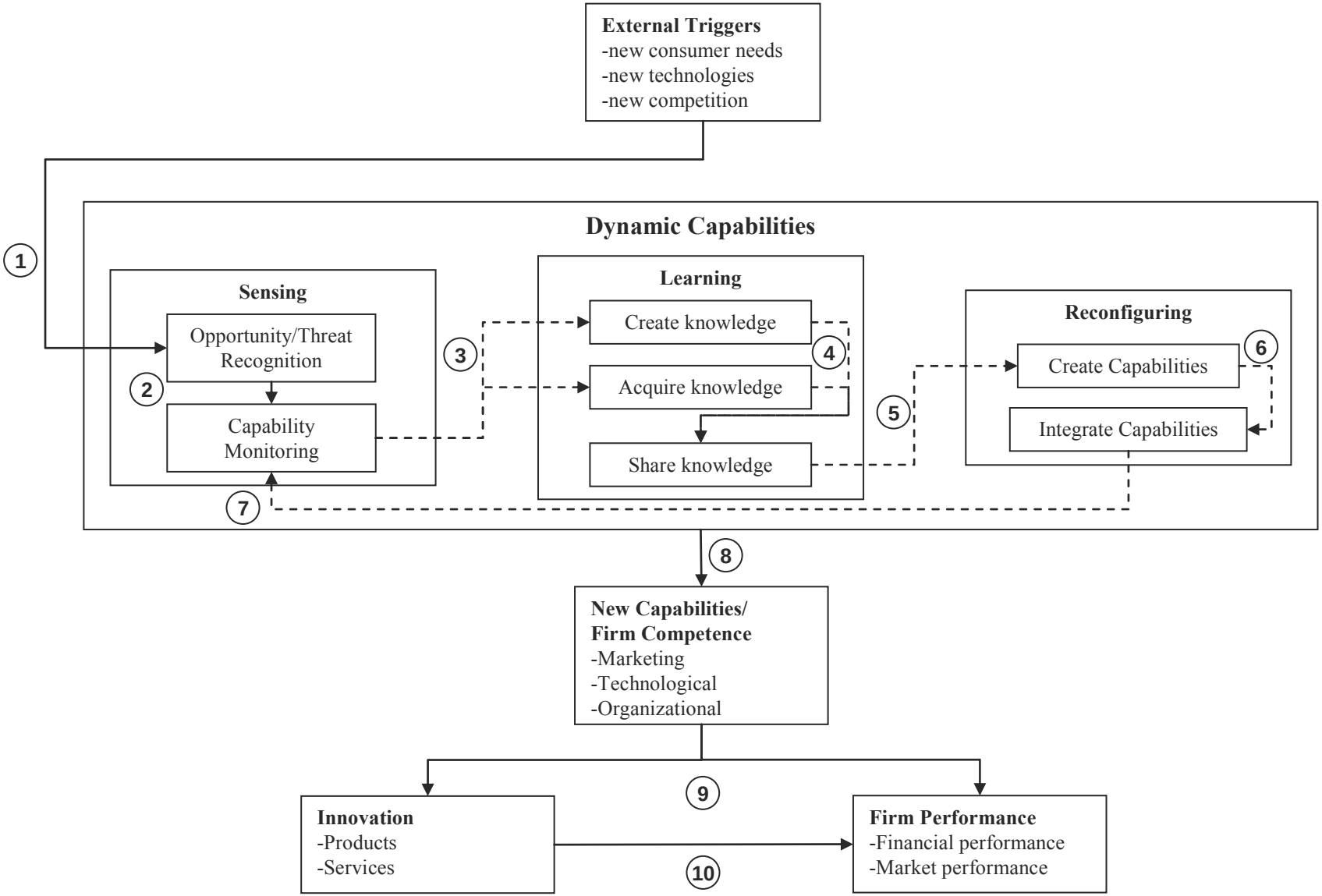
Reconfiguration. Like sensing and learning, reconfiguration also relates to several facets. Capabilities can be built internally or can be acquired from external sources. Building capabilities internally relates to the transformation of existing capabilities, i.e. to change the form, shape, or appearance of capabilities existing within the firm (Carlile, 2004; Teece, 2007). This includes redeployment or recombination of existing capabilities (Galunic & Rodan,

1998). Acquiring capabilities refers to purchasing capabilities with or without physical transfer from outside sources, e.g. licensing, purchasing contracts, alliancing, mergers and acquisitions of firms or parts of firms (see Capron, Dussauge & Mitchell, 1998; Capron & Mitchell, 2009; Lavie, 2006).

Capabilities that have been newly created or acquired further have to be integrated into the existing capability configuration. Integration refers to an inclusion of new capabilities into the organization, connecting them and linking them with existing resources and capabilities (see Eisenhardt & Martin, 2000; Iansiti & Clark, 1994; Teece et al., 1997; Teece, 2007). In the context of dynamic capabilities, organizations must be able to respond to changes in their business environment by effectively reconfiguring their capabilities. In order to implement an adequate course of action independent of the nature or the characteristic of the arising challenge, organizations must be able to engage in all the different activities that come with capability reconfiguration. Furthermore, they must be able to recognize the appropriate reconfiguration mechanism and must be able to decide in which sourcing mode to engage (Capron & Mitchell, 2009; Lavie, 2006). Reconfiguration capability, thus, is reflected by the general ability to create new capabilities and the ability to integrate newly created or acquired capabilities independent of the specific conditions.

To sum up the observation, dynamic capabilities manifest in several distinct but related capabilities that conjointly enable the firm to identify the need for change, to formulate a response, and to implement appropriate measures. Here I derive seven distinct capabilities in which dynamic capabilities manifest: opportunity recognition, capability monitoring, knowledge creation, knowledge acquisition, knowledge sharing, capability creation, and capability integration. Figure 2.1 depicts a *simplified*, *exemplary* procedural model showing external triggers for change, dynamic capabilities and their components, as well as the outcomes of dynamic capabilities. The model is applied to gain a general impression regarding the interrelatedness among the dimensions of dynamic capabilities; thereby no claims to completeness are raised regarding the interdependencies among the dimensions.

FIGURE 2.1: Exemplary Process Model of Dynamic Capabilities, their External Triggers, and Consequences



As a starting point, (1) it is necessary that firms are able to recognize whether new consumer needs, new technologies, or new competitors (or a combination of the aforementioned) might pose a threat to the existing business model or whether such changes might provide opportunities to enhance the firm's value creation. Google, for example, recognized that Facebook poses a significant threat to the current business model due to Facebook's advantages to personalize advertising. After such a potential threat has been recognized, it is further necessary to assess (2) whether the firm can cope with the challenge based on the existing capability configuration. For Google this was related to the question, whether they can compete with Facebook based on their current capability and resource endowment. As a next step, (3) a potential response has to be formulated. This requires gaining new knowledge in order to make a decision how the new challenge should be addressed. It involves learning about the strength and weaknesses of the new competitor, to learn about the technology that is applied and how a competing business model addresses certain consumer needs. It involves understanding whether alternative solutions exist (e.g. technologies or business models) and which potential advantages or disadvantages exist between such alternatives. It further involves understanding which capabilities or resources are necessary to successfully implement the one or the other alternative. Such new knowledge can be created internally or can be acquired from external sources or both. As regularly different knowledge domains are affected (e.g. market related, technological, etc.), and knowledge is acquired at different interfaces with the environment, or created by different sub-groups within the firm, (4) such new knowledge has to be effectively shared across the firm. For Google this could have meant to learn whether there are other options to compete with Facebook or whether Google should launch its own social network. Further, Google had to understand what capabilities are necessary to build a social network and use it effectively to sell personalized advertising. This also involves learning how members use a social network and how they can best be addressed with advertising. The next step (5) involves creating new capabilities which are needed to implement the response. This can relate to building completely new capabilities or modifying existing capabilities or recombining existing capabilities in a novel way. For Google this may relate to new customer-related capabilities. While Google still aims at selling personalized advertising the resources and the business model might change. It may for example require different consumer-related capabilities to convince people to use a certain internet search engine than joining a certain social network. Further, the technological capabilities which are required to effectively run an internet search engine or a social network may differ significantly. This urges Google to create the necessary capabilities. In a next step (6) such newly created capabilities,

e.g. novel consumer-related capabilities have to be aligned with other resources and capabilities in order to build an effective capability configuration. Google has to make sure that their technological capabilities and their marketing capabilities, for example, address the same value proposition. As a final step in such a procedural perspective (7) a firm must check whether the reconfiguration effort reached the desired state and whether the novel capability configuration is sufficient to address the challenges that have been identified in the beginning. Thus, the dimensions of dynamic capabilities conjointly enable (8) to develop new capabilities in different capability domains and thus alter the capability endowment relative to competition. Such novel capabilities can now be used (9) to develop and introduce new products and/or services which may indirectly affect firm performance. In the case of Google, we could observe the launch of Google+ recently. Thus, with the launch of an own social network Google attempts to react to the challenge posed by the rise of Facebook and other social networks. Alternatively, existing products/services can be produced or marketed more effectively or more efficiently which may directly affect firm performance.

This procedural perspective based on a specific example reveals the interplay of the seven dimensions of dynamic capabilities in coping with external challenges exemplarily. This example that shows how the several dimensions may be involved and build on each other when firms recognize and react to external challenges underscores the rationale to derive these seven dimensions as relevant facets of dynamic capabilities. Apart from this procedural perspective on a specific external event, the seven dimensions of dynamic capabilities coexist at all times and conjointly enable the firm to react to different external challenges arising from environmental changes over time.

2.2.3. Measurement Model Specification

When examining multi-dimensional constructs like dynamic capabilities the relations between the construct and its dimensions have to be specified (Edwards, 2001; Law, Wong & Mobley, 1998; Law & Wong, 1999). A multidimensional construct, thereby, is a construct that refers to several *distinct* but *related* dimensions which are treated as a single theoretical concept (Edwards, 2001; Law et al., 1998). The most basic decision regarding the specification of a multidimensional construct as a superordinate or aggregate construct relates to the direction of the relationship between the construct and its dimensions (Edwards, 2001; Law & Wong, 1999). When causality flows from the dimensions to the construct in the sense that the dimensions combine to ‘produce’ the construct, this is referred to as aggregate construct,

while a construct is termed superordinate, when the causality flows from the construct to the dimensions, in the sense that the dimensions are manifestations of the underlying latent construct (Edwards, 2001). Thus, in the case of a superordinate construct the dimensions are 'outcomes' of the construct and not 'input factors' as in the aggregate view.

To model dynamic capabilities as an aggregate multidimensional construct would require to operationalize the dimensions as the constituent parts that combine to compose the construct, or in other words the 'input factors' that build the construct (Edwards, 2001; Edwards & Bagozzi, 2000). A literature review on dynamic capabilities reveals various constituent parts or 'input factors' which are proposed to combine to build the construct dynamic capabilities in the sense of an aggregate multidimensional construct.

Regarding the constituent parts that build dynamic capabilities several propositions have been outlined in the literature. Some authors refer to certain processes as constituent parts of dynamic capabilities. Pavlou and El Sawy (2006) state that dynamic capabilities consist of distinctive processes, namely processes for sensing, learning, reconfiguration, coordination, and integration. Eisenhardt and Martin (2000, p. 1106), for example, state that '…dynamic capabilities consist of specific strategic and organizational processes…' (e.g. strategic decision making). Danneels (2008) also identifies certain processes (e.g. environmental scanning) as constituent parts of dynamic capabilities. Prieto et al. (2009) indicate distinctive individual, social, and collaborative processes associated with e.g. knowledge generation as constituent parts of dynamic capabilities. Another group of authors refer to certain distinctive routines as constituent parts of dynamic capabilities. Helfat and Peteraf (2003, p. 1003) state that dynamic capabilities '*…consist of multiple routines for individual tasks and for task coordination*.' Other authors also point to certain routines as constituent parts of dynamic capabilities, especially to certain distinctive learning mechanisms (Zahra et al., 2006; Zollo & Winter, 2002).

Further, Danneels (2008) points to cultural aspects such as willingness to cannibalize, constructive conflict, and tolerance for failure as constituent parts of dynamic capabilities. Barreto (2010) defines cognitive aspects like *propensities* to sense opportunities and threats, to make timely decisions, to make market-oriented decisions, and to change the firm's resource base as constituent parts that form dynamic capabilities. Prieto et al. (2009) further define contextual antecedents like autonomy, trust, and management practices as additional 'input factors'. Augier and Teece (2009) point to the importance of managers who develop decision-making skills and organizational processes to sense and seize opportunities and their role in

selecting/developing routines, making investment choices, and orchestrating assets. Finally, Teece (2007, p. 1319) points to '…distinct skills, processes, procedures, organizational structures, decision rules, and disciplines…' that undergird dynamic capabilities. Further, he indicates analytical systems, leadership skills, cognitive and creative skills, governance and management practices as constituent parts of dynamic capabilities (Teece, 2007).

It is important to note, that these various facets that combine to build dynamic capabilities outlined above do not constitute abilities or capabilities themselves. These facets are activities or propensities that in combination may enable the organization to identify the need for change, to create and share new knowledge, and to reconfigure the capability configuration. These facets rather refer to the execution of activities and do not necessarily include successful performance of an activity in terms of reaching a specific objective. There is a small but important difference between just doing something and accomplishing a task successfully. To give an example, there is a difference between conducting activities that should enable learning, such as regular cross-departmental meetings, and the ability to quickly learn new things. However, the engagement in such activities is certainly an enabling factor for successfully accomplishing the respective tasks.

Thus, the combination of the 'input factors' of dynamic capabilities cause the seven dimensions of dynamic capabilities as derived in Chapter 2.2.2., which represent the capabilities of *opportunity recognition, capability monitoring, knowledge acquisition, knowledge sharing, knowledge creation, capability creation, and capability integration.* In other words, the combination of the 'input factors' enable organizations to perform the respective activities successfully, which is the manifestation of the underlying capability. To give a simplified example regarding the causal chain, one may consider scanning activities, which are conducted in a certain frequency, in a certain range, and in a certain depth. A variation in these attributes, meaning varying scanning frequency, scanning range, and/or scanning depth, may cause variation in the ability to recognize opportunities and threats arising from the environment. When this example is expanded to all constituent parts outlined above, this means that a variation in the 'input factors' cause a variation in an organization's dynamic capabilities, which would as a consequence cause a variation in the firms ability to recognize opportunities and threats, the ability to monitor the capability endowment, the abilities to create, acquire, and share knowledge, as well as the abilities to create and integrate capabilities.

According to Edwards (2001) the defining characteristic of a superordinate construct is the direction of the relationship that flows from the construct to its dimensions. This implies that

variation in the construct causes variation in its dimensions (Coltman, Devinney, Midgley & Venaik, 2008; Jarvis, MacKenzie & Podsakoff, 2003). In the case outlined above, variation in the constituent parts or 'input factors' causes variation in dynamic capabilities, which in turn causes variation in its manifestations, the successful performance of the respective activities.

In this thesis I focus on the 'output side' of dynamic capabilities and operationalize dynamic capabilities as a superordinate multidimensional construct. Thus, the operationalization applied here represents a general construct that is manifested by its dimensions (Edwards, 2001). Analogous to reflective measures the seven dimensions serve as manifestations of the latent construct, with the exception that they are latent constructs themselves (Edwards, 2001; Edwards & Bagozzi, 2000).

2.3. Construct Validity

2.3.1. Convergent and Discriminant Validity

A critical aspect of construct validity is discriminant and convergent validity (Campbell & Fiske, 1959). Discriminant validity relates to the degree to which measures of different constructs are distinct, while convergent validity relates to the degree to which multiple measures of the same construct are in agreement (Bagozzi, Yi & Phillips, 1991). Although within a multidimensional construct dimensions are naturally related (Edwards, 2001), discriminant validity requires that the dimensions reflect distinct components. Convergent validity requires that, although reflecting distinct components, each dimension is related to an overall construct. Regarding the several facets of dynamic capabilities, discussed above, discriminant validity requires that the seven dimensions opportunity recognition, capability monitoring, knowledge acquisition, knowledge creation, knowledge sharing, capability creation, and capability integration not only theoretically but also statistically discriminate. Although being different constructs, convergent validity requires that the seven dimensions relate to one underlying overall construct.

Further, the discussed dimensionality of dynamic capabilities would require that opportunity recognition and capability monitoring converge on one underlying dimension – sensing capability. Knowledge creation, knowledge acquisition, and knowledge sharing should also converge on one underlying dimension – learning capability. Finally, capability creation and capability integration should both converge on one underlying dimension – reconfiguration capability. Further, these three second-order dimensions – sensing, learning, and reconfigura-

tion should discriminate from each other while simultaneously converge on one underlying third-order dimension – dynamic capabilities. Thus:

Hypothesis 1a: Opportunity recognition, capability monitoring, knowledge acquisition, knowledge creation, knowledge sharing, capability creation, and capability integration are seven distinct first-order dimensions of dynamic capabilities.

Hypothesis 1b: Opportunity recognition, capability monitoring, knowledge acquisition, knowledge creation, knowledge sharing, capability creation, and capability integration relate to an overall construct of dynamic capabilities.

Hypothesis 1c: Opportunity recognition, capability monitoring, knowledge acquisition, knowledge creation, knowledge sharing, capability creation, and capability integration will converge on three distinct second-order factors – sensing, learning, and reconfiguration.

Hypothesis 1d: Sensing, learning, and reconfiguration relate to an overall construct of dynamic capabilities.

2.3.2. Nomological Validity

Another critical aspect of construct validity is nomological validity. Nomological validity refers to the degree to which the focal measure relates to other theoretically connected constructs in the way it is expected to (Hair, Black, Babin & Anderson, 2010; Peter, 1981). Therefore, key relationships of the underlying framework have to be investigated (Hair et al., 2010) and the congruence of the theoretical relationship and the empirical relationship of the constructs under study has to be ascertained (Peter, 1981). The analysis of nomological validity can thereby include the investigation of relations between the focal construct and theoretically expected antecedents or theoretically expected consequences (Spreitzer, 1995). Here I want to focus on consequences of dynamic capabilities within a nomological network in order to investigate nomological validity. Two theoretically proposed consequences of dynamic capabilities are that they drive the development of ordinary capabilities as they build, integrate, and reconfigure ordinary capabilities (Helfat & Peteraf, 2003), and further, that dynamic capabilities help to establish firm competence (Teece et al., 1997), meaning that they create ordinary capabilities of superior quality.

A central argument underpinning the dynamic capabilities framework is that firms now and then have to renew their capability endowment to stay competitive (Eisenhardt & Martin, 2000; Teece et al., 1997). Therefore, existing capabilities have to be improved or new capabilities have to be created. Although dynamic capabilities and capability development are often used synonymously, they represent different constructs. Capability building does not necessarily require dynamic capabilities (Helfat & Peteraf, 2003). As alternative explanations for the occurrence of new capabilities and resources might be 'ad hoc' (Winter, 2003), accident or luck (Helfat et al., 2007), or experimentation, dynamic capabilities are one possible driver of capability development beneath others. While dynamic capabilities are often referred to as a capacity or potential to create new capabilities (Helfat *et al.*, 2007), the effective activity of improving existing and creating new resources and capabilities is an expected outcome of applying dynamic capabilities, and thus a different construct that should clearly discriminate from dynamic capabilities.

Dynamic capabilities are proposed to enable capability development through the recognition of the need for change, through the acquisition and integration of required knowledge, and through enabling reconfiguration. As one important element of dynamic capabilities, Collis (1994) and Winter (2003) state that they govern the rate of change of operational capabilities. Based on this argument, dynamic capabilities are the driving force behind the development of new operational capabilities. Dynamic capabilities thus become effective by creating new operational capabilities. Dynamic capabilities enable firms to recognize opportunities and threats arising from shifts in the environment as well as the need for action based on the internal capability position. Further, dynamic capabilities enable firms to integrate internal and external knowledge as well as to create and integrate new capabilities. Dynamic capabilities thereby help to extend, modify or build operational capabilities (Eisenhardt & Martin, 2000; Winter, 2003). Thereby, dynamic capabilities likewise drive the development of different types of operational capabilities, such as marketing capabilities, technological capabilities, and organizational/managerial capabilities.

> **Hypothesis 2:** Dynamic capabilities are positively related to the development of operational capabilities.

Dynamic capabilities help to cope with external challenges regarding the firm's resource and capability configuration (Eisenhardt & Martin, 2000; Teece, 2007). As dynamic capabilities help to extend, modify or build functional capabilities and resource configurations

(Eisenhardt & Martin, 2000; Winter, 2003), dynamic capabilities strengthen the relative quality of the capability configuration (Danneels, 2008; Pavlou & El Sawy, 2006). As they enable a firm to integrate and build capabilities, dynamic capabilities are capable of strengthening the firm's competence in the respective functional areas (Capron & Mitchell, 2009; Lavie, 2006). Capron and Mitchell (2009), for example, show that firms with a higher ability to manage reconfiguration were more effective in creating capabilities. Accordingly, dynamic capabilities are expected to have a positive effect on the relative quality of the capability endowment.

> **Hypothesis 3:** Dynamic capabilities are positively related to firm competence (relative strength in operational capabilities).

2.4. Methods

2.4.1. Sample and Data Collection

The focus of this empirical study was set on the business unit level of large companies from various industries operating in Germany. Prior to the survey I conducted six interviews with managers from different industries to (1) analyze if the theoretical concepts reflect actual managerial challenges, (2) ensure the industry-independent relevance of the concept and the captured capability configuration, (3) ensure that the phrasing of the items and the meaning of the concepts are equally understood independently of industry focus, (4) confirm the business unit level as reasonable level of analysis within the organization and to identify persons in terms of their professional position who are most likely to provide valid answers to the questions provided, (5) to validate if respondents are able to asses their capabilities in comparison with their main competitor.

As capabilities, and especially dynamic capabilities, are firm-level constructs, I expected the business unit level to be the appropriate level to study dynamic capabilities in large companies. In large companies business units have budgeting, investment, and profit and loss responsibility and often constitute separate legal entities, and therefore act as independent firms. The interviews supported the assumption that the business unit is a reasonable level of analysis, as most of the activities relating to dynamic capabilities are performed at the business unit level and not at the corporate level. A further rationale to study dynamic capabilities on the level of business units arises from their theoretical linkage to competitive advantage and superior performance. As performance differential between companies are for the most

part attributable to the business unit level (McGahan & Porter, 1997; McGahan & Porter, 2002; Misangyi et al., 2006; Rumelt, 1991), their potential sources, i.e. dynamic capabilities, should also be examined on business unit level (Rouse & Daellenbach, 1999).

As noted earlier, often dynamic capabilities are automatically linked to rather dynamic environments and often dynamic capabilities' effects are examined in settings (countries or industries), which are rather dynamic. This bears the risk of drawing conclusions based on a sample that only reflect high environmental dynamism, and thus would inhibit a generalizability of the results. In order to generate a cross-industry sample that varies regarding the dynamism of the environment, I analyzed the environmental settings with objective measures. I examined the environmental dynamism of different industries with archival data reflecting the volatility of financial returns, which is seen as a proxy for environmental dynamism (Snyder & Glueck, 1982). Based on this analysis I clustered the industries into three groups, which comprise high, moderate, and low levels of environmental dynamism respectively. To reach a representative sample, I approached the largest companies based on revenue and employees of the selected industries. For consideration, companies had to exceed revenues of US-Dollar 100 million and 200 employees. The companies in the final sample report revenues of US-Dollar 3.4 billion on average. The average size of the surveyed business units is 2,500 employees and the average age of the surveyed business units is 27 years. The final industry distribution is: telecommunication (8.3%), automobile (13.6%), computer/IT (9.4%), banking/insurance (8.7%), power production and distribution (8.3%), chemicals/pharmaceuticals (11.7%), machinery (11.7%), transport and services (8.3%), consumer goods (11.7%), and others (8.3%).

Within the field phase of three months the questionnaire was sent to 626 firms. To boost response rate, reminder e-mails were sent. Until the end of the field phase 265 business units from 179 companies returned completed questionnaires. In case when more than one questionnaire per company was returned, I additionally checked for potential overlap. 46% of the respondents had a commercial function, such as Head of Marketing & Communications, Director of Sales, or Director Business Development, 45% had a general function, such as CEO, COO, or Head of Business Unit, and 9% had other functions, such as Director R&D or Head of Production. At the time of the survey, the respondents had an average professional experience of 13 years and held their current positions for four years on average. I validated respondent's self reported position and business unit affiliation with archival data and found

100 percent agreement and thus believe the self-reported data to be reliable and valid (Batjargal, 2010).

2.4.2. Measures

Wherever possible, I relied on existing measures that have been validated in prior studies. However, appropriate scales for several of the constructs analyzed in this study were not readily available. In order to develop appropriate scales, I reviewed relevant literature to identify several items that relate to the domain of the construct in question. Then I adopted suitable items from prior empirical studies, adapted items so that they fit the facets examined here, or created new items based on conceptual studies. The resulting questionnaire was first discussed with academics and then validated in six interviews with managers from different industries. All items except industry affiliation were measured on Likert-scales. The industry controls are dummy-coded. The items with their respective scale ratings and anchor points are presented in Table 2.1.

Dynamic capabilities. I applied seven scales to capture the sub-dimensions of dynamic capabilities. All items captured the extent to which the business units were able to successfully perform the respective activities during the *last three years*. Thus, the items capture the ability to perform the respective activity. To capture *sensing*, I applied two scales. The first scale captures *recognition* ($\alpha = 0.86$) of opportunities and threats from the external environment, and the second scale captures *monitoring* ($\alpha = 0.87$) of the internal capability configuration. The scale of *recognition* consists of four items and was adopted from prior research (Danneels, 2008; Jansen, Van Den Bosch & Volberda, 2005; Jaworski & Kohli, 1993; Lichtenthaler, 2009). As there was no scale available to measure *capability monitoring*, I developed a set of items based on Schreyögg and Kliesch-Eberl's (2007) conceptual study. Finally, *capability monitoring* was measured with four items that capture activities relating to the internal fit of operational capabilities, the necessity of external-driven change, and the monitoring of change processes as well as the results of changes in functional capabilities.

Learning was captured with three scales. To measure *knowledge acquisition* ($\alpha = 0.81$), I used a scale consisting of three items adopted from prior studies (Jansen et al., 2005; Jaworski & Kohli, 1993; Lichtenthaler, 2009) that measure the firm's ability to acquire knowledge from sources outside the firm. *Knowledge sharing* ($\alpha = 0.77$) was measured with three items, adopted from prior work of Jaworski and Kohli (1993) and Tippins and Sohi (2003), that capture the ability to share knowledge between and among employees, depart-

ments, and between hierarchical levels within the business unit. For measuring *knowledge creation* (α = 0.88), the ability of business unit's employees to learn from internal sources and produce novel ideas internally, I adapted items applied by Flatten, Brettel, Engelen and Greve (2009), Pavlou and Sawy (2006), and Prieto, Revilla and Rodriguez-Prado (2009). The applied scale consists of four items.

Reconfiguration is measured with two scales. To measure c*apability creation* (α = 0.90), I created a four-item scale adapted from prior research (Lichtenthaler, 2009; Pavlou & El Sawy, 2006; Prieto et al., 2009) that covers the different facets of the internal development of new capabilities. To measure *capability integration* (α = 0.87), I applied a three-item scale indicating how good firms are at integrating new capabilities into their existing capability configuration. Two items were adopted from prior studies (Pavlou & El Sawy, 2006; Prieto et al., 2009) and the third one was newly developed.

Operational Capability Development. Based on prior research (Danneels, 2008; Spanos & Lioukas, 2001), I created items to measure the development of operational capabilities. The development of marketing capabilities was measured with three items (α = 0.77), the development of technological capabilities (α = 0.84) and organizational capabilities (α = 0.88) were both captured with four items. The items captured to what extent the respective business unit actually developed new or improved existing operational capabilities in the different capability areas during the *last three years*.

Firm competence. To measure firm competence, I relied on the common approach where respondents rate the strength of their respective capabilities against their main competitors (e.g. Capron & Mitchell, 2009; Danneels, 2008; Spanos & Lioukas, 2001; Vorhies & Morgan, 2005). Based on prior research (Danneels, 2008; Spanos & Lioukas, 2001; Vorhies & Morgan, 2005), I developed new scales to capture firm competence. *Marketing competence* (α = 0.75) was measured with three items reflecting different facets of marketing capability. To measure the facets of *R&D/technological competence* (α = 0.80), I developed three items measuring effectiveness of production operations, applying adequate technologies, assessing the feasibility of new technologies, and effective engineering. *Managerial/organizational competence* (α = 0.85) is captured with four items reflecting the ability of decision making, of workflow integration, of setting up organizational design, and of setting up efficient processes. All items captured the *actual position* relative to competition *at the time the survey was conducted*.

Control variables. I controlled for corporate support to isolate the effects on business unit-level. Further, I controlled for firm size. Size enables economies of scale and larger organizations have a larger knowledge base (Lichtenthaler, 2009). However, larger firms also tend to be less flexible and adaptive, and therefore have difficulties in renewing their capability endowment (Danneels, 2008). Size was captured with the logarithm of the number of employees. Slack resources are expected to influence capability development (Danneels, 2008). Stronger funds provide better research opportunities and enable quick reaction via mergers and acquisitions, for example. Slack human resources allow drawing employees from day-to-day-business and engaging in capability development activities (Danneels, 2008). Further, slack human resources may influence firm competence due to higher personnel capacities. However, slack also comes at a cost and may thus negatively influence capability development or firm competence. I measured slack resources ($\alpha = 0.72$) via three items adopted from Danneels' (2008) scale. I controlled for Firm Age as I wanted to isolate the effects of newly acquired and created knowledge from prior knowledge and experience, which are drivers for dynamic capability development (Zollo & Winter, 2002) or opportunity recognition (Shane, 2000). On the other hand, prior experience might have the effect of blinders that lead to path-dependency (Danneels, 2008). For a sub-sample of business units I validated the self-reported measures for size with data from annual reports and found them to correlate with 0.999 ($p<0.001$; N=30), indicating the reliability and validity of the measures.

TABLE 2.1: Variables and Operationalization

Recognition (α = .86) (7, "strongly agree", and 1, "strongly disagree")
We are slow to detect fundamental shifts in our industry (e.g. competition, technology, regulation).
We periodically review the likely effect of changes in our business environment (e.g. regulation) on customers.
We quickly understand new opportunities to serve our clients.
We are very good in observing and anticipating technological trends.
Monitoring (α = .87) (7, "strongly agree", and 1, "strongly disagree")
We regularly check the quality of our functional capabilities in comparison with competition.
We regularly check the quality of our functional capabilities in comparison with companies in different industries.
We pay a great attention on monitoring the change of functional capabilities.

After changing existing capabilities or integrating new capabilities, we pay a great attention on monitoring the efficiency of new processes.

Knowledge Acquisition (α = .81) (7, "strongly agree", and 1, "strongly disagree")

We frequently acquire knowledge about technologies and market trends from external sources.

We are able to identify and acquire external knowledge (e.g. market, technology) very quickly.

Employees of our unit regularly visit other branches to learn about new technologies, trends, or business models.

Knowledge Sharing (α = .77) (7, "strongly agree", and 1, "strongly disagree")

Existing knowledge (e.g. market or technology) is readily available to each department within our business unit.

Our business unit periodically circulates codified knowledge in form of documents (e.g., reports, newsletters) to update other departments.

When something important happens (market or technological development), the whole business unit knows about it in a short period.

Knowledge Creation (α = .88) (7, "strongly agree", and 1, "strongly disagree")

Our employees have the capabilities to produce many novel and useful ideas

Within this business unit, we have the capabilities successfully to learn new things.

We have the capabilities to effectively develop new knowledge or insights that have the potential to influence product development.

When solving problems, we can rely on good cross-departmental support.

Capability Creation (α = .90) (7, "strongly agree", and 1, "strongly disagree")

We are effective in transforming existing knowledge into new resources (e.g. new organization structure, new technical equipment).

Our employees introduce perceptible changes that lie outside the existing features of existing capabilities.

Our employees are able to identify valuable capability elements, connect, and combine them in new ways.

We can effectively recombine existing capabilities into 'novel' combinations

Capability Integration (α = .87) (7, "strongly agree", and 1, "strongly disagree")

Employees integrate new and existing ways of doing things without stifling their efficiency.

We can effectively integrate new externally sourced capabilities and combine them with existing capabilities into 'novel' combinations.

We can successfully integrate the new knowledge acquired with our existing knowledge.

Marketing Capability Development (α = .77) (During the last three years, we built/improved our capabilities to…) (7, "to a great extent", and 1, "not at all")

…price products/services appropriately.

…manage our sales force.

…effectively segment and target markets.

Technological Capability Development (α = .84) (During the last three years, we built/improved our capabilities to…) (7, "to a great extent", and 1, "not at all")

…run new kinds of production operations or facilities.

…use our engineering skills and resources in new technical areas.

…improve the efficiency and effectiveness of production department.

…master new technological equipment.

Organizational Capability Development (α = .88) (During the last three years, we built/improved our capabilities to…) (7, "to a great extent", and 1, "not at all")

…improve effective coordination of activities among departments.

…set up incentives systems.

…adequately allocate decision rights.

…organize the division of labor.

Marketing Competence (α = .75) (Relative to our best competitor, our business unit performs **today** with regard to…) (+3, "much better", and -3, "much worse")

…setting up new distribution channels.

…communication towards our customers.

…managing our sales force.

Technological Competence (α = .80) (Relative to our best competitor, our business unit performs **today** with regard to…) (+3, "much better", and -3, "much worse")

…effectiveness and efficiency of production facilities and operations.

…applying adequate technology to produce our products and services.

…assessing the feasibility of new technologies.

Organizational Competence (α = .85) (Relative to our best competitor, our business unit performs **today** with regard to…) (+3, "much better", and -3, "much worse")

…quickly deciding on important issues.
…integrating workflows from several departments.
…effective organizational design.
…terms of process duration.
Slack Resources (α = .72)) (7, "strongly agree", and 1, "strongly disagree")
My business unit has a reasonable amount of resources in reserve.
We have ample discretionary financial resources.
We can always find the 'manpower' to work on special projects.
Corporate Support (1, "never", 2, "rarely", 3, "sometimes", and 4, "often")
How often has your business unit used the support of specialized, internal departments, e.g. staff divisions or corporate center, for projects regarding strategic renewal or corporate development during the last three years?

2.4.3. Analytical Procedure

The objective of the analyses is to examine the construct validity of the proposed multi-dimensional measure of dynamic capabilities, including the hypotheses regarding the nomological validity, which refer to theoretically expected consequences of dynamic capabilities. To assess construct validity, I analyzed the correlation matrix of the items (Campbell & Fiske, 1959; Fornell & Larcker, 1981), and applied exploratory factor analysis (Segars & Grover, 1993) and confirmatory factor analysis (Bagozzi et al., 1991; Fornell & Larcker, 1981; Hair et al., 2010). The rationale behind this multi-method approach is to examine and ascertain the congruence between the results of the different methods. Additionally to Cronbach's alphas construct reliability (CR) is estimated for each measure based on confirmatory factor analysis to assess the internal consistency and thus reliability of the measures (Hair et al., 2010).

To examine convergent and discriminant validity of the seven first-order factors of dynamic capabilities (hypothesis 1a) I applied correlation analysis, exploratory factor analysis, and second-order confirmatory factor analysis. To examine hypothesis 1b, stating that the seven first-order factors of dynamic capabilities converge on one underlying second-order factor of dynamic capabilities, I applied second-order confirmatory factor analysis. Thereby, I operationalized dynamic capabilities as a superordinate construct (Edwards, 2001). To apply a superordinate model is appropriate as the sub-dimensions are manifestation of the underlying dynamic capabilities (Edwards, 2001). For all sub-dimensions of dynamic capabilities

being the first-order factors in the model, I used a reflective measurement model as all underlying items comprise the performance of a certain activity. This operationalization is further appropriate as it enables to account not only for the direct effects of the underlying dimensions, but also for complementary and compensatory effects among the dimensions (Tanriverdi & Venkatraman, 2005). To validate this superordinate model specification, I calculated the competing aggregate second-order version of the measurement model (Edwards, 2001). In order to examine if common method variance is an alternative explanation for the emergence of one single underlying factor I also tested a uni-dimensional measurement model of dynamic capabilities. Hypotheses 1c and 1d were tested applying third-order confirmatory factor analysis.

I assessed nomological validity (hypotheses 2 and 3) by applying structural equation modeling. Before assessing the relation between the dynamic capabilities measure and the expected consequences, I examined discriminant validity between these constructs applying the same methods outlined above. To account for convergent validity and discriminant validity within the confirmatory factor analysis and structural modeling, each item was allowed to load only on the factor for which it was the intended indicator and error terms were not allowed to correlate (Byrne, 2001; Mathieu & Farr, 1991). For confirmatory factor analysis and structural equation modeling, AMOS 19 with maximum-likelihood estimation was used. The data distribution shows skewness below 2 and a kurtosis below 7, and thus maximum-likelihood estimation is expected to provide reliable estimates (Curran, West, and Finch, 1996).

To evaluate model fit, I applied χ^2/df, TLI, CFI, RMSEA, and SRMR (Byrne, 2001; Cheung & Rensvold, 2002; Hair et al., 2010; Hu & Bentler, 1999; Marsh, Hau & Wen, 2004) with the usual cut-off values. For χ^2/df, values between 1.0 and 2.0 indicate a good fit and values between 2.0 and 3.0 indicate an acceptable fit (Schermelleh-Engel, Moosbrugger & Müller, 2003). For the TLI and the CFI, values above .90 traditionally are seen as good fit (Byrne, 2001; Cheung & Rensvold, 2002). An RMSEA below .05 also indicates a good model fit. The value for the SRMR should be less than .08. Hu and Bentler (1999) recommended a cut-off value for the TLI and CFI of .95, which has been criticized as being too rigid by Marsh et al. (2004). Byrne (2001) also states that the requirement for a cut-off value for the TLI and CFI above .95 is only reasonable with large sample size. In the context of management research, where senior managers are surveyed, the sample size of n=265 can be considered as large, however, in statistical terms large sample size is considered as being

above 1,000. For model comparisons, additionally AIC, BIC, and BCC are recommended, with lower values indicating the favorable model (Byrne, 2001; Schermelleh-Engel et al., 2003).

To validate the measurement and examine external validity, I used data from second informants and archival data for different sub-samples and examined the congruence with the self-reported data obtained from the first set of key informants. This also assures that the results are not inflated by single source bias. To validate the measures of dynamic capabilities and operational capability development, I first applied a sub-sample of second informants and examined the congruence between the two groups of key informants. To validate the measures of dynamic capabilities and operational capability development with archival data, I used R&D expenses and SG&A (selling, general, and administrative expenses) expenses, both in relation to sales value. As the use of capabilities is proposed to increase revenues and/or reduce costs (Barua, Konana, Whinston & Yin, 2004; Drnevich & Kriauciunas, 2011; Wang & Ang, 2004), the development of new capabilities or the improvement of existing capabilities is expected to lead to a smaller ratio of the respective expenses divided by sales. Thus, for operational capability development it can be expected that a higher amount of marketing and organizational capability development relates to a smaller ratio of SG&A expenses divided by sales and a higher amount of technological capability development relates to a smaller ratio of R&D expenses divided by sales. As dynamic capabilities are the drivers behind the development of operational capabilities it can be expected that they, albeit to a lesser extent, lead to a smaller ratio of both SG&A and R&D expenses divided by sales. For the validation of the measure for firm competence, I applied archival performance data. Prior research suggests that a higher use of ordinary capabilities (Drnevich & Kriauciunas, 2011) or a higher relative quality of ordinary capabilities (Spanos & Lioukas, 2001) is positively related to relative firm performance. Thus, for validation, I examined the relation of the measure for firm competence (which is the relative quality of operational capabilities) with relative measures of revenues and operating profits, obtained from the annual reports of the respective business units.

To assess the reliability and validity of the structural model, as a further statistical remedy to detect potential common method variance and common method bias, I applied the ULMC (Unmeasured Latent Method Construct)-technique, which accounts for all systematic variance within the data that is not accounted for by explicitly modeled relations (Podsakoff, MacKenzie, Lee & Podsakoff, 2003; Richardson, Simmering & Sturman, 2009). To further

assess the validity of the results, I applied random sub-sampling validation and examined if the results are robust across different sub-populations (Hair et al., 2010). Therefore, I conducted a group comparison with a random sample split and tested for the invariance of the model between the two randomly selected groups. To account for inter-method reliability, I applied ordinary least squares regression using SPSS. For the regression analysis I computed scales as the mean of the assigned items to operationalize the respective variables.

2.5. Results

2.5.1. Convergent, Discriminant, and External Validity of the Dynamic Capabilities Measure

To get a first impression regarding convergent and discriminant validity of the dynamic capabilities measure, I analyzed the Pearson correlations among all items assigned to the seven dimensions of dynamic capabilities (Hair et al., 2010). Table 2.2 gives the respective results.

Generally, in Table 2.2 we can observe significant correlations among all items assigned to the different dimensions of dynamic capabilities, indicating that all captured items are related to one overall construct. This is an important evidence for the appropriateness of deriving these items in order to reflect the overall measure of dynamic capabilities. A closer look at the correlation pattern further reveals that all items which are assigned to the same factor, show especially strong inter-correlations among each other. The high and significant correlations between the items assigned to the same factor thereby provide first evidence of convergent validity (Fornell & Larcker, 1981). In order to show discriminant validity any item should show higher correlations with items assigned to the same factor than with items assigned to another factor (Campbell & Fiske, 1959; Fornell & Larcker, 1981). The results in Table 2.2 show that this condition is met for any item of the seven first-order factors of dynamic capabilities. These results therefore are the first evidence for discriminant validity of the different variables reflecting the overall dynamic capabilities measure

TABLE 2.2: Descriptive Statistics and Pearson Correlations among Dynamic Capabilities Items

Item domain	No.	Mean	s.d.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1 Opportunity Recognition	1	5.07	1.46																								
2 Opportunity Recognition	2	4.91	1.38	.660**																							
3 Opportunity Recognition	3	4.69	1.42	.617**	.695**																						
4 Opportunity Recognition	4	4.62	1.45	.526**	.552**	.530**																					
5 Cability Monitoring	1	4.63	1.64	.420**	.346**	.401**	.369**																				
6 Cability Monitoring	2	3.62	1.71	.395**	.407**	.382**	.405**	.587**																			
7 Cability Monitoring	3	4.04	1.58	.406**	.404**	.422**	.458**	.704**	.638**																		
8 Cability Monitoring	4	4.12	1.51	.369**	.420**	.448**	.442**	.581**	.579**	.743**																	
9 Knowlege Acquisition	1	5.39	1.40	.360**	.298**	.290**	.355**	.369**	.417**	.369**	.342**																
10 Knowlege Acquisition	2	4.59	1.45	.494**	.469**	.462**	.458**	.375**	.474**	.414**	.404**	.633**															
11 Knowlege Acquisition	3	4.35	1.59	.333**	.314**	.364**	.381**	.339**	.420**	.394**	.344**	.531**	.584**														
12 Knowledge Transfer	1	3.97	1.61	.373**	.355**	.382**	.293**	.342**	.275**	.334**	.350**	.134*	.236**	.265**													
13 Knowledge Transfer	2	4.28	1.72	.255**	.340**	.336**	.295**	.335**	.220**	.359**	.296**	.281**	.273**	.316**	.574**												
14 Knowledge Transfer	3	4.77	1.70	.330**	.299**	.320**	.294**	.331**	.205**	.260**	.299**	.289**	.290**	.298**	.493**	.527**											
15 Knowledge Creation	1	5.46	1.18	.372**	.341**	.379**	.336**	.320**	.292**	.326**	.271**	.376**	.427**	.378**	.183**	.264**	.337**										
16 Knowledge Creation	2	5.10	1.29	.461**	.443**	.496**	.452**	.352**	.365**	.418**	.384**	.408**	.528**	.453**	.302**	.300**	.366**	.649**									
17 Knowledge Creation	3	5.23	1.26	.443**	.399**	.454**	.421**	.336**	.340**	.367**	.362**	.423**	.507**	.388**	.262**	.316**	.350**	.628**	.714**								
18 Knowledge Creation	4	5.11	1.40	.400**	.348**	.444**	.354**	.355**	.299**	.407**	.387**	.357**	.455**	.420**	.388**	.376**	.425**	.599**	.639**	.640**							
19 Capability Creation	1	4.45	1.37	.462**	.489**	.498**	.476**	.500**	.352**	.520**	.532**	.313**	.375**	.381**	.333**	.360**	.364**	.376**	.515**	.457**	.514**						
20 Capability Creation	2	4.79	1.27	.363**	.392**	.442**	.458**	.407**	.278**	.402**	.453**	.294**	.330**	.259**	.231**	.249**	.332**	.447**	.470**	.510**	.469**	.685**					
21 Capability Creation	3	4.86	1.24	.339**	.334**	.408**	.370**	.367**	.305**	.375**	.431**	.308**	.383**	.363**	.305**	.273**	.358**	.452**	.503**	.483**	.548**	.640**	.734**				
22 Capability Creation	4	4.71	1.37	.388**	.428**	.438**	.419**	.401**	.261**	.398**	.426**	.249**	.328**	.319**	.309**	.299**	.384**	.404**	.496**	.428**	.557**	.714**	.667**	.789**			
23 Capability Integration	1	4.70	1.20	.323**	.441**	.424**	.379**	.314**	.270**	.344**	.395**	.295**	.301**	.303**	.244**	.262**	.306**	.335**	.423**	.364**	.409**	.524**	.438**	.457**	.471**		
24 Capability Integration	2	4.81	1.14	.390**	.524**	.544**	.366**	.362**	.268**	.391**	.395**	.303**	.356**	.318**	.291**	.293**	.349**	.369**	.448**	.397**	.456**	.541**	.443**	.454**	.538**	.706**	
25 Capability Integration	3	5.01	1.19	.398**	.510**	.503**	.409**	.328**	.211**	.343**	.373**	.305**	.398**	.339**	.358**	.402**	.378**	.382**	.447**	.463**	.512**	.549**	.477**	.524**	.542**	.652**	.714**

N=265

**p<0.01; *p<0.05

In a next step I assessed convergent validity of the seven first-order factors of dynamic capabilities based on internal consistency, construct reliability, factor loadings, and average variance extracted of the seven first-order factors (Hair et al., 2010). Cronbach's alphas for the seven first-order factors of dynamic capabilities range between 0.77 and 0.90, suggesting good reliability and indicate internal consistency (Hair et al., 2010; Shook, Ketchen Jr, Hult & Kacmar, 2004).

Table 2.3 provides standardized factor loadings, construct reliabilities (CR), and average variance extracted (AVE) for the seven firs-order factors of dynamic capabilities obtained from a second-order confirmatory factor analysis.

TABLE 2.3: Standardized Factor Loadings, Construct Reliabilities, and Average Variance Extracted Dynamic Capabilities Dimensions

	Opportunity Recognition	**Capability Monitoring**	**Knowledge Creation**	**Knowledge Acquisition**	**Knowledge Sharing**	**Capability Creation**	**Capability Integration**
Item 1	0.68						
Item 2	0.82						
Item 3	0.83						
Item 4	0.77						
Item 5		0.81					
Item 6		0.90					
Item 7		0.72					
Item 8		0.77					
Item 9			0.78				
Item 10			0.83				
Item 11			0.85				
Item 12			0.75				
Item 13				0.71			
Item 14				0.85			
Item 15				0.73			
Item 16					0.71		
Item 17					0.76		
Item 18					0.73		
Item 19						0.87	
Item 20						0.86	
Item 21						0.81	
Item 22						0.81	
Item 23							0.84
Item 24							0.86
Item 25							0.80
AVE	60.5%	64.6%	64.6%	58.6%	53.4%	70.8%	69.2%
CR	0.86	0.88	0.88	0.81	0.77	0.91	0.87

All factor loadings of the seven first-order factors are highly significant ($p<0.001$) and exceed .70 with one exemption that falls just below the .70 standard with a value of .68. The average variance extracted estimates of all seven first-order factors exceed 50 percent, rang-

ing between 53.4 percent for knowledge sharing and 70.8 percent for capability creation. Construct reliabilities range from .77 for knowledge sharing to .91 for capability creation. Once again, these estimates exceed .70, indicating adequate internal consistency and reliability. Taken together, these results provide evidence supporting convergent validity of the seven first-order factors of dynamic capabilities.

To further examine discriminant validity, I conducted the Fornell-Larcker discriminant validity test based on confirmatory factor analysis. This is a more conservative approach providing stronger evidence for discriminant validity. Thereby the average variance extracted of a variable is compared with the squared correlation between the respective variable and any other variable in the model. There is evidence for discriminant validity if for each variable the average variance extracted exceeds the squared correlation with any other variable (Fornell & Larcker, 1981; Hair et al., 2010). Table 2.4 displays the construct correlations (below the diagonal) among the seven first-order factors of dynamic capabilities and the respective squared correlations (above the diagonal). All average variance extracted estimates from Table 2.3 exceed the corresponding squared correlations in Table 2.4. Therefore, this test also supports discriminant validity of the dynamic capabilities measurement model.

TABLE 2.4: Construct Correlations and Squared Construct Correlations Dynamic Capabilities Dimensions

	Opportunity Recognition	Capability Monitoring	Knowledge Creation	Knowledge Acquisition	Knowledge Transfer	Capability Development	Capability Integration
Opportunity Recognition	1.00	0.35	0.47	0.38	0.30	0.44	0.42
Capability Monitoring	0.59	1.00	0.35	0.28	0.22	0.32	0.31
Knowledge Creation	0.69	0.59	1.00	0.38	0.30	0.44	0.42
Knowledge Acquisition	0.62	0.53	0.62	1.00	0.24	0.35	0.34
Knowledge Transfer	0.55	0.47	0.55	0.49	1.00	0.28	0.27
Capability Development	0.66	0.57	0.66	0.59	0.53	1.00	0.39
Capability Integration	0.65	0.56	0.65	0.58	0.52	0.63	1.00

Significance level: all correlations are significant on the 0.001-level

Note: Values below the diagonal are correlation estimates among constructs, values above the diagonal are squared correlations.

According to these results, within an exploratory factor analysis the respective items loaded cleanly on the seven desired factors, providing additional support for convergent and discriminant validity of the seven first-order factors of dynamic capabilities. Table 2.5 provides these results.

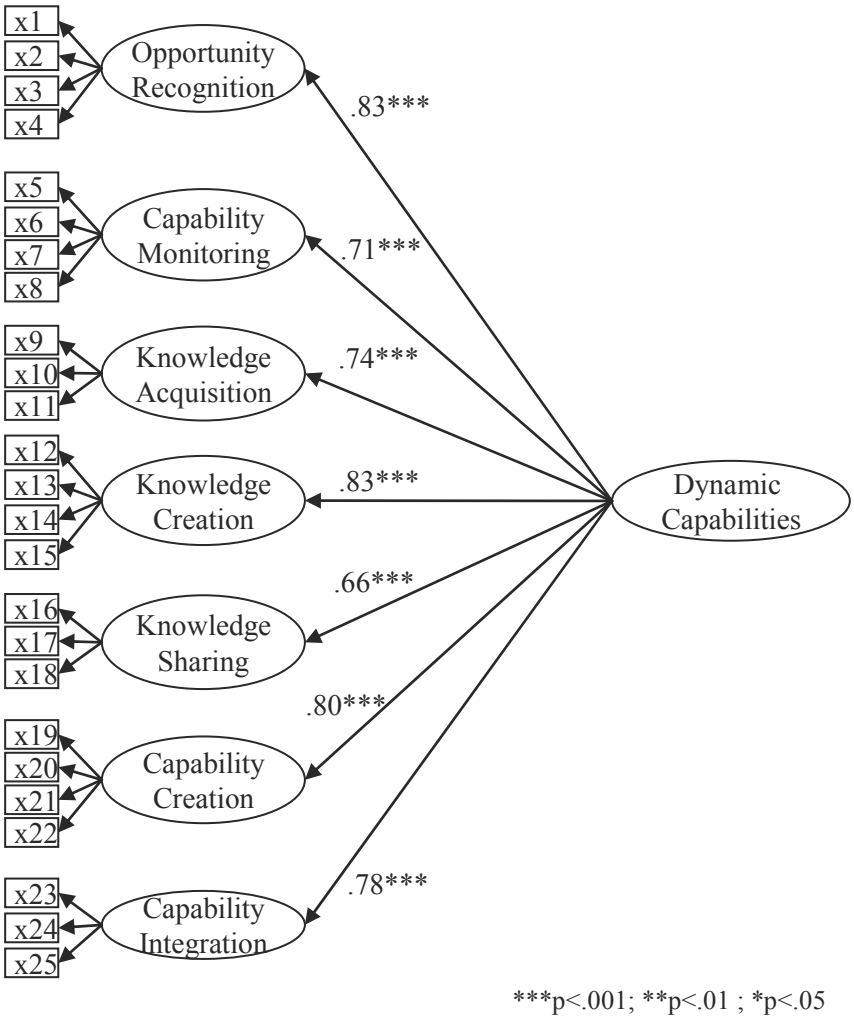
TABLE 2.5: Results of Exploratory Factor Analysis Dynamic Capabilities Measure

	Opportunity Recognition	Capability Monitoring	Knowledge Creation	Knowlege Acquisition	Knowledge Transfer	Capability Creation	Capability Integration
Item 1	.782						
Item 2	.657						
Item 3	.602						
Item 4	.432						
Item 5		.916					
Item 6		.700					
Item 7		.669					
Item 8		.598					
Item 9			.811				
Item 10			.784				
Item 11			.764				
Item 12			.615				
Item 13				.736			
Item 14				.695			
Item 15				.583			
Item 16					.737		
Item 17					.730		
Item 18					.574		
Item 19						.900	
Item 20						.806	
Item 21						.724	
Item 22						.536	
Item 23							.842
Item 24							.750
Item 25							.643

Note: Maximun-likelihood extraction with oblimin rotation and Kaiser-normalization; values below .30 are not displayed

Figure 2.2 presents the second-order measurement model of dynamic capabilities. All of the seven first-order factors show highly significant ($p<0.001$) and strong standardized second-order factor loadings. With .66 only knowledge sharing shows a factor loading just below the .70 standard, while all other factor loadings exceed this value ranging from .71 for capability monitoring to .83 for opportunity recognition and knowledge creation. Cronbach's alpha and construct reliability (CR) for the overall dynamic capabilities measure are 0.94 and 0.91 respectively, indicating an excellent internal consistency. The average variance extracted estimate of the second-order factor is 58.9 percent and thus exceeds the 50 percent rule of thumb.

FIGURE 2.2: Second-order Measurement Model of Dynamic Capabilities



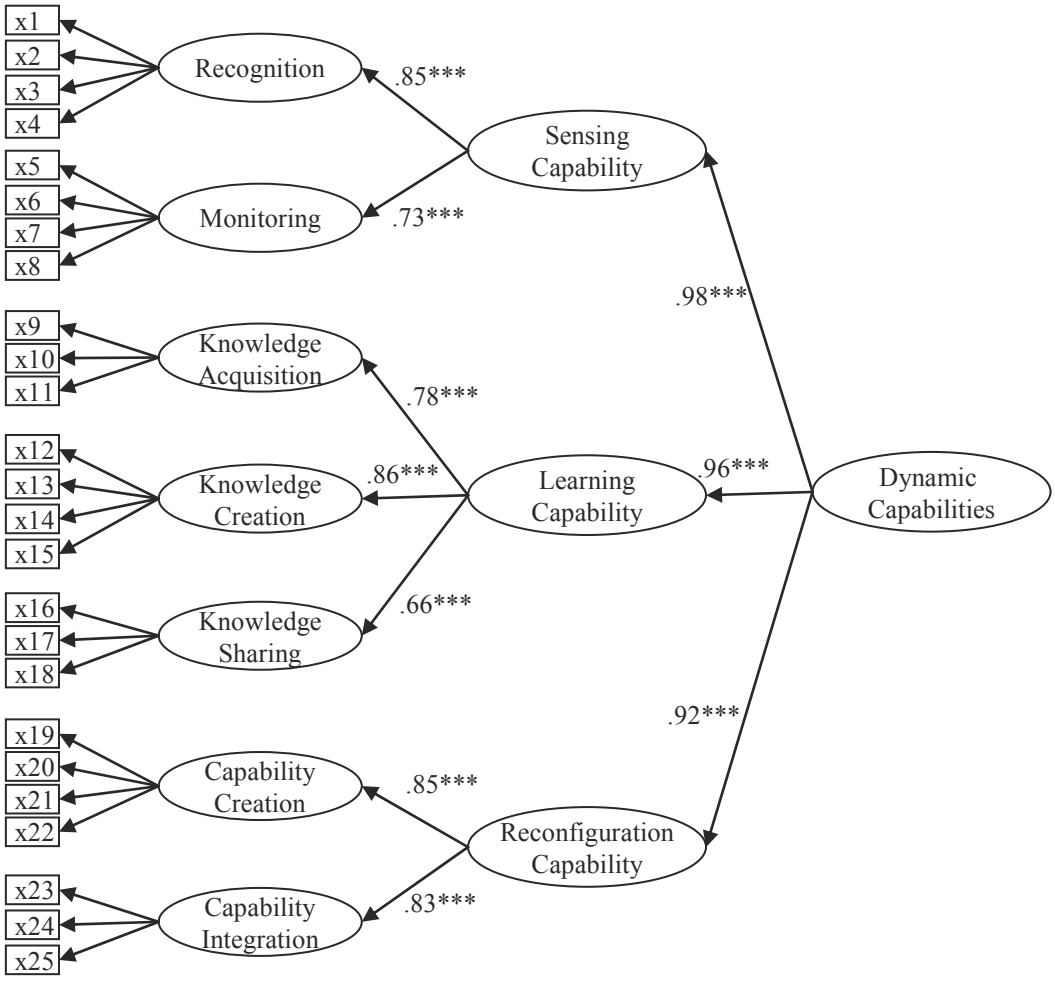
These results provide adequate evidence for the convergent validity of the second-order measurement model of dynamic capabilities (Fornell & Larcker, 1981; Hair et al., 2010; Shook et al., 2004). The second-order model fits with χ^2/df = 1.74, TLI = .95, CFI = .95, RMSEA = .05, and SRMR = .05 and thus indicates good fit with the data (Hair et al., 2010; Schermelleh-Engel et al., 2003). As no cross-loadings were drawn and error terms were not allowed to correlate, the strong and significant factor loadings in combination with the good model fit additionally evidence convergent and discriminant validity (Hair et al., 2010; Mathieu & Farr, 1991; O'Leary-Kelly & Vokurka, 1998). Within an exploratory factor analysis conducted on the seven first-order factors (not the underlying items as above), one single factor emerged underlying the seven first-order factors of the dynamic capabilities measure. Altogether, these results provide strong support for hypotheses 1a and 1b.

Because the measures were self-reported, an alternative explanation for the second-order factor might be common method variance rather than the overall construct of dynamic capabilities. If the second-order factor represented common method variance, one single, unidimensional first-order factor would also explain the variance within the data. A Harman's one factor test in a confirmatory factor analysis showed fit measures of χ^2/df = 5.65, TLI = .66, CFI = .69, RMSEA = .13, and SRMR = .09, and thus clearly has to be rejected. Based on these results common method variance is not expected to be severely problematic (Podsakoff et al., 2003; Podsakoff & Organ, 1986). To examine potential single source bias and to examine external validity, I validated the dynamic capabilities measure with data from second informants for a subsample of respondents. As I found a congruence in 82 percent of the cases with a correlation of .78 ($p<0.001$, N=22), I believe the measure to be reliable and valid (Batjargal, 2010; Carlson & Herdman, 2010). Further, the validation with archival data showed the expected negative relation between the measure of dynamic capabilities and SG&A expenses divided by sales ($r = -.19$; $p<0.1$; N = 75). However, the dynamic capabilities measure showed no significant correlation with R&D expenses divided by sales.

To validate the specification of the superordinate second-order model, I calculated the competing aggregate second-order version (Edwards, 2001; Jarvis et al., 2003; Law & Wong, 1999). With χ2/df = 1.81, TLI = .93, CFI = .94, RMSEA = .06, and SRMR = .06 the model shows lower fit values. Further, none of the second-order factor loadings is significant and the explained variance (48%) is much lower than in the superordinate version (68%). These results support the superordinate model specification (Borsboom, Mellenbergh & van Heerden, 2003; Coltman et al., 2008).

Hypothesis 1c stated that the seven first-order factors of dynamic capabilities will converge on three distinct second-order factors, which comprise sensing, learning, and reconfiguration. Hypothesis 1d stated that these three distinct second-order factors will converge on one overall construct of dynamic capabilities. To test these hypotheses, I conducted third-order confirmatory factor analysis. Figure 2.3 presents the results.

FIGURE 2.3: Third-order Measurement Model Dynamic Capabilities



***p<.001; **p<.01 ; *p<.05; †<.01

All second-order factor loadings and third-order factor loadings are strong and highly significant (p<0.001) and exceed .70. The average variance extracted estimates of sensing (63.2 percent), learning (59.1 percent), reconfiguration (70.7 percent), and the overall measure of dynamic capabilities (90.7 percent) all exceed .50. Construct reliability estimates are 0.77 for sensing, 0.81 for learning, 0.83 for reconfiguration, and 0.91 for the overall measure of dynamic capabilities. These results provide adequate evidence for convergent validity (Hair et al., 2010).

To examine discriminant validity between the three proposed second-order factors, I again compared the average variance extracted estimates for each second-order factor with the squared inter-construct correlations associated with that factor. Table 2.6 provides the respective squared correlations. For all three proposed second-order factors the average variance extracted estimates do not exceed the respective squared inter-construct correlations. A

nested model comparison with three correlated second-order factors comprising sensing, learning, and reconfiguration, where in one model the covariance estimates between the second-order factors were set to unity, underscores this result by showing that the model with freely estimated second-order correlations does not show significantly better fit (Hair et al., 2010). Thus, I fail to observe discriminant validity for the three second-order factors within the third-order model of dynamic capabilities, and therefore hypothesis 1c finds no support. While the three second-order factors for sensing, learning, and reconfiguration converge on one third-order factor, and thus, formally support hypothesis 1d, this observation is of limited value, as the second-order factors do not discriminate.

TABLE 2.6: Squared Construct Correlations Sensing, Learning, and Reconfiguration

	Sensing	Learning	Reconfiguration
Sensing	1.00		
Learning	0.89	1.00	
Reconfiguration	0.81	0.77	1.00

Note: all underlying correlations are significant at the 0.05-level (two-tailed)

2.5.2. Convergent, Discriminant, and External Validity Dependent Variables

Again, I assessed construct validity for the dependent variables applying second-order confirmatory factor analysis, exploratory factor analysis, and the item-based Pearson correlations.

Operational Capability Development. The measurement model of capability development fits with $\chi^2/df = 1.80$, TLI = .97, CFI = .97, RMSEA = .06, and SRMR = .05 and indicates good model fit. All factor loadings are highly significant ($p<0.001$) and range between .64 and .89. Cronbach's alphas for marketing capability development ($\alpha = 0.77$), the development of technological capabilities ($\alpha = 0.84$) and organizational capabilities ($\alpha = 0.88$) indicate good internal consistency. Average variance extracted estimates are 53.9 percent for marketing capability development, 56.6 percent for technological capability development, and 64.3 percent for organizational capability development. The overall construct reliability (CR) is 0.72. Further, the average variance extracted estimates for each capability dimension exceeds any squared correlation between two of the capability dimensions (see Table 2.7).

TABLE 2.7: Squared Construct Correlations among Dynamic Capabilities and Operational Capability Development Measures

	Dynamic Capabilities	Capability Dev. Organizational	Capability Dev. Technological	Capability Dev. Marketing	Capability Monitoring	Capability Integration	Capability Creation	Knowledge Creation	Knowledge Transfer	Knowledge Acquisition	Opportunity Recognition
Dynamic Capabilities	1.00										
Capability Dev. Organizational	0.28	1.00									
Capability Dev. Technological	0.24	0.16	1.00								
Capability Dev. Marketing	0.34	0.23	0.19	1.00							
Capability Monitoring	0.53	0.15	0.13	0.18	1.00						
Capability Integration	0.61	0.17	0.14	0.21	0.32	1.00					
Capability Creation	0.65	0.18	0.15	0.22	0.35	0.40	1.00				
Knowledge Creation	0.65	0.19	0.15	0.22	0.35	0.40	0.42	1.00			
Knowledge Transfer	0.45	0.13	0.11	0.16	0.24	0.28	0.29	0.29	1.00		
Knowledge Acquisition	0.54	0.15	0.13	0.18	0.29	0.33	0.35	0.35	0.24	1.00	
Opportunity Recognition	0.70	0.20	0.16	0.24	0.37	0.42	0.45	0.45	0.32	0.38	1.00

Note: all underlying correlations are significant at the 0.05-level (two-tailed)

TABLE 2.8: Squared Construct Correlations among Dynamic Capabilities and Firm Competence Measures

	Dynamic Capabilities	Organizational Competence	Technological Competence	Marketing Competence	Capability Monitoring	Capability Integration	Capability Creation	Knowledge Creation	Knowledge Transfer	Knowledge Acquisition	Opportunity Recognition
Dynamic Capabilities	1.00										
Organizational Competence	0.19	1.00									
Technological Competence	0.07	0.15	1.00								
Marketing Competence	0.13	0.28	0.10	1.00							
Capability Monitoring	0.50	0.10	0.03	0.07	1.00						
Capability Integration	0.62	0.12	0.04	0.08	0.31	1.00					
Capability Creation	0.64	0.12	0.04	0.08	0.32	0.40	1.00				
Knowledge Creation	0.68	0.13	0.05	0.09	0.34	0.42	0.43	1.00			
Knowledge Transfer	0.45	0.08	0.03	0.06	0.22	0.28	0.28	0.30	1.00		
Knowledge Acquisition	0.53	0.10	0.04	0.07	0.27	0.33	0.34	0.36	0.24	1.00	
Opportunity Recognition	0.70	0.13	0.05	0.09	0.35	0.44	0.45	0.48	0.31	0.38	1.00

Note: all underlying correlations are significant at the 0.05-level (two-tailed)

The Pearson correlations between the items assigned to the same factor are higher than between any item assigned to another factor. Accordingly, an exploratory factor analysis revealed the intended three-factor structure. Altogether, this indicates convergent and discriminant validity of the measures for operational capability development (Fornell & Larcker, 1981; Hair et al., 2010).

To examine potential single source bias and to examine external validity, I validated the measure with data from second informants for a subsample of N=18 respondents. As I found a congruence in 94% of the cases, I believe the measure to be reliable and valid (Batjargal, 2010; Carlson & Herdman, 2010). The validation with archival data partly showed the expected relations. The measure for marketing capability development ($r = -.31$; $p < 0.01$; $N = 75$) and the measure for organizational capability development ($r = -.32$; $p < 0.01$; $N = 75$) show the expected relation with the archival measure for SG&A expenses divided by sales. The respective correlation of technological capability development with R&D expenses divided by sales also shows the expected negative relation but is not significant.

Firm Competence. The measurement model of firm competence, with $\chi^2/df = 2.25$, TLI = .95, CFI = .96, RMSEA = .07, and SRMR = .06 and all factor loadings being highly significant ($p<0.001$) and substantive, also indicates an acceptable model fit. The factor loadings range between .64 and .84. Cronbach's alphas for marketing competence ($\alpha = 0.75$), technological competence ($\alpha = 0.80$) and organizational competence ($\alpha = 0.85$) show good internal consistency. Average variance extracted estimates are 51.1 percent for marketing competence, 59.2 percent for technological competence, and 59.3 percent for organizational competence. The construct reliability (CR) of the overall measure is 0.69. The average variance extracted estimates of the three competence dimensions exceed any squared correlation between two of the competence dimensions (see Table 2.8). The Pearson correlations between the items assigned to the same factor are higher than between any item assigned to another factor. Accordingly, an exploratory factor analysis revealed the intended three-factor structure. These results adequately evidence convergent and discriminant validity of the measurement model for firm competence (Fornell & Larcker, 1981; Hair et al., 2010).

To examine potential single source and single method bias and to examine external validity, I validated the measure for firm competence with archival data for market and financial performance. As firm competence is argued to be positively related to firm performance (Spanos & Lioukas, 2001), firm performance measures are adequate for validation. To validate the subjective measure of firm competence I applied the following approach. At the be-

ginning of the survey, the respondents were asked to indicate their strongest competitor, before they actually were asked to rate their relative operational capabilities and performance against them. I validated the indication of the strongest competitor based on available data sources (e.g. Hoover's company profiles). In a second step, I compared the archival performance data (net sales and operating profits) of the business unit with the archival performance data of the competitor which was indicated in the survey. Then I compared the result with the subjective scale ratings where the respondents indicated their firm competence and investigated if an advantage (disadvantage) in both performance measures corresponds with an advantage (disadvantage) in self-reported firm competence. For 15 pairs of business units, I found congruence in 67 percent of the cases, indicating reliability and validity of the competence measure.

2.5.3. Discriminant Validity between Dynamic Capabilities and Dependent Variables

Before I actually test the hypotheses regarding nomological validity of dynamic capabilities, I examined discriminant validity between the dynamic capabilities measure and operational capability development and firm competence, which serve as dependent variables, respectively. Table 2.7 and Table 2.8 display the squared inter-construct correlations of the measures of operational capability development (Table 2.7) and firm competence (Table 2.8) with the dynamic capabilities measure, respectively, both obtained from simultaneous confirmatory factor analysis. In Table 2.7, we can observe that the squared inter-construct correlation between the measures of capability development and the second-order measure of dynamic capabilities do not exceed the average variance extracted estimates of the corresponding factors. Thus, there is adequate evidence for discriminant validity. In Table 2.8, the respective results for firm competence also provide adequate evidence for discriminant validity. Table 2.9 displays the squared inter-construct correlations between the measures for operational capability development and firm competence. As all squared inter-construct correlations are well below the average variance extracted estimates associated with the corresponding constructs, these results further evidence discriminant validity between the measures of operational capability development and the measures of firm competence.

TABLE 2.9: Squared Construct Correlations Operational Capability Development and Firm Competence Measures

	Capability Dev. Organizational	Capability Dev. Technological	Capability Dev. Marketing	Organizational Competence	Technological Competence	Marketing Competence
Capability Dev. Organizational	1.00					
Capability Dev. Technological	0.16	1.00				
Capability Dev. Marketing	0.24	0.19	1.00			
Organizational Competence	0.09	0.07	0.10	1.00		
Technological Competence	0.03	0.03	0.04	0.14	1.00	
Marketing Competence	0.07	0.05	0.08	0.29	0.11	1.00

Note: all underlying correlations are significant at the 0.05-level (two-tailed)

To simultaneously examine discriminant validity of the seven factors assigned to the dynamic capabilities construct, the measures of operational capability development and firm competence, I analyzed the item correlations and conducted exploratory factor analysis. In order to show discriminant validity any item should show higher correlations with items assigned to the same factor than with items assigned to another factor (Campbell & Fiske, 1959; Fornell & Larcker, 1981). Within an exploratory factor analysis the items should load cleanly on the 13 desired factors without significant cross loadings. The analysis of the Pearson correlations revealed higher intra-factor correlations than inter-factor correlations for any item in the study and thus provide support for discriminant validity (Fornell & Larcker, 1981). Table 2.10 gives the results of exploratory factor analysis, where the items loaded cleanly on the 13 desired factors without showing cross loadings that could be of any concern. Thus, the result of exploratory factor analysis also provides evidence for discriminant validity of the measures applied in this study.

TABLE 2.10: Results of Exploratory Factor Analysis Dynamic Capabilities, Operational Capability Development, and Firm Competence

	Faktor												
	Opportunity Recognition	**Capability Monitoring**	**Knowledge Creation**	**Knowledge Acquisiton**	**Knowledge Sharing**	**Capability Creation**	**Capability Integration**	**Mark. Cap. Development**	**Organ. Cap. Development**	**Technol. Cap. Development**	**Marketing Competence**	**Organizational Competence**	**Technological Competence**
Item 1	**.702**	.193	.147	.137	.143	.108	.270	.147	.100	.131	.069	.235	.031
Item 2	**.563**	.220	.241	.198	.139	.123	.093	.074	.089	.178	.200	.148	-.009
Item 3	**.536**	.216	.261	.114	.142	.158	.259	.247	.114	.082	.179	.195	-.015
Item 4	**.437**	.264	.206	.187	.115	.173	.118	.106	.086	.297	.057	.061	.121
Item 5	.089	**.842**	.172	.103	.130	.102	.125	.107	.143	.193	-.005	.073	.048
Item 6	.160	**.672**	.117	.113	.131	.229	.148	.091	.185	.138	.041	.037	.010
Item 7	.085	**.644**	.139	.153	.183	.160	.122	.219	.065	.117	.103	.007	.071
Item 8	.198	**.617**	.136	.312	.041	.053	-.002	.049	.175	.069	.071	.077	.004
Item 9	.201	.135	**.738**	.197	.128	.174	.135	.032	.080	.121	.014	-.003	.081
Item 10	.165	.188	**.694**	.208	.099	.200	.134	.001	.130	.097	.098	.232	.017
Item 11	.093	.119	**.674**	.187	.080	.181	.120	.023	.096	.069	.017	.087	.021
Item 12	.042	.156	**.601**	.153	.263	.261	.196	.069	.173	.108	.067	.076	.073
Item 13	.269	.226	.306	**.668**	.075	.097	.094	.004	.084	.136	.065	.095	.006
Item 14	.048	.192	.241	**.666**	.058	.038	.108	.129	.154	.189	.021	-.018	.007
Item 15	.110	.233	.245	**.551**	.199	.128	.113	.028	.095	.065	-.036	.036	-.049
Item 16	.066	.153	.135	.122	**.685**	.042	.109	.158	.153	.091	-.022	.115	.086
Item 17	.184	.204	.095	.019	**.676**	.111	.065	.005	.132	-.012	.148	.118	.075
Item 18	.043	.049	.213	.138	**.554**	.155	.141	.135	.148	.142	.156	.064	.034
Item 19	.044	.154	.285	.166	.114	**.775**	.173	.066	.154	.086	.037	.075	.150
Item 20	.121	.166	.241	.046	.151	**.704**	.260	.118	.151	.144	.080	.110	.056
Item 21	.148	.174	.300	.036	.047	**.624**	.168	.138	.121	.313	-.001	.066	.140
Item 22	.207	.313	.229	.064	.153	**.524**	.274	.128	.206	.168	.011	.124	.049
Item 23	.180	.159	.198	.095	.110	.198	**.748**	.104	.163	.105	.065	.164	.004
Item 24	.120	.157	.178	.111	.085	.237	**.651**	.018	.174	.079	.014	.178	.006
Item 25	.196	.083	.235	.136	.230	.258	**.616**	.015	.219	.080	.068	.127	.132
Item 26	.108	.115	.031	.023	.077	.154	-.008	**.778**	.126	.168	.173	.089	-.058
Item 27	.078	.177	.083	.113	.115	.081	.066	**.595**	.249	.221	.080	.154	-.006
Item 28	.097	.112	-.013	.033	.103	.031	.081	**.517**	.168	.248	.146	.000	.070
Item 29	-.001	.130	.086	.078	.038	.106	.113	.087	**.864**	.108	.068	.122	.006
Item 30	.028	.125	.026	.132	.132	.154	.105	.099	**.701**	.054	.081	.104	.042
Item 31	.076	.123	.143	.022	.042	.009	.092	.158	**.694**	.123	.106	.081	-.014
Item 32	.149	.085	.137	.074	.264	.141	.112	.129	**.684**	.055	.020	.064	.080
Item 33	.058	.106	.028	.093	.077	.134	.095	.064	.055	**.775**	.071	.061	.107
Item 34	-.050	.149	.131	.061	.022	.059	.040	.162	.110	**.747**	.069	.011	.139
Item 35	.101	.037	.022	.051	-.006	.071	.037	.119	.005	**.720**	-.055	-.025	.072
Item 36	.171	.104	.132	.091	.102	.080	.021	.134	.158	**.597**	-.002	.030	.028
Item 37	.053	.086	.051	-.026	.003	.047	-.040	.143	.129	-.020	**.760**	.237	.118
Item 38	.052	-.027	.023	.059	.125	.036	.053	.099	.027	.074	**.649**	.132	.050
Item 39	.124	.108	.048	-.007	.060	-.013	.081	.088	.099	-.013	**.534**	.270	.162
Item 40	.004	.081	.090	.022	.031	.002	.112	.083	.124	-.009	.120	**.816**	.130
Item 41	.044	.033	.019	.058	.066	.054	.077	.028	.006	.075	.114	**.727**	.137
Item 42	.111	.058	.114	.001	.063	.178	.039	.119	.135	.012	.167	**.706**	.147
Item 43	.169	-.016	.059	.006	.107	.011	.096	-.013	.086	-.014	.187	**.639**	.039
Item 44	.082	.004	.040	.023	.080	.101	.011	.028	-.061	.143	-.003	.076	**.909**
Item 45	-.012	.049	.072	-.079	.081	.051	-.025	.061	.079	.078	.143	.158	**.686**
Item 46	-.023	.041	.004	.055	-.004	.073	.114	-.119	.068	.145	.191	.263	**.610**

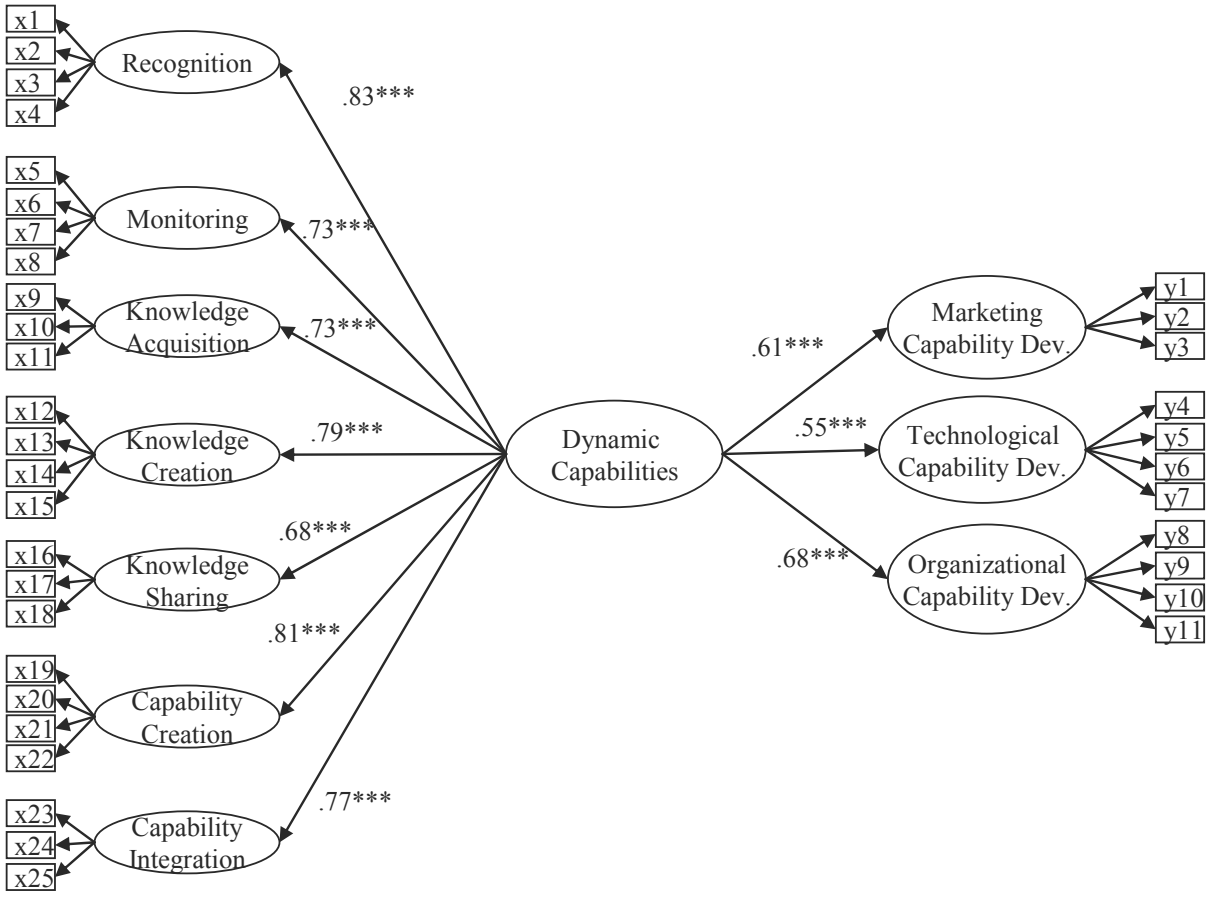
Note: Maximum-likelihood estimation with varimax rotation and Kaiser-normalization. Boldface indicates the 13 factors derived.

2.5.4. Nomological Validity Dynamic Capabilities Measure

To test the relation of the dynamic capabilities measure with its theoretically expected consequences, I applied structural equation modeling. To test hypothesis 2, stating that dynamic capabilities are positively related to the development of operational capabilities, I constructed a structural model where dynamic capabilities as independent variable omits paths to three separate first order factors comprising the development of marketing, technological, and organizational capabilities as dependent variables.

First, I included all control variables into the model. From all control variables I drew a path to all three dependent variables. Then I removed insignificant controls as this does not affect substantive results, but reduce the model fit due to higher complexity and the non-significant relations (Danneels, 2008). Figure 2.4 presents the resulting model with the standardized path estimates of the main effects.

FIGURE 2.4: Results Structural Equation Modeling Dynamic Capabilities and Operational Capability Development



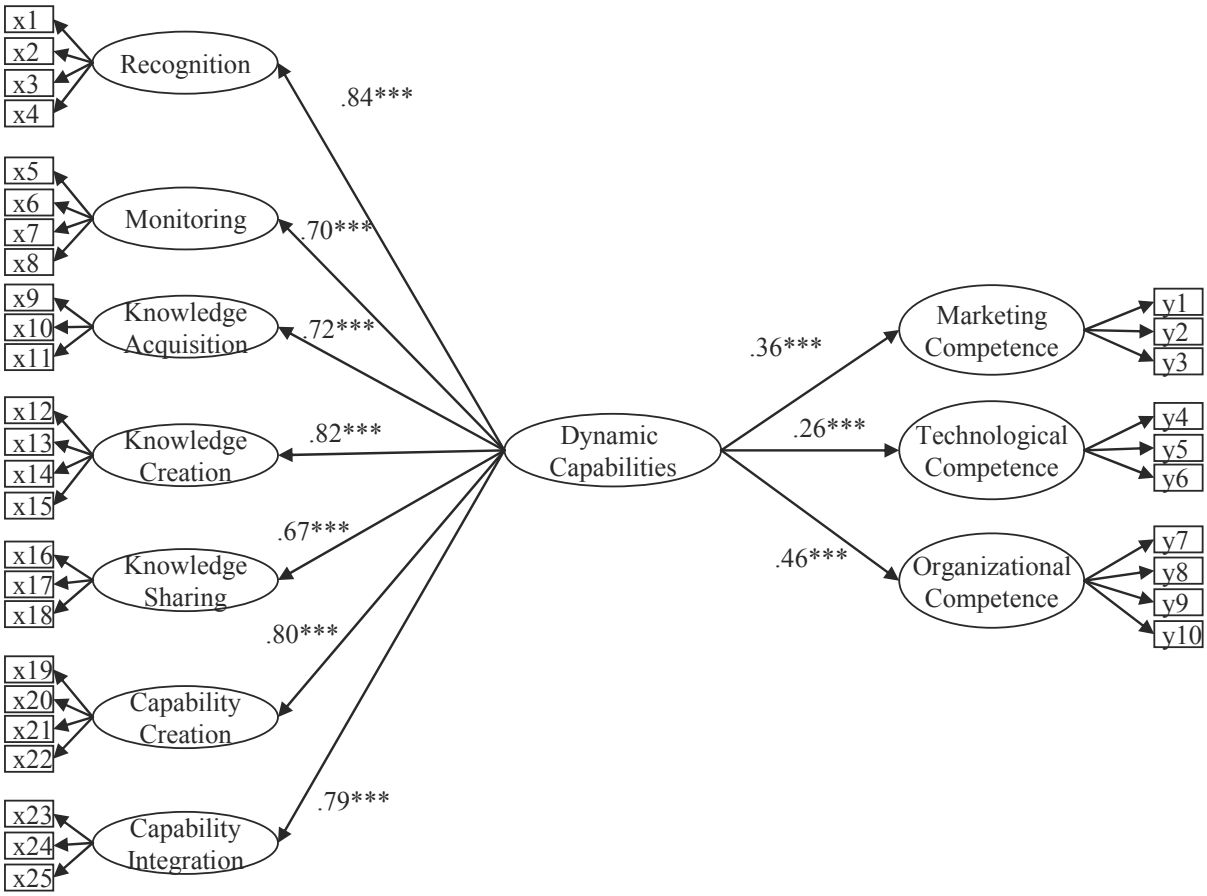
***p<.001; **p<.01 ; *p<.05

The model fit is: χ^2/df = 1.63, TLI = .91, CFI = .92, RMSEA = .05, and SRMR = .07. Dynamic capabilities show strong and significant effects on all three areas of capability development, with the strongest effect on organizational capability development followed by marketing capability development and technological capability development, thereby providing support for hypothesis 2. Firm size shows a positive and significant (.28; $p<0.001$) effect on technological capability development, while banking/insurance shows a negative and significant (-.14; $p<0.01$) effect. Firm age (-.13; $p<0.05$) and slack resources (-.20; $p<0.001$) show a negative and significant effect on marketing capability development, while the industry control for consumer goods shows a positive and significant (.14; $p<0.01$) effect.

To detect potential common method variance, I applied the ULMC (Unmeasured Latent Method Construct)-technique (Podsakoff et al., 2003; Richardson et al., 2009). To identify the trait-method model, I constrained the measurement factor loadings of the method construct to be equal (Podsakoff *et al.*, 2003). The method-only model did not fit the data at all, while the trait-only model (χ^2/df = 1.63) showed better fit than the trait-method model (χ^2/df = 1.65). These results suggest that the path estimates are not biased based on common method variance (Podsakoff et al., 2003; Richardson et al., 2009). Moreover, within the trait-method model, where the unmeasured latent construct accounts for all systematic variance within the data that is not accounted for by the hypothesized relations, the main effects of dynamic capabilities on the development of marketing capabilities (.58; $p<0.001$), technological capabilities (.52; $p<0.001$), and organizational capabilities (.55; $p<0.001$) are not significantly different compared to the trait-only model, neither in effect strength nor in significance level.

To examine the effect of dynamic capabilities on firm competence (hypothesis 3), I constructed a model containing dynamic capabilities as independent variable and the three competence dimension. – marketing, technological, and organizational – as dependent variables. Further, I included the same controls and followed the same approach as outlined above. Figure 2.5 presents the results.

FIGURE 2.5: Results Structural Equation Modeling Dynamic Capabilities and Firm Competence



***p<.001; **p<.01 ; *p<.05

The model fit is: χ^2/df = 1.64, TLI = .91, CFI = .92, RMSEA = .05, and SRMR = .07. Dynamic capabilities show strong and significant effects on marketing and organizational competence and a moderately strong and significant effect on technological competence. These results support hypothesis 3. Again, a single method construct could not explain the data, so that common method variance is not expected to be severely problematic (Podsakoff et al., 2003; Podsakoff & Organ, 1986). The industry controls for consumer goods (.17; p<0.01), transport and services (.13; p<0.05), and firm size (-.15; p<0.05) show significant effects on marketing competence. Consumer goods (.14; p<0.05) and transport and services (.19; p<0.01) also show significant effects on organizational competence. Slack resources show a significant effect (.17; p<0.01) on technological competence.

To cross-validate the results, I conducted a variation of holdout validation. Therefore, I randomly split the sample in two subsamples of equal size and tested for invariance of the structural paths within a group comparison. If the results were sample specific or the model

was fitted to the specific sample under analysis, this should result in different effects within the two subsamples. Again, I evaluated the competing models based on χ^2/df. For both structural models presented above, the results of the group comparison provided evidence that the structural paths do not vary between the two randomly selected subsamples, and thus, evidence the stability of the results and their validity. Further, I cross-validated the two structural models applying ordinary least squares regression. As the variance inflation factors of the seven sub-dimensions of dynamic capabilities are below 2.5, multicollinearity is not expected to be severely problematic (Hair et al., 2010). The results are displayed in Table 2.11. The OLS results support the findings from structural equation modeling.

TABLE 2.11: Results Cross Validation with OLS Regression

	Dependent Variable					
	Capability Development Marketing	Capability Development Technological	Capability Development Organizational	Marketing Competence	Technological Competence	Organizational Competence
	Beta Sign.	**Beta Sign.**	**Beta Sign.**	**Beta Sign.**	**Beta Sign.**	**Beta Sign.**
Telecommunication	.00	.00	.01	-.03	-.02	.07
Automobile	-.01	.13	.05	-.01	.09	-.02
Computer/IT	-.05	.08	-.01	-.03	-.02	-.02
Banking/Insurance	.01	-.15 **	.09	.09	-.07	.07
Energy	.01	-.02	.02	-.03	-.01	-.02
Chemicals/Pharmaceuticals	.08	.12	-.07	.10	-.01	.06
Machinery	.06	.08	.08	-.01	.04	-.06
Transport and Services	-.07	-.08	.05	.14 *	.03	.18 **
Consummer Goods	.14 *	-.04	.10	.13	-.06	.13
Firm Size	.12 *	.16 **	.11 *	-.08	.02	-.04
Firm Age	-.16 **	.00	.02	-.01	-.06	.02
Slack Resources	-.17 **	.05	.03	.03	.20 **	.07
Corporate Support	.03	.09	.03	-.01	-.02	-.06
Dynamic Capabilities	.51 ***	.43 ***	.50 ***	.29 ***	.20 **	.36 ***
R^2	.30 ***	.30 ***	.31 ***	.15 ***	.12 ***	.19 ***

N=265
*** p<0.001
** p<0.01
* p<0.05

2.6. Discussion

2.6.1. Implications and Future Research Directions

This study takes an initial step in developing and validating a comprehensive multidimensional measurement model of dynamic capabilities. Based on prior conceptual research on dynamic capabilities seven distinct but related dimensions are derived, in which dynamic capabilities manifest, which in turn enable a firm to identify the need for change, to formulate a response to arising opportunities and threats, and to implement appropriate actions in terms of

capability reconfiguration. In order to identify the need for reconfiguration, firms must be able to recognize opportunities and threats arising from changes in the business environment and must relate these changes to the internal capability position (Barreto, 2010; Schreyögg & Kliesch-Eberl, 2007; Teece, 2007). In order to formulate a response, firms need a strong learning ability (Teece et al., 1997; Teece, 2007), and thus, must be able to internally create and to externally acquire knowledge and to share this knowledge throughout the organization (Eisenhardt & Martin, 2000; Verona & Ravasi, 2003; Zahra & George, 2002). Finally, to implement a response, firms must be able to create new capabilities and to integrate newly created or acquired capabilities into the existing capability configuration (Barreto, 2010; Eisenhardt & Martin, 2000; Teece, 2007). In this regard the proposed multidimensional measure of dynamic capabilities shows good content validity when compared to prior conceptual research on dynamic capabilities.

The analyses in this study provide evidence of the convergent and discriminant validity of the seven sub-dimensions of dynamic capabilities and further indicate that each of the seven sub-dimensions contributes to an overall construct of dynamic capabilities, while not being related to a uni-dimensional underlying construct. All sub-dimensions and the overall construct of dynamic capabilities further show high internal consistency. However, the analyses showed that the three theoretically distinct second-order dimensions of dynamic capabilities – sensing, learning, and reconfiguration – could not be extracted as three empirically discriminating dimensions.

As an additional step towards construct validity, I examined the nomological validity of the proposed measure of dynamic capabilities by investigating its relation towards the development of operational capabilities and firm competence, which I showed to be two distinct outcomes of dynamic capabilities that also clearly discriminate from the focal construct. Thereby, I found support for the proposed relations by showing that the measure of dynamic capabilities is positively related to the development of operational capabilities and to a weaker extent to firm competence. The difference in effect strength regarding these two dependent variable sets provides additional evidence for the validity of the measure, as it mirrors the sequence of the theoretical effect chain. Dynamic capabilities drive the development of operational capabilities in the first place, which as a consequence may establish firm competence in the respective areas. The congruence with perceptual measures obtained from second informants and with archival data further underscores the validity of the proposed measurement model of dynamic capabilities. The application of a parallel test with OLS regression and

holdout validation provide further evidence of the stability of the results presented, and thus, also underscores the validity and reliability of the dynamic capabilities measure.

Regarding the archival measures, I applied for validation, some issues are noteworthy. SG&A expenses divided by sales show the expected relations with dynamic capabilities and capability development in the marketing and in the organizational domain and seem adequate for validation purposes. However, the measure expectably shows a stronger relation with capability development than with dynamic capabilities. Thus, while being adequate for validation purposes, such measures are inadequate to be applied as direct measure for dynamic capabilities. Even though R&D expenditures divided by sales has been applied as a measure for dynamic capabilities or related concepts (e.g. absorptive capacity) in prior studies, this measure turns out to be inadequate to capture dynamic capabilities. This finding is congruent with the findings of Lichtenthaler (2009), who found that R&D intensity is not related with absorptive capacity. R&D expenditures divided by sales are further an inadequate measure for technological capability development. R&D expenditures mirror the efforts a firm undertakes in research and development. Such research effort is to a large extent related to technological features of new products and services, and are not necessarily directed towards production technology. Further, R&D expenditures do not mirror the costs associated with applying production technologies for the production of goods and services. A measure that directly covers these 'production costs' would rather show the expected relations with dynamic capabilities and technological capability development.

This research contributes to the literature by developing a multidimensional measurement model of dynamic capabilities which shows high construct validity. My hope is to contribute to future research by providing guidance for applying measures of dynamic capabilities that conjointly account for the relevant facets of the construct. This is necessary to assure that findings in fact relate to the overall construct instead of singular facets, where the results might be contingent to different conditions as the overall construct (Wong, Law & Huang, 2008). Further, the measure of dynamic capabilities proposed in this study helps to clarify between the nature of the construct and its effects (Zahra et al., 2006). While showing that the measure of dynamic capabilities is positively related to the development of operational capabilities, the results also clearly demonstrate that these are two distinct constructs. By only applying measures for capability development as proxy for dynamic capabilities, we risk to neglect alternative explanations for observed relations. Once proxies are applied for measuring dynamic capabilities when testing for their effects (e.g. on firm performance) we risk to as-

cribe characteristics or effects to dynamic capabilities which actually relate to a different construct.

As a further effort in developing and validating a multidimensional measure of dynamic capabilities future research might expand the number of dimensions attributable to dynamic capabilities. Further, future research might develop objective measures for the dimensions of dynamic capabilities outlined in this study or investigate the partial nomological net applied here in a longitudinal study design. In this study I developed a superordinate model of dynamic capabilities as I derived seven dimensions in which dynamic capabilities manifest. Future studies might develop a competing aggregate multidimensional measurement model of dynamic capabilities by operationalizing the various dimensions which combine to 'produce' the construct and are outlined in prior conceptual work on dynamic capabilities.

2.6.2. Limitations

This study applies perceptual measures from the same data source for dependent and independent variables, which bears the risk of common method variance that can not be totally ruled out. However, the inclusion of an unmeasured latent method construct and the validation based on objective measures and second informants reduced my concerns that the results might be biased based on common method variance. The high inter-rater reliability and the congruence with archival data suggest the results to be reliable and valid.

As this empirical study focuses on business units of large firms operating in Germany, the findings should be validated in alternative settings. I approached the largest firms of the respective industries, which include all 110 firms listed in the three major stock exchanges and all 100 largest firms operating in Germany. Those firms might be more successful in the market place than the average of the basic population, in terms of financial performance or firm competence. While this may explain the relatively high level of dynamic capabilities and firm competence in many firms, it also calls for a validation within a broader sample. However, in this study I controlled for firm size, excess resources, and corporate support in order to detect potential effects. As the surveyed firms operate internationally, the results should hold in comparable settings than Germany.

3. THE DIRECT AND COMPLEMENTARY EFFECTS OF DYNAMIC CAPABILITIES ON OPERATIONAL CAPABILITY DEVELOPMENT AND FIRM COMPETENCE

3.1. Introduction

The dynamic capabilities framework (Teece et al., 1997) has important implications for research and managerial practice as it explains how firms can build operational capabilities of superior quality and in turn may attain or sustain competitive advantage (Eisenhardt & Martin, 2000; Helfat et al., 2007; Teece et al., 1997) by implementing value creating strategies, which are not simultaneously being implemented by competitors (Barney, 1991). Prior empirical research suggests that dynamic capabilities indeed affect operational capabilities (Protogerou et al., 2011) and thereby contribute to a superior quality of operational capabilities (Pavlou & El Sawy, 2006).

Dynamic capabilities are a multi-dimensional construct that relates to several distinct but related dimensions (Barreto, 2010; Helfat et al., 2007; Teece, 2007). They include the ability to identify the need for change, to formulate a response, and to implement appropriate measures (Helfat *et al.*, 2007). While conjointly unfolding an overall contribution to the establishment of operational capabilities of superior quality, Helfat et al. (2007) argue that not every dimension fulfils all functions. This raises the question about the direct contributions of the several dimensions of dynamic capabilities regarding the overall outcome of dynamic capabilities. Further, it raises questions about the interrelatedness of the several dimensions of dynamic capabilities in order to conjointly contribute to an overall outcome. When the simultaneous contributions of the direct effects of several related dimension on a certain output are examined, this automatically raises the question of potential complementary effects of these several dimensions. Complementarity among different dimensions is defined as when the increase of one of them increases the returns from doing more of one of the others (Milgrom & Roberts, 1995). To date there is a dearth of knowledge regarding the simultaneous direct contributions of dynamic capabilities' dimensions and their potential complementary effects.

To better understand the impact of dynamic capabilities on other organizational outcomes like operational capabilities or firm competence it is potentially interesting to further explore the direct and complementary effects of their several dimensions. Prior research on the complementarity between resources and/or capabilities found that resource complementarity cre-

ates greater synergy potential from acquisitions and alliances (Harrison, Hitt, Hoskisson & Ireland, 2001) or that marketing and technological capabilities unfold additional complementary effects on joint venture performance in high levels of environmental dynamism (Song et al., 2005). Tanriverdi and Venkatraman (2005) found that product knowledge relatedness, customer knowledge relatedness, and managerial knowledge relatedness do not unfold significant positive direct effects on firm performance on their own, but that synergies arising from their complementary effects unfold significant positive effects on performance. Lichtenthaler (2009) found that exploratory, transformative, and exploitative learning of absorptive capacity unfold complementary effects on innovation and performance.

Dynamic capabilities manifest in several capabilities. Opportunity recognition, capability monitoring, knowledge acquisition, knowledge creation, knowledge sharing, capability creation, and capability integration conjointly drive the development of operational capabilities and conjointly enable to create operational capabilities of superior quality and thereby help to establish firm competence. While conjointly contributing to the development of capabilities and the establishment of firm competence, the several dimensions fulfill partly different functions. To better understand the nature and the effects of dynamic capabilities, I examine the direct effects of the seven dimensions of dynamic capabilities in order to identify the respective portion of the overall effect that is attributable to the several dimensions. Further, for a better understanding of dynamic capabilities, it is interesting to examine the relative contribution of the several dimensions, and to examine whether the several dimensions equally contribute to different outcomes, e.g. capability development, firm competence, or different capability areas. The interrelatedness of the seven dimensions of dynamic capabilities suggests potential complementary effects (Arora, 1996; Milgrom & Roberts, 1995). Thus, it is potentially promising to examine how different levels of opportunity recognition, for example, affect the outcome of learning abilities or capability creation.

Findings reveal that the several dimensions of dynamic capabilities unfold divergent effects on the development of operational capabilities and the establishment of firm competence. Further, the results show that on a stand-alone basis not every dimension of dynamic capabilities directly contributes to dynamic capabilities' expected outcomes, but that synergies arise from their combinative effects. The results show that, additional to the direct effects, dynamic capabilities dimensions unfold significant complementary and compensatory effects on the several dimensions of firm competence.

This study provides several contributions to the research field of dynamic capabilities. First, this study unveils the direct effects by which the several dimensions of dynamic capabilities drive the development of new operational capabilities. Thereby, this study offers deeper insight into the nature and the effects of dynamic capabilities by examining their impact as a specific mode of capability development. The results show that the several dimensions of dynamic capabilities have a different direct impact on the development of new operational capabilities and the establishment of competence in certain capability areas. Further, the impact of the several dimensions of dynamic capabilities on capability development and firm competence seems to partly depend on the content of the capability domain, in which new capabilities are developed. Second, the analysis of potential complementary effects unveils that additional positive effects on the establishment of firm competence arise from synergies among the dynamic capabilities dimensions. The results provide evidence that additionally to the direct effects significant complementarities arise from the combination of the several dimensions. Thereby, each of the seven dimensions is found to be part of at least one significant complementary effect. Taken together these results provide important implications for research and management practice.

While an analysis of the direct effects of several dynamic capability dimensions clearly contribute to a deeper understanding, the results of this study question the usefulness of examining the effects of singular dimensions of the concept and drawing conclusions on concept level. In the case of multi-dimensional constructs like dynamic capabilities, the involved dimensions conjointly contribute to an overall outcome and often this contribution may vary due to the nature of the examined outcome. As the overall effect of such a multi-dimensional construct arises from the superadditive effect of the several dimensions' direct effects and their multilateral interactions, future research on dynamic capabilities should account for this issue by applying appropriate operationalizations (Tanriverdi & Venkatraman, 2005; Wong et al., 2008). Further, this study provides important implications for managerial practice. The results reveal why some firms may be more successful in developing new operational capabilities and in turn are more successful in creating a stronger relative capability position. For firms aiming at building or implementing dynamic capabilities this study's results imply that it might be disadvantageous to implement only individual dimensions of dynamic capabilities. Instead of implanting individual dimensions, firms aiming at the development of dynamic capabilities should aim at completely implementing the several dimensions in order to gain from their potential benefits.

3.2. Theory and Hypotheses

3.2.1. Direct Effects of the Dynamic Capability-Dimensions on Operational Capability Development and Firm Competence

Dynamic capabilities operate on operational capabilities by building, improving, or modifying these operational capabilities (Helfat & Peteraf, 2003) and in turn foster a higher relative quality in operational capabilities, which is termed firm competence in this paper (Pavlou & El Sawy, 2006; Teece et al., 1997). In order to examine the direct effects of this causal chain, I analyze both the direct effects of the dynamic capabilities dimensions on the development of operational capabilities and on firm competence.

Opportunity recognition refers to the ability to identify changes in the business environment, such as the development of novel technological solutions or the change in customer preferences. As changes in the business environment may have competence-destroying effects on existing capabilities (Anderson & Tushman, 1990), such changes may require a reconfiguration of existing operational capabilities (Teece et al., 1997). In order to stay competitive in terms of the existing capability configuration, it is vital to recognize the opportunities and threats that may arise from changes in the business environment and to identify the trajectories in which potential novel developments will evolve (Teece, 2007). Changes in the external environment may open up capability gaps that weaken a focal firm's ability to compete successfully in the market place (Capron & Mitchell, 2009; Lavie, 2006). The identification of external events that might drive changes in technologies or customer needs is therefore expected to be an important trigger for the development of capabilities in order to avoid capability gaps or as an attempt to close capability gaps that have been opened up. A better ability to recognize potential opportunities and threats arising from changes in the environment quicker or more accurate further provides firms with an advantage regarding the establishment of competence. Earlier recognition allows for more time to develop new capabilities, allows for a better adjustment during the development process, and enables to complete the reconfiguration of capabilities ahead of competition. Thus, opportunity recognition is very much likely to be positively related to the development of operational capabilities and to firm competence.

Capability monitoring refers to the internal surveillance of the existing capability configuration. According to Schreyögg and Kliesch-Eberl (2007) this relates to monitoring the systems capabilities as well as its evolvement and usage. Monitoring is thereby seen as a sepa-

rate function to continuously check whether and why the capability configuration has to be adjusted to cope with external challenges (Schreyögg & Kliesch-Eberl, 2007). Thereby it relates to tracking the internal fit of operational capabilities, the necessity of external-driven change, and the surveillance of change processes as well as the results of changes in operational capabilities. Capability monitoring thus enables to calibrate the internal capacity (in terms of effectiveness and efficiency) of the capability configuration with externally driven requirements. The ability to monitor the existing capability configuration serves as a further trigger for the development of capabilities as it helps to identify the need to reconfigure the capability configuration. Further, it helps to track the development process and helps to identify when the desired capability position is reached. A better ability to conduct such monitoring activities may provide an additional advantage for developing capabilities of superior quality due to a better adjustment of the newly developed capabilities to their desired purpose. Therefore, it is likely that capability monitoring is positively related to the development of operational capabilities and to firm competence.

Knowledge acquisition refers to the ability to acquire new knowledge from external sources. Prior research (Lichtenthaler, 2009; Zahra & George, 2002) suggests that a firm's ability to acquire new knowledge from external sources is an integral part of dynamic capabilities. Eisenhardt and Martin (2000) state that the acquisition of external knowledge fosters superior performance. Capabilities of any kind in a large part consist of knowledge (Grant, 1996a; Zander & Kogut, 1995). The acquisition of external knowledge broadens the existing knowledge base of the firm, allows gaining new insights, and enables to implement alternative solutions that are new to the focal firm. The acquisition of new knowledge from external sources is further important for replicating skills existing outside of the firm (Teece et al., 1997). The acquisition of new knowledge leverages existing knowledge and skills and newly acquired knowledge can be utilized to create and augment capabilities (Lyles & Salk, 1996). This allows for developing new capabilities based on the recombination of existing and newly acquired knowledge. A better knowledge acquisition ability is likely to enable the acquisition of new knowledge quicker and more effectively and thus to strengthen capability development. Firms with a better ability to acquire new external knowledge are likely to show a higher performance regarding the development of new capabilities. As a consequence they are also rather able to create capabilities of superior quality. A better ability to acquire new knowledge enables a better access to valuable knowledge resources on an ongoing basis which strengthen the firm's capabilities. Therefore, it is likely that knowledge acquisition

ability enables a firm to establish capabilities of higher quality. Thus, knowledge acquisition is expected to be positively related to the development of operational capabilities and firm competence.

Knowledge creation refers to the ability to create new knowledge internally. Internal knowledge creation is a complement for external learning through the acquisition of knowledge from external sources (Cassiman & Veugelers, 2006). Internal learning, as opposed to external acquisition of knowledge, is also a vital part for developing or improving capabilities (Teece, 2007) as it allows to develop new capabilities by the recombination of existing and novel knowledge (Kogut & Zander, 1992). Internal creation of knowledge allows improving the capability configuration by enhancing its effectiveness and efficiency. The creation of new knowledge thereby builds the fundament for building new capabilities (Iansiti & Clark, 1994). Thus, knowledge creation fosters the development of new capabilities, such as product development capabilities (Smith, Collins & Clark, 2005). Again, a better ability to create new knowledge is likely to lead to a higher performance in capability development and in turn help to create a higher quality of operational capabilities. Therefore, knowledge creation is expected to be positively related to the development of operational capabilities and to firm competence.

Knowledge sharing refers to the ability to transfer and disseminate knowledge throughout the firm, sharing it among different departments and hierarchy levels. When new knowledge emanates from different sources (internal and external), in the case that externally acquired knowledge originates from different interfaces with the environment (Cohen & Levinthal, 1990), or relates to partly different capability areas, such knowledge has to be effectively shared throughout the organization. As knowledge further resides within individuals and knowledge acquisition within the firm also occurs on the level of individuals, knowledge sharing among individuals and groups is vital for enabling collective activities (Cohen & Levinthal, 1990; Grant, 1996a). In order to be used appropriately new knowledge from different sources has to be assimilated (Zahra & George, 2002) as its combination is especially vital for the development of new capabilities (Kogut & Zander, 1992). Developing new capabilities requires bringing together specialized knowledge residing in various areas within the firm (Grant, 1996a). The development of new capabilities thereby largely depends on sharing knowledge throughout the firm (Kogut & Zander, 1996). A higher ability to share knowledge fosters the ability to develop new capabilities and in turn enables to establish capabilities of

superior quality. Thus, knowledge sharing is expected to be positively related to the development of operational capabilities and firm competence.

Capability creation refers to the ability to internally build new capabilities. This relates to the transformation of existing resources and capabilities, i.e. to change the form, shape, or appearance of capabilities existing within the firm (Carlile, 2004; Teece, 2007). Further, it includes redeployment or recombination of existing capabilities (Galunic & Rodan, 1998). Capability creation involves the transformation of knowledge into novel capabilities (Kogut & Zander, 1992; Zahra & George, 2002). Further, the ability to recombine existing capabilities into novel combinations drives the development of new operational capabilities (Eisenhardt & Martin, 2000; Zander & Kogut, 1995). This also includes the reconfiguration of existing configurations by linking their components in a new way (Henderson & Clark, 1990). Such abilities drive the successful development of new capabilities. The building of new capabilities or the modification and improvement of existing capabilities strengthens the firm's capability configuration (Helfat & Peteraf, 2003), and is thus expected to be positively related to the development of operational capabilities and to firm competence.

Capability integration refers to the ability to include new capabilities into the firm's existing capability configuration, connecting them and linking them with existing resources and capabilities (see Eisenhardt & Martin, 2000; Iansiti & Clark, 1994; Teece et al., 1997; Teece, 2007). Capability integration is a further important foundation of capability development (Iansiti & Clark, 1994). When new capabilities are created or acquired, it is important to integrate these new capabilities into the existing capability configuration without stifling the effectiveness and efficiency of the existing capability configuration. Thus, the ability to integrate new capabilities without harming the capability configuration is likely to be positively related to the successful development of operational capabilities and to firm competence.

Hypothesis 1a: The seven dimensions of dynamic capabilities have independent positive direct effects on ordinary capability development.

Hypothesis 1b: The seven dimensions of dynamic capabilities have independent positive direct effects on firm competence.

3.2.2. Complementary Effects of the Dynamic Capability-Dimensions on Firm Competence

When the direct effects of distinct but related dimensions of an overall construct are examined, it is likely to observe additional complementary effects on a certain outcome arising from the combination of two or more of these dimensions. Complementary effects, again, are defined as when "doing *more* of one thing *increases* the returns to doing *more* of another" (Milgrom & Roberts, 1995, p. 181).

As outlined above, the seven dimensions of dynamic capabilities fulfill distinct functions in order to foster capability development and establish firm competence. Due to their interrelatedness, it is likely that the combinative effects of several of the seven dimensions additionally contribute positively to firm competence (Arora, 1996; Milgrom & Roberts, 1995; Tanriverdi & Venkatraman, 2005).

It is very likely that firms with a better ability to recognize opportunities and threats may also realize higher benefits from performing other activities relating to the application of dynamic capabilities. For example, the effectuation of necessary adjustments aiming at calibrating the requirements for change also depends on the ability to identify external changes (Teece et al., 1997). A better ability to identify changes in customer needs or to identify relevant external technological developments is likely to increase the benefits from monitoring the internal capability configuration in order to calibrate the internal capacity with external demands. Further, timely recognition and the identification of trajectories of possible development paths (e.g. technological development) allows for focusing and optimizing activities regarding the creation and acquisition of knowledge, and thus may additionally increase the benefits from performing these activities. The accurate detection of external changes and the ability to recognize which capability areas might be affected may additionally increase the benefits from knowledge sharing. Further, early recognition allows to select appropriate reconfiguration mechanism (Lavie, 2006) and a better ability to recognize relevant changes provides better guidance about the capabilities or capability areas that have to be modified. Thus, a better ability to recognize opportunities and threats may additionally increase the benefits from capability creation, as these activities are better adjusted to future requirements.

A better ability to monitor the capacity of the existing capability configuration is also very likely to increase the benefits from activities such as knowledge creation and knowledge sharing or capability creation. A better understanding about the existing capability position in

the sense of understanding its capacity provides better information about which kind of new knowledge is necessary and about the question, whether existing capabilities just have to be modified or whether new capabilities have to be developed. Thus, capability monitoring becomes the source for 'critical signals' and puts potential change requirements on the agenda of organizational decision making (Schreyögg & Kliesch-Eberl, 2007). Therefore, capability monitoring may additionally increase the effectiveness and efficiency of activities like knowledge creation and acquisition or capability creation. Capability monitoring may increase the benefits from conducting these activities as it helps to focus on relevant aspects and helps to concentrate activities. Monitoring may therefore increase the benefits from abilities such as knowledge creation, knowledge acquisition, and knowledge sharing.

In order to react to changes through the creation of new capabilities, firms often need to acquire or create new knowledge to foster the development of new capabilities. Prior research thereby suggests that firms often cannot rely on internal sources for new knowledge alone, but additionally have to use external sources to acquire new knowledge (Kogut & Zander, 1992; Lichtenthaler, 2009). Kogut and Zander (1992) propose that there is some value in knowledge recombination through internal and external learning. This is because externally acquired knowledge leverages the value of internally created knowledge and vice versa. Cassiman and Veugelers (2006), for example, reported complementary effects of internal R&D and external knowledge sourcing on innovation activities. In light of these results it is likely that knowledge creation and knowledge acquisition unfold complementary effects on firm competence. Further, knowledge acquisition and knowledge creation should also increase the benefits from performing activities related to capability creation. As capabilities consist of knowledge to a large extent (Grant, 1996b), the acquisition and creation of new knowledge additionally enhance the quality of newly developed capabilities, and thus increase the benefits from capability creation. Often external change affects several capability areas. Changing customer need may not only require new marketing capabilities to address them but also new technological capabilities to produce the required products or services as well as new complementary organizational and managerial capabilities to internally coordinate the respective activities (Teece, 2007). When external changes arising from different sources affect different capability areas within the organization, the ability to effectively share new knowledge throughout the organization is vital for implementing appropriate responses (Cohen & Levinthal, 1990; Jaworski & Kohli, 1993). Thus, it is likely that complementary effects arise

from performing knowledge sharing activities and activities relating to capability creation and capability integration.

Further, it is likely that complementary effects arise from the abilities to create new capabilities and to effectively integrate new capabilities. The benefits from creating new capabilities are likely to be at least partly dependent on effectively integrating newly developed capabilities into the existing capability configuration without stifling its effectiveness and efficiency. New capabilities have to be linked to existing capabilities and resources in a way that enables the performance of the ongoing business activities without disruption. Thus, a better ability to integrate newly developed capabilities into the current capability configuration is likely to increase the benefits from creating new capabilities.

> **Hypothesis 2:** Dynamic capabilities' dimensions unfold complementary effects on firm competence.

3.3. Methods

3.3.1. Sample and Data Collection

The analyses of this study are based on the same data as the study described in Chapter 2. Thus, the sample and the data collection procedure are equal to those described in Chapter 2.4.1. To minimize redundant repetition I would like to refer to Chapter 2.4.1. for a recall of the explanations regarding sample and data collection.

3.3.2. Measurement and Validation of Constructs

To analyze the direct and complementary effects of dynamic capabilities on capability development and firm competence, I applied the same variables based on the same items as described in Chapter 2.4.2.

Firm competence was again measured applying the three scales for m*arketing competence* (α = 0.75), *R&D/technological competence* (α = 0.80), and m*anagerial/organizational competence* (α = 0.85). *Operational capability development* was again measured with the three scales representing marketing capability development (α = 0.77), technological capability development (α = 0.84), and organizational capability development (α = 0.88). *Dynamic capabilities* were again measured applying the seven scales capturing *opportunity recognition* (α = 0.86), *capability monitoring* (α = 0.87), *knowledge acquisition* (α = 0.81), k*nowledge sharing* (α = 0.77), *knowledge creation* (α = 0.88), c*apability creation* (α = 0.90), and *capa-*

bility integration ($\alpha = 0.87$). Within the analyses, I further controlled for corporate support, firm size, firm age, and slack resources using the same operationalization as in Chapter 2.

Please refer to Table 2.1 in Chapter 2 for the explicit operationalization of the variables. To re-examine the validation of the measures, please consult Chapter 2.5. As the aim of this study is to explore the direct and complementary effects of the dynamic capabilities dimensions on the several dimensions of capability development and firm competence, I measured all variables as separate first-order factors and did not apply higher-order modeling.

3.3.3. Discriminant Validity among Dependent Variables and Independent Variables

In order to assess convergent and discriminant validity for all constructs in the study, I conducted confirmatory and exploratory factor analysis and the analysis of the item-based Pearson correlations simultaneously with all factors relating to the independent variables and the dependent variables. For all variables analyzed, the correlations between items assigned to the same factor are higher than between the respective items and any item assigned to another factor, revealing the intended 13-factor structure. Within the confirmatory factor analysis the average variance extracted estimate for each variable exceeds the squared multiple correlation between each underlying factor and any other factor in the study. Accordingly, an exploratory factor analysis also revealed the intended 13-factor structure. I further established discriminant validity between the measures of dynamic capabilities, firm competence, and operational capability development with a nested model comparison. Therefore, I conducted separate confirmatory factor analyses for each pair of variables, where in one model the covariance between the two constructs was constrained to unity while being freely estimated in the other model. For each pair the model with the freely estimated covariance showed better fit based on χ^2/df with a significant ($p<0.001$) χ^2-difference test, providing evidence for discriminant validity among the measures (Hair et al., 2010). Please see also Chapter 2.5.3 regarding discriminant validity between the variables representing the dependent and independent variables in this study.

3.4. Analysis and Results

3.4.1. Analytical Procedure

To test hypotheses 1a and 1b regarding the direct effects of the dynamic capabilities dimensions on operational capability development and firm competence, I applied structural equation modeling (SEM) based on maximum-likelihood estimation with AMOS 19 software package and for cross validation ordinary least squares regression with SPSS. The data distribution shows skewness below 2 and a kurtosis below 7, and thus maximum-likelihood estimation is expected to provide reliable estimates (Curran, West, and Finch, 1996). To account for convergent validity and discriminant validity within the structural models, each item was allowed to load only on the factor for which it was the intended indicator and error terms were not allowed to correlate (Byrne, 2001; Mathieu & Farr, 1991). To account for the intercorrelations among the seven dimensions of dynamic capabilities, I drew covariances between any two of the dimensions, which were allowed to be freely estimated. To evaluate model fit, I applied χ^2/df, TLI, CFI, RMSEA, and SRMR (Byrne, 2001; Cheung & Rensvold, 2002; Hair et al., 2010; Hu & Bentler, 1999; Marsh et al., 2004) with the usual cut-off values. To account for potentially differing effects on the distinct competence dimensions, I created three separate models with marketing competence, technological competence, and organizational competence as dependent variables, respectively. Further, I included the control variables corporate support, slack resources, firm size, and firm age into the models.

To test for potential complementary effects between the dimensions, I used pair-wise interaction tests of each pair of the seven dynamic capability dimensions. Using pair-wise interaction tests is common when the complementarity between three or more dimensions is examined (Tanriverdi & Venkatraman, 2005). While this approach may not be capable to capture potentially existing multilateral interactions among the seven dimensions (Lichtenthaler, 2009; Whittington, Pettigrew, Peck, Fenton & Conyon, 1999), it is appropriate in order to identify at least the existence of complementary effects arising from the combination of any pair of the seven dimensions.

Tanriverdi and Venkatraman (2005) argue that it is potentially problematic when there are high intercorrelations between the predictor variables (the seven dimensions of dynamic capabilities) and between the predictor variables and their pair-wise interaction terms. While high intercorrelations among the several dimensions are congruent with complementarity theory (Milgrom & Roberts, 1995), multicollinearity may be problematic for the interpretation of the results (Frazier, Tix & Barron, 2004). Even though the several dimensions of dy-

namic capabilities show significant intercorrelations all variance inflation factors are below 2.5, indicating that multicollinearity is not severely problematic (Hair et al., 2010). Nevertheless, to further reduce the potential for problems regarding high intercorrelations, I z-standardized the continuous predictor variables to calculate their interaction terms (Frazier et al., 2004). In consequence, the highest observed intercorrelation between a predictor variable and an interaction term containing the respective predictor variable was r=-.44, which is at the lower end of the range that Tanriverdi and Venkatraman (2005) report in their study. The variance inflation factors within the models containing the interaction terms were below 2.5, again reducing concerns regarding multicollinearity.

3.4.2. Results

Table 3.1 presents the descriptive statistics and Pearson correlations of the variables analyzed in this study. In Table 3.1 we can observe high and significant intercorrelations among the dynamic capabilities dimensions, which is congruent with complementarity theory (Milgrom & Roberts, 1995) and with findings regarding the complementary effects of related constructs, e.g. absorptive capacity (Lichtenthaler, 2009). An examination of the nomological relations reveals that overall the dimensions of dynamic capabilities show stronger correlations with the dimensions of operational capability development than with the dimensions of firm competence. This correlation pattern is in congruence with the theoretically proposed relations, where dynamic capabilities drive the development of operational capabilities, which in turn fosters competence (a relative advantage) in the respective capability dimensions. It is interesting to note that, while the development of technological capabilities only shows significant relations with competence in the technological domain, the development of marketing capabilities is positively associated with competence in the marketing *and* the organizational domain.

TABLE 3.1: Descriptive Statistics and Pearson Correlations

Variables	Mean	s.d.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1 Marketing competence	4.38	1.02																
2 Technological competence	4.34	0.94	.29 ***															
3 Organizational competence	4.07	0.99	.43 ***	.34 ***														
4 Marketing capability development	4.87	1.28	.33 ***	.10	.23 ***													
5 Technological capability development	4.65	1.36	.11	.25 ***	.11	.43 ***												
6 Organizational capability development	4.39	1.30	.25 ***	.14 *	.27 ***	.42 ***	.27 ***											
7 Corporate support	3.10	0.96	.05	.02	.03	.06	.11	.11										
8 Firm size (log)	3.21	1.08	-.14 *	.01	-.08	-.01	.28 ***	.07	.14 *									
9 Firm age (log)	1.30	0.54	.03	.01	.02	-.10	.14 *	.00	-.01	.38 ***								
10 Slack resources	3.36	1.32	.11	.23 ***	.15 *	-.07	.14 *	.14 *	.16 *	.08	.00							
11 Opportunity recognition	4.82	1.19	.33 ***	.20 **	.37 ***	.44 ***	.40 ***	.38 ***	.02	-.07	.06	.15 *						
12 Capability monitoring	4.10	1.37	.21 ***	.14 *	.20 ***	.41 ***	.35 ***	.40 ***	.11	.04	.03	.18 **	.57 ***					
13 Knowledge acquisition	4.78	1.26	.13 *	.07	.16 **	.28 ***	.32 ***	.34 ***	.17 **	-.03	.02	.14 *	.54 ***	.54 ***				
14 Knowledge transfer	4.34	1.39	.27 ***	.20 ***	.28 ***	.35 ***	.24 ***	.40 ***	.10	-.06	-.06	.09	.47 ***	.42 ***	.38 ***			
15 Knowledge creation	5.23	1.10	.20 **	.18 **	.28 ***	.26 ***	.30 ***	.38 ***	.07	.00	.05	.15 *	.57 ***	.48 ***	.59 ***	.46 ***		
16 Capability creation	4.70	1.16	.20 ***	.26 ***	.28 ***	.38 ***	.40 ***	.43 ***	-.01	-.07	-.02	.16 *	.57 ***	.53 ***	.43 ***	.43 ***	.63 ***	
17 Capability integration	4.84	1.05	.22 ***	.19 **	.35 ***	.29 ***	.27 ***	.44 ***	.07	-.08	-.01	.15 *	.58 ***	.43 ***	.43 ***	.43 ***	.55 ***	.63 ***

N = 265
*** p<0.001
** p<0.01
* p<0.05

Table 3.1 further shows that the development of new organizational/managerial capabilities shows a positive relation to all three competence domains. This indicates the importance of organizational/managerial capabilities in order to establish firm competence in different functional areas, which in turn is an important precondition for firm performance and competitive advantage. Studies that investigate the performance effects of capabilities often focus on marketing or technological capabilities as their links to firm performance are more obvious, while the potential contribution of organizational capabilities is often neglected. Corporate support shows no significant relation with capability development or firm competence, which confirms the decision to conduct this study on the level of business units. Firm size, firm age, and slack resources, however, show significant relations with the several dependent variables, underpinning the decision to control for their effects.

Table 3.2 presents the results from SEM and OLS analysis. They present the direct effects of the seven dynamic capabilities dimensions on capability development within the different capability areas. The structural models show good fit measures and the regression models explain a significant portion of variance. Overall, we can observe that not each dimension of dynamic capabilities unfolds a significant effect on every dimension of operational capability development. Opportunity recognition shows significant positive relations to marketing capability development and technological capability development, while capability monitoring only shows a significant relation to marketing capability development. Knowledge acquisition shows a marginally significant positive effect on technological capability development only in the SEM analysis. Knowledge sharing shows significant positive direct relations to marketing capability development and organizational capability development.

Different than expected, knowledge creation shows (marginally) significant negative relations to marketing and technological capability development within the SEM analysis and to marketing capability development within the OLS analysis. Capability creation shows significant positive relations to marketing and technological capability development within the SEM analysis, while showing significant positive relations to all three capability areas in the OLS analysis. Capability integration shows a significant negative relation to marketing capability development and a significant positive relation to organizational capability development within the SEM analysis. Within the OLS analysis, capability integration only shows a significant positive relation to organizational capability development. Corporate support shows no significant influence on the three areas of capability development. Further, slack resources and firm age show negative relations to marketing capability development, while firm size shows positive relations to technological and organizational capability development within

the SEM analysis and with all three capability dimensions within the OLS analysis. The partly differing results between SEM and OLS mainly result from differences in scale construction. In SEM the items have individual weights within a factor, while in OLS equal weights are assigned to each item. Taken together, the results described here provide partial support for hypothesis 1a.

TABLE 3.2: SEM and OLS Results Direct Effects of Dynamic Capabilities Dimensions on Operational Capability Development

	Dependent Variable: **Marketing Capability Development**	Dependent Variable: **Technological Capability Development**	Dependent Variable: **Organizational Capability Development**
Independent Variables			
SEM Results			
	β sign.	**β sign.**	**β sign.**
Opportunity recognition	.49 ***	.24 *	-.05
Capability monitoring	.17 †	.03	.12
Knowledge acquisition	-.02	.18 (†)	.07
Knowledge sharing	.16 †	.04	.21 *
Knowledge creation	-.24 †	-.20 (†)	-.06
Capability creation	.31 **	.41 ***	.17
Capability integration	-.19 †	-.13	.24 *
Corporate support	.05	.04	.04
Slack resources	-.20 ***	.03	.04
Firm size	.09	.31 ***	.11 †
Firm age	-.15 *	.04	-.04
$\chi 2$/df	1.55	1.55	1.59
TLI	.94	.94	.94
CFI	.95	.95	.94
RMSEA	.05	.05	.05
OLS Results			
	β sign.	**β sign.**	**β sign.**
Opportunity recognition	.31 ***	.23 **	.00
Capability monitoring	.17 *	.07	.13 †
Knowledge acquisition	.00	.08	.04
Knowledge sharing	.15 *	.02	.18 **
Knowledge creation	-.15 †	-.07	.00
Capability creation	.20 **	.29 ***	.16 *
Capability integration	-.06	-.09	.18 *
Corporate support	.06	.07	.04
Slack resources	-.17 **	.04	.03
Firm size	.11 *	.16 **	.12 *
Firm age	-.14 **	.01	.04
R^2	.33 ***	.25 ***	.31 ***

Note: Standardized estimates
N=265
*** $p < 0.001$
** $p < 0.01$
* $p < 0.05$
† $p < 0.1$

Table 3.3 presents the results from SEM and OLS analysis of the direct effects models on firm competence. The structural models show good fit measures and the regression models explain a significant portion of variance. Again, we can observe that not every sub-dimension of dynamic capabilities unfolds a significant effect on every dimension of firm competence. Opportunity recognition shows significant positive relations to marketing competence and organizational competence, while capability monitoring does not show any significant relation. Different than expected, knowledge acquisition shows (marginally) significant negative relations to marketing and organizational competence in the SEM analysis and marginally significant negative relations to all three competence dimensions within the OLS analysis. Knowledge sharing shows (marginally) significant positive direct relations to marketing and technological competence within the SEM analysis, while showing significant positive relations on all three competence dimensions within the OLS analysis. Other than expected knowledge creation shows no significant relations to any of the competence dimensions in either analysis. Capability creation shows significant positive relations to technological competence in both SEM and OLS analysis. Capability integration only shows a significant positive relation to organizational competence within the OLS analysis. Corporate support and firm age show no significant influence on the firm competence within the three capability areas. Further, slack resources show positive relations to technological competence, while firm size shows a negative relation to marketing competence within the OLS analysis. Taken together, these results only partially support hypothesis 1b.

TABLE 3.3: SEM and OLS Results Direct Effects of Dynamic Capabilities Dimensions on Firm Competence

	Dependent Variable: **Marketing Competence**	Dependent Variable: **Technological Competence**	Dependent Variable: **Organizational Competence**
Independent Variables			
SEM Results			
	β sign.	**β sign.**	**β sign.**
Opportunity recognition	.44 **	.09	.37 **
Capability monitoring	.02	-.07	-.07
Knowledge acquisition	-.23 †	-.12	-.20 (†)
Knowledge sharing	.17 (†)	.18 †	.12
Knowledge creation	.06	.00	.11
Capability creation	-.02	.29 *	-.03
Capability integration	-.09	-.08	.16
Corporate support	.06	-.01	.02
Slack resources	.09	.19 **	.09
Firm size	-.19 **	.01	-.06
Firm age	.10	.01	.04
χ^2/df	1.52	1.58	1.58
TLI	.94	.94	.94
CFI	.95	.94	.94
RMSEA	.04	.05	.05
OLS Results			
	β sign.	**β sign.**	**β sign.**
Opportunity recognition	.29 ***	.08	.26 **
Capability monitoring	.03	-.04	-.05
Knowledge acquisition	-.12 (†)	-.12 (†)	-.11 (†)
Knowledge sharing	.15 *	.12 †	.12 †
Knowledge creation	.01	.02	.05
Capability creation	-.02	.19 *	-.01
Capability integration	.01	.00	.18 *
Corporate support	.04	.00	.00
Slack resources	.06	.20 ***	.09
Firm size	-.07	.03	.01
Firm age	-.01	-.04	.00
R^2	.14 ***	.13 ***	.19 ***

Note: Standardized estimates
N=265
*** $p < 0.001$
** $p < 0.01$
* $p < 0.05$
† $p < 0.1$

Table 3.4, Table 3.5, and Table 3.6 show the interaction effects of the dynamic capabilities dimensions on marketing, technological, and organizational competence, respectively. In Table 3.4 we can observe significant complementary effects of opportunity recognition with knowledge sharing, capability creation, and capability integration on marketing competence. Further, capability monitoring and capability creation unfold significant complementary ef-

fects on marketing competence. Knowledge acquisition and capability creation further unfold significant complementary effects on marketing competence. Knowledge sharing unfolds significant complementary effects with knowledge creation, capability creation, and capability integration. Finally, capability creation and capability integration unfold a significant complementary effect on marketing competence.

TABLE 3.4: Interaction Effects Dynamic Capabilities Dimensions on Marketing Competence

Dependent Variable: Marketing Competence						
	Opportunity recognition	Capability monitoring	Knowledge acquisition	Knowledge sharing	Knowledge creation	Capability creation
Opportunity recognition						
Capability monitoring	n.s.					
Knowledge acquisition	n.s.	n.s.				
Knowledge sharing	.18**	n.s.	n.s.			
Knowledge creation	n.s.	n.s.	n.s.	.10†		
Capability creation	.24***	.11†	.12*	.19**	n.s.	
Capability integration	.18**	n.s.	n.s.	.15**	n.s.	.19**

N = 265
Significance levels: ***p<0.001; **p<0.01; *p<0.05; †<0.1; n.s. = not significant
Note: standardized estimates

The results in Table 3.5 show that opportunity recognition unfolds significant complementary effects on technological competence with capability monitoring and capability creation. Further, capability creation shows significant complementary effects on technological competence with knowledge sharing and capability integration.

TABLE 3.5: Interaction Effects Dynamic Capabilities Dimensions on Technological Competence

Dependent Variable: Technological Competence						
	Opportunity recognition	Capability monitoring	Knowledge acquisition	Knowledge sharing	Knowledge creation	Capability creation
Opportunity recognition						
Capability monitoring	.11†					
Knowledge acquisition	n.s	n.s.				
Knowledge sharing	n.s	n.s.	n.s.			
Knowledge creation	n.s	n.s.	n.s.	n.s.		
Capability creation	.15*	n.s.	n.s.	.12†	n.s.	
Capability integration	n.s	n.s.	n.s.	n.s.	n.s.	.12†

N = 265
Significance levels: ***p<0.001; **p<0.01; *p<0.05; †<0.1; n.s. = not significant
Note: standardized estimates

The results in Table 3.6 reveal unexpected findings. The significant interaction effects of capability monitoring with knowledge acquisition and knowledge creation show negative slopes. In this case, we therefore do not observe complementary effects among the dynamic capabilities dimensions on organizational competence, but compensatory effects. As opposed to complementary effects, compensatory effects are defined as when doing *more* of one thing *decreases* the returns to doing *more* of another. This refers to what sometimes is also termed 'substitutability' (e.g. Arora, 1996).

TABLE 3.6: Interaction Effects Dynamic Capabilities Dimensions on Organizational Competence

Dependent Variable: Organizational Competence						
	Opportunity recognition	Capability monitoring	Knowledge acquisition	Knowledge sharing	Knowledge creation	Capability creation
Opportunity recognition						
Capability monitoring	n.s					
Knowledge acquisition	n.s	-.14*				
Knowledge sharing	n.s	n.s.	n.s.			
Knowledge creation	n.s	-.13*	n.s.	n.s.		
Capability creation	n.s	n.s.	n.s.	n.s.	n.s.	
Capability integration	n.s	n.s.	n.s.	n.s.	n.s.	n.s.

N = 265
Significance levels: ***p<0.001; **p<0.01; *p<0.05; †<0.1; n.s. = not significant
Note: standardized estimates

3.5. Discussion and Conclusion

3.5.1. Implications

This study provides a strong contribution to the dynamic capabilities literature as it enables a more in-depth understanding about how dynamic capabilities contribute to the development of operational capabilities and especially about how dynamic capabilities contribute to the creation of operational capabilities of superior quality (competence). Thereby, this study also provides deeper insight into the nature of dynamic capabilities, their dimensions, and the interrelatedness between the dimensions.

Regarding their direct effects, the results show that different dimensions of dynamic capabilities unfold partly different contributions to the development of operational capabilities and to firm competence. Further, it is interesting to note that the direct contributions of the dynamic capabilities dimensions also partly differ depending on the distinct content of the operational capability areas. Opportunity recognition, for example, seems to play no role in developing organizational capabilities, while it seems to be very important for the development of marketing and technological capabilities. A plausible explanation might be that opportunity recognition is outward-directed and identifies opportunities and threats based on changes in technological development or the change in customer preferences. Such changes are likely to directly affect the effectiveness and efficiency of existing marketing and technological capa-

bilities in the first place. Thus, it is the development of marketing and technological capabilities that is directly triggered by the recognition of external changes. The development of organizational capabilities, however, might be rather triggered by internal sources, when for example the development of new capabilities in different capability areas requires new process-related alignment.

It is further interesting that knowledge sharing directly contributes to the development of marketing and organizational capabilities, but seems unimportant for the development of technological capabilities. An explanation might be that technological capabilities are especially dependent on specialized knowledge and skills which reside in a specific domain of expertise (e.g. R&D department) within the organization. Thus, the development of new technological capabilities is driven through this domain of expertise while being rather less dependent on input from other capability domains of expertise, such as the marketing department. However, an effective marketing capability that enables to successfully market the firm's output also requires consideration of the technological features of the firm's products or the general technological capacity of the organization. Thus, the development of new marketing capabilities is likely to be much more dependent on the sharing of knowledge among different domains of expertise (i.e. different functional departments).

The negative effect of knowledge creation on the development of marketing and technological capabilities is a rather unexpected finding. An explanation might be that firms use newly created knowledge to implement rather small but perceptible changes to existing capabilities in order to enhance their effectiveness, and thus rather modify existing capabilities than developing new ones. Further, the development of organizational capabilities seems rather less dependent on the ability to create or build completely new capabilities. The development of organizational capabilities seems to rather depend on the recombination of knowledge, and thus mainly on the sharing of new knowledge among different departments. Capability integration shows a negative effect on the development of marketing capabilities, but a positive effect on the development of organizational capabilities. The very distinct function those capabilities fulfill within the firm may provide a plausible explanation for this differing effect. While activities relating to marketing capabilities are directed towards the external environment, activities relating to organizational capabilities address the coordination of other activities within the organization. Thus, it is an inherent characteristic of the effectiveness of an organizational capability to account for characteristics or attributes of other capability areas. For the development of marketing capabilities, the first challenge is to develop a capability that most effectively addresses customer demands and market products. An additional

challenge in this respect is to consider and calibrate the requirements of other capability areas, e.g. the technological domain. Thus, a stronger focus on integrating and aligning a new capability with the existing configuration is likely to hinder its development compared to a situation where such an alignment is neglected.

With the exemption of technological competence, the recognition of opportunities arising from changes in the environment unfolds significant direct effects on firm competence. To establish competence (a higher relative quality of the capability) in the technological domain also other aspects seem relevant than just identifying the need for change. Within the other capability domains the early recognition of opportunities and threats seem to provide an advantage for firms so that they are able to establish an advantage with respect to their operational capabilities. A very interesting finding is the negative direct effect of knowledge acquisition on firm competence. A plausible explanation is inherent to the resource-based view of the firm, which states that firms build advantages based on unique and heterogeneous resource and capability bundles. Knowledge that has been acquired from outside the firm, and thus also exists within other firms or may also be accessible by other firms, is therefore unlikely to establish an advantage on a stand-alone basis. Only when combined internally to new and firm specific knowledge combinations, acquired knowledge may provide a relative advantage. The significant effect of capability creation underpins the argument made above. To establish competence in the technological capability domain requires the ability to build completely new capabilities. Thus, technological competence is much more dependent on the ability to create new capabilities than just to identify the need for change.

The relative unimportance of corporate support regarding the development of operational capabilities as well as for establishing competence undergirds dynamic capabilities as a firm-level (i.e. business segment level) construct. Prior research revealed that the business unit level explains far more variation in performance than the industry or the corporate level (McGahan & Porter, 1997; McGahan & Porter, 2002; Misangyi et al., 2006; Rumelt, 1991). The results of this study suggest that the reason for the outstanding performance contribution of the business unit may be due to the fact that capabilities are developed on the level of the business units and as a consequence competence, which drives performance differences, is also established on the level of the business units.

Other than Danneels (2008) I find slack resources only to be positively related to competence in the technological domain. To establish competence in the technological domain seems to be much more dependent on excess financial and human resources than establishing

competence in other domains. Interestingly, slack resources seem to hinder the development of new marketing capabilities. This might be due because firms possessing higher amounts of slack may be rather satisfied with the current situation and thus may not feel the urge to market their products more effectively (Danneels, 2008).

The results suggest that larger firms are rather engaging in the development of technological capabilities and organizational capabilities, but are not favored in terms of competence within these capability areas. As the development of technological solutions is especially costly, larger firms are likely to be favored due to a stronger potential to realize economies of scale, and thus are rather willing to engage in technological capability development. The explanation for the stronger engagement of larger firms in the development of organizational capabilities is also straight forward. The larger the firm the higher the challenges of effectively dividing labor among departments and employees. Moreover, the more employees or departments are present within a firm the stronger the urge to implement effective coordination mechanisms and to implement effective communication structures. Firm age shows a negative relation to the development of marketing capabilities. This might be due to the proposition that prior knowledge and experience may have the effect of blinders (Danneels, 2008) or that prior experience prevents overhasty engagement in capability development.

Regarding the complementary effects of the dynamic capabilities dimensions, the results show several significant complementarities among the different pairs of dimensions. Thereby, each of the seven dimensions is part of at least one pair of variables that unfold a significant complementary effect on a dimension of firm competence. These results indicate that a good part of dynamic capabilities' effects on other organizational outcomes arises from synergies among the several dimensions of dynamic capabilities, which would not be detected when the direct effects are analyzed on a stand-alone basis (Tanriverdi & Venkatraman, 2005). Based on an analysis of the direct effects alone, I might have incorrectly concluded that not all of the dimensions contribute to firm competence, although they indeed contribute through their synergetic effects in combination with other dimensions of dynamic capabilities (Lichtenthaler, 2009).

The present study provides deeper insight into the nature of dynamic capabilities and their effects and informs about the direct contributions of the dynamic capabilities dimensions and their synergetic effects. Future studies might investigate their complementary effects in more detail and examine the multilateral interactions among the dimensions. For firms aiming at developing or implementing dynamic capabilities, the results of this study implicate that it

might be of rather limited value to implement only single dimensions of the concept. As the overall effect of dynamic capabilities on firm competence is significantly affected by the synergetic effects of the several dimensions, firms are well advised to rather implement dynamic capabilities comprehensively. Due to the complementary effects, the benefits arising from dynamic capabilities are harder to imitate for competitors as the likelihood of successfully imitating several dimensions is significantly lower than for imitating singular capabilities (Tanriverdi & Venkatraman, 2005).

Further, the results of this study have important implications for empirically examining the effects of dynamic capabilities and drawing theoretical conclusions on construct level. In the case where multi-dimensional constructs are present within theoretical relationships, examination of the relations should be conducted on construct level rather than on the level of their dimensions in order to draw appropriate theoretical conclusions (Wong et al., 2008). When examination is conducted on dimension level it bears the risk to neglect joint effects and interrelations among the dimensions and findings on dimension level cannot simply be aggregated and applied to construct level (Wong et al., 2008). Further, partly divergent effects or partly non-significant relations on dimension level may lead to incorrect conclusions about the impact of the overall construct on its expected outcome (Tanriverdi & Venkatraman, 2005). In order to capture potential multilateral interactions and covariance among several dimensions, and thus to completely capture the overall effect of a multi-dimensional construct, higher-order modeling should be applied (Edwards, 2001; Tanriverdi & Venkatraman, 2005; Wong et al., 2008). This seems especially relevant in the present case, where we can observe direct effects with different directions and significance levels as well as complementary and compensatory effects among the dimensions.

3.5.2. Limitations

This study applies perceptual measures from the same data source for dependent and independent variables, which bears the risk of common method variance that can not be totally ruled out. However, the validation based on objective measures and second informants reduced my concerns that the results might be biased due to common method variance. Nevertheless, future studies might combine perceptual measures with objective data and use multiple data sources. As this study applies a newly developed model of dynamic capabilities, external validation is difficult. Although the applied measure shows high congruence with theoretically proposed effects and expected related measures further validation is necessary.

As I applied two-way interaction to detect potential complementarities of pairs of dimensions, this approach is not sufficient to detect potential multi-lateral interactions among the seven dimensions. Future studies might address this issue by applying an approach that may also cover the multi-lateral interactions.

As this empirical study focuses on business units of large firms operating in Germany, the findings should be validated in alternative settings. I approached the largest firms of the respective industries, which include all 110 firms listed in the three major stock exchanges and all 100 largest firms operating in Germany. Those firms might be more successful in the market place than the average of the basic population, in terms of firm competence. However, in this study I controlled for firm size, excess resources, and corporate support in order to detect potential effects. As the surveyed firms operate internationally, the results should hold in comparable settings than Germany. Future studies might focus on a broader sample in terms of performance differentials and might focus on small firms or on corporate level.

4. DYNAMIC CAPABILITIES AND INNOVATION PERFORMANCE: DIRECT AND INDIRECT DRIVERS OF SUCCESSFUL INNOVATION AND THE INFLUENCE OF ENVIRONMENTAL DYNAMISM

4.1. Introduction

Innovation is seen as a key driver of competitive advantage and superior performance (Sharma & Lacey, 2004). However, while successful innovation creates positive outcomes like customer satisfaction, competitive advantage in the market place, and in turn superior financial returns, innovation activity is most often accompanied by increasing costs, innovation failure, and a negligence of core competences (Simpson, Siguaw & Enz, 2006). Moreover, Simpson et al. (2006) argue that the negative effects of innovation activity may actually outweigh the positive outcomes, meaning that positive innovation outcome (i.e. newly developed products) is not necessarily accompanied by positive innovation performance (i.e. market success or profitability of newly developed products).

Especially more dynamic business environments are characterized by higher innovation activity, and simultaneously by a quicker product obsolescence and higher risk regarding investment decisions directed towards innovation activities (Calantone, Garcia & Dröge, 2003). Turbulent business environments lead to increased research and development costs, more rapid and radical technological development, shorter product life cycles, more intense competition, and as a consequence, high innovation failure rates that make innovation more risky and difficult (Droge, Calantone & Harmancioglu, 2008). In order to stay competitive especially in turbulent environments firms are constantly urged to innovate (Danneels, 2002) and innovation performance is more challenging (Kessler & Chakrabarti, 1996). Thus, in turbulent environments successful innovation is both more important and more difficult to achieve (Droge et al., 2008). While being vital in turbulent environments, innovation performance is even harder to achieve under such conditions.

The high failure rates of innovation activity between 40 percent and 90 percent, which are regularly reported (e.g. Edgett, Shipley & Forbes, 1992; Mahajan, Muller & Wind, 2000), draw the attention to the question which factors might enhance successful innovation. Several studies therefore investigated potential success factors for innovation activities. Findings suggest that structural complexity and organizational size are positively related to organizational

innovation, while both relations are positively moderated by environmental uncertainty (Damanpour, 1996). Moreover, a meta-analysis between innovation and potential organizational determinants found positive relations between innovation and specialization, functional differentiation, professionalism, managerial attitude toward change, technical knowledge resources, administrative intensity, slack resources, and external and internal communication (Damanpour, 1991). Other studies found conflict management to have a positive effect on innovation performance (Song, Dyer & Thieme, 2006) or that innovation speed positively influences new product performance (Carbonell & Rodriguez, 2006). Droge et al. (2008) found that market intelligence (in low environmental turbulence) and innovative orientation (in high environmental turbulence) foster new product success. Maurer, Bartsch and Ebers (2011) recently found that social capital, mediated by knowledge transfer, positively influences innovation performance.

Organizational theory suggests that large, established firms are especially threatened to fail in innovation-based competition because of inertia and inflexibility (Henderson, 1993). Dougherty (1992) proposes the argument that large firms often face problems to effectively link technological and market possibilities in product designs, which is vital for the development of commercially valuable new products. Dougherty and Hardy (1996) find that large firms suffer from an inability to connect innovation with organizational resources, processes, and strategy. In his later work Schumpeter (1942, 1949) pointed towards a possible advantage of large and established companies with respect to innovation due to the implementation of innovation routines that help to create new resource and capability combinations, which in turn enable successful innovation (Galunic & Rodan, 1998; Hagedoorn, 1996; Mahoney, 1995).

Since the early days dynamic capabilities are linked to a Schumpeterian world of innovation-based competition (Teece et al., 1997). Yet, relatively little research has been conducted on this link. Dynamic capabilities are proposed to build new resources and capabilities like new product development capabilities and new process development capabilities (McKelvie & Davidsson, 2009; Prieto et al., 2009), which in turn underpin the development of innovative products and services (Eisenhardt & Martin, 2000; Pavlou & El Sawy, 2006; Zahra et al., 2006). Further, dynamic capabilities seem to govern the efficiency of innovative activity by managing the timing, the direction, and the costs of resource and capability development (Zott, 2003). However, there is a dearth of empirical research and thus the mechanisms and the effect chain by which dynamic capabilities may contribute to innovation performance re-

main unclear. Prior research indicates that process level dynamic capabilities lead to competitive advantage in new product development (Pavlou & El Sawy, 2006). In their study, Pavlou and El Sawy (2006) find that dynamic capabilities in the area of new product development positively influence functional competence in new product development, which in turn positively influences competitive advantage in new product development. They further find that on business process level the effect of dynamic capabilities on functional competence is positively moderated by environmental dynamism while the effect of functional competence is negatively moderated. More recently, Lichtenthaler (2009) found that absorptive capacity, a firm's ability to acquire, integrate, and utilize *external* knowledge, is positively related to innovation performance, but found the proposed moderation of market and technological turbulence not to be supported.

In this study I broaden the scope by examining how firm-level dynamic capabilities enable successful innovation activities and in turn lead to superior innovation performance in the sense of a more successful new product development program. A recent definition states that dynamic capabilities include the ability to identify the need for change, to formulate a response to arising opportunities and threats, and to implement appropriate actions in terms of capability reconfiguration (Helfat et al., 2007). In order to identify the need for reconfiguration, firms must be able to recognize opportunities and threats arising from changes in the business environment and must relate these changes to the internal capability position (Barreto, 2010; Schreyögg & Kliesch-Eberl, 2007; Teece, 2007). To formulate a response, firms must be able to internally create and to externally acquire knowledge and to share this knowledge throughout the organization (Eisenhardt & Martin, 2000; Verona & Ravasi, 2003; Zahra & George, 2002). Finally, to implement appropriate actions, firms must be able to create new capabilities and to integrate newly created or acquired capabilities into the existing capability configuration (Barreto, 2010; Eisenhardt & Martin, 2000; Teece, 2007).

This study contributes to the literature by providing evidence for the linkage between dynamic capabilities and the Schumpeterian perspective on innovation. Thereby this study helps to explain how large firms succeed in innovation-based competition and why some firms are more successful in managing their new product development programs and in turn achieve higher innovation performance. The results suggest that dynamic capabilities are the means by which Schumpeter's entrepreneurial orientation can be implemented within large organizations. The capability based perspective applied here explains a significant portion of the variance in innovation performance. Against prior theoretical arguments indicating an indirect

effect of dynamic capabilities on innovation performance, which is fully mediated by the current capability configuration, the results suggest direct relations that exceed the indirect relations in effect strength. This indirect link was already implicitly proposed by Schumpeter, who argued that the professionalized entrepreneurial orientation enables to create novel combinations regarding marketing, technological, and organizational aspects, which in turn foster successful innovation (Galunic & Rodan, 1998; Hagedoorn, 1996; Nelson & Winter, 1982). Further, the results suggest that dynamic capabilities are likewise effective in creating operational capabilities of superior quality in different levels of environmental dynamism, while the effects on innovation performance differ significantly under different environmental conditions. In moderately dynamic environments the direct effect of dynamic capabilities on innovation performance is fully mediated by the existing capability configuration. Hence, in moderately dynamic environments dynamic capabilities are an indirect source of successful innovation, while innovation performance is directly driven by the existing operational capabilities. In turbulent environments, however, the indirect effect of dynamic capabilities on innovation performance is mitigated while the direct effect of dynamic capabilities on innovation performance is reinforced. Thus, in turbulent environments dynamic capabilities are a direct driver of successful innovation.

4.2. Theory and Hypotheses

4.2.1. The Entrepreneurial Firm as the Innovator

Schumpeter (1934) highlighted the role of the entrepreneur inducing change by generating innovations. While in his early work he mainly concentrated on the individual entrepreneur, characterized by proactive behavior and an ongoing search for opportunities, he already stated that in modern capitalism large companies become increasingly important as innovators (Hagedoorn, 1996; Schumpeter, 1934). In his later work Schumpeter (1942, 1949) focused on the role of the entrepreneur within large companies or the entrepreneurial company itself (Hagedoorn, 1996). Thereby, innovation activity is becoming a professional business function, conducted by specialized employees, who develop what is required and market it successfully. In large companies, innovation activity is conducted as co-operative entrepreneurship and is gradually depersonalized and automatized, and therefore, innovation activity assumes the shape of routinized behavior (Schumpeter, 1942, 1949). In this context entrepreneurial activity is analyzed as a collective activity, in terms of a business function that enables

the recognition and seizing of opportunities through the development of search routines, firm-specific skills, and new knowledge (Hagedoorn, 1996).

Innovation from a Schumpeterian perspective involves to develop novel combinations in technical, marketing, and organizational aspects, and finally, to develop new products and services that can successfully be placed on the market (Fagerberg, 2003; Hagedoorn, 1996). Thereby, Schumpeter provides the linkage where the resource-based view of the firm (Penrose, 1995) and the evolutionary theory of the firm (Nelson & Winter, 1982) tied on by drawing from the link where novel resource combinations are a source for firm innovation (Galunic & Rodan, 1998). Penrose (1995), for example, indicates that novel combinations of resources or a novel usage of resources may create new utility. Nelson and Winter (1982) state that innovation consists to a large part of a recombination of existing tangible and intangible assets, which they call conceptual and physical materials. With respect to novel resource combinations that underpin innovation, Galunic and Rodan (1998) emphasize the role of knowledge-based resources and the ways how they are manipulated and transformed in order to add value. Through the creation or acquisition of new knowledge (Kogut & Zander, 1992) the firm may alter these knowledge-based resources, and further may create new capabilities or competences trough recombining such knowledge assets (Galunic & Rodan, 1998; Kogut & Zander, 1992). From Galunic and Rodan's (1998) perspective, these knowledge combinations result in a capability, as they enable to perform a productive task (Grant, 1996a).

It is in this linkage where the connection between the Schumpeterian perspective on innovation and dynamic capabilities resides. The development of innovations (new products and services) is enabled through novel combinations of existing resources and capabilities and the transformation of resource and capability configurations (Mahoney, 1995). Schumpeter (1934) already pointed to novel combinations of assets that underpin innovation. These novel combinations relate to marketing, technological, and organizational/managerial aspects (Hagedoorn, 1996). It is this connection between resources and processes with new products that is of outstanding importance for successful innovation especially in large organizations (Dougherty & Hardy, 1996). In other words, from a Schumpeterian perspective, large organizations must be able to create new combinations of their resources and capabilities in the domains of marketing, technology, and organization/management in order to create successful innovations. According to Schumpeter (1942, 1949) large firms implement such an 'innovation ability' by implementing specialized functions within the firm that enable entrepreneurial action and behavior in a routinized, i.e. stable and recurring, fashion (Hagedoorn, 1996). In

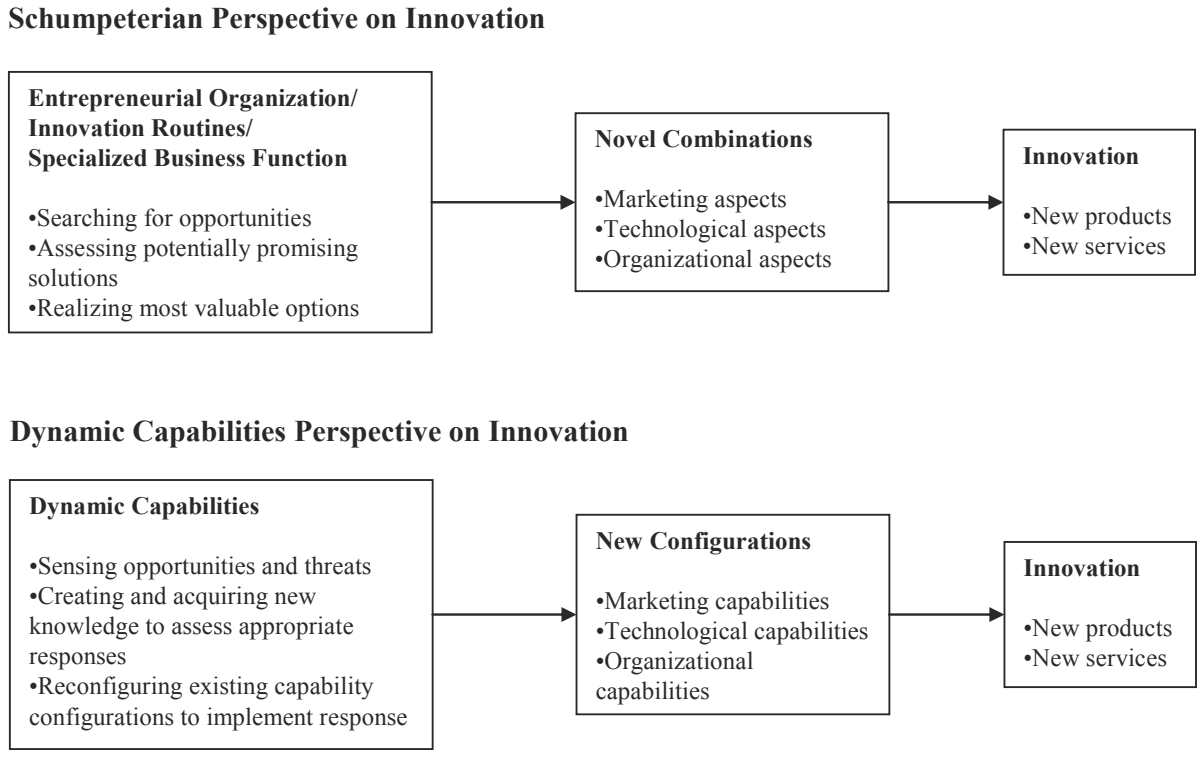
other words, according to Schumpeter firms seek to implement mechanisms with which they can collectively regularly search for opportunities, can regularly assess how to seize such opportunities, and can regularly implement a course of action to address such opportunities with innovations. Mahoney (1995) also makes the connection to dynamic capabilities by indicating dynamic capabilities as the drivers behind this transformation process and the role of knowledge accumulation and learning in order to create novel resource and capability combinations. Teece et al. (1997) propose dynamic capabilities as the mechanisms behind successful innovation in a world of Schumpeterian competition, as they help to identify and create the novel capability combinations most likely to support the development of novel valuable products and services. Teece (2007) expands this perspective to the entrepreneurial firm, where dynamic capabilities help to sense opportunities trough scanning the environment, to seize these opportunities through accumulation of knowledge and skills as well as through making informed investment decisions, and to accomplish necessary transformation through managing reconfiguration. Through the enabling of new capability development, dynamic capabilities support successful innovation.

According to Helfat et al. (2007), dynamic capabilities regularly involve the identification of the need for change, the formulation of an appropriate response, and the implementation of appropriate measures. It may be this threefold composition, in which Schumpeter's innovation routine (Schumpeter, 1942, 1949) manifests. The notion of a routine thereby relates to the structural aspect, not to the performative aspect of routines (Feldman & Pentland, 2003). In other words, there is a stable and recurring pattern regarding what is done, but not necessarily a stable and recurring pattern in how this is done. More precisely, this means that firms regularly engage in activities that enable to identify necessary changes, to formulate the response, and to implement a response, but show variation within the activities that build the content of these phases. As noted above, several distinct but related capabilities may build the fundament of these three phases. In order to identify the need for reconfiguration, firms must be able to recognize opportunities and threats arising from changes in the business environment and must relate these changes to the internal capability position (Barreto, 2010; Schreyögg & Kliesch-Eberl, 2007; Teece, 2007). To formulate a response, firms must be able to internally create and to externally acquire knowledge and to share this knowledge throughout the organization (Eisenhardt & Martin, 2000; Verona & Ravasi, 2003; Zahra & George, 2002). Finally, to implement appropriate actions, firms must be able to create new capabilities and to

integrate newly created or acquired capabilities into the existing capability configuration (Barreto, 2010; Eisenhardt & Martin, 2000; Teece, 2007).

Figure 4.1 contrasts the Schumpeterian and the dynamic capabilities perspectives on innovation, thereby displaying the congruence between the key concepts involved and their relation. Thereby, it becomes obvious that dynamic capabilities are the internal mechanisms that drive the reconfiguration of the firm's capability configuration, which in turn support the development of new products and services. Prior research suggests that successful innovation is directly driven by the firm's operational capabilities, which in turn are affected by dynamic capabilities (Danneels, 2002; Kraatz & Zajac, 2001; Verona, 1999), as dynamic capabilities build, modify, or reconfigure operational capabilities (Helfat & Peteraf, 2003). This argumentation mirrors recent research results, where dynamic capabilities indirectly contribute to new product success via their effects on operational capabilities (Ellonen, Jantunen & Kuivalainen, 2011; Pavlou & El Sawy, 2006).

FIGURE 4.1: Contrasting the Schumpeterian and Dynamic Capabilities Perspectives on Innovation



However, dynamic capabilities' attributes suggest that they also help to increase the efficiency and speed of innovation activities and help to assess the value potential of innovation

projects. Thus, it is likely that dynamic capabilities unfold additional direct effects on innovation performance, which are not mediated by the firm's operational capabilities.

To examine how dynamic capabilities influence successful innovation, I therefore investigate the direct and indirect relations of dynamic capabilities with innovation performance. To account for the indirect effects of dynamic capabilities on innovation performance, I control for the mediating role of the current capability configuration. To capture a firm-level capability configuration that may meaningfully mediate the effect between dynamic capabilities and innovation performance, I included marketing capabilities, technological capabilities, and organizational/managerial capabilities into the analysis (Dougherty, 1992; Hagedoorn, 1996). Furthermore, it is unclear to what extent the direct and indirect effects of dynamic capabilities on innovation performance may be contingent to different levels of environmental dynamism. Is the effectiveness of dynamic capabilities independent of environmental dynamism (Eisenhardt & Martin, 2000; Zahra et al., 2006) or are dynamic capabilities indeed especially valuable in turbulent environments (Teece et al., 1997)?

In this study, innovation is defined as the development of new products and/or services (Brown & Eisenhardt, 1995) and innovation performance is defined as the absolute or relative success of the product/service development program (Song et al., 2006). A capability in general is defined as the ability to perform an activity (Amit & Schoemaker, 1993; Grant, 1991; Helfat & Peteraf, 2003; Penrose, 1995) in the sense that a firm can carry out a specific activity purposefully, repeatedly, reliable, and in an at least minimally satisfactory manner (Helfat et al., 2007; Helfat & Winter, 2011). Further, I distinguish between operational capabilities, which are defined as those that enable an organization to perform the ordinary business activities (Collis, 1994; Helfat & Winter, 2011; Winter, 2003) and dynamic capabilities, which operate on these operational capabilities by building, integrating, or modifying operational capabilities (Helfat & Peteraf, 2003). A better relative capability in comparison to competition is referred to as competence in this paper, in the sense of a distinctive competence (Snow & Hrebiniak, 1980; Teece et al., 1997). Environmental dynamism is defined as the rate of change in technologies, customer preferences, and the intensity of competition (Jaworski & Kohli, 1993).

According to the observation made above, large organizations survive in a world of innovation-based competition through the possession of dynamic capabilities. Based on this Schumpeterian perspective on successful innovation, dynamic capabilities are the mechanisms that drive the creation of new operational capabilities – i.e. marketing, technological,

and organizational/managerial – through opportunity recognition, knowledge accumulation, and transformation of the capability configuration, which in turn foster innovation performance. To analyze the conditions and requirements for successful innovation, and thus innovation performance, and to examine how dynamic capabilities enable organizations to meet these demands, I reviewed relevant innovation and dynamic capabilities literature.

4.2.2. Dynamic Capabilities and Innovation Performance

Beneath competitive advantage in the market place and financial and market performance as outcomes of dynamic capabilities (Helfat et al., 2007), dynamic capabilities have since the early days been linked to innovation (Eisenhardt & Martin, 2000; Teece et al., 1997). Innovation is seen as a key driver of organizational renewal (Danneels, 2002) and is often associated with competitive advantage and superior financial performance (Sharma & Lacey, 2004). However, it is often overlooked that innovation per se does not lead to competitive advantage, superior financial or market performance, or even firm survival (Barnett & Freeman, 2001; Lichtenthaler & Lichtenthaler, 2009; Simpson et al., 2006). Actually, many organizations suffer from unsuccessful innovation and innovation failure (Edgett et al., 1992; Mahajan et al., 2000).

Verona (1999) points out that innovation performance is directly influenced by an organization's operational capabilities. Pavlou and El Sawy (2006) report such an effect for customer, technical, and managerial competence having a positive influence on new product development. Several scholars in the field of innovation previously argued that operational competences underpin successful innovations (Brown & Eisenhardt, 1995; Danneels, 2002; Galunic & Rodan, 1998; Simpson et al., 2006; Teece, 1986). The use of capabilities can thereby increase revenues and/or reduce cost (Drnevich & Kriauciunas, 2011). Different capabilities affect innovation performance differently, and as one capability might also affect another – e.g. organizational capability might strengthen technological and marketing capabilities – it is important to account for a relevant capability configuration instead of singular capabilities and draw conclusions on construct level (Spanos & Lioukas, 2001; Wong et al., 2008). Song et al. (2005), for example, find that the conjoint effects of technological and marketing capabilities on performance are stronger than the combined singular effects. Marketing capabilities, technological capabilities, and organizational capabilities seem especially relevant in the context of innovation. Innovation most often requires applying new technical or technological solutions in order to serve new customer demands and needs. Thus, innovation activity directly involves marketing and technological capabilities, but also requires the

involvement of different functions or departments within the organization, such as R&D, production, business development, and marketing. In order to effectively coordinate the activities of these various functions and to enable effective communication, organizational/managerial capabilities seem to play a role of outstanding importance. Thus, marketing capabilities, technological capabilities, and organizational capabilities enable to perform the necessary activities to successfully launch new products. A higher relative quality in comparison with competition, resulting in firm competence, is very likely to have a positive effect on the success of innovation activities, and thus, innovation performance.

Dynamic capabilities enable firms to identify the need for change, to acquire and integrate necessary knowledge to react to challenges, and to reconfigure the firm's existing capability configuration. Thereby, dynamic capabilities help to meet external demands regarding the firm's resource and capability configuration (Eisenhardt & Martin, 2000; Teece, 2007). They do so by helping to extend, modify or build operational capabilities and resource configurations (Helfat et al., 2007). Hereby, dynamic capabilities help to strengthen the relative quality of the capability configuration (Pavlou & El Sawy, 2006). Capron and Mitchell (2009) show that firms with a higher ability to manage reconfiguration were more effective in creating capabilities. Firms which posses dynamic capabilities continuously monitor their resource and capability endowment and calibrate their internal capacity with external demands in order to avoid capability gaps. Accordingly, dynamic capabilities are expected to have a positive effect on relative quality of the resource and capability endowment. While strengthening the quality of capability development, dynamic capabilities enable to build operational capabilities of superior quality which results in firm competence. Thereby, dynamic capabilities increase the positive outcomes of ordinary capabilities (Drnevich & Kriauciunas, 2011), and thus their contribution to innovation performance. Based on the arguments above, I propose that dynamic capabilities have a positive effect on firm competence, which in turn positively affects innovation performance. Thus, dynamic capabilities unfold an indirect positive effect on innovation performance.

While this indirect effect is in line with the argument that the performance effects of dynamic capabilities are mediated by the resource base (Eisenhardt & Martin, 2000; Helfat & Peteraf, 2009; Pavlou & El Sawy, 2006; Zahra et al., 2006), I propose that the effects of dynamic capabilities on innovation performance are more complex. Dynamic capabilities enable to meet the requirements of successful innovation as they help to identify trajectories of technological and market development, to identify and interpret the relevant information, and to

determine the implications for the actual business model (Danneels, 2008; Teece, 2007). Cohen and Levinthal (1990) argued that knowledge acquisition and assimilation foster innovation. Beside the acquisition of technological knowledge that enables product innovation, it is also important to learn which alternative technological solutions or alternative business models coexist and which implications can arise from engaging in the one or the other path before starting to launch new products in order to address potential customer needs (Danneels, 2002). Tsai (2001) found a positive relation between knowledge acquisition and innovation. The simultaneous presence of knowledge creation, knowledge acquisition, and knowledge sharing is indispensable for successful innovation (Verona & Ravasi, 2003) as innovation most often involves to market new products to new customer groups in new markets. Recent research provides evidence for the positive influence of knowledge sharing on innovation performance (Maurer et al., 2011). The learning component of dynamic capabilities enables the internal creation of new knowledge (Kogut & Zander, 1992), the acquisition of new knowledge from external sources (Cohen & Levinthal, 1990; Zahra & George, 2002), and the integration of internal and external knowledge (Augier & Teece, 2008; Teece et al., 1997) through knowledge sharing and assimilation, and thus, underpin the decisions regarding the choice of a business model, an organizational design, and the choice which customer needs to be addressed by which strategy and based on which technology (Teece, 2007).

According to Simpson et al. (2006) the costs and the focus of innovation activities are key success factors for innovation outcome. Other authors emphasize the importance of cost and speed (Kessler & Chakrabarti, 1996). Innovation performance results from the benefits created by innovations (i.e. new product development) and the costs associated with the development of these innovations (Lichtenthaler & Lichtenthaler, 2009; Simpson et al., 2006). I suggest that dynamic capabilities enable more efficient innovation by reducing the variable costs of capability development and thus new product development (see also Lichtenthaler & Lichtenthaler, 2009; Zahra et al., 2006; Zott, 2003), which in turn increase the profitability of an organizations' product development program. When a firm commands sensing capability it is able to economize on transaction costs that arise with the acquisition of information (Macdonald, 1995). Superior learning mechanisms enable firms to economize on transaction costs regarding the acquisition of knowledge, and learning itself lowers the costs of resource deployment (see Zott, 2003). Learning mechanisms, such as knowledge codification, additionally support acquisition performance (Zollo & Singh, 2004). Different capability reconfiguration mechanisms are associated with different levels of costs and seem to be effective

only under certain internal and external conditions (Lavie, 2006). Dynamic capabilities enable the selection of the appropriate reconfiguration mechanism and sourcing mode (Capron & Mitchell, 2009), and thus, ceteris paribus reduce reconfiguration costs. Based on this observation, dynamic capabilities are expected to increase the profitability of innovation activity, and thus, directly strengthen innovation performance.

Kessler and Chakrabarti (1996) argue that the speed of the innovation process positively influences innovation performance. This is because innovation speed decreases development costs as it leads to more efficient and overall lower resource consumption during the innovation process and because faster innovation enables organizations to be early-to-market and to benefit from first- or second-mover advantages (Kessler & Chakrabarti, 1996). The positive effect of innovation speed on innovation performance has been confirmed by Carbonell and Rodriguez (2006), who found that firms with higher innovation speed enhanced their new product performance. Dynamic capabilities foster innovation speed (Wu, 2010) as they enable early recognition of opportunities and threats and quick acquisition and creation of new knowledge. Furthermore, innovation often requires simultaneous development of new skills and capabilities (Danneels, 2002), which decreases innovation speed (Kessler & Chakrabarti, 1996). Dynamic capabilities have the potential to outweigh this negative effect, and thereby, to strengthen innovation performance. This is because dynamic capabilities enable organizations to develop new skills and capabilities quicker. While firms often tend to 'reinvent the wheel' when engaging in innovation activities, the monitoring dimension of dynamic capabilities helps to avoid 'over-engineering' in terms of capability development. Moreover, exclusive reliance on internal development hampers speed (Kessler & Chakrabarti, 1996). Dynamic capabilities enable organizations to simultaneously source from internal and external sources and to integrate those components, and thus increase innovation speed. As a consequence of this observation, I expect dynamic capabilities to increase the speed of the innovation process, and thus directly influence innovation performance.

Organizations that engage in innovation activities should avoid 'trying a shot in the dark' and should focus their efforts. To simultaneously engage in multiple innovation projects can lead to organizational failure (Barnett & Freeman, 2001), while the clarity of goals and targets are proposed to foster innovation (Kessler & Chakrabarti, 1996). As different people recognize different opportunities based on the same information (Shane, 2000), it is very important to identify the opportunity with the highest potential for value creation. The challenge is to identify the ideal point, where technical feasibility matches customer benefits and can be ad-

dressed most efficiently based on the organization's current resource and capability position. Beneath the capacity to identify this potential based on recognition and monitoring capacities, effective knowledge sharing between different departments is of outstanding importance to address this goal, as it involves the skills of different functions, such as marketing, R&D, and production (Cohen & Levinthal, 1990). Jansen, Van Den Bosch and Volberda (2006) find that such a connectedness is important for exploratory and exploitative innovation. Further, it is essential for successful innovation to recognize how technological developments can satisfy potential customer needs (Danneels, 2002). Thereby, it is vital to recognize whether there is adequate customer demand to avoid the failure of innovative activity (Simpson et al., 2006). The identification of the next position needed to stay ahead of competition and markets is a further key element of successful innovations (Simpson et al., 2006). Especially the sensing and learning components of dynamic capabilities enable organizations to identify and focus the most promising development paths for their innovation activities and thereby directly contribute to innovation performance.

As an enabling capacity of the different drivers that are expected to support successful innovation, dynamic capabilities are likely to have a positive effect on the success of organizational innovation. I analyzed the complex effects the different facets of dynamic capabilities unfold on innovation performance, and thereby focused especially on the effect chain. The analysis shows that a part of dynamic capabilities' effects operate on the resource base in the first place and influence innovation performance indirectly. However, there are additional positive effects of dynamic capabilities that are not mediated by the organizations resource and capability position. Based on the observation made above, I conclude:

HYPOTHESIS 1: Dynamic capabilities directly and indirectly positively contribute to innovation performance.

4.2.3. The Influence of Environmental Dynamism on the Relation between Dynamic Capabilities and Innovation Performance

Environmental dynamism refers to the rate of change in technologies, customer preferences, and to the intensity of competition (Jaworski & Kohli, 1993). The role of environmental conditions within the concept of dynamic capabilities might be the most important unsolved question to date (Zahra et al., 2006). Teece et al. (1997) state that dynamic capabilities are especially valuable in turbulent environments, while Eisenhardt and Martin (2000) argue that they are also valuable in moderately dynamic environments. Winter (2003) pointed to certain

environmental conditions where alternative modes of capability development might be superior to dynamic capabilities. While conceptual and empirical studies mainly focus on how environmental dynamism might affect the relation between dynamic capabilities and firm performance in terms of overall financial performance (e.g. Drnevich & Kriauciunas, 2011), the effects on successful innovation are less investigated.

Teece et al.'s (1997) definition emphasizes the role of dynamic capabilities in rapidly changing environments. And indeed, manipulation or reconfiguration of resources and capabilities is especially critical in such environments (Grant, 1996b; Lavie, 2006; Zahra et al., 2006). Further, it is argued that in turbulent environments it is not sufficient to solely rely on internal creation of new knowledge, but that firms additionally have to exploit external knowledge sources (Lichtenthaler, 2009). In more stable environments, characterized by lower rates of change, lower speed of change, and lower frequency of change, the development of new capabilities is less vital. However, Eisenhardt and Martin (2000) argue that dynamic capabilities are also effective in creating new resources and capabilities in moderately dynamic environments, but may vary in pattern. Zahra et al. (2006) also state that dynamic capabilities may be most valuable in dynamic environments, but that dynamism in the environment is not a necessary precondition for dynamic capabilities to effectively create operational capabilities. Environmental dynamism may be an important trigger for capability development, but is just one driving force beneath others (Zahra et al., 2006). The impact of dynamic capabilities to help to create operational capabilities is thus suspected to be unconditional to the state of environmental dynamism. Therefore, the effectiveness of dynamic capabilities, which leads to firm competence, is not solely determined by environmental conditions. It follows that, while dynamic capabilities are assumed to effectively create operational capabilities and establish firm competence in turbulent environments, the logical consequence is that they also establish firm competence in less turbulent environments.

HYPOTHESIS 2: Dynamic capabilities positively contribute to firm competence in all levels of environmental dynamism.

Successful innovation heavily depends on the firm competence an organization possesses (Danneels, 2002). In dynamic environments, technological changes, changes in customer needs, and competitive intensity create ongoing challenges for organizations (Jaworski & Kohli, 1993). Technological change can have disastrous impact on the organization's competences (Teece et al., 1997). Irrespective of this technological change being radical, incre-

mental, or minor change, it might severely affect the ability to compete successfully (Henderson & Clark, 1990). Technological change affects technological capabilities by modifying production techniques or methods, components or systems (Lavie, 2006), and affects organizational/managerial capabilities, because new technologies might require adjusted organizational processes (Teece et al., 1997). Further, it provides additional alternatives to perform activities or to configure capabilities (Lavie, 2006). Additionally, technological change affects competitive intensity by strengthening or weakening entry barriers, and market turbulence by stimulating customer needs or preferences (Lavie, 2006). Tushman and Anderson (1986) show that increased environmental turbulence is associated with competence-destroying discontinuities. In dynamic environments current products and services as well as once valuable competences erode and become obsolete. Further, development in science and technology create opportunities for some firms, while others are urged to adapt to the new conditions (Teece, 2007). A change in customer needs or customer behavior can render the product or service offerings of firms obsolete (Kohli & Jaworski, 1990). As a firm's business model and product offerings are underpinned by specific complementary capabilities, e.g. production techniques and organizational processes, a shift in consumer preferences additionally threatens the effectiveness and efficiency of an existing capability configuration.

Moreover, changes in technology and customer needs require new products and services that differ from existing offers in order to compete successfully, urging organizations to engage in exploratory innovation (Jansen et al., 2006). To develop and market new products, again requires new technological, marketing, and organizational capabilities. While a current resource and capability endowment is still useful to some extend when external conditions change, I expect that the effectiveness and efficiency decreases. Thus, in dynamic environments the existing capability configuration is much less sufficient to innovate successfully than in moderately dynamic environments. So, I conclude:

HYPOTHESIS 3: Environmental dynamism negatively moderates the impact of firm competence on innovation performance.

According to Teece et al. (1997) dynamic capabilities are especially valuable in turbulent environments, as there is a continuous need for adaptation and because the changing conditions permanently create opportunities. In turbulent environments, firms are especially urged to innovate in order to keep pace with external development (Danneels, 2002; Jansen et al., 2005). With increasing environmental dynamism the need constantly to innovate increases as

pressures simultaneously arise from different dimensions: external technological developments, changing customer preferences, and competitive actions. Under such conditions innovation activity is more challenging. It requires gathering more information from different sources in order to detect possible opportunities and threats. Further, it requires acquiring and creating more knowledge and simultaneously developing more complementary resources and capabilities. In turbulent environments, firms have to track more different information sources in order to identify relevant changes in their technological or market environment, which raises demands for scanning and interpreting information. As in more turbulent environments firms can not solely rely on their internal knowledge creation capabilities, but additionally have to acquire knowledge through external sources to a larger extent (Cassiman & Veugelers, 2006; Lichtenthaler, 2009), simultaneously managing these processes becomes an additional challenge. Furthermore, in order to accomplish capability reconfiguration successfully in turbulent environments, firms have to be able to apply more different reconfiguration mechanisms and sourcing modes (Capron & Mitchell, 2009; Lavie, 2006). Selection between these modes and simultaneously managing reconfiguration is more demanding than managing reconfiguration in moderately dynamic environments.

Further, in more dynamic environments, innovation speed is more important. Kessler and Chakrabarti (1996) discuss how environmental dynamism influences the need for innovation speed. Technological turbulence, for example, increases the need for innovation speed, as new technologies push out new products and services faster and new technologies increase the allure of newly developed products and services. Competitive intensity also increases the need for innovation speed, as organizations become more aggressive and market dynamics are more difficult to predict. Changing customer needs increase the need for innovation speed as product life-cycles are shortened and more opportunities for innovation are created. As outlined above, I expect dynamic capabilities to increase the speed of the innovation process, and thus innovation performance. This effect is reinforced in dynamic environments, and therefore, the positive direct effect of dynamic capabilities on innovation performance is stronger in dynamic environments.

When environmental conditions are constantly in a flux, it is much more difficult to identify potentially valuable development paths and opportunities for potentially lucrative innovations. In such environments dynamic capabilities are especially important (Teece, 2007) for the identification of potentially valuable positions. Under such conditions, the ability to identify the need for change, based on the identification of opportunities and threats arising from

shifts in the environment and the current capability configuration, is increasingly important. Moreover, the ability to manage different learning and reconfiguration mechanisms are expected to have stronger effects under conditions of high environmental dynamism. Thus, I conclude:

HYPOTHESIS 4: Environmental dynamism positively moderates the direct impact of dynamic capabilities on innovation performance.

4.3. Methods

4.3.1. Sample and Data Collection

The analyses in this study are based on the same sample as the study described in Chapter 2. Thus, the sample and the data collection procedure are equal to those described in Chapter 2.4.1. To minimize redundant repetition I therefore would like to refer to Chapter 2.4.1. for a recall of the explanations regarding sample and data collection.

In order to study dynamic capabilities as drivers of innovation performance, which is regarded as a source of competitive advantage (Sharma & Lacey, 2004), the business unit is the reasonable unit of analysis. This is because long-term performance differentials are largely attributable to the business unit level (McGahan & Porter, 1997; McGahan & Porter, 2002; Misangyi et al., 2006; Rumelt, 1991), and thus, their sources should also be examined on the level of business units (Rouse & Daellenbach, 1999).

4.3.2. Measurement and Validation of Constructs

Dynamic capabilities and firm competence were measured with the same scales and items as displayed in Table 2.1 in Chapter 2. In order to develop appropriate scales for innovation performance and environmental dynamism, I reviewed relevant literature to identify existing scales or items that relate to the domain of the constructs in question. The resulting scales were validated in interviews with academics and practitioners as described in Chapter 2.4.2. The items for innovation performance and environmental dynamism were both measured on a seven-point Likert-scale. The items and their scales are presented in Table 4.1.

Innovation Performance ($\alpha = 0.85$) was measured with an existing three-item scale (Lichtenthaler, 2009; Song et al., 2006), where respondents were asked to rate the *actual* absolute and relative performance of their product development program.

I validated the subjective measures with patent counts (see Rothaermel & Hess, 2007) obtained from the German Patent and Trademark Office for a sub-sample of 40 business units. Although patent counts are not a perfect equivalent for the *success* of a product development program, it mirrors innovation activity and should indicate the ability of the respondents to provide reliable estimates. I compared the patent counts of the respective business units with the patent counts of the strongest competitor which the respondents were asked to indicate in the survey. To validate the indication of strongest competitor, I cross-checked with objective data from Hoover's Company Profiles and found full congruence. Then, I calculated the ratio of the patent counts of the focal business unit and its main competitor and compared it with the item ratings, where the respondents indicated their relative innovation performance. Thereby, in 75 % of the cases I found the item ratings of 4 and above (below 4) correspond to patent count ratios of 1 and above (below 1), with higher (lower) ratings corresponding with higher (lower) ratios. Based on these results I believe the subjective measure of innovation performance to be reliable and valid (Batjargal, 2010). I was only able to obtain objective data for a subsample of 40 business units because on two reasons. First, it is necessary that the focal business unit is a separate legal entity (not just an organizational entity) and that the patent filing is attributable to this legal entity (some companies file all patents under the corporate firm). Second, as I compared the patent counts to those of the strongest competitor, also the strongest competitor had to be a legal entity with respective patent filing.

Firm competence was measured with the three scales m*arketing competence* ($\alpha = 0.75$), *R&D/technological competence* ($\alpha = 0.80$), *managerial/organizational competence* ($\alpha = 0.85$). As I am analyzing relations on construct level in this study – i.e. the effects of dynamic capabilities on and via the capability configuration - (Wong et al., 2008), I operationalized firm competence as a composite measure consisting of marketing competence, technological competence, and organizational/managerial competence. The Cronbach's Alpha of the composite measure for firm competence is .83, indicating good internal consistency. This measure captures the *actual* strength of the capability position in comparison with the strongest competitor. Again, I assessed construct validity applying confirmatory factor analysis, exploratory factor analysis, and the item-based Pearson correlations. The measurement model of firm competence, with $\chi^2/df = 2.25$, TLI = .95, CFI = .96, RMSEA = .07, and SRMR = .06 and all factor loadings being highly significant ($p<0.001$) and substantive, indicates an acceptable model fit. The Pearson correlations between the items assigned to the same factor are higher than between any item assigned to another factor. All average variance extracted estimates of

the first-order factors exceed 50 percent and any squared inter-construct correlation. Accordingly, an exploratory factor analysis revealed the intended three-factor structure. This indicates convergent and discriminant validity of the constructs (Fornell & Larcker, 1981; Hair et al., 2010). The second-order factor loadings are all .5 and above and with a construct reliability (CR) of 0.69 there is adequate evidence of convergent validity of the second-order construct (Hair et al., 2010).

The rationale for including the *actual* capability position as a mediator is based on the argument that innovation performance, captured in a given business year, results from the current capability configuration. In this respect, it is important to denote that *the actual* capability strength does not change from day to day and thus has certain stability over time. This is because the creation of new capabilities or the modification of existing capabilities is a time consuming process. The respondents indicated that in more than 80 percent of the cases, where capabilities in the different areas were newly created or modified, it took more than 6 months until these newly created or modified capabilities have been successfully integrated into the capability configuration.

However, one could argue that the effect of the capability configuration on innovation performance is lagged and that the actual innovation performance is rather dependent on a *prior* capability configuration. In order to control for such potential temporal effects, I additionally asked the respondents to indicate the relative strength of their capability position at the time *one year earlier*. To capture the relative capability strength *one year before*, I applied the same items that were applied to capture the *current* capability configuration (see Table 2.1). Cronbach's Alphas for the measures capturing the *prior* relative capability position are: m*arketing competence* (α = 0.78), *R&D/technological competence* (α = 0.78), *managerial/organizational competence* (α = 0.77), and overall *firm competence* (α = 0.83). These values indicate good internal consistency of the measures. Within a nested model comparison with confirmatory factor analysis, I assured that the measures of *actual* firm competence and *prior* firm competence constitute two distinct measures. To assess potential lagged effects or the extent to which the results vary when the prior capability configuration is accounted for, I recalculated the models with the measure for prior firm competence. The results are given in Chapter 4.4.

Dynamic capabilities were again captured with the seven scales measuring *opportunity recognition* (α = 0.86), *capability monitoring* (α = 0.87), *knowledge acquisition* (α = 0.81), *knowledge sharing* (α = 0.77), *knowledge creation* (α = 0.88), c*apability creation* (α = 0.90),

and *capability integration* (α = 0.87). Please consult Chapter 2.5. regarding the construct validity of the dynamic capabilities measure. Due to the fact that I analyze the relations on construct level in this study, I applied the superordinate second-order model of dynamic capabilities (Figure 2.2 in Chapter 2) as validated in Chapter 2.5.

Environmental dynamism relates to technological change, market development, and the intensity of competition (Jaworski & Kohli, 1993). I captured these dimensions with items from Jaworski and Kohli's (1993) study and two self-developed items to additionally capture the rate of change. As environmental dynamism is an aggregate of the dynamism in its dimensions, I aggregated the three scales. The final scale of *environmental dynamism* (α = 0.81) consists of 13 items. The items captured the dynamism of the environment during the *last three years*.

To validate the subjective measure of environmental dynamism, I applied objective data that reflects the dynamism of the business environment. The volatility in returns is widely accepted as an appropriate objective measure for environmental dynamism (see for example McNamara, Vaaler & Devers, 2003; Snyder & Glueck, 1982). Therefore, I analyzed the mean and distribution of the subjective measures of environmental dynamism as a function of the respective industry membership and compared these results with the corresponding volatility in stock market returns, which reflect the volatility in economic returns. The results of the objective measure match very well the subjective data. Furthermore, the subjective measure for environmental dynamism shows computer/IT, telecommunication, and automobile on the upper end of the dynamism spectrum and consumer goods on a lower level, which corresponds with findings of prior studies (Rosenkopf & Schilling, 2007). Based on these result, I believe the subjective measure of environmental dynamism to be reliable and valid.

Control variables. I applied the same control variables as described in Chapter 2. Thus, I controlled for corporate support, firm size, firm age, slack resources, and industry effects. Additionally, controls for the amount of operational capability development (marketing, technological, and organizational) were included to assure that the identified effects of dynamic capabilities are independent from omitted variable bias in terms of newly developed operational capabilities.

The rationale to include these controls relating to firm competence is equal to that described in Chapter 2.4.2. In relation to innovation performance as dependent variable, I controlled for corporate support to isolate the effects on business unit level. Further, I controlled

for slack resources as an alternative explanation for innovation as excess resources provide stronger funds for innovation activities and allow absorbing for failures (Damanpour, 1991). On the other hand, slack resources may hamper innovation, due to lower discipline in innovation projects (Nohria & Gulati, 1996). I controlled for the effects of firm size on innovation performance, as larger organizations are often more successful in commercializing product innovations (Ettlie & Rubenstein, 1987). Further, larger firms have larger knowledge bases, which may influence innovation (Lichtenthaler, 2009). I further included firm age as a control variable to control for the potential effects of prior knowledge and experience on innovation performance.

TABLE 4.1: Variables and Operationalization

Innovation Performance (α = .85) (7, "strongly agree", and 1, "strongly disagree")
The overall performance of our new product development program has met our objectives.
From an overall profitability stand point, our new product development program has been successful.
Compared with our major competitors, our newly developed products are far more successful.
Environmental Dynamism (α = .81) (7, "strongly agree", and 1, "strongly disagree")
The technology in our industry is changing rapidly.
Technological changes provide big opportunities in our industry.
A large number of new product ideas have been made possible through technological breakthroughs in our industry.
Technological innovations in our industry differ significantly from their antecessors.
In our industry major technological innovations are developed quite regularly.
In our kind of business, customers' product preferences change quite a bit over time.
Our customers tend to look for new products all the time.
Sometimes our customers are very price-sensitive, but on other occasions, price is relatively unimportant.
Competition in our industry is cutthroat.
There are many "promotion wars" in our industry.
Anything that one competitor can offer others can match readily.
Price competition is a hallmark of our industry.
One hears of a new competitive move almost every day.

4.3.3. Discriminant Validity among Dependent Variable, Mediating Variable, and Independent Variable

To assess discriminant validity between the measures, I applied confirmatory factor analysis, exploratory factor analysis, and examined the item correlations. As the average variance extracted estimate for each first-order construct exceeds any squared inter-construct correlation with any other construct in the study, there is evidence of discriminant validity on first-order level (Fornell & Larcker, 1981; Hair et al., 2010; Shook et al., 2004). Further, the correlations between the items assigned to the same factor are significantly higher than the correlations with items assigned to another factor (Fornell & Larcker, 1981). Accordingly, in an exploratory factor analysis (Table 4.2) simultaneously covering all factors relating to the dependent variable, the mediating variable, and the independent variable, the items cleanly loaded on the eleven desired factors. I established discriminant validity between the overall measures of dynamic capabilities, firm competence, and innovation performance with a nested model comparison. Therefore, I conducted separate confirmatory factor analyses for each pair of variables, where in one model the covariance between the two constructs was constrained to unity while being freely estimated in the other model. For each pair the model with the freely estimated covariance showed better fit based on χ^2/df with a significant ($p<0.001$) χ^2-difference test, providing evidence for discriminant validity among the overall measures (Hair et al., 2010).

TABLE 4.2: Results of Exploratory Factor Analysis

	Opportunity Recognition	Capability Monitoring	Knowledge Creation	Knowledge Acquisition	Knowledge Sharing	Capability Creation	Capability Integration	Marketing Competence	Organizational Competence	Technological Competence	Innovation Performance
Item 1	.727										
Item 2	.593										
Item 3	.562										
Item 4	.464										
Item 5		.866									
Item 6		.692									
Item 7		.652									
Item 8		.618									
Item 9			.720								
Item 10			.699								
Item 11			.662								
Item 12			.574								
Item 13				.681							
Item 14				.679							
Item 15				.569							
Item 16					.689						
Item 17					.683						
Item 18					.562						
Item 19						.784					
Item 20						.728					
Item 21						.641					
Item 22						.558					
Item 23							.750				
Item 24							.661				
Item 25							.640				
Item 26								.787			
Item 27								.646			
Item 28								.540			
Item 29									.822		
Item 30									.709		
Item 31									.705		
Item 32									.634		
Item 33										.895	
Item 34										.674	
Item 35										.621	
Item 36											.761
Item 37											.739
Item 38											.707

Maximum-likelihood estimation with varimax rotation and Kaiser-normalization. Values below 0.40 are not displayed.

4.4. Analysis and Results

Table 4.3 presents the descriptive statistics and correlations of the variables analyzed in this study. From Table 4.3 we can see a relatively high level of dynamic capabilities and innovation performance in many firms, which is not unusual in this kind of study (see for example Drnevich & Kriauciunas, 2011; Lichtenthaler, 2009). An explanation might be that in this study I surveyed the largest (and often more successful) firms of the respective industries. The significant correlations of the capability development measures underpin their inclusion as control variables in order to isolate the effects of dynamic capabilities. Thereby organizational capability development shows the strongest relation with innovation performance. Firm size, firm age, and slack resources show no significant correlations with the dependent variable. Firm size and firm age show a significant correlation, indicating that older firms are also larger in size.

Dynamic capabilities show no significant correlation with firm size or firm age, indicating that the possession of dynamic capabilities is independent of firm size and firm age. Slack resources, however, show a significant correlation with dynamic capabilities, indicating that excess human and financial resources may support the possession or execution of dynamic capabilities. The significant correlation between environmental dynamism and dynamic capabilities underpin the argument that dynamic capabilities may be implemented as a response towards perceived environmental dynamism (Wang & Ahmed, 2007). Dynamic capabilities and firm competence both show significant correlations with innovation performance, underpinning the argument that the effect of dynamic capabilities on innovation performance may not be fully mediated by firm competence.

TABLE 4.3: Descriptive Statistics and Pearson Correlations

	Variables	Mean	s.d.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	Innovation Performance	4.65	1.23																			
2	Corporate Support	3.10	0.96	.01																		
3	Firm Size (log)	3.21	1.08	.04	.14 *																	
4	Firm Age (log)	1.30	0.54	.02	-.01	.38 ***																
5	Slack Resources	3.36	1.32	.08	.16 *	.08	.00															
6	Marketing cap. dev.	4.31	1.78	.18 **	.06	.00	-.12	-.06														
7	Technological cap. dev.	5.01	1.66	.27 ***	.10	.24 ***	.11	.11	.20 **													
8	Organizational cap. dev.	4.69	1.50	.31 ***	.02	.05	.00	.06	.25 ***	.20 **												
9	Telecommunication	0.08	0.28	-.01	-.03	.08	-.18 **	-.16 *	.08	-.01	-.05											
10	Automobile	0.13	0.34	.14 *	.02	.11	.04	-.05	-.09	.11	.08	-.12										
11	Computer/IT	0.08	0.28	.02	-.10	.09	-.01	-.03	.04	.09	.02	-.09	-.12									
12	Banking/Insurance	0.09	0.28	-.03	.16 **	-.20 ***	-.13 *	-.03	.04	-.09	.11	-.09	-.12	-.09								
13	Energy	0.07	0.25	-.11	.05	-.05	-.05	.14 *	.02	-.04	-.11	-.08	-.11	-.08	-.08							
14	Chemicals/Pharmaceuticals	0.09	0.29	.02	-.03	.09	.12	.03	-.05	.10	-.14 *	-.10	-.13 *	-.10	-.10	-.09						
15	Machinery	0.12	0.32	-.05	-.11	-.08	.04	-.06	-.06	-.04	.04	-.11	-.14 *	-.11	-.11	-.10	-.12					
16	Transport/Services	0.08	0.27	.02	.09	.01	.00	.13 *	-.11	.00	.07	-.09	-.11	-.09	-.09	-.08	-.09	-.11				
17	Consumer goods	0.11	0.31	-.02	.06	.06	.04	.04	.14 *	-.10	.02	-.10	-.13 *	-.10	-.11	-.09	-.11	-.13 *	-.10			
18	Environmental dynamism	4.49	0.88	.09	-.03	.02	-.04	-.06	.19 **	.18 **	.01	.22 ***	.11	.22 ***	-.11	-.12	-.18 **	-.22 ***	-.02	.06		
19	Functional competence	4.24	0.75	.44 ***	.04	-.10	.02	.21 ***	.14 *	.20 **	.26 ***	-.08	-.01	-.03	.04	-.06	.01	-.09	.17 **	.06	.04	
20	Dynamic capabilities	4.69	0.93	.45 ***	.10	-.04	.01	.19 **	.27 ***	.37 ***	.51 ***	-.11	.04	.09	.07	-.06	-.09	-.06	.03	-.04	.22 ***	.40 ***

N = 265
*** p<0.001
** p<0.01
* p<0.05

As described above (Chapter 4.3.2.), I focused on the mediating role of the *actual* capability position. The structural models applied in the study are displayed in Figure 4.2. I first included all control variables into the model. All control variables had a path to firm competence and innovation performance. The resulting model shows a fit of χ^2/df = 1.73, TLI = .85, CFI = .86, RMSEA = .05, and SRMR = .07. I removed insignificant controls as this does not affect substantive results, but reduce the model fit due to higher complexity and the non-significant relations (Danneels, 2008). The fit measures of the resulting model are: χ^2/df = 1.57, TLI = .92, CFI = .93, RMSEA = .05, and SRMR = .06. The direct effects of dynamic capabilities on firm competence (.54, $p<0.001$) and on innovation performance (.30, $p<0.001$) are substantial and significant. The effect of firm competence on innovation performance is .39 with $p<0.001$. The indirect effect of dynamic capabilities on innovation performance is .21 and significant ($p<0.001$). To test for the significance of the indirect effect, I conducted the bootstrapping procedure with bias-corrected confidence intervals on a 95%-confidence level and 1000 bootstrap samples (Mallinckrodt, Abraham, Wei & Russell, 2006). The industry control for automobile shows an effect of .15 ($p<0.01$) on innovation performance. The industry controls for consumer goods (.13, $p<0.05$) and transport and services (.19, $p<0.01$) show significant effects on firm competences.

In order to control for the potential temporal/lagged effects, discussed in Chapter 4.3.2., I reran the final model and thereby included the measure of *prior* firm competence as mediating variable. The fit measures of the resulting model are: χ^2/df = 1.54, TLI = .92, CFI = .93, RMSEA = .05, and SRMR = .06. The direct effects of dynamic capabilities on firm competence (.47, $p<0.001$) and on innovation performance (.38, $p<0.001$) are substantial and significant. The effect of firm competence on innovation performance is .27 with $p<0.01$. The indirect effect from dynamic capabilities on innovation performance is .13 and significant ($p<0.01$). This means that the effect of dynamic capabilities on firm competence is slightly weaker and the direct effect of dynamic capabilities on innovation performance is slightly stronger, when the *prior* capability configuration is included as a mediator. Further, the effect of the *prior* capability configuration on innovation performance is weaker than that of the *current* capability position. These results underpin the argument to include the *current* capability configuration as the mediating variable. The difference in effect strength of the direct effect of dynamic capabilities on innovation performance can be explained by the operational capabilities that have been developed during the one-year period that lies between the measures of *prior* and *current* firm competence. This means that when the effects of the *prior* capability configuration on the *actual* innovation performance is assessed, additional effects on

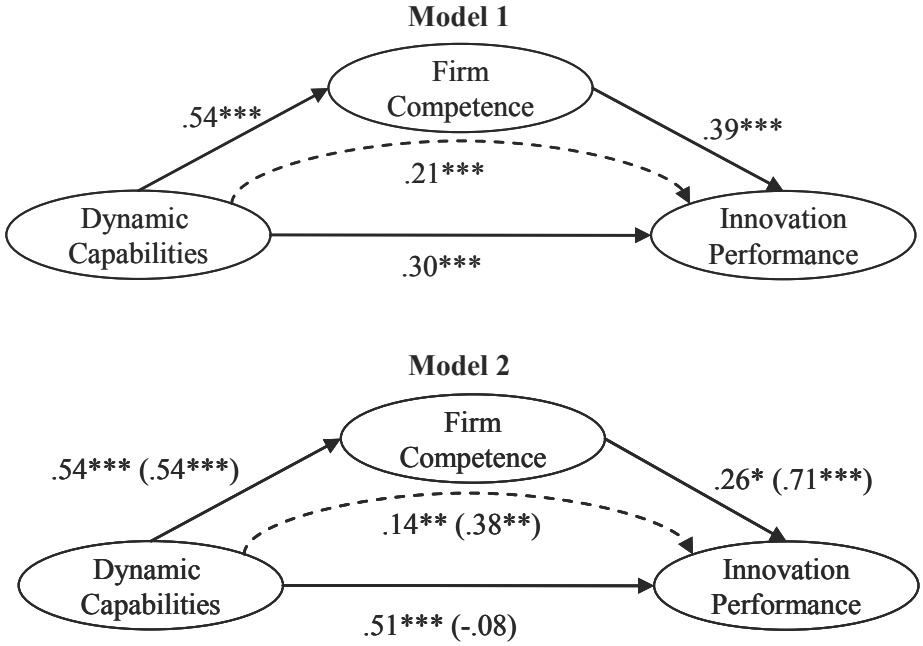
innovation performance arise from operational capabilities that have been newly developed during the one-year period that lies between the *actual* and the *prior* capability position. When these effects are not explicitly controlled for, they are attributed to the direct effect of dynamic capabilities on innovation performance, as dynamic capabilities are the drivers behind this capability development. To test this argumentation, I again included the formerly non-significant controls for capability development into the model. The control variables for technological capability development (.11, $p<0.1$) and organizational capability development (.10, $p<0.1$) now show marginally significant effects on innovation performance. Moreover, while all other effects remain unchanged in effect strength and significance level, the direct effect of dynamic capabilities is reduced to .30 ($p<0.001$), showing equal strength than in the model containing the *current* capability position.

After assessing the rationale for conducting the analysis based on the *current* capability position, I proceeded with the analysis applying the measure for *actual* firm competence as described in Chapter 4.3.2. To test the influence of environmental dynamism, I applied multi-group analysis as a recommended technique to test moderation in SEM (Byrne, 2001; Hair et al., 2010) and tested for the invariance of the structural models between different levels of environmental dynamism. In this case, where I modeled higher-order factors, manifest product indicators are not available to directly test for interaction effects within the structural model. To generate the groups, I conducted a sample split based on the median of the environmental dynamism index to obtain two groups of equal size, and calculated a dummy variable for environmental dynamism comprising high and low level respectively.

Before I tested for the moderating effect, I established measurement model invariance (Hair et al., 2010; Qureshi & Compeau, 2009). Therefore, I created a nested model with a full-constrained model, where every parameter was set equal between the two groups comprising low and high levels of environmental dynamism and a partly constrained model, where the structural paths were free to vary between the two groups (Byrne, 2001; Qureshi & Compeau, 2009). The comparative evaluation of the fit of alternative models can be conducted based on χ^2-difference test (Byrne, 2001; Qureshi & Compeau, 2009), with lower values of χ^2/df indicating the favorable model. First, I included all control variables into the model. With $\chi^2/df = 1.67$ the model shows a better fit than the respective baseline model ($\chi^2/df = 1.73$). Again, I removed non-significant controls to improve the fit of the model. The resulting model shows a fit of $\chi^2/df = 1.51$, which also indicate a better fit as the respective baseline model ($\chi^2/df = 1.57$). This indicates that the structural paths vary between the levels of environmental dynamism (Byrne, 2001; Hair et al., 2010).

The effect of dynamic capabilities on firm competence is equally strong and significant (.54, p<0.001) in both levels of environmental dynamism, which supports hypothesis 2. The effect of firm competence on innovation performance is much stronger and of significant difference in moderately dynamic environments (.71, p<0.001) compared to turbulent environments (.26, p<0.05). This supports hypothesis 3. The direct effect of dynamic capabilities on innovation performance differs fundamentally between the two levels of environmental dynamism. While in moderately dynamic environments the effect is not significant, dynamic capabilities unfold a strong and significant direct effect (51, p<0.001) on innovation performance in turbulent environments. This is support for hypothesis 4. The indirect effect of dynamic capabilities is stronger in moderately dynamic environments (.38, p<0.01) than in turbulent environments (.14, p<0.01). In moderately dynamic environments the total effect of dynamic capabilities on innovation performance is (.30, p<0.01) and in turbulent environments (.66, p<0.01). Within the group comprising high environmental dynamism slack resources show a strong and significant effect on firm competence (.21, p<0.05), while they show no significant effect in moderately dynamic environments. Within the group characterized by low environmental dynamism, the industry control for automobile shows a positive effect (.23, p<0.01). The results of the baseline model (Model 1) and the group comparison (Model 2) are displayed in Figure 4.2.

FIGURE 4.2: Results of Structural Equation Modeling



Note: Parentheses represent low environmental dynamism

***p<.001; **p<.01; *p<.05 - - -► = indirect effect

To control for the significance of the difference of the effect size between the levels of environmental dynamisms, I checked the critical ratios for difference between parameters. The z-values are 3.50 for the effect of dynamic capabilities on innovation performance, .16 for the effect of dynamic capabilities on firm competence, and -2.62 for the effect of firm competence on innovation performance. This means that the direct effects of dynamic capabilities and firm competence on innovation performance are significantly different between the levels of environmental dynamism ($p<0.001$), while the effect of dynamic capabilities on firm competence is not significantly different between the levels of environmental dynamism.

To detect potential common method bias, I applied the ULMC (Unmeasured Latent Method Construct)-technique (Podsakoff et al., 2003; Richardson et al., 2009). The trait-only model fitted the data very well, while the method-only model had to be rejected. As the constrained trait-method model (construct correlations are constrained to the values obtained from the trait-only model) did not fit significantly worse than the trait-method model, there is evidence that there is no bias based on common method variance (Richardson et al., 2009, p. 780). Furthermore, within the trait-method model, where the unmeasured latent method construct controls for all systematic variance that is independent of the constructs of interest and their hypothesized relations, the main effects stay significant and substantive, which also indicates that the results are not biased due to common method variance (Podsakoff et al., 2003). Further, the results of confirmatory factor analysis and exploratory factor analysis show that the items not only theoretically relate to distinct constructs, but also empirically relate to distinct constructs.

For further assessing the reliability of the results, I applied a variation of holdout validation and conducted cross validation with OLS. Moreover, to further reduce concerns regarding common method variance or halo effects, I reran the OLS model with the archival data for innovation (patent count ratios) and the archival data for environmental dynamism (volatility of stock market returns) for the sub-sample of 40 business units for which I was able to obtain patent data for the focal business unit as well as strongest competitor. For holdout validation, I conducted a group comparison with a random sample split and tested for the invariance of the model between the two groups (Hair et al., 2010). The model in which the path coefficients were allowed to vary between the two groups showed lower fit than the model where the paths were set equal, indicating that the path estimates do not differ between randomly selected subsamples. To cross validate the results, I applied mediated moderation analysis with OLS (Muller, Judd & Yzerbyt, 2005). Regarding the model construction and the test for moderating effects, I followed the procedure recommended by Frazier, Tix, and Barron (2004).

This means that I z-standardized the continuous predictor variables and calculated the product terms based on the standardized measures. The variance inflation factors of all variables in the respective models were below 2, and thus show that multicollinearity is not a problem within the data. The results are displayed in Table 4.4. The findings from OLS basically support the findings from SEM. The results support hypothesis 1 as the effect of dynamic capabilities on innovation performance is only partially mediated by firm competence (Frazier et al., 2004). Model 2 in Table 4.4 shows that the product term of dynamic capabilities and environmental dynamism is not significant and thus supports hypothesis 2. The product term of firm competence and environmental dynamism in Model 3 in Table 4.4 shows a negative slope, which supports hypothesis 3 by trend. However, this effect is not significant and thus does not qualify as a full support of the respective SEM result. As the direct effect of dynamic capabilities on innovation performance in Model 3 is stronger than the respective effect in Model 1 (see Muller et al., 2005), the results provide support for hypothesis 4.

TABLE 4.4: OLS Regression Results Mediated Moderation

	Model 1 DV: Innovation Performance		**Model 2** DV: Firm Competence		**Model 3** DV: Innovation Performance	
	Beta	**Sig.**	**Beta**	**Sig.**	**Beta**	**Sig.**
Coporate support	-.025	.664	-.022	.707	-.019	.738
Firm size	-.020	.760	-.170 *	.012	.030	.632
Firm age	.021	.736	.077	.230	-.002	.978
Slack resources	.009	.885	.135 *	.026	-.032	.569
Capability development: marketing	.059	.330	.055	.378	.043	.462
Capability development: technological	.085	.178	.096	.136	.055	.364
Capability development: organizational	.088	.188	.065	.343	.068	.287
Telecommunication	.084	.229	.047	.517	.070	.293
Computer/IT	.159 *	.028	.036	.625	.149 *	.031
Banking/Insurance	.025	.706	.000	.995	.025	.696
Energy	-.003	.971	.038	.583	-.014	.833
Chemicals/Pharmaceuticals	-.034	.601	-.027	.689	-.026	.676
Machinery	.089	.196	.065	.355	.068	.296
Tranport and Services	.007	.916	-.040	.572	.019	.771
Consumer	.045	.492	.166 *	.015	-.006	.923
Dynamic capabilities	.390 ***	.000	.300 ***	.000	.299 ***	.000
Environmental dynamism	-.030	.644	-.052	.431	-.013	.829
Dynamic capabilities x environmental dynamism	.157 **	.006	.048	.407	.146 *	.012
Firm competence					.307 ***	.000
Firm competence x environmental dynamism					-.010	.854
Adjusted R^2	0.23 ***		0.19 ***		0.30 ***	

N = 265
*** p<0.001
** p<0.01
* p<0.05

Table 4.5 provides the results of the basic model calculated with archival data. As outlined above, I applied patent counts as a proxy for innovation performance. To obtain a measure of relative success, I calculated the ratio between the patent counts of the focal business unit and its strongest competitor. I then applied this patent count ratio as dependent variable. As a proxy for environmental dynamism, I applied the volatility in stock market returns. To obtain

a moderating variable that differentiates between low and high dynamism, I calculated a dummy-variable based on the median of the volatility measures.

TABLE 4.5: OLS Results Basic Model with Archival Data

	Model 1 DV: Patent Count Ratio		**Model 2** DV: Patent Count Ratio		**Model 3** DV: Patent Count Ratio		**Model 4** DV: Patent Count Ratio	
	Beta	**Sig.**	**Beta**	**Sig.**	**Beta**	**Sig.**	**Beta**	**Sig.**
Dynamic capabilities	.280	†	.022		.005		.022	
Environmental dynamism	.214		.210		.223		.234	
Dynamic capabilities x environmental dynamism			.359	†	.375	†	.365	†
Firm competence					.079		-.002	
Firm competence x environmental dynamism							.097	
R^2	0.13	†	0.20	*	0.19	†	0.20	

N = 40
*** p<0.001
** p<0.01
* p<0.05
† p<0.1

In Table 4.5, we can observe that dynamic capabilities also unfold a significant positive effect when innovation performance is measured with a relative patent count ratio. Further, the results also show that this positive effect is moderated by environmental dynamism, also when environmental dynamism is measured with an archival proxy. The fact that firm competence shows no significant relation with the innovation performance in terms of patent count ratios, is not surprising. The capability configuration captured in this study relates to marketing capabilities, technological capabilities also with respect to conduct efficient production, and to organizational capabilities in terms of coordinating the co-operation among departments. These capabilities were captured in that way, as the initial purpose of this study is to find factors that support the market success of developed products. As outlined above, patent counts are not an adequate measure to capture the market success of developed products. Firms patent technical components, technological features, or design patterns sometimes relating to product components, sometimes relating to the production procedure. Therefore, successful new products may contain several newly patented features, sometimes more of them, sometimes less. On the other hand, a higher number of patented features does not guarantee market success and is thus a limited proxy. Last but not least patent counts may reflect the innovativeness of a firm, but is not driven by marketing or organizational or production capabilities, but directly and solely by R&D activities.

As a final step in validating the results subsequent to the analysis of the results, I conducted additional interviews with four managers from different industries and presented and discussed the results. In all four interviews the results were judged as plausible based on the practical experience of the respective managers and thus indicate face validity.

4.5. Discussion and Conclusion

4.5.1. Implications

This study advances empirical research on dynamic capabilities and provides important theoretical contributions. The results provide evidence for the linkage between dynamic capabilities and Schumpeterian innovation. In the Schumpeterian perspective (Schumpeter, 1942, 1949) successful innovation is enabled through novel combinations of marketing, technological, and organizational aspects (Hagedoorn, 1996). This is enabled by implementing mechanisms that enable opportunity recognition, knowledge accumulation, and transformation. In this study, I found support for dynamic capabilities being the mechanisms that create the entrepreneurial ability of large, established organizations that enables to succeed in innovation-based competition (Galunic & Rodan, 1998; Mahoney, 1995). This study's results present a strong argument that dynamic capabilities are the manifestations of the innovation routines outlined by Schumpeter (1942) with which large and established firms implement entrepreneurial activities in a depersonalized, specialized, and professional co-operative fashion. The notion of a routine thereby refers to the structural aspect in the sense that specific activity domains manifest in a stable and recurring pattern, e.g. searching for opportunities, accumulating new knowledge, or reconfiguring resource and capability configurations, but that the specific activities within these domains are not necessarily routinized (Feldman & Pentland, 2003).

The results provide strong evidence for dynamic capabilities as a driving force of innovation performance (Danneels, 2002; Verona & Ravasi, 2003) and thereby inform research on innovation, and especially innovation performance (Brown & Eisenhardt, 1995; Simpson et al., 2006; Song et al., 2006) about additional influencing factors of successful innovation. Thereby, the applied model provides substantial explanatory power. In the competition for successful innovations, organizations often rely on their current capabilities. While the findings support prior propositions that operational capabilities positively influence innovation performance (Danneels, 2002; Simpson et al., 2006), they also indicate that organizations should not rest on the laurels of once achieved capability positions. Organizations that additionally possess dynamic capabilities – especially in more dynamic environments - are likely to outperform their competitors based on an innovation process that is faster-to-market, more focused, and more efficient. Based on such an advantage new entrants often pose a real threat for industry incumbents (Teece, 2007). In order to increase the competitiveness of their innovation activities, organizations are well advised to invest in dynamic capabilities. Contrary to

prior studies on innovation (Damanpour, 1991, 1996), firm size and slack resources show no significant effect on innovation performance, when dynamic capabilities are accounted for, underpinning the argument that industry incumbents cannot rest on profitable positions once captured.

Moreover, this study unveils that the performance effects of dynamic capabilities are more complex than recent research indicated. Beneath an indirect effect on innovation performance via the operational capabilities (Pavlou & El Sawy, 2006), dynamic capabilities unfold an additional direct effect on innovation performance by reducing the costs, increasing the speed, and focusing the direction of innovation activities, which has been previously suggested to increase innovation performance (Kessler & Chakrabarti, 1996). As I controlled for the amount of capability development, this direct effect is independent of new operational capabilities that have actually been developed. Thus, the performance links of dynamic capabilities have to be reconsidered, as the effectiveness and the efficiency of dynamic capabilities unfold their performance effects on different paths. Therefore, it is potentially promising for future research to address and investigate the mechanisms by which dynamic capabilities directly drive innovation performance in more detail.

With reference to the debate on the role of environmental dynamism, this study offers insights which go beyond the current state of knowledge. The results show that dynamic capabilities positively influence firm competence both in moderately dynamic and turbulent environments, providing support for their effectiveness in different levels of environmental dynamism (Eisenhardt & Martin, 2000; Zahra et al., 2006). Thereby, the results contradict prior findings indicating that the relationship between dynamic capabilities and firm competence is positively moderated by environmental dynamism (e.g. Pavlou & El Sawy, 2006), but support the results of another recent study also indicating the effectiveness of dynamic capabilities in different levels of environmental dynamism (Protogerou et al., 2011).

However, the findings also show significant differences of dynamic capabilities' effects between different levels of environmental dynamism. In moderately dynamic environments the impact of dynamic capabilities is fully mediated by the firm's capability position. In such settings innovation speed is less important and potentially valuable paths for innovation activities are easier to track. Therefore, in moderately dynamic environments organizations are rather able to cope with the challenges of innovation with their current capability endowment. Furthermore, more stable environments require less innovation activities, and ceteris paribus, less development of complementary capabilities. Thus, the potential of dynamic capabilities

to compensate the costs of innovation activity is reduced. In turbulent environments, however, the value of current capabilities for successful innovation erodes. Technological change, change in customer needs, and increasing competition significantly lowers the performance effects of the current capability endowment, which builds a core argument of conceptual research on dynamic capabilities (Teece et al., 1997; Teece, 2007). In environments characterized by high dynamism, dynamic capabilities unfold a strong direct effect and compensate for the lower impact of firm competence. In such environments organizations benefit from dynamic capabilities as they increase innovation speed, help to focus on valuable innovation paths, and reduce the costs of innovation activities. These results underpin the outstanding importance of dynamic capabilities in turbulent environments (Teece et al., 1997). Furthermore, in more stable environments it is easier to successfully innovate based on existing knowledge and skills, while in turbulent environments organizations have to engage in more exploratory innovation in order to be successful (Jansen et al., 2006). Overall, the much stronger performance effect of dynamic capabilities in dynamic environments supports the basic proposition that dynamic capabilities are especially valuable in terms of fostering successful innovation in turbulent environments (Teece et al., 1997; Teece, 2007).

Overall, I find support for Schumpeter's theory of innovation in the sense that large and established firms implement specialized mechanisms that enable co-operative and collective entrepreneurial activities in large organizations. Thereby, I find support for the indirect linkage proposed by Schumpeter, where these entrepreneurial mechanisms create novel combinations in the marketing domain, the technological domain, and the organizational domain, and in turn foster successful innovation. By relating this perspective to different levels of environmental dynamisms, I reveal additional interesting insights that expand Schumpeter's innovation theory. In more stable environmental settings, I find the indirect link between the mechanisms of entrepreneurial orientation and innovation performance supported. Thus, in more stable environments, dynamic capabilities create novel capability configurations (i.e. marketing, technological, and organizational) of superior quality, which in turn foster successful innovation. In more turbulent environmental settings, however, dynamic capabilities unfold strong and positive direct effects on innovation performance. Thus, in more turbulent environments the ability to recognize valuable opportunities and to increase the speed as well as the efficiency of innovation activities directly supports successful innovation. The perspective provided in this study therefore expands Schumpeter's innovation theory regarding the effect chain to different levels of environmental dynamism.

4.5.2. Limitations

This study applies perceptual measures from the same data source for dependent and independent variables, which bears the risk of common method variance that can not be totally ruled out. However, the inclusion of an unmeasured latent method construct and the validation based on objective measures and second informants reduced my concerns that the results might be biased based on common method variance. Nevertheless, future studies might combine perceptual measures with objective data and use multiple data sources.

To account for potential temporal or lagged effects of the mediating variable, I asked the respondents to retrospectively indicate their *prior* capability position. While there certainly is something to it that retrospective measures might be biased, the use of retrospective measures is a viable research method if the variables are reliable and valid (Miller, Cardinal & Glick, 1997).

As this study applies a newly developed model of dynamic capabilities, external validation is difficult. Although the applied measure shows high congruence with theoretically proposed effects and expected related measures, i.e. capability development, further validation is necessary. Future research might operationalize the constituent parts of dynamic capabilities instead of the manifestations in order to design the competing aggregate model and combine it with the superordinate model of dynamic capabilities that has been applied in this study.

As this empirical study focuses on business units of large firms operating in Germany, the findings should be validated in alternative settings. I approached the largest firms of the respective industries, which include all 110 firms listed in the three major stock exchanges and all 100 largest firms operating in Germany. Those firms might be more successful in the market place and regarding their innovation activities than the average of the basic population. On the other hand it is a plausible rationale to isolate business units which are more successful than the industry average. This is because the consideration of business units that perform below and above average might impede the identification of potential sources of competitive advantage (Rouse & Daellenbach, 1999). However, in this study I controlled for firm size, excess resources, and corporate support in order to detect potential effects. As the surveyed firms operate internationally, the results should hold in comparable settings than Germany. Future studies might focus on a broader sample in terms of performance differentials and might focus on small firms or on corporate level.

5. THE DIRECT AND INDIRECT EFFECTS OF DYNAMIC CAPABILITIES ON FIRM PERFORMANCE AND THE DIFFERING INFLUENCE OF MARKET AND TECHNOLOGICAL TURBULENCE

5.1. Introduction

The dynamic capabilities framework (Teece et al., 1997) has attracted great attention in management and organizational research as it has great potential to explain how firms may attain and sustain competitive advantage. Hence, several scholars addressed the performance implications of dynamic capabilities to examine their relation with firm or process level performance. Adner and Helfat (2003) found that dynamic managerial decisions which relate to building, integrating, and reconfiguring organizational resources and competences affect the variance of business performance. Kor and Mahoney (2005) found that a history of increased resource deployments in marketing leads to higher economic firm performance. Drnevich and Kriauciunas (2011) examined the performance contributions of ordinary and dynamic capabilities and found that ordinary capabilities positively contribute to relative firm performance while dynamic capabilities are negatively related to relative firm performance. Protogerou, Calothirou and Lioukas (2011) also examined the effects of dynamic and operational capabilities on firm performance and found that dynamic capabilities only unfold a positive indirect effect on firm performance which is fully mediated by operational capabilities.

Despite the commendable efforts in examining their performance outcomes, there is still confusion regarding the performance link of dynamic capabilities. As a result the overall performance outcomes of dynamic capabilities are not fully understood yet. Teece, Pisano and Shuen's (1997) conceptual study implies (at least partly) direct performance effects of dynamic capabilities (see Helfat & Peteraf, 2009), while Eisenhardt and Martin (2000) argue that dynamic capabilities indirectly contribute to firm performance via the resource base. In some studies there is the proposition that dynamic capabilities indirectly contribute to firm performance (Helfat & Peteraf, 2003; Zahra et al., 2006), while others argue that dynamic capabilities unfold direct and indirect effects on firm performance (Helfat & Peteraf, 2009). Arend and Bromiley (2009) argue that most studies treat dynamic capabilities as direct drivers of firm performance and criticize the diffuse performance links in many studies on dynamic capabilities. While partly arguing against a partially different conceptual background,

all definitions of dynamic capabilities that influenced the development of the field share the view that dynamic capabilities operate on other capabilities within the resource base of a firm (see for example Eisenhardt & Martin, 2000; Helfat et al., 2007; Teece et al., 1997; Winter, 2003). Thus, in line with the resource-based logic of value creation (Peteraf & Barney, 2003), dynamic capabilities positively contribute to a firm's value creation by enhancing the effectiveness and efficiency of the firm's other capabilities and resources.

Often dynamic capabilities are conceptualized and assessed in a way that makes it difficult and sometimes impossible to separate their existence from their effects (Zahra et al., 2006). This is one major source for the confusion regarding their performance outcomes. In many studies dynamic capabilities are operationalized in terms of the capabilities or resources that have been developed (e.g. Drnevich & Kriauciunas, 2011). However, dynamic capabilities are the *ability* or the *capacity* to develop other capabilities (see for example Helfat et al., 2007; Teece et al., 1997), meaning they are a mean to an end and not the end itself. Dynamic capabilities thereby manifest in several distinct but related dimensions (see for example Barreto, 2010; Teece, 2007) that conjointly enable a firm to identify the need for change, to formulate an appropriate response, and to implement adequate measures (Helfat et al., 2007).

Drnevich and Kriauciunas (2011) propose a positive direct effect of dynamic capabilities on firm performance, which is not mediated by other 'ordinary' or 'operational' capabilities. Moreover, they propose this effect to exist independently from a simultaneously occurring positive performance effect of 'ordinary' capabilities. In light of the theoretical considerations outlined above, such a performance effect of dynamic capabilities is very unlikely. Not really surprisingly they find that this proposed positive effect of 'dynamic capabilities' indeed negatively contributes to relative firm performance. Considering how dynamic capabilities are measured in this study, the occurrence of a negative effect on relative firm performance is not surprising. As they actually measure the development of new capabilities and resources (Drnevich & Kriauciunas, 2011, p. 265) and we know that capability development is a very costly venture (Barney, 1986; Dierickx & Cool, 1989; Lavie, 2006), it is unsurprisingly that a higher amount of capability development creates higher costs, and in turn, lower relative firm performance. A positive effect of capability development on relative firm performance would occur via the use of these newly developed capabilities, thus, indirectly. Drnevich and Kriauciunas (2011), however, neglect this indirect performance link in their study.

From a theoretical standpoint, two issues are especially problematic when drawing conclusions based on such designs. First, we do not know how these new resources and capabilities

have been developed. As capability building does not necessarily require dynamic capabilities (Helfat & Peteraf, 2003), alternative explanations for the occurrence of new capabilities and resources might be 'ad hoc' (Winter, 2003), accident or luck (Helfat et al., 2007), or experimentation. Second, it is at least disputable that the performance outcomes of capability development and dynamic capabilities are fully congruent as different modes of capability development may have different performance implications dependent on different contingencies (Winter, 2003).

Protogerou et al. (2011) operationalize dynamic capabilities as consisting of (1) coordination capabilities, (2) learning capabilities, and (3) strategic competitive response capability. As coordination capability is a core organizational/managerial capability that supports usual business operations, this capability seems merely to be an 'ordinary' or 'operational' capability, which disqualifies this kind of capability to be an integral element of dynamic capabilities. The ability to respond in a strategic and competitively meaningful manner is – though rather abstract – rather a qualitative performance outcome of dynamic capabilities rather than a constituent part.

In light of the shortcomings outlined above, this study aims at contributing to the dynamic capabilities research by examining and clarifying the performance links of dynamic capabilities by explicitly examining both direct and indirect effect chains of dynamic capabilities on firm performance. To avoid confusion regarding dynamic capabilities' nature and their effects, the several dimensions of dynamic capabilities are explicitly operationalized independently from any performance outcome on organizational level. Thereby, this study helps to clarify the performance effects of dynamic capabilities.

Further, this study investigates how, in which way, and to what extent dynamic capabilities' performance effects are contingent to environmental dynamism. As these topics are naturally related, the performance effects of dynamic capabilities can not be entirely examined without accounting for the role of environmental dynamism. From the outset, the performance effects of dynamic capabilities were linked to environmental dynamism (Teece & Pisano, 1994; Teece et al., 1997). Other scholars, however, argued that dynamic capabilities value contribution may be independent from environmental dynamism (Eisenhardt & Martin, 2000; Zahra et al., 2006). Empirical findings mirror these conceptual inconsistencies. While some studies find dynamic capabilities' indirect effects to be moderated by environmental dynamism (e.g. Pavlou & El Sawy, 2006), other studies find no moderating effect (e.g. Protogerou et al., 2011). Further studies indicate that the direct performance effects may be

positively moderated by environmental dynamism (e.g. Drnevich & Kriauciunas, 2011; Wu, 2010).

Most often the impact of environmental dynamism on the performance effects of dynamic capabilities is investigated by applying a composite measure of environmental dynamism that conjointly captures facets as market turbulence, technological turbulence, competitive intensity, etc. (e.g. Drnevich & Kriauciunas, 2011; Pavlou & El Sawy, 2006; Protogerou et al., 2011). While this approach is certainly not inadequate, there is some rationale to examine the impact of environmental dynamism on the performance effects of dynamic capabilities in more detail. With respect to technological change, prior research suggests that environmental dynamism may have competence-enhancing or competence-destroying effects (Anderson & Tushman, 1990; Tushman & Anderson, 1986). In which way environmental dynamism affects a firm's competences thereby depends on the specific characteristics of environmental change. Market turbulence and technological turbulence seem to differ significantly in their characteristics and prior empirical research often observed differing impact of these dimensions of environmental dynamism (e.g. Jaworski & Kohli, 1993; Lichtenthaler, 2009) on a firm's capabilities. Thus, in this study I examine the potential impact of market turbulence and technological turbulence on dynamic capabilities' performance effects separately.

In this study, I differentiate between different types of capabilities by their function. For that purpose, I distinguish between operational capabilities, which are defined as those that enable an organization to perform the ordinary or regular business activities (Collis, 1994; Helfat & Winter, 2011; Winter, 2003) and dynamic capabilities. A capability in general is defined as the ability to perform an activity (Amit & Schoemaker, 1993; Grant, 1991; Helfat & Peteraf, 2003; Penrose, 1995) in the sense that a firm can carry out a specific activity purposefully, repeatedly, reliable, and in an at least minimally satisfactory manner (Helfat et al., 2007; Helfat & Winter, 2011). Ordinary business activities relate to the activities necessary to design, produce, market, and deliver the product, as well as the necessary supporting activities (Collis, 1994; Porter, 1985). Thus, I apply a functional perspective on capabilities. Accordingly, examples of operational capabilities are R&D, product development, marketing, organization, management, etc. (Amit & Schoemaker, 1993; Grant, 1991). A better relative capability in comparison with competition is referred to as competence in this paper, in the sense of a 'distinctive competence' (Snow & Hrebiniak, 1980; Teece et al., 1997). Dynamic capabilities are those that operate on operational capabilities (Collis, 1994; Winter, 2003) by building, integrating, or reconfiguring these operational capabilities (Helfat & Peteraf, 2003).

Thereby, dynamic capabilities likewise operate on different kinds of ordinary capabilities. To account for dynamic capabilities effects on and via a broader capability configuration, I incorporate marketing capabilities, technological capabilities, and organizational/managerial capabilities into the analysis. The different dimensions of environmental dynamism that are captured in this study are the rate and speed of change in technologies and customer preferences (Jaworski & Kohli, 1993; Lichtenthaler, 2009). Firm performance is captured as relative financial performance.

This study offers several theoretical and empirical contributions to the research field of dynamic capabilities. First, this study examines how dynamic capabilities strengthen the relative quality of operational capabilities and how this relative strength in operational capabilities (firm competence) in turn positively influences relative firm performance. Thus, the indirect performance effects of dynamic capabilities are analyzed and the positive indirect effect of dynamic capabilities is supported (Protogerou et al., 2011). Further, the potential direct performance links between dynamic capabilities and firm performance are examined. This study is to my best knowledge the first that proposes *and* finds *and* explains a negative direct effect of dynamic capabilities on firm performance. At this junction, the complexity of dynamic capabilities' performance effects is unveiled by providing evidence and explanation that dynamic capabilities unfold positive indirect performance effects, which are mediated by operational capabilities, but negative direct effects on firm performance due to costs for implementing, maintaining, and applying dynamic capabilities.

Finally, the impact of environmental dynamism on the performance effects of dynamic capabilities is analyzed. The results show that market turbulence and technological turbulence affect the impact of dynamic capabilities differently. While market turbulence positively moderates the contribution of dynamic capabilities on operational capabilities, this relation is negatively moderated by technological turbulence. Further, the results suggest that the negative direct effect of dynamic capabilities on relative firm performance is mitigated in higher levels of market and technological turbulence. All in all, the results suggest that dynamic capabilities unfold a positive overall effect on financial firm performance only under conditions of high market turbulence. While dynamic capabilities seem to be effective in terms of building operational capabilities of superior quality in all levels of environmental dynamism, in most cases they seem not to be efficient, as their benefits are consumed by their costs.

In the arena of organizational adaptation and change, dynamic capabilities have long been treated as a 'magic bullet' and few scholars focused on the potential downside of the concept.

The costs associated with building, maintaining, and applying dynamic capabilities are often neglected in conceptual and empirical research on the topic, while studies most often focus on potential benefits. This study raises doubts that all in all - when benefits and costs of dynamic capabilities are accounted for – dynamic capabilities contribute to superior financial firm performance. In most settings investing in dynamic capabilities seems to be a zero-sum game in terms of relative financial performance. This calls for a rethinking regarding the value of dynamic capabilities in strategic management and regarding the research settings in which the outcomes of dynamic capabilities are examined.

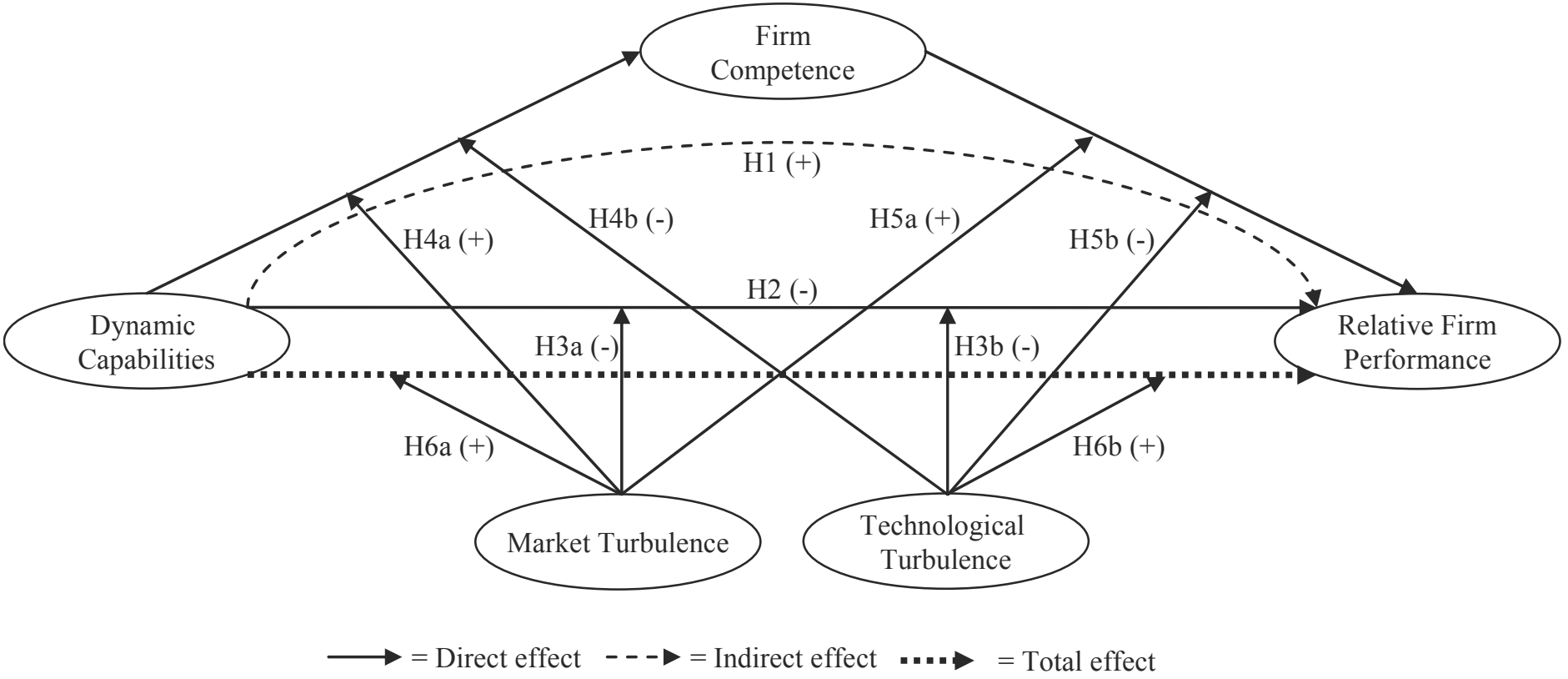
Moreover, the findings of this study suggest that with regard to environmental dynamism technological turbulence is the far greater threat for a firm's capability position, and as a consequence, to the firm's ability to compete successfully. In this regard the results further suggest that dynamic capabilities may not be a remedy against sharp and high paced technological changes.

5.2. Theory and Hypothesis

5.2.1 The Performance Effects of Dynamic Capabilities

Two main discussions – which are necessarily related - regarding the dynamic capabilities framework relate to the effect chain of dynamic capabilities' contribution to firm performance and to the question how environmental dynamism influences the performance effects of dynamic capabilities (Helfat & Peteraf, 2009; Zahra et al., 2006). The first discussion relates to the question whether dynamic capabilities unfold a positive direct effect on firm performance or whether this positive contribution is mediated by the firm's operational capabilities, hence indirectly. Further, it relates to the question whether a potential direct effect is positive or negative. Such a negative direct effect of dynamic capabilities has not been proposed in empirical research on dynamic capabilities, yet (Drnevich & Kriauciunas, 2011). The second discussion relates to the question to what extent the value contribution of dynamic capabilities is contingent to environmental dynamism (Eisenhardt & Martin, 2000; Teece et al., 1997; Zahra et al., 2006). As market and technological turbulence often seem to affect capabilities differently (see for example Jaworski & Kohli, 1993; Lichtenthaler, 2009); I examine their influence on dynamic capabilities' performance effects separately. Figure 5.1 presents the research model and proposed relations with which I aim to contribute by providing answers to the questions outlined above.

FIGURE 5.1: Research Model and Proposed Relations



The core argument of the resource-based view is that an advantage in the resource and capability endowment relative to competition creates a competitive advantage in the market place, and as a consequence, an advantage in firm performance relative to competition (Amit & Schoemaker, 1993; Barney, 1991; Peteraf, 1993; Wernerfelt, 1984). Operational capabilities contribute to firm performance by increasing revenues and/or reducing costs (Barua et al., 2004; Drnevich & Kriauciunas, 2011; Wang & Ang, 2004). Further, operational capabilities improve the quality of existing processes (Barua et al., 2004; Drnevich & Kriauciunas, 2011). Better capabilities enable firms to choose and implement the activities necessary to produce and deliver a product or service more efficiently or effectively (Collis, 1994). Firms with a higher relative quality in their ordinary capabilities are more efficient, meaning that they are able to produce more economically and/or deliver a higher quality that better satisfies customer needs (Peteraf & Barney, 2003). A higher relative capability enables to provide higher benefits to the customers for a given cost or to provide the same benefit at a lower cost. As a consequence, firms with a higher relative quality in their operational capabilities are likely to show a higher relative firm performance. Empirical research support the argument that resource and capability differences relative to competition have a significant direct effect on relative firm performance (Spanos & Lioukas, 2001). Vorhies and Morgan (2005) found that a gap in marketing capabilities between top-performing benchmarks and other firms explains significant variance in performance. Further results show that marketing and technological capabilities positively influence joint venture performance (Song et al., 2005) and that ordinary capabilities are positively associated with relative firm performance (Drnevich & Kriauciunas, 2011; Protogerou et al., 2011).

The main proposition of the dynamic capabilities framework is that dynamic capabilities are a source of competitive advantage as they establish an advantage in the relative resource and capability endowment (Eisenhardt & Martin, 2000; Helfat & Peteraf, 2009; Teece et al., 1997; Teece, 2007; Zahra et al., 2006) by building or modifying operational capabilities (Helfat & Peteraf, 2003), and as a consequence, lead to a relative advantage in firm performance. Based on the competence definition made above, in this paper, I refer to such an advantage in operational capabilities relative to competition as *firm competence*. Dynamic capabilities enable firms to sense the need for change, to acquire and integrate necessary knowledge to react to challenges (Teece et al., 1997; Teece, 2007), and to reconfigure the firm's resource base (Eisenhardt & Martin, 2000; Teece, 2007). Dynamic capabilities thereby help to extend, modify or build operational capabilities (Helfat & Peteraf, 2003), and as a consequence

strengthen the relative quality of the capability configuration (Pavlou & El Sawy, 2006; Protogerou et al., 2011).

The mechanisms underlying dynamic capabilities operate on operational capabilities in the first place as they help to create or improve operational capabilities (Helfat & Peteraf, 2003; Pavlou & El Sawy, 2006; Protogerou et al., 2011; Zahra et al., 2006). Dynamic capabilities are the drivers behind the development of new capabilities as a new source of competitive advantage (Eisenhardt & Martin, 2000). Zott (2003) also suggests that dynamic capabilities change a firm's competences, which in turn foster competitive advantage due to performance differentials. While strengthening capability development, dynamic capabilities enable organizations to build capabilities of superior quality which results in firm competence. Zahra et al. (2006) share this view by arguing that dynamic capabilities' effect on competitive advantage works through the resource base (which capabilities are a part of). Several scholars state that the performance impact of dynamic capabilities is mediated by the firm's resource position and capabilities (Pavlou & El Sawy, 2006; Protogerou et al., 2011; Zahra et al., 2006). By building, improving, or reconfiguring operational capabilities, dynamic capabilities increase the efficiency of the existing capability configuration and increase the firm's value creation potential. Drnevich and Kriauciunas (2011) argue that dynamic capabilities enable to respond to opportunities through developing new processes or improving the speed, effectiveness, and efficiency with which a firm operates. But still the firm operates based on its operational capabilities, which's improvement through dynamic capabilities increases firm performance. From this observation follows that dynamic capabilities improve the relative quality of operational capabilities, whereas the relative advantage in operational capabilities positively contributes to relative firm performance. Thus:

> **HYPOTHESIS 1:** Dynamic capabilities unfold a positive indirect effect on relative firm performance which is mediated by the firm's operational capabilities.

Besides the indirect effect via the resource position and operational capabilities, dynamic capabilities are also often proposed to have a direct effect on firm performance (see Helfat & Peteraf, 2009). Contrary to their prediction Drnevich and Kriauciunas (2011) observe a negative direct effect of what they measure as dynamic capabilities on relative firm performance. The sources, however, of this direct effect remain rather unclear. According to the resource-based logic of value creation (Peteraf & Barney, 2003), value creation through dynamic ca-

pabilities occurs via the resource and capability endowment, and thus implicates no positive direct effect of dynamic capabilities on firm performance.

Though, Winter (2003) and Zollo and Winter (2002) argue that there are fixed costs associated with having dynamic capabilities, which in turn would entail a negative performance impact. These costs occur with the development and usage of dynamic capabilities and relate to the consumption of organizational resources (Zahra *et al.*, 2006). Further, it is argued that the costs of having dynamic capabilities can exceed the benefits when there is no occasion to apply them (Winter, 2003; Zahra *et al.*, 2006). Zott (2003) argues that performance differences among firms are also caused by the costs of dynamic capabilities. Dynamic capabilities create permanent costs, whether applied or not. The costs associated with e.g. scanning the environment, codifying knowledge, and the overhead costs for specialized employees may create a negative effect on performance, in any environmental setting. Such a cost effect, arising from developing, holding, and using dynamic capabilities can be expected to occur as an additional distinctive effect compared to the positive indirect effect discussed above.

Furthermore, dynamic capabilities create additional costs when applied for capability development. Zollo and Winter (2002) discuss the cost of capability development in the case of learning mechanisms and evolution. They distinguish the costs of experience accumulation, knowledge articulation, and knowledge codification, with the former bearing the lowest cost and the latter the highest cost burden. Zott (2003) analyses the costs of resource deployment in a dynamic capability context and finds that resource deployment costs differ between firms which leads to intra-industry differences in performance. He analyses costs associated with imitative and experimental resource deployment and suggests that resource redeployment costs may affect firm performance both directly and indirectly (Zott, 2003).

Several scholars also discuss transaction costs in case of capability development (Augier & Teece, 2009; Kogut & Zander, 1992; Teece et al., 1997; Teece, 2007). The transfer of resources and capabilities among firms creates transaction and transfer costs (Szulanski, 1996; Teece *et al.*, 1997). As capability development involves the acquisition and transfer of resources and capabilities, it generates transaction costs. Be it information, knowledge, physical assets or human resources, in nearly any case capability development involves integration of additional resources from outside the firm boundaries. Such market transactions always imply transaction costs.

The existence of dynamic capabilities creates fixed costs for organizations. Besides the investments to build dynamic capabilities, there are maintenance costs for information systems, costs for specialized employees (e.g. M&A department, competitive intelligence), and knowledge codification, even when there is no occasion for change. Costs incur when firms frequently scan their business environment, observe technological trends and regulation acts. In the case of environmental change that triggers capability development, additional variable costs arise. Such variable costs consist of transaction costs, cost of coordination, investments in material, acquisition costs, and integration costs. These costs associated with dynamic capabilities clearly unfold a negative effect on a firm's financial performance. Firms investing more in the development of dynamic capabilities in order to implement higher levels of or stronger dynamic capabilities will ceteris paribus show weaker relative financial performance than firms investing lesser amounts or abstain from developing and implementing dynamic capabilities. Thus:

HYPOTHESIS 2: Dynamic capabilities unfold a negative direct effect on relative firm performance.

5.2.2. The Impact of Market Turbulence and Technological Turbulence on the Performance Effects of Dynamic Capabilities

The environmental context of an organization can be determined via its constituent parts or via its state (Jaworski & Kohli, 1993; Miller, 1987; Miller & Dröge, 1986). For the dynamic capabilities framework the focus of interest lies on the dynamism of the environmental context, meaning the rate or speed of change with which the challenges change an organization has to cope with (Eisenhardt & Martin, 2000; Teece et al., 1997). Thus, the change of the state of environmental constituent parts is of interest here and not the state itself. Often scholars operationalize environmental dynamism with measures capturing uncertainty, heterogeneity, or the intensity of competition. As long as the changes in these constructs are not captured, such measures reflect the state of the environment and not the dynamism in it.

I examine the influence of market turbulence and technological turbulence as these two seem to be the most relevant environmental contingent factors of dynamic capabilities (Eisenhardt & Martin, 2000; Jaworski & Kohli, 1993; Lichtenthaler, 2009; Pavlou & El Sawy, 2006; Teece et al., 1997; Teece, 2007) and further seem to unfold differing impact based on their different characteristics. Market turbulence refers to the rate and speed of change in customer preferences and technological turbulence refers to the rate and speed of

change in technologies (Jaworski & Kohli, 1993; Lichtenthaler, 2009). As market and technological turbulence often affect relations differently, I discuss and examine their effects separately when deemed necessary. The role of environmental conditions within the concept of dynamic capabilities might be the most important unsolved question to date (Zahra *et al.*, 2006). Teece et al. (1997) state that dynamic capabilities are especially valuable in turbulent environments, while Eisenhardt and Martin (2000) argue that they are also valuable in moderately dynamic environments. Winter (2003) points to certain environmental conditions where alternative modes of capability development might be superior to dynamic capabilities.

According to Teece et al. (1997) dynamic capabilities are especially valuable in turbulent environments, as there is a continuous need for adaptation and permanent chance for opportunities. In turbulent environments, firms are especially urged to develop new capabilities in order to keep pace with external development (Capron & Mitchell, 2009; Lavie, 2006). Therefore, with increasing environmental dynamism the need to constantly create new capabilities increases.

Under conditions of high environmental dynamism firms regularly have to respond to external developments and adapt to changes. Firms have to respond to changing customer needs and changes in technologies in order to keep pace with competition. When it is regularly necessary to develop new capabilities, dynamic capabilities are argued to be superior in terms of cost efficiency in comparison with alternative modes of capability development (Winter, 2003). Thus, under such conditions firms that invest in maintaining dynamic capabilities are likely to bear lower or at least not higher costs than firms applying alternative modes for capability development. Given that dynamic capabilities decrease the marginal costs of capability development, as discussed above, their relative cost efficiency in comparison with alternative modes for capability development increases with increasing need for building new capabilities. In other words, the more often a firm needs to build new capabilities in a given period of time the more efficient to invest in dynamic capabilities. The higher the dynamism in the environment the more often firms need to adapt to technological developments, changing customer needs, or competitor moves. Under such conditions it is very likely that alternative modes of capability development bear a relative cost disadvantage in comparison with dynamic capabilities. Thus, it is likely that more firms invest in building and maintaining dynamic capabilities when they operate in more turbulent business environments. One way or the other, in environments characterized by high levels of dynamism in order to stay competitive and to survive firms have to bear the costs associated with the development of new capa-

bilities as well as the costs for applying the mode of capability development they use. Thus, most or all firms have to bear similar costs for maintaining dynamic capabilities or for applying another mode of capability development. Thus, ceteris paribus, the possession of dynamic capabilities is unlikely to bear higher costs and in turn it is unlikely that the possession of dynamic capabilities negatively influence relative financial firm performance.

To build and maintain dynamic capabilities creates costs whether applied or not. In environments characterized by low levels of environmental dynamic capabilities a higher number of firms are likely to abstain from investing in dynamic capabilities as there is no or less occasion to attain benefits from their application (Winter, 2003). Further, with few opportunities to apply dynamic capabilities for the development of new capabilities other modes of capability development are superior from a cost perspective (Winter, 2003). In environments characterized by low dynamism the pressure to regularly adapt to changes is less strong leading to fewer firms investing in dynamic capabilities. Firms that do invest to build and maintain dynamic capabilities under such conditions have to bear the costs associated with dynamic capabilities, while a higher number of competitors do not have to bear these costs. With fewer firms having dynamic capabilities under such conditions, the additional costs arising with them ceteris paribus lead to a lower relative financial performance. Thus:

HYPOTHESIS 3a: In environments characterized by high market turbulence the negative direct effect of dynamic capabilities on relative firm performance is mitigated.

HYPOTHESIS 3b: In environments characterized by high technological turbulence the negative direct effect of dynamic capabilities on relative firm performance is mitigated

Prior research often suggests that market and technological turbulence likewise affect organizational or performance outcomes (Drnevich & Kriauciunas, 2011; Jaworski & Kohli, 1993; Lichtenthaler, 2009). While it is sometimes discussed that this might also be contingent to characteristics like the type of change, the speed of change, or the current capability position (Drnevich & Kriauciunas, 2011; Helfat et al., 2007), this has not been explicitly argued or modeled yet. Based on their very different characteristics and impact on the current capability configuration, I argue that market turbulence and technological turbulence confront firms with very different challenges, and based on that, with very different difficulties in order to cope with these challenges.

Market turbulence, defined as the change of the composition of customers and their preferences, require firms to constantly modify their products and services (Jaworski & Kohli, 1993). While this clearly affects the effectiveness of the current capability configuration, it is very unlikely that single capability areas or the whole capability configuration is rendered obsolete. Changing customer preferences may require a modification of marketing capabilities in order to adequately address the changed preferences, but it is very unlikely that the existing marketing capability becomes entirely useless. The change in customer preferences may require an enhancement of the current technological capabilities of a firm in order to extend product or service features to address the changed customer preferences. However, it is very unlikely that changing customer preferences require a completely new technological basis, leading to the conclusion that the current technological capabilities are not completely rendered obsolete. This could only be the case, when (1) changing customer preferences would indeed require a completely new technology and (2) an appropriate technology would already evolve, but then this effect would merely relate to technological change. Such changes that require perceptible but restricted modification of the capability configurations are less challenging (Lavie, 2006). Furthermore, changes in customer preferences, which are often influenced by general social or demographic trends, are far easier to detect and to predict. In light of these characteristics, dynamic capabilities are expected to be very helpful in detecting such changing customer preferences, in creating or acquiring the relevant knowledge about how to address these new preferences, and in accomplishing the necessary modifications of the capability configuration. Thus, dynamic capabilities are likely to additionally increase the relative quality of the capability configuration in higher levels of market turbulence.

HYPOTHESIS 4a: The contribution of dynamic capabilities to firm competence (relative strength of ordinary capabilities) increases with increasing market turbulence.

Technological turbulence refers to the rate and speed of technological change (Jaworski & Kohli, 1993; Lavie, 2006). Changing technologies modify the components, systems techniques, or methods required for producing organizational outputs (Lavie, 2006), which is often competence-destroying when initiated externally (Tushman & Anderson, 1986). Technological change is thereby understood as a rather exogenous event (Lavie, 2006), as technological developments are not always initiated by one and the same firm. Therefore, for any firm technological changes are exogenous events in most cases that urge the firm to adapt.

While the threat arising from major technological changes are more obvious, yet seemingly minor improvements in technological products sometimes have disastrous effects on industry incumbents (Henderson & Clark, 1990). Rosenbloom and Christensen (1994) also acknowledge the potentially large cumulative economic consequences of incremental changes, but see more radical technological change as one of the greatest threats for industry incumbents due to its potential to render existing capabilities completely obsolete. Capabilities can be rendered obsolete by technological change as knowledge, human, site, or physical assets that were specific to an efficient relationship can be rendered obsolete, rendering the whole relation inefficient (Afuah, 2001). Further Afuah (2001) argues, that there are cases in which a technological change leaves knowledge of components intact, while knowledge regarding links between components becomes useless, rendering related assets obsolete.

The higher the speed and rate of technological change the more likely it is that it renders the current capability configuration of a firm obsolete with the consequence that current capabilities have to be completely substituted (Lavie, 2006). Technological change thereby affects underlying processes and the products themselves (Anderson & Tushman, 1990). Major technological changes offer sharp price-performance improvements over existing technologies and often imply technical advance so significant that no increase in scale, efficiency, or design can make older technologies competitive with the new technology (Tushman & Anderson, 1986). Technological change thereby often enables dramatic improvements in performance at constantly decreasing cost (Rosenbloom & Christensen, 1994). Moreover, often newly developed technologies are patented, requiring competing firms to develop completely novel alternative technological solutions. It is very difficult to forecast technological trends as often alternative technologies compete and it is difficult to assess which criteria might lead to a succession of one or the other alternative. Technological change regularly initiates strong technological rivalry between alternative technological regimes and there are complex social, political, and organizational dynamics that select dominant designs among technological alternatives (Anderson & Tushman, 1990).

Major technological changes fundamentally alter relevant sets of competences within whole product classes (Tushman & Anderson, 1986). Thus, it is more challenging to create or acquire new knowledge in order to develop alternative technologies, as when existing technological features simply have to be enhanced or modified. Further, to create and integrate completely new technological capabilities and aligning them with existing marketing or organizational capabilities is much more challenging. Still, dynamic capabilities aid in such an

endeavor of developing new technological capabilities (Tripsas, 1997), but their effectiveness is expected to decrease in higher levels of technological turbulence. The challenge is to break up the inertia around capabilities which are aligned with old technologies, and further, to overcome the difficulties of both anticipating the devaluation of the old capabilities and of efficiently creating new ones which are directed to supporting the new technological regime (Rosenbloom & Christensen, 1994). The possession of dynamic capabilities may help to cope with such challenges, but it is unlikely that the challenges 'simply vanish' due to the existence of dynamic capabilities.

The development of technological capabilities is much harder, when the speed of change and the rate of change increase. The question here is not if firms facing high levels of technological change are better off with or without dynamic capabilities. Clearly, under conditions of high paced, radical technological change, firms are better prepared to cope with the challenges with dynamic capabilities than without. The relevant question here is if the positive effect of dynamic capabilities in creating operational capabilities is stronger in the presence or in the absence of radical technological change. Dynamic capabilities may speed up the development of new technological capabilities, but they are unlikely to simply conjure them up. While dynamic capabilities may still have a positive influence on the relative quality of operational capabilities, the contribution will be weaker than in less turbulent environments.

HYPOTHESIS 4b: The contribution of dynamic capabilities to firm competence (relative strength of ordinary capabilities) decreases with increasing technological turbulence.

Prior research suggests that environmental dynamism decreases the positive effects of ordinary capabilities on relative firm performance (Drnevich & Kriauciunas, 2011; Pavlou & El Sawy, 2006; Protogerou et al., 2011). However, it is also argued that environmental change can have competence enhancing effects on a firm's capabilities (Lavie, 2006; Tushman & Anderson, 1986). Again, how firms can cope with environmental change also depends on the type of change, the rate and speed of change, as well as the current capability endowment (Capron & Mitchell, 2009; Lavie, 2006).

As argued above, a change in customer preferences alone is unlikely to render the current capability configuration obsolete. The existing marketing capabilities are expected to still be of some value, but might need some modification. Organizational and technological capabilities are expected to be much less affected by market turbulence alone and still provide an adequate basis for coping with the change. Moreover, I argue that firms with a weaker rela-

tive capability endowment will be comparatively stronger affected by such external changes. Firms with a higher relative quality of organizational and technological capabilities are expected to be rather capable to seize the opportunities that also arise from a change in customer preferences or are rather able to avoid the downturn. Accordingly, ceteris paribus, firm with a higher relative capability strength are likely to be able to further increase their relative advantage in firm performance in comparison with competitors that have a weaker capability endowment.

HYPOTHESIS 5a: Market turbulence increases the positive effect of firm competence (relative strength of ordinary capabilities) on relative firm performance.

Compared to changes in customer preferences, technological change is a different kind of threat. When radical technological change renders the technological capabilities of a firm obsolete, the entire capability configuration is likely to be devaluated. When a firm is no longer able to provide products or services with the technological features the market demands and competitors (at least the initiator of the technological change) already offer to the market, former strong marketing or organizational capabilities are not likely to be of much value in the competition. Prior research suggests that under conditions of high technological turbulence technological capabilities might have to be substituted as the current configuration is no longer valuable (Lavie, 2006; Tushman & Anderson, 1986). Song et al. (2005) outline the possibility that technological turbulence may either have a competence-enhancing or competence-destroying effect on the performance contribution of technological capabilities while it downplays the role of marketing capabilities. As a consequence, even though a focal firm still might have a relative advantage in its overall capability configuration compared with competition, the relative advantage in firm performance will decrease as it is not able to accrue value from the advantage in its operational capabilities.

HYPOTHESIS 5b: Technological turbulence decreases the positive effect of firm competence (relative strength of ordinary capabilities) on relative firm performance.

To answer the initial question, whether dynamic capabilities are valuable in turbulent environments, moderately dynamic environments, or both, the complete effect chain of dynamic capabilities has to be considered. Thus far I argued that the positive indirect effect of dynamic capabilities on firm performance is reinforced in settings characterized by high market turbulence while it is mitigated in settings characterized by high technological turbulence. Further,

I argued that the negative direct effects of dynamic capabilities on relative firm performance are mitigated in both settings (high market turbulence and high technological turbulence). Therefore, it is likely that in lower levels of environmental dynamism (market and technological) turbulence the benefits of dynamic capabilities are consumed by their costs. While I expect dynamic capabilities to be still effective in order to create a higher relative quality of operational capabilities, they are unlikely to contribute meaningful to a relative advantage in firm performance in moderately dynamic environments. In higher levels of environmental dynamism a (in the case of technological turbulence partly weakened) positive indirect effect of dynamic capabilities on relative firm performance is flanked by a mitigated negative direct effect. Thus:

HYPOTHESIS 6a: In environments characterized by high market turbulence the overall effect of dynamic capabilities on relative firm performance is stronger than in environments characterized by low market turbulence.

HYPOTHESIS 6b: In environments characterized by high technological turbulence the overall effect of dynamic capabilities on relative firm performance is stronger than in environments characterized by low technological turbulence.

5.3. Methods

5.3.1. Sample and Data Collection

The analyses of this study are based on the same sample as the study described in Chapter 2. Thus, the sample and the data collection procedure are equal to those described in Chapter 2.4.1. To minimize redundant repetition I therefore would like to refer to Chapter 2.4.1. for a recall of the explanations regarding sample and data collection. In order to study dynamic capabilities as drivers of relative firm performance the business unit is the reasonable unit of analysis. This is because long-term performance differentials are largely attributable to the business unit level (McGahan & Porter, 1997; McGahan & Porter, 2002; Misangyi et al., 2006; Rumelt, 1991), and thus, their sources should also be examined on the level of business units (Rouse & Daellenbach, 1999).

5.3.2. Measurement and Validation of Constructs

Dynamic capabilities and firm competence were measured with the same scales and items as displayed in Table 2.1 in Chapter 2. As I again aimed at examining the relations on construct level, I operationalized dynamic capabilities and firm competence as second-order measures as described and validated in Chapter 2.5.1. and 4.3.2. Again, I controlled for potential temporal or lagged effects regarding the inclusion of the *current* capability position as the mediator variable. The rationale in this regard is equivalent to that discussed in Chapter 4.3.2. and I used the same measures and the same procedure as described before.

I applied the same control variables as described in Chapter 2. Thus, I controlled for corporate support, firm size, firm age, slack resources, capability development, and industry effects. The rationale to include these controls relating to firm competence is equal to that described in Chapter 2.4.2. In relation to financial firm performance as dependent variable, I again controlled for corporate support to isolate the effects on business unit level. Further, I controlled for slack resources as a higher flexibility in available resources is expected to positively influence performance (Daniel, Lohrke, Fornaciari & Turner, 2004; George, 2005). I controlled for the effects of firm size on financial firm performance, as larger organizations are able to realize economies of scale, which may increase financial performance. I further included firm age as a control variable to control for the potential effects of prior knowledge and experience on financial firm performance. In order to control that proposed negative direct effect is not attributable to new operational capabilities that have actually been developed, and thus, is fully attributable to dynamic capabilities, I included the control variables for marketing capability development, technological capability development, and organizational capability development.

In order to develop appropriate scales for firm performance, market turbulence, and technological turbulence, I reviewed relevant literature to identify existing items that relate to the domain of the construct in questions or to derive items based on conceptual studies discussing the respective domain. The resulting scales were validated in interviews with academics and practitioners as described in Chapter 2.4.2. The items for firm performance, market turbulence, and technological turbulence were measured on a seven-point Likert-scale. The items with their respective scale ratings and anchor points are presented in Table 5.1. For a subsample of business units (Batjargal, 2010), I validated the dependent variable with archival data reflecting the financial performance of the focal business unit and its main competitor.

Relative firm performance. To capture relative financial firm performance, respondents were asked to rate their *actual* financial performance in comparison to their main competitor (Spanos & Lioukas, 2001). The scale comprises operating profit and return on investment ($\alpha = 0.91$). To validate the subjective measure of relative firm performance I applied the following approach: At the beginning of the survey, the respondents were asked to indicate their strongest competitor, before they actually were asked to rate their performance against them. I validated the indication of the strongest competitor based on available data sources (e.g. Hoover's company profiles). Further, the respondents were asked to self-report the net sales and operating profits of their business units. In a first step, I validated the self reported performance data with archival data from annual reports. I found the self-reported data to be nearly perfectly correlated with the archival data (net sales: $r = .99$, $p<0.001$, $N = 27$; operating profits: $r = .97$, $p<0.001$, $N = 27$). In a second step, I compared the archival performance data of the focal business unit with the archival performance data of the competitor which was indicated in the survey and compared this result with the subjective scale ratings where the respondents indicated their relative performance. Thereby, I found a match in 90% of the cases for net sales and in 87% of the cases for operating profits, which indicates the reliability and validity of the measures (Batjargal, 2010; Carlson & Herdman, 2010). Further, I analyzed the inter-rater correlations of the performance measures for different business units. As opposed to checking for inter-rater reliability, when second informants rate the same phenomenon, in this case the different measures should show low or no correlation. The performance measures of the different business units showed a non-significant correlation of 0.09.

Environmental dynamism. I captured market and technological turbulence with items from Jaworski and Kohli's (1993) study and two newly developed items to additionally capture the rate of change. The scales measuring *technological turbulence* ($\alpha = 0.90$) and *market turbulence* ($\alpha = 0.67$) consist of 5 items each. The items captured the dynamism of the environment during the *last three years*.

To validate the subjective measures of market and technological development, I applied objective data that reflects the dynamism of the business environment. Therefore, I analyzed the mean and distribution of the subjective measures of environmental dynamism as a function of the respective industry membership and compared these results with the corresponding volatility in stock market returns, which reflect the volatility in economic returns. The volatility in returns is widely accepted as an appropriate objective measure for environmental dynamism (see for example McNamara et al., 2003; Snyder & Glueck, 1982). The results of

the objective measure match very well the subjective data. Furthermore, the subjective measures for environmental dynamism shows computer/IT, telecommunication, and automobile on the upper end of the dynamism spectrum and consumer goods on a lower level, which corresponds with findings of prior studies (Rosenkopf & Schilling, 2007). Based on these results, I believe the subjective measures of market and technological turbulence to be reliable and valid.

TABLE 5.1: Variables and Operationalization

Technological Turbulence (α = .90) (7, "strongly agree", and 1, "strongly disagree")
The technology in our industry is changing rapidly.
Technological changes provide big opportunities in our industry.
A large number of new product ideas have been made possible through technological breakthroughs in our industry.
Technological developments in our industry are rather minor. (reverse-coded)
In our industry major technological innovations are developed quite regularly.
Market Turbulence (α = .67) (7, "strongly agree", and 1, "strongly disagree")
In our kind of business, customers' product preferences change quite a bit over time.
Our customers tend to look for new products all the time.
We are witnessing demand for our products and services from customers who never bought them before.
New customers tend to have product-related needs that are different from those of our existing customers.
We cater to many of the same customers that we served in the past. (reverse-coded)
Relative Firm Performance (α = .91) (Please rate the actual performance of your business unit in comparison with your best/most successful competitor.) (+3, "much better", and -3, "much worse")
Operating profit/EBIT
Return on investment

5.3.3. Discriminant Validity among Dependent Variable, Mediating Variable, and Independent Variable

In order to assess convergent and discriminant validity for of the dependent variable, the mediating variable, and the independent variable, I conducted confirmatory and exploratory factor analysis and the analysis of the item-based Pearson correlations simultaneously with all factors relating to the independent variable, the mediator, and the dependent variable. For all variables, the correlations between items assigned to the same factor are higher than between the respective item and any item assigned to another factor, revealing the intended 11-factor structure. Within the confirmatory factor analysis the average variance extracted for each variable exceeds the squared multiple correlation between each underlying factor and any other factor in the study. Accordingly, an exploratory factor analysis also revealed the intended 11-factor structure. Table 5.2 gives the results. I established discriminant validity between the overall measures of dynamic capabilities, firm competence, and firm performance with a nested model comparison. Therefore, I conducted separate confirmatory factor analyses for each pair of variables, where in one model the covariance between the two constructs was constrained to unity while being freely estimated in the other model. For each pair the model with the freely estimated covariance showed better fit based on χ^2/df with a significant ($p<0.001$) χ^2-difference test, providing evidence for discriminant validity among the overall measures (Hair et al., 2010).

TABLE 5.2: Results of Exploratory Factor Analysis

	Variables										
	Opportunity Recognition	**Capability Monitoring**	**Knowledge Creation**	**Knowledge Acquisition**	**Knowledge Sharing**	**Capability Creation**	**Capability Integration**	**Marketing Competence**	**Technological Competence**	**Organizational Competence**	**Relative Firm Performance**
Item 1	**.73**	.21	.12	.15	.16	.14	.26	.08	.04	.23	.04
Item 2	**.60**	.23	.22	.22	.15	.15	.09	.19	.00	.13	.06
Item 3	**.56**	.24	.22	.13	.17	.20	.26	.20	-.02	.20	-.03
Item 4	**.47**	.30	.20	.21	.13	.22	.11	.05	.14	.05	.08
Item 5	.11	**.87**	.16	.13	.15	.14	.13	.00	.06	.07	.02
Item 6	.17	**.70**	.11	.13	.14	.25	.16	.05	.01	.05	.00
Item 7	.12	**.66**	.12	.16	.20	.19	.11	.12	.08	.01	.02
Item 8	.20	**.62**	.12	.32	.06	.07	.01	.08	.00	.09	-.01
Item 9	.22	.15	**.73**	.22	.14	.21	.14	.02	.09	-.01	-.03
Item 10	.18	.20	**.68**	.23	.11	.23	.15	.10	.02	.24	-.06
Item 11	.11	.13	**.65**	.21	.10	.22	.13	.02	.02	.09	.00
Item 12	.07	.18	**.57**	.19	.28	.32	.21	.07	.08	.08	-.02
Item 13	.28	.23	.28	**.69**	.08	.11	.10	.06	.02	.09	-.04
Item 14	.09	.23	.22	**.67**	.09	.08	.12	.04	.02	-.02	.01
Item 15	.11	.24	.22	**.57**	.20	.15	.11	-.03	-.04	.05	-.05
Item 16	.09	.18	.13	.13	**.71**	.07	.11	-.01	.09	.11	.04
Item 17	.18	.20	.08	.03	**.67**	.11	.07	.15	.07	.12	-.02
Item 18	.08	.08	.20	.16	**.57**	.19	.15	.16	.05	.07	-.03
Item 19	.05	.16	.25	.18	.13	**.79**	.17	.05	.15	.08	-.01
Item 20	.14	.19	.20	.07	.16	**.75**	.25	.10	.06	.11	.00
Item 21	.19	.22	.28	.07	.07	**.67**	.16	.01	.17	.06	.04
Item 22	.23	.34	.20	.09	.18	**.57**	.27	.03	.06	.13	-.01
Item 23	.20	.18	.18	.12	.13	.24	**.76**	.07	.01	.16	.06
Item 24	.14	.17	.17	.12	.10	.27	**.64**	.01	.00	.17	.09
Item 25	.20	.10	.22	.16	.25	.30	**.61**	.07	.12	.13	.04
Item 26	.06	.10	.05	-.02	.03	.06	-.03	**.77**	.10	.23	.12
Item 27	.07	-.01	.02	.07	.13	.05	.05	**.65**	.06	.12	.07
Item 28	.13	.11	.05	.00	.07	.00	.08	**.55**	.15	.27	.09
Item 29	.10	.01	.03	.02	.07	.11	.00	.00	**.93**	.06	.02
Item 30	-.01	.06	.07	-.06	.10	.08	-.02	.15	**.67**	.15	.12
Item 31	-.01	.04	.02	.07	.00	.08	.10	.16	**.61**	.25	.16
Item 32	.02	.09	.08	.03	.05	.02	.12	.14	.12	**.81**	.09
Item 33	.06	.04	.00	.07	.07	.06	.08	.12	.15	**.72**	.02
Item 34	.12	.08	.11	.00	.07	.19	.06	.20	.15	**.71**	.00
Item 35	.17	-.02	.08	.01	.12	.01	.08	.17	.03	**.64**	.20
Item 36	.06	.00	-.03	-.04	.02	.01	.02	.12	.13	.13	**.97**
Item 37	.00	.02	-.04	-.02	-.02	-.01	.09	.14	.14	.12	**.81**

Note: Maximum-likelihood estimation with varimax rotation and Kaiser-normalization. Boldface indicate the factors derived.

5.4. Analysis and Results

Table 5.3 presents the descriptive statistics and correlations of the variables analyzed in this study. The data shows a relatively high level of dynamic capabilities in many firms, which is not unusual in this kind of study (see for example Drnevich & Kriauciunas, 2011; Lichtenthaler, 2009). An explanation might be that in this study I surveyed the largest firms of the respective industries. Many of the business units might therefore be among the most successful in their business area, also in terms of adaptation and change. The measures for firm competence and relative firm performance are approximately normally distributed with a mean close to 4 and a standard deviation close to 1. We can see that dynamic capabilities show no significant correlation with relative firm performance, reducing the concern of common method variance or halo-effects. The correlation pattern indicate the proposed indirect effect chain of dynamic capabilities, where dynamic capabilities affect firm competence, which in turn affect firm performance (Eisenhardt & Martin, 2000; Zahra et al., 2006). Slack resources show positive correlations with firm size, firm competence, and dynamic capabilities. Corporate support, firm size, and firm age show no significant correlations with relative firm performance, firm competence, or dynamic capabilities. We can see that market turbulence shows a positive relationship with telecommunication and a negative with energy and machinery. Technological turbulence shows positive relations with telecommunication, automobile, and computer/IT and negative relations with machinery and consumer goods. These associations show good face validity. Further, market and technological turbulence show significant positive correlations with dynamic capabilities, indicating that firms especially invest in the development of dynamic capabilities when challenged by higher environmental dynamism.

TABLE 5.3: Descriptive Statistics and Pearson Correlations

Variables	Mean	s.d.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1 Relative firm performance	4.18	1.35																	
2 Telecommunication	.08	.28	-.16 *																
3 Automobile	.13	.34	-.03	-.12															
4 Computer/IT	.08	.28	-.04	-.09	-.12														
5 Bank/Insurance	.09	.28	.02	-.09	-.12	-.09													
6 Energy	.07	.25	.05	-.08	-.11	-.08	-.08												
7 Chemicals/Pharmaceuticals	.09	.29	.03	-.10	-.13 *	-.10	-.10	-.09											
8 Machinery	.12	.32	-.02	-.11	-.14 *	-.11	-.11	-.10	-.12										
9 Transport and services	.08	.27	.02	-.09	-.11	-.09	-.09	-.08	-.09	-.11									
10 Consumer	.11	.31	.04	-.10	-.13 *	-.10	-.11	-.09	-.11	-.13 *	-.10								
11 Corporate support	3.10	.96	-.02	-.03	.02	-.10	.16 **	.05	-.03	-.11	.09	.06							
12 Firm size (log)	3.21	1.08	.08	.08	.11	.09	-.20 ***	-.05	.09	-.08	.01	.06	.14 *						
13 Firm age (log)	1.30	.54	.09	-.18 **	.04	-.01	-.13 *	-.05	.12	.04	.00	.04	-.01	.38 ***					
14 Slack resources	3.36	1.32	.05	-.16 *	-.05	-.03	-.03	.14 *	.03	-.06	.13 *	.04	.16 *	.08	.00				
15 Market turbulence	3.59	1.04	-.11	.14 *	-.06	.11	.04	-.16 **	-.04	-.15 *	.00	.10	.08	-.05	-.15 *	.01			
16 Technological turbulence	5.19	1.31	-.12	.15 *	.15 *	.28 ***	-.30 ***	-.04	-.12	-.12 *	-.09	-.13 *	-.06	.08	-.02	-.01	.40 ***		
17 Firm competence	4.24	.75	.35 ***	-.08	-.01	-.03	.04	-.06	.01	-.09	.17 **	.06	.04	-.10	.02	.21 ***	.09	.03	
18 Dynamic capabilities	4.69	.93	.06	-.11	.04	.09	.07	-.06	-.09	-.06	.03	-.04	.10	-.04	.01	.19 **	.17 **	.34 ***	.40 ***

N = 265
*** p<0.001
** p<0.01
* p<0.05

In order to test the hypotheses, I conducted structural equation modeling with AMOS 19 applying maximum-likelihood estimation. Structural equation modeling is the adequate method for this purpose as it allows (1) to simultaneously model mediation and moderation effects, (2) to simultaneously analyze path estimates in different levels of the moderator, (3) to account for different weights of the sub-dimensions of a multidimensional construct, and (4) to account for measurement error. First, I calculated a baseline model with dynamic capabilities as exogenous variable and firm competence and relative firm performance as endogenous variables and included all control variables into the model. From all control variables I drew a path to firm competence and relative firm performance. Then I removed insignificant controls as these do not affect substantive results, but reduce the model fit due to higher complexity and non-significant relations (Danneels 2008).

To detect possible common method variance, I applied the ULMC (Unmeasured Latent Method Construct)-technique (Podsakoff et al., 2003; Richardson et al., 2009). To identify the trait-method model, I constrained the measurement factor loadings of the method construct to be equal (Podsakoff *et al.*, 2003). According to Richardson et al. (2009) there is evidence of common method bias if the constrained trait-method model (construct correlations are constrained to the values obtained from the trait-only model) fits significantly worse than the trait-method model. The trait-method model fits with $\chi^2/df = 1.501$, while the constrained trait-method model fits with $\chi^2/df = 1.498$. Based on these fit measures, the constrained trait-method model fits better than the trait-method model (Schermelleh-Engel et al., 2003), leading to the conclusion that there is no bias based on common method variance (Richardson *et al.*, 2009). To further assess the reliability of the overall model, I applied a variation of hold-out validation (Hair et al., 2010). Therefore, I divided the sample randomly into two groups of equal size and tested for the invariance of the structural models between these randomly selected groups. The results show that the structural models do not vary between randomly selected groups.

To test the influence of environmental dynamism, I applied multi-group analysis as a recommended technique to test moderation in SEM (Byrne 2001, Hair et al. 2010) and tested for the invariance of the structural models between different levels of environmental dynamism. In this case, where I modeled higher-order factors, manifest product indicators are not available to directly test for interaction effects within the structural model. I created two separate models to test the moderation effects of market and technological turbulence. To generate the groups for the two models, I conducted a sample split based on the median of the respective

moderator (see also Jaworski & Kohli, 1993) to obtain two groups of equal size, and calculated a dummy variable for market and technological turbulence each comprising high and low level respectively. Before I tested for the moderating effect, I established measurement model invariance (Hair et al. 2010, Qureshi and Compeau 2009). Therefore, I created a nested model with a full-constrained model, where every parameter was set equal between the two groups comprising low and high levels of the moderator and a partly constrained model, where the structural paths were free to vary between the two groups (Byrne 2001, Qureshi and Compeau 2009). Within the moderation models, I again removed control variables that did not show a significant relation in either of the two groups. To test for the significance of the indirect and the total effects, I conducted the bootstrapping procedure with bias-corrected confidence intervals on a 95%-confidence level and 1000 bootstrap samples (Mallinckrodt et al., 2006). The comparative evaluation of the fit of alternative models I conducted based on a χ2-difference test (Byrne, 2001; Qureshi & Compeau, 2009), in which lower values of χ2/df indicate the favorable model. To control for the significance of the difference of the effect size between the levels of environmental dynamisms, I checked the critical ratios for difference between parameters.

The fit measures of the final baseline model (Table 5.4) that resulted after removing non-significant controls are χ^2/df = 1.53, TLI = .93, CFI = .94, RMSEA = .05, and SRMR = .06, indicating a good fit of the hypothesized model. An alternative model, in which firm competence was captured by three separate first-order factors with the respective singular effects, showed lower fit (χ^2/df = 1.56).

The baseline model (Table 5.4) shows that dynamic capabilities unfold a significant positive indirect effect (.28; $p<0.001$) and a significant negative direct effect (-.23; $p<0.01$) on relative firm performance, providing support for hypotheses 1 and 2. Dynamic capabilities show no significant total effect on relative firm performance in the baseline model. The industry control for transport and services shows a significant positive effect (.17; $p<0.05$) on firm performance, while the industry control for telecommunication shows a significant negative effect (-.15; $p<0.05$) on firm performance.

To double-check that the negative direct effect on firm performance is not attributable to capability development, I again included the controls for capability development into the final baseline model. The resulting model showed lower fit (χ^2/df = 1.71) and none of the controls for capability development showed a significant effect on firm performance. In this model, the negative direct effect of dynamic capabilities is slightly weaker and slightly less

significant (-.20; $p<0.05$). The other effects, however, remained stable both in effect strength and significance level.

As described above (Chapter 5.3.2.), to control for potential temporal/lagged effects, I also calculated an alternative baseline model containing the measure for the *prior* capability position. The results suggest that firm performance is stronger affected by the *current* capability position than by the prior capability position. This result underpins the decision to include the *current* capability position as mediation variable into the model.

The moderation models containing the different groups with market turbulence ($\chi^2/df = 1.52$) and technological turbulence ($\chi^2/df = 1.49$) as moderators both show a better comparative fit than the baseline model (see Table 5.4), indicating that the effect size of the structural paths vary between the different levels of the respective moderators (Byrne, 2001; Hair et al., 2010). Both models also fitted the data better than the respective reference models within the group comparison, where the structural paths were fixed between the two groups (market turbulence: $\chi^2/df = 1.53$; technological turbulence: $\chi^2/df = 1.50$). Hypothesis 3a and 3b proposed that the negative direct effect of dynamic capabilities on relative firm performance is mitigated in high levels of market turbulence and technological turbulence, respectively. While dynamic capabilities still show a significant negative direct effect on relative firm performance in low levels of market turbulence (-.23; $p<0.05$) and technological turbulence (-.38; $p<0.05$), this negative direct effect is not significant in high levels of the respective moderators. These results indicate support for hypothesis 3a and 3b.

TABLE 5.4: Results of Structural Equation Modeling

	Path Estimates[a]									
	DC→Perf. Indirect effect	**DC→Perf.** Direct effect	**DC→Comp.** Direct effect	**Comp.→Perf.** Direct effect	**DC→Perf.** Total Effect	**x^2/df** **Free paths**	**x^2/df** **Fixed paths**	**x^2-difference test** x^2	**df**	**P**
Baseline model	.28 ***	-.23 **	.54 ***	.52 ***	.05	1.53				
Market turbulence model						1.52	1.53	9.700	3	.021
Market turbulence (low)	.25 **	-.23 *	.43 ***	.58 ***	.02					
Market turbulence (high)	.45 **	-.23	.73 ***	.62 **	.22 †					
Critical ratio for difference		*.04*	*2.94 ** *	*-.77*						
Technological turbulence model						1.49	1.50	6.398	3	0.09
Technological turbulence (low)	.48 ***	-.38 *	.68 ***	.71 ***	.10					
Technological turbulence (high)	.19 **	-.05	.47 ***	.41 **	.14					
Critical ratio for difference		*1.82 †*	*-2.02 **	*-1.22*						

[a] Standardized estimates

***p < 0.001

** p < 0.01

* p < 0.05

† p < 0.10

N = 265

Hypothesis 4a proposed that the contribution of dynamic capabilities to firm competence increases with increasing market turbulence, while hypothesis 4b proposed that this contribution decreases with increasing technological turbulence. The positive effect of dynamic capabilities on firm competence is stronger in higher levels of market turbulence (.73; $p<0.001$) than in lower ones (.43; $p<0.001$), while in higher levels of technological turbulence (.47; $p<0.001$) it is weaker than in lower levels of technological turbulence (.68; $p<0.001$). For both moderation models, the difference in effect strength between the two groups of environmental turbulence is significant. Thus, the results indicate support for hypotheses 4a and 4b. Hypothesis 5a states that the positive effect of firm competence on relative firm performance increases with higher levels of market turbulence. The results indicate that the performance contribution of firm competence indeed increases in higher levels of market turbulence. Hypothesis 5b stated that the relation between firm competence and relative firm performance is negatively moderated by technological turbulence. The results indicate that this effect is less strong under conditions of higher technological turbulence. The critical ratios for difference, however, do not indicate a significant difference in the effect strength between the two levels of the moderator, neither for market turbulence nor for technological turbulence. For testing hypothesis 6a and 6b, stating that the overall effect of dynamic capabilities on relative firm performance is positively moderated by market and technological turbulence, the total effects of the two moderation models have to be compared. Both moderation models (market and technological turbulence) show a not significant total effect of dynamic capabilities on relative firm performance in low levels of dynamism. While showing a significant positive effect of dynamic capabilities on relative firm performance in high levels of market turbulence, the respective effect is not significant in high levels of technological turbulence. These results support hypothesis 6a.

5.5. Discussion and Conclusion

5.5.1. Theoretical Contribution

This study provides several important contributions to the dynamic capabilities framework. While dynamic capabilities are measured explicitly and independently from their outcomes at the operational level this study avoids confusion regarding their existence and their effects (Zahra *et al.*, 2006). The research model in this study allows for unveiling the complex performance effects of dynamic capabilities by accounting for their benefits and their cost effects. Prior studies often measured changes in the resource base or the development of capabilities and just inferred dynamic capabilities at work, which might lead to wrong theorizing regarding their performance effects.

Relating to the performance effects of dynamic capabilities this study enhances current knowledge in several respects. With reference to the discussion whether dynamic capabilities have a direct or an indirect effect on firm performance, or both (e.g. Eisenhardt & Martin, 2000; Galunic & Eisenhardt, 2001; Helfat & Peteraf, 2009; Teece et al., 1997; Teece, 2007; Zahra et al., 2006; Zott, 2003), this study provides interesting new findings. In this study, I also find the positive indirect performance effect of dynamic capabilities on relative firm performance confirmed (Pavlou & El Sawy, 2006; Protogerou et al., 2011). This indicates the nomological validity of the dynamic capabilities measure and the study design. As a novel contribution, in this study I further propose *and* reveal the existence of a negative direct effect of dynamic capabilities on relative firm performance. To implement and maintain dynamic capabilities creates permanent costs, whether they are applied or not. These costs unfold a negative direct effect on firm performance. By explicitly considering the costs associated with dynamic capabilities, this study avoids to just focusing on the potential benefits of dynamic capabilities and also discusses the possible downside.

In this paper, I outline the outset of a 'cost theory' of dynamic capabilities that should be further explored in future research. To better understand the performance implications of dynamic capabilities, future studies might explicitly account for the costs and benefits that arise when dynamic capabilities are applied for the development of specific capabilities and compare these with the costs and benefits of alternative modes of capability development. The proposed negative direct effect unveiled and explained in this study is different from the negative direct effect found by Drnevich and Kriauciunas (2011), which captures the costs of capability development rather than the costs of dynamic capabilities.

This study further provides novel insight into the role of environmental dynamism within the dynamic capabilities' framework. Prior studies on dynamic capabilities' performance effects most often captured environmental dynamism by applying an overall measure (Drnevich & Kriauciunas, 2011; Pavlou & El Sawy, 2006; Protogerou et al., 2011). While this is a plausible rationale for capturing the overall dynamism, it neglects potentially differing impact based on different characteristics of the dimensions of environmental dynamism. By analyzing the effects of market and technological turbulence separately, I find that these dimensions of environmental dynamism affect the effectiveness of dynamic capabilities differently. While market turbulence increases the contribution of dynamic capabilities in creating operational capabilities of higher relative quality, technological turbulence negatively moderates the effectiveness of dynamic capabilities in order to create such a relative advantage in operational capabilities. While firms are still better off with dynamic capabilities when facing high speed and rate of technological change, these conditions not only weaken the existing capability configuration but also the effectiveness of dynamic capabilities. This observation suggests that dynamic capabilities may not be a universal remedy and that technological discontinuities can occur where dynamic capabilities no longer provide a solution for coping with the change.

In this respect, several authors point to extreme environmental conditions (e.g. high-velocity environments) in which the effectiveness of dynamic capabilities may be severely weakened (Drnevich & Kriauciunas, 2011; Eisenhardt & Martin, 2000; Helfat et al., 2007). Under conditions of extremely high pace *and* rates of change, for example, in which new technologies emerge regularly that are very distinct from the former technologies, and thus, firms regularly face rather large capability gaps (Capron & Mitchell, 2009; Lavie, 2006), regularly and timely adaptation becomes extremely challenging. There may still be some value in possessing the dimensions of dynamic capabilities which enable to recognize such changes (Helfat et al., 2007), but to acquire relevant knowledge and to create new or to modify existing capabilities still requires some time. Thus, when firms regularly have to bridge rather large capability gaps in relatively short time, successful reconfiguration of the capability configuration may be difficult if not impossible. Under such conditions it is likely that firms are still better of with having dynamic capabilities than without as they enable better reactive adaptation, but the possession of dynamic capabilities may not be sufficient in order to sustain a formerly given competitive or relative advantage. Further – internal – contingent factors may be of importance when it comes to the recurring need for reconfiguration within relatively short periods of time. The embeddedness of the capabilities (Lavie, 2006) that have to be reconfigured or the inherent resource flexibility (Sanchez, 1995), may not offset the

general ability of a firm to reconfigure its capability configuration. But it is likely that such factors limit the speed with which reconfiguration may be accomplished.

The separate examination of the influence of market and technological turbulence suggests that market and technological turbulence might affect the competence-performance-relationship differently. Based on their different characteristics market turbulence seems to have more competence-enhancing attributes while technological turbulence seems to have more competence-destroying attributes. However, further research is necessary to better understand both types of environmental change and their implications for a firm's capabilities. While there is a broad body of research that examines different implications of different types of technological change (e.g. Anderson & Tushman, 1990; Danneels, 2004; Rosenbloom & Christensen, 1994; Tushman & Anderson, 1986), the literature review conducted for this study did not unveil such differentiated discussion regarding a potentially different impact of market and technological turbulence or regarding different types of market turbulence.

Regarding the negative direct effects of dynamic capabilities on relative firm performance, I find that in higher levels of market and technological turbulence the negative direct effects of dynamic capabilities on relative firm performance are mitigated. Under such conditions firms regularly have to enhance their capabilities or built new capabilities in order to stay competitive and more firms are urged to invest in dynamic capabilities or alternative modes of capability development. The costs for building and maintaining dynamic capabilities are no longer disadvantageous in such settings. However, with the exemption of settings characterized by high market turbulence investing in dynamic capabilities seems to be a zero-sum game in terms of contribution to relative financial firm performance. All in all, the positive indirect effects of dynamic capabilities on relative firm performance seem to be consumed by their costs in almost all settings. Thus, the value of studying the performance outcomes of dynamic capabilities in terms of firm performance (i.e. financial performance) seems limited. Future studies might therefore address the potential implications of dynamic capabilities for attaining competitive advantage in the market place. Potentially valuable insights could be gained by understanding how dynamic capabilities contribute to the implementation of a value creating strategy that is not simultaneously implemented by a current or potential competitor (Barney, 1991). Further, to understand the contributions of dynamic capabilities to firm survival is potentially valuable. Future research might investigate how dynamic capabilities contribute to long-term firm survival or to survival during disruptive changes in the market environment.

In this study I highlighted that the possession of dynamic capabilities is also associated with bearing the costs for implementing and maintaining dynamic capabilities. These costs arise whether dynamic capabilities are applied or not (Winter, 2003). In the case when dynamic capabilities are applied for capability development additional costs arise, which may differ from the costs for applying alternative modes of capability development. Either way, this study's results show that there are cost effects that may countervail the benefits arising from dynamic capabilities. This observation draws attention to a very important issue regarding the performance links of capabilities in general and dynamic capabilities in particular. Williamson (1999) already questioned the implicit assumption of the capabilities perspective indicating that possessing 'more' of a capability is always better. With respect to dynamic capabilities, however, it is likely that they have a diminishing marginal utility in terms of creating new operational capabilities. In terms of their performance contribution, due to countervailing cost effects, it is very much likely that we rather observe a curve-linear function than a positive linear function. However, future research is necessary to examine these issues in more detail.

5.5.2. Limitations and Outlook

This study applies perceptual measures from the same data source for dependent and independent variables, which bears the risk of common method variance that can not be totally ruled out. However, the inclusion of an unmeasured latent method construct and the validation based on objective measures and second informants reduced my concerns that the results might be biased due to common method variance. Nevertheless, future studies might combine perceptual measures with objective data and use multiple data sources. The discussion regarding the retrospective measurement of the *prior* capability position as a control for temporal effects, provided in Chapter 4.5.2. applies here as well.

As this study applies a newly developed model of dynamic capabilities, external validation is difficult. Although the applied measure shows high congruence with theoretically proposed effects and objective proxies, further validation is necessary. Future research might operationalize the constituent parts of dynamic capabilities instead of the manifestations in order to design the competing aggregate model and combine it with the superordinate model of dynamic capabilities that has been applied in this study.

To better understand the impact of different types or environmental change, and how dynamic capabilities are an effective remedy against these different threats, more longitudinal research is necessary. This is especially important to understand which impact the possession

of dynamic capabilities has in the long term. In order to examine if the possession of dynamic capabilities helps to regain a relative advantage in the capability position or financial performance after environmental shifts, longitudinal study designs are necessary.

As this empirical study focuses on business units of large firms operating in Germany, the findings should be validated in alternative settings. I approached the largest firms of the respective industries, which include all 110 firms listed in the three major stock exchanges and all 100 largest firms operating in Germany. Those firms might be more successful in the market place than the average of the basic population, in terms of financial performance or firm competence. On the other hand it is a plausible rationale to isolate business units which are more successful than the industry average. This is because the consideration of business units that perform below and above average might impede the identification of potential sources of competitive advantage (Rouse & Daellenbach, 1999). However, in this study I controlled for firm size, excess resources, and corporate support in order to detect potential effects. As the surveyed firms operate internationally, the results should hold in comparable settings than Germany. Future studies might focus on a broader sample in terms of performance differentials and might focus on small firms or on corporate level.

In this study I captured financial firm performance relative to the strongest competitor, which is a common approach in this kind of research (e.g. Pavlou & El Sawy, 2006; Spanos & Lioukas, 2001) as it allows to assess whether a focal firm possesses a relative competitive advantage in its industry. Further, this approach allows for assessing whether dynamic capabilities may help to protect a leading industry position in the face of external changes. However, it neglects whether both the focal firm and its main competitor may possess a relative competitive advantage in terms of performance differentials in comparison to the industry average. Future research may address this issue. Based on a representative sample of the basic population, a longitudinal design, and the relative performance in comparison with the industry average, future research may reveal whether dynamic capabilities may help to sustain a competitive advantage in terms of performance differentials in comparison with industry average.

6. ORGANIZATIONAL ANTECEDENTS OF DYNAMIC CAPABILITIES: THE SUPPORTING AND HINDERING INFLUENCE OF ORGANIZATIONAL DESIGN CHARACTERISTICS

6.1. Introduction

To survive in turbulent and competitive business environments, firms have to be able to recognize opportunities and threats arising from shifts in their environment, to assess how these challenges can best be addressed, and to adapt to these pressures by developing new capabilities and resource configurations. This ability, referred to as dynamic capabilities (Teece et al., 1997), has been catapulted to the forefront of many research agendas, due to its potential to explain how firms may attain and sustain competitive advantage (Zahra et al., 2006).

In order to inform about how dynamic capabilities can be established within the organization, it is important to understand their organizational antecedents. While several empirical studies address antecedents of dynamic capabilities like cultural aspects (Danneels, 2008), managerial support (Prieto et al., 2009), prior experience (King & Tucci, 2002), or complementary assets (Helfat, 1997), the influence of organizational design characteristics has been largely ignored.

Organizational design characteristics are important for leveraging capabilities (Greenwood & Miller, 2010). With respect to dynamic capabilities, to date the influence of organizational design characteristics has neither been sufficiently discussed nor empirically tested. As dynamic capabilities, like any other capability, are embedded in organizational design, it is important to understand how these characteristics influence dynamic capabilities and which organizational design characteristics may support or restrain dynamic capabilities in organizations. While there is no study that explicitly investigates the influence of organizational design on dynamic capabilities, there are some hints towards certain design characteristics that might influence dynamic capabilities.

A review of the dynamic capabilities literature reveals certain assumptions regarding the relation between organizational characteristics and the emergence of dynamic capabilities in firms. Zollo and Winter (2002) indicate formalization of knowledge as an antecedent of dynamic capabilities. However, Prieto and Easterby-Smith (2006) state that formalization of

knowledge management reduces creativity while dynamic capabilities are rather supported by informal knowledge management. Eisenhardt and Martin (2000) point to loosely structured organizations, and Teece et al. (1997) and Teece (2007) indicate decentralized organizations as important preconditions for dynamic capabilities. Rindova and Kotha (2001), in their comparative case study of Yahoo! and Excite, also propose a positive relation between decentralization and dynamic capabilities. However, Baum and Wally (2003) find that a centralized strategic management fosters strategic decision speed, which is often argued as being an constituent part of dynamic capabilities (Barreto, 2010). Some scholars see certain routines as constituent parts of dynamic capabilities (e.g. Eisenhardt & Martin, 2000; Winter, 2003), and thus implicitly state routinization of work tasks as relevant conditions for establishing dynamic capabilities, while other scholars see routinization as contradicting the logic of dynamic capabilities (e.g. Schreyögg & Kliesch-Eberl, 2007; Teece, 2007) as they may impede flexibility and change (Feldman & Pentland, 2003; Hannan & Freeman, 1984). This brief overview reveals that there is all but a consistent view within the literature on how organizational design characteristics are related to dynamic capabilities.

A review of other literature streams that focus on the effects of these organizational attributes reveals certain contradictions and unanswered questions. Contingency theory (Burns & Stalker, 1961; Lawrence & Lorsch, 1967), for example, proposes that different organizational designs are more or less effective under different conditions and for different purposes (Tushman & Nadler, 1978) and that more flexible designs are better suited for more dynamic or complex environments (Miles, Snow, Meyer & Coleman, 1978; Miller, 1988). In particular, contingency theory suggests that in order to be effective in dynamic environments firms are required to implement a decentralized and informal structure accompanied by less routinization in work tasks (Miles et al., 1978; Pennings, 1987; Ruekert, Walker Jr & Roering, 1985). As dynamic capabilities are proposed to be the internal mechanism by which firms adapt to or align with dynamic environments, a contingency theory perspective would suggest that dynamic capabilities are supported by less centralization, less routinization, and less formalization. Thus, a contingency theory perspective on the proposed role of routinization and formalization within the dynamic capabilities framework reveals inconsistencies. The routines literature suggests that routines are a source of inertia, inflexibility, and mindlessness (Feldman & Pentland, 2003; Hannan & Freeman, 1984) and thus impede change. Feldman and Pentland (2003) also argue that variability in the performative domain of a routine and the interplay between the performative and ostensive aspect of a routine may enable flexibil-

ity and change. As there is a dearth of research that addresses the potential level of routinization within dynamic capabilities and the potential implications of different levels of routinization on dynamic capabilities, it is all but clear how routinization affects dynamic capabilities.

In consequence, it is rather unclear how dynamic capabilities are influenced by these organizational design characteristics, also because the influence of these organizational characteristics on dynamic capabilities has not been empirically tested yet. Prior research argues that firms have to manage the recognition of opportunities and threats arising from shifts in their environment, the assessment of an appropriate response to these challenges, and the reconfiguration of the capability endowment to gain or sustain competitive advantage (Helfat et al., 2007; Teece, 2007). To examine the effects of organizational design characteristics on dynamic capabilities and their different dimensions would not only inform about how firms can establish dynamic capabilities, but also explain why some firms have higher levels of dynamic capabilities than others.

This study therefore investigates the effects of organizational design characteristics (i.e. centralization, routinization, and formalization) on dynamic capabilities and their several dimensions. The results reveal that centralization and routinization negatively influence dynamic capabilities while formalization unfolds a positive effect on dynamic capabilities. Thereby, this study contributes to existing theory in several ways. First, this study contributes to organizational research literature in general by analyzing the influence of organizational design characteristics on core organizational outcomes like capabilities. Thereby, this study re-establishes the link between research on organizational design and modern concepts of strategic management. Second, this study contributes to contingency theory as it links the structural aspects of organizational design to the internal mechanisms which establish a 'fit' with dynamic environments by enabling recurring adaptation. Thereby, this study provides novel insights into the role of formalization in terms of enabling flexibility and change. In prior research formalization, like centralization and routinization, is most often regarded as a structural parameter that fosters inflexibility and thus impedes change. The results of this study suggest that the proposed impact of formalization on organizational flexibility has to be reconsidered. This study's results further suggest a more detailed analysis of organizational design parameters with respect to formalization and routinization. Prior studies often regarded routinization as quasi-automatic outcome of formalization, while only few studies explicitly analyze or discuss these two parameters separately. By revealing that formalization

and routinization affect dynamic capabilities differently, this study provides a strong argument for analyzing the effects of these determinants separately in future research.

Third, this study contributes to the dynamic capabilities literature by investigating important antecedents. Thereby, this study reveals the influence of centralization, routinization, and formalization on dynamic capabilities. Given the contradictory arguments within the dynamic capabilities literature regarding the impact of these organizational design parameters, this study contributes to a better understanding regarding their effects. The findings presented in this study show which organizational design characteristics might support or hinder dynamic capabilities. This is also important to inform managerial practice about the organizational design configurations in which dynamic capabilities are most likely to prosper, laying the ground for the implementation of dynamic capabilities. Fourth, this study contributes to the routines literature and to the research stream within the dynamic capabilities literature seeing routines as fundament of dynamic capabilities. The results show that routinization impedes the successful performance of activities associated with dynamic capabilities. This study therefore challenges the assumptions stating routines as a fundament of dynamic capabilities.

6.2. Theory and Hypotheses

6.2.1. Dimensions of Dynamic Capabilities

Dynamic capabilities include the ability to identify the need for change, to formulate a response, and to implement appropriate measures (Helfat et al., 2007). To identify the need for change requires to recognize whether shifts in the environment could impact the firm's business based on the current capability position (Teece, 2007). Thus, the identification of the need for change relates to the *recognition* of opportunities and threats and the *monitoring* of the current capability endowment (Barreto, 2010; Schreyögg & Kliesch-Eberl, 2007; Teece, 2007). The second facet, the formulation of a response, is based on learning. Teece et al. (1997) already propose learning as a core element of dynamic capabilities (Teece, 2007, p. 1341). The formulation of a response by shaping opportunities is also a learning function, as it involves learning about customer needs as well as technologies and/or business models to address them adequately (Teece, 2007). Learning in this context relates to *knowledge creation*, *knowledge acquisition*, and *knowledge sharing* (Eisenhardt & Martin, 2000; Verona & Ravasi, 2003). The third facet, the implementation of a response, relates to the reconfiguration of the existing capability configuration. Based on the understanding of the organization as a certain configuration of capabilities and resources, in this paper any type of alteration of

this configuration is termed reconfiguration. Reconfiguration is the final chain in a procedural perspective on dynamic capabilities and is widely accepted as a core element of dynamic capabilities (Barreto, 2010; Eisenhardt & Martin, 2000; Pavlou & El Sawy, 2006; Teece, 2007). Reconfiguration relates to the internal *creation* of new capabilities and the *integration* of newly created or acquired capabilities (Capron & Mitchell, 2009; Lavie, 2006).

Dynamic capabilities thus manifest in several distinct but related dimensions: opportunity recognition, capability monitoring, knowledge creation, knowledge acquisition, knowledge sharing, capability creation, and capability integration.

6.2.2. Organizational Design Characteristics

Organizational design characteristics are defined as parameters that influence organizational structure and process organization and thus determine the characteristics of overall organizational design (Pugh, Hickson, Hinings & Turner, 1968). Design Characteristics of organizations are often applied to distinguish organizational 'forms' or 'types' in order to analyze the appropriateness of distinct configurations in different environmental settings or their influence on certain organizational outcomes (Aiken & Hage, 1971; Damanpour, 1991; Pugh et al., 1968; Rindova & Kotha, 2001). The shape of singular structural determinants as well as the shape of their combinative configuration can unfold supporting or lagging effects on organizational outcomes, such as capabilities (Jansen et al., 2005). Design characteristics of organizations are antecedents of organizational capabilities as they form the general organizational framework in which organizational capabilities evolve.

Several authors focus on partly different organizational design characteristics to examine the effects of organizational configurations. With reference to Mintzberg (1979), Miller (1987) identifies routinization, standardization, specialization, and formalization as determining structural configurations. Pugh et al. (1968) identify specialization, standardization, formalization, centralization, and configuration as primary dimension of organizational structure. As outlined in the introduction, in this study I focus on the analysis of centralization, routinization, and formalization as the influence of centralization (Rindova & Kotha, 2001; Teece et al., 1997; Teece, 2007), routinization (Eisenhardt & Martin, 2000; Schreyögg & Kliesch-Eberl, 2007; Winter, 2003), and formalization (Menguc & Auh, 2006; Prieto & Easterby-Smith, 2006; Zollo & Winter, 2002) on dynamic capabilities seems especially promising. This is because the argumentation regarding the influence of these three organizational design characteristics is inconsistent within the dynamic capabilities literature and fur-

ther reveals inconsistencies with other theory-driven propositions, e.g. from a contingency theory perspective.

Centralization of decision making reflects the locus of authority to make decisions (Pugh et al., 1968) and mirrors the level to which the authority to decide is concentrated at a few positions within the firm (Aiken & Hage, 1968; Jansen et al., 2006). Routinization is the extent to which work tasks are repetitious, invariable and sequential, in order to require relatively little attention and to ensure consistent output (Jansen et al., 2005; Withey, Daft & Cooper, 1983). Formalization is defined as the extent to which rules, procedures, instructions, and communication is formalized or written down (Jansen et al., 2005; Pugh et al., 1968).

6.2.3. The Influence of Organizational Design Characteristics on Dynamic Capabilities

In this chapter, I discuss the tasks associated with dynamic capabilities and analyze how the characteristics of centralization, routinization, and formalization are likely to facilitate or hamper the establishment of dynamic capabilities.

To recognize opportunities and threats, information from different interfaces with the environment has to be combined with internal information from different sources. Technological developments have to be assessed in light of latent customer needs and and the current state of the internal technological and marketing capabilities. Accordingly, Jaworski and Kohli (1993) found that the most adaptive organizations perform an organization-wide generation of market intelligence. Beside the acquisition of information, recognition of and reaction to external challenges also ivolves the effective dissemination of information within the organization, which requires effective information flows as well as supporting structures and communication systems (Cohen & Levinthal, 1990). Task specific learning requires to identify, acquire, and assimilate valuable knowledge (Zahra & George, 2002). Relevant knowledge differs in content, e.g. customer knowledge or technological knowledge, and thus, the ability of individuals to recognize and to evaluate relevant knowledge differs accordingly (Cohen & Levinthal, 1990). As knowledge creation or knowledge acquisition occurs on individual level or the level of subgroups, learning in an organizational context also requires effective sharing of knowledge between individuals, groups, or departments (Cohen & Levinthal, 1990; Zahra & George, 2002). As capabilities partially consist of knowledge and accumulated experience (Zander & Kogut, 1995), different capabilities are undergirded by different knowledge assets. Thus, specific capabilities, such as marketing or technological capabilities, usually are somewhat concentrated in specialized areas within the organization,

i.e. functional areas or departments. In order to effectively conduct the organizations business operations, these capability areas have to be linked together, leading to an interrelated capability configuration. Capability reconfiguration requires alteration or replacement of existing capabilities and integration of newly developed capabilities into the respective area of deployment. Thereby, links with other capability areas have to be retained or re-established.

Centralization narrows communication channels (Cardinal, 2001; Jansen et al., 2006) and slows down the responsiveness in organizations (Jaworski & Kohli, 1993). Decentralization, however, is seen as supporting capability development and increasing responsiveness towards change, because it brings the decision makers closer to new technologies, the customers, and the market (Teece et al., 1997; Teece, 2007).

Jaworski and Kohli (1993), for example, confirmed the negative effect of centralization on the generation and dissemination of market intelligence as well as on the responsiveness of organizations. As pointed out before, early recognition of shifts in the environment and quick responsiveness are crucial for efficient capability development. The longer the decision paths within the organization, the more time is consumed that would be needed for the implementation of appropriate actions. Centralization of decision making maximizes the distance between the interfaces, where information or knowledge is acquired, the positions in the firm, where information or knowledge is interpreted or combined, and the locations where appropriate measures can be decided. Further, centralization requires the transformation of information across hierarchy levels to meet the attention of people who have the authority to decide. This is often a political process that cannot assure that information reaches appropriate locations because of the value of its content, but because of the question whether the content is desired or not. Although, Baum and Wally (2003) find centralization of strategic management to increase the speed of strategic decisions, but this rather relates to the speed of decision-making and the execution of this decision based on the information available. The time it takes for relevant information that is absorbed at different interfaces to reach the responsible positions or persons might thereby be neglected.

Moreover, prior research suggests that different people recognize different opportunities based on the same information provided (Shane, 2000). A higher level of centralization would concentrate the authority to decide about which information to account for and which potential opportunity to consider on fewer people within the organization. This reduces the motivation of employees to engage in activities regarding opportunity recognition, because they do not know if their efforts are accounted for. As a consequence opportunity recognition

is hampered, because centralization might facilitate the adoption of some opportunities while inhibiting others (Moch & Morse, 1977). Moch and Morse (1977) thus find centralization to negatively influence the adoption of compatible innovations. Furthermore, employees within the respective areas are likely to be better in identifying external changes that could affect their capability area.

Several empirical studies confirm that centralization of decision making negatively affects capabilities, e.g. learning, that concern openness to new information and knowledge, creativity or innovativeness (Damanpour, 1991; Galbraith & Merrill, 1991; Jansen et al., 2006). Jansen et al. (2005), for example, report that participation in decision making positively influence knowledge acquisition. Centralization negatively affects knowledge creation and knowledge acquisition as it decreases the quality and quantity of ideas and knowledge organizational members can access (Sheremata, 2000) and the efforts of employees to search for new solutions (Atuahene-Gima, 2003). Centralization decreases the autonomy of individuals and their participation in the decision-making process. Thus, fewer individuals are involved in the knowledge creation process and employees are less motivated to create new knowledge, which decreases the chance of finding valuable information (Nonaka, Toyama & Konno, 2000; Ouchi, 2006). Thereby, centralization inhibits the development and implementation of ideas (Kim, 1980) and knowledge performance (Pertusa-Ortega, Zaragoza-Sáez & Claver-Cortés, 2010). Further, interdepartmental communication and the sharing of ideas is hindered by restricted autonomy of the involved individuals (Pertusa-Ortega et al., 2010), which decreases a firm's knowledge sharing capability.

Regarding capability reconfiguration, it is likely that employees in the affected capability areas are better informed about the complexity, the embeddedness, or the interconnectedness of focal capabilities than managers in central functions. Thus, it is also likely that the employees in the affected capability areas make better decisions about the appropriate reconfiguration mode or mechanism. While centralization hinders knowledge sharing it simultaneously hampers the transformation of existing and new knowledge into novel combinations (Jansen et al., 2005), which is a vital building block for the creation of new organizational capabilities (Kogut & Zander, 1992; Zahra & George, 2002). Prior research suggests that more centralized firms face difficulties in developing or establishing new capabilities (Galbraith & Merrill, 1991; Kazanjian & Rao, 1999; Vorhies & Morgan, 2003). As centralization decreases the speed of decision making, experimentation, and the creation of creative solutions (Pertusa-Ortega et al., 2010), it restricts the ability of a firm to effectively create new capa-

bilities. Centralization reduces the involvement and number of individuals or departments to engage in scanning activities and further restricts to acquisition of knowledge from various interfaces with the business environment. Centralized organizations are less able to stimulate the communication and to manage information flows and the exchange of ideas and fail to appropriately deploy the potential of the various departments and employees in order to recognize opportunities and threats arising from external changes. Further, as centralization decreases awareness, commitment, and involvement of organizational members, it prevents innovative solutions. Based on the observations discussed above, this leads to:

> **Hypothesis 1:** Centralization is negatively related to dynamic capabilities and their dimensions.

Routinization means regular, predictable and repetitious patterns of activity (Grant, 1991; Winter, 2003), which can lead to inertia and can hamper change (King & Tucci, 2002). Routinization requires that employees only deal with a small range of problems with few exceptions, limit the search for new knowledge, and restricts interaction among employees (Jansen et al., 2005). Thus, quick reactions on novel challenges from the environment are hampered, and search for new knowledge and the scope for information processing are restricted. Jansen et al. (2005), thus, confirmed that routinization negatively affects knowledge acquisition and assimilation. As recognition of opportunities and the creation or acquisition of new knowledge both deal with the identification and evaluation of novel issues, routinization of tasks is a direct contradiction for their purpose. Routinized tasks require concentration and reliance on known fields while suffering from discontinuity or adaptation. Under those circumstances it is unrealistic that a high level of routinization supports the early recognition of novel and weak signals that might have an implication for the firm in the far future. It is more realistic that organizations with higher levels of routinization do not recognize such events before they already begin to have an impact on their actual business model. Further, prior research suggests that there is no one best way of reconfiguring the resource base, but that the appropriate sourcing mode and the appropriate reconfiguration mechanisms depend on certain internal and external contingencies (Capron & Mitchell, 2009; Lavie, 2006). The situational selection and application of different modes is in conflict with the routinization of work tasks. Brady and Davies (2004), for example, found that firms at least partly have to depart from existing routines in order to develop new capabilities. Capability development is associated with a high task variability and low analyzability, which decreases the effective-

ness of routinized behavior. Thus, Vorhies (1998) argues that the development of, for example, marketing capabilities is associated with lower levels of routinization. Moreover, routinization negatively influences the transformation of knowledge (Jansen et al., 2005), which is a driver of capability development (Kogut & Zander, 1992). As Schreyögg and Kliesch-Eberl (2007) put it, routinization means programming and narrowing the scope, while a frame-breaking approach like dynamic capabilities requires openness and flexibility. Routinizing activities means conducting tasks in regular and repetitious patterns, which disables that new events are adequately absorbed and that novel solutions are discovered and implemented, and thus, restricts the firm's ability to recognize opportunities and threats or create new knowledge and capabilities. Thus, I conclude:

> **Hypothesis 2:** Routinization is negatively related to dynamic capabilities and their dimensions.

Formalization reflects prior experience with organizational phenomena, codified prior knowledge as well as the experience regarding former best practices (Jansen et al., 2005). Through formalization organizations make knowledge easier to exploit and faster to implement (Jansen et al., 2005). Several researchers before assumed that formalization has a negative effect on the acquisition and assimilation of information or knowledge like centralization and routinization. The expected negative effects on intelligence generation and dissemination (Jaworski & Kohli, 1993), or knowledge acquisition and assimilation (Jansen et al. 2005), however, were often not supported. Drawing from Zollo and Winter's (2002) analysis, it is likely that formalization may also be the expression of the codification of knowledge and experience. To write down (codify) existing knowledge or experience in certain fields or contexts seems to have much more positive implications for the organization than negative. Formalization allows spreading knowledge across the organization far easier and faster. Consequently, knowledge becomes available for other individuals within the firm without even knowing the source. It has the effect of reducing internal transaction costs by lowering search and information costs, e.g. regarding appropriate contact persons or solutions for already experienced challenges. Furthermore, it reduces uncertainty for individual decisions by providing solid information and back up. For any employee who is confronted with a certain problem, it is very helpful to have access to a database, so that the affected person can possibly be inspired by precedent cases, in which colleagues were confronted with a similar situation and successfully solved it. Such a potential of public knowledge bases within the firm is much

more efficient than always to reinvent the wheel when challenged. While assuming that formalization has at least no negative effect on the firm's ability to acquire knowledge, I expect positive effects on opportunity recognition, knowledge creation, and knowledge assimilation. As stated before, opportunity recognition involves acquisition, filtering, and dissemination of information. Different peaces of information, gathered at various interfaces, have to be combined and interpreted. Formalization regarding responsible contact persons for certain contents or events support an efficient sensing process by reducing costs and avoiding mislead of information. In its function as knowledge codification, formalization enables easy and source-independent access to any kind of knowledge generated in the organization, and therefore supports the process of knowledge sharing in the firm. Zollo and Winter (2002) display the discussion about advantages and disadvantages of formalization and denote the positive effects on learning and the development of dynamic capabilities. Knowledge codification and experience accumulation also seem to support complex activities like capability reconfiguration. Again, it appears to be obvious that formalized knowledge or best-practices can be a valuable source to inform individuals challenged with arranging various kinds of capability sourcing. There is empirical support that formalization positively influences alliance success (Kale & Singh, 2007) and acquisition success (Zollo & Singh, 2004). Further, formalization of rules and guidelines with regard to capability development support rational decision making regarding the need and the options for capability reconfiguration and reduce internal conflicts for scarce resources (Kazanjian & Rao, 1999) as well as potential errors in performing activities (Vorhies & Morgan, 2003). Formalization, thus fosters the transformation of knowledge (Jansen et al., 2005) and support the development of capabilities (Galbraith & Merrill, 1991; Kazanjian & Rao, 1999). As formalization helps to explicate tacit knowledge, makes knowledge far easier accessible throughout the organization, and reduces uncertainty regarding complex decisions, it is likely that formalization fosters dynamic capabilities in firms. Thus:

Hypothesis 3: Formalization is positively related to dynamic capabilities and their dimensions.

6.3. Methods

6.3.1. Sample and Data Collection

The analyses in this study are based on the same sample as the study described in Chapter 2. Thus, the sample and the data collection procedure are equal to those described in Chapter 2.4.1. To minimize redundant repetition, for a recall of the explanations regarding sample and data collection, I therefore would like to refer to Chapter 2.4.1.

6.3.2. Measurement, Validity, and Reliability

To measure dynamic capabilities I again applied the same scales and items as displayed in Table 2.1 in Chapter 2. Please consult chapter 2.5.1. for a recall of the validation procedure. Further, I applied the same control variables as described in Chapter 2. Thus, I controlled for corporate support, firm size, firm age, slack resources, and industry effects. In relation to dynamic capabilities as dependent variable, I again controlled for corporate support to isolate the effects on business unit level. Further, I controlled for slack resources as a higher flexibility in available resources is expected to positively influence activities relating to the development of operational capabilities (Danneels, 2008). I controlled for the effects of firm size and firm age as prior research suggests that older and larger firm are less able to change their resource base and capability configuration (Danneels, 2008). Further, I aimed at controlling for the effects of larger knowledge bases (Lichtenthaler, 2009) and potential effects of prior knowledge and experience (Zollo & Winter, 2002). I controlled for industry effects to account for potential industry-specific differences regarding dynamic capabilities.

In order to develop appropriate scales for organizational design characteristics, I reviewed relevant literature to identify existing items that relate to the domain of the construct in questions. The resulting scales were validated in interviews with academics and practitioners as described in Chapter 2.4.2. The items for centralization, routinization, and formalization were measured on a seven-point Likert-scale. The items with their respective scale ratings and anchor points are presented in Table 6.1.

Organizational Design Characteristics. To measure centralization, routinization, and formalization, I relied on scales applied in prior studies. To measure *centralization* ($\alpha = 0.93$), I adopted three items from prior research (Dewar, Whetten & Boje, 1980; Hage & Aiken, 1967; Jansen et al., 2006). *Routinization* ($\alpha = 0.91$) was tabbed with four items adopted from

prior studies (Jansen et al., 2005; Withey et al., 1983). *Formalization* (α = 0.69) was operationalized with four items also based on prior work (Deshpande & Zaltman, 1982; Jansen et al., 2005). To assess construct validity, I examined the bivariate Pearson correlations of the items and applied exploratory and confirmatory factor analysis. Each item shows higher correlations with items assigned to the same construct than with items assigned to another construct. Accordingly, in an exploratory factor analysis with maximum-likelihood extraction and varimax rotation with Kaiser normalization all items loaded cleanly on their desired factors. I applied confirmatory factor analysis to conduct the Fornell-Larcker discriminant validity test. For each of the three constructs the average variance extracted is higher than any squared correlation with another construct. These results indicate convergent and discriminant validity of the measures (Fornell & Larcker, 1981; Hair et al., 2010).

TABLE 6.1: Variables and Operationalization

Centralization (α = .93) (7, "strongly agree", and 1, "strongly disagree")
There can be little action taken here until a supervisor approves a decision.
Even small matters have to be referred to someone higher up for a final decision.
Most decisions people make here have to have their supervisor's approval.
Routinization (α = .91 (7, "strongly agree", and 1, "strongly disagree")***)***
Most of the tasks are the same from day-to-day.
People in this unit do about the same job in the same way most of the time.
Basically, unit members perform repetitive activities in doing their jobs.
Duties in this business unit are very repetitious.
Formalization (α = .69) (7, "strongly agree", and 1, "strongly disagree")
Whatever situation arises, written procedures are available for dealing with it.
Rules and procedures occupy a central place in the organization.
Written records are kept of everyone's performance.
Written job descriptions are formulated for positions at all levels in the organizational unit.

I also assessed the construct validity for all constructs conjointly. Therefore, again, I applied confirmatory factor analysis, exploratory factor analysis, and examined the Pearson correlations on item-basis. The correlation matrix of all items in the study (independent and dependent variables) for each item showed higher correlations with items assigned to the same factor than with items assigned to another factor. Accordingly, in an exploratory factor analysis, the items cleanly loaded on the ten desired factors. Table 6.2 displays the results.

TABLE 6.2: Results of Exploratory Factor Analysis all Variables

Variables	Opportunity Recognition	Capability Monitoring	Knowledge Creation	Knowledge Acquisition	Knowledge Transfer	Capability Creation	Capability Integration	Formalization	Centralization	Routinization
Item 1	**.75**	.20	.11	.11	.16	.14	.28	.05	-.08	-.06
Item 2	**.63**	.23	.21	.20	.18	.15	.09	-.04	-.13	-.06
Item 3	**.62**	.23	.20	.10	.19	.18	.26	.03	-.16	-.08
Item 4	**.47**	.30	.18	.20	.12	.23	.13	.05	-.02	-.06
Item 5	.14	**.85**	.15	.12	.14	.15	.14	.13	-.05	.04
Item 6	.19	**.69**	.09	.12	.15	.25	.17	.12	-.02	.00
Item 7	.14	**.66**	.09	.16	.19	.19	.11	.12	-.11	-.01
Item 8	.25	**.63**	.13	.30	.08	.07	.01	.00	-.04	-.01
Item 9	.22	.14	**.68**	.23	.12	.23	.13	.17	-.10	-.08
Item 10	.24	.21	**.66**	.19	.13	.23	.18	.06	-.12	-.23
Item 11	.15	.12	**.64**	.20	.08	.21	.13	.16	-.11	-.07
Item 12	.09	.18	**.57**	.17	.30	.32	.22	.07	-.08	-.10
Item 13	.11	.23	.19	**.71**	.08	.08	.11	.10	-.02	-.05
Item 14	.32	.25	.26	**.64**	.08	.12	.11	.03	-.03	-.22
Item 15	.12	.25	.21	**.53**	.18	.13	.12	.07	-.03	-.12
Item 16	.21	.19	.06	-.01	**.71**	.11	.08	.12	-.03	-.10
Item 17	.11	.18	.10	.12	**.67**	.08	.13	.13	-.09	-.06
Item 18	.10	.08	.19	.16	**.58**	.19	.14	.06	-.13	-.03
Item 19	.09	.15	.23	.16	.14	**.79**	.17	.12	-.11	-.07
Item 20	.16	.19	.18	.05	.18	**.75**	.27	.00	-.13	-.10
Item 21	.20	.21	.23	.07	.05	**.68**	.17	.17	-.11	-.06
Item 22	.25	.34	.19	.09	.18	**.58**	.29	.02	-.08	.01
Item 23	.24	.17	.16	.10	.13	.23	**.75**	.08	-.13	-.03
Item 24	.17	.17	.17	.11	.11	.27	**.68**	.04	-.02	-.01
Item 25	.24	.08	.18	.16	.25	.30	**.63**	.15	-.14	-.02
Item 26	-.05	.04	.03	-.02	-.08	.14	.06	**.75**	.25	.23
Item 27	-.04	.07	-.03	.00	.05	.08	.06	**.65**	.08	.32
Item 28	.02	.10	.11	.06	.14	-.01	.00	**.47**	.07	-.05
Item 29	.08	.04	.10	.07	.09	.04	.05	**.41**	.05	-.09
Item 30	-.09	-.03	-.09	.01	-.08	-.10	-.07	.14	**.88**	.15
Item 31	-.11	-.09	-.07	-.07	-.08	-.13	-.11	.08	**.88**	.11
Item 32	-.06	-.08	-.12	-.02	-.07	-.07	-.02	.30	**.80**	.20
Item 33	.01	-.02	-.09	-.11	-.07	-.09	-.08	.03	.10	**.89**
Item 34	-.07	.03	-.09	-.09	-.06	-.07	.00	.00	.13	**.85**
Item 35	.00	-.04	-.07	-.06	.00	-.03	-.01	.06	.11	**.81**
Item 36	-.09	.01	-.02	.00	-.06	.00	.02	.10	.05	**.78**

Note: Maximum-likelihood extraction with varimax rotation and Kaiser normalization. Boldface indicates the ten factors derived.

Further, the Fornell-Larcker discriminant validity test with a confirmatory factor analysis shows that the average variance extracted for each construct is higher than the squared correlation with any other construct. These results indicate convergent and discriminant validity of the constructs (Fornell & Larcker, 1981; Hair et al., 2010).

To detect potential common method variance within the data and potential common method bias in the results, I applied the CFA-Marker-technique as it is the best-performing technique to accurately detect the presence or absence of common method variance within the data (Richardson et al., 2009). The trait-only model (χ^2/df = 1.64; RMSEA = .035) and the constrained (construct correlations are constrained to the values obtained from the trait-only model) trait-method model (χ^2/df = 1.54; RMSEA = .032) show better fit than the trait-method model (χ^2/df = 1.69; RMSEA = .036). These results indicate that there is no common method variance within the data and that the results are not biased based on common method variance (Richardson et al., 2009).

6.4. Results

Table 6.3 presents the descriptive statistics and Pearson correlations for the variables in the study. As in other studies on similar or related constructs (Drnevich & Kriauciunas, 2011; Jansen et al., 2005; Lichtenthaler, 2009), we can observe a relatively high level of dynamic capabilities in many firms, which is not implausible, as firms have to be able to accomplish such tasks to a certain degree in order to survive in the market place. The significant correlations between dynamic capabilities and their several subdimensions support the assumption of a single underlying latent construct and are consistent with complementarity theory (Milgrom & Roberts, 1995) and with related constructs, such as absorptive capacity (Lichtenthaler, 2009). As expected, we can observe positive correlations between formalization and dynamic capabilities and their subdimensions and negative correlations between centralization and routinization and dynamic capabilities and their subdimensions. Corporate support only shows significant correlations with knowledge acquisition. Slack resources show positive correlations with all subdimensions of dynamic capabilities, except knowledge transfer.

TABLE 6.3: Descriptive Statistics and Pearson Correlations

Variables	Mean	s.d.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1 Dynamic Capabilities	4.69	.93																							
2 Opportunity Recognition	4.82	1.19	.81 ***																						
3 Capability Monitoring	4.10	1.37	.77 ***	.57 ***																					
4 Knowledge Acquisition	4.78	1.26	.73 ***	.54 ***	.54 ***																				
5 Knowledge Sharing	4.34	1.39	.67 ***	.47 ***	.42 ***	.38 ***																			
6 Knowledge Creation	5.23	1.10	.80 ***	.57 ***	.48 ***	.59 ***	.46 ***																		
7 Capability Creation	4.70	1.16	.80 ***	.57 ***	.53 ***	.43 ***	.43 ***	.63 ***																	
8 Capability Integration	4.84	1.05	.74 ***	.58 ***	.43 ***	.43 ***	.43 ***	.55 ***	.63 ***																
9 Corporate Support	3.10	.96	.10	.02	.11	.17 **	.10	.07	-.01	.07															
10 Firm Size (log)	3.21	1.08	-.04	-.07	.04	-.03	-.06	.00	-.07	-.08	.14 *														
11 Firm Age (log)	1.30	.54	.01	.06	.03	.02	-.06	.05	-.02	-.01	-.01	.38 ***													
12 Slack Resources	3.36	1.32	.19 **	.15 *	.18 **	.14 *	.09	.15 *	.16 *	.15 *	.16 *	.08	.00												
13 Telecommunication	.08	.28	-.11	-.09	-.04	-.06	-.06	-.11	-.12	-.12	-.03	.08	-.18 **	-.16 *											
14 Automobile	.13	.34	.04	.02	.03	.01	.01	.04	.10	.01	.02	.11	.04	-.05	-.12										
15 Computer/IT	.08	.28	.09	.00	.10	.05	.17 **	.00	.09	.06	-.10	.09	-.01	-.03	-.09	-.12									
16 Banking/Insurance	.09	.28	.07	-.02	.04	.08	.10	.10	-.01	.15 *	.16 **	-.20 ***	-.13 *	-.03	-.09	-.12	-.09								
17 Energy	.07	.25	-.06	-.02	-.05	-.03	-.04	-.05	-.09	-.03	.05	-.05	-.05	.14 *	-.08	-.11	-.08	-.08							
18 Chemicals/Pharmaceuticals	.09	.29	-.09	-.03	-.13 *	-.12	.01	-.09	-.05	-.10	-.03	.09	.12	.03	-.10	-.13 *	-.10	-.10	-.09						
19 Machinery	.12	.32	-.06	-.01	-.10	-.08	-.10	-.02	.03	-.06	-.11	-.08	.04	-.06	-.11	-.14 *	-.11	-.11	-.10	-.12					
20 Transport and Services	.08	.27	.03	.05	.05	-.01	.03	.08	-.04	.02	.09	.01	.00	.13 *	-.09	-.11	-.09	-.09	-.08	-.09	-.11				
21 Consumer	.11	.31	-.04	-.04	.01	-.08	-.10	-.04	-.01	.04	.06	.06	.04	.04	-.10	-.13 *	-.10	-.11	-.09	-.11	-.13 *	-.10			
22 Formalization	4.87	1.19	.22 ***	.09	.20 ***	.14 *	.18 **	.20 **	.18 **	.17 **	.09	.17 **	.04	.01	-.09	.26 ***	-.06	.05	-.06	.00	-.07	-.01	-.02		
23 Centralization	3.79	1.66	-.31 ***	-.29 ***	-.18 **	-.17 **	-.22 ***	-.28 ***	-.28 ***	-.25 ***	.06	.10	.01	-.04	.07	.10	-.12 *	-.05	.09	.02	-.04	-.07	.03	.27 ***	
24 Routinization	3.54	1.35	-.21 ***	-.17 **	-.06	-.25 ***	-.16 **	-.25 ***	-.16 **	-.11	-.05	.24 ***	.15 *	-.01	-.01	.07	.02	-.08	-.01	-.07	.01	.05	.12	.18 **	.29 ***

N = 265

*** p<0.001

** p<0.01

* p<0.05

To test the proposed relations, I applied structural equation modeling (SEM) using AMOS 19 with maximum-likelihood estimation. The data distribution shows skewness below 2 and a kurtosis below 7, and thus maximum-likelihood estimation is expected to provide reliable estimates (Curran, West, and Finch, 1996). Cronbach's Alpha for the applied scales range between 0.69 and 0.94 and the respective factor loadings are strong and highly significant, and thus show good reliability and validity (Shook et al., 2004). To account for convergent validity and discriminant validity, each item was allowed to load only on the factor for which it was the intended indicator and error terms were not allowed to correlate (Byrne, 2001; Mathieu & Farr, 1991). To evaluate model fit, I applied χ^2/df, TLI, CFI, RMSEA, and SRMR (Byrne, 2001; Cheung & Rensvold, 2002; Hair et al., 2010; Hu & Bentler, 1999; Marsh et al., 2004).

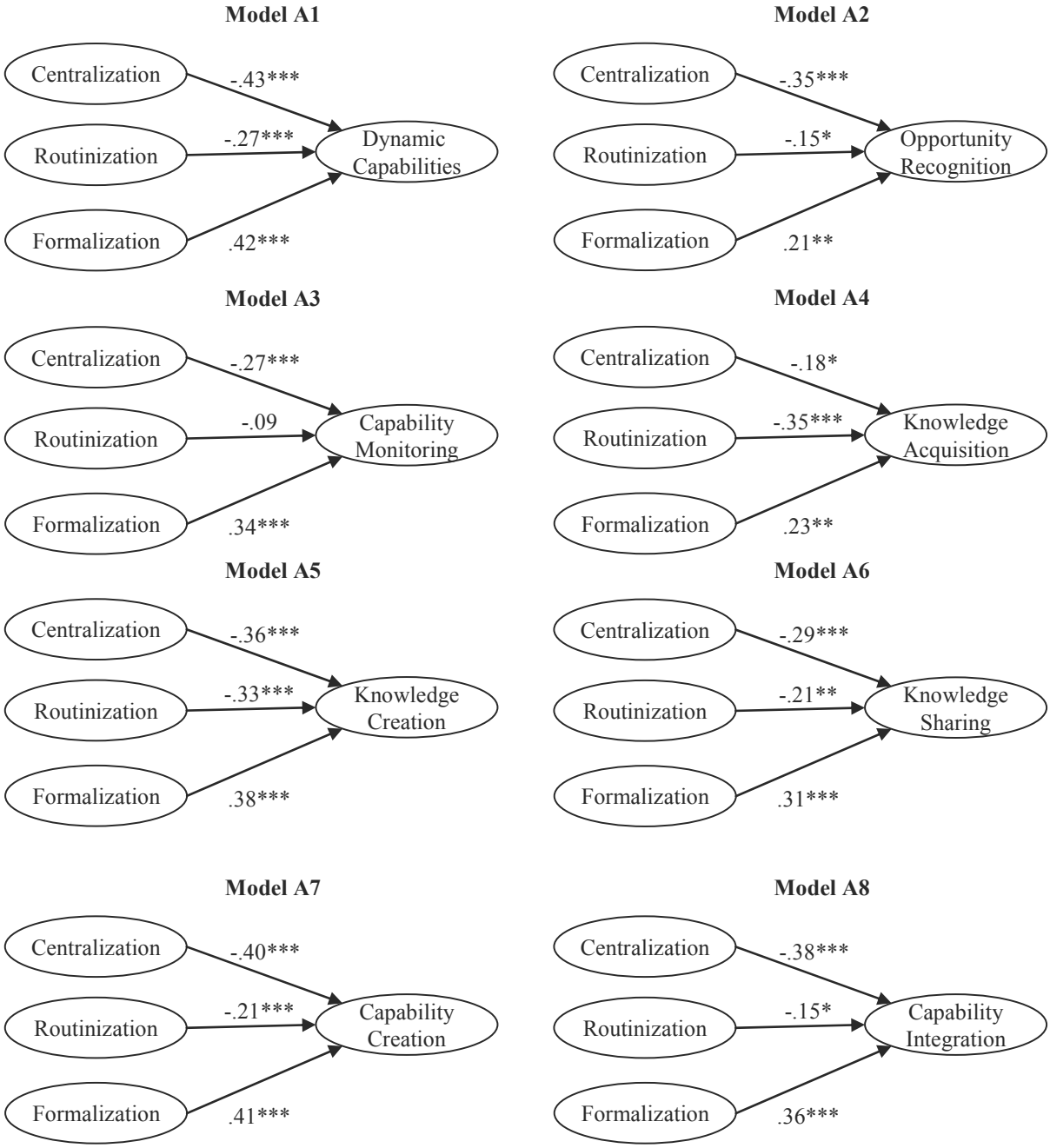
In order to test the hypotheses on construct and dimension level (Wong et al., 2008), I constructed several structural models with centralization, routinization, and formalization as independent variables and dynamic capabilities (Model A1), opportunity recognition (Model A2), capability monitoring (Model A3), knowledge acquisition (Model A4), knowledge creation (Model A5), knowledge sharing (Model A6), capability creation (Model A7), and capability integration (Model A8) as dependent variables, respectively. I first included the control variables corporate support, slack resources, firm size, and firm age as well as the industry dummies into the models. As formalization, centralization, and routinization are expected to be interrelated and also depend on firm size, I drew covariances between the respective constructs, which were allowed to be freely estimated. Further, firm size and firm age as well as slack resources and corporate support are not independent of each other, which I accounted for in the same manner. I then removed non-significant controls as they reduce model fit due to higher complexity and non-significant relations. The removal of non-significant controls is not expected to alter substantive results (Danneels, 2008). Figure 6.1 presents the standardized estimates of the main effects of Models A1 to Model A8.

Model A1 fits well with χ^2/df = 1.61, TLI = .92, CFI = .92, RMSEA = .05, and SRMR = .06. Centralization unfolds a strong and negative effect on dynamic capabilities (-.43; $p<0.001$), while routinization shows a moderately strong negative influence on dynamic capabilities (-.27; $p<0.001$). In contrast, the effect of formalization on dynamic capabilities (.42; $p<0.001$) is strongly positive. Slack resources show an effect of .17 ($p<0.005$) on dynamic capabilities. The industry control for chemicals/pharmaceuticals shows a significant ($p<0.05$) effect of -.11 on dynamic capabilities. To further assess the reliability of the results, I applied

a variation of holdout validation (Hair et al., 2010). Therefore, I conducted a group comparison based on a random sample split and tested for the invariance of the model between the two randomly selected groups. The model in which the path coefficients were allowed to vary between the two groups showed lower fit than the model where the paths were set equal, meaning that the path estimates do not vary between randomly selected groups.

Model A2 ($\chi 2/df = 2.49$, TLI = .90, CFI = .92, RMSEA = .08, and SRMR = .08) shows significant negative effects of centralization (-.35; $p<0.001$) and routinization (-.15; $p<0.05$) and a significant positive effect of formalization (.21; $p<0.01$) on opportunity recognition. Further, slack resources (.14; $p<0.05$) unfold a significant effect. Model A3 ($\chi 2/df = 2.45$, TLI = .92, CFI = .93, RMSEA = .07, and SRMR = .07) shows a significant negative effect of centralization (-.27; $p<0.001$) and a significant positive effect of formalization (.34; $p<0.001$) on capability monitoring. The effect of routinization on capability monitoring is negative, but not significant. Slack resources (.17; $p<0.01$) and chemicals/pharmaceuticals (-.13; $p<0.05$) unfold additional significant effects.

FIGURE 6.1: Results of SEM Analysis with Dynamic Capabilities and Sub-dimensions as Dependent Variables



***p<.001; **p<.01 ; *p<.05

Model A4 ($\chi 2/df = 2.44$, TLI = .91, CFI = .92, RMSEA = .07, and SRMR = .07) shows significant negative effects of centralization (-.18; $p<0.05$) and routinization (-.35; $p<0.001$) and a significant positive effect of formalization (.23; $p<0.01$) on knowledge acquisition. Corporate support (.14; $p<0.05$) and chemicals/pharmaceuticals (-.15; $p<0.05$) unfold additional significant effects. Model A5 ($\chi 2/df = 2.37$, TLI = .92, CFI = .94, RMSEA = .07, and SRMR = .07) shows significant negative effects of centralization (-.36; $p<0.001$) and routinization (-.33; $p<0.001$) and a significant positive effect of formalization (.38; $p<0.001$) on knowledge creation. Slack resources (.14; $p<0.05$) and chemicals/pharmaceuticals (-.12; $p<0.05$) unfold additional significant effects. Model A6 ($\chi 2/df = 2.69$, TLI = .90, CFI = .92, RMSEA = .08, and SRMR = .08) shows significant negative effects of centralization (-.29; $p<0.001$) and routinization (-.21; $p<0.01$) and a significant positive effect of formalization (.31; $p<0.001$) on knowledge sharing. Corporate support (.14; $p<0.05$), and computer/IT (.21; $p<0.01$) unfold additional significant effects. Model A7 ($\chi 2/df = 2.84$, TLI = .91, CFI = .93, RMSEA = .08, and SRMR = .07) shows significant negative effects of centralization (-.40; $p<0.001$) and routinization (-.21; $p<0.001$) and a significant positive effect of formalization (.41; $p<0.001$) on capability creation. Only slack resources (.14; $p<0.05$) unfold additional significant effects. Model A8 ($\chi 2/df = 2.92$, TLI = .91, CFI = .93, RMSEA = .08, and SRMR = .07) shows significant negative effects of centralization (-.38; $p<0.001$) and routinization (-.15; $p<0.05$) and a significant positive effect of formalization (.36; $p<0.001$) on capability creation. Again, only slack resources (.13; $p<0.05$) unfold additional significant effects. These results provide full support for hypotheses 1, 2, and 3 with the exemption that the effect of routinization on capability monitoring is not significant.

To cross validate the results, I applied OLS-regression. I operationalized the constructs by summing scores on their dimensions (Edwards, 2001), thereby accounting for the different numbers of dimensions or items, respectively. Further, I z-standardized the continuous predictor variables (Frazier et al., 2004). The variance inflation factors of all variables in the respective models were below 2, and thus show that multicollinearity is not a problem within the data. The results from OLS are displayed in Table 6.4. Models B1 to B8 display the standardized coefficients and respective significance levels of the effects of centralization, routinization, and formalization on dynamic capabilities and the seven sub-dimensions. Centralization shows a significant negative effect on dynamic capabilities and every single sub-dimension of dynamic capabilities while formalization shows a significant positive effect on dynamic capabilities and all sub-dimensions. Routinization shows a significant negative ef-

fect on dynamic capabilities and all sub-dimensions with exemption of capability monitoring (Model B3) and capability integration (Model B8), where the negative effect is not significant. Regarding the main effects, the results of models B1 to B8 support the findings from models A1 to A8 with the exception that the negative effect of routinization on capability integration in Model B8 is not significant. With respect to the effects of the control variables the results from OLS are congruent with the results from SEM with the exception that Model B4 shows additional significant industry effects and that in Model B6 the effect of corporate support is only marginally significant on the 0.1-level. These results also provide full support for hypotheses 1 and 3, while providing only partial support for hypothesis 2.

TABLE 6.4: Results of OLS Analysis with Dynamic Capabilities and Sub-dimensions as Dependent Variables

	Model B1 DV: Dynamic Capabilities		**Model B2** DV: Opportunity Recognition		**Model B3** DV: Capability Monitoring		**Model B4** DV: Knowledge Acquisition		**Model B5** DV: Knowledge Creation		**Model B6** DV: Knowledge Sharing		**Model B7** DV: Capability Creation		**Model B8** DV: Capability Integration	
	Beta	**Sig.**	**Beta**	**Sig.**	**Beta**	**Sig.**	**Beta**	**Sig.**	**Beta**	**Sig.**	**Beta**	**Sig.**	**Beta**	**Sig.**	**Beta**	**Sig.**
Coporate support	.06	.308	.01	.919	.08	.218	.14 *	.024	.02	.767	.09	.139	-.02	.682	.02	.788
Slack resources	.17 **	.003	.13 *	.034	.17 **	.005	.11	.059	.12 *	.034	.07	.252	.16 **	.006	.13 *	.037
Firm size	.02	.786	.00	.990	.00	.960	.06	.313	.05	.393	-.05	.387	.01	.809	.02	.785
Firm age	-.02	.718	.02	.787	-.04	.557	.03	.650	.02	.768	-.03	.671	-.07	.267	-.04	.519
Telecommunication	-.10	.143	-.09	.219	-.04	.571	-.15 *	.037	-.09	.181	.00	.991	-.09	.195	-.08	.266
Automobile	-.07	.309	-.06	.440	-.08	.269	-.17 *	.025	-.04	.577	-.02	.752	.02	.748	-.04	.594
Computer/IT	.00	.948	-.08	.267	.02	.746	-.07	.295	-.05	.480	.15 *	.030	.03	.660	.02	.820
Banking/Insurance	-.05	.429	-.12	.105	-.07	.354	-.11	.120	.00	.942	.04	.553	-.08	.261	.09	.219
Energy	-.10	.128	-.06	.408	-.10	.161	-.14 *	.031	-.07	.318	-.02	.734	-.09	.153	-.03	.693
Chemicals/Pharmaceuticals	-.16 **	.014	-.10	.141	-.18 **	.011	-.26 ***	.000	-.14 *	.045	.01	.894	-.08	.240	-.11	.117
Machinery	-.11	.117	-.08	.282	-.14	.064	-.19 **	.008	-.04	.526	-.07	.324	.01	.936	-.05	.463
Tranport and Services	-.07	.275	-.05	.527	-.06	.429	-.16 *	.018	.00	.942	.01	.936	-.10	.143	-.03	.630
Consumer	-.09	.174	-.09	.205	-.06	.441	-.20 **	.005	-.05	.441	-.08	.291	-.03	.656	.02	.749
Formalization	.33 ***	.000	.18 **	.004	.27 ***	.000	.20 **	.001	.30 ***	.000	.26 ***	.000	.27 ***	.000	.25 ***	.000
Centralization	-.33 ***	.000	-.30 ***	.000	-.22 **	.001	-.15 *	.018	-.28 ***	.000	-.23 ***	.000	-.31 ***	.000	-.28 ***	.000
Routinization	-.16 **	.006	-.12 †	.071	-.03	.580	-.23 ***	.000	-.22 ***	.000	-.11 †	.073	-.12 *	.052	-.06	.308
Adjusted R^2	0.24 ***		0.10 ***		0.12 ***		0.16 ***		0.20 ***		0.13 ***		0.17 ***		0.13 ***	

N = 265; ***p<0.001; **p<0.01; *p<0.05; †p<0.1

6.5. Discussion and Conclusion

6.5.1. Implications

This study contributes to organizational research in general and to research on dynamic capabilities in particular in several ways. Given the dearth of knowledge on the influence of organizational design characteristics on organizational outcomes like capabilities, this study provides important insights into a largely blind spot of organizational research. Most important, the present study informs about the influence of organizational design characteristics on the constitution of dynamic capabilities. The results contribute to the understanding of scholars why certain organizations perform better in developing new capabilities and thus are more likely to successfully adapt to changing environments. The study further informs managerial practice about the organizational settings in which dynamic capabilities are most likely to prosper, thereby providing important information about the preconditions for the development of dynamic capabilities. Altogether, the results show that the routinization of work tasks and the centralization of decision making impede the constitution of dynamic capabilities while formalization supports the development of dynamic capabilities. This reveals that organizations may differ in their ability to develop and apply dynamic capabilities and in turn may differ in their ability to adapt to changing environments by developing new capabilities partly due to their organizational design characteristics.

With respect to centralization the findings of this study are congruent with the predictions of contingency theory. However, this study contributes to a deeper insight as it links centralization to the internal mechanisms that enable the alignment with dynamic environments. Thereby the results suggest that the performance effect of organizational design characteristics in different levels of environmental dynamism as proposed within contingency theory is mediated by the firm's capabilities.

The findings show that centralization impedes the development of dynamic capabilities as the recognition of opportunities and threats, the integration of new internal and external knowledge, and the reconfiguration of the capability endowment is inhibited. The results of this study indicate that organizations are better able to identify the need for change when the respective activities are conducted in a de-centralized manner. This is because different people or different organizational entities recognize different opportunities and threats, and because people who are closer to the domain in question perform better based on their specific knowledge (Shane, 2000). Changes in customer needs, for example, are likely to be detected

quicker and more accurate in departments or teams which are closer to the customer. The evaluation whether such a change in customer needs can be addressed based on the current technological capability endowment or whether there is a need for change is also more likely to be better evaluated within the capability domain in question.

Centralization further hinders the creation and the acquisition of new knowledge. Knowledge acquisition occurs at various interfaces with the environment (Cohen & Levinthal, 1990) resulting in the fact that de-centralized organizations are supposed to have a stronger ability to acquire valuable new knowledge. Similarly to Jansen et al. (2005), I find more de-centralized organizations performing better regarding the acquisition of new external knowledge. Moreover, centralized organizations suffer from the fact that the creation and sharing of knowledge is impeded which additionally restrains their learning capability. In order to formulate an appropriate response by which identified opportunities and threats can be best addressed, the internal creation, external acquisition, and sharing of knowledge is vital, as it further lays the ground for the implementation through the reconfiguration of capabilities (Eisenhardt & Martin, 2000; Kogut & Zander, 1992; Teece, 2007; Zahra & George, 2002).

Further, the results indicate that de-centralized organizations cope better with the challenge to reconfigure their resource base by creating and integrating new capabilities. Centralization reduces the ability to perform the respective activities that come with capability reconfiguration and thus reduce the adaptive ability of the organization. This study finds evidence that centralization reduces the ability of organizations to create and integrate new capabilities. Higher levels of centralization reduce the involvement of employees or departments which are deeper involved in the respective capability domain, reduce the speed of decision making, and restrict the creation of creative solutions. More de-centralized firms, therefore, are likely to perform better in creating and integrating new capabilities.

Accordingly, centralized organizations are less able to stimulate the communication and to manage information flows and the exchange of ideas. As this is vital in order to identify the need for change and to formulate a response, centralized organizations are restricted in their efforts to develop and apply dynamic capabilities. Moreover, they fail to appropriately deploy the potential of the various departments and employees in order to recognize opportunities and threats arising from external changes. Further, as capability creation and integration is best conducted in the areas where they are applied and embedded, centralized organizations also show a weaker performance in capability reconfiguration. Centralization of decision

making, thus, prevents innovative solutions as it decreases awareness, commitment, and involvement of organizational members (Damanpour, 1991).

Regarding the impact of work task routinization, the results show a negative influence, indicating that more routinized organizations are less able to establish dynamic capabilities. While there is certainly some value in routinization under more stable conditions due to cost efficiency (Miles et al., 1978), routinization makes regular adaptation to changing conditions more difficult. Prior research suggests that routinization unfolds a restraining influence on tasks like the acquisition, the sharing, and the transformation of new knowledge, which require openness, creativity, and flexibility (see for example Jansen et al., 2005). Additionally, this study provides new insight by showing that routinization also unfolds a negative influence on opportunity recognition, knowledge creation, and capability creation. When activities are conducted in regular and repetitious patterns it is not likely that new events are adequately absorbed or that novel solutions are discovered and implemented. This restricts the firm's ability to recognize opportunities and threats or to create new knowledge and capabilities. Capability monitoring and capability integration, however, seem not to be negatively affected by higher levels of routinization. An explanation might be that monitoring the existing capability configuration and integrating new capabilities into the current capability configuration involves 'known territory' to a greater extend than dealing with completely new events. At least the existing capability configuration and their characteristics are well known and thus calibrating requirements is less likely to suffer from routinized activity.

Overall, these results indicate that routinized organizations are less able to cope with the challenges arising from changing environments as their ability to apply dynamic capabilities is restricted. Moreover, the negative effect of routinization on dynamic capabilities calls the routine concept as fundament of dynamic capabilities into question (Schreyögg & Kliesch-Eberl, 2007; Teece, 2007). Dynamic capabilities virtually cry out 'flexibility' and 'awareness', which contradicts the notion of routines as stable and repetitious patterns of collective interaction (Winter, 2003). A thing such unreceptive towards change as a routine, is unlikely to be an adequate response to changing conditions. Schreyögg and Kliesch-Eberl (2007) discuss this contradicting logic, stating that capabilities and especially dynamic capabilities consist of much more than interlinked routines. The present findings underpin this argument by showing that routinization hampers the performance of activities associated with applying dynamic capabilities.

Nevertheless, the idea that dynamic capabilities to some extent do have features of routines (e.g. replicability, stability, recurrence) is widely spread within the dynamic capabilities' literature (e.g. Eisenhardt & Martin, 2000; Winter, 2003; Zahra et al., 2006; Zollo & Winter, 2002) and thus further clarification is necessary. Feldman and Pentland's (2003) reconceptualization of routines, which differentiates between the ostensive and performative aspects of routines, may provide a promising venue for such further examination. The results of this study indicate that routinization of the performative domain, i.e. repetitious, invariable, and sequential performance of work tasks, impedes the performance of activities related to applying dynamic capabilities. This draws the attention to the question to what extent the several dimensions of dynamic capabilities may resemble a stable and recurring pattern, so that they constitute a stable structure in which the ostensive aspect of a routine finds expression. This would require that for recurring events when firms adapt to external changes by creating and implementing new capabilities, we can observe the manifestation of the same dimensions of dynamic capabilities in the same sequential order in a recurring and stable pattern. However, future research is necessary to address this issue by clarifying to what extent several dimensions of dynamic capabilities resemble a stable ostensive aspect of a routine.

The results of this study put the role of formalization into a new light. Prior studies often highlighted the restricting and inflexible character of formalization and thus expected a negative impact on learning (Jansen et al., 2005) or the development of novel solutions (Damanpour, 1991), but often found this negative impact not to be supported or found ambiguous results (Lane & Lubatkin, 1998). Within this study, I highlighted the role of formalization as the codifying of valuable knowledge and experience. Formalization makes knowledge far easier accessible throughout the organization and reduces uncertainty regarding complex decisions. The results of this study show that these characteristics of formalization have a strong positive effect on dynamic capabilities. The codification of knowledge and experience has previously been proposed as positively influencing the constitution of dynamic capabilities (Zollo & Winter, 2002). This study provides empirical support for this proposition. While prior research provided some support for the proposition that capability reconfiguration might be fostered by formalization, the present results support this argument for all dimensions of dynamic capabilities. Organizations can gain a stronger ability to effectively create and integrate new capabilities by a higher level of formalization. As formalization makes tacit knowledge explicit and makes knowledge in general far easier accessible, it supports the recognition of opportunities and fosters task-specific learning in the organization.

Contingency theory suggests that firms are required to be less formalized when operating in more dynamic environments (Pennings, 1987). The results presented here contradict this view by providing evidence that formalization supports dynamic capabilities which in turn enable a firm to adapt to changing business environments by creating new operational capabilities. However, different characteristics of formalization may have different implications. When formalization leads to inflexible rules that employees have to follow without variation, formalization may unfold hindering effects on tasks that require openness and flexibility. This notion of formalization is often found in contingency-related research. Ruekert et al. (1985, p. 15), for example, state that "…formalization represents the degree to which activities and relationships are governed by rules, procedures, and contracts." At first glance, this definition seems to be very similar to the notion of formalization as made by Pugh et al. (1968) but implies very different consequences. The notion of formalization made by Ruekert et al. (1985) implies that people have to stick to various rules and guidelines when conducting activities, while the notion of formalization made by Pugh et al. (1968) merely states that rules or guidelines – so they exist – are written down. Thus, in the terms of Ruekert et al. (1985) formalization leads to routinization of activities, making it difficult to differentiate between the effects of these two design parameters. However, when formalization is applied as codification of knowledge and experience, it may reduce uncertainty and foster knowledge circulation within the organization and thus may unfold positive effects on activities associated with adaptation and change. The inflexibility lies within the rules, not within the formalization of the rules.

Slack resources also show a positive impact on dynamic capabilities. Prior research suggests a positive relationship between slack resources and adaptability (McKee, Varadarajan & Pride, 1989) or between slack resources and strategic flexibility (Sharfman & Dean, 1997). The results of this study confirm the relation between slack resources and dynamic capabilities by providing evidence that slack resources positively influence dynamic capabilities, which in turn enable adaptation and change (Eisenhardt & Martin, 2000; Teece, 2007). In this regard, the results of the present study are congruent with prior research, finding slack to positively influence second-order competences (Danneels, 2008) or innovative activity (Damanpour, 1991). Slack resources are important as applying dynamic capabilities involves additional tasks that are different from operational day-to-day business and require additional investments in and maintenance costs for information systems (Teece, 2007). Thus, in order to develop dynamic capabilities organizations are well advised to have a certain amount of personnel and financial resources in reserve. Slack resources are especially relevant within the dimensions of dynamic capabilities that require accomplishing additional tasks or where addi-

tional financial resources are necessary, e.g. opportunity recognition, capability monitoring, and knowledge and capability creation. Regarding firm size and firm age, the results do not suggest that larger or older organizations are advantaged or disadvantaged in order to develop or apply dynamic capabilities. In this regard the results are congruent with prior research on related constructs (e.g. Lichtenthaler, 2009). Corporate support seems to be of some value for the acquisition and sharing of new knowledge. An explanation might be that for business units that are part of a multi-business corporation the access to new knowledge sources and the dissemination of new knowledge from different industries or business segments is far easier.

Finally, I come to four main conclusions: First, organizational design characteristics unfold a strong impact on a firm's dynamic capabilities, and thus, organizational design is a very important antecedent for dynamic capabilities. Firms differ in their ability to establish or manage dynamic capabilities due to favorable or unfavorable organizational design, and therefore, differ in their ability to compete successfully by building new organizational capabilities. Second, firms that need to develop or apply dynamic capabilities to regularly renew their capability configuration in order to sustain their competitiveness are well advised to implement more flexible organizational designs. Centralization should be reduced in favor of more autonomy for the business units and the individuals in the organization and routinization should be reduced in favor of more creativity and flexibility of the individuals in order to perform their work tasks. Third, firms should acknowledge the positive influence of formalization and should find ways to implement the formalization of knowledge and experience in a way that employees gain from. The challenge is to implement such systems without restricting flexibility and creativity. Firms must be very careful about the content that is formalized. When rules or guidelines are formalized in a way that it is obligatory to follow them, formalization restricts the autonomy of employees and leads to negative outcomes. Fourth, firms are well advised to hold additional resources in reserve that are not totally consumed by day-to-day business. This is important also for financial resources, but especially vital for employees. When employees are overstrained in performing their ordinary day-to-day tasks it is very unlikely that they can keep mental capacity available for engaging in additional tasks that involve the identification and exploration of novel solutions.

6.5.2. Limitations and Outlook

Several limitations of this study are worth to be discussed. First, this study applies perceptual measures from key informants. Although, I applied recommended procedural and statistical remedies to limit concerns regarding single-informant data (Podsakoff et al., 2003), the issues

of informant bias and common method variance cannot totally be ruled out. However, the anonymity that was guaranteed for respondents, together with the strong interrater agreement and interrater reliability, reduced my concern that responses are artificially inflated or disguised. Additionally, the inclusion of a CFA-Marker indicated that the results are not biased due to common method variance (Richardson et al., 2009).

Second, as this study applies a newly developed measure for an inherently difficult-to-measure construct, validation of the measure is difficult. Although the measure shows strong interrater reliability, further validation is necessary. In future studies, researchers may try to measure the dimensions of dynamic capabilities using objective measures.

Third, as this empirical study focuses on business units of large firms operating in Germany, the findings should be validated in alternative settings. I approached the largest firms of the respective industries operating in Germany. These firms might require different structural design than smaller firms to coordinate their respective tasks effectively. Further, the largest firms of the respective industries might be more successful in the market place than the average of the basic population, which might explain the relatively high level of dynamic capabilities in many firms. However, in this study I controlled for firm size, excess resources, and corporate support in order to detect potential effects. As the surveyed firms operate internationally, the results should hold in comparable settings than Germany. However, future studies might focus on a broader sample in terms of size or performance, on small firms, or on corporate level.

Fourth, in this study I captured an 'average' level of centralization, routinization, and formalization across the focal business units. If different levels of centralization, routinization, or formalization were implemented within different departments or functions, this might affect the results presented in this study. However, contingency theory proposes that firms implement the appropriate organizational design in due consideration of the environmental context they face (Pennings, 1987). Thus, they decide on the appropriate level of centralization, routinization, or formalization based on their perception of the dynamism or complexity in their business environment. As the level of dynamism or complexity of the environment is not expected to differ in respect to one and the same focal business unit, there is no rationale to implement different levels regarding the organizational design parameters. Baum and Wally (Baum & Wally, 2003), for example, examined the differing effects of centralization within strategic and operations management. The descriptive statistics in their study does not unveil significant differences regarding the level of centralization between these two management

domains. Thus, I believe that capturing the ‘average’ level of the design parameters is appropriate for the purpose of this study.

7. OVERALL CONCLUSION AND OUTLOOK

7.1. Implications

Within this thesis, I addressed some of the most important research questions relating to the dynamic capabilities framework. With respect to the call for a more accurate operationalization, this thesis contributes to existing research by offering an operationalization of dynamic capabilities that conjointly captures the various facets of the construct and allows differentiating between dynamic capabilities existence and their outcomes on organizational level (Zahra et al., 2006). According to Helfat et al. (2007) dynamic capabilities include the identification of the need for change, the formulation of a response, and the implementation of a course of action. Based on conceptual research regarding dynamic capabilities, I derive seven dimensions in which these different facets of dynamic capabilities manifest.

In Chapter 2, I provide evidence that these seven dimensions are not only theoretically distinct from proposed outcomes of dynamic capabilities on organizational level, such as capability development or firm competence, but also empirically discriminate from these constructs. The results presented in Chapter 2 further show that dynamic capabilities positively influence the development of operational capabilities in several different areas and as a consequence help to foster competence (a higher relative quality) in the respective capability areas.

The results of the study presented in Chapter 3 underpin the necessity to adequately operationalize dynamic capabilities as a multi-dimensional construct. The several dimensions of dynamic capabilities unfold partly diverging effects and the impact of dynamic capabilities seems to be partly dependent on the characteristics of the different capability areas within the organization. Further, there are synergies arising from the combination of the different dimensions which unfold complementary and compensatory effects on firm competence. These findings underpin the need to operationalize dynamic capabilities in a way that enables to capture their overall effect (Tanriverdi & Venkatraman, 2005). Further, these results underscore the argument that theoretical relations regarding dynamic capabilities should be analyzed on construct level and theoretical conclusions should also be drawn on construct level instead of dimension level (Wong et al., 2008).

The studies combined in this dissertation thesis provide strong support for the dynamic capabilities framework, in the sense that dynamic capabilities become effective by driving the development of new operational capabilities and help to establish a higher relative quality in

several capability areas. In Chapter 4, I further confirm the proposed link between dynamic capabilities and successful innovation. While being indicated in prior conceptual research (Danneels, 2002; Eisenhardt & Martin, 2000; Teece, 2007; Verona, 1999), this study confirms the positive contribution of firm-level dynamic capabilities to innovation performance and explicitly discusses the mechanisms by which dynamic capabilities support innovation activity and success. Thereby, the potential of dynamic capabilities to actively shape the environment is unveiled. By fostering innovation performance dynamic capabilities help organizations to influence their environment proactively instead of just helping to adapt reactively to external changes.

Thus far this thesis provides strong support for dynamic capabilities being a potential source for competitive advantage. As dynamic capabilities drive the development of new operational capabilities, help to foster firm competence, and positively influence successful innovations, they are very likely to be an enabling force for implementing value creating strategies, which are not simultaneously being implemented by competitors (Barney, 1991). Due to the multi-dimensionality of dynamic capabilities and the interdependence of the different dimensions, it is very difficult for competitors to imitate such a potential source of competitive advantage (Tanriverdi & Venkatraman, 2005).

The analyses in Chapter 5, where I examine the contribution of dynamic capabilities on financial firm performance, provide novel findings regarding the performance effects of dynamic capabilities. The results show that dynamic capabilities unfold a positive contribution to financial firm performance indirectly via the establishment of firm competence (higher relative quality of operational capabilities), but additionally unfold negative direct effects due to costs associated with dynamic capabilities. Thereby, the results unveil that in terms of financial performance in the short run the costs outweigh the relative benefits in almost any situations analyzed. While dynamic capabilities are most often 'automatically' associated with superior firm performance, most studies neglect the cost side of dynamic capabilities. The study in Chapter 5 thereby helps to resolve inconsistencies between prior studies (Drnevich & Kriauciunas, 2011; Protogerou et al., 2011) regarding the performance effects of dynamic capabilities. Moreover, the results of this study question the usefulness of financial firm performance as the 'ultimate' outcome of dynamic capabilities. The results indicate that the value of dynamic capabilities may not lie within potential performance differences they generate. This calls for a rethinking about the performance outcome of dynamic capabilities. Future studies exploring the performance effects of dynamic capabilities might examine the contribution to the implementation of value creating strategies or the contribution to firm survival.

Overall the studies presented in Chapter 4 and Chapter 5 provide evidence that the performance effects of dynamic capabilities are more complex than often assumed and that dynamic capabilities unfold indirect and direct effects on different performance outcomes.

The results provided in Chapter 4 and Chapter 5 further provide deeper and partly novel insights regarding the influence of environmental dynamism on the effects of dynamic capabilities. In Chapter 4, I capture the dynamism of the business environment with a composite measure of market turbulence, technological turbulence, and competitive intensity. The results show that the effectiveness of dynamic capabilities in terms of creating operational capabilities of superior quality (firm competence) is independent from the overall dynamism in the business environment (Eisenhardt & Martin, 2000; Zahra et al., 2006). However, in higher levels of environmental dynamism the contribution of firm competence on innovation performance decreases, while the direct contribution of dynamic capabilities on innovation performance increases. Thus, for fostering successful innovation dynamic capabilities are indeed especially important in turbulent environments (Teece et al., 1997).

In Chapter 5, I examine the influence of environmental dynamism on the performance effects of dynamic capabilities in greater detail. Therefore, I examine the influence of market turbulence and technological turbulence separately and find that these dimensions of environmental dynamism unfold different influence on dynamic capabilities' effects. The results indicate that market turbulence has a rather competence-enhancing character, while technological turbulence has a rather competence-destroying character (Anderson & Tushman, 1990; Tushman & Anderson, 1986). While market turbulence positively moderates dynamic capabilities' effects on firm competence and firm performance, technological turbulence positively moderates the direct effect of dynamic capabilities on firm performance, but negatively moderates dynamic capabilities' influence on firm competence. The results suggest that technological turbulence is the far greater threat for the competitiveness of organizations and further indicate that there might be technological discontinuities where the possession of dynamic capabilities might no longer be a remedy.

The results in Chapter 6 provide novel insights regarding the organizational settings in which dynamic capabilities are most likely to prosper. The results show that more flexible designs in terms of lower levels routinization and lower levels of centralization support dynamic capabilities. Formalization of knowledge and experience turns out to be positively related to dynamic capabilities. These findings provide a strong contribution to research as they link core organizational research to core strategic management issues (Greenwood & Miller,

2010). The findings further inform managerial practice about supporting framing conditions for the implementation of dynamic capabilities.

Overall, the dynamic capabilities framework has great value for strategic management. This dissertation thesis shows that dynamic capabilities drive capability development and foster firm competence as well as successful innovation. Thus, dynamic capabilities show a great potential to create competitive advantage. However, further research is necessary to clarify the role of dynamic capabilities in creating *sustainable* competitive advantage. The dynamic capabilities framework further provides additional value in comparison with alternative strategic frameworks, such as the resource-based view or the competitive forces approach. The dynamic capabilities framework is able to explain how firms build or renew their competences with which they compete successfully due to efficiency advantages or advantageous market positions. In comparison with other theoretical frameworks aiming at the explanation of adaptation and change, the dynamic capabilities perspective provides additional insights by revealing the internal mechanisms that enable adaptation and change.

7.2. Future Research

Within this thesis, I developed, validated, and applied a superordinate multi-dimensional measurement model of dynamic capabilities. Additional insight into the nature of dynamic capabilities may be gained by developing and validating a comprehensive aggregated multi-dimensional measurement model of dynamic capabilities that incorporates the various facets that combine to 'produce' dynamic capabilities. Several potential constituent parts of dynamic capabilities are frequently outlined in conceptual and empirical research. A further promising research area is to examine the micro-foundations of capabilities and especially dynamic capabilities (Abell et al., 2008; Felin & Foss, 2005). Important insights can be gained from a better understanding of the factors that constitute organizational capabilities on the individual level and how these factors are leveraged to form organizational level capabilities.

Further research is necessary to understand the potential contribution of dynamic capabilities to *sustainable* competitive advantage. However, in order to examine questions regarding the sustainability of a competitive advantage longitudinal research designs are necessary that should cover not only several years, but decades. In strategy research the search for the drivers of sustainable competitive advantage is somewhat like the quest for the Holy Grail. If such a thing like a *sustainable* competitive advantage exists, the identification of the factors that allow sustaining this advantage is of outstanding importance for strategy research. However, observations of several researchers raise doubts about the existence of a sustainable competi-

tive advantage, especially in more turbulent environments. Tushman and O'Reilly III (1996), for example, provide an overview over the leading companies in the semiconductor industry between 1955 and 1995, displaying the rise and fall of the industry leaders during the decades. Another example might be Yahoo!, which was identified as a 'fair example' of dynamic capabilities in organizations when its succession in comparison to Excite was examined (Rindova & Kotha, 2001). If Yahoo! really was a 'fair example' of dynamic capabilities a comparison with Google ten years later would raise doubts whether dynamic capabilities alone are really sufficient to sustain a competitive advantage. Currently, we can observe Google as a 'fair' example of possessing dynamic capabilities. Google recognized the threat to its current business model posed through the rise of social networks like Facebook. After recognizing this potential threat, Google formulated a response by developing the necessary skills and implemented a response by setting up an own social network – Google+ (Maier & Rickens, 2011). Time will tell whether Google will be successful in terms of sustaining a given competitive advantage.

Moreover, in a recent study Aime, Johnson, Ridge and Hill (2010) show that even a given competitive advantage that resides in complex routines can be competed away due to imitation that is enabled by the movement of specialized employees. Further, technological discontinuities provide an ongoing threat for organizations. Prior research suggests that the rise of a novel, superior technology may offer performance advantages that erode any prior competitive advantage (Anderson & Tushman, 1990; Rosenbloom & Christensen, 1994; Tushman & Anderson, 1986). The results of the study presented in Chapter 5 indicate that the existence of dynamic capabilities is no 'magic bullet' and that the possession of dynamic capabilities may not be a protection against all external developments. External shocks – market driven, technology driven, or based on regulations - pose significant threats for organizations whether they possess dynamic capabilities or not. German energy producers, for example, were coldly gotten by the nuclear power phase-out in Germany, which was suddenly enacted in the light of the Fukushima disaster. Certainly, the possession of dynamic capabilities is likely to help them to create the new capabilities needed for competing successfully with alternative energy sources, but they were no remedy against the devaluation of prior investments in their nuclear sites and against the sudden devaluation of complementary capabilities. Finally, D'aveni (1994) points to hypercompetitive settings where the existence of a sustainable competitive advantage is unlikely. As Winter (2003) pointed sharply…

…THERE IS NO RULE FOR RICHES!

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Lebenslauf

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Berufserfahrung

Seit 01/2009	**Universität zu Köln**, Köln Wiss. Mitarbeiter, Seminar für Allg. BWL, Unternehmensentwicklung und Organisation **Lehrtätigkeit:** Übungen zu den Vorlesungen „Unternehmensentwicklung", „Organisationsgestaltung" und „Unternehmensführung und Internationales Management", Hauptseminar zu Dynamischen Fähigkeiten, Betreuung von Abschlussarbeiten **Administrative Aufgaben:** Haushalt und wiss. Hilfskräfte. Budgetverantwortung ca. 150.000 €, Personalverantwortung für 6-8 Mitarbeiter
10/2006 – 12/2008	**KPMG DTG AG,** Köln Assistant Manager, Advisory, Corporate Finance **Verantwortung:** Fachliche Anleitung von bis zu 5 Teammitgliedern, Mitarbeit beim Pitching, Unterstützung der Auftrags- und Vertragsverhandlung, Projekt-Controlling **Themen:** Unternehmens-, Marken- und Technologiebewertung, Restructuring, Portfoliosteuerung, M&A, Risikomanagement **Sonderthema:** Selbständige Weiterentwicklung eines Ansatzes zur Bewertung systematischer Länderrisiken von Produktions- und Vertriebsgesellschaften multinationaler Konzerne
08/2006 – 09/2006	**BBDO Consulting,** Düsseldorf Consultant Marketing & Customer Equity **Verantwortung:** Mitarbeit im Beraterteam **Themen:** Strategieentwicklung, Reorganisation und Markenbewertung
01/2006 – 06/2006	**Amata Power Ltd.,** Bangkok, Thailand In-house Consultant, Corporate Development **Verantwortung:** Projektleitung. Leitungsspanne: zwei Mitarbeiter **Projekt & Thema:** Analyse der Auswirkungen der Deregulierung des Energiemarkts, Entwicklung und Modellierung alternativer Szenarien und Reaktionsstrategien **Sonderthema:** Entwicklung eines quantitativen Modells zur Bewertung strategischer Optionen

Internationale Erfahrung

10/2007 – 11/2007	Auslandsentsendung zur KPMG LLP, Corporate Finance, London, Großbritannien

12/2005 – 07/2006	Arbeitsaufenthalt in Bangkok, Thailand

Ausbildung

Seit 01/2009	**Universität zu Köln**, Cologne Graduate School, Köln
	Promotionsstudium: Structural Equation Modeling (2009), Applied Methods in Organizational Research (2010), Partial Least Squares SEM (2010)
	Forschungsinteresse: Strategic Change, Unternehmensentwicklung, Innovation, Wettbewerbsstrategien, M&A, Organisationseffizienz
	Dissertationsthema: The Value of Dynamic Capabilities for Strategic Management
	Internationale Konferenzen:
	• Tilburg Conference on Innovation 2010 • Academy of Management Meeting Montréal 2010 • European Academy of Management Conference 2011 • Academy of Management Meeting San Antonio 2011
	Gutachtertätigkeit:
	• Tilburg Conference on Innovation 2010 • European Academy of Management Conference 2011 • Academy of Management Meeting San Antonio 2011
04/2003 – 10/2005	**Eberhard-Karls-Universität,** Tübingen Hauptstudium Betriebswirtschaftslehre
	Schwerpunkte: Marketing, Unternehmensrechnung & Controlling, Planung/Personal & Organisation
	Diplomarbeit: Die Entwicklung von Marketingstrategien auf Basis der Conjoint-Analyse
	Abschluss: Diplom-Kaufmann
10/2000 – 03/2003	**Universität Osnabrück** Vordiplom
09/1997 – 06/2000	**Wirtschaftsgymnasium,** Tübingen Allgemeine Hochschulreife

Sprach- und EDV-Kenntnisse

Sprachen	Deutsch (Muttersprache), Englisch (verhandlungssicher), Französisch/Spanisch/Thai (Grundkenntnisse)
EDV	MS Office (sehr gut), SPSS/AMOS (sehr gut), SAP/FiBu/Lexware (Grundkenntnisse)

Wehrdienst

03/1996 – 12/1996	**Luftwaffenkommando Süd,** Meßstetten

Freizeitaktivitäten

Fußball, Volleyball, Basketball, Wing Tsun, Schach, Joggen, Lesen

Köln, 31. Januar 2012