

Capitalizing the balance of exploration and exploitation:

Evidence from Australian, German, and Indian biotechnology firms

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To my family.

Preface

The last few years have been a really exciting, inspiring, and fast-paced period for me – marked by many bright and intense moments and a lot of hard work – and, finally, this PhD thesis is completed. My research could not have been realized without the assistance and support of many people and I want to start with thanking those people who are academically close to this PhD thesis.

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Thesis Abstract

Research has widely acknowledged the beneficial impact of ambidexterity—the balance between exploration and exploitation—on a firm’s performance outcomes such as innovativeness and financial performance. Small and medium-sized enterprises (SMEs), however, are especially challenged to simultaneously pursue both exploration and exploitation because they cannot rely on the same slack resources and administrative systems that larger firms can. While prior research indicates that SMEs might develop firm capabilities to overcome resource constraints and profit from ambidexterity, the results are either inconclusive or there are too few studies to confirm these assumptions. This dissertation explains how SMEs can use capabilities such as contextual ambidexterity and absorptive capacity in order to capitalize on the outcomes resulting from the balance of inter- and intrafirm exploration and exploitation. Specific findings from this conceptual and empirical work are that (1) A tailored approach to absorptive capacity amplifies the effect of ambidexterity in small firms; (2) national context and its effect on leadership affects the level of ambidexterity; and (3) incorporating social-integration measures boosts potential and realized absorptive capacity and their complementary effects on firm performance.

Study 1, titled *A capability-based framework to capture the performance outcomes of alliance ambidexterity: The moderating roles of contextual ambidexterity and absorptive capacity*, indicates that both contextual ambidexterity and absorptive capacity enable smaller firms to overcome the negative impacts of alliance ambidexterity resulting from operational redundancy and coordination conflicts by using their limited financial and managerial resources more efficiently to balance their alliances. This integrative approach to multiple levels of ambidexterity and absorptive capacity provides a move towards understanding the complex interplay of a firm’s contextual ambidexterity and absorptive capacity when leveraging explorative and exploitative alliances. Thus, it helps to identify bottlenecks in the

ambidexterity and absorptive capacity research and offers new and useful links for future empirical studies to overcome these limitations.

The findings of Study 2, titled *How absorptive capacity impacts the value of balanced alliance networks: Evidence from new biotechnology firms in Germany*, demonstrate that alliance ambidexterity is negatively related to firm performance, but that absorptive capacity can help firms overcome these detrimental effects by resolving internal contradictions, intensifying the speed of knowledge sharing, and reducing operational redundancy. This study thus extends our understanding of how new ventures can benefit from balanced alliance networks and underscores the importance of partner-related capabilities to profit from alliance ambidexterity.

Study 3, titled *Antecedents and performance outcomes of absorptive capacity: An empirical investigation into the German biotechnology industry*, shows that potential and realized absorptive capacity are differently influenced by distinct social integration mechanisms, and both dimensions of absorptive capacity have complementary effects on a firm's innovativeness and financial performance. Thus, this study shows that intra-organizational antecedents of absorptive capacity lead to varying levels of potential and realized absorptive capacity and thus enhances our understanding of why some firms benefit more from external knowledge than do others.

The final study, *Organizational ambidexterity in light of national culture: A comparative study of Australian, German, and Indian biotechnology SMEs*, shows how the combination of goal-setting, risk-taking, and supportive leadership shapes an organizational context in a way that promotes ambidextrous behaviour within these firms. This study also provides evidence about how national culture influences ambidexterity by showing that power distance positively affects ambidexterity and uncertainty avoidance negatively affects ambidexterity. Moreover, findings demonstrate that uncertainty avoidance in particular negatively moderates the relationship between an organizational context and ambidexterity.

Thus, this study explores how socio-environmental factors influence firm-level activities such as leadership processes and employees' behaviour and offers an explanation for cross-national differences in balancing exploration and exploitation.

In sum, this dissertation addresses with (1) the role of firm capabilities in leveraging alliance ambidexterity; (2) the complementarity of absorptive capacity; (3) leadership's role in contextual approaches of ambidexterity; and (4) national culture's impact on ambidexterity several important research issues about ambidexterity and absorptive capacity, two major concepts in organizational learning literature. Hence, these four studies theoretically refine the concepts of organizational ambidexterity and absorptive capacity, as well as to develop recommendations for managers about how to balance exploration and exploitation by using their firm's capabilities in a more targeted and directed way.

Statement of Original Authorship

This thesis is submitted in fulfillment of the requirements of the degree of Doctor of Philosophy in Marketing and Management at Macquarie University (Australia). I declare that the materials contained in this thesis with the title “Capitalizing the balance of exploration and exploitation: Evidence from Australian, German, and Indian biotechnology firms” are my own work. Where the works of others have been drawn upon, whether published or unpublished (such as books, articles, or non-book materials in the form of audio recordings, electronic publications and the internet) due acknowledgements according to appropriate academic conventions have been given.

As this thesis has been conducted under a Cotutelle agreement between Macquarie University (Australia) and Georg-August-University Goettingen (Germany), I also hereby declare that the materials contained in this thesis have not been published before or presented for a higher degree in any other university or institution. In addition, I took reasonable care to ensure that the work is original, and, to the best of my knowledge, does not breach copyright law, and has not been taken from other sources except where such work has been cited and acknowledged within the text.

Undertaking this thesis has involved human subjects, for which I have received approval from the Ethics Committee at Macquarie University (see Appendix A: Ethics Approval), Approval No. Reference: 5201500442 on 16 June 2015.



René Abel

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Acknowledgements of Contribution

This thesis by publication includes four papers written in a journal-article format. While I am the principal author of all the papers, I acknowledge the contribution of my supervisors, Prof. Dr. Indre Maurer (Georg-August-University Goettingen, Germany) and Dr. Meena Chavan (Macquarie University, Australia) in Study 1, 2, and 4. I sincerely thank both my supervisors for their outstanding constructive and helpful feedback, support, and guidance throughout the entire time of my PhD candidature. In addition, I acknowledge the contribution of Dr. Suleika Bort (Mannheim University, Germany) in Study 2 as well as the professional work of the editor Marc Abernathy.

The following overview presents the four papers included in this thesis with all conference presentations, journal submissions and co-authorship of each paper.

Study 1

Title: A capability-based framework to capture the performance outcomes of alliance ambidexterity: The moderating roles of contextual ambidexterity and absorptive capacity

Authors: René N. Abel and Meena Chavan

Chapter in thesis: Chapter 2

An earlier version of this paper was presented at a Doctoral Colloquium at Georg-August-University Goettingen in 2016.

Study 2

Title: How Absorptive Capacity impacts the Value of Balanced Alliance Networks: Evidence from new biotechnology firms in Germany

Authors: René N. Abel, Indre Maurer, and Suleika Bort

Chapter in thesis: Chapter 3

This paper was presented at a Doctoral Colloquium at the Georg-August-University Goettingen in 2014. Further, earlier versions of this paper have been accepted in competitive tracks at two conferences. First, this paper was presented at the Australian & New Zealand Academy of Management (ANZAM) Conference 2015 in Queenstown, New Zealand. Secondly, it was accepted at the European Academy of Management (EURAM) Conference

2016 in Paris (France) and finalist of the Doctoral Colloquium Best Paper Awards at the EURAM 2016 conference.

Study 3

Title: Antecedents and performance outcomes of absorptive capacity: An empirical investigation into the German biotechnology industry

Author: René N. Abel

Chapter in thesis: Chapter 4

Earlier versions of this paper have been accepted in competitive tracks at two conferences. First, this paper was presented at the Australian & New Zealand Academy of Management (ANZAM) Year-End Doctoral Workshop 2015 in Queenstown, New Zealand and it was awarded with the “Most Promising Paper Award”. Secondly, it was presented at the European Academy of Management (EURAM) Doctoral Colloquium 2016 in Paris, France.

Study 4

Title: Organizational ambidexterity in light of national culture: A comparative study of Australian, German, and Indian biotechnology SMEs

Author: René N. Abel, Meena Chavan, Indre Maurer

Chapter in thesis: Chapter 5

Earlier versions of this paper have been accepted in competitive tracks at two conferences. First, it was presented at the European Academy of Management (EURAM) Doctoral Colloquium 2016 in Paris, France. Further, it was presented at the British Academy of Management (BAM) Conference 2016 in Newcastle, England and it was accepted at the European Academy of Management (EURAM) Conference 2017 in Glasgow (Great Britain).

1 Chapter 1. Introduction

1.1 The Balance of Exploration and Exploitation

Over the last decades, March's (1991) exploration-exploitation construct has received much attention in organizational-learning research. Exploration includes activities such as "search, variation, risk taking, experimentation, play, flexibility, discovery, innovation", whereas exploitation activities are those associated with "refinement, choice, production, efficiency, selection, implementation, execution" (March, 1991: p. 71). According to March (1991), firms have to find an appropriate balance between both activities to ensure their long-term survival. Firms that overinvest in exploitation may increase their short-term performance by receiving more predictable returns from activities that are closer to their locus of learning; yet these firms risk future obsolescence by falling into a competency trap that inhibits them from continuously adapting themselves to environmental changes (Levinthal & March, 1993; Volberda & Lewin, 2003). Conversely, firms that exclusively pursue exploration might renew their knowledge base that can be used for long-term innovation, but these activities can result in an endless cycle of search and unrewarding change because exploration returns are uncertain, distant, and often negative (Ahuja & Morris Lampert, 2001; Levinthal & March, 1993).

The capability to simultaneously pursue exploration and exploitation is known as organizational ambidexterity (Simsek, 2009; Tushman & O'Reilly, 1996). Empirical findings have demonstrated that ambidexterity has positive effects on financial performance, innovation, sales growth, and firm survival (see the reviews of Junni, Sarala, Taras, & Tarba, 2013 and; O'Reilly & Tushman, 2013); however, firms face difficulties appropriately balancing exploration and exploitation because the two activities require different organizational learning models and entail different processes, routines, and structures (e.g., Benner & Tushman, 2003; Jansen, Van Den Bosch, & Volberda, 2006). As a result, firms that try to balance these two activities suffer from resource-allocation constraints, organizational

inertia, and undesirable organizational outcomes (Gupta, Smith, & Shalley, 2006; Lavie, Stettner, & Tushman, 2010).

Thus, researchers are increasingly asking themselves how this balance can realistically and profitably be achieved. Scholars have identified three major drivers of ambidexterity: organizational structures, leadership processes, and behavioural contexts (Raisch & Birkinshaw, 2008). The organizational-structures approach argues that exploitation and exploration can be balanced by structurally separating the two activities into distinct business units (Tushman & O'Reilly, 1996). Separating these activities into different units provides a strong internal consistency, because the cultures, processes, and routines of each can be aligned to the respective unit's tasks (O'Reilly & Tushman, 2013). Koza and Lewin (1998) have extended the idea of structural separation to the network level and distinguish between explorative and exploitative alliances. Explorative alliances offer access to new knowledge sources and enable firms to develop new competencies and technologies (Koza & Lewin, 1998), whereas exploitative alliances support the improvement and application of a firm's existing knowledge base (Rothaermel & Deeds, 2004). The leadership-processes approach argues that distinct leadership methods and styles that use economic, structural, social, and cognitive influences can promote ambidextrous behaviour in employees (e.g., Jansen, Tempelaar, Van den Bosch, & Volberda, 2009; Lubatkin, Simsek, Ling, & Veiga, 2006; Raisch & Birkinshaw, 2008; Smith & Tushman, 2005). The behavioural-contexts argument claims that ambidexterity can be encouraged by an appropriate organizational context, which affects the behaviour of employees in such a way that they are encouraged to decide for themselves how best to divide their time between exploitation and exploration activities (e.g., Gibson & Birkinshaw, 2004). Context here refers to all systems, processes, and beliefs that affect the behaviour of employees (Ghoshal & Bartlett, 1994) and is distinguished between performance-oriented and support-oriented elements (Gibson & Birkinshaw, 2004).

Despite these various approaches to balancing the two activities, the limited resources and less developed administrative systems of SMEs mean that it is especially difficult for them to simultaneously carry out both (Voss & Voss, 2013). One possible way for SMEs to overcome their resource restrictions and expand their own resource base is through alliances, which offer small firms cost-efficient access to new knowledge (Koza & Lewin, 1998; Powell, Koput, & Smith-Doerr, 1996) that stimulates innovation and new-product development (Deeds & Hill, 1996). Employing alliances shifts ambidexterity to the network level, and requires that firms possess additional partner-related capabilities, such as absorptive capacity, that allow them to recognize the value of new external knowledge, assimilate it, and apply it to commercial ends (Cohen & Levinthal, 1990; Zahra & George, 2002). The few findings about ambidexterity in SMEs suggest that developing and using capabilities such as absorptive capacity might help these firms to overcome their resource constraints and profit from ambidexterity. Even though these ideas are promising, it is still unclear which specific capabilities SMEs can use to balance their ambidextrous activities and how they can do it.

This dissertation is made up of four studies that investigate the capabilities that enable SMEs to profit from external and internal ambidexterity. The studies are based on conceptual and empirical work and aim to theoretically refine two major concepts in organizational research: organizational ambidexterity and absorptive capacity. The results of these studies also encourage the development of a combined research design that captures the closely linked relations between both concepts. The overarching question is thus: ***How can SMEs use capabilities to capitalize on the balance between exploration and exploitation?***

1.2 Research Aim and Questions

Since March (1991) published his study, much has changed in business and firms increasingly face uncertain and hypercompetitive market conditions that lead to increased complexity and higher innovation and new-product development costs (Zahra, 1996). Alliances offer firms cost-efficient access to new knowledge and research opportunities (Deeds, DeCarolis, & Coombs, 2000), and by shifting explorative and exploitative activities to the network level, firms are no longer bounded by their own limits (D'aveni, 2010; Lavie & Rosenkopf, 2006; Powell et al., 1996). Explorative alliances provide novel knowledge sources and support the development of new competencies and technologies (Koza & Lewin, 1998), whereas exploitative alliances complement a firm's existing knowledge base and help to improve and leverage its existing capabilities (Rothaermel & Deeds, 2004). Research has suggested that both alliance types are vital for firms, and that to succeed in the long term they should employ a balance of both. This balancing of the two types of alliances in a firm's alliance network is known as alliance ambidexterity (Lavie & Rosenkopf, 2006; Rothaermel & Deeds, 2004). While research suggests that firms benefit from alliance ambidexterity (e.g., He & Wong, 2004; Koza & Lewin, 1998; Rothaermel & Deeds, 2004), it also indicates that in balancing explorative and exploitative alliances, firm performance may suffer from operational redundancy and coordination conflicts (e.g., Lavie, Kang, & Rosenkopf, 2011; Stettner & Lavie, 2014; Yamakawa, Yang, & Lin, 2011). Compared to large firms, SMEs find it especially challenging to successfully handle the conflicting exploration-exploitation trade-offs (Lin, Yang, & Demirkan, 2007). These mixed results in current research call into question the advantage of alliance ambidexterity and raise several important issues, the first of which is the *association between ambidexterity and SME performance*. The majority of research has pointed out obvious differences between small and large firms (e.g., available resources) (Voss & Voss, 2013), but the focus of empirical research on large firms and their alliance ambidexterity-performance relationship has neglected study on the same relationship

in SMEs. Studies 1 and 2 address this issue and aim to conceptually and empirically explain how alliance ambidexterity can benefit small firm performance.

In addition to these prior research oversights, most contemporary studies have focussed on the relationship between firm performance and distinct modes of balancing explorative and exploitative alliances, as well as moderators such as environmental factors or firm size (e.g., Lavie et al., 2011; Lavie & Rosenkopf, 2006; Lin et al., 2007). While these relationships and moderators are important, a firm's own capabilities can also support the management of explorative and exploitative alliances (Yamakawa et al., 2011). In-depth investigations on firm capabilities and their relationship to alliance ambidexterity, however, have yet to be carried out, and therefore Study 1 considers *how firm capabilities influence alliance ambidexterity and firm performance*. This study focuses on two capabilities that have been emphasized by prior research as being potentially important for alliance ambidexterity: contextual ambidexterity (Im & Rai, 2008) and absorptive capacity (Lavie & Rosenkopf, 2006). Absorptive capacity is a crucial capability, required by firms to absorb and commercially apply external knowledge from explorative and exploitative alliances. This capacity in particular might explain why firms benefit differently from alliance ambidexterity because it helps firms to resolve internal contradictions, intensify the speed of knowledge sharing, and reduce operational redundancy.

Study 2 builds on Study 1; specifically, it expands on the practical and theoretical relevance of partner-related capabilities as a way to utilize external knowledge sources and empirically explores *how potential and realized absorptive capacity influence the relationship between alliance ambidexterity and firm performance*.

Study 3 continues looking at potential and realized absorptive capacity, but asks a slightly different question: *Do potential and realized absorptive capacity enhance performance outcomes by complementing one another?* The current state of knowledge on this question is limited. Research has shown that absorptive capacity is an important

capability that supports firms in turning new external knowledge into performance outcomes (Cohen & Levinthal, 1990; Fabrizio, 2009; Tsai, 2001; Wales, Parida, & Patel, 2013). Researchers have further delineated the concept by distinguishing between potential and realized capacity (Zahra & George, 2002). Potential absorptive capacity is a firm's capability to acquire and assimilate new external knowledge, and realized absorptive capacity is a firm's capability to transform and exploit that knowledge. Zahra and George (2002) suggest that both dimensions play separate but complementary roles in the process of value generation. While potential absorptive capacity helps firms to continuously renew their knowledge base by absorbing novel information, realized absorptive capacity converts the absorbed knowledge into commercial returns (Zahra & George, 2002). Even though this idea is pioneering, only a few empirical studies have investigated the underlying processes and routines that constitute potential and realized absorptive capacity (e.g., Ebers & Maurer, 2014; Jansen, Van Den Bosch, & Volberda, 2005a). The majority of studies have used overall measurement proxies for absorptive capacity, leaving several research gaps that call for further clarification (Lane, Koka, & Pathak, 2006; Lewin, Massini, & Peeters, 2011; Todorova & Durisin, 2007; Volberda, Foss, & Lyles, 2010).

Study 3 also seeks to shed light on *how social integration mechanisms, as intra-organizational antecedents, influence potential and realized absorptive capacity*. Research has suggested that in addition to the complementary performance effects of potential and realized absorptive capacity, the two capacities also have distinct antecedents (Lewin et al., 2011). Empirical evidence on these effects, though, is also limited (Volberda et al., 2010). Because a firm's knowledge base is closely linked to its organizational processes and routines (Grant, 1996), it is very likely that firms have varying levels of potential and realized absorptive capacity rather than one uniform level of absorptive capacity (Jansen et al., 2005a). Therefore, it is important to understand how intra-organizational antecedents such as social

integration mechanisms affect the level and distinct dimensions of absorptive capacity (Cohen & Levinthal, 1990; Todorova & Durisin, 2007; Zahra & George, 2002).

As mentioned earlier, ambidexterity literature underlines the importance of organizational context for enabling ambidexterity (e.g., Gibson & Birkinshaw, 2004). While research has made clear that an organizational context contains all systems, processes, and beliefs that affect employees' behaviour (Ghoshal & Bartlett, 1994), O'Reilly and Tushman (2013) criticize that "...the organizational systems and processes...that enable this individual adjustment [is] never concretely specified, other [than] that they promote stretch, discipline, and trust" (p. 329). Unlike large firms, SMEs strongly rely on their top management in order to influence their employees' behaviour, and research has suggested that an organizational context "is created and renewed through tangible and concrete management actions" (Ghoshal & Bartlett, 1994: p. 91). Only a few studies, however, have developed a combined view of different drivers of ambidexterity (e.g., Chang & Hughes, 2012; Kauppila, 2010) and empirical insights into leadership as an enabler of an organizational context in SMEs are rare. Thus, Study 4 goes further than these earlier studies and asks *how does leadership shape an organizational context so that it can enable ambidextrous behaviour in SMEs*.

The preceding question draws attention to the situational circumstances and environments in which firms are embedded. Study 4 examines the *association between national culture – as represented by power distance and uncertainty avoidance – and ambidexterity* and asks *how power distance and uncertainty avoidance influence the relationship between an organizational context and ambidexterity*. According to Hofstede (1980), the structure and function of firms is affected by national dimensions. Specifically, the two dimensions of power distance and uncertainty avoidance are particularly likely to impact the behaviour of firm members because they guide social norms, rules, and procedures (House, Hanges, Javidan, Dorfman, & Gupta, 2004). Hence, it seems reasonable that national culture also influences a firm's tendency to explore or exploit. While (Mueller, Rosenbusch,

& Bausch, 2013) recently found evidence for this claim, the bulk of current research has failed to include national culture, and therefore empirical evidence on the cultural effects on ambidexterity is still lacking.

Table 1.1 in Section 1.4 gives an overview of research questions of the four studies.

1.3 Research Contributions

This dissertation contributes to contemporary organizational learning research in several ways.

First, it conceptually links alliance ambidexterity and contextual ambidexterity. Scholars have indicated that structural, leadership, and contextual drivers of ambidexterity might overlap, and researchers have emphasized the importance of developing an integrative view of ambidexterity at multiple levels (e.g., Birkinshaw & Gupta, 2013; O'Reilly & Tushman, 2013; Raisch & Birkinshaw, 2008; Raisch, Birkinshaw, Probst, & Tushman, 2009). Kauppila (2010), for instance, has indicated in his in-depth case study that the complementary perspective of inter- and intrafirm ambidexterity might be a promising starting point for developing a holistic understanding of the ambidexterity concept. In taking a combined view, the first study in this dissertation addresses this call by conceptually developing links between alliance ambidexterity and contextual ambidexterity. This integrative approach to multiple levels of ambidexterity and absorptive capacity provides in-depth insights into the complex interplay of a firm's contextual ambidexterity and absorptive capacity when leveraging alliance ambidexterity. Hence, the theoretical reasoning offered by Study 1 considers the interrelated explorative and exploitative activities at the network and firm level and thus it helps to identify bottlenecks in the ambidexterity and absorptive capacity research.

Second, it provides insight into the close links between ambidexterity and absorptive capacity. Research has recently started to advance the ambidexterity-performance relationship by examining how absorptive capacity affects this relationship (e.g., Rothaermel &

Alexandre, 2009). This dissertation continues these investigations by introducing absorptive capacity as a firm-level solution that enables smaller firms to increase the efficiency of, as well as resolve the contradictions related to, their exploratory and exploitative alliances so that they can profit from alliance ambidexterity. Studies 1 and 2 emphasize that firms seeking alliance ambidexterity benefit from developing both ambidextrous routines because they improve the coordination, and facilitate the management, of different knowledge sources. In addition, developing both routines helps to integrate various knowledge resources and reconciles the trade-offs resulting from alliance ambidexterity. This dissertation therefore complements prior insights on the close links between ambidexterity and absorptive capacity and extends our understanding of how partner-related capabilities support new ventures in leveraging alliance ambidexterity.

Third, this dissertation expands on the scarce number of empirical studies on the antecedents of potential and realized absorptive capacity. Research has underscored the role of organizational mechanisms in influencing the level of absorptive capacity (Cohen & Levinthal, 1990), yet the intra-organizational antecedents of absorptive capacity have received inadequate attention from empirical studies and their association with different dimensions of absorptive capacity remains unclear (Volberda et al., 2010). Study 3 of this dissertation examines how distinct social integration mechanisms—as intra-organizational antecedents—affect potential and realized absorptive capacity. In doing so, this study adds to the scarce number of empirical studies on this theme and promotes the perspective that the distinct dimensions of absorptive capacity arise from different antecedents, implying the complementarity of the absorptive-capacity construct.

Fourth, it provides reliable and valid scales for formal and informal social integration mechanisms. Common scales of social integration mechanisms are not available, and this dissertation uses prior research on organizational learning (e.g., Flatten, Engelen, Zahra, & Brettel, 2011; Jansen et al., 2006; Maurer, Bartsch, & Ebers, 2011) to carefully design and

test various measures for the constructs of formal (i.e., formalized knowledge sharing and participation in decision finding) and informal (i.e., information communication and trust) social integration mechanisms. While most previous studies have used proxies such as density of linkages to measure social integration mechanisms (e.g., Fosfuri & Tribó, 2008), the use of proxies neglects the variety of social integration mechanisms and might cause conflicting and misleading implications. For instance, firms strongly differ regarding their density of linkages, questioning if this proxy fully captures a firm's social integration mechanisms. Moreover, research on social interaction suggests that the density of linkages is not the only source of social integration mechanisms (e.g., O'Reilly, Caldwell, & Barnett, 1989). Thus, this study helps to redress these shortcomings and offers reliable and valid measures that strengthen the explanatory power of future research studies.

Fifth, it helps explain why some firms achieve better performance outcomes from absorptive capacity than do others. Research suggests that potential and realized absorptive capacity not only have distinct antecedents, but also complementary performance outcomes (Lewin et al., 2011; Volberda et al., 2010). Study 3 examines the effects of absorptive capacity's complementarity on a firm's innovativeness and financial performance and thus strengthens the argument that both dimensions of absorptive capacity play unique but complementary roles in the process of value creation. Hence, this dissertation offers an explanation for why some firms achieve higher performance outcomes with their absorptive capacity than do others, and thus offers fruitful insights for future research.

Sixth, this dissertation offers new insights into the combination of leadership and ambidexterity. Scholars have emphasized that leadership enables ambidexterity (e.g., Gibson & Birkinshaw, 2004; Tushman & O'Reilly, 1996) and they indicate that SMEs in particular depend on their top management to affect employee behaviour (Lubatkin et al., 2006). This dissertation complements previous research by investigating (in Study 4) how leadership in SMEs can create an appropriate organizational context that encourages employees'

ambidextrous behaviour. By linking leadership and contextual drivers of ambidexterity, this dissertation offers new insights that enhance our understanding of the ambidexterity construct.

Seventh, this dissertation includes a study of the effects of national culture on ambidexterity. Hofstede's (1980) theory of cultural dimensions has received much attention in research, and the very recent findings of Mueller et al.'s (2013) meta-analysis indicate that power distance and uncertainty avoidance most likely influence exploration and exploitation (Mueller et al., 2013). Despite this contention, empirical studies on the cultural influence on ambidexterity are very limited. Study 4, to the best of my knowledge, is one of the first that investigates the effects of national culture on ambidexterity. Using cross-cultural data from Australian, German, and Indian biotechnology firms, it highlights the importance of cultural differences as they affect the antecedents of ambidexterity and its successful implementation.

Finally, this dissertation adds to the scarce number of empirical studies on ambidexterity in SMEs. The majority of research has widely acknowledged that SMEs differ from larger firms in terms of their organizational structures, available administrative systems and resources, and organizational contexts (e.g., Chang & Hughes, 2012; Voss & Voss, 2013). Most research on ambidexterity, though, has studied large multiunit firms, making it difficult to generalize the findings (see Raisch & Birkinshaw, 2008; Raisch et al., 2009). Thus, more detailed research on the antecedents and outcomes of ambidexterity in SMEs is needed (Lubatkin et al., 2006; Raisch & Birkinshaw, 2008; Simsek, Heavey, Veiga, & Souder, 2009). This dissertation moves toward addressing this need by focussing on how SMEs can use capabilities to capitalize on a balance of exploration and exploitation. This dissertation therefore adds to the scarce number of empirical studies on ambidexterity in SMEs and provides new fruitful insights that strengthen the importance of using different research designs for SMEs and larger firms.

1.4 Research Design

This dissertation relies on quantitative survey data and panel data from small and medium-sized biotechnology firms to investigate the balance of exploration and exploitation. The research was carried out in the following steps: First, I conducted an extensive literature review to understand in detail the current literature on organizational ambidexterity (e.g., Gibson & Birkinshaw, 2004; Gupta et al., 2006; March, 1991; Tushman & O'Reilly, 1996), absorptive capacity (e.g., Cohen & Levinthal, 1990; Todorova & Durisin, 2007; Zahra & George, 2002), as well as social-network theory (Burt, 2004; Granovetter, 1983; Lavie & Rosenkopf, 2006). In a second step, I carried out a series of semi-structured qualitative interviews with experts in the German biotechnology industry. The focus of these interviews was on identifying industry-specific characteristics in cooperative behaviour and knowledge exchange. Based on the findings of both the interviews and the literature review, I developed my hypotheses and an online survey. For the third step, I collected extensive data on realized business collaborations and successful innovation projects in the biotechnology industry. The data collection was separated into two stages: (1) The first was conducted in Germany between August and December 2014 (database for Studies 2 and 3) and (2) the second data collection was conducted in Australia, Germany, and India between September 2015 and February 2016 (database for Study 4). I also collected publicly available data on the firms at the same time as the databases were being built. In a fourth step, I tested the hypotheses of the Studies 2 to 4 by conducting a thorough data analysis based on different data management systems (e.g., STATA, SPSS). The quantitative data provided a deep understanding of the statistical relationships and patterns between the constructs and allowed me to more easily generalize the results (Bryman & Cramer, 1994).

The first study uses a conceptual approach and integrates literature from organizational design, organizational learning, social-network theory, and strategic management to postulate three new theoretical propositions. Studies 2 and 3 rely on survey

data collected from SMEs in the German biotechnology industry. In total, 469 potential firms for participation were identified and 163 completed the survey, corresponding to a response rate of 35 percent. Complementing the survey data, panel data was used to identify the firms' alliances, with an observed 643 alliances in total. Study 2 applies an ordinary least-squares (OLS) regression technique to estimate the factors influencing firm performance. More concretely, it uses the option *robust* in the STATA OLS regression command to account for heteroscedasticity in our models, which we detected using the Breusch-Pagan test. In Study 3, I used SPSS and AMOS software packages version 24 to conduct structural equation modelling—based on the maximum likelihood estimates (MLE) approach—to estimate and test correlative relationships between endogenous and exogenous variables, as well as to estimate and test intermediate hidden structures (Hair, Black, Babin, & Anderson, 2010). The final study of this dissertation uses data from 185 Australian, German, and Indian biotechnology SMEs. We contacted 163 firms in Germany, of whom 54 responded; 151 firms in Australia, of whom 31 firms participated; and 772 Indian firms, of whom 100 took part in our survey. All hypotheses in Study 4 were tested by using ordinary least-squares (OLS) regression analysis with SPSS version 24.

Table 1.1 presents a summary of the four studies of this dissertation.

Table 1.1: Overview of Dissertation Studies

	Research Questions	Research focus	Method	Key findings
<i>Study 1</i>	<p>What is the association between alliance ambidexterity and firm performance?</p> <p>How do firm capabilities influence this association?</p>	<ul style="list-style-type: none"> • Alliance ambidexterity • Moderators (Contextual ambidexterity & absorptive capacity) • Performance outcomes 	<ul style="list-style-type: none"> • Conceptual paper 	Contextual ambidexterity and absorptive capacity positively influence the relationship between alliance ambidexterity and firm performance.
<i>Study 2</i>	<p>What is the association between young firms' alliance ambidexterity and firm performance?</p> <p>How do potential and realized absorptive capacity influence the relationship between alliance ambidexterity and firm performance?</p>	<ul style="list-style-type: none"> • Alliance ambidexterity • Moderator (Absorptive capacity) • Performance outcomes 	<ul style="list-style-type: none"> • Proprietary survey and panel data from 158 German biotechnology SMEs • Hierarchical Regression 	The negative relationship between alliance ambidexterity and firm performance decreases with increasing levels of potential and realized absorptive capacity.

Table 1.1: Overview of Dissertation Studies (continued)

	Research Questions	Research focus	Method	Key findings
<i>Study 3</i>	<p>Do potential and realized absorptive capacity enhance performance outcomes?</p> <p>How do social integration mechanisms influence potential and realized absorptive capacity?</p>	<ul style="list-style-type: none"> • Antecedents • Absorptive capacity • Performance outcomes 	<ul style="list-style-type: none"> • Proprietary survey and panel data from 158 German biotechnology SMEs • Structural Equation Model 	<p>Informal communication negatively influences potential absorptive capacity, whereas participation in decision finding positively influences potential absorptive capacity.</p> <p>Formalized knowledge sharing and participation in decision finding positively influences realized absorptive capacity.</p> <p>Potential and realized absorptive capacity complement one another in enhancing a firm's performance outcomes (i.e., innovativeness and financial performance).</p>
<i>Study 4</i>	<p>How does leadership shape an organizational context so that it can encourage ambidextrous behaviour in SMEs?</p> <p>What is the association between national culture—as represented by power distance and uncertainty avoidance – and ambidexterity?</p> <p>How do power distance and uncertainty avoidance influence the relationship between an organizational context and ambidexterity?</p>	<ul style="list-style-type: none"> • Antecedents • Environmental factors • Contextual ambidexterity 	<ul style="list-style-type: none"> • Proprietary survey data from 31 Australian, 54 German, and 100 Indian biotechnology SMEs, in total 185 firms. • Hierarchical Regression 	<p>The more an organizational context is characterized by an interaction of goal-setting, risk-taking, and supportive leadership, the higher the level of ambidexterity.</p> <p>Power distance positively influences ambidexterity, whereas uncertainty avoidance negatively influences ambidexterity.</p> <p>Uncertainty avoidance negatively moderates the relationship between an organizational context and ambidexterity.</p>

2 Chapter 2. Study 1: A capability-based framework to capture the performance outcomes of alliance ambidexterity: The moderating roles of contextual ambidexterity and absorptive capacity¹

Study 1 develops a combined view of ambidexterity that highlights the roles of contextual ambidexterity and absorptive capacity as means for small and medium-sized firms to leverage the performance outcomes resulting from alliance ambidexterity. The central thesis of this study is that both capabilities enable smaller firms to use their limited financial and managerial resources more efficiently to balance their explorative and exploitative alliances. Based on a thorough literature analysis, this study addresses the major theoretical concepts of this thesis: alliance ambidexterity, absorptive capacity, and contextual ambidexterity. The theoretical reasoning in this study integrates the interrelated explorative and exploitative activities at the network and firm level and also includes firm capabilities such as absorptive capacity. Hence, Study 1 provides an appropriate starting point for the subsequent studies, which apply a narrower research focus on distinct concepts.

¹ This chapter has been crafted together with Meena Chavan.

2.1 Introduction

Ever since researchers identified knowledge as a major source of a firm's competitive advantage (Grant, 1996), organizational learning has received growing attention in research. March (1991) introduced the concept of distinct learning activities and further delineated this concept by highlighting the relationship between creating new possibilities (exploration) and supporting the refinement and use of existing knowledge (exploitation). To date, scholars widely acknowledge that the long-term success of firms depends on their ability to explore new opportunities and exploit existing competencies at the same time (Junni et al., 2013; Raisch & Birkinshaw, 2008; Simsek et al., 2009). Many researchers have pointed out that the concept of organizational ambidexterity, i.e. a firm's capability to simultaneously pursue exploration and exploitation, is a viable reconciliation of these contradictory activities (Duncan, 1976; Gibson & Birkinshaw, 2004; He & Wong, 2004; O'Reilly & Tushman, 2008).

Since March (1991) published his study, much has changed in business. In today's business environment, exploration and exploitation tasks are not limited by organizational boundaries. Innovation and new-product development in high-tech, science-based industries such as biotechnology are of utmost importance, yet are becoming increasingly complex and more expensive (Deeds et al., 2000). As a result, market uncertainty and hyper-competition mean that generating new knowledge no longer takes place exclusively within firms (D'aveni, 2010), a development that is especially challenging for small and medium-sized firms (SMEs) (Zahra, 1996). Alliances, however, offer SMEs cost-efficient access to new knowledge (DeCarolis & Deeds, 1999; Powell et al., 1996) that stimulates innovation and new-product development (Deeds & Hill, 1996; Flatten, Greve, & Brettel, 2011). With a transition to alliances, the locus of learning shifts to the network level (Powell et al., 1996), and explorative and exploitative activities move to the inter-organizational level. Koza and Lewin (1998) expanded on March's ideas applying them to two types of alliances: explorative and exploitative. Firms enter explorative alliances to access new knowledge and to develop new

skills, whereas firms join exploitative alliances to improve and apply their existing knowledge base (Rothaermel & Deeds, 2004). Henceforth, in this paper we refer to alliance ambidexterity as a firm's capability to simultaneously balance explorative and exploitative alliances.

While empirical findings have shown that firms tend to employ and balance both types of alliances (Lavie & Rosenkopf, 2006), and scholars have discussed the potential benefits of alliance ambidexterity in the last decades (Beckman, Haunschild, & Phillips, 2004; Koza & Lewin, 1998; Rothaermel & Deeds, 2004), recent empirical studies have found that it is difficult for firms to fully benefit from alliance ambidexterity (Stettner & Lavie, 2014; Yamakawa et al., 2011). A possible explanation is that collaboration with partners relies on the current knowledge of a firm and its alliance network, which can lead to a success trap that limits learning and exploration, because firms prefer to rely on familiar knowledge that has been successfully applied in the past rather than pursuing the more uncertain and unfamiliar knowledge in new partnerships in the future (Levinthal & March, 1993). In these situations, alliance ambidexterity may negatively affect a firm's performance outcomes. Another possible explanation is that exploitation might be difficult when the firm's existing knowledge base is inapplicable or incompatible with the new external knowledge from their alliance partners (Das & Teng, 2000). A final possibility comes from recent studies, which indicate that operational redundancy and coordination conflicts can reduce the performance benefits from alliance ambidexterity (Lavie et al., 2011), and SMEs in particular find it challenging to balance conflicting demands from exploration and exploitation because of their limited resources (Lin et al., 2007).

In short, current research on the performance implications resulting from alliance ambidexterity is still very limited and ambiguous. In this article, we propose that the mixed results of alliance ambidexterity can be attributed to the neglected role of a firm's capabilities. Concretely, we suggest that contextual ambidexterity and absorptive capacity can support

firms in managing and integrating the differing learning activities from alliance ambidexterity and thus overcome the negative implications described above.

The idea of contextual ambidexterity was introduced by Gibson and Birkinshaw (2004) and refers to a firm's behavioural capacity to simultaneously balance explorative and exploitative learning activities. According to these authors, contextual ambidexterity is enabled when organizational contexts are characterized by performance management and social support, in an environment conducive to the processes and routines for handling the conflicting demands of exploration and exploitation. Coordination and integration of external knowledge from alliances are very time-intensive activities, and because smaller firms have limited human resources, they have particular difficulty efficiently handling them. Prior research has shown that the performance-oriented components of an organizational context positively influence the coordination efficiency of exploration and exploitation by providing standardized procedures (Jansen et al., 2006) and by clearly defining intended goals (Chang & Hughes, 2012). Additionally, scholars have found that social support within organizations encourages firm members to more easily switch between contradictory mindsets and thus reduce managerial overload and role conflicts (Adler, Goldoftas, & Levine, 1999; Andriopoulos & Lewis, 2009; Gibson & Birkinshaw, 2004). Transferred to the network level, we argue that the efficiency-increasing components of contextual ambidexterity can potentially explain why some firms profit more from their alliance ambidexterity than do others. For instance, Im and Rai (2008) have shown that contextual ambidexterity is positively related to knowledge sharing ambidexterity in long-term inter-organizational relationships, indicating the usefulness of contextual ambidexterity for managing explorative and exploitative alliances. While these arguments move a bit closer to an explanation of the effects of ambidexterity, the conflicting results still call out for further explanation.

Another possible explanation for performance variations from alliance ambidexterity is a firm's absorptive capacity. Previous research has shown that barriers to knowledge sharing

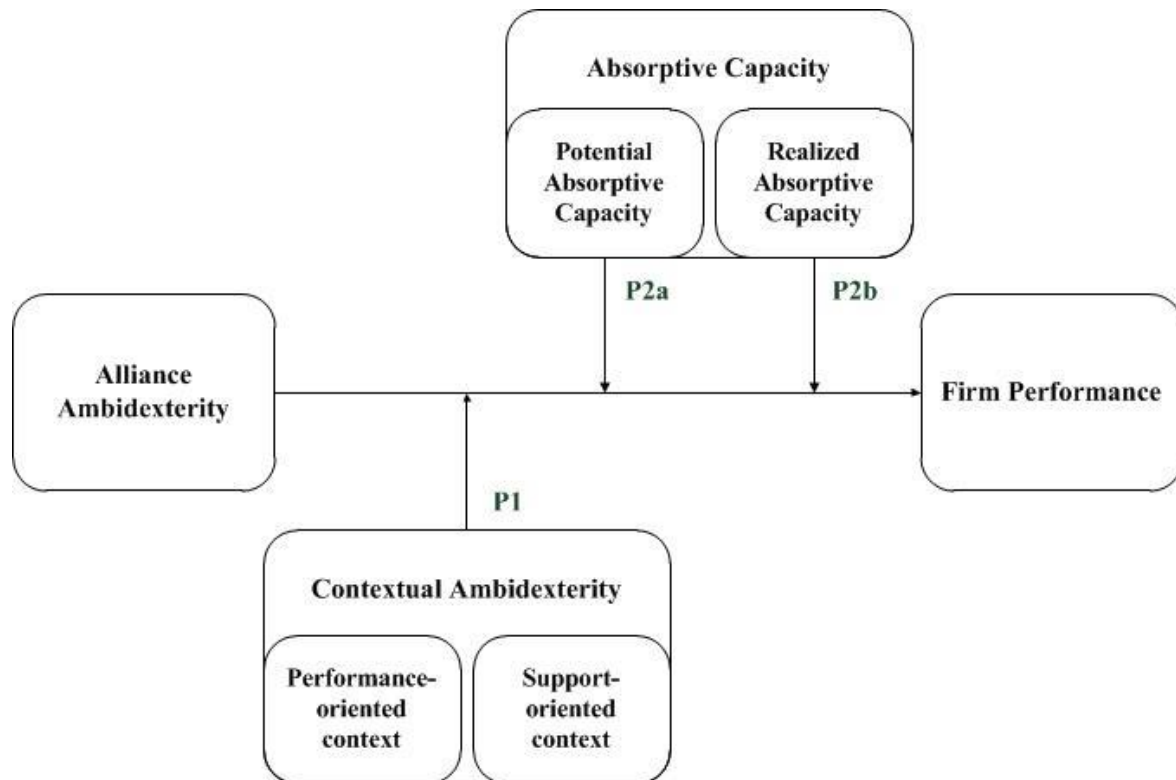
represent a major source of inefficient knowledge transfer and alliance failure (Szulanski, 1996). To overcome these impediments, over the last decades a growing research stream has examined the role of a firm's partner-related capabilities and has found much evidence for the beneficial effects of absorptive capacity on the performance outcomes from inter-organizational learning (e.g., Bishop, D'Este, & Neely, 2011; Chen, Lin, & Chang, 2009; Cohen & Levinthal, 1990). For instance, *potential* absorptive capacity—defined as a firm's capability for acquiring and assimilating external knowledge (Zahra & George, 2002)—can help identify valuable new knowledge and increase the efficiency of absorbing and understanding external knowledge (Lavie & Rosenkopf, 2006). Complementing potential absorptive capacity, *realized* absorptive capacity—defined as a firm's capability for transforming and exploiting external knowledge (Zahra & George, 2002)—can facilitate knowledge integration by improving cross-departmental coordination and communication and thus reducing operational redundancy and coordination conflicts (Jansen et al., 2005a). Together, potential and realized absorptive capacity might explain the differences between firms' performance outcomes from alliance ambidexterity (Datta, 2011). However, empirical research on the effects of absorptive capacity on the relation between alliance ambidexterity and performance outcomes is still in its infancy. In this paper, we hope to move it to the next stage of development.

In brief, contextual ambidexterity and absorptive capacity present potential and fruitful capabilities for managing, integrating, and leveraging explorative and exploitative knowledge from alliances, but current research does not yet provide an integrative view of both (1) a firm's capabilities and (2) its alliance ambidexterity. Thus, this study aims to develop a combined view of ambidexterity by emphasizing the roles of contextual ambidexterity and absorptive capacity as capabilities that can be used to leverage alliance ambidexterity and create performance outcomes. Based on a thorough literature analysis, the central thesis of this article is that both capabilities enable smaller firms to overcome the negative implications

from alliance ambidexterity by using their limited financial and managerial resources more efficiently to balance explorative and exploitative alliances.

In taking a combined view, our study contributes to current research as follows: First, this study enhances our understanding of the relationship between ambidexterity at multiple levels by conceptually developing links between alliance ambidexterity and contextual ambidexterity, thus offering fruitful insights for further empirical studies. Secondly, we put forward the idea that absorptive capacity plays an important role in overcoming the impediments of alliance ambidexterity, especially for smaller firms. Hence, this article complements prior research on absorptive capacity by conceptually exploring *how* absorptive capacity resolves the contradictions related to alliance ambidexterity and increases the efficient leveraging of explorative and exploitative alliances. Third and most important, this paper represents an integrative approach to multiple levels of ambidexterity and absorptive capacity that various authors have called for (Birkinshaw & Gupta, 2013; Datta, 2011; Kauppila, 2010; O'Reilly & Tushman, 2013). Such an integrative approach reduces the gap between the different research streams and extends our understanding of a firm's capabilities and how these capabilities impact alliance ambidexterity and the resulting performance outcomes. This approach is particularly important in emphasizing the cross-boundary interplay between ambidexterity and absorptive capacity for generating performance outcomes, an idea that needs further empirical evaluation. Based on insights from literature on ambidexterity and absorptive capacity, our capability-based framework offers a potential roadmap for future empirical studies to overcome the current limitations in alliance ambidexterity research. Figure 2.1 represents the conceptual model developed in this study.

Figure 2.1: Conceptual Model



The remainder of this paper is structured as follows: In Section 1 we discuss the important role of explorative and exploitative alliances for extending the scarce resource base of SMEs as well as performance implications resulting from alliance ambidexterity. In Section 2, we evaluate the moderating impact of contextual ambidexterity on the relationship between alliance ambidexterity and a firm’s performance outcomes. In Section 3, we discuss the role of absorptive capacity as a moderator for the relationship between alliance ambidexterity and a firm’s performance outcomes. Finally, we present a summary of our contributions, suggestions for future research, and implications for managers.

2.2 Literature Review

2.2.1 Alliance Ambidexterity and Performance Outcomes

In current research, March’s (1991) influential argument for balancing explorative and exploitative learning activities is well established. To ensure long-term survival, each firm is challenged “to engage in sufficient exploitation to ensure its current viability and, at the same

time, to devote enough energy to exploration to ensure its future viability” (Levinthal & March, 1993: p.105). Scholars have labelled a firm’s ability to simultaneously pursue exploration and exploitation as “ambidexterity” (Gibson & Birkinshaw, 2004; Jansen, Volberda, & Van Den Bosch, 2005b; Tushman & O’Reilly, 1996). While most prior studies have examined ambidexterity within a firm’s organizational boundaries (e.g., He & Wong, 2004; Sarkees, Hulland, & Prescott, 2010), other researchers have shown that inter-organizational learning plays an important role in generating innovations (Baum, Calabrese, & Silverman, 2000; Grant & Baden-Fuller, 2004), and that smaller firms especially benefit from stretching their boundaries by using alliances to access novel knowledge (Deeds & Hill, 1996).

Based on the increasing relevance of using alliances for the creation of new knowledge in various industries (Powell et al., 1996), scholars have indicated that firms might benefit from establishing alliance ambidexterity (Lavie & Rosenkopf, 2006). Explorative alliances, such as research and development (R&D) alliances, offer firms access to novel knowledge that allows them to develop new capabilities and technologies (Koza & Lewin, 1998; Mowery, Oxley, & Silverman, 1996), while exploitative alliances, such as marketing and development (M&D) alliances, enable them to leverage the firm’s existing knowledge base and enhance existing capabilities and technologies (Rothaermel, 2001a; Rothaermel & Deeds, 2004). Because both types of alliances offer new opportunities and value-chain functions that are otherwise unavailable for SMEs with their restricted resource base (Im & Rai, 2008), firms that exclusively focus on explorative alliances abandon the option of efficiently leveraging their new knowledge because their access to the market is limited (Lavie, 2006). Conversely, firms that solely enter exploitative alliances might struggle to comprehend and integrate new capabilities and technologies that are too complex and resource intensive for internal development (Mowery et al., 1996). Thus, previous research

indicates that an imbalance of explorative and exploitative alliances can be disadvantageous for firms (Hoffmann, 2007).

However, recent empirical results have shown (surprisingly) that especially SMEs often struggle to fully profit from this alliance ambidexterity (Lin et al., 2007; Stettner & Lavie, 2014; Yamakawa et al., 2011). The reasons for this performance loss are manifold: First, exploration and exploitation activities compete for limited resources (March, 1991) and research has widely acknowledged the conflicting resource-allocation trade-offs within firms (Raisch & Birkinshaw, 2008). This resource competition leads to process inefficiencies and endangers innovative process outcomes. Furthermore, separating explorative and exploitative activities into distinct alliances may cause operational redundancy that is more resource consuming and thus exacerbates the problems of limited resources (Lavie et al., 2011; Tushman & O'Reilly, 1996), which in turn dampens the benefits of alliance ambidexterity. Moreover, separation of differing external partnerships presents a challenge of coordination for a firm's top management (Lavie et al., 2011) because they have to switch quickly between distinct mindsets and routines that might overload managers' cognitive capabilities (McNamara & Baden-Fuller, 1999). Thus, they fail to achieve an efficient management of both alliance types in the portfolio, putting process outcomes at risk.

Secondly, and relatedly, managers' role conflicts might result in reduced acceptance of decisions (Jansen, George, Van den Bosch, & Volberda, 2008; O'Reilly & Tushman, 2004). In particular, research shows that the likelihood of conflicts is much more pronounced when senior managers handle both explorative and exploitative units (Eisenhardt, Kahwajy, & Bourgeois, 1997; Tushman & O'Reilly, 1996). Because of their contrasting explorative and exploitative goals, managers take on roles and behaviours that are unclear, inconsistent, and confound the expectations and perceptions of employees (Bonesso, Gerli, & Scapolan, 2014; Smith & Tushman, 2005). Senior management might struggle with such inherent challenges and fail to recognize the different, ambiguous, and conflicting expectations from

differentiated exploratory and exploitative units and subsequently also fail to translate them into workable strategies (Jansen et al., 2009). As a result, management's role conflicts might decrease the coordination efficiency and thus the disadvantages from alliance ambidexterity outweigh its benefits.

These problems are particularly acute for small firms, and based on their characteristic features (e.g., Lubatkin et al., 2006; Voss & Voss, 2013), we argue that SMEs are especially more likely to suffer from these inefficiencies and contradictions than are larger firms. Because they lack resources, SMEs are more strongly affected by organizational impediments associated with inefficiencies and contradictions (Yang, Zheng, & Zhao, 2014). Prior research has shown that firm size is positively related to the available resources and can influence a firm's performance outcomes (e.g., Ahuja, Lampert, & Tandon, 2008; Stettner & Lavie, 2014). Slack resources enable larger firms to deal with operational redundancy resulting from balancing explorative and exploitative alliances (Beckman et al., 2004; Lin et al., 2007). In contrast, SMEs risk being stuck in the middle (Cao, Gedajlovic, & Zhang, 2009; Ebben & Johnson, 2005) since they tend to have flat hierarchies and fewer formal processes and planning activities because of their limited human resources (Busenitz & Barney, 1997). Managers of smaller firms are thus affected to a greater extent by managerial overload and role conflicts (Andriopoulos & Lewis, 2009) and as a result, SMEs struggle to effectively manage the exploration-exploitation trade-offs and contradictions in their alliance portfolio.

While these issues can put the performance outcomes from alliance ambidexterity at risk, previous studies suggest that a firm's behavioural capabilities, such as contextual ambidexterity (Chang, Chang, Chi, Chen, & Deng, 2012; Im & Rai, 2008), and partner-related capabilities, such as absorptive capacity (Lin, Wu, Chang, Wang, & Lee, 2012), might allow firms to improve their management of explorative and exploitative alliances. In the sections that follow, we propose that managing these alliances effectively—in particular by

taking advantage of contextual ambidexterity and absorptive capacity—moderates the relationship between alliance ambidexterity and performance outcomes.

2.2.2 Moderating Role of Contextual Ambidexterity

The structural separation of explorative and exploitative alliances requires routines and processes that enable the coordination and integration of the distinct learning activities at all levels of organizing (Jansen et al., 2009). To overcome harmful isolation from structurally separated units, Gibson and Birkinshaw (2004) introduced the idea of contextual ambidexterity and defined it as the firm's behavioural capacity to simultaneously balance explorative and exploitative learning activities. To enable contextual ambidexterity, they argue that firms have to build up an organizational context formed by a carefully selected set of systems and processes that encourage individuals to make their own decisions about how to balance the conflicting demands of exploration and exploitation. Based on prior research of Ghoshal and Bartlett (1994), Gibson and Birkinshaw (2004) distinguish the context-shaping systems, processes, and beliefs into two categories: (1) performance management (formed by discipline and stretch), and (2) social context (formed by support and trust). Further, Gibson and Birkinshaw (2004) emphasize the “important role played by senior executives in making an organization context effective and developing ambidexterity” (p. 223). While several studies have shown that leadership is an essential factor for ambidexterity (more detailed see Raisch & Birkinshaw, 2008), Raisch et al. (2009) indicate that managers not only have to handle the challenge of “balancing exploitation and exploration but also of integrating external and internal knowledge” (p. 690). Taking together, research describes management's role as one that not only moulds the behavioural culture of a firm, but one that also establishes processes that can support new knowledge integration. In an ambidextrous context, leadership needs various routines and organizational mechanisms that support the behavioural ability to *switch* between exploration and exploitation. For instance, O'Reilly and Tushman (2008) state

that ambidexterity as a dynamic capability “embodies a complex set of routines including decentralization, differentiation, targeted integration, and the ability of senior leadership to orchestrate the complex trade-offs that ambidexterity requires” (p. 200).

Expanding on these ideas, next we focus on leadership and organizational mechanisms that enable both dimensions of an ambidextrous context—in other words, the *performance-oriented context* as well as the *support-oriented context*—and evaluate their influence on the relationship between alliance ambidexterity and performance outcomes. A performance-oriented context encourages firm members to push for ambitious goals and efficiency, whereas a support-oriented context promotes a cooperative and trustful atmosphere to facilitate knowledge sharing and integration among firm members.

One of the first challenges for firms in achieving the expected outcomes from alliance ambidexterity is to simultaneously coordinate explorative and exploitative alliances. The coordinative activities are very time intensive and because smaller firms have particular difficulty in managing these activities, performance-oriented and goal-driven management as part of an ambidextrous context might offer a way out. Goal-driven leadership can achieve high performance outcomes by clearly defining specific and accepted behavioural standards and norms in order to improve coordination efficiency (Ghoshal & Bartlett, 1994). Continuous target agreements about explorative and exploitative outcomes can set the framework and preconditions for ambidextrous behaviour in each employee’s mind by providing candid and rapid feedback about employees’ achievement of these outcomes (Gibson & Birkinshaw, 2004). Research suggests that top management’s decision-making based on established and consistently applied rules contributes to consistently applied managerial sanctions and discipline within firms (Ghoshal & Bartlett, 1994) and goal-setting leadership that uses reactive control systems with clear guidelines can prevent costly and inefficient misbehaviour (Snell, 1992).

In addition to a performance-oriented and goal-driven management approach, top management should be accompanied by specific integrating mechanisms to increase the efficiency in managing and coordinating alliance ambidexterity. As Markides (2013) exposed, previous research has identified a high number of integrating mechanisms to leverage synergies between exploration and exploitation. For instance, empirical research findings suggest that formal decision-making mechanisms promote the management explorative and exploitative activities because they increase self-control of decisions, allowing firm members to actively respond to diverse demands and needs (Lubatkin et al., 2006; Mom, Van Den Bosch, & Volberda, 2009), while Jansen et al. (2006) found empirical support for the idea that formalization positively influences exploitative innovation because it reduces coordination conflicts. Regarding alliance ambidexterity, Kauppila (2010) show in his illustrative case study on the development of a Micro Weather Station by the company Vaisala the importance of balancing and switching mechanisms for profiting from explorative and exploitative partners: While the previous inventions of Vaisala took a long development time and were focused on exploration rather than exploitation, tightly intertwined matrix organizational structure and formal product development processes enabled employees to use paradoxical mindsets and consider exploitation since day one. The matrix organizational structure enabled cross-departmental connection between salespeople and R&D professions and thus facilitated the incorporation of both technology and business reviews from internal and external sources. Because the new formal product development processes required an exploitation plan, both reviews were judged in various phases of the process to ensure that both aspects are leading towards exploitable outcomes in the long run. Kauppila (2010) sums up that in explorative alliances, balancing and switching mechanisms improve the efficiency of coordinating and supervising knowledge integration into the value-creation process. Concurrently, these mechanisms advance the organization of knowledge utilization by exploiting alliances and implementing discipline and structure into the innovation-development process (Kauppila,

2010). We therefore propose that leadership should be assisted by integrative mechanisms to improve the coordination efficiency because they provide firm members with clearly defined criteria for distributing and spending scarce resources to achieve the targeted outcomes, thus avoiding operational redundancy and managerial conflicts.

Coordination activities are further enhanced when firms reinforce explorative behaviour by implementing an innovative working environment. A corporate culture that strongly emphasizes innovations facilitates knowledge integration and utilization, because increased self-identification is combined with challenging aims (Tushman & O'Reilly, 1996). Complementing their performance-oriented leadership style, top managers should also promote risk-taking behaviour by providing stimulative rewards as a way to encourage firm members to push for ambitious goals (Gibson & Birkinshaw, 2004). Risk taking leadership is characterized by high risk tolerance and acceptance of possible failure costs (Kohli & Jaworski, 1990). To further this aim, Adler et al. (1999) suggest that job enrichment can increase employees' task autonomy and therefore promote firm members to shoulder more responsibility for achieving self-set goals. In doing so, individuals can use the management-supported autonomy to stretch their risk tolerance and experiment with new alternatives (Birkinshaw & Gibson, 2004). Successful risk-taking leadership demands, however, that employees themselves participate in the goal-development process to ensure self-identification and comprehension of the firm's strategic aims (Chang & Hughes, 2012). Moreover, to set their own goals, individuals within a firm also need autonomy (Gibson & Birkinshaw, 2004) and access to the resources required to take on risky projects (Chang & Hughes, 2012). In this regard, innovative firm culture with shared behavioural values as described above becomes more critical for smaller firms in order to provide individuals adequate access to scarce resources. All in all, we expect that performance-oriented and risk-taking leadership supported by several integration mechanisms will enhance firm members'

ambidextrous behaviour and improve their ability to efficiently coordinate the balance of explorative and exploitative alliances.

A second challenge for firms in enhancing performance outcomes from alliance ambidexterity is addressing the managerial overload and role conflicts that result from balancing explorative and exploitative alliances. For several reasons, we argue that a support-oriented context might be especially helpful in overcoming these issues. Top managers can adopt a leadership style that empowers employees to handle role conflicts in a more self-determined way (Birkinshaw & Gibson, 2004; Chang & Hughes, 2012). To increase the success of innovation and creativity, supportive leadership can offer access to resources and assistance in the face of difficulties (Andriopoulos & Lewis, 2010; Tierney & Farmer, 2004). Social support also encourages firm members to switch between contradictory mindsets more easily and thus reduces managerial overload and role conflicts. For example, Adler et al. (1999) described that underlying the Toyota production system are meta-routines of supportive management systems and culture that enable firm members to continuously improve their non-routine tasks (exploration) while maximizing their routine tasks (exploitation). Toyota uses a standardized problem-solving process including continuous reflection-reviews for changing existing routines and for creating new ones which provides structure and role clarity for employees. Adler et al. (1999) underlined that the success of these meta-routines relies on the mutual agreement that these control instruments are only used to support improvements rather than sanctioning employees' misbehaviour.

In addition, supportive atmospheres can promote trusting relationships among firm and project members that facilitate knowledge exchange in both inter- and intra-organizational collaboration (Jansen et al., 2006). Being able to rely on a firm member's commitments fosters the strength of members' ties (Tsai & Ghoshal, 1998), which in turn motivates employees to exchange knowledge among each other, and thus facilitates utilization of knowledge from distinct functional areas (Luca & Atuahene-Gima, 2007). Scholars suggest

that SMEs especially need to draw on close social interaction to overcome the constraints of their limited resource base and more efficiently utilize their innovation potential (Chang & Hughes, 2012). Moreover, supportive leadership can reduce conflict potential resulting from interpersonal differences by providing open, transparent communication which enlarges the likelihood that employees raise issues related to differing explorative and exploitative activities (Jehn, Greer, Levine, & Szulanski, 2008; Lovelace, Shapiro, & Weingart, 2001). Hence, supportive leadership can encourage critical reflection on opposing views and facilitate to find a consensus about conflicting exploratory and exploitative goals (Jansen, Kostopoulos, Mihalache, & Papalexandris, 2016). Based on these arguments, we assume that social support resulting from interaction between supportive leadership and organizational mechanisms remedy shortcomings of managerial overload and role conflicts because it aids communication, establishes trust, and helps firms to better exploit knowledge.

In sum, we argue that a firm's contextual ambidexterity is a critical capability for integrating and balancing the explorative and exploitative knowledge created by external partnerships. We discussed the multifaceted role of leadership for creating an ambidextrous context that enables the behavioural capacity to manage and integrate external exploration and exploitation. Next, we stated that successful leadership needs the support of organizational mechanisms that foster performance-oriented and supportive leadership. While leadership and mechanisms are important, it is also important to mention that superior performance effects of contextual ambidexterity are not achieved primarily through these two aspects alone, because an ambidextrous context is collectively formed by a carefully selected set of both leadership and organizational mechanisms that enable meta-capabilities to manage and integrate exploration and exploitation simultaneously (Gibson & Birkinshaw, 2004). Based on our rationale presented in this section, we assume that contextual ambidexterity helps firms to manage and integrate knowledge from explorative and exploitative alliances more efficiently.

As a consequence, we argue that smaller firms might especially profit from an improved coordination and integration efficiency when adopting alliance ambidexterity. Thus, we posit:

Proposition 1: Contextual ambidexterity positively moderates the relationship between alliance ambidexterity and firm performance: The negative impact of alliance ambidexterity on a firm's performance outcomes will be reversed if SMEs have a high contextual ambidexterity.

2.2.3 Moderating Role of Absorptive Capacity

In addition to an organizational context that enables contextual ambidexterity, alliance ambidexterity requires additional capabilities that promote the search for external knowledge as well as the combination of that knowledge into a firm's established knowledge base (Raisch et al., 2009; Wuyts & Dutta, 2014; Zollo, Reuer, & Singh, 2002). Therefore, we argue that firms have to develop partner-related capabilities such as absorptive capacity to fully benefit from alliance ambidexterity. In this section, we discuss absorptive capacity and how it can benefit firms.

Zahra and George (2002) define absorptive capacity "as a set of organizational routines and processes by which firms acquire, assimilate, transform, and exploit knowledge" (p. 186). Further, they introduce a distinction between *potential* and *realized* absorptive capacity. Potential absorptive capacity includes a firm's ability to acquire (i.e., access and import) and assimilate (i.e., interpret and understand) new knowledge from external partners (Ebers & Maurer, 2014). To capture Cohen and Levinthal's (1990) argument that the successful use of absorbed external knowledge primarily depends on a search process that values knowledge, Todorova and Durisin (2007) indicate extending the construct of potential absorptive capacity by adding the ability to recognize (i.e., observe and detect) the value of new external knowledge. In contrast, realized absorptive capacity refers to a firm's ability to transform the absorbed knowledge by combining it with the firm's existing knowledge base and exploiting

it by applying it to the firm's operations (Ebers & Maurer, 2014). For several reasons, we suppose that absorptive capacity, particularly in smaller firms, positively influences the integration of explorative and exploitative knowledge resulting from alliance ambidexterity.

First, we argue that the firm's ability to recognize the value of external knowledge as first dimension of potential absorptive capacity supports firms in overcoming the negative implications of alliance ambidexterity. At the beginning of their inter-organizational collaboration, firms are challenged to identify the most suitable explorative and exploitative alliances for their portfolio. This partner-selection process requires firms to observe and judge characteristics of potential partners from a large number of industry contacts. Producing innovative research findings in science-based industries mostly necessitate an understanding of alliance partners' prior research results (Fleming & Sorenson, 2004; Oliver, 2004; Zucker, Darby, & Armstrong, 2002) and becomes more critical to ensure a successful working liaison (Fabrizio, 2009). Here, Stuart, Hoang, and Hybels (1999) have shown that smaller firms particularly benefit from partners whose skills, capabilities, and knowledge bases complement their own needs and requirements. Therefore small firms must have effective judgment capabilities. In highly scientific industries such as biotechnology, however, knowledge beyond a firm's boundaries is often less targeted to its specific needs (Cohen & Levinthal, 1990). While larger firms are more likely in a position to engage contract research labs to receive more targeted knowledge, smaller firms often enter alliances with providers of less targeted knowledge, such as universities, because they have a limited overview of other market participants (George, Zahra, & Wood, 2002). Hence, we suppose that a high ability to recognize the most promising partners enables smaller firms to join alliances that have more-applicable knowledge.

Another aspect of recognizing the value of external knowledge is that the ability to observe and detect suitable knowledge sources fosters the efficiency of the search process for external opportunities or new knowledge and helps to use scarce resources in a more efficient

way (Lavie & Rosenkopf, 2006). The accurate assessment of potential partners' capabilities, knowledge, and skills enables firms to successfully deal with internal constraints and biases resulting from cognitive embeddedness, path dependency, or the misapplication of selection criteria by the focal firm and is necessary to enable novel insights in new procedures (Maurer & Ebers, 2006). To sum up, we argue that a high ability to recognize the value of new explorative and exploitative knowledge sources improves the performance outcomes of alliance ambidexterity by avoiding inefficiencies and resolving contradictions during the formation of suitable partnerships (Lavie & Rosenkopf, 2006).

A second reason explaining the benefits of potential absorptive capacity is that we expect that firms that have to manage both explorative and exploitative alliances as a requirement of their business or industry benefit from a strong *ability to acquire novel external knowledge*. This “forced” ambidexterity creates a higher awareness and perceptive ability as a result of “juggling” these two activities, and in so doing, induces learning effects. To achieve alliance ambidexterity, firms have to meet the different demands of both explorative and exploitative partners in order to successfully gather external information. For example, routines to absorb knowledge from R&D alliances (e.g., universities or research institutes) have to be more science focused or technology based, whereas processes to acquire knowledge from M&D alliances (e.g., consultants or marketing agencies) are more market related. Following Zahra and George (2002), the quality of a firm's acquisition ability is mainly determined by the intensity of its endeavour to access and import new knowledge. When firms invest greater effort in their acquisition processes and routines, the speed of absorbing novel information is significantly increased.

Further, research has shown that the accumulated prior knowledge base positively influences the ability to acquire new knowledge (Cohen & Levinthal, 1990). The reason for these beneficial effects is posited by Bower and Hilgard (1981), who show that knowledge acquisition is a self-reinforcing process in which the number of objects, patterns, and concepts

stored in memory directly increases the availability of new knowledge and its application in new settings. However, the self-reinforcing knowledge-accumulation process is also path dependent (Nelson & Winter, 2009), and firms in science-based industries need a prior understanding of knowledge before they can interpret novel information (Zucker et al., 2002). To ensure access to novel information from both science-focused R&D alliances as well as market-related M&D alliances, firms need to develop experience in both of these different areas to successfully absorb new knowledge (Rocha, 1999).

Hence, smaller firms with a strong ability to acquire new knowledge profit from an increased speed of accessing novel information. Recent research confirms this idea. Fosfuri and Tribó (2008) have found empirical evidence that a strong ability to acquire a partner's knowledge facilitates the absorption of new knowledge from other explorative and exploitative alliances. Moreover, their findings empirically support Zahra and George's (2002) claim that an acquisition ability of high quality intensifies the speed of accessing and importing knowledge from a wide range of value-chain activities, and as a result increases the efficiency of resource allocation in the acquisition process. Therefore, we summarize that a firm benefits from high acquisition ability because this ability increases the efficiency of accessing and importing novel knowledge from both explorative and exploitative alliances. Furthermore, we assume that a strong ability to acquire a partner's knowledge enables SMEs in particular to use their limited resources more effectively in managing their alliance portfolio.

A third reason for expecting benefits from absorptive capacity is that we believe that a strong ability to assimilate new knowledge as a dimension of potential absorptive capacity helps firms to overcome the negative impediments resulting from alliance ambidexterity. In their empirical study on absorptive capacity and exploratory alliances in biopharmaceutical firms, Xia and Roper (2008) have shown that successful application of knowledge in the future depends on understanding the absorbed knowledge, a skill that is enabled by a high

assimilation ability. While firms that manage explorative and exploitative alliances are confronted with various knowledge sources, firms face the risk that new ideas and research findings might be overlooked because they cannot easily analyse and interpret these ideas and findings (Cyert & March, 1963; Rosenkopf & Nerkar, 2001). This is particularly critical in innovative industries like biotechnology, where the proportion of scientific knowledge is very high and requires a thorough understanding of the underlying processes and routines to repeat, modify, and advance outcomes (Cohen & Levinthal, 1989; Fleming & Sorenson, 2004). Hence, we argue that firms need to build up an assimilation ability that supports learning processes in either kind of alliance by focusing on the deep comprehension of absorbed information. We propose that firms with highly developed processes and routines to assimilate new knowledge increase their efficiency of knowledge sharing and future application, for two reasons: First, firms benefit from an increased speed of knowledge transfer, since they have the ability to analyse and interpret their partners' knowledge quickly and thus advance their overall coordination efficiency. Second, firms profit from a reduced operational redundancy because their assimilation ability prevents misplaced behaviour by providing clear processes and routines for understanding external knowledge and improving learning (Szulanski, 1996).

All in all, we argue that a high level of potential absorptive capacity allows smaller firms in particular to handle and reverse the undermining effects of balancing explorative and exploitative alliances. First, a strong ability to recognize the most promising alliance partners increases the efficiency of the partner-selection process by synchronizing the partners' characteristics and knowledge sources with the firm's demands and capabilities. Moreover, firms that can more reasonably judge and evaluate also reduce the inconsistencies they face in the alliance-formation process, which allows them to capitalize on alliance ambidexterity more efficiently. Second, we assume that firms with a pronounced ability to acquire partners' knowledge use their scarce resource base more effectively in the acquisition process and thus

significantly reduce the negative restraints of alliance ambidexterity. Third, we suppose that a high ability to assimilate newly absorbed knowledge supports firms in fully leveraging partners' knowledge from a balanced alliance network by enhancing comprehension of knowledge and reducing operational redundancy. Thus, we propose:

Proposition 2a: Potential absorptive capacity positively moderates the relationship between alliance ambidexterity and firm performance: The negative impact of alliance ambidexterity on firm performance will be reversed if SMEs have a high potential absorptive capacity.

Moving from potential to realized absorptive capacity, we assume that the different dimensions of realized absorptive capacity (i.e., transformation and exploitation of absorbed new knowledge) allow smaller firms to further reverse the negative impediments of alliance ambidexterity. First, SMEs are challenged to transform and internalize the assimilated knowledge in the application process. To successfully use transferred knowledge, it must be adapted to current needs and situational circumstances (Garud & Nayyar, 1994). In the case of internationally and inter-culturally transferred technological knowledge, for example, research has widely demonstrated the need for modification of knowledge to accommodate external and internal conditions (e.g., Teece, 1981). Second, firms are challenged to combine multiple knowledge bases from explorative and exploitative alliances. Hence, firms need capabilities that foster the awareness of combination opportunities in distinct knowledge areas. Finally, firms are confronted with the challenge of successfully applying and commercializing the absorbed knowledge from explorative and exploitative alliances. The ability to exploit assimilated knowledge can support SMEs to harvest resources more efficiently by decreasing the time-to-market of innovative outcomes resulting from alliance ambidexterity. In this section, we therefore argue that firms benefit from their realized absorptive capacity in several ways: (1) transformational ability accelerates knowledge development; (2) combination of

multiple knowledge bases increases awareness of complementary expertise among partners; and (3), exploiting the combined knowledge by applying and commercializing it allows firms to benefit more from alliance ambidexterity.

First, we suggest that a firm's strong transformation ability accelerates knowledge integration from both explorative and exploitative alliances. Developing new ideas by combining external and internal information demands well-performing integration processes for both scientific and market-related knowledge. Transformative integration processes are characterized by key features such as shared contexts and mindsets, job rotation, and learning through experience (Fontes, 2005; Garud & Nayyar, 1994; Jansen et al., 2005a). For example, Jansen et al. (2005a) have shown empirically that cross-functional interfaces and job rotation improve a firm's transformation capability because they facilitate knowledge combination and thus prevent operational redundancy. In addition, Fontes (2005) argued in her study on knowledge transformation that the transformative process is an application-oriented thought process that enables commercial exploitation of research findings that might otherwise have remained unused. Along these lines, we assume that smaller firms in particular benefit from improved efficiency and reduced resource input in the transformation process of their partners' knowledge because they modify both external and internal knowledge sources faster than larger firms do, as well as identify the most promising opportunities for combination (Zahra & George, 2002).

A second reason we believe that realized absorptive capacity can benefit small firms is that we suppose that combining multiple knowledge bases increases the awareness of complementary expertise among explorative and exploitative alliance partners. One example of complementary expertise for SMEs is the demand that they successfully toggle between research and the market. While research has widely emphasized the role of new technology-based firms as important agents for transforming research results into market products (Fontes & Coombs, 2001; Kenney, 1986), Fontes (2005) underscored that "an understanding of user

needs is necessary and thus relationships outside the academic world (e.g., previous industry linkages) may be a requirement” for successful knowledge exploitation (p. 343). Transferred to alliance ambidexterity, we argue that a firm’s well-developed transformation ability allows firm members to reinvent and adapt knowledge by successfully mastering the transformation process between explorative and exploitative partners. Thus, we propose that a high ability to transform enables firms to combine and interpret external knowledge in a different manner and improves knowledge sharing within the balanced alliance network.

Indeed, firms rely on prior knowledge to be able to identify commercial opportunities for the transformed knowledge. While firms normally thoroughly comprehend the involved technological knowledge during the assimilation and transformation processes, research has underlined market-related knowledge as essential for identifying appropriate application opportunities in the market (Cassiman & Veugelers, 2006; Jansen et al., 2005a; Smith, Collins, & Clark, 2005). This suggestion complements the widely acknowledged idea that knowledge exploitation is a trade-off between a firm’s knowledge base and its market needs and concerns (Lane et al., 2006). Thus, we presume that a firm’s ability to exploit transformed knowledge influences the ease of utilizing and incorporating combined knowledge into commercial outcomes. In particular, we argue that smaller firms especially benefit from well-developed exploitation ability by harvesting resources in a more efficient way. Moreover, knowledge exploitation from alliance ambidexterity directly leads to measurable outcomes such as new products or services that are strongly related to a firm’s efficiency in the knowledge-leveraging processes (Spender, 1996). In addition, Zahra and George (2002) indicate that exploitation ability includes routines and processes that enable a firm “to refine, extend, and leverage existing competencies or to create new ones by incorporating acquired and transformed knowledge into its operations” (p. 190). These underlying processes save firm resources by building up new core competencies. Thus, we assume that firms with strong

exploitation ability can refine and extend more efficiently the existing competencies in their explorative and exploitative alliances.

Another level of complexity in this area is that scholars indicate that assimilated knowledge might be stored for a long time before it can be implemented in new products (Lane et al., 2006; Rothaermel & Deeds, 2004). To successfully apply assimilated knowledge after a lengthy period of time, well-developed recoding and converting skills are required. Transformation skills provide a broad set of conversion and recombination competencies that allow firms to more efficiently retrieve and combine assimilated knowledge. For instance, Jansen et al. (2005a) found empirical evidence that formalizing codification processes can increase a firm's transformation ability and thus enable firms to exploit knowledge more efficiently, apply it more easily, and implement it faster (Zander & Kogut, 1995). Hence, we assume that SMEs in particular benefit from a well-marked transformation capability because it reduces financial and managerial resource input and lessens the competition for scarce resources.

Lastly, we suggest that the ability to exploit the combined knowledge helps firms to benefit more from balancing explorative and exploitative alliances. Lane and Lubatkin (1998) illustrated that the greater the overlap between a firm's and its partner's "dominant logic" for commercializing knowledge, the greater the success of inter-organizational learning. Past research discovered that this dominant logic is grounded in each firm's preferences for certain project characteristics (e.g., size or risk level) as well as in its favoured strategic key figures (e.g., stages of product life cycle) (Grant, 1988). In line with Cohen and Levinthal (1990), Lane and Lubatkin (1998) suggest that firms work together more harmonically when they have similar experiences and sets of routines to solve problems of the same kind. That said, research on organizational learning also advises caution in these situations, because too much similarity may result in organizational rigidity, which might prevent firms from effectively handling other types of partnerships (Leonard-Barton, 1992; March, 1991). Despite this

caution, we argue that the risk of organizational inertia is very likely limited for a firm's exploitation ability because firms with explorative and exploitative alliances constantly renew their knowledge base (Lavie & Rosenkopf, 2006).

Summarizing, we propose that a high level of realized absorptive capacity allows smaller firms in particular to reduce negative implications from alliance ambidexterity by utilizing explorative and exploitative alliances in a more efficient way. First, SMEs profit from more efficient knowledge integration processes for both explorative and exploitative alliances because they have strong transformation ability. Second, exploitation ability enables SMEs to implement and commercialize combined knowledge more efficiently, and in so doing, to overcome constraints resulting from limited resources and conflicting processes. Thus, we posit:

Proposition 2b: Realized absorptive capacity positively moderates the relationship between alliance ambidexterity and firm performance: The negative impact of alliance ambidexterity on firm performance will be reversed if SMEs have a high realized absorptive capacity.

2.3 Discussion

In this paper, we introduced a capability-based framework that integrates multiple levels of ambidexterity by emphasizing the role of a firm's contextual ambidexterity as a way to leverage alliance ambidexterity. In addition, we underscored the importance of absorptive capacity as a way for SMEs to overcome the impediments of alliance ambidexterity and increase its performance outcomes. Based on a thorough literature analysis, the central thesis of this article is that both contextual ambidexterity and absorptive capacity enable SMEs to overcome the negative effects from alliance ambidexterity by using their limited financial and managerial resources more efficiently to balance explorative and exploitative alliances. Thus, our capability-based framework represents an integrative approach to different ambidexterity

levels and absorptive capacity which multiple authors have called for (Birkinshaw & Gupta, 2013; Datta, 2011; Kauppila, 2010; O'Reilly & Tushman, 2013).

2.3.1 Theoretical Implications and Future Research Directions

This paper has several theoretical implications for research on alliances and networks, organizational ambidexterity, and knowledge management. Regarding alliances and networks, our conceptual framework draws attention to how SMEs benefit from balancing explorative and exploitative alliances. We contribute to current discussions in research on alliance ambidexterity by developing arguments for the empirically mixed results of alliance ambidexterity (e.g. Lavie et al., 2011; Lin et al., 2007). Specifically, smaller firms are challenged to benefit from alliance ambidexterity because they have insufficient processes and face managerial overload. At the same time, however, our inter-organizational learning perspective underscores that both explorative and exploitative alliances are important enablers for SMEs to extend and renew their own limited knowledge base. Because firms face an environment characterized by increased innovation speed and research complexity, alliances offer a resource-efficient alternative for smaller firms to compete in the dynamic market field of science-intensive industries. One important insight of our framework is that SMEs with well-developed behavioural capabilities, such as contextual ambidexterity, and partner-related capabilities, such as absorptive capacity, might overcome the negative impediments of alliances ambidexterity.

Concerning organizational ambidexterity, our conceptual model integrates insights from various lines of ambidexterity research and points out the complementary interplay between network-level and firm-level ambidexterity. First, our paper continues prior research on contextual ambidexterity by exploring the leadership routines as well as the organizational mechanisms that form an ambidextrous context and thus allow firms to successfully balance exploration and exploitation. Here, we assume that a supportive context is created by an

interaction of leadership routines and organizational mechanisms that enable the flexibility to switch between exploration and exploitation. In addition, components of a performance-oriented context increase the efficiency of knowledge integration and utilization. Thus, we suppose that smaller firms might especially profit from the advantages of an ambidextrous context because these firms often cannot draw on extensive slack resources and thus profit more from an increased efficiency. Second, our paper replies to increasing research calls from scholars demanding an integrative view of different ambidexterity levels (e.g., Birkinshaw & Gupta, 2013; Raisch et al., 2009). For instance, Kauppila's (2010) illustrative case study has shown that the complementary perspective of inter- and intrafirm ambidexterity might be a promising starting point for developing a holistic understanding of the ambidexterity concept. Accordingly, we extend the traditional perspective of contextual ambidexterity and develop a theoretical reasoning that considers the interrelated explorative and exploitative activities at the network and firm level. In particular, we argue that contextual components such as leadership routines and organizational mechanisms enable the firm's *behavioural* capacity, which in turn allows them to handle exploration and exploitation not only within firm boundaries, but also across them. In doing so, we offer new insights that explain that firms not only have to build up an ambidextrous organizational context to internally balance exploration and exploitation, but also have to manage and integrate knowledge flows from alliance ambidexterity. Thus, the integrative framework presented in this paper provides fruitful links for future research. For instance, scholars could empirically examine the influence of leadership routines and organizational mechanisms on alliance ambidexterity.

With regard to absorptive capacity, our conceptual framework expands existing studies in a number of ways. While recent research on ambidexterity has started to combine the ambidexterity concept with the absorptive capacity construct (Datta, 2011; Fernhaber & Patel, 2012; Rothaermel & Alexandre, 2009), we put forward the idea that absorptive capacity plays an important role in overcoming negative implications of alliance ambidexterity, in

particular for smaller firms. From a theoretical point of view, our model improves our understanding of how the distinct dimensions of absorptive capacity influence the firm's ability to fully leverage alliance ambidexterity and achieve superior performance outcomes. In doing so, our conceptual model may be used to empirically investigate whether the application of potential and realized absorptive capacity unfolds separate and complementary effects on the performance outcomes of alliance ambidexterity (Zahra & George, 2002). The rationale we developed in this paper underlines that all dimensions might be vital in order for firms to reverse the negative implications of alliance ambidexterity and thus our framework might provide a promising starting point for investigating the role of absorptive capacity in more detail. Moreover, this work has the potential to enhance prior research on ambidexterity and absorptive capacity by reducing the theoretical gap between both concepts. Drawing on the behavioural capacity (i.e., contextual ambidexterity) as well as the partner-related capability (i.e., absorptive capacity), our combined view allows new insights into the interaction between these capabilities and the knowledge-generating and knowledge-leveraging processes in alliances. Future research might investigate additional partner-related capabilities and instruments that positively influence the balance of exploration and exploitation in alliance portfolios. Fruitful ideas to extend our propositions are offered by Kauppila's (2010) framework of inter- and intrafirm ambidexterity, which implies, for example, that the strength of ties may play an important role as well.

Following this paper, we encourage empirical studies with a combined research design of ambidexterity and absorptive capacity to investigate the closely linked relations between both concepts. Our proposed conceptual framework (as shown in Figure 1) can provide a fruitful starting point for future studies. In this paper, we developed an argument for why behavioural and partner-related capabilities might be appropriate for SMEs in order to increase the efficiency of their alliance management and thus increase the performance outcomes from alliance ambidexterity. As a next step, future research should test the

propositions presented here to validate our integrative framework. For example, in-depth case studies will deepen our knowledge of the practices and routines used by SMEs to balance explorative and exploitative partners. In addition, long-term studies and large-scaled meta-analyses are needed to meet the requirements of the longer time horizons of explorative outcomes (March, 1991). Finally, scholars might explicitly examine branch-specific differences by conducting in-depth case studies in less knowledge-intensive industries to include external conditions such as environmental turbulence.

2.3.2 Managerial Implications

This paper offers a number of practical implications for those managing SMEs. In particular, our conceptual model helps to enhance practitioners' viewpoint of managing distinctive alliance partners and successfully integrating various learning activities by integrating contextual ambidexterity and absorptive capacity. While SMEs often struggle to fully benefit from alliance ambidexterity (Lavie et al., 2011), our arguments suggest that SMEs with an ambidextrous context and high absorptive capacity will advance performance outcomes by balancing explorative and exploitative alliances. First, SMEs need to create an organizational context that supports the simultaneous management of exploration and exploitation and thus fosters knowledge sharing and diffusion through internal coordination and socialization mechanisms. Second, SMEs have to develop a high level of absorptive capacity to identify the most promising collaboration partners and improve the overall efficiency in their knowledge acquisition and application processes. However, the development of both capabilities is time consuming and does not necessarily influence firm performance instantaneously. For example, the creation of an appropriate organizational context is usually accompanied by thorough changes of values and norms in organizational culture, which takes much time. Therefore, it is important that managers do not immediately rescind previous investments in capability development at the first sign of failure or missed performance success at the very

beginning of a project. Here, benchmarking the applied practices with industry peers could be a solution to ensure successful capability development in the addressed areas of organizational learning.

2.3.3 Conclusion

In conclusion, we reemphasize the primary aim of this paper, which is to offer a capability-based framework for alliance ambidexterity in SMEs. Our integrative approach provides a move towards understanding the complex interplay of a firm's contextual ambidexterity and absorptive capacity when leveraging explorative and exploitative alliances. By thoroughly evaluating empirical and theoretical studies on ambidexterity, organizational learning, alliances, and absorptive capacity, we developed several propositions that offer useful paths for future studies in these research fields. Particularly, scholars could empirically test the propositions posited in this paper by using in-depth case studies of multiple SMEs in different industries to discover practical insights for the applied behavioural and partner-related capabilities; that is, contextual ambidexterity and absorptive capacity. Additionally, the longer time horizons of explorative outcomes demand long-term and large-scaled studies to verify these propositions. Our integrative framework can pave the way for new studies, but future research should also be mindful of one big limitation of our conceptual paper: We noticed the manifold relations between the concepts of ambidexterity and absorptive capacity that prior research has already discovered (e.g., Datta, 2011; Rothaermel & Alexandre, 2009). For example, prior studies have shown that various organizational mechanisms (e.g., formalization or connectedness) influence ambidexterity as well as absorptive capacity (Jansen et al., 2005a; Jansen et al., 2005b). Nevertheless, we treat both as two distinct approaches without overlap. Here, further conceptual development is required to work out the close interrelations of both concepts. Especially regarding the tension between internal and external learning, prior research has indicated that ambidextrous firms not only have to deal

with the trade-offs that emerge from simultaneously balancing exploration and exploitation but also with the trade-offs that arise from combining internal and external knowledge (Rothaermel & Alexandre, 2009). Absorptive capacity enables firms to interact with the external environment by exploring new technological knowledge and market opportunities (Hoang & Rothaermel, 2010; Lavie et al., 2010), whereas ambidexterity implements organizational routines and processes to manage learning and innovation and helps to integrate internal and external knowledge sources (Fernhaber & Patel, 2012). Therefore, the notion of absorptive capacity can complement the existing research on ambidexterity by offering new insights on the role of externally imported knowledge.

In sum, we are confident that the ideas presented here offer new conceptual links for understanding how contextual ambidexterity and absorptive capacity influence alliance ambidexterity and thus improve the performance outcomes of smaller firms. By systematically developing a complementary perspective of the interrelated dimensions, our capability-based framework helps to identify bottlenecks in the ambidexterity and absorptive capacity research. While further conceptual and empirical work is required to strengthen the conceptual model, our integrative view provides a starting point and direction for investigating the suggested relations between both concepts.

3 Chapter 3. Study 2: How Absorptive Capacity impacts the Value of Balanced Alliance Networks: Evidence from New Biotechnology Firms in Germany²

While Study 1 developed a capability-based framework that offers a theoretical reasoning for the interplay between alliance ambidexterity, contextual ambidexterity, and absorptive capacity, Study 2 empirically tests the moderating impact of absorptive capacity on the relationship between alliance ambidexterity and firm performance. The hypothesis is that absorptive capacity can facilitate the integration of various knowledge resources and reconcile the trade-offs resulting from alliance ambidexterity. We tested the hypothesis on 158 new biotechnology firms in Germany, and the results show that alliance ambidexterity is negatively related to firm performance, but that firms can apply absorptive capacity to overcome these detrimental effects. Study 2 is one of the first to provide evidence about the performance effects of alliance ambidexterity in SMEs, which is significant because it shows that small firms have a way of overcoming their inherent limitations to achieve growth and it provides practical relevance for managers of these firms as they try to balance explorative and exploitative alliances.

² This chapter has been crafted together with Indre Maurer and Suleika Bort.

3.1 Introduction

Based on March's (1991) influential idea that successful firms need to balance exploration and exploitation activities, Koza and Lewin (1998) established the distinction between explorative and exploitative alliances. Explorative alliances provide access to new knowledge and enable firms to develop new competencies and technologies (Koza & Lewin, 1998), whereas exploitative alliances leverage a focal firm's existing knowledge base and improve its existing capabilities (Rothaermel & Deeds, 2004). When firms develop and maintain both exploration and exploitation alliances simultaneously they exhibit a balanced alliance network, henceforth referred to as alliance ambidexterity (e.g., Hoang & Rothaermel, 2010; Rothaermel & Deeds, 2004).

Empirical studies have revealed that firms often cannot fully benefit from alliance ambidexterity in their networks (Lin et al., 2007; Stettner & Lavie, 2014; Yamakawa et al., 2011), despite growing scholarly attention on the potential benefits of such ambidexterity (Beckman et al., 2004; Koza & Lewin, 1998; Rothaermel & Deeds, 2004) as well as evidence that firms tend to balance explorative and exploitative alliances (Lavie & Rosenkopf, 2006). Possible reasons for this negative effect include the fact that inter-firm collaboration is often based on a firm's current knowledge, which increases the tendency to prefer familiar over unfamiliar knowledge and restricts exploration. Additionally, alliances can hamper exploitation when external knowledge from alliance partners is inapplicable or incompatible with the firm's established knowledge base (Das & Teng, 2000). Moreover, recent research has shown that balancing exploration and exploitation can undermine or even negatively impact firm performance because of operational redundancy and coordination conflicts (Lavie et al., 2011). This is especially true for new ventures, which face difficulties pursuing exploration and exploitation simultaneously because they lack resources as well as face conflicting demands between both activities (Casper, 2000; Lin et al., 2007).

Prior literature indicates that firms can overcome performance loss from alliance ambidexterity by developing and fostering cooperative, partner-specific capabilities that support the search for novel knowledge in unfamiliar domains while combining this new knowledge with a firm's idiosyncratic knowledge base (Kim & Song, 2007; Zollo et al., 2002). Absorptive capacity can explain why some firms benefit more from their alliance network than do others (Lavie & Rosenkopf, 2006; Wuyts & Dutta, 2014), both potential and realized. For example, Lavie and Rosenkopf (2006) argue that potential absorptive capacity—as a firm's capability for acquiring and assimilating external knowledge (Zahra & George, 2002)—fosters an efficient search process for external opportunities and new knowledge and helps to overcome the constraints resulting from limited resources. This built-in absorptive capacity allows a firm to transform the knowledge and exploit it (Zahra & George, 2002) by taking advantage of cross-functional interfaces—combining existing and newly acquired knowledge and avoiding operational redundancy (Cohen & Levinthal, 1990; Jansen et al., 2005a). Although alliance literature suggests that partner-related capabilities such as a firm's absorptive capacity can help firms to fully leverage the benefits of balanced alliance networks (e.g., Datta, 2011; Soh & Subramanian, 2014; Zheng, Liu, & George, 2010), empirical research on that issue is still in its infancy.

This study seeks to address this gap by examining the moderating impact of absorptive capacity on the relationship between alliance ambidexterity and firm performance. Based on proprietary survey and panel data from 163 new biotechnology firms (NBFs) (Oliver, 2001: p. 467; 2009: p. 35) in Germany, this study underscores the role of absorptive capacity as a way to capture the full value of balanced alliance networks. More concretely, our findings demonstrate that both potential and realized absorptive capacity can mitigate the risks from balancing explorative and exploitative alliances and thus reverse the negative performance effects of alliance ambidexterity.

This study offers three contributions to current literature. First, it introduces the idea that absorptive capacity is a partner-related capability that enables new ventures to benefit from alliance ambidexterity by increasing the efficiency of, as well as resolving the contradictions related to, firms' exploratory and exploitative alliances. Secondly, this study extends our understanding of the relationship between ambidexterity and absorptive capacity, thus offering fruitful insights for further studies to develop a combined view of both concepts. Finally, this paper argues that ability to recognize the value of new knowledge should be regarded as first dimension of potential absorptive capacity, and underlines its relevance for avoiding the inefficiencies and resolving the contradictions of balanced alliance networks. This argument contributes to current debates in the conceptual literature on absorptive capacity (Todorova & Durisin, 2007).

3.2 Theory and Hypotheses

3.2.1 Ambidexterity in Balanced Alliance Networks

Since March's (1991) influential idea that successful firms need to balance exploration and exploitation activities, the term "ambidexterity" has received much attention in organization and management research. Ambidexterity describes a firm's ability to simultaneously pursue both exploration and exploitation (Jansen et al., 2005b). While many empirical studies underline the importance of balancing exploration and exploitation activities for firm success (e.g., Adler et al., 1999; Gibson & Birkinshaw, 2004; He & Wong, 2004; Tushman & O'Reilly, 1996; Uotila, Maula, Keil, & Zahra, 2009), some studies acknowledge that new ventures in particular struggle to carry out both activities simultaneously (Yamakawa et al., 2011) because they lack the internal resources and capabilities to do so. Thus, stretching their boundaries by forming inter-organizational alliances for exploring new and exploiting existing knowledge allows new ventures—especially those operating in dynamic high-tech industries where learning is of utmost importance—to overcome their resource restrictions

and to expand their own resource base (Deeds & Hill, 1996; Koza & Lewin, 1998). In addition to shifting the locus of learning to the network level (Powell et al., 1996), research suggests that firms can profit from ambidexterity by establishing and maintaining balanced networks consisting of both exploration and exploitation alliances, henceforth referred to as alliance ambidexterity (Kauppila, 2010; Raisch et al., 2009).

While prior research has often focused on a particular dimension of alliance ambidexterity (e.g., Rothaermel, 2001b), more recently scholars have taken a broader view on the balance of explorative and exploitative alliances by introducing different domains in which firms can achieve it (Lavie & Rosenkopf, 2006). Specifically, the value-chain functions of alliances as well as the structural characteristics of alliance partnerships have been identified as the most important domains of alliance ambidexterity (Beckman et al., 2004; Koza & Lewin, 1998; Lavie et al., 2011; Lavie & Rosenkopf, 2006; Lin et al., 2007; Park, Chen, & Gallagher, 2002). Firms can pursue balance in the value-chain function of their different alliances, resulting in functional ambidexterity (Koza & Lewin, 1998; Rothaermel, 2001a, 2001b; Rothaermel & Deeds, 2004), because in the early stage of the value chain, research and development (R&D) alliances share tacit information and generate new knowledge, and are therefore focused on exploration. In contrast, marketing and distribution (M&D) alliances are mainly used for exploitation because commercialization and utilization of existing competencies are in the foreground here (Rothaermel, 2001b). Therefore, the focal firms' tendencies to engage in both alliance types can balance the explorative and exploitative knowledge in the value chain (Lavie & Rosenkopf, 2006; Park et al., 2002).

Firms can also balance exploration and exploitation in the structural characteristics of alliance partnerships, henceforth referred to as structural ambidexterity (Beckman et al., 2004; Lavie et al., 2011; Lavie & Rosenkopf, 2006; Lin et al., 2007; Rosenkopf & Nerkar, 2001). Recurrent alliances with existing partners are focused more on exploitation because firms can use established agreements as well as an existing knowledge base between the two firms

(Chung, Singh, & Lee, 2000; Gulati & Gargiulo, 1999). In contrast, alliances with new partners are used for exploration because by expanding their networks and generating new opportunities, firms also accept higher risk and the uncertainty of success (Beckman et al., 2004). Hence, balancing explorative knowledge and accessibility from new partners as well as exploitative knowledge with specific existing partners can enable ambidexterity at the level of the alliance network (Lavie & Rosenkopf, 2006; Lin et al., 2007).

3.2.2 Alliance Ambidexterity and Performance Outcomes

While past research has found that firms exhibit a tendency to balance explorative and exploitative alliances (Lavie & Rosenkopf, 2006), only a few recent empirical studies have examined the performance effects of alliance ambidexterity. These studies tend to question the benefits of balanced alliance networks and thus challenge an overall positive view of alliance ambidexterity. Lin et al. (2007), for example, found that structural balance in a firm's tendency to explore new alliance ties versus exploit recurrent ties has an undermining effect on performance. Similarly, Lavie et al. (2011) found that balancing exploration and exploitation within the functional and structural domains of alliance ambidexterity, respectively, leads to negative performance effects that can only be overcome by cross-balancing explorative and exploitative alliances over the functional and structural domains of alliance ambidexterity. Finally, Yamakawa et al. (2011) indicated that a fully balanced alliance network might be disadvantageous to firm performance if firms fail to base their strategic choice on their own internal firm characteristics as well as their industry's external environment. Therefore, firms might benefit more from specializing in exploration or exploitation in their alliance network if this strategic choice fits better with their organizational characteristics and environmental conditions.

One explanation for the decreasing performance implications of alliance ambidexterity might be the inefficiencies and contradictions arising when exploration and exploitation are

pursued simultaneously (Lavie et al., 2011; Levinthal & March, 1993). When sought at the same time, the firm's limited resource base might not be sufficient to carry out either process properly, leading to resource competition and putting process outcomes at risk. Moreover, locating exploration and exploitation activities within different business units (here, different alliance types) may result in operational redundancy, which is resource consuming and thus further increases problems of resource scarcity (Lavie et al., 2011; Tushman & O'Reilly, 1996). Thus, because they have limited resources, firms that try to balance their alliance networks might forego the benefits of specialization, leading to major inefficiencies that decrease firm performance (Stettner & Lavie, 2014). As firm size and age are positively associated with the amount of available resources (Beckman et al., 2004; George et al., 2002), new ventures are more likely to suffer from these inefficiencies.

In addition to the inefficiencies arising from balanced alliance networks, contradictions between the competing activities of exploration and exploitation prevent firms from fully benefiting from alliance ambidexterity. Routines and behavior that support exploration activities contradict those related to exploitation activities (March, 1991). Maintaining separate business units (here alliances) for the respective activities merely relegates the challenge of coordinating exploration and exploitation to top management, who must serve as referee decision maker for the two competing activities (Lavie et al., 2011). However, relegating the job of managing different external partnerships to top management may overload them as well as present a conflict of strategic pursuits, resulting in internal role conflicts when making strategic decisions (Maurer & Ebers, 2006). Moreover, firms that pursue exploration and exploitation simultaneously may ignore critical dissimilarities between these activities or even misapply routines and behavior that fit one activity but are mismatched or even detrimental to the other (Rothaermel & Deeds, 2006). As a result, organizational impediments associated with inefficiencies and contradictions can outweigh the benefits of balance, so that firms which simultaneously explore and exploit via their

alliances might experience negative performance consequences, especially when they are young and small.

While these conflicts are definitely a risk, recent research indicates that firms need cooperative, partner-related capabilities to fully leverage external knowledge from their alliances (e.g., Hoang & Rothaermel, 2010; Zahra & Hayton, 2008). By partner-related capabilities (particularly in science-based industries such as biotechnology) we mean a firm's capacity to select, absorb, and leverage its partner's knowledge (Grant, 1996; Grant & Baden-Fuller, 2004; Powell, 1998)—that is, their absorptive capacity. In the following section, we propose that constructing these alliances effectively—in particular by focusing on absorptive capacity—moderates the relationship between alliance ambidexterity and performance outcomes.

3.2.3 The moderating Role of Absorptive Capacity

Zahra and George (2002) define absorptive capacity „as a set of organizational routines and processes by which firms acquire, assimilate, transform, and exploit knowledge” (p. 186), and they distinguish between *potential* absorptive capacity (PACAP) and *realized* absorptive capacity (RACAP).

PACAP is the ability of a firm to acquire (i.e., access and import) and assimilate (i.e., interpret and understand) external knowledge from partner firms (Zahra & George, 2002). Additionally, Todorova and Durisin (2007) suggest extending the construct of PACAP by adding the ability to recognize (i.e., observe and detect) the value of new knowledge, which represents the first component in Cohen and Levinthal's (1990) original conceptualization of absorptive capacity. For several reasons, described below, PACAP can dampen the inefficiencies and contradictions related to establishing and entertaining explorative and exploitative alliances simultaneously.

A thorough observation of a firm's environment and an accurate assessment of potential partners' skills, capabilities, and knowledge ensures that firms are capable of recognizing the most suitable partners from a larger number of potential industry contacts (Lavie & Rosenkopf, 2006). Suitability may refer to exploratory alliances as well as to exploitative ones. For either kind of alliance, the ability to recognize the value of a partner's knowledge and skills helps a focal firm to overcome internal constraints and biases resulting from cognitive embeddedness, path dependency, or the misapplication of selection criteria (Maurer & Ebers, 2006; Todorova & Durisin, 2007). This helps avoid inefficiencies and resolve contradictions in the partner-selection process. Moreover, it lays the ground for a smooth functioning of the alliance activities to follow, as the firm is likely to profit from suitable partners whose skills, capabilities, and knowledge fit to the focal firm's needs and requirements (Stuart et al., 1999). Furthermore, the ability to acquire external knowledge helps firms to handle a simultaneous pursuit of exploration and exploitation alliances. It facilitates the absorption of external knowledge and increases the benefits from inter-firm collaboration with explorative and exploitative alliances (Fosfuri & Tribó, 2008). It also intensifies the speed of accessing and importing knowledge from a wide range of alliances and thus increases the efficiency of resource allocation in the acquisition process (Todorova & Durisin, 2007; Tsai & Wang, 2008). Additionally, the ability to assimilate enables firms to interpret and understand the acquired knowledge properly and is therefore of great importance for firms in order to realize the full value of their alliance networks (Xia & Roper, 2008). Firms that interpret their partners' knowledge properly benefit from an increased speed of knowledge sharing and collaboration in their balanced alliance network. Finally, the ability to understand partners' knowledge prevents misplaced behavior and reduces operational redundancy when carrying out exploration and exploitation alliances at the same time.

In sum, a high level of PACAP, defined as the ability to recognize, acquire, and assimilate external knowledge, allows firms to resolve internal contradictions, intensifies the

speed of knowledge sharing, and reduces operational redundancy. This enables firms, in particular new ventures, to overcome their internal resource constraints and the contradictions related to balancing explorative and exploitative alliances and thus to capture the full value of alliance ambidexterity. Therefore, we posit:

Hypothesis 1: The negative relationship between alliance ambidexterity and firm performance decreases with increasing levels of potential absorptive capacity.

Complementing PACAP, RACAP, using Zahra and George's (2002) definition, is the firm's capability to transform external knowledge (i.e., combine the newly acquired with existing knowledge) and apply it to the organization's operations. For several reasons explained below, RACAP can dampen the impediments related to establishing and maintaining exploration and exploitation alliances simultaneously.

The ability to combine external knowledge with the firm's current knowledge base accelerates both exploration and exploitation resulting from a firm's alliances. Because reinterpreting and converting external knowledge are time-consuming and resource intensive (Hansen, Podolny, & Pfeffer, 2001), a strong ability to transform knowledge helps firms reduce resource input and internal competition for limited resources, resulting in higher efficiency (Jansen et al., 2005a; Zander & Kogut, 1995). Additionally, combining multiple knowledge bases increases awareness of the similarities and critical differences between different knowledge-sharing processes. A better overview enables firms to avoid operational redundancy as well as reduce the risk of misapplied routines and behaviour in either process (Fontes, 2005; Lane et al., 2006). Further, the ability to apply knowledge helps firms to benefit more from their balanced alliance networks. In particular, the ability to create value from this knowledge harvests resources in a more efficient way and leads to measurable outcomes that are strongly related to a firm's efficiency in the knowledge-leveraging processes.

Taken together, a high level of RACAP increases the overall efficiency of knowledge integration and helps to overcome constraints resulting from limited resources and conflicting processes. This allows firms, in particular new ventures, to overcome the negative performance implications resulting from alliance ambidexterity. Accordingly, we propose:

Hypothesis 2: The negative relationship between alliance ambidexterity and firm performance decreases with increasing levels of realized absorptive capacity.

3.3 Methods

3.3.1 Sample and Data

The study focuses on the alliance networks of firms in the German biotechnology industry in the time frame from 2010 to 2014. To be competitive in the long-run, NBFs have to join alliances to overcome their restricted internal resources (Maurer & Ebers, 2006; Rothaermel & Deeds, 2004). Indeed, research has shown that the biotechnology industry compared with other industries has one of the highest alliance frequencies (Baum et al., 2000; Hagedoorn, 1993). Thus, we assume our sample is well suited to study our research questions.

We used several data sources to test our hypotheses on NBFs in Germany. First, to identify the NBFs, we used the *Yearbooks of the German Biotechnology Industry*, which is an annual directory of biotechnology firms in Germany published by BIOCOM AG³. We used the yearbook from 2013 to collect data on the number of employees and the type of biotechnology (i.e., red, green, blue, or white—a common distinction that represents the firm's focused application of biotechnology) the firms are active in. Secondly, we exactly determined the respective firms' founding dates, exit dates and circumstances, and legal forms and structures by using the daily registration and deregistration records of the German Commercial Register. Third, based on archival data coded from the monthly *Transcript* newsmagazine and the internet platform Bionity.com—both of which report on the German

³ <http://biocom.de>. BIOCOM AG is the leading information and consultancy provider for biotechnology and life sciences in Europe.

biotechnology industry—as well as the individual daily press releases published by the respective firms, we captured and coded the formation and termination of various cooperation events (such as research and development [R&D] and marketing and distribution [M&D] alliances, and in- and out-licensing agreements). Next, we used the European Patent Office to count the number of patents of the firms. Finally, we conducted a thoroughly pre-tested survey from August 2014 until December 2014 to collect data on the potential and realized absorptive capacity of firms as well as firm performance. Based on the pre-tests with industry experts, we identified the Chief Executive Officer (CEO) and the head of R&D as suitable informants for our survey because these senior managers are deeply involved in a firm's strategy and performance (McEvily & Zaheer, 1999). In total, we identified 469 potential firms for participation and in the end collected information on 163 of them, corresponding to a response rate of 35 percent. Due to missing data, we excluded five cases and used 158 (with complete data) for the further research analyses. On average, the firms in our sample are 11 years old and have 23 employees. Thus, the characteristics of our firms are similar to those of other studies in the biotechnology industry (e.g., Oliver, 2009: 36). For example, Oliver (2009) reports that biotech firms are rather small and most firms (87%) have fewer than 300 employees. In our case, the firms are even smaller because 87% of our firms have fewer than 40 employees. We observed 643 alliances in total in the observed five- year window from 2010 to 2014.

3.3.2 Variables and Measures

Dependent Variable

Most of the NBFs in our sample are private firms that are not affected by the strict disclosure regulations of publicly traded companies. Therefore, objective and reliable data on their financial performance was often not available from external sources. For this reason, we relied on the validated scale of Worren, Moore, and Cardona (2002). We used three items to

measure *firm performance* on a five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). As the survey data was collected in 2014, the performance variable was collected at the end of the five-year window we used for measuring alliance ambidexterity. In this way we aimed to account for the time lag between balancing the alliance network and the resulting performance effects. As described above, our respondents were the firm's CEO or head of R&D. The validity of this approach was backed by prior empirical studies showing that performance data reported by senior executives significantly correlates with other objective measures of firm performance (Dess & Robinson, 1984; Robinson & Pearce, 1988). For items, factor loadings, and Cronbach's alpha, see Table 3.1 below.

Independent Variables

To measure *ambidexterity* we relied on the distinction between a functional and a structural alliance ambidexterity (Lavie & Rosenkopf, 2006). To measure *functional ambidexterity* we used alliance announcements and classified each alliance as explorative if the alliance was a knowledge-generating R&D agreement (coded 1), exploitative if it was a knowledge-leveraging joint M&D or licensing agreement (coded 0), or a mixture of an R&D alliance and another alliance (coded 0.5). While some scholars might criticize labelling R&D alliances as explorative and M&D alliances as exploitative, this classification is well established in prior research (e.g. Lavie et al., 2011; Lavie & Rosenkopf, 2006; Rothaermel & Deeds, 2004). In addition, our pretest confirmed that—particularly in the biotechnology industry—R&D alliances focus on generating new knowledge, while M&D alliances focus on leveraging existing knowledge. Following the methods of Lin et al. (2007), we then generated an index for the firm's alliance portfolio by dividing the total number of exploration alliances by the total number of all alliances in a five-year window (2009-2013) prior to measuring our dependent variable. As also suggested by Lin et al. (2007), we classified all firms with index

values from 0.2 to 0.8 as ambidextrous alliances. As a result, we received a binary variable coded as 1 if the firm has a functional ambidexterity and 0 otherwise.

To measure *structural ambidexterity*, we classified new and old partners as proposed by March (1991) and executed by Beckman et al. (2004), Lavie and Rosenkopf (2006), and Lin et al. (2007). Based on our alliance search, we classified the alliances formed by a firm as exploitative if the firm had ties with old partners (i.e., partners the firm had prior cooperations with) and as explorative if the firm had ties with new partners (i.e., partners the firm had no prior cooperations with). As we did for functional ambidexterity, we generated an index by dividing the total number of new partners by the total number of all partners for a firm's alliances based on a five-year alliance window prior to the measure of our dependent variable. Using a five-year window is common in alliance research in the field of biotechnology (e.g., Milanov & Fernhaber, 2009; Phene & Tallman, 2012). Again, as with our functional ambidexterity measurements, we classified all firms with an index value from 0.2 to 0.8 as having an ambidextrous functional alliance set up, and again, as a result, our binary variable is coded as 1 if the firm has a structural ambidexterity and 0 otherwise.

Following prior research (Ebers & Maurer, 2014; Lane et al., 2006; Lewin et al., 2011), we measured the dimensions of *absorptive capacity* as manifestations of knowledge processes and routines to overcome the difficulties related to the measurement of intangible capabilities. The data were collected in 2014; that is, at the end of the five-year window in which we measured alliance ambidexterity. However, as Cohen (2007) states, knowledge processes and routines are commonly assumed to be stable and rigid over time. Thus, we are confident that the manifestation of absorptive capacity in the surveyed firms also applies to the four years prior to data collection. Based on Todorova and Durisin's (2007) argumentation, *potential absorptive capacity* captures the knowledge processes of recognizing, acquiring, and assimilating external knowledge, and we adopted the items from

the empirical studies of Engelen, Kube, Schmidt, and Flatten (2014); Jansen et al. (2005a); and Szulanski (1996).

To include the new dimension of recognition, we combined and adapted existing scales by following the standards of the current literature (Bagozzi & Yi, 1988). Five items assessed the extent to which firms were able to recognize the value of new knowledge. Further, four items measured the extent to which firms were able to acquire external knowledge. Due to low factor loadings, one item was deleted and the final scale for acquisition has three items. Finally, five items captured the extent to which firms were able to assimilate new knowledge. *Realized absorptive capacity* is reflected by the dimensions of transformation and exploitation (Zahra & George, 2002). We relied on validated items from empirical studies to measure this construct (Engelen et al., 2014; Jansen et al., 2005a; Smith et al., 2005). Six items measured the ability to transform new knowledge. Due to low factor loadings, two items were deleted and the final scale consists of four items. Four items were used to capture the extent to which firms are able to exploit new knowledge. We harnessed a five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree) for all the items. The measurement scales, the standardized loadings, and Cronbach's alphas of absorptive capacity dimensions are presented in Table 3.1.

Table 3.1: Standardized Loadings and Cronbach's Alphas of Performance and Absorptive Capacity

Factors and items	Standardized loadings	Cronbach's alpha
<i>Performance</i>		.865
- Compared to our competitors, our financial performance is significantly better.	.952	
- Compared to the industry average, our financial performance is outstanding.	.933	
- Compared to our competitors, our sales growth is significantly higher.	.762	
<i>Potential Absorptive Capacity (PACAP)</i>		
Recognize		.875
- We thoroughly observe technological trends in our industry sector.	.850	
- We have information on the state-of-the-art of external technologies within our industry.	.785	
- We frequently scan the environment for relevant information for our company.	.758	
- We thoroughly collect industry information (e.g. potential competitors, customer needs, etc.).	.752	
- We observe external sources of new products and technologies in detail.	.672	
Acquire		.653
- We often transfer new knowledge to our firm in response to acquisition opportunities.	.799	
- Employees regularly approach external institutions (e.g. universities, research institutes, etc.) to acquire technological knowledge.	.582	
- We periodically organize special meetings with external partners to acquire new technologies.	.491	
Assimilate		.787
- We quickly analyse and interpret new technology trends.	.926	
- We quickly analyse and interpret changing market demands (e.g. shifting structure of competition).	.714	
- We quickly understand new opportunities in our market (e.g. emerging customer needs)	.688	
- We constantly use the opportunity to ask our alliance partners for a better understanding of acquired knowledge.	.467	
<i>Realized Absorptive Capacity (RACAP)</i>		
Transform		.748
- We regularly match new technologies with ideas for new products.	.746	
- We quickly recognize the usefulness of new external knowledge to existing knowledge.	.618	
- We periodically discuss consequences of market trends and new technological developments for our knowledge base.	.594	
- We are used to recording and storing newly acquired knowledge for future reference.	.508	
Exploit		.816
- We are used to exploiting technologies in new products.	.800	
- We regularly apply technologies in new products.	.694	
- We are proficient in transforming technological knowledge into new products.	.687	
- We constantly consider how to better exploit knowledge.	.668	

We conducted several research steps to ensure the reliability and validity of the constructs after data collection. First, we tested the reliability of each construct. With exception of the dimension *acquire* ($\alpha = .653$), our Cronbach's alpha values are higher than the usual lower limit of .70 (Nunnally, 1978). Therefore, we additionally performed a corrected item-total correlation (CITC) reliability test and all of our CITC values are higher than the minimum acceptable value of .30 (Kerlinger, 1986). Thus, we reason from both Cronbach's alpha and CITC values that the scales for all constructs are reliable.

Next, we conducted a confirmatory factor analysis (CFA) to measure the degree of model fit, the explained variances and standardized residual for the measurement variables, and the adequacy of the factor loadings (Hoyle, 1995; Mulaik & James, 1995). As a result of the heterogeneous conception of absorptive capacity, we followed prior research and tested the convergent and discriminant validity as well as the dimensionality of the absorptive capacity construct by comparing four alternative measurement models (Ebers & Maurer, 2014; Tanriverdi & Venkatraman, 2005). To account for the variance among all 20 items, Model 1 has a unidimensional first-order factor. In Model 2, the 20 items form five first-order factors (recognize, acquire, assimilate, transform, exploit). In Model 3, the items form two first-order factors (PACAP and RACAP). Model 4 has the five first-order factors form two correlated higher-order factors (PACAP and RACAP). In Model 4, PACAP includes *recognize*, *acquire*, and *assimilate*, whereas RACAP contains *transform* and *exploit*. Comparison of Model 1 ($\chi^2 = 491,139$; $df = 163$ 3,013) with Models 2 ($\chi^2 = 305,721$; $df = 154$), 3 ($\chi^2 = 381,757$ und $df = 162$), and 4 ($\chi^2 = 313,613$ und $df = 158$) reveals that all other models are superior to Model 1 because they have lower chi-squares in relation to the degrees of freedom. These findings strongly support the previous assumption that the underlying dimensions of absorptive capacity are distinguishable and thus provide evidence for the multidimensionality of the construct. In Model 2, five first-order factors represent the distinct dimensions of absorptive capacity and the results show that it fits better than Model 3 with

PACAP and RACAP as two first-order factors. In line with prior research, these findings offer support for the process character of absorptive capacity with distinct process stages (e.g., Ebers & Maurer, 2014; Jansen et al., 2005a). Compared with Model 2 ($\chi^2/df = 1,9852$), the results of Model 4 do not make much of a difference, but Model 4 has a slightly lower ratio between χ^2 and degrees of freedom ($\chi^2/df = 1,9849$) and thus it is the better-fitting model. In further analysis, Model 2 was excluded because the two-factor solution proved superior and Model 4 covers the five dimensions as first-order factors, which form PACAP and RACAP as two higher-order factors. Furthermore, the results in Model 4 indicate convergent validity because all standardized factor loadings are highly significant ($p < .001$) and above the recommended minimum of 0.40 (Ford, MacCallum, & Tait, 1986). The results from another model in which the factors were not allowed to correlate demonstrated poorer fit and indicated that the correlations between the two factors are significantly different from zero. Moreover, the correlations are also below 0.90, showing the distinctiveness of the theoretical content captured by the first-order factors (Bagozzi, Yi, & Phillips, 1991). Together with the items' convergence on their factors, the findings provide support for discriminant validity (Bagozzi & Yi, 1988). Summarizing, comparisons between the different models promote the two-dimensionality of the higher-order constructs as well as their interrelationship.

Control Variables

To control for other factors that might influence the performance of our sample firms, we used a set of seven control variables.

First, we controlled for the *independence of the firms*, as firms belonging to larger companies are more likely equipped with adequate resources to support firm performance. For this measure, we used a dummy variable: 1 if the firm is not independent (i.e., a German subsidiary of a larger foreign biotechnology firm) and 0 if it is independent. Second, we controlled for *firm size*, as larger firms can draw on greater and more heterogeneous

resources, which is likely to increase firm performance and might also affect a firm's absorptive capacity. We measured firm size by the number of employees in 2013. Since biotechnology firms usually do not have a positive revenue stream at the beginning of their life, measuring firm size in terms of the number of employees circumvents the problems arising when trying to use the usual financial measures of size, such as revenues or market share (Stuart, Ozdemir, & Ding, 2007). We used a natural log to normalize the distribution of this variable. Third, we controlled for the *type of biotechnology* in which the firm is active in order to acknowledge the differences in opportunities and risks distributed across industry sectors and potentially having an impact on firm performance. We differentiated the firms in our sample based on their focused application of biotechnology. Following earlier research (Oehme & Bort, 2015), we also used a dummy variable, with 1 indicating that a biotechnology firm is mainly active in medical applications (Biotech type dummy [red = 1]), and 0 if otherwise. In doing so, we account for the fact that research and development in this sector is driven by a different agenda and operates within a distinctive regulatory regime (Powell et al., 1996). Fourth, consistent with prior research studies in the context of biotechnology—and in order to take into account liabilities of newness—we used *firm age* as a control variable (Owen-Smith & Powell, 2004; see also Phelps, 2010). Fifth, we also controlled for the *number of prior patent applications*. This variable is measured by the total number of a firm's patent applications cumulated to 2013. Since patenting is not only viewed as a strategic decision (e.g., for signaling), but also reflects the overall stock of knowledge of a firm and its commercial behavior, it might have an impact on firm performance (Tzabbar, Aharonson, Amburgey, & Al-Laham, 2008; Whittington, Owen-Smith, & Powell, 2009). Sixth, we controlled for the *amount of grants* a firm received in the year 2013 from the German Federal Ministry of Education and Research (BMBF), since not only the funds received but also the knowledge gained from taking part in this funding framework can have an effect on the performance of firms. We used a natural log to normalize the distribution of

the variable (*BMBF grant prior ln*). Finally, we controlled for the *number of alliances* in the alliance portfolio. We assume that the number of alliances has a positive impact on firm performance, as firms with many alliances can benefit from increased access to resource and information flows (Sorenson & Stuart, 2001).

3.3.3 Analysis

We used an ordinary least squares (OLS) regression technique to estimate the factors influencing firm performance. The least squares regression equation is

$$Y = a + b_n X_n + e$$

where a is the least-squares estimate of the population intercept, b_n is the least-squares estimate of the regression coefficient for the variables X_n , and e is a residual term. An important assumption in OLS regression is that the variance in the residuals is homoscedastic or constant (Stock & Watson, 2007). We used the Breusch-Pagan test and detect heteroscedasticity in our models. Thus, to account for heteroscedasticity we used the option *robust* in the STATA OLS regression command.

3.4 Results

Table 3.2 presents descriptive statistics and a correlation matrix for the variables used in the analyses.

Table 3.3 presents the results of the regression analysis. Model 1 in Table 3 is the base model, which includes the control variables. The other models subsequently add the parameter estimates.

Table 3.2: Descriptive Statistics and Correlations for the Analyses of Performance

Nr.	Variables	Mean	S.D	VIF	1	2	3	4	5	6	7	8	9	10	11	12
1	Performance	2.717	0.861	1.380	1											
2	Independent (yes=0)	0.114	0.319	1.090	0.018	1										
3	Number of employees in 2013 (ln)	2.703	0.936	1.310	0.269	0.17	1									
4	Firm age	11.190	12.269	1.180	-0.049	0.038	0.257	1								
5	Biotech type dummy (red=1)	0.734	0.443	1.060	-0.026	-0.1	-0.061	-0.095	1							
6	Number of alliances in Portfolio	3.241	4.089	1.070	0.162	-0.139	0.032	0.086	0.053	1						
7	Number of prior patent applications	3.494	7.641	1.130	-0.002	-0.047	0.133	0.17	-0.087	0.009	1					
8	BMBF grant prior ln	1.533	4.044	1.110	0.073	-0.073	0.156	0.004	0.094	0.083	0.107	1				
9	Functional ambidexterity	0.525	0.501	1.120	-0.18	-0.018	-0.032	-0.155	0.059	-0.022	0.077	-0.098	1			
10	Structural ambidexterity	0.437	0.498	1.120	-0.166	-0.035	0.016	-0.045	0.01	0.017	-0.035	0.01	0.096	1		
11	Realized absorptive capacity (RACAP)	3.804	0.637	2.180	0.311	0.04	-0.044	-0.079	-0.104	0.085	-0.061	0.164	-0.181	0.156	1	
12	Potential absorptive capacity (PACAP)	3.851	0.577	1.910	0.225	-0.048	0.021	0.021	-0.107	0.102	0.127	0.119	-0.129	0.068	0.662	1
Mean VIF				1.310												

N = 158

Table 3.3: OLS Regression Results, Dependent Variable: Performance

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Independent (yes=0)	-0.046 (0.209)	-0.108 (0.197)	-0.030 (0.204)	-0.109 (0.199)	-0.124 (0.197)	-0.176 (0.198)	-0.093 (0.188)	-0.137 (0.194)	-0.144 (0.190)
Number of employees in 2014	0.285*** (0.073)	0.306*** (0.070)	0.287*** (0.072)	0.306*** (0.070)	0.297*** (0.069)	0.292*** (0.069)	0.245*** (0.067)	0.276*** (0.068)	0.238*** (0.067)
Firm age	-0.012* (0.006)	-0.010 (0.005)	-0.012* (0.005)	-0.010 (0.005)	-0.011* (0.005)	-0.010 (0.005)	-0.009 (0.005)	-0.010 (0.005)	-0.009 (0.005)
Biotech type dummy (red=1)	-0.044 (0.148)	0.037 (0.141)	-0.000 (0.146)	0.036 (0.141)	0.042 (0.140)	0.022 (0.139)	0.077 (0.133)	0.023 (0.137)	0.065 (0.134)
Number of alliances in Portfolio	0.035* (0.016)	0.029 (0.015)	0.031 (0.016)	0.029 (0.015)	0.029 (0.015)	0.030* (0.015)	0.032* (0.014)	0.027 (0.015)	0.033* (0.014)
Number of prior patent applications	-0.001 (0.009)	0.000 (0.008)	-0.004 (0.009)	0.001 (0.008)	0.001 (0.008)	-0.000 (0.008)	0.004 (0.008)	0.000 (0.008)	0.003 (0.008)
BMBF grant prior ln	-0.000 (0.016)	-0.012 (0.016)	-0.004 (0.016)	-0.012 (0.016)	-0.010 (0.016)	-0.011 (0.016)	-0.015 (0.015)	-0.010 (0.015)	-0.014 (0.015)
Functional ambidexterity	-0.304* (0.132)	-0.199 (0.127)	-0.256† (0.131)	-0.200 (0.127)	-1.772* (0.774)	-2.232* (0.874)	-0.160 (0.120)	-0.185 (0.124)	-1.679† (0.921)
Structural ambidexterity	-0.286* (0.130)	-0.383** (0.125)	-0.316* (0.128)	-0.383** (0.125)	-0.340** (0.126)	-0.347** (0.124)	-3.664*** (0.752)	-2.973*** (0.833)	-3.392*** (0.906)
Realized absorptive capacity (RACAP)		0.445*** (0.102)		0.452** (0.136)	0.237 (0.170)	0.448** (0.134)	-0.033 (0.169)	0.376** (0.134)	-0.001 (0.203)
Potential absorptive capacity (PACAP)			0.309** (0.113)	-0.012 (0.146)	-0.045 (0.145)	-0.344 (0.201)	-0.086 (0.138)	-0.352* (0.178)	-0.329 (0.223)
Functional ambidexterity x RACAP					0.409* (0.199)				-0.026 (0.261)
Functional ambidexterity x PACAP						0.524*			0.417

						(0.223)			(0.305)
Structural ambidexterity x RACAP							0.864***		0.833**
							(0.196)		(0.272)
Structural ambidexterity x PACAP								0.675**	-0.033
								(0.215)	(0.300)
Constant	2.300***	0.494	1.083*	0.511	1.492*	1.868*	2.678***	2.185**	3.535***
	(0.248)	(0.474)	(0.508)	(0.520)	(0.701)	(0.772)	(0.693)	(0.734)	(0.856)
Number of observations	158	158	158	158	158	158	158	158	158
R-sq	0.178	0.273	0.218	0.273	0.294	0.300	0.359	0.319	0.374
Adj. R-sq	0.128	0.224	0.165	0.218	0.235	0.242	0.306	0.263	0.308
Root mean squared error	0.804	0.759	0.787	0.762	0.753	0.750	0.717	0.739	0.717

Legend: † p<.1; * p<.05; ** p<.01; *** p<.001

With regard to both functional and structural ambidexterity we find a consistent negative effect for structural ambidexterity in all our models. Functional ambidexterity is significantly negative only in the models without the interaction terms and absorptive capacity variables. In Hypothesis 1 we stated that the negative relationship between balancing explorative and exploitative alliances and firm performance decreases with increasing levels of potential absorptive capacity. We find that potential absorptive capacity weakens the negative effect of structural and functional ambidexterity in such a way that the coefficient for the interaction between structural ambidexterity and potential absorptive capacity (.675; $p < .01$) as well as the interaction between functional ambidexterity and potential absorptive capacity (.524; $p < .05$) has a positive impact on firm performance. Thus, Hypothesis 1 can be supported. Figures 3.1 and 3.2 illustrate this finding graphically.

In Hypothesis 2 we proposed that the negative relationship between balancing explorative and exploitative alliances and firm performance decreases with increasing levels of realized absorptive capacity. We find that the interaction coefficients between functional ambidexterity and realized absorptive capacity (.409; $p < .05$) as well as structural ambidexterity and realized absorptive capacity (.864; $p < .001$) have a positive effect on firm performance. Thus, Hypothesis 2 is fully supported by the data. Figures 3.3 and 3.4 illustrate this finding graphically.

We conducted a slope-difference test one standard deviation above and below the mean. The interaction between functional ambidexterity and realized absorptive capacity one standard deviation below the mean is negative and statistically significant, while the slope for the interaction between functional ambidexterity and realized absorptive capacity one standard deviation above the mean is positive but not statistically significant (see Figure 3.1). We find a similar pattern in the other interaction effects (Figures 3.2, 3.3, and 3.4). In particular, in all cases the interaction between functional ambidexterity and realized absorptive capacity, between structural ambidexterity and potential absorptive capacity, and

between structural ambidexterity and realized absorptive capacity one standard deviation below the mean is negative and statistically significant, while the slope for one standard deviation above the mean is positive but not statistically significant.

Figure 3.1: Functional Ambidexterity x RACAP

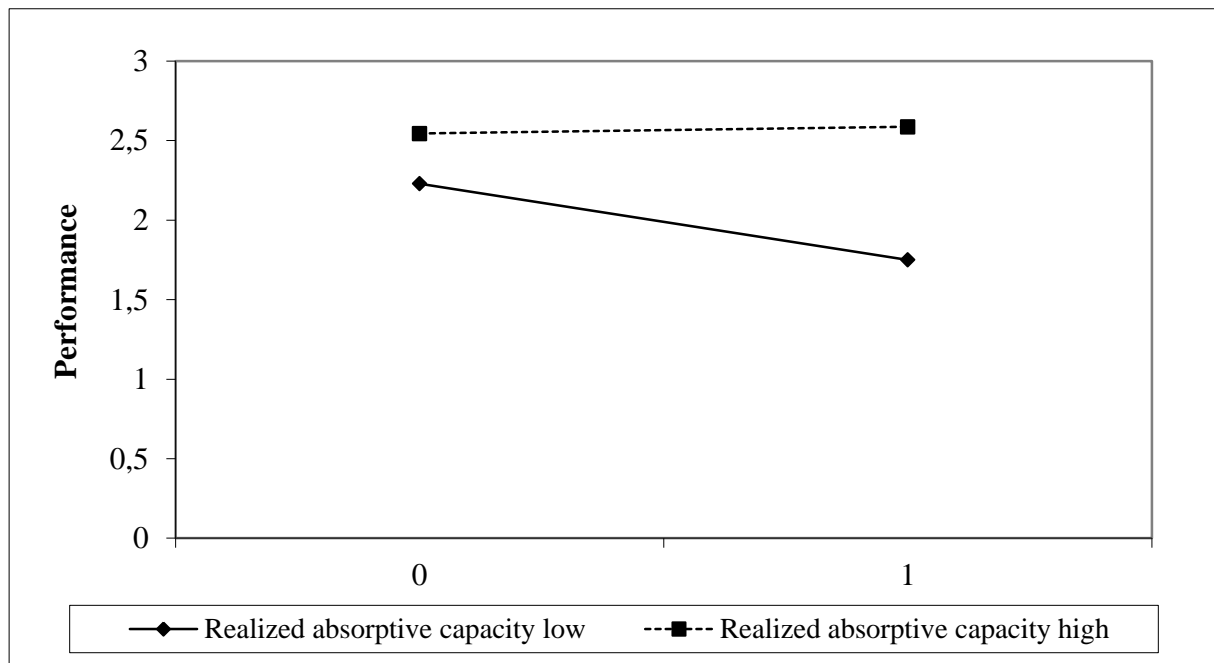


Figure 3.2: Functional Ambidexterity x PACAP

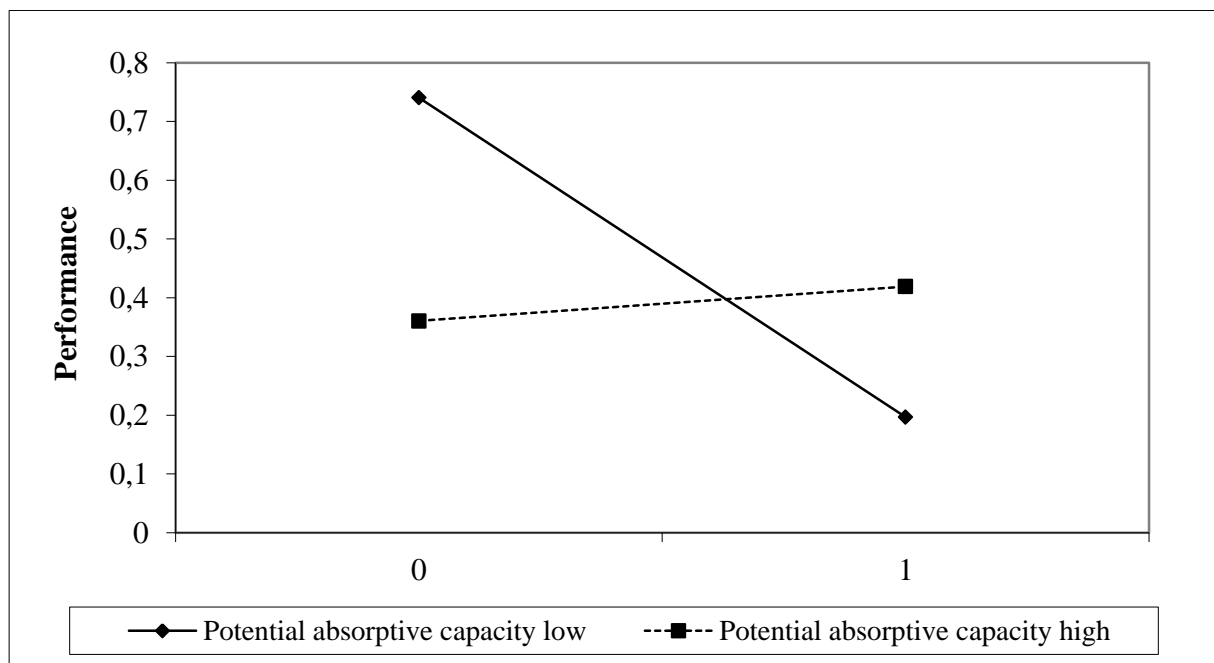


Figure 3.3: Structural Ambidexterity x RACAP

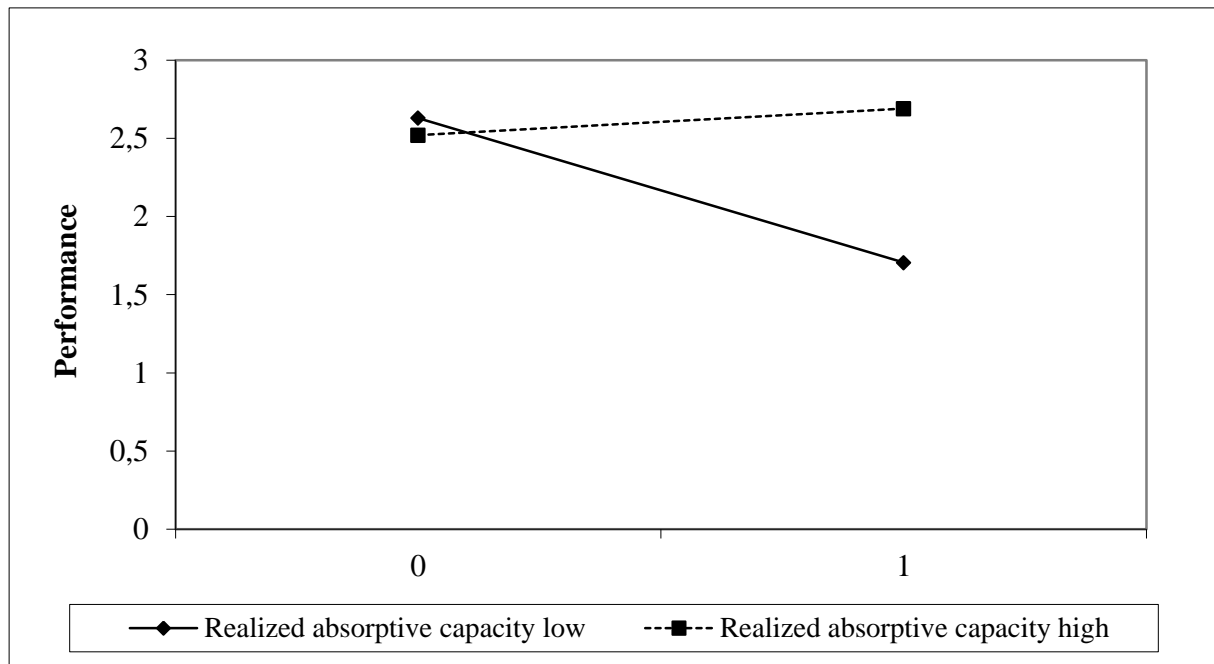
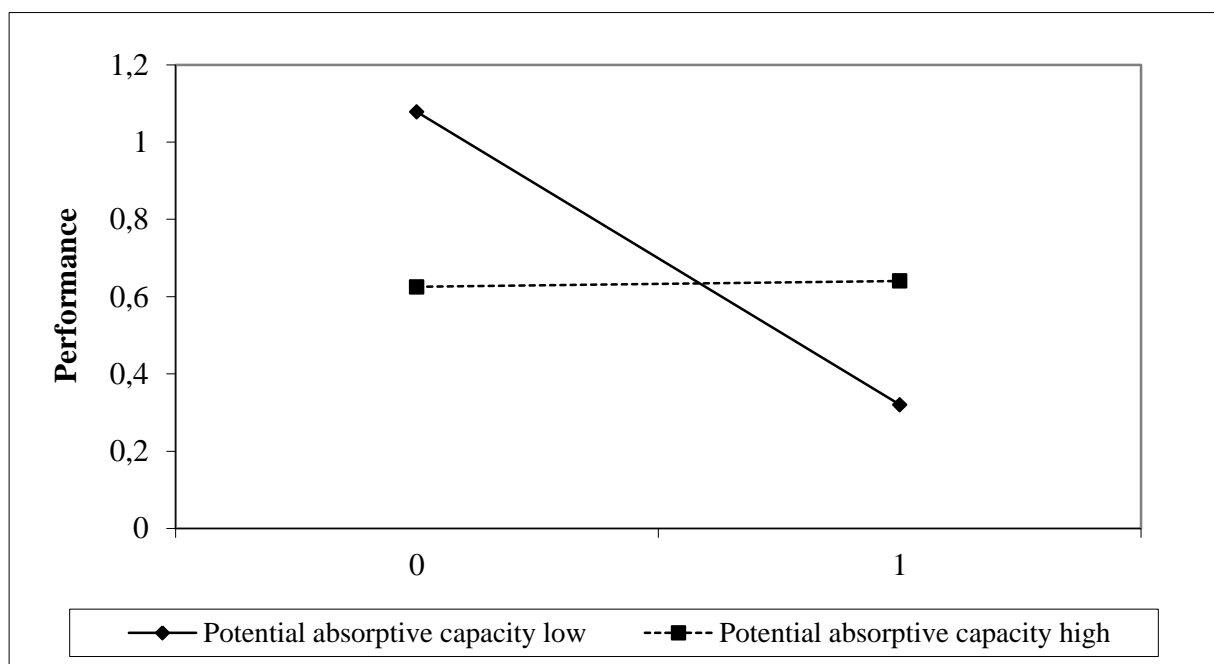


Figure 3.4: Structural Ambidexterity x PACAP



3.5 Robustness Checks

We conducted several checks to assess the robustness of our findings. First, as found in previous network studies (e.g., Milanov & Fernhaber, 2014), the correlations between alliance variables can be comparatively high. To address this issue, and in line with previous research

(e.g. Milanov & Fernhaber, 2014), we first calculated the variance inflation factor (VIF) for all variables. The mean VIF was 1.3, and all obtained VIFs of the independent and control variables were below the suggested critical value of 10 (Neter, Kutner, Nachtsheim, & Wasserman, 1996). Second, even if using a five- year alliance duration window is common in alliance research in the field of biotechnology (e.g., Milanov & Fernhaber, 2009; Phene & Tallman, 2012), we tested a three-year alliance window and found that our results are consistent in terms of the sign of the coefficients. However, since we have a shorter observation horizon, we lose 73 observations (firms) and, thus, the results are not significant anymore.

3.6 Discussion and Conclusion

While alliance literature promotes the merits of alliance ambidexterity (Beckman et al., 2004; Koza & Lewin, 1998; Rothaermel & Deeds, 2004), empirical findings reveal that firms, especially new ventures, often cannot realize the performance promises related to balancing exploration and exploitation in their alliance networks (Lin et al., 2007; Stettner & Lavie, 2014; Yamakawa et al., 2011). Therefore, this study sought to examine the impact of absorptive capacity as a specific partner-related capability on the relationship between alliance ambidexterity and firm performance. Findings underscore the role of both potential and realized absorptive capacity for capturing the full value of balanced alliance networks. More concretely, in line with prior research (Lavie et al., 2011; Lin et al., 2007), our findings demonstrate that balanced alliance networks have detrimental effects on firm performance, thus challenging an exclusively positive view of alliance ambidexterity. Yet, our findings also show that firms can realize positive performance effects from structurally balancing explorative and exploitative alliances when they are able to recognize the value of external knowledge, acquire this knowledge, and understand it properly, thus exhibiting high levels of PACAP. Similarly, when firms exhibit the ability to combine external knowledge with

existing knowledge and apply it, indicating high levels of RACAP, both functional and structural alliance ambidexterity positively impact firm performance.

These findings contribute to current research in several ways. First, this study introduces absorptive capacity as a partner-related yet firm-level capability that enables firms to overcome the impediments of balanced alliances networks. While slack resources enable larger firms to establish and entertain both explorative and exploitative alliances, new ventures—due to their scarce resource base—are likely to suffer from the inefficiencies and contradictions arising when exploration and exploitation are pursued simultaneously (Lavie et al., 2011). Accordingly, prior research proposed and corroborated that new ventures seem to benefit more from a focused approach, in which firms form either exploratory or exploitative alliances (Lin et al., 2007) or cross-balance explorative and exploitative alliances over the functional and structural domain of alliance ambidexterity (Lavie et al., 2011). While these studies provide fruitful insights by showing that new ventures can avoid the inefficiencies and contradictions of alliance ambidexterity when they implement the above-mentioned solutions at the level of the alliance network, they neglect firm-level solutions to cope with the impediments of balanced alliance networks. This study complements prior insights by introducing absorptive capacity as a firm-level solution that enables new ventures to increase the efficiency of, as well as resolve the contradictions related to, their exploratory and exploitative alliances and thus to profit from alliance ambidexterity.

Second, this study offers new insights into the complex interplay between ambidexterity and absorptive capacity. While Raisch and Birkinshaw (2008) in their literature review endorsed further investigations of variables that moderate the ambidexterity-performance relationship, we continued work from recent research that identifies absorptive capacity as an important moderator influencing this relation. While these studies found evidence that firms with higher levels of absorptive capacity profit more from ambidexterity in technology sourcing (Rothaermel & Alexandre, 2009) and cost mitigation of product

portfolio complexity (Fernhaber & Patel, 2012), our findings suggest that absorptive capacity is also vital to leverage ambidexterity at the network level. This is because firms with a well-developed absorptive capacity are able to reduce the impediments arising from a balance of explorative and exploitative alliances and concurrently profit from an increased efficiency in inter-organizational learning processes. Whereas ambidextrous routines improve the coordination of both types of partnerships and facilitate the management of different knowledge sources (Lavie & Rosenkopf, 2006), absorptive capacity reconciles the conflicting tensions of exploration and exploitation and thus allows for the integration of various knowledge resources (Eisenhardt & Martin, 2000). From a theoretical point of view, this study encourages further empirical research using a combined research design of ambidexterity and absorptive capacity to investigate the close links between both concepts. Moreover, future research might further investigate partner-related capabilities and instruments that positively influence the balance of exploration and exploitation in alliance portfolios. Fruitful ideas to extend our results are offered by Kauppila's (2010) framework of creating ambidexterity through inter-organizational partnerships.

Third, this study supports Todorova and Durisin's (2007) suggestion to further research a firm's ability to recognize the value of new knowledge as a first component of potential absorptive capacity. Our findings indicate that the ability to observe, evaluate, and judge new information is a critical dimension in the alliance ambidexterity context for various reasons. To form beneficial alliance networks, firms are challenged to identify the most suitable alliances from a larger number of industry contacts. Especially in high-technology industries like biotechnology, knowledge beyond the firm's boundaries does not often suit its specific demands (Cohen & Levinthal, 1990). Moreover, the absorption of new knowledge necessitates an understanding of prior related knowledge (Fleming & Sorenson, 2004; Oliver, 2004; Zucker et al., 2002). Accordingly, prior research has found evidence that the understanding of the partner's knowledge becomes crucial to ensure a successfully working

liaison (Fabrizio, 2009), and that smaller firms in particular profit more from partners whose skills, capabilities, and knowledge bases match their own needs and requirements (Stuart et al., 1999). The precise evaluation of potential partners' capabilities, knowledge, and skills therefore seems an important first component of a firm's overall capability to absorb external knowledge. Thus, the ability to recognize the value of new knowledge should be reconsidered in the concept of potential absorptive capacity (Todorova & Durisin, 2007).

Besides these theoretical contributions, the results of our study provide some managerial implications. Our findings confirm the difficulties of balancing alliance networks as well as the importance of firm-level capabilities to manage balanced alliance networks. This implies that new ventures in general, and NBFs more specifically, have to carefully weigh their firm capabilities and resources against the benefits of establishing and maintaining exploratory and exploitative alliances simultaneously. To fully profit from their alliance portfolio, firms need to invest in the development of partner-related capabilities. However, if the firm's resource base is too limited, it might be more efficient to focus on one alliance type to avoid negative performance effects (Lavie et al., 2011).

There are a number of limitations of this study that merit discussion. First, our study relies on self-reported data of senior managers to measure absorptive capacity. Though we conducted several steps in the design and testing stages of our survey to reduce concerns related to single-informant bias, we cannot completely exclude bias issues. Future research might therefore consider other informants and data sources for measuring absorptive capacity. Second, our sample of NBFs consists of small and young firms. As prior research already indicates that larger firms are not confronted with similarly limited resources and thus benefit more from an ambidextrous formation of explorative and exploitative alliances than do smaller ones (Lavie et al., 2011; Lin et al., 2007), our findings might not be directly transferable to larger firms. Still, future research could investigate whether specific partner-related capabilities also help larger firms to derive higher returns from their ambidextrous

alliance networks. Third, our findings reflect the present situation in the German biotechnology industry. Given the characteristic features of the biotechnology industry regarding networks for learning and knowledge creation (e.g. Oliver, 2009), our findings might contain some biotech idiosyncrasies. Although this focus on a single industry is useful to avoid significant industry- and country-specific effects, further empirical studies in other industries and countries are necessary to generalize the results.

In conclusion, this study extends our understanding of how new ventures can benefit from balanced alliance networks and thus invites future research to include firm-level capabilities such as absorptive capacity into the further investigation of the ambidexterity-performance link.

4 Chapter 4. Study 3: Antecedents and performance outcomes of absorptive capacity: An empirical investigation into the German biotechnology industry

After analysing how absorptive capacity, as a partner-related capability, influences the relationship between alliance ambidexterity and firm performance, Study 3 investigates how distinct intra-organizational antecedents affect the level of absorptive capacity, while at the same time testing the complementary effects of potential and realized absorptive capacity on firm performance. This study uses the process-based approach of absorptive capacity to examine how various social integration mechanisms influence the underlying processes of potential and realized absorptive capacity. The results show that potential and realized absorptive capacity benefit from formalized knowledge sharing and participation in decision finding but potential absorptive capacity suffers from informal communication. Moreover, findings show that potential and realized absorptive capacity not only have individually but also complementary effects on a firm's innovativeness and financial performance. Thus, this study shows that intra-organizational antecedents of absorptive capacity lead to varying levels of potential and realized absorptive capacity and thus enhances our understanding of why some firms benefit more from external knowledge than do others.

4.1 Introduction

Current research indicates that knowledge is an important source of competitive advantage in science-based industries such as biotechnology (Grant, 1996; Grant & Baden-Fuller, 2004; Spender, 1996). The biotechnology industry is mainly composed of small and medium-sized enterprises (SMEs) that face uncertainty and hypercompetitive market conditions (D'aveni, 2010). These market conditions—especially for SMEs—can hamper the exclusive intrafirm generation of new knowledge (Zahra, 1996). Therefore, alliances offer biotechnology firms cost-efficient access to new knowledge (DeCarolis & Deeds, 1999; Powell et al., 1996) that stimulates innovation and new-product development (Deeds & Hill, 1996; Flatten, Greve, et al., 2011). For successful cooperation, though, biotechnology firms need the ability to acquire and exploit the external knowledge (Powell, 1998). Literature on organizational learning suggests that absorptive capacity can provide that critical ability and help firms turn it into performance outcomes (Cohen & Levinthal, 1990; Tsai, 2001; Zahra & George, 2002).

Although empirical research has widely demonstrated that absorptive capacity is an essential driver of performance outcomes (e.g., Cohen & Levinthal, 1990; Fosfuri & Tribó, 2008; Kostopoulos, Papalexandris, Papachroni, & Ioannou, 2011), our understanding of how the distinct dimensions of absorptive capacity influence performance outcomes is still in its infancy (Volberda et al., 2010). In their conceptualization of absorptive capacity, Zahra and George (2002) suggest that potential absorptive capacity—defined as the firm's capability to acquire and assimilate new external knowledge—and realized absorptive capacity—defined as the firm's capability to transform and exploit external knowledge—have separate but complementary roles. Potential absorptive capacity is needed to continuously renew the firm's stock of knowledge, whereas realized absorptive capacity is necessary to achieve short-term profits by commercially leveraging the absorbed knowledge (Zahra & George, 2002). With exception of a few empirical studies (Ebers & Maurer, 2014; Jansen et al., 2005a; Schleimer & Pedersen, 2013), however, most research has investigated absorptive capacity by using

overall measurement proxies, and thus has neglected the underlying processes and routines that constitute its two separate components: potential and realized absorptive capacity (Flatten, Engelen, et al., 2011; Lane et al., 2006). Additionally, research indicates that potential and realized absorptive capacity not only have complementary effects on performance outcomes but might also have distinct antecedents (Lewin et al., 2011). Understanding how antecedents influence the underlying processes and routines of potential and realized absorptive capacity is important because differences in absorptive-capacity levels can explain why some firms profit more from external knowledge than do others. The explanatory effect of empirical findings on how intra-organizational antecedents influence the distinct dimensions of absorptive capacity is limited, though, because many studies have used absorptive capacity as an independent variable (Volberda et al., 2010), which means that measurement of separate effects has been masked by only looking at absorptive capacity as a whole.

This study contributes to current literature on absorptive capacity by addressing these two major research gaps: the underlying processes and routines of potential and realized absorptive capacity and the influence of antecedents on processes and routines as these relate to firm profit levels. First and foremost, this study examines how distinct social integration mechanisms—as intra-organizational antecedents—help firms to overcome barriers in knowledge-sharing processes and thus capitalize on the full value of absorptive capacity. While prior research has shown that several barriers, including structural or cognitive ones, might hamper the sharing and integration of knowledge (e.g., Dyer & Hatch, 2006; Nahapiet & Ghoshal, 1998), literature on absorptive capacity highlights the use of social integration mechanisms as a way to overcome these barriers and thus enhance absorptive capacity (Todorova & Durisin, 2007; Zahra & George, 2002). Therefore, this study distinguishes and empirically validates informal (i.e., informal communication and trust) and formal (i.e., formalized knowledge sharing and participation in decision finding) social integration

mechanisms and their impact on a firm's ability to recognize, acquire, assimilate, transform, and exploit new external knowledge—in other words, the impacts on a firm's absorptive capacity. Secondly, this study advances current research on absorptive capacity by examining the individually and complementary effects of potential and realized absorptive capacity on a firm's innovativeness and financial performance. Hence, the results emphasize that both dimensions of absorptive capacity play unique but complementary roles in the process of value creation. Together, these findings can explain why some firms achieve higher performance outcomes with their absorptive capacity than do others, and thus offers fruitful insights for future research (Volberda et al., 2010).

4.2 Theoretical Development

Zahra and George (2002) define absorptive capacity “as a set of organizational routines and processes by which firms acquire, assimilate, transform, and exploit knowledge” (p.186). The authors further differentiate this definition and distinguish between potential and realized absorptive capacity. Potential absorptive capacity (PACAP) refers to a firm's ability to “acquire (i.e. access and import) and assimilate new knowledge (i.e. interpret and understand it),” whereas realized absorptive capacity (RACAP) concerns a firm's ability “to transform the knowledge (i.e. combine the newly acquired with the existing knowledge) and exploit it (i.e. apply it to the organization's operations)” (Ebers & Maurer, 2014, p. 319). Todorova and Durisin (2007) further refine the definition and construct by adding to it the ability to recognize the *value* of new knowledge, the first component of Cohen and Levinthal's (1990) original conceptualization.

To avoid intangibility issues by conceptualizing absorptive capacity as a bundle of routines and capabilities (Zahra & George, 2002), other researchers have highlighted the process-based view of absorptive capacity, which captures the separate underlying processes that form the capability (Lane et al., 2006; Lewin et al., 2011). However, the number of

studies that have empirically examined these underlying processes and routines is very limited (e.g. Ebers & Maurer, 2014; Jansen et al., 2005a) because most empirical studies have deployed overall proxies such as R&D spending to measure absorptive capacity (Lewin et al., 2011). This approach is heavily criticized because it distorts construct validity (Lane et al., 2006) and therefore calls for a new approach to examine and understand the underlying processes.

In addition to construct validity, it remains unclear how the distinct dimensions of absorptive capacity impact a firm's performance outcomes. Particularly, scholars indicate that PACAP and RACAP are differently influenced by antecedents (Jansen et al., 2005a; Vega-Jurado, Gutiérrez-Gracia, & Fernández-de-Lucio, 2008) that have individual and complementary effects on these outcomes (Volberda et al., 2010; Zahra & George, 2002). Complementarity appears when two activities are positively interconnected and mutually reinforce each other (Cassiman & Veugelers, 2006). In the context of absorptive capacity, PACAP is necessary to continuously renew the firm's knowledge base, whereas the RACAP enables firms to achieve short-term profits (Volberda et al., 2010). Hence, firms with stronger PACAP will achieve greater performance outcomes independent of the level of RACAP (and vice versa). By relying on the process-based approach of absorptive capacity (Lane et al., 2006; Zahra & George, 2002), this study addresses the separate and complementary effects of the underlying processes of PACAP and RACAP on the firm's performance outcomes. Thus, it contributes to current research by enhancing our understanding of performance implications stemming from the distinct dimensions of absorptive capacity.

According to Volberda et al. (2010), another important research gap is how intra-organizational antecedents influence the level of absorptive capacity, a gap that exists because most empirical investigations have used absorptive capacity as an independent variable. As a consequence, only few studies have investigated the antecedents of the distinct dimensions of absorptive capacity (e.g. Jansen et al., 2005a). Differences in the *degree* of absorptive

capacity, however, might explain why some firms achieve higher performance outcomes than do others. Previous research has indicated that several barriers inhibit knowledge transfer and integration (Nahapiet & Ghoshal, 1998), and thus hamper firms from fully capitalizing on the value of absorptive capacity. However, we still know little about intra-organizational antecedents that lower the barriers to organizational learning by influencing distinct dimensions of potential and realized absorptive capacity.

These barriers are relevant and important to understand, because learning is a social process among individuals and it demands that information be shared in order to successfully apply and leverage knowledge (Zahra & George, 2002). Research has shown that several barriers impede intrafirm knowledge transfer and application, including organizational barriers, such as separate units and departments within a firm (Ardichvili, Maurer, Li, Wentling, & Stuedemann, 2006; Hofstede, 2001); cognitive barriers, which include distinct mindsets and learning schemata (Nahapiet & Ghoshal, 1998; Szulanski, 1996); and hierarchical barriers of authority and responsibility (Matusik, 2002; Teece, Pisano, & Shuen, 1997).

To overcome these barriers, Zahra and George (2002) have highlighted that social integration mechanisms (SIMs) can enhance knowledge sharing and integration and thus enhance absorptive capacity. Social integration refers to the “degree to which an individual is psychologically linked to others in a group” (O'Reilly et al., 1989: p. 22). Consisting of sociocultural shared values, norms, and other socially enabling mechanisms (Lewin et al., 2011; Tsai & Ghoshal, 1998), SIMs seek to connect all firm members (Jansen et al., 2005a) and thus facilitate the generation, sharing, and integrating of knowledge (Todorova & Durisin, 2007). Because absorptive capacity is conceptualized as a set of organizational routines and processes consisting of social interactions (Zahra & George, 2002), it is very likely that SIMs influence each dimension of PACAP and RACAP (Todorova & Durisin, 2007). While research has identified SIMs as important intra-organizational antecedents of absorptive

capacity (Lewin et al., 2011; Todorova & Durisin, 2007; Volberda et al., 2010; Zahra & George, 2002), only few empirical studies have investigated the distinct effects of SIMs on the different dimensions of absorptive capacity. Jansen et al. (2005a) demonstrate that a firm's coordination capabilities (e.g., participation) primarily empower PACAP, while its socialization capabilities (e.g., socialization tactics) primarily advance RACAP. Further, Fosfuri and Tribó (2008) have examined the antecedents of PACAP and find evidence that SIMs positively influence the relationship between PACAP and innovation performance. Instead of using a direct measure for SIMs, however, Fosfuri and Tribó (2008) use the density of linkages as a proxy to measure socialization capabilities. While the use of proxy measures is criticized on the grounds of validity (Lane et al., 2006), there is as yet no alternative explanation in the form of empirical evidence explaining how distinct SIMs impact the complementarity of absorptive capacity. These limitations prevent us from fully understanding how SIMs affect absorptive capacity.

This study seeks to address these critical limitations in absorptive capacity research by empirically examining whether the underlying processes of PACAP and RACAP are differently influenced by specific sets of SIMs. In the sections that follow, this study outlines the influence of informal (i.e., informal communication and trust) and formal (i.e., formalized knowledge sharing and participation in decision finding) SIMs on the distinct dimensions of absorptive capacity.

4.2.1 How Informal Communication and Trust impact Absorptive Capacity

While research has shown that strong ties facilitate knowledge sharing among individuals (e.g., Ahuja, 2000; Maurer et al., 2011; Van Wijk, Jansen, & Lyles, 2008), scholars argue that underlying those strong ties is communication (Hansen, 1999). In this section, we focus on informal communication mechanisms which aim to promote strong ties among firm members. First, though, a distinction between weak and strong ties: According to Granovetter's (1973)

theory, weak ties are distant and infrequent relationships offering access to new knowledge by connecting otherwise isolated parties in knowledge-change processes. Thus, weak ties are an efficient mode for seeking and acquiring new knowledge, because a widely scattered number of contacts decreases the likelihood of redundant knowledge (Granovetter, 1973). While searching for new knowledge is beneficial to the extent that the recipient receives different information from each sender, strong ties—in contrast—can restrict access to novel information because recipients restrict their intense relations to a limited number of contacts, resulting in potentially redundant knowledge (Hansen, 1999). Hence, informal communication with dense linkages among employees reduces their available time to develop new contacts to external knowledge sources, and therefore inhibits the search for diverse knowledge opportunities (Jansen et al., 2005a). Moreover, informal communication mechanisms that foster strong ties among firm members are likely to increase redundancy of information and limit the openness to new information, reducing the inflow of new knowledge (Nahapiet & Ghoshal, 1998; Todorova & Durisin, 2007). Therefore, this study proposes that informal communication mechanisms which aim to promote the strength of ties among firm members will constrain members' ability to recognize, acquire, and assimilate new external knowledge; in other words, these mechanisms limit a firm's PACAP.

Hypothesis 1a: Informal communication negatively influences potential absorptive capacity.

Although strong ties can increase redundancy of information, scholars indicate that these same ties among firm members are positively related to knowledge sharing and integration (Bartsch, Ebers, & Maurer, 2013; Maurer et al., 2011; Rowley, Behrens, & Krackhardt, 2000) and can enhance a firm's RACAP (Ebers & Maurer, 2014). This suggestion is empirically supported by Jansen et al. (2005a), who find evidence that a high density of linkages positively influences the ability to transform and exploit new absorbed knowledge. Transforming that knowledge, however, is a complex process that can be

negatively impacted by reduced personal mobility and lack of common understanding (Fontes, 2005). In a study on communication patterns and project performance, Katz and Tushman (1979) have shown that the efficiency of integration mechanisms depends on the task characteristics and they detect that especially complex tasks require intensive face-to-face contact with other firm members. Informal communication mechanisms promoting the strength of ties offer rich communication channels that increase the frequency of face-to-face contacts and thus the awareness of the existence and value of new information (Nahapiet & Ghoshal, 1998; Smith et al., 2005). Moreover, dense relationships are likely based on common understanding, which reduces the costs of linking existing knowledge with new insights (Reagans & McEvily, 2003; Zahra & George, 2002). Further, research indicates that close relationships among firm members reduce the likelihood of implementation issues and conflicting goals, facilitating the application and utilization of absorbed and transformed knowledge (Rindfleisch & Moorman, 2001). Hence, this study suggests that informal communication which aims to intensify the strength of ties will positively influence the ability to transform and exploit new absorbed knowledge; that is, it positively influences a firm's RACAP.

Hypothesis 1b: Informal communication positively influences realized absorptive capacity.

In knowledge-sharing processes, trust is understood as an exchange partner's positive expectations that the opposite party acts with goodwill and competence (Das & Teng, 2001). These positive expectations increase the likelihood that other firm members ask for information and support (Nahapiet & Ghoshal, 1998; Tsai & Ghoshal, 1998) and thus foster intrafirm knowledge sharing and integration (Dirks & Ferrin, 2001; Inkpen & Tsang, 2005). Establishing mutually trusting relationships, though, is very time intensive and because of that, firm members might misallocate their resources by overinvesting in intrafirm trust, reducing their opportunities to search for external knowledge (McEvily, Perrone, & Zaheer,

2003). By investing excessively in establishing trusting relationships within the firm, firm members tend to rely on only a few trusted firm contacts to gather information, inhibiting the inflow of new ideas (Molina-Morales, Martínez-Fernández, & Torlo, 2011). Moreover, the one-sided focus on internally trusted relationships can result in the “not-invented-here” syndrome or other forms of constrained thinking that hamper the monitoring of alternative views from external knowledge sources (McEvily et al., 2003). Thus, firms that overemphasize intrafirm trust might suffer collective blindness and inertia which prevent them from observing and accessing external knowledge sources with alternative information (Molina-Morales et al., 2011; Yli-Renko, Autio, & Sapienza, 2001). Based on the discussion above, this study argues that trust inhibits a firm’s ability to recognize, acquire, and assimilate new external knowledge; that is, it negatively affects its PACAP.

Hypothesis 2a: Trust will negatively affect potential absorptive capacity.

Another aspect of trust, according to research, is that it not only increases knowledge sharing and integration (Dirks & Ferrin, 2001; Inkpen & Tsang, 2005), but also facilitates knowledge transformation (Wu, 2008) and knowledge utilization (Szulanski, Cappetta, & Jensen, 2004; Zaheer, McEvily, & Perrone, 1998). Integrative mechanisms such as informal norms of reciprocity or common goals create compatible systems and cultures which positively influence the openness and speed in knowledge-exchange processes, and thus increase cooperation and joint problem solving (Dyer & Singh, 1998; McEvily et al., 2003). Further, high levels of reciprocal expectations and common goals can decrease the cost of knowledge sharing because firm members feel less need to verify the knowledge for accuracy, enabling them to spend more time transforming and exploiting the assimilated knowledge (McEvily et al., 2003; Zaheer et al., 1998). Recently, Ebers and Maurer (2014) empirically showed that project members’ trusted internal relations with other firm members strengthen RACAP because trusted relationships with high expectations of reliability and quality of novel information increase the likelihood that firm members apply new knowledge

(Schoorman, Mayer, & Davis, 2007). Therefore, this study hypothesizes that trust enhances a firm's ability to transform and exploit newly absorbed knowledge; that is, trust enhances a firm's RACAP.

Hypothesis 2b: Trust positively enhances realized absorptive capacity.

4.2.2 How Formalized Knowledge Sharing and Participation in Decision Finding impact Absorptive Capacity

Formalized knowledge sharing is the degree to which firms use formalized instructions and formal integration mechanisms to promote knowledge exchange among firm members. Formalized knowledge sharing aims to enhance communication and coordination opportunities, and research has demonstrated that several formal integration mechanisms such as information systems and databases (Allen, 1970; Goh, 2002), technological gatekeepers and coordinators (Allen & Cohen, 1969; Whitley & Frost, 1973), and job rotation (Adler et al., 1999; Lam, 1997) are useful in facilitating the processes of observing and acquiring new external knowledge (Zahra & George, 2002). For instance, Jansen et al. (2005a) have examined coordination mechanisms as organizational antecedents of absorptive capacity and find empirical evidence that job rotation supports knowledge acquisition and assimilation because it creates diverse knowledge structures that foster explorative learning and mutual understanding. Formalized knowledge sharing that uses tools (e.g., intranet, internal studies/reports) to spread knowledge within the whole firm can enhance the ability to recognize the value of new information (Cabrera & Cabrera, 2002). Moreover, formalized knowledge sharing enables quick information flows, increasing knowledge exchange and thus the ability to access new information (Alavi & Leidner, 2001). Hence, this study posits that formalized knowledge sharing positively influences a firm's ability to recognize, acquire, and assimilate new external knowledge; in other words, it positively influences a firm's PACAP.

Hypothesis 3a: Formalized knowledge sharing positively influences potential absorptive capacity.

Formalized knowledge sharing is also beneficial in improving a firm's RACAP by reducing structural barriers that inhibit an effective communication and knowledge combination across distinct firm departments. Due to knowledge specialization, expertise and knowledge is often held locally in projects, teams, or departments (Garvin, 1993). Although firm members who are directly involved in local groups profit from specialized knowledge, scholars suggest that firms with effective formal coordination instruments that connect all firm members will do better in leveraging knowledge than will firms with weakly coupled firm members (Levinthal & March, 1993; March, 1991). Knowledge-transformation processes require the ability to interpret knowledge in a different manner and recognize new links between an existing knowledge base and new information (Zahra & George, 2002). Hence, formalized knowledge-sharing mechanisms which foster cross-departmental cooperation in a firm can support the transformation of new knowledge because they increase communication, teamwork, and interaction (Cohen & Levinthal, 1990; Jones & Craven, 2001). For example, Jansen et al. (2005a), in addition to arguing that job rotation fosters PACAP, provide empirical evidence that job rotation as a formal integration mechanism positively influences a firm's ability to transform that new knowledge because it increases awareness of alternative knowledge sources within the firm and thus fosters the abilities of employees to combine distinct knowledge sources. Further, formal integration mechanisms like peer-reviewed databases offer new combination and storage opportunities for firms (Nonaka & Konno, 1998) and research has shown that contributing to and using a database positively affect cross-departmental communication and knowledge combination (Cabrera & Cabrera, 2002). Thus, this study assumes that formalized knowledge sharing is positively related to a firm's ability to transform and exploit new absorbed knowledge; that is, it positively relates to RACAP.

Hypothesis 3b: Formalized knowledge sharing positively relates to realized absorptive capacity.

Participation in decision finding refers to the degree to which employees are encouraged or allowed to take part in higher-level decision-making processes (Mitchell, 1973; Schuler, 1980). Research indicates that participation is an important and appropriate instrument for overcoming barriers in knowledge-sharing processes (Van Den Bosch, Volberda, & De Boer, 1999) and enhancing PACAP (Jansen et al., 2005a). Participation of different firm members increases the variety of perspectives in decision finding and thus positively affects members' ability to recognize the value and quality of new ideas (Cohen & Levinthal, 1990). Moreover, participation of employees with different backgrounds can increase the comprehension of distinct knowledge sources and thus support the assimilation of new knowledge. Recently, Vega-Jurado et al. (2008) provide empirical support for this suggestion in their study on innovative behaviour of SMEs by showing that SIMs promoting employee participation positively influence a firm's PACAP. Hence, this study argues that participation in decision finding positively influences a firm's PACAP.

Hypothesis 4a: Participation in decision finding positively influences potential absorptive capacity.

In addition, participation in decision finding can also facilitate the exchange, transformation, and exploitation of assimilated knowledge because it provides more opportunities for knowledge combination (Hurley & Hult, 1998; Sheremata, 2000; Swart & Kinnie, 2003). Employee participation improves the communication and information flow between distinct hierarchical levels and thus enables firms to utilize individuals' knowledge located at lower firm levels (Grant, 1996). Participative work environments enhance firm members' awareness of opportunities for linking existing knowledge with novel information (Damanpour, 1991). Firm members who are involved in decision-finding processes are encouraged to experiment with new ideas and opportunities, increasing the transformation and

application of absorbed knowledge (Hurley & Hult, 1998; Scott & Bruce, 1994). Therefore, this study argues that participation in decision finding positively influences a firm's ability to transform and exploit new assimilated knowledge; that is, decision finding positively influences a firm's RACAP.

Hypothesis 4b: Participation in decision finding positively influences realized absorptive capacity.

4.2.3 Performance Outcomes of Absorptive Capacity

Empirical studies have widely demonstrated that absorptive capacity has positive effects on a firm's performance outcomes such as innovation (e.g., Ebers & Maurer, 2014; Fabrizio, 2009), financial performance (e.g., Kostopoulos et al., 2011; Wales et al., 2013), and competitive advantage (Chen et al., 2009). The conceptual distinction between PACAP and RACAP, however, suggests that both constructs have unique but complementary roles in the process of value creation (Zahra & George, 2002). PACAP is necessary to successfully value and acquire new external knowledge, but RACAP is the primary source for commercially leveraging the absorbed knowledge (e.g. Grant & Baden-Fuller, 2004). This implies that firms with stronger RACAP will have greater performance outcomes than those with weaker RACAP independent of the level of PACAP, because a stronger RACAP enables them to transform and commercially exploit more of the knowledge they have previously absorbed. Conversely, firms with stronger PACAP will achieve greater innovativeness compared to firms with weaker PACAP independent of the level of RACAP, because a stronger PACAP allows firms to acquire and assimilate more new knowledge from external sources.

Despite this strong logic, only a few studies have empirically investigated how PACAP and RACAP separately and together influence a firm's performance outcomes such as financial performance and innovation (Ebers & Maurer, 2014; Schleimer & Pedersen, 2013; Volberda et al., 2010). While Flatten, Greve, et al. (2011) find evidence that all

dimensions of PACAP and RACAP positively impact firm performance, as well as the success of strategic alliances, Ebers and Maurer (2014) have shown that PACAP and RACAP not only separately positively influence, but also complementarily positively influence a firm's performance outcomes, indicating that absorptive capacity is greater than its separate dimensions. To test the applied conceptualization of absorptive capacity and to contribute to the limited empirical research findings regarding the separate but likely complementary effects of PACAP and RACAP, this study posits:

Hypothesis 5: Potential and realized absorptive capacity complement one another in enhancing a firm's performance outcomes (i.e., innovativeness and financial performance).

4.3 Methods

4.3.1 Sample and Data

This study focuses on small and medium-sized German biotechnology firms to investigate how distinct SIMs impact the different dimensions of absorptive capacity by allowing a firm to overcome barriers in knowledge-sharing processes and increasing connectedness among a firm's employees. The choice of the biotechnology industry as research setting was influenced by prior research and is suitable for several reasons: First, the industry is characterised by many SMEs that have to join alliances in order to extend their limited internal resources and to be competitive in the long term (Baum et al., 2000; Powell et al., 1996). Indeed, prior research finds that the biotechnology industry has one of the highest alliance frequencies of any industry (Hagedoorn, 1993). Second, research has highlighted the importance of absorptive capacity as a way to successfully leverage external knowledge from biotechnology alliances (Deeds et al., 2000; Powell et al., 1996) and has empirically shown that biotechnology firms benefit from a high absorptive capacity (George, Zahra, Wheatley, &

Khan, 2001; Hoang & Rothaermel, 2010; Lane & Lubatkin, 1998). For these reasons, I believe that this sample is appropriate to examine my research questions.

I rely on several data sources to investigate the above hypotheses, and in the discussion below, I use the SME definition from the European Commission, which applies an upper limit of 250 employees to these firms⁴.

First, I identified the complete population of German biotechnology SMEs by using the *Yearbooks of the German Biotechnology Industry*, an annual directory of all active biotechnology firms in Germany published by BIOCOM AG⁵. More precisely, I used the yearbook from 2013 to determine the number of employees of each firm and the type of biotechnology (i.e., red, green, blue, or white—a common distinction that represents the firm's focused application of biotechnology). Second, I used the daily registration and deregistration records of the German Commercial Register to determine the firm's founding and exit dates as well as its legal form and structure. Thirdly, I captured and coded events such as the formation and termination of alliances, licensing agreements, and the initiation or termination of international activities by using archival data coded from the monthly *Transcript* newsmagazine and the internet platform bionity.com—both of which report on the German biotechnology industry—as well as the individual daily press releases published by the respective firms. Additionally, I gathered the firms' patents from the European Patent Office. Finally, I collected the data for the independent and dependent variables by using a thoroughly pre-tested questionnaire conducted between August and December 2014. The pre-tests with industry experts identified the Chief Executive Officer (CEO) and the head of R&D as the most appropriate informant for my survey because they are strongly integrated in processes of knowledge acquisition, knowledge sharing, and knowledge application.

⁴ http://ec.europa.eu/growth/smes/business-friendly-environment/sme-definition_en. The European Commission offers a definition of SMEs in order to determine eligibility for EU support specifically targeted to small firms.

⁵ <http://biocom.de>. BIOCOM AG is the leading information and consultancy provider for biotechnology and life sciences in Europe.

Moreover, previous research has shown that these senior management positions are also suitable informants for the firm's innovativeness and financial performance (McEvily & Zaheer, 1999). To further limit the risk of common-method bias for the dependent variable, however, I additionally compared the subjective performance statements with available objective data for firm performance (i.e., firm growth) and found no significant differences. Additionally, I compared the subjective statements of the respondents with a second data collection in February 2016 among the 163 participating firms of my first sample. The 33 percent response rate for the second data collection and the comparison of both data sets showed a strong, positive, and highly significant correlation of the performance variables. Thus, I assume that the subjective statements for the performance data are valid and reliable.

In total, I identified a complete population of 469 biotechnology SMEs as potential participants for my study and in the end, 163 firms participated in the study, representing a response rate of 35 percent. Five cases were excluded due to missing data, thus the data analysis that follows relies on 158 cases with complete data. To control for non-response bias, I conducted a t-test, which showed no significant differences between the participating firms and nonparticipating firms in relation to variables such as industry and firm size (number of employees). Moreover, I also found no significant differences between early and late participating firms with respect to all major variables and controls. On average, the firms in my sample are 11 years old and have 23 employees. These numbers are consistent with other studies conducted in the biotechnology industry (e.g. Oliver, 2009, p. 36). For instance, Oliver (2009) has reported that most biotechnology firms (87 percent) have fewer than 300 employees. Compared to her study, the firms in my sample are even smaller because 87 percent of them have fewer than 40 employees. Because external knowledge absorption for the firms in my sample plays an important role, I additionally recorded the number of alliances of each firm. In total, all firms have a combined 643 alliances in the observed five-year window from 2010 to 2014.

4.3.2 *Operational Measures of the Variables*

To measure the dependent and independent variables, this study uses existing measures from the literature whenever possible. However, appropriate scales for SIMs were not available and I developed appropriate scales by following the standards of the current literature (Bagozzi & Yi, 1988). More specifically, I created a pool of items for each construct of social integration mechanisms by thoroughly reviewing existing relevant literature (e.g. Flatten, Engelen, et al., 2011; Jansen et al., 2005a; Jansen et al., 2006; Maurer et al., 2011). In a second step, I pre-tested the survey measures in 15 in-depth interviews with biotechnology industry experts to ensure the construct validity, homogeneous understanding, and practical relevance of the items. After the experts completed the survey, they were prompted to make suggestions for improving it (e.g., phrasing of the items). For all variables of my theoretical model, I used multiple-item constructs to enlarge content coverage. With the exception of some control variables, I harnessed a five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree) for the items. The Appendix shows all measurement scales.

Performance Outcomes

Following previous research on absorptive capacity (e.g., Escribano, Fosfuri, & Tribó, 2009; Tsai, 2001), I used *innovativeness* and *financial performance* as the most common variables for capturing the overall firm performance from absorptive capacity. In the study's sample, the majority of participating SMEs are private firms which are not required to observe the strict disclosure regulations of publicly traded companies. Hence, objective and reliable data on their performance outcomes is often not available from external sources. Thus, I relied on validated five-point Likert scales from 1 (strongly disagree) to 5 (strongly agree) and used a scale with two items developed by Zaheer and Bell (2005) to measure each firm's *innovativeness*. To measure a firm's *financial performance*, I adapted a three-item scale used by Worren, Moore, and Cardona (2002). As mentioned above, my respondents are the firm's

CEO or head of R&D, and previous research has shown evidence that performance data reported by senior executives significantly correlates with other, objective measures of firm performance (Dess & Robinson, 1984; Robinson & Pearce, 1988).

Absorptive Capacity

To avoid the difficulties related to the measurement of intangible capabilities, I followed prior empirical studies that relied on the process-based approach of absorptive capacity (Ebers & Maurer, 2014; Jansen et al., 2005a). Thus, I measured the dimensions of absorptive capacity as manifestations of a set of knowledge processes and routines (Lane et al., 2006; Lewin et al., 2011). By relying on existing measures from empirical studies whenever possible, I have carefully selected suitable items that solely capture processes and routines and used the most conservative approach possible.

I followed Todorova and Durisin's (2007) argument and extended *potential absorptive capacity (PACAP)* by including the knowledge processes of *recognition*, *acquisition*, and *assimilation* of external knowledge, and I used items from the empirical studies of Engelen et al. (2014); Jansen et al. (2005a); and Szulanski (1996). To the most commonly applied dimensions of PACAP (i.e., acquisition and assimilation) I added the dimension of recognizing the value of new external knowledge. To capture this additional dimension, I combined and adapted existing scales following the standards of the current literature (Bagozzi & Yi, 1988). Five items estimate the extent to which firms are able to *recognize* the value of new knowledge. Further, the extent to which firms are able to *acquire* external knowledge was measured by four items. Due to low factor loadings, one item was deleted and the final scale has three items. Finally, five items assess the extent to which firms are able to *assimilate* new knowledge.

Realized absorptive capacity (RACAP) captures the two dimensions *transform* and *exploit* (Zahra & George, 2002). I selected suitable items from existing scales to measure this

construct (Engelen et al., 2014; Jansen et al., 2005a; Smith et al., 2005). *Transform* consists of six items which measure the ability to combine new knowledge with the existing knowledge base. Because of low factor loadings, two items were deleted and the final scale has four items. The measures of *exploit* consist of four items that assess the extent to which firms are able to exploit new external knowledge to develop new products.

Social Integration Mechanisms

To measure *Social integration mechanisms* (SIMs), I distinguished informal communication, trust, formalized knowledge sharing, and participation in decision finding. Eight items measure a firm's informal communication used to promote the strength of ties among employees. Low factor loadings excluded two items and the final scale consists of six items. Four items measure trust within firms, but because of low factor loadings, one item was deleted and the final scale consists of three items. Seven items were used to measure the extent of formalized knowledge sharing. Six items measure participation in decision finding procedures firms use to foster knowledge exchange, but again, because of low factor loading, two items were deleted and the final scale consists of four items.

Control Variables

I used a set of six control variables to test for other factors that might influence a firm's innovativeness and financial performance. First, I controlled for *firm size* because larger firms might have slack resources that likely increase their innovativeness and financial performance (Damanpour, 1991). Since young biotechnology firms in particular often have no positive revenue streams, I measured firm size by the logarithm of the number of employees in 2013 to avoid the issues resulting from the use of financial measures for size in these cases, such as revenues or market share (Stuart et al., 2007). Secondly, I controlled for the *type of biotechnology* in which a firm is active because within-industry differences may influence a

firm's innovativeness and financial performance (George et al., 2001). In line with current research (Oehme & Bort, 2015), I used a dummy variable with 1 indicating that a biotechnology firm is mainly active in medical applications (biotech type dummy [red = 1]), and 0 if otherwise. By including this variable, I take into account prior results which indicate that research and development in the biotechnology industry is driven by a different strategy agenda and operates under different regulatory systems (Powell et al., 1996). Thirdly, I included *firm age* (measured by the number of years from the founding date to 2014) as a control variable because it may affect a firm's innovativeness: organizational inertia can hamper older firms and result in fewer new innovations (Levinthal & March, 1993; March, 1991). Fourth, I controlled for the *number of prior patent applications*, which is measured by the total number of a firm's patent applications cumulated through 2013. While patenting can be viewed as a strategic decision (e.g., for signalling), it also reflects the overall stock of a firm's knowledge and its commercial behaviour. Therefore, it might have an impact on a firm's innovativeness and financial performance (Tzabbar et al., 2008; Whittington et al., 2009). Fifth, funding plays an important role for young biotechnology firms, and financial support influences a firm's financial performance. In addition, a firm's innovativeness might profit from the knowledge acquired by taking part in this funding framework. Hence, I controlled for the total *amount of grants* (in Euros) a firm received in the year 2013 from the German Federal Ministry of Education and Research (BMBF) by using a natural log to normalize the distribution of the variable (BMBF grant prior ln). Lastly, I controlled for the *number of alliances* in the alliance portfolio of the firms in my sample. I assume that the number of alliances might have a positive impact on a firm's innovativeness and financial performance because firms with many alliances can profit from increased access to resource and information flows (Sorenson & Stuart, 2001).

4.3.3 Analytical Procedures and Validation of Measures

Data Analysis Methods

I conducted the data analysis by using the statistical software packages of SPSS and AMOS version 24 and I selected the maximum likelihood estimates (MLE) approach for determining the structural equation modelling (SEM). Using Anderson and Gerbing's (1988) two-step approach, I first tested the measurement model by using the confirmatory factor analysis (CFA) prior to the structural model to ensure that my theoretically derived model would match the available data.

Reliability and Validity

Several research steps were taken to ensure the reliability and validity of my constructs after data collection. First, I tested the reliability of each construct. All Cronbach's alpha values are higher than the recommended minimum of 0.70 (Nunnally, 1978) except for the acquisition dimension ($\alpha = 0.653$). Although this value seems acceptable because of the theoretical foundation of the constructs (and other studies might also accept a value slightly below 0.70; e.g. Bartsch et al. 2013), I additionally conducted a corrected item-total correlation (CITC) reliability test, and all CITC values are above the acceptable lower limit value of 0.30 (Kerlinger, 1986). Hence, I conclude from both Cronbach's alpha and CITC values that the measures for all constructs are reliable. Table 4.1 represents the results of the reliability analysis.

Table 4.1: Reliability Analysis for the Constructs

Construct	Initial number of items	Number of items carried forward to the analysis	Cronbach's α	CITC range of the underlying items
<i>Potential absorptive capacity</i>				
Recognize	5	5	.875	.644 ~ .758
Acquire	4	3	.653	.435 ~ .517
Assimilate	5	4	.787	.399 ~ .756
<i>Realized absorptive capacity</i>				
Transform	6	4	.748	.488 ~ .609
Exploit	4	4	.816	.489 ~ .708
<i>Social integration mechanisms (SIMs)</i>				
Formalized knowledge sharing	7	7	.800	.447 ~ .635
Participation in decision-finding	6	4	.783	.537 ~ .636
Informal communication	8	6	.830	.522 ~ .748
Trust	4	3	.830	.617 ~ .736
<i>Performance outcomes</i>				
Innovativeness	2	2	.844	.731 ~ .731
Financial performance	3	3	.865	.659 ~ .801

Confirmatory Factor Analysis (CFA)

In a next step, I performed a confirmatory factor analysis (CFA) to measure the degree of model fit, the explained variances and standardized residual for the measurement variables, and the adequacy of the factor loadings (Hoyle, 1995; Mulaik & James, 1995). As a consequence of the heterogeneous conception of absorptive capacity, I followed previous studies and first tested the convergent and discriminant validity as well as the dimensionality of the absorptive capacity construct by comparing five alternative measurement models (Ebers & Maurer, 2014; Tanriverdi & Venkatraman, 2005). Model 1 has a unidimensional first-order factor to capture the variance among all 20 items. Based on all 20 items, Model 2 creates five first-order factors (*recognize, acquire, assimilate, transform, exploit*). In Model 3, the items form two first-order factors (PACAP and RACAP). In Model 4, five first-order factors create the two correlated higher-order factors PACAP and RACAP, in which PACAP is formed by the first-order factors *recognize, acquire, and assimilate*; and RACAP contains the first-order factors *transform and exploit*. Model 5 constitutes absorptive capacity as a higher-order factor that accounts for the relationship between the second-order factors PACAP and RACAP. Comparison of Model 1 ($\chi^2 = 491,139$; $df = 163$ 3,013) with Model 2 ($\chi^2 = 305,721$; $df = 154$), Model 3 ($\chi^2 = 381,757$ and $df = 162$), and Model 4 ($\chi^2 = 313,613$ and $df = 158$), respectively, demonstrates that all other models are superior to Model 1 because they have lower chi-squares in relation to the degrees of freedom. These comparisons confirm the previously stated assumption that absorptive capacity dimensions are distinguishable, since they promote the multidimensionality of the construct. Compared with the two first-order factors PACAP and RACAP in Model 3, results show that Model 2, with five first-order factors for the distinct dimensions of absorptive capacity, fits better. These results reinforce previous findings that point to an absorptive capacity process character with distinct process stages (e.g., Ebers & Maurer, 2014; Jansen et al., 2005a). In comparison to Model 2 ($\chi^2/df = 1,9852$), the results of Model 4 only vary slightly, but Model 4 has a slightly lower ratio

between χ^2 and degrees of freedom ($\chi^2/\text{df} = 1,9849$) and thus it is the better-fitting model. I excluded Model 2 in further analyses because the two-factor solution proved superior, and Model 4 covers the five dimensions as first-order factors which form PACAP and RACAP as two higher-order factors. In addition, all standardized factor loadings in Model 4 are highly significant ($p < 0.001$) and above the acceptable lower limit of 0.40, which supports convergent validity (J. K. Ford et al., 1986). Further, I also tested another model in which both higher-order factors were not allowed to correlate. The results from this model showed poorer fit and suggested that the correlations between the higher-order factors are significantly different from zero. Moreover, correlation values are below 0.90, indicating that the theoretical content represented by the first-order factors is distinct (Bagozzi, Yi, & Phillips, 1991).

In addition to the items' convergence on their factors, these results indicate discriminant validity (Bagozzi & Yi, 1988). So far, model comparisons offer support for the two-dimensionality of the higher-order factors PACAP and RACAP as well as their interrelationship.

In another configuration, I examined whether absorptive capacity as a higher-order factor is superior to the two lower-order factors PACAP and RACAP. Following the advice from Venkatraman's (1990) study, I included *innovativeness* and *financial performance* as external criterion variables to enable the comparison of Model 5 with Model 4 from the previous stage. For higher-order factors, it is unsuitable to compare the ratio between the change in chi-square and the change in degrees of freedom (Venkatraman, 1990). Therefore, I followed Tanriverdi and Venkatraman's (2005) procedure and used three criteria: (1) model statistics of the two specifications (Venkatraman, 1990), (2) target coefficient (T) statistics (Marsh & Hocevar, 1985), and (3) significance of the parameters reflecting the higher-order factor loadings (Venkatraman, 1990).

Model statistics of the lower-order ($\chi^2 = 447$, $df = 259$) and higher-order ($\chi^2 = 448.9$, $df = 260$) models are approximately similar. These results promote the higher-order model because it explains the factor covariations more effectively (fewer parameters to be estimated and more degrees of freedom) (Venkatraman, 1990). Next, I calculated the ratio of the chi-square value of the lower-order factor model to the chi-square value of the higher-order factor model to generate the target coefficient value ($T = 0.9956$). This value is very close to the theoretical upper bound of 1, which strongly supports the claim that the higher-order factor effectively explains the inter-correlations between the lower-order factors (Marsh & Hocevar, 1985). The target coefficient of 0.9956 demonstrates that absorptive capacity accounts for 99.56 percent of the relations among the lower-order factors PACAP and RACAP. Moreover, all factor loadings were highly significant ($p < 0.001$), which provides further complementary empirical support for the acceptance of the higher-order factor model (Venkatraman, 1990).

These results indicate reliability, multi-dimensionality, and convergent and discriminant validity of the absorptive capacity construct. In line with the underlying theory, absorptive capacity as a higher-order construct accounts for the complementarities among the lower-order factors PACAP and RACAP.

In a further step, I conducted an integrated CFA on all items of absorptive capacity, social integration mechanisms, and the firm's performance outcomes to control for construct independence (Hair et al., 2010; O'Leary-Kelly & Vokurka, 1998). Each item is permitted to load only on the factor for which it is the proposed indicator. For an acceptable model fit, Hair et al. (2010) suggest that at least three indices must fit well. Table 4.2 shows the overall fit indices for the CFA model and indicates a good model fit, with $\chi^2/df = 1.473 < 3$, $SRMR = 0.0761 < 0.090$, $RMSEA = 0.055 < 0.08$.

Table 4.2: Summary of Model Fit Indices for CFA Model

Measure	Threshold	Results
Chi-square		1349,053
df		916
Chi-square/df (cmin/df)	< 3 good (Kline, 2011)	1.473
CFI	> .95 great; > .90 traditional; > .80 sometimes permissible (Hair et al., 2010)	.877
PGFI	> .50 (James, Mulaik, & Brett, 1982)	.654
IFI	> .90 (Hair et al., 2010)	.880
TLI	> .90 (Browne, Cudeck, Bollen, & Long, 1993)	.868
SRMR	< .09 (Hair et al., 2010)	.0761
RMSEA	< .80 (Bagozzi & Yi, 1988)	.055
PCLOSE	> .05 (Hair et al., 2010)	.101

I tested this measurement model for its reliability, convergent validity, and discriminant validity. Results showed that Cronbach's alpha values and the composite reliability (CR) for the six latent variables achieve the critical minimum of 0.70, which indicates a satisfactory level of internal consistency of the measures (Bagozzi & Yi, 1988; Hair et al., 2010).

Convergent validity of all multi-item constructs was proved using factor loadings, CR, and average variance extracted (AVE). The paths from the items to the factors are all highly significant ($p < 0.001$) and the standardized factor loadings are above the recommended minimum of 0.40 (Ford et al., 1986). In addition, CR values match the advised minimum of 0.70 and the AVE results are above 0.50 (Bagozzi & Yi, 1988). In sum, these results provide support for convergent validity (Hair et al., 2010).

I used the maximum shared squared variance (MSV) to test the discriminant validity of the measurement model. For discriminant validity, Hair et al. (2010) recommend that the MSV values should be less than the AVE values. Additionally, I used Fornell and Larcker's (1981) test to determine whether each construct's AVE is greater than its squared correlation with any other construct in the model. The results for both tests imply that the measurement model aligns with the assumptions that were initially made and that multicollinearity is not a problem in my model (Grewal, Cote, & Baumgartner, 2004; Hair et al., 2010).

Finally, I conducted a common-method bias test where I compared the unconstrained common-method factor model to the fully constrained common-method factor model (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). The results from the Chi-Square test showed no significant difference between the two models, thus I have no significant shared variance in the measurement model.

Structural Model Analysis

All constructs were included in a path model and I added all control variables for the structural-equation analysis. To examine the proposed complementarities between PACAP and RACAP in influencing innovativeness and financial performance for Hypothesis 5, I followed previous research and compared two structural-equation models (Ebers & Maurer, 2014; Tanriverdi & Venkatraman, 2005). In Model I, a firm's innovativeness and financial performance are directly affected by PACAP and RACAP. Model II captures absorptive capacity as a higher-order factor formed by the lower-order indicators PACAP and RACAP. As the primary source of covariance among the lower-order factors PACAP and RACAP, the higher-order construct *absorptive capacity* provides an explanation for the coexistence and covariance of the lower-order factors (Ebers & Maurer, 2014). Figure 4.1 shows the direct-effects model (Model I) in my research, whereas Figure 4.2 represents the complementarity model (Model II).

Figure 4.1: Direct Effects Model (Model I)

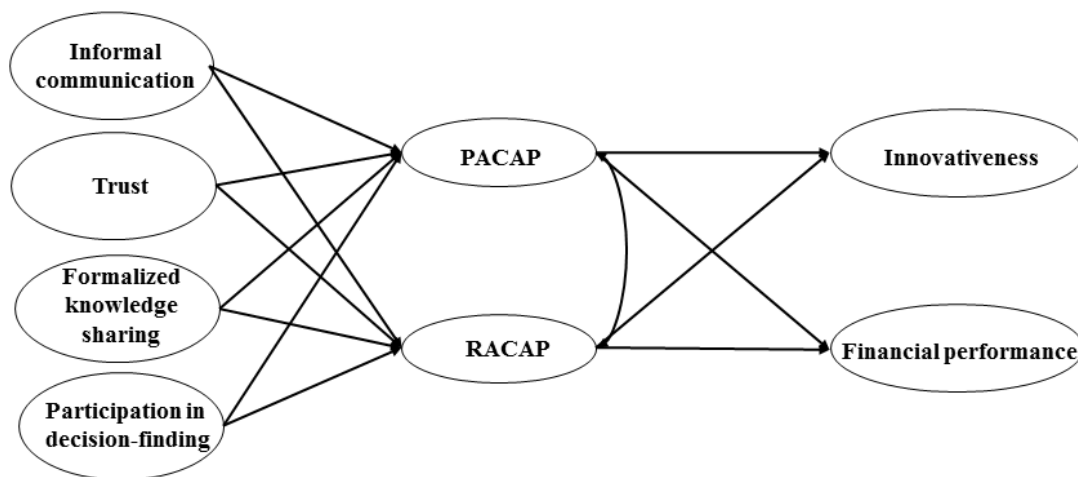
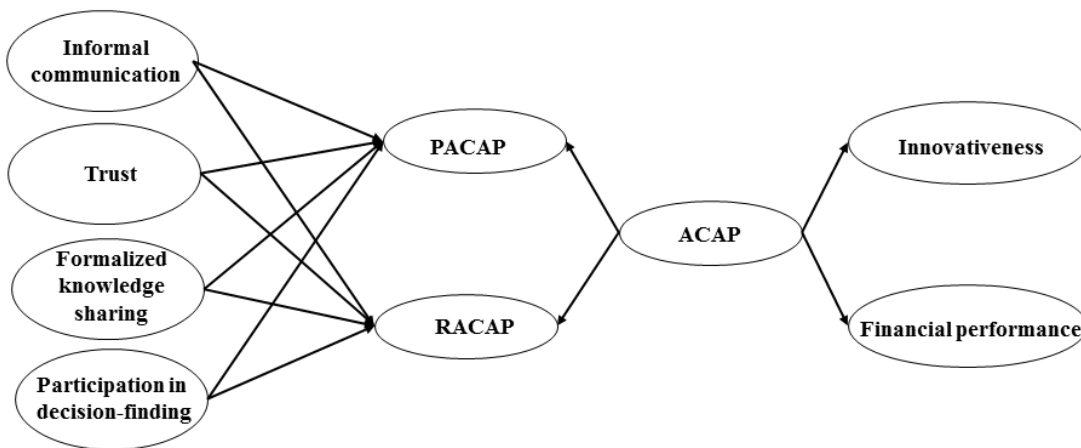


Figure 4.2: Complementarity Model (Model II)



In the final presentation of my findings, I omitted the insignificant paths-of-control variables on the dependent variables. While these specifications improved model fit in both models, significance and direction of hypothesized paths remained unaltered.

4.4 Results

Table 4.3 shows the descriptive statistics and correlations for all model constructs.

Table 4.4 presents the values and significance levels of the path coefficients as well as all control variables and the goodness-of-fit results for both structural equation models: In Model I, I tested the direct effects of PACAP and RACAP on innovativeness and financial performance. Model II captures absorptive capacity as a higher-order factor that accounts for

complementarities among PACAP and RACAP in affecting innovativeness and financial performance.

Hypothesis 1a states that informal communication negatively affects a firm's PACAP. The coefficient for informal communication in Model I (PACAP, $p < .05$) is significant and negative and in Model II, results show a marginally significant negative influence of informal communication on PACAP ($p < .10$). Thus, Hypothesis 1a is supported. Hypothesis 1b, which posited that informal communication is positively related to RACAP, is not supported. The coefficients (RACAP, $p > .10$) are not significant. Thus, informal communication does not improve the transformation and exploitation of new absorbed knowledge. The coefficients for trust (PACAP, $p > .10$; RACAP, $p > .10$) are not significant either; hence, Hypotheses 2a and 2b are not supported. Hypotheses 3a and 3b stated that formalized knowledge sharing is positively related to PACAP and RACAP. While the results do not support Hypothesis 3a (PACAP, $p > .10$), formalized knowledge sharing has highly significant and positive effects on RACAP ($p < .001$). Thus, Hypothesis 3b is fully supported by the data. Hypotheses 4a and 4b refer to participation in decision finding as a further antecedent for PACAP and RACAP. As hypothesized, participation in decision finding positively enhances both dimensions of absorptive capacity. Thus, the results provided support for both hypotheses. Hypothesis 5 claimed that PACAP and RACAP complement each other in increasing innovativeness and financial performance. Comparing the results between Model I and Model II offers support for this hypothesis. Coefficients of the higher-order construct *absorptive capacity* are strongly positive and significant for the dependent variables *innovativeness* ($p = .002$) and *financial performance* ($p = .014$). Results in Model I show that the direct effects of PACAP on innovativeness and financial performance are not significant. Contrary to my prediction, these findings promote previous assumptions in research showing that the PACAP does not relate to the commercial leveraging of absorbed knowledge (Lane et al., 2006).

Table 4.3: Means, Standard Deviations, and Correlations for all Constructs in the Model

Nr.	Variables	Mean	S. D.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1.	Innovativeness	3.47	.95																		
2.	Financial Performance	2.72	.86	.441**																	
3.	Firm size	2.70	.94	.076	.253**																
4.	Biotech type dummy (red=1)	.73	.44	-.041	-.016	-.061															
5.	Firm age	11.12	12.27	-.092	-.048	.257**	-.095														
6.	Number of prior patent applications	3.49	7.64	-.020	.001	.133	-.087	.170*													
7.	Grants	1.53	4.04	.114	.081	.156	.094	.004	.107												
8.	Number of alliances	3.24	4.09	.136	.150	.031	.053	.086	.009	.083											
9.	Recognize	4.02	.69	.316**	.096	-.025	-.039	.058	.172*	.079	-.035										
10.	Acquire	3.61	.78	.237**	.186*	.027	-.107	.024	.092	.068	.184*	.498**									
11.	Assimilate	3.92	.65	.461**	.299**	.052	-.117	-.035	.050	.148	.085	.577**	.401*								
12.	Transform	3.90	.64	.399**	.281**	-.054	-.153	-.071	.063	.099	.073	.503**	.396**	.643**							
13.	Exploit	3.71	.76	.384**	.294**	-.032	-.040	-.076	-.166*	.191*	.082	.430**	.446**	.558**	.655**						
14.	PACAP	3.85	.58	.408**	.236**	.022	-.108	.021	.129	.118	.101	.844**	.803**	.790**	.624**	.585**					
15.	RACAP	3.80	.64	.429**	.317**	-.046	-.100	-.081	-.068	.164*	.085	.509**	.465**	.655**	.891**	.926**	.662**				
16.	Informal communication	4.36	.54	.095	.046	-.134	.053	-.171*	-.108	-.043	-.072	.264**	.222**	.318**	.422**	.347**	.326**	.419**			
17.	Trust	4.07	.65	.148	.127	-.133	-.023	-.054	-.095	.082	.054	.248**	.314**	.306**	.421**	.356**	.357**	.423**	.559**		
18.	Formalized knowledge sharing	3.64	.71	.133	.198*	.054	-.082	-.105	.151	.160*	-.045	.340**	.335**	.382**	.550**	.497**	.432**	.572**	.325**	.389**	
19.	Participation in decision-finding	3.90	.75	.157*	.114	-.072	-.021	-.086	.019	.057	-.005	.412**	.380**	.421**	.468**	.363**	.496**	.451**	.492**	.348**	.534**

** p < .01

* p < .05

Table 4.4: Structural Equation Model Results for Model I (Direct Effects Model) and Model II (Complementarity Model)

	Coefficient (model I)	Coefficient (model II)
Description of path		
PACAP → Innovativeness	n.s.	—
PACAP → Financial performance	n.s.	—
PACAP → Absorptive capacity	—	.31**
RACAP → Innovativeness	.19*	—
RACAP → Financial performance	.33***	—
RACAP → Absorptive capacity	—	.45***
Informal communication → PACAP	-.18*	-.15 ⁺
Informal communication → RACAP	n.s.	n.s.
Trust → PACAP	n.s.	n.s.
Trust → RACAP	n.s.	n.s.
Formalized knowledge sharing → PACAP	n.s.	n.s.
Formalized knowledge sharing → RACAP	.31***	.33***
Participation in decision finding → PACAP	.78***	.75***
Participation in decision finding → RACAP	.50***	.45***
Absorptive capacity → Innovativeness	—	.64**
Absorptive capacity → Financial performance	—	.37*
Control variables		
Firm size → Innovativeness	.16*	.13 ⁺
Firm size → Financial performance	.30***	.29***
Type of biotechnology → Innovativeness	n.s.	n.s.
Type of biotechnology → Financial performance	n.s.	n.s.
Firm age → Innovativeness	n.s.	n.s.
Firm age → Financial performance	n.s.	n.s.
Number of prior patent applications → Innovativeness	n.s.	n.s.
Number of prior patent applications → Financial performance	n.s.	n.s.
Amount of grants → Innovativeness	n.s.	n.s.
Amount of grants → Financial performance	n.s.	n.s.
Number of alliances → Innovativeness	.13 ⁺	n.s.
Number of alliances → Financial performance	n.s.	n.s.
Model fit statistics		
CMIN/DF (p)	1.358 (.040)	1.088 (.303)
GFI	.938	.946
IFI	.968	.992
TLI	.944	.986
CFI	.966	.991
RMSEA	.048	.024

In contrast, direct effects of RACAP on innovativeness and financial performance are strongly positive and significant. Furthermore, model-fit indices of the complementarity Model II are superior to the direct effects Model I (Hair et al., 2010). In line with previous research (e.g. Ebers & Maurer, 2014), these findings support Zahra and George's (2002) assumption that absorptive capacity is formed by PACAP and RACAP, both of which have distinct but complementary roles in affecting innovativeness and performance.

4.5 Discussion and Conclusion

While prior research has suggested that PACAP and RACAP might have distinct antecedents and unfold separate and complementary performance effects (Volberda et al., 2010), only few empirical studies have addressed these gaps in research by examining the underlying processes and routines of absorptive capacity (e.g., Ebers & Maurer, 2014; Jansen et al., 2005a). In contrast, most empirical studies have used overall proxies to measure the absorptive capacity construct (Flatten, Engelen, et al., 2011). In addition to the resulting issues of the construct validity, these studies also fail to explain how the distinct dimensions of absorptive capacity influence a firm's innovativeness and financial performance (Lane et al., 2006). Further, many scholars have used absorptive capacity as an independent variable and thus key antecedents to absorptive capacity, especially intra-organizational antecedents, have not received much attention in research (Volberda et al., 2010). Variations of absorptive capacity, however, may offer an explanation for why some firms profit more from external knowledge than do others. Thus, the aim of this study was to investigate the distinct effects of SIMs on absorptive capacity and to examine the separate and complementary performance implications of PACAP and RACAP.

This study contributes to current research on absorptive capacity in various ways. First, it examines the impact of distinct SIMs on PACAP and RACAP, since intra-organizational antecedents have received inadequate attention in research on absorptive capacity (Volberda et al., 2010). Hence, this study contributes to current research by enhancing our understanding of how the dimensions of absorptive capacity emerge from SIMs related to informal communication, trust, formalized knowledge sharing, and participation in decision finding.

The study's results show that informal communication promoting the strength of ties among employees is negatively related to the ability to recognize, acquire, and assimilate external knowledge (i.e., PACAP), while at the same time does not enhance a firm's ability to

transform and exploit absorbed knowledge (i.e., RACAP). The finding of a negative impact of informal communication mechanisms on a firm's PACAP supports the claims in Granovetter's (1973) theory of weak ties by showing that SMEs in particular, because they have fewer employees, are less open to new external information when they promote strong intrafirm ties. However, these results also contradict the expectation that informal communication promoting strong ties is positively related to knowledge transformation and exploitation (Hansen, 1999). One possible reason could be that informal communication within small high-tech firms does not represent a critical barrier for knowledge sharing and application. On average, the firms in the study's sample have 23 employees, implying that the use of additional mechanisms to promote informal communication cannot enhance the current communication structures in knowledge processes in a significant way. Thus, it might be fruitful for future research to investigate the impact of firm size on the relationship between intra-organizational antecedents such as informal communication and absorptive capacity.

While research on social capital suggests that trust enhances knowledge sharing (e.g., Inkpen & Tsang, 2005) and other studies confirm a positive impact of trust on a firm's absorptive capacity (e.g., Ebers & Maurer, 2014), this study surprisingly does not find the expected effects of trust on a firm's PACAP and RACAP. One possible reason could be that the general level of trust within firms is already high (Smith et al., 2006). As a result, Smith et al. (2006) argue that trust cannot capture the variances in knowledge-sharing processes any further, and it remains unclear if trust supports knowledge sharing or whether it is in fact only the *absence* of trust that influences the exchange of knowledge. Since the level of trust in the firms in this study sample correspond to this line of reasoning, these high levels of trust might explain the non-effects of trust on absorptive capacity. Thus, further studies are required in order to shed light on the role of trust in enhancing the distinct dimensions of absorptive capacity.

In addition, this study shows that formalized knowledge sharing contributes to the ability to transform and exploit newly assimilated knowledge; that is, it contributes to a firm's RACAP. Hence, these results underline the importance of cross-departmental cooperation and knowledge exchange to enhance the awareness of opportunities for combining the existing knowledge base with the novel assimilated information. However, this study does not find evidence that formalized knowledge sharing enhances the ability to recognize, acquire, and assimilate external knowledge; that is, knowledge sharing does not enhance a firm's PACAP. A possible explanation for this finding might be that knowledge in the biotechnology industry is highly specialised, which makes technical expertise necessary in order to search for new knowledge (Lane & Lubatkin, 1998). Thus, mechanisms that foster the cross-departmental exchange and cooperation (e.g., encouraging exchanges between research and marketing) might be not suitable for enhancing the firm's PACAP because the employees involved lack technical expertise. Thus, future studies might incorporate further integration mechanisms that especially focus on the technical expertise of employees.

Further, the findings show that participation in decision-finding has strong and positive effects on a firm's PACAP and RACAP. In line with prior research (Jansen et al., 2005a), these results indicate that firms benefit from employee participation because it increases the variety of alternative views, which enhances the openness in the search for new knowledge sources as well as for new combination opportunities. Particularly in small high-tech firms, it seems beneficial to integrate the employees into the decision-finding process, because these employees often hold specialized expertise in different knowledge areas and thus their participation can identify new opportunities (Starbuck, 1992). At the same time, these highly educated and specialized employees combined with flat hierarchies in small biotechnology firms might be context-dependent. Hence, our finding include biotech idiosyncrasies and further empirical studies in other industries and larger firms are necessary to generalize the results.

Summarizing, the study's findings regarding the intra-organizational antecedents of absorptive capacity show that distinct SIMs have different effects on PACAP and RACAP, which implies that both dimensions have different antecedents. Moreover, the findings indicate that some intra-organizational antecedents impact all dimensions of absorptive capacity, whereas other SIMs selectively affect PACAP and RACAP. The mixed results of informal communication and trust, however, demand further research to investigate more precisely the role of informal SIMs in small high technology firms, for example, by adding firm size or the kind of knowledge to the research design.

As for the distinct effects of PACAP and RACAP, the results of this study confirm the validity of Zahra and George's (2002) conceptual distinction of the two as having unique but complementary roles in value creation. In line with empirical findings of recent research (Ebers & Maurer, 2014; Schleimer & Pedersen, 2013), this study supports the process-based view of absorptive capacity that captures the underlying processes forming the capability (Lane et al., 2006). The detailed examination of the underlying processes and routines of the distinct absorptive capacity dimensions has shown that the higher-order construct absorptive capacity is formed by the two lower-order constructs PACAP and RACAP. Therefore, the results of this study strengthen the theoretical view that PACAP and RACAP are differently influenced by antecedents and have separate and complementary effects on performance outcomes (Volberda et al., 2010; Zahra & George, 2002), which encourages the application of distinct measurements for PACAP and RACAP instead of using overall proxies to measure absorptive capacity. Further, this study finds that only RACAP has a significant direct effect on innovativeness and financial performance, indicating that knowledge is primarily transferred into commercial outcomes by the use of transformation and exploitation processes (Zahra & George, 2002). Moreover, findings show that the model-fit indices of the complementarity model are superior to the direct-effects model, implying that the combined effect of PACAP and RACAP is greater than the separate effects of each dimension. As a

consequence, firms have to develop each dimension equally to fully benefit from their absorptive capacity rather than only focussing on either PACAP or RACAP (Lane et al., 2006). Not only do the results demonstrate that complementary effects of PACAP and RACAP enhance a firm's innovativeness and financial performance, but also that these underlying processes and routines of the complementary abilities—recognize, acquire, assimilate, transform and exploit—are more challenging for competitors to imitate because they are more difficult to observe (Lewin et al., 2011).

Moreover, this finding draws attention to Zahra and George's (2002) suggestion that the benefits of new knowledge depend on the balance between PACAP and RACAP; in other words, where RACAP levels are on par with PACAP. For example, Baker, Miner, and Eesley (2003) find that some firms have a strong capability to identify new knowledge, but fail to translate and exploit that knowledge into new products and processes. Based on the argument that high PACAP does not necessarily lead to increasing performance effects when firms have an insufficient capability of transforming and exploiting the knowledge, Zahra and George (2002) introduced the idea of an efficiency factor for absorptive capacity that measures the firm's ability to transform and exploit its knowledge base (Fosfuri & Tribó, 2008). Based on this idea, scholars indicate that SIMs can reduce the gap between PACAP and RACAP by lowering the barriers to knowledge sharing and thereby increase the so-called efficiency factor (Todorova & Durisin, 2007; Zahra & George, 2002). Hence, the efficiency factor offers important insights that might offer an alternative explanation for performance differences between firms. Thus, this study strongly encourages further studies to investigate the efficiency factor in more detail to enhance our current understanding of the absorptive capacity concept and open up new research possibilities.

Finally, the idea of the efficiency factor prompts questions regarding the current conceptualization of absorptive capacity. The current construct is based on the assumption that the ability to recognize the value of new knowledge leads to a perfectly matching

knowledge absorption. However, it remains unclear what happens if during the phases of assimilation and transformation firms detect absorbed knowledge that is not valuable for the firm's present knowledge base.⁶ It is very likely that firms decide to reject the absorbed knowledge in cases that would also increase the efficiency of absorptive capacity. But because the actual conceptualization of absorptive capacity does not factor in absorbed knowledge—knowledge that does not match well or is no longer valuable—the efficiency-factory concept, while unique and novel, requires further optimizing to encompass a wider range of scenarios. Future research could thus include and examine the ability to reject absorbed knowledge into the conceptualization of the absorptive capacity construct to further improve the explanatory power of future investigations.

While there are a number of limitations to this study, they might also present fruitful opportunities for future research. First, this study relies on self-reported data by senior firm managers, because most of the biotechnology firms in the sample are relatively small and young, and thus objective measures of the firm's absorptive capacity, social integration mechanisms, and performance outcomes are scarce. Moreover, many biotechnological SMEs in the sample are private firms that do not have to report their financial figures according to the strict disclosure regulations of publicly traded companies. Although I have followed several aspects of good research practice in the design and testing phases of the survey, key-informant bias and common bias cannot be fully ruled out. In a first step, I restricted artificially inflated or disguised responses of the participants by integrating strong interrater agreement and reliability measures. Additionally, I ensured confidentiality for all participants. Next, I compared the unconstrained common-method factor model to the fully constrained common-method factor model, and the results from the Chi-Square test show no significant differences between the two models (Podsakoff et al., 2003). Moreover, I also found different effects of several variables on the firm's innovativeness and financial performance, whereas

⁶ I thank David Teece for this suggestion.

common-method bias would have generated consistent impacts of the same variables on the dependent variable. Nevertheless, this methodology cannot completely eliminate the bias concerns. Hence, future studies might use other proxies that reflect a firm's performance outcomes in a more detailed way.

Second, this study concentrates on biotechnology SMEs in Germany that cooperate in alliances to acquire and leverage new knowledge. Therefore, these findings may not directly be transferable to large firms which can draw on slack resources and broader networks (Daniel, Lohrke, Fornaciari, & Turner, 2004; George, 2005). For instance, the results of this study show that SIMs related to informal communication negatively influence PACAP, while trust-related SIMs demonstrate no significant impact on either PACAP or RACAP. Compared with previous research findings from a large, European, multi-unit financial service firm indicating that connectedness (i.e., the density of linkages) positively affects absorptive capacity (Jansen et al., 2005a), these results imply that larger firms might benefit differently from distinct informal intra-organizational antecedents. Therefore, future studies could investigate how the impact of firm size changes the relationship between intra-organizational antecedents and absorptive capacity. In addition, the results of this study show the present situation in the German biotechnology industry. While this industry focus is suitable to prevent significant industry- and country-specific effects, cultural differences might influence the choice and application of social integration mechanisms. However, to confirm and generalize my findings, further cross-national studies are necessary.

Lastly, this is a cross-sectional study that cannot illustrate the performance implications of absorptive capacity or how SIMs might impact the dimensions of absorptive capacity over time. Thus, the findings of this study can only reveal correlations, and longitudinal data is required to show causation effect with time lags.

In conclusion, examining distinct intra-organizational antecedents and performance outcomes of PACAP and RACAP enhances our practical and theoretical understanding of the

complementarity of absorptive capacity. Thus, this study's findings offer an explanation for why some firms achieve higher performance outcomes than do others and encourages further studies to investigate the complementarity of absorptive capacity in more detail.

4.6 Appendix: Scale Items

Potential Absorptive Capacity

Recognize (Flatten, Engelen, et al. 2011; Szulanski 1996)

- We observe external sources of new products and technologies in detail.
- We frequently scan the environment for relevant information for our company.
- We thoroughly observe technological trends in our industry sector.
- We thoroughly collect industry information (e.g. potential competitors, customer needs, etc.).
- We have information on the state-of-the-art of external technologies within our industry.

Acquire (Jansen et al. 2005a)

- We periodically organize special meetings with external partners to acquire new technologies.
- Employees regularly approach external institutions (e.g. universities, research institutes, etc.) to acquire technological knowledge.
- We often transfer new knowledge to our firm in response to acquisition opportunities.

Assimilate (Flatten, Engelen et al. 2011; Jansen et al. 2005a)

- We quickly understand new opportunities in our market (e.g. emerging customer needs).
- We quickly analyze and interpret changing market demands (e.g. shifting structure of competition).
- We constantly use the opportunity to ask our alliance partners for a better understanding of acquired knowledge.
- We quickly analyze and interpret new technology trends.

Realized Absorptive Capacity

Transform (Flatten, Engelen et al. 2011; Jansen et al. 2005a)

- We are used to recording and storing newly acquired knowledge for future reference.
- We quickly recognize the usefulness of new external knowledge to existing knowledge.
- We periodically discuss consequences of market trends and new technological developments for our knowledge base.
- We regularly match new technologies with ideas for new products.

Exploit (Jansen et al. 2005a; Smith et al., 2005)

- We are proficient in transforming technological knowledge into new products.
- We regularly apply technologies in new products.
- We constantly consider how to better exploit knowledge.
- We are used to exploiting technologies in new products.

Social Integration Mechanisms

Formal SIMs – Formalized Knowledge Sharing

- Our company uses tools (e.g. intranet, internal studies / reports) to spread knowledge in the whole organization.
- Our management emphasizes a quick information flow, e.g., if employees obtain important information they communicate this information promptly to all relevant employees.
- Our company uses periodical documents to exchange new findings.
- Presentations in our company are systematically deployed to make information accessible to all employees.
- There are regular discussions on cross-departmental cooperation in our company.
- Our management demands periodical cross-departmental meetings to interchange new developments, problems, and achievements.
- Our company uses temporary workgroups for knowledge exchange between departments on a regular basis.

Formal SIMs – Participation in Decision Finding

- In our company, employees participate in the decision on adoptions of new policies (e.g. new techniques, methods, procedures, etc.).
- In our company, employees participate in decisions in the development process of new products/technologies.
- Our management frequently participates with employees from different departments in strategic decision-making.
- In our company, employees participate in decisions that affect collaborations (e.g. partner selection, organization of teamwork).

Informal SIMs - Informal Communication

- In our company, there is ample opportunity for informal „hall talk“ among employees.
- The employees in our company are very close to each other.
- In our company, employees from different departments feel comfortable calling each other when the need arises.
- Our company encourages employees to discuss work-related topics with colleagues who are not their line managers.
- In our company, it is easy to talk with virtually anyone you need to, regardless of rank or position.
- The employees in our company communicate with each other very often.

Informal SIMs – Trust

- In our company, all employees can always trust that each would decide and act professionally and competently.
- In our company, all employees can always trust that each would receive necessary and reliable information and service.
- In our company, all employees can always trust that each would keep the promises they make.

Performance Outcomes

Innovativeness (Zaheer and Bell, 2005)

- We have more innovative products and technologies than our competitors.
- We tend to lead the industry in introducing new products and adopting new technologies.

Financial Performance (Worren et al., 2002)

- Compared to the industry average, our financial performance is outstanding.
- Compared to our competitors, our financial performance is significantly better.
- Compared to our competitors, our sales growth is significantly higher.

5 Chapter 5. Study 4: Organizational ambidexterity in light of national culture: A comparative study of Australian, German and Indian biotechnology SMEs⁷

Finally, Study 4 investigates how organizational context and national culture impact organizational ambidexterity in SMEs. We show that the interaction of goal-setting, risk-taking, and supportive leadership shapes an organizational context in such a way that it promotes and enhances ambidextrous behaviour within SMEs. This study also shows that power distance and uncertainty avoidance—two dimensions of national culture— have a distinct impact on a firm’s capability to balance exploitation and exploration. More specifically, the results from 185 biotechnology SMEs in Australia, Germany, and India show that SMEs’ ambidexterity benefit from high power distance and low uncertainty avoidance. Moreover, findings show that uncertainty avoidance strongly negatively moderates the relationship between an organizational context and ambidexterity. The results of this study are important because they reveal that ambidexterity is culturally dependent and that for firms to benefit from it, there are certain organizational characteristics that need to be in place that account for socio-environmental factors. In addition, they support the idea that leadership can have powerful firm-level effects, and that if managers of small firms adopt certain approaches to leadership, their influence on employee behaviour can increase the gains from their firm’s ambidextrous activities.

⁷ This chapter has been developed together with Meena Chavan and Indre Maurer.

5.1 Introduction

For many firms innovations are a necessary element for achieving a competitive advantage in their markets (McGrath, Tsai, Venkataraman, & MacMillan, 1996). While incremental improvements lead to short-term success, radical innovations assure firms' long-term survival (Levinthal & March, 1993). One way for firms to encourage innovation is by pursuing organizational ambidexterity, which is achieved by simultaneously carrying out exploitation and exploration activities (Jansen et al., 2005b). Exploitation is the "refinement and extension of existing competencies, technologies and paradigms", while exploration is the "experimentation with new alternatives" (March, 1991: p. 85). Organizational ambidexterity has been empirically shown to increase performance outcomes (Junni et al., 2013) and to enable long-term survival of firms (e.g., Hill & Birkinshaw, 2014; Uotila et al., 2009).

While organizational ambidexterity is often achieved through structural or temporal separation of exploitation and exploration activities (Raisch & Birkinshaw, 2008; see also Simsek et al., 2009), Gibson and Birkinshaw (2004) first introduced the idea of ambidexterity as one arising from a firm's behavioural context. This idea of contextual ambidexterity argues that rather than separating exploitation and exploration, firm leaders should develop and sustain an appropriate organizational context which encourages all firm members to make their own decisions as to how to best divide their time between the conflicting demands of these two activities (Gibson & Birkinshaw, 2004). Context here refers to all systems, processes, and beliefs that influence firm members' behaviour (Ghoshal & Bartlett, 1994). Gibson and Birkinshaw (2004) further refine this definition by distinguishing between hard elements (discipline and stretch) related to performance-oriented management, and soft elements (support and trust) which describe the social context. While current research finds empirical support for the positive performance effects of contextual ambidexterity (e.g., Gibson & Birkinshaw, 2004; Wang & Rafiq, 2014), it is surprising how little we know about how firms can create an appropriate and successful organizational context (O'Reilly &

Tushman, 2013). Indeed, implementing this behavioural context is precisely the challenge various firms face, and an important research question is to ask which organizational components most successfully affect and contribute to ambidexterity. In other words: What are the antecedents of contextual ambidexterity?

To uncover the antecedents of contextual ambidexterity, we can look more closely at a firm's size, its accompanying resources, and its leadership. Large firms often have an advantage in facilitating the balance of exploitative and explorative activities: Compared with small and medium-sized enterprises (SMEs), large firms usually have hierarchical administrative systems and slack resources that can facilitate the balance of exploitative and explorative activities (Lubatkin et al., 2006; Voss & Voss, 2013). Instead of relying on these systems and resources, SMEs are often especially dependent on another resource—leadership—to influence firm members' behaviour, which then enables ambidexterity. Managers in SMEs are more likely than their counterparts in large firms to be involved in both strategic and operational tasks because they work in environments with fewer hierarchical levels (Lubatkin et al., 2006), which means that their influence on internal firm conditions such as cooperation, autonomy, and rewards is greater than it would be in large firms (Chang & Hughes, 2012). This increased influence of SME leadership is shown in the work of Wiklund and Shepherd (2005), who suggest that risk-taking managers can promote innovative behaviour by creating a culture of experimentation that encourages members to seek new opportunities and that accepts the cost of possible failures. Despite these findings, research to date fails to provide insights into the role of leadership as an antecedent of contextual ambidexterity. This study, therefore, questions, empirically examines, and provides insight into leadership, and behavioural organizational context in particular, and its influences on ambidexterity in SMEs.

While leadership might create a behavioural context that enables ambidexterity within SMEs, efficacy of leadership also depends on the national culture in which it is practiced,

because national culture influences individuals' expectations of leadership as well as their innovative behaviour (Brodbeck, Frese, & Javidan, 2002). Power distance and uncertainty avoidance are two particular dimensions of a national culture that affect the structure and function of organizations (Hofstede, 1985). Power distance refers to the degree to which "a community accepts and endorses authority, power differences, and status privileges" (House et al., 2004: p.513), whereas uncertainty avoidance describes the extent to which a community relies "on social norms, rules, and procedures to alleviate the unpredictability of future events" (House et al., 2004: p. 30). Research in this area supports the effects of these dimensions in business; Zhang and Zhou (2014), for instance, have shown that an interaction of empowering leadership, uncertainty avoidance, and trust affects employee creativity: empowering leadership has the strongest positive effect on employee creativity when employees exhibit high levels of uncertainty avoidance and have high levels of trust in their supervisors.

Moreover, research indicates that power distance and uncertainty avoidance also impact exploitation and exploration. In a meta-analysis of the influence of institutional factors on success patterns of exploitation and exploration, Mueller et al. (2013) have shown that high power distance positively moderates the relation between exploration and firm performance, while high uncertainty avoidance decreases the performance outcomes resulting from both exploitation and exploration. In spite of these results, research on ambidexterity has widely neglected the impact of national cultural on ambidexterity, leaving us with little knowledge about how antecedents (e.g., leadership) in different cultural contexts affect ambidexterity.

By addressing these shortcomings in current research, this study enhances our understanding of ambidexterity in several ways. First, it examines how leadership, as an antecedent, can create and sustain an organizational context that enables ambidexterity in SMEs. In doing so, this study responds to Lubatkin et al.'s (2006) call to investigate the antecedents of ambidexterity in SMEs in more detail and underlines the crucial role of

leadership in achieving ambidexterity, especially in the context of SMEs. Second, to the best of our knowledge, this study is one of the first to investigate the impact of national culture on ambidexterity. In particular, we explore how power distance and uncertainty avoidance influence the relationship between an organizational context and ambidexterity. Hence, this study deepens understanding and helps to explain how distinct socio-environmental factors influence firm-level activities such as leadership processes and employees' innovative behaviour.

5.2 Theoretical Development and Hypotheses

5.2.1 Organizational Context, Leadership, and Ambidexterity

March's (1991) work on organizational learning has become increasingly popular because of his argument that organizations have to balance both exploitation and exploration activities for their long-term survival. An overinvestment in exploitation might increase short-term performance, but firms can fall into a competency trap and struggle to continuously adapt to environmental changes (Levinthal & March, 1993; Volberda & Lewin, 2003). Conversely, firms that overemphasize exploration may improve their knowledge base, but at the same time end up in an endless cycle of search and unrewarding change which can negatively impact on their short-term performance (Ahuja & Morris Lampert, 2001; Levinthal & March, 1993). To avoid these outcomes, research suggests that firms should pursue simultaneously both explore and exploit; in other words, that they should practice organizational ambidexterity.

In recent decades, scholars have identified three major antecedents of ambidexterity: organizational structures, leadership processes, and behavioural contexts (Raisch & Birkinshaw, 2008). First, Tushman and O'Reilly (1996) suggest that ambidexterity can be achieved by structurally separating exploitation and exploration into distinct units within an organization. While organizational structures that are separately aligned to a unit's tasks provide a strong internal consistency regarding systems, incentives, processes, and cultures,

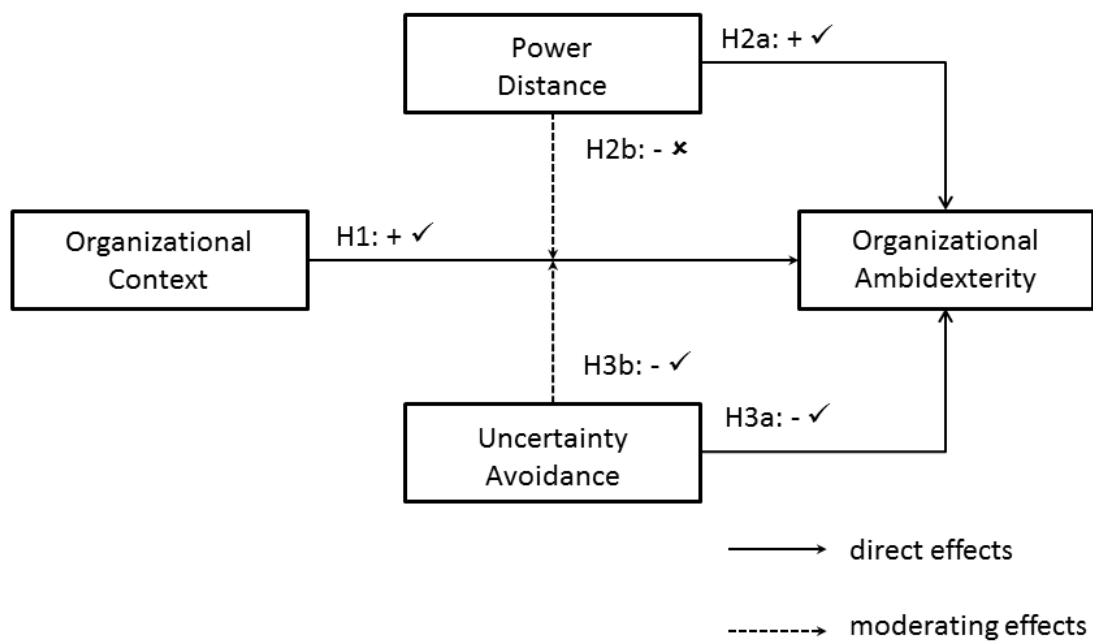
strategic integration by an overarching set of values and targeted linking mechanisms is required to ensure the most efficient use of resources and capabilities (O'Reilly & Tushman, 2013).

Second, scholars indicate that distinct leadership methods and styles support and enable ambidexterity by using economic, structural, social, and cognitive influences that affect the firm's tendency to explore or exploit (Lavie et al., 2010; Lubatkin et al., 2006; Smith & Tushman, 2005). Third, Gibson and Birkinshaw (2004) find that ambidexterity is enabled by an organization's behavioural context, one which "encourages each employee to achieve an appropriate level of balance among the conflicting demands on his or her time and attention" (Markides, 2013: p. 316). The enabling power of behavioural contexts within an organization is especially important for SMEs, because they often lack the slack resources that large firms have to structurally separate exploitation and exploration into distinct business units, thus suggesting that a supportive behavioural context can compensate for lack of resources in order to achieve the benefits of ambidexterity (Gibson & Birkinshaw, 2004). Gibson and Birkinshaw (2004) also distinguish between two context-shaping elements that determine firm members' behaviour: (1) performance management (formed by discipline and stretch), and (2) social context (formed by support and trust), a distinction based on prior research of Ghoshal and Bartlett (1994), whose definition of discipline is the extent of firm members' commitment to achieving a firm's expectations (as effected by their behaviour), whereas stretch is the degree to which individuals voluntarily extend their efforts beyond their own standards and expectations. Support is the extent to which firm members are assisted in their own initiatives and entrepreneurship, while trust refers to the degree to which individuals rely on the commitments of one another. Together, these four interdependent attributes create a supportive organizational context which encourages individuals to engage in both exploitation-oriented and exploration-oriented actions, and the interaction of all these elements is known as contextual ambidexterity (Gibson & Birkinshaw, 2004).

Research has shown that contextual ambidexterity increases a firm's performance outcomes (e.g., Cegarra-Navarro & Dewhurst, 2007; Gibson & Birkinshaw, 2004; Wang & Rafiq, 2014) and can lead to a competitive advantage because it is difficult for competitors to imitate these unique and integrated attributes of a behavioural organizational context (Simsek et al., 2009). However, scholars cannot yet explain *how* firms implement contextual ambidexterity because only a few studies have investigated the drivers that shape an appropriate organizational context (e.g., Brion, Mothe, & Sabatier, 2010; see also O'Reilly & Tushman, 2013). One possible driver in shaping an appropriate organizational context is leadership. Ghoshal and Bartlett (1994) have highlighted that leadership is as important enabler and that a behavioural organizational context "is created and renewed through tangible and concrete management actions" (p. 91). Further, leadership shapes an organizational context by way of various decisions and actions (Carmeli & Halevi, 2009), and because they have less formalized management systems and limited resources, SMEs are especially dependent on their top management to influence firm members' exploitative and explorative behaviour (Lubatkin et al., 2006).

In the following section, we discuss how goal-setting, risk-taking and supportive leadership shape an appropriate organizational context in SMEs and thus enables a firm's behavioural capacity, which in turn balances firm members' exploitation and exploration activities. Furthermore, we add the layer of Hofstede's (1980) cultural-dimensions theory to our discussion of leadership, and examine the direct effects of power distance and uncertainty avoidance—as filtered through a culturally dependent leadership style—on a firm's ambidexterity. Finally, we analyse how leadership and culture moderate the relationship between an organizational context and ambidexterity (Figure 5.1 illustrates these direct and moderating effects).

Figure 5.1: Overview of Hypotheses and Results



In SMEs, top managers are challenged to marshal limited resources to achieve a balance between the contradictory activities of exploitation and exploration (Ghoshal & Bartlett, 1994; Smith & Tushman, 2005). Scholars have indicated that exploitative activities are aimed at efficiency and short-term profits, whereas explorative activities require flexibility and a focus on long-term performance (Adler et al., 1999; Brion et al., 2010). To balance these two activities, firms need to provide an organizational context that can direct firm members' behaviour in appropriate ways. Firms can provide this context by a combination of goal-setting leadership, risk-taking leadership, and supportive leadership.

First, a behavioural organizational context needs to provide clear and tangible objectives to direct firm members' performance outcomes and promote efficiency (Gibson & Birkinshaw, 2004). *Goal-setting leadership* provides both because it encourages firm members to deliver high-quality outcomes and increases their sense of responsibility for achieving those results (Gibson & Birkinshaw, 2004; Locke & Latham, 1990). Research has shown that specific, clear, and accepted goals positively influence performance “by directing

attention, mobilizing effort, increasing persistence, and motivating strategy development” (Locke, Shaw, Saari, & Latham, 1981: p.125). Goal-setting leadership can also enhance a firm’s efficiency because firm members who are committed to a goal focus more on goal-relevant activities than they do on goal-irrelevant activities (Latham, 2004). In addition, Latham (2004) argues that goal-setting leadership increases the pace of work by continuously setting deadlines and milestones for the goal achievement, thus reducing the amount of time required to achieve a goal. Open and fast-cycle feedback on goal progress and attainment (Gibson & Birkinshaw, 2004) also increases overall efficiency because it allows firm members to immediately adjust their actions to help achieve their goals (Ghoshal & Bartlett, 1994). This feedback depends on top managers’ ability to control the outcomes of the firm members’ behaviour (Adler et al., 1999). Goal-setting leadership that uses reactive control systems with clear guidelines might prevent costly and inefficient misbehaviour (Snell, 1992). Moreover, research indicates that managerial decision-making based on established and consistently applied rules contributes to consistently applied managerial sanctions and discipline within firms (Ghoshal & Bartlett, 1994) and thus can promote ambidextrous behaviour of the firm members (Jansen et al., 2005b).

While goal-setting leadership can promote performance and efficiency, it can also foster flexibility and creativity within firms by offering clear signals to employees about the current need for explorative or exploitative activities (Hambrick & Mason, 1984). Managers who make target agreements on creative outcomes encourage firm members to experiment with existing and novel knowledge to achieve them (Latham, 2004). Firm members are willing to invest more time in exploring a variety of potential solutions, whereas individuals without “creativity goals” might try only a few possibilities before generating a final solution (Shalley, 1995). Shalley (1991), for instance, has found evidence that creativity goals positively affect firm members’ creative behaviour because individuals are more likely to focus their attention and effort on attaining these goals. When top managers set creativity

goals, they signal to employees that they should behave ambidextrously and therefore their leadership influences the extent to which a firm pursues exploration and exploitation (Griffin, Neal, & Parker, 2007). The supportive context provided by goal-setting leadership enables efficient exploitation and flexible exploration, and thus promotes ambidextrous behaviour.

Another aspect of organizational context that promotes firm members' behaviour is a manager's risk tolerance. To generate innovations by means of exploitative and explorative activities requires it, because the outcomes of innovation processes are often uncertain and negative (Lavie et al., 2010; March, 1991). Hence, *risk-taking leadership* can encourage firm members to favour innovative opportunities and pursue creative actions to achieve exploitation and exploration outcomes (Ford, 1996; Lumpkin & Dess, 1996). Risk-taking leadership takes into account both the failure and opportunity costs of testing new approaches (Dickson & Giglierano, 1986) and by accepting these costs, risk-taking managers create a culture of experimentation (Wiklund & Shepherd, 2005) which motivates firm members to learn from their mistakes and develop new ideas (Amabile, Conti, Coon, Lazenby, & Herron, 1996; Woodman, Sawyer, & Griffin, 1993). Research has identified risk tolerance as one of the most important factors in promoting innovation and creativity (Amabile & Conti, 1999; O'Reilly & Tushman, 2008), and scholars have shown that risk-taking leadership encourages employees to develop new products and services in order to take advantage of emerging market opportunities (Janney & Dess, 2006).

Moreover, research indicates that risk-taking leadership motivates firm members to strive for more ambitious objectives than they otherwise would because they receive higher degrees of freedom to experiment with new alternatives (Chang & Hughes, 2012). The management-supported autonomy to pursue creative and risky actions can also increase subordinates' intrinsic motivation and effort because they can take ownership of challenging objectives and the delivery of results (Covin & Slevin, 1989; Latham, 2004). In order to intrinsically motivate and creatively engage employees, a firm's leadership needs to show

how firm members' creative actions are strategically relevant (Chang & Hughes, 2012; Fletcher & Williams, 1996). To do so, risk-taking leadership needs to give personal meaning to the exploitative and explorative actions by which employees contribute to the firm's overall ambidexterity (Gibson & Birkinshaw, 2004). For instance, Ghoshal and Bartlett (1994) describe in their in-depth case study that a firm's top management was able to convey explicit and visible associations of how the employees' actions and sub-goals affect the overall firm priorities by allocating and translating the broad targets into specific actions for each firm member. As a result, subordinates were motivated to stretch their sub-goals at the individual level because leadership created a sense of personal involvement that gave meaning to each individual's work. In short, risk-taking leaders can encourage employees to pursue both exploitative and explorative activities by setting creative challenges and accepting the costs of possible failures.

As another facet of organizational context, supportive leadership directs employee behaviour in an appropriate direction. Research on organizational learning has highlighted that active support by top management is important for the success of innovation and creativity (e.g., Amabile et al., 1996; Rosing, Frese, & Bausch, 2011). *Supportive leadership* can enhance employees' creative self-efficacy and constructive problem solving by providing access to resources as well as assistance in the face of difficulties (Tierney & Farmer, 2004). Innovation tasks require autonomy, which allows employees to flexibly decide between exploitative and explorative activities and to pursue them independently of directives (Adler et al., 1999; Amabile et al., 1996; Brion et al., 2010). Scott and Bruce (1994), for instance, have shown that supportive leadership strongly increases innovative behaviour within firms when the relationship between supervisor and subordinate is characterized by trust and autonomy. In a similar case, Oldham and Cummings (1996) have demonstrated that employees achieve higher creative results when they work with supportive and non-controlling leadership. Together, the combination of a greater availability of resources, higher

task autonomy, and more assistance with difficulties creates an atmosphere which encourages more creative initiatives and entrepreneurship at lower hierarchical levels (Ghoshal & Bartlett, 1994; Gibson & Birkinshaw, 2004).

In addition, supportive leadership increases the likelihood of establishing trusted relationships between leaders and subordinates by providing open, transparent processes which facilitates employees' knowledge sharing and knowledge utilization when pursuing creative actions (Tsai & Ghoshal, 1998). Scholars suggest that SMEs especially need to draw on close social interaction to overcome the constraints of their limited resource base and more efficiently utilize their innovation potential (Chang & Hughes, 2012). By intelligently using participation in task-related decision making, supportive and trusted SME leadership can strengthen the involvement of firm members in creative tasks (Ghoshal & Bartlett, 1994) and thus enhance their employees' innovative behaviour by promoting employees' own initiatives (Carmeli & Halevi, 2009).

In sum, we hypothesize that combination of goal-setting, risk-taking, and supportive leadership creates an appropriate organizational context which enables the ambidextrous behaviour of firm members. Following the argument of Gibson and Birkinshaw (2004) that context is formed by interdependent components, we argue that the meta-capabilities of exploitation and exploration are achieved by a combination of all three types of leadership. Thus, we posit:

Hypothesis 1: The more an organizational context is characterized by an interaction of goal-setting, risk-taking, and supportive leadership, the higher the level of ambidexterity.

5.2.2 National Culture and Ambidexterity

In his widely-noted research on national culture, Hofstede (1980) states that organizations mainly serve two functions: (1) to distribute power (who should decide, and about what?), and

(2) to control uncertainty (in members' behaviour, in the quality of output, and in maintaining continuity). To realize these functions, organizations use various symbols (e.g., job titles, written instructions, rewards) that members are able to interpret and that affect their behaviour (Hofstede, 1980, 1985). The ability to interpret these symbols depends on a national culture that provides social norms, rules, and procedures that then determine which individual and firm behaviours are accepted by society (Mueller et al., 2013; Stephan & Uhlaner, 2010). Power distance and uncertainty avoidance, as two dimensions of national culture, might influence a society's expectations of what an organization should be and thus impact how organizations within a country function and are structured (Hofstede, 1980; Schneider & De Meyer, 1991). In addition, previous research has shown that these two particular dimensions are most likely to affect exploration and exploitation because they shape an individual's attitudes toward innovation and change (Mueller et al., 2013; Roth, 1995). Moreover, other dimensions such as masculinity have been criticized for being related to a specific time or context (Steenkamp, 2001), and prior results have found no effects on innovation outcomes (Grinstein, 2008; Shane 1993). Hence, this study does not consider other dimensions of Hofstede's national culture approach and this section therefore discusses how power distance and uncertainty avoidance influence the relationship between organizational context and ambidexterity.

How Power Distance influences Ambidexterity

Power distance describes the extent to which members of a society accept that power in organizations is distributed unequally and the degree to which they support status privileges and authority (Hofstede, 1980; House et al., 2004). Hofstede (1980) suggests that societies with high power distance are more autocratic and their organizations are more likely to be centralized and have autocratic leaders, whereas societies with low power distance prefer democratic participation and their organizations more likely employ flat hierarchies and

decentralized decision making, including employees' participation. In addition, research has shown that a high degree of centralization negatively affects the successful implementation of innovative behaviour within firms (e.g., Damanpour, 1991; Jansen et al., 2006; Siggelkow & Levinthal, 2003).

Both explorative and exploitative activities can benefit from centralized leadership. Because exploratory activities are often complex, resource intensive, focussed on long-term outcomes, and entail greater risk and uncertainty (Lavie et al., 2010; March, 1991), they can benefit from centralized decision makers who have the authority to promote more risky innovation projects and marshal firm resources (Tushman, Smith, & Binns, 2011). Burgers, Van Den Bosch, and Volberda (2008), for example, have investigated explorative new-business development projects and found evidence that the likelihood of failure increases without an influential leader who supports and monitors the implementation of the distinct project stages. Because radical product innovations often cannibalize existing returns (Chandy & Tellis, 1998), centralized authorities are necessary to overcome the intrafirm resistance to (1) investments in new concepts and ideas, as well as (2) necessary changes to realize exploratory innovation (Nakata & Sivakumar, 1996). Exploitative activities might also benefit from centralized authority. Since these activities focus on refining and implementing innovations, they can profit from a centralized authority who keeps a close eye on time expenditures, costs, and outcomes (Lavie et al., 2010). And since they are not required to seek consensus from large numbers of firm members, powerful top managers can improve operational efficiency by taking quick decisions (Sheremata, 2000). Furthermore, exploitative activities are less variable and central coordination can enhance operational efficiency (Benner & Tushman, 2003).

In contrast to the benefits of centralized authority described above, there are also disadvantages to high power distance. Some research findings suggest that power distance is negatively associated with patent and trademark registration (Shane, 1992, 1993) and that

high centralization reduces a firm's innovativeness (e.g., Damanpour, 1991; Mueller et al., 2013; Nakata & Sivakumar, 1996). Scholars have also found that “organic” firms characterized by decentralization and delegated authority outperform “mechanistic” (centralized and tightly controlled) ones in terms of innovative outcomes (Aiken & Hage, 1971; Hurley & Hult, 1998). Explorative activities—the creation of new ideas—require non-routine problem solving and flexible experimentation (March, 1991). In centralized organizations, however, the amount of information decision makers receive is reduced because information flows more slowly and is filtered by many firm members before it reaches them (Cardinal, 2001). Because accurate and timely information is necessary to comprehend and solve problems, and is often held by employees at lower hierarchical levels who are closer to the source of the problem, the slow flow of information hinders decision making (Cao, Simsek, & Zhang, 2010). In addition to reducing the quantity of information available to solve problems, centralization might also reduce the quality of information because as information makes its way through higher and higher hierarchical levels, the likelihood of misunderstanding increases (Sheremata, 2000). As a result, centralization negatively influences exploration because debased information quantity and quality leads to faulty reasoning and judgements about the feasibility of innovative projects (Jansen et al., 2006). High degrees of centralization can also inhibit exploitation. Although exploitation tasks are less risky and need less thorough checks and controls (March, 1991), they require ad-hoc problem solving, and thus flat and decentralized structures that facilitate this on-the-spot problem solving should outperform organizations characterized by time-consuming, centralized controls because there are fewer costs and less risk of information overload at higher hierarchical levels (McGrath, 2001; Olson, Walker Jr, & Ruekert, 1995).

While high and low levels of power distance—reflected by the extent of centralization—can both promote and inhibit exploitation and exploration within an organization, these hypothesized contradictions need to be tested on a level of firm members’

expectations regarding innovation and leadership. In firms with high power distance, members accept centralized decision making by powerful leaders because they expect that organizational decision makers at higher levels have the ability and knowledge to successfully manage complex tasks such as risky innovation projects (Mueller et al., 2013). The status and power differences between higher and lower organizational levels reinforces the gap between leaders and employees, resulting in a greater sensitivity and cautiousness in the communication between subordinates and their supervisors (Kirkman, Chen, Farh, Chen, & Lowe, 2009). Employees in organizations with high power distance behave respectfully towards their supervisors and try to internalize the values of influential leaders (Elenkov & Manev, 2005). Moreover, subordinates seek to obtain centralized authorities' acceptance by accomplishing tasks that meet the authorities' approval (Hofstede, 1980). In turn, powerful leaders who support exploitative and explorative projects signify to employees their approval and commitment to innovative tasks, encouraging subordinates to allocate more resources toward these projects (Mueller et al., 2013). All in all, we argue that high power distance can have a positive impact on ambidexterity by promoting the resource allocation towards exploitative and explorative projects. Thus, we propose:

Hypothesis 2a: High power distance positively influences a firm's ambidexterity.

Concurrently, members of high-power distance organizations often rely on powerful individuals and are expected to be told what tasks to do (Hofstede, 1980). These attitudes run counter to the organizational behaviour described earlier that supports ambidexterity, behaviour that should be enabled by goal-setting, risk-taking, and supportive leadership. For instance, goal-setting leadership aims to encourage firm members' increased personal responsibility as a means of achieving innovative results, whereas top management in high-power distance organizations tends to focus on completing daily work and performing efficiently rather than empowering employees to pursue exploitative and explorative activities (Bochner & Hesketh, 1994). Although it seems reasonable that risk-taking leadership benefits

from powerful leaders who promote risky projects, research indicates that high power distance may reduce employees' motivation to actively involve themselves in exploitative and explorative projects, thus dampening their motivation to strive for more ambitious objectives (Cao et al., 2010). Finally, supportive leadership seeks to establish trusted relationships between leaders and subordinates and to increase employees' task autonomy, thus encouraging creative initiatives and entrepreneurial behaviour at lower hierarchical levels. Hence, the relations predominant in high power-distance organizations are in stark contrast to the close and trustful leadership relations sought in an organizational context. Instead, these organizations are characterized by distant leaders, hierarchical structures, and reserved interactions (Offermann & Hellmann, 1997). In addition, research has shown that employees in high-power distance organizations are subject to top-down communication, which makes them feel uninvolved and reduces their willingness to interact with their supervisors (Madlock, 2012). In sum, we expect that higher levels of power distance negatively influence the relationship between an organizational context formed by goal setting, risk taking, and supportive leadership; and a firm's ambidexterity.

Hypothesis 2b: High power distance has a negative moderating influence on the relationship between an organizational context and ambidexterity.

How Uncertainty Avoidance influences Ambidexterity

The effect of uncertainty avoidance on ambidexterity is more complex. *Uncertainty avoidance* is the degree to which members of a society rely on social norms, rules, and procedures to promote the certainty and conformity of future events (Hofstede, 1980; House et al., 2004). Organizations in societies with high uncertainty avoidance are characterized by high degrees of formalization and standardization, whereas organizations in societies with low uncertainty avoidance have less formalized and routinized processes. As described above, explorative activities have uncertain and distant returns (March, 1991), and hence their

feasibility and success are difficult to accurately plan, requiring a high tolerance for unexpected changes (Lavie et al., 2010). Exploitative activities, in contrast, lead to more predictable and certain outcomes and have closer returns (March, 1991). One might expect that organizations with high levels of uncertainty avoidance, with their focus on efficiency, planning, and structure, would benefit from increased exploitation activities and outcomes. In contrast, one might expect that in the same organizations exploration would suffer because of excessive managerial control and hierarchical hindrance. However, the effects of uncertainty avoidance on ambidexterity are not that direct.

Organizations in societies with high uncertainty avoidance are less risk taking and focus on stability and security rather than on entrepreneurship (Hofstede, 1980). To manage uncertainty, organizations formalise rules, procedures, instructions, and communications, as well as develop contingency plans for possible future events (Jansen et al., 2006). Previous research suggests that incremental innovations benefit from clear procedures and guidelines that improve the coordination and reduce the likelihood of errors, thus increasing the operational efficiency (Nakata & Sivakumar, 1996). In addition, thorough planning can help manage unexpected events by reducing the variance in innovative processes and routines (Benner & Tushman, 2003). While uncertainty avoidance seeks to eliminate as much risk as possible, and exploitation seeks to refine existing routines and processes, even incremental innovations are unpredictable and are at risk of failure (Levinthal & March, 1993). That said, the bulk of research has shown that exploitation activities especially profit from efficiency-oriented behaviour enabled by standardized processes, detailed routines, and written rules (Kang & Snell, 2009).

In contrast, exploration requires more risk tolerance (Levinthal & March, 1993). While a certain degree of formalization and planning activities are useful to avoid chaotic and unproductive behaviour, extensive reliance on established and formal rules to manage uncertainty can dampen a firm's commitment to pursue risky, innovative projects (Jansen et

al., 2006). High degrees of bureaucratic control and formalization hinder innovation (Damanpour, 1991). Highly detailed plans reduce firm members' flexibility to experiment with new ideas and thus their exploration activities (e.g., Lavie et al., 2010; Mom et al., 2009). Indeed, research shows that organizations with low levels of uncertainty avoidance tend to be more entrepreneurial (Hofstede, 1980) and that high uncertainty avoidance is negatively related to a country's number of patent registrations (Shane, 1993). Scholars have also indicated that an increasing extent of formalization and standardization negatively influences the outcomes of innovative behaviour within firms (e.g., Damanpour, 1991; Jansen et al., 2006).

The overall picture of uncertainty avoidance and its effects on exploitation and exploration is both mixed and unclear. Although the expected effects of formalization on exploitation and exploration seems theoretically plausible, current research still fails to provide empirical evidence for the relation between formalization and ambidexterity (Junni, Sarala, Tarba, Liu, & Cooper, 2015). We suggest that firms using thoroughly formalized processes to avoid uncertainty will inhibit both exploitative and explorative activities because a high degree of uncertainty avoidance and formalization reduces deviant and variation-seeking (and thus potentially innovative) behaviour of firm members. Although we recognize that uncertainty avoidance might have different effects on exploitation and exploration because their activities consist of distinct levels of risk and uncertainty, we suppose that the overall effect of uncertainty avoidance will negatively influence ambidexterity. Hence, we hypothesize:

Hypothesis 3a: High uncertainty avoidance negatively influences a firm's ambidexterity.

In addition to the effects on ambidexterity, uncertainty avoidance can also counteract the intended effects of goal-setting, risk-taking, and supportive leadership discussed earlier. At first glance, goal-setting leadership might benefit from well-developed plans and

objectives that firms use to reduce uncertainty. Formal procedures with fixed milestones offer an increased performance-orientation in employees' behaviour (Locke et al., 1981). However, uncertainty avoidance might also dampen leaders' willingness to set creative goals that motivate employees to explore new avenues. Further, societies with high uncertainty avoidance (and those working in them) are less tolerant of deviant persons and ideas (Hofstede, 1980). Risk-taking leadership aims to stretch employees' innovative behaviour and encourage experimentation with new alternatives (Chang & Hughes, 2012). Hence, high uncertainty avoidance can constrain the acceptance of new solutions and the tolerance of risks, which inhibits both exploitative and explorative activities (Song, Im, Bij, & Song, 2011). Finally, organizations with high uncertainty avoidance promote conformity and focus on control as a way to enhance predictability (Hofstede, 1980). While supportive leadership provides more task autonomy based on a trustful atmosphere between leaders and subordinates, top managers in high uncertainty avoidance environments are likely to maintain control over innovative projects (House et al., 2004). Moreover, and counter to a supportive leadership approach, prior research indicates that uncertainty-avoiding leaders have a less-delegating management style and are less approachable for creative initiatives from employees at lower organizational levels (Offermann & Hellmann, 1997). We therefore propose that high uncertainty avoidance negatively influences the relationship between an organizational context and ambidexterity.

Hypothesis 3b: High uncertainty avoidance has a negative moderating influence on the relationship between an organizational context and ambidexterity.

5.3 Methods

5.3.1 Sample and Data

This study focuses on small and medium-sized Australian, German, and Indian biotechnology firms to examine how the interplay of managerial components of an organizational context

influence organizational ambidexterity. In addition, this study investigates the impact of national culture on the relation between organizational context and organizational ambidexterity. We believe the biotechnology industry is an appropriate research setting for testing our hypotheses because research has shown that this industry is highly dynamic and that technological progress within it is rapid (e.g., Orsenigo, Pammolli, & Riccaboni, 2001). These industry characteristics require firms to continuously leverage their existing capabilities to better survive competition in the present, while developing new capabilities to gain a sustainable competitive advantage in the future. Accordingly, scholarship provides empirical support that biotechnology firms can profit from a balance of exploitation and exploration (e.g. Hoang & Rothaermel, 2010; Rothaermel & Deeds, 2004).

To identify the population of biotechnology firms in the three countries, we used various data sources. First, we used data from the internet platform of AusBiotech.org, which provides an annual directory of all active biotechnology firms in Australia released by the official Australian biotechnology association. We identified 151 Australian firms as suitable candidates for our study and 31 firms participated in our survey, representing a response rate of about twenty-one percent. Second, we identified the complete population of small and medium-sized Australian biotechnology firms by using the *Yearbooks of the German Biotechnology Industry*, an annual directory of all active biotechnology firms in Germany published by Biocom AG, as well as yearly reports from the internet platform Biotechnologie.de. In sum, we contacted 163 firms as potential participants and ended up with 54 German firms agreeing to provide data, corresponding to a response rate of approximately thirty-three percent. Finally, we identified the population of the Indian firms by using the annual directory of all active biotechnology firms in India provided by the internet platform Biotechsupportbase.com, as well as the services of an external provider who assisted our data collection locally. In total, we identified 772 firms as potential participants for our study, with 100 of them completing our survey, demonstrating a response rate of thirteen percent. On

average, the Australian firms are 16 years old, the German firms in our study are 12 years old, and the Indian firms are 23 years old. Further, all firms have an average of between 20 and 49 employees. These firm characteristics, therefore, are similar to those of other studies of the biotechnology industry. For example, Oliver (2009) has reported that biotech firms are rather small and that most firms (87%) have fewer than 300 employees. In total, we tested our hypotheses on a sample of 185 small and medium-sized biotechnology firms from all three countries.

During our pre-tests, we identified the Chief Executive Officer and the head of R&D as the most appropriate respondents for our survey because they are strongly integrated in processes of implementing an organizational context. Additionally, previous research has shown that these senior management positions provide reliable information about innovative outcomes (McEvily & Zaheer, 1999). To further limit common-method bias for the dependent variables, we also compared the subjective innovation statements of the participants with available objective data—patent applications and reported research successes (e.g., successful attainment of clinical stages)—and found no significant differences. Finally, we conducted the Harman one-factor test (Podsakoff & Organ, 1986). Results from the factor analysis of the dependent and independent variables showed five factors accounting for 64 percent of the variance, with the first factor accounting for sixteen percent of the variance. Because a single factor did not appear, and no general factor accounted for the majority of the variance, it is unlikely that common-method variance is a serious problem in our data. Further, we controlled for nonresponse bias, and the results from the t-test of various variables such as type of biotechnology and firm size (number of employees) showed no significant differences between the participating firms and nonparticipating ones. Moreover, we also found no significant differences between early- and late-participating firms.

5.3.2 Operational Measures of the Variables

The study mainly used existing items and scales from prior empirical studies for the measurement of the dependent and independent variables. We also conducted 15 in-depth interviews with industry experts to ensure construct validity, homogeneous understanding, and practical relevance of the selected survey measures. After the experts completed the survey, they were prompted to make suggestions for improving it (e.g., phrasing of the items). To increase content coverage of the measures, we used multiple-item constructs for all variables of our theoretical model. For all items except some control variables, we used a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) for our survey measures. The Appendix includes all questionnaire items.

Dependent Variable

Exploitation and *exploration* are the underlying measures of the integrative construct of organizational ambidexterity, and in line with previous studies we consider both as orthogonal (Gibson & Birkinshaw, 2004; Gupta et al., 2006; He & Wong, 2004). To capture organizational ambidexterity, we relied on the established two-step approach (e.g., Jansen et al., 2009) and first measured exploitation and exploration by adopting validated items from He and Wong (2004) and Jansen et al. (2006). Due to low factor loading, two items of the exploitation scale were deleted. The exploration scale consists of five items, and the final exploitation scale is reflected by four items. We employed an exploratory factor analysis (EFA) to ensure the convergent and discriminant validity of the exploitation and exploration measures. The EFA results provided support for the intended two-factor structure by demonstrating that each item loaded on its intended factor, with factor loadings above 0.62 and cross-loadings below 0.16. Moreover, both factors have eigenvalues greater than one and they both account for 65 percent of the variance. In a second step, we followed prior research on ambidexterity (Gibson & Birkinshaw, 2004) and developed a measure for *ambidexterity* by computing the multiplicative interaction between exploitation and exploration.

Independent Variable

Previous research on ambidexterity suggests that leadership is an important antecedent required to successfully balance exploitation and exploration (e.g., Gibson & Birkinshaw, 2004; Tushman & O'Reilly, 1996). Especially in SMEs, leadership is likely to influence the internal firm conditions such as cooperation and autonomy, and thus the firm members' behaviour (Chang & Hughes, 2012). For this reason, we used multi-item scales representing leadership to measure the *organizational context*. To measure *leadership* specifically, we adapted three multi-item scales validated by Chang and Hughes (2012) that reflect the dimensions of goal-setting, risk-taking, and supportive leadership. Four items were used to

capture goal-setting leadership. Due to low factor loading, one item was deleted and the final scale consists of three items. Five items measured mechanisms related to risk-taking leadership. Due to low factor loadings, two items were deleted and the final scale has three items. Six items were used to measure supportive leadership within firms, and again, low factor loadings meant that one item was deleted, with the final scale consisting of five items. Finally, we followed Gibson and Birkinshaw's (2004) argumentation on contextual components and assumed that the distinct components of leadership do not represent substitutable and holistic variables. Thus, we calculated a multiplicative interaction of the distinct leadership variables to constitute the new variable *organizational context*. Table 5.1 in the Section 5.3.3 presents the initial number of items and the number of items carried forward to the analyses.

Moderating Variables

We followed the recommended procedure of Mueller et al. (2013) to determine the dimensions of national culture, and first coded the country of the data set (i.e., Australia, Germany, and India). In a second step, we relied on the GLOBE study of House et al. (2004) and used the values for power distance and uncertainty avoidance associated with each country. While Hofstede's (1980) work has been criticized in several ways for its operationalization and the US and specifically IBM centric nature of its data (Javidan, House, Dorfman, Hanges, & Sully de Luque, 2006; MacSweeney, 2002), the GLOBE study aim to replicate and expand on Hofstede's (1980) national culture approach (Venaik & Brewer, 2008). By especially focusing on leadership topics, data from the GLOBE study is suitable for our specific research design regarding the role of leadership by implementing an ambidextrous organizational context.

Control Variables

We controlled for three variables that might affect exploratory and exploitative innovation. First, we used the logarithm of the number of employees in 2015 to control for *firm size*, because prior research indicates that the slack resources of larger firms might impact a firm's innovation activities (Damanpour, 1991). Using the number of employees for firm size is an appropriate measure to avoid problems resulting from financial measures, like turnover, because young biotechnology firms often exhibit no positive revenue streams in their first years (Stuart et al., 2007). Second, we controlled for the *type of biotechnology* in which a firm is mainly active because differences between subsectors of the industry might affect a firm's ambidexterity (Rothaermel & Deeds, 2004). Thus, we categorized firms in our sample based on their primary business application. We followed current research (Oehme & Bort, 2015) and used a dummy variable with 1 indicating that a biotechnology firm is mainly active in medical application (red biotechnology), and 0 if otherwise. Lastly, we followed prior research on innovations in the biotechnology industry (Owen-Smith & Powell, 2004; see also Phelps, 2010) and controlled for *firm age* because we expect that a firm's innovativeness decreases over time and that older firms might struggle to implement explorative activities as a result of organizational inertia (Levinthal & March, 1993; March, 1991). We measured firm age by the logarithm of the number of years from the founding date until 2015.

5.3.3 Reliability and Validity of Measures

After data collection, we performed several research steps to ascertain the constructs' reliability and validity. First, we examined the reliability of each construct. With the exception of the subscale *goal-setting leadership* ($\alpha = 0.679$), all Cronbach's alpha values are higher than the minimal cut-off point of 0.70 (Nunnally, 1978). Even though the theoretical foundation of this subscale supports the internal consistency of the construct, we additionally conducted a corrected-item total correlation (CITC) test to improve the reliability of our

measure, and all of our CITC values are higher than the lower limit of 0.30 (Kerlinger, 1986). Based on these findings, we reason that the scales for all constructs are reliable. Table 5.1 shows the results of the reliability analysis.

In a second step, we conducted three confirmatory factor analyses (CFAs) on theoretically related constructs to validate the degree of model fit and the adequacy of the factor loadings (Hoyle, 1995; Mulaik & James, 1995). Each item was permitted to load only on the factor for which it was the proposed indicator, and the results showed that all factor loadings are above the acceptable lower limit of 0.40 (Ford et al., 1986). Further, our model fit demonstrated good goodness-of-fit values for all constructs (Hair et al., 2010). The Appendix provides a detailed overview of the scales, standardized regression weights, and model-fit indices for each CFA.

Finally, we assessed an integrated CFA on all items to control for construct independence and convergent and discriminant validity (Hair et al., 2010; O'Leary-Kelly & Vokurka, 1998). Hair et al. (2010) advise that at least three indices must be well fitted to determine the model fit. Our results achieved this requirement and showed that the overall model fits the data well, since $\chi^2/df = 1.583 < 3$, comparative fit index (CFI) = 0.950 > 0.90, incremental fit index (IFI) = 0.951 > 0.90, Tucker Lewis Index (TLI) = 0.942 > 0.90, root mean square error of approximation (RMSEA) = 0.056 < 0.080, and standardized root mean squared residual (SRMR) = 0.0574 < 0.090 (Bagozzi & Yi, 1988; Bollen & Long, 1993; Hair et al., 2010; Kline, 2011). Further, findings show that the values of Cronbach's alpha and the composite reliability (CR) for the latent variables are above the lower limit of 0.70 (with exception of *goal-setting leadership*, $\alpha = 0.679$), thus indicating that the measures have an acceptable level of internal consistency (Bagozzi & Yi, 1988; Hair et al., 2010). To test for convergent validity of all multi-item constructs, we used average variance extracted (AVE) and factor loadings in addition to CR values.

Table 5.1: Reliability Analysis for the Constructs

Construct	Initial number of items	Number of items carried forward to the analysis	Cronbach's α	CITC range of the underlying items
<i>Organizational Context</i>				
<i>Leadership</i>			.867	
Goal-setting	4	3	.679	.455 ~ .547
Risk-taking	5	3	.777	.535 ~ .666
Supportive	6	5	.810	.504 ~ .634
<i>Organizational Ambidexterity</i>				
Exploration	5	5	.893	.654 ~ .783
Exploitation	6	4	.885	.690 ~ .805

The results demonstrate that the AVE values are above 0.50, whereas all CR values achieve the critical cut-off-point of 0.70 (Bagozzi & Yi, 1988). Moreover, all factor loadings are highly significant ($p < 0.001$) and above the recommended minimum of 0.40 (Ford et al., 1986). Summarizing, these findings provide support for convergent validity (Hair et al., 2010). As for discriminant validity, the results for correlations between the factors are below 0.90, which indicates that the theoretical content captured by the first-order factors is distinguishable (Bagozzi, Yi, & Phillips, 1991). Together with the item's convergence on their factors, these findings suggest discriminant validity (Bagozzi & Yi, 1988).

5.4 Analyses and Results

Table 5.2 presents the descriptive statistics and correlations of all hypothesized and control variables. The results show that exploitation and exploration are strong and positively correlated, suggesting that firms actually can achieve both simultaneously. As expected, organizational context and its components goal-setting, risk-taking, and supportive leadership are significantly positively related to organizational ambidexterity. Further, the descriptive statistics demonstrate a significant negative correlation between uncertainty avoidance and ambidexterity, whereas the correlation between power distance and ambidexterity is not significant. Lastly, the results show that all inter-factor correlations are below the cut-off point of 0.65, which indicates that our estimations are not influenced by multicollinearity problems (Tabachnick & Fidell, 1996).

We tested all hypotheses by using ordinary least-squares (OLS) regression analysis. To control for potential multicollinearity issues, we calculated the variance inflation factors (VIF). The maximum VIF value within the models was 1.506, which is well below the threshold of 10 (Kutner, Nachtsheim, Neter, & Li, 2005). We developed four models to analyse the independent and interaction effects of our variables on organizational ambidexterity. Table 5.3 shows the regression results for all models.

Table 5.2: Descriptive Statistics and Correlations (N = 185)

Variable ^a	Mean	s.d.	1	2	3	4	5	6	7	8	9	10	11	12
(1) Ambidexterity	16.19	5.57	1											
(2) Exploration	4.03	.84	.881**	1										
(3) Exploitation	3.91	.84	.886**	.615**	1									
(4) Org. Context	66.79	28.11	.646**	.550**	.610**	1								
(5) Risk-taking Leadership	3.85	.93	.598**	.479**	.613**	.821**	1							
(6) Supportive Leadership	4.05	.74	.572**	.562**	.520**	.782**	.518**	1						
(7) Goal-setting Leadership	4.04	.74	.412**	.410**	.392**	.762**	.448**	.639**	1					
(8) Power Distance	5.27	.22	.060	.021	.081	.034	-.008	.017	.058	1				
(9) Uncertainty Avoidance	4.47	.58	-.313**	-.146*	-.329**	-.192**	-.301**	-.029	.058	.426**	1			
(10) Firm Age ln	2.64	.82	.074	-.034	.118	.003	.059	-.100	-.056	-.108	-.372**	1		
(11) Number Employees ln	.90	.43	.009	-.044	.039	.077	.081	-.056	.041	-.155*	-.169*	.411**	1	
(12) Biotech type	.43	.50	.007	.021	.008	-.039	-.057	.052	.058	-.052	-.014	-.054	-.147*	1

^a Ambidexterity is the multiplicative interaction of exploitation and exploration, Organizational context is the multiplicative interaction of leadership and social integration mechanisms.

** p < .01

Table 5.3: Results of OLS Analyses with Ambidexterity as the Dependent Variable^a

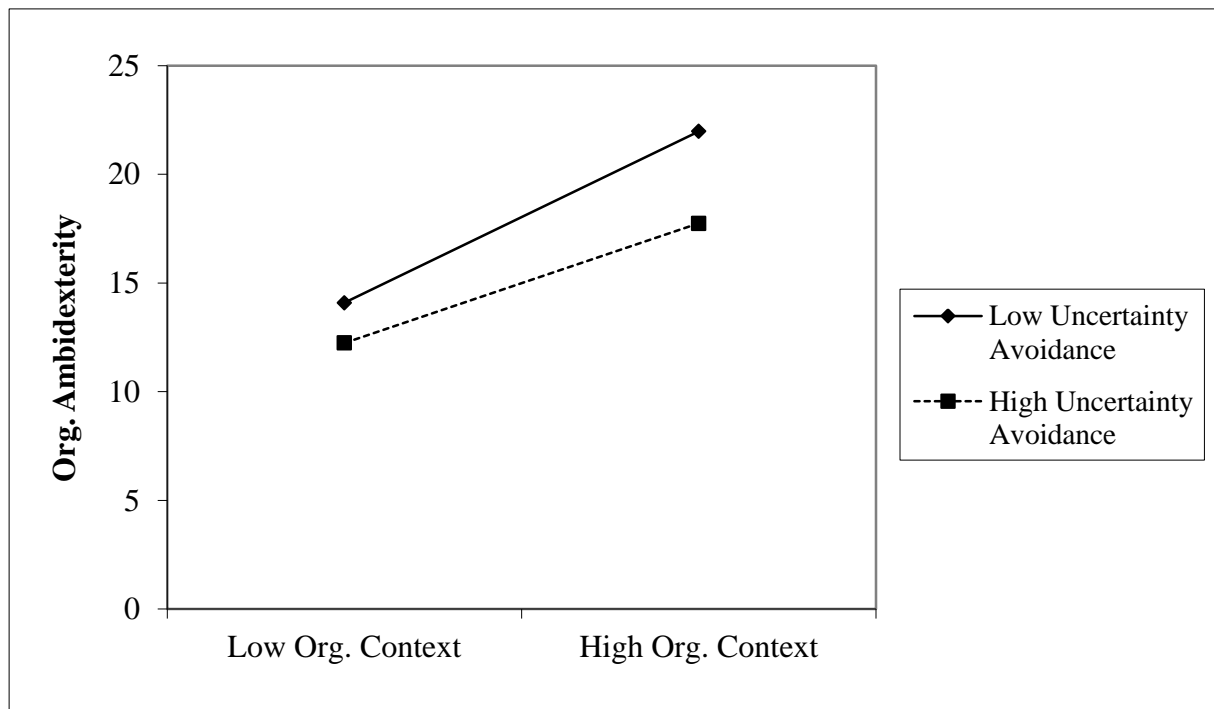
	Model 1	Model 2	Model 3	Model 4	95% Confidence Interval ^b	
					Lower	Upper
Constant	14.913	15.084	16.479	16.515	14.210	18.819
<i>Control variables</i>						
Firm age	.573 (.551)	.725 (.419) [†]	.113 (.433)	.055 (.428)	-.790	.900
Firm size	-.311 (1.056)	-1.043 (.805)	-.795 (.783)	-.738 (.771)	-2.261	.784
Biotech type	.095 (.842)	.298 (.640)	.294 (.618)	-.214 (.609)	-.987	1.416
<i>Independent variable</i>						
Organizational context		3.640 (.315) ^{***}	3.323 (.313) ^{***}	3.347 (.317) ^{***}	2.720	3.973
<i>Moderators</i>						
Power Distance			.811 (.342) [*]	.638 (.351) [†]	-.054	1.330
Uncertainty Avoidance			-1.472 (.370) ^{***}	-1.521 (.365) ^{***}	-2.241	-.801
<i>Interactions</i>						
Context x Power Distance				-.450 (.432)	-1.303	.403
Context x Uncertainty Avoidance				-.598 (.346) [†]	-1.281	.086
R ²	.006	.429	.477	.499		
Adjusted R ²	-.010	.417	.460	.476		
F (sign. level)	.371 (.774)	33.876 ^{***}	27.106 ^{***}	21.916 ^{***}		

^a Non-Standardized regression coefficients are reported.^b For model 4.[†] $p \leq .10$; * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$

N = 185

Model 1 was the base model including all control variables. With the exception of the marginally significant and positive effect of *firm age* in Model 2 ($b = .725, p < .10$), all non-survey control variables were nonsignificant across all models. In Model 2, we added the independent variable to the model and the results showed that organizational context is highly significant, strong, and positively related to a firm's organizational ambidexterity ($b = 3.640, p < .001$), providing strong support for Hypothesis 1. Model 2 explains an additional 42 percent of the variance in organizational ambidexterity over the control variables. In Model 3, power distance is significant and positively related to organizational ambidexterity ($b = 3.670, p < .05$), whereas uncertainty avoidance is highly significant and negatively related to organizational ambidexterity ($b = -2.533, p < .001$). Both results support Hypotheses 2a and Hypothesis 3a. Model 4 contained the interaction terms. As expected, in Hypothesis 2b, the interaction of organizational context and power distance seems to be negative but not statistically significant in terms of ambidexterity. Thus, Hypothesis 2b is not supported. Results for Hypothesis 3b show that uncertainty avoidance reduces the positive effect of an organizational context on ambidexterity ($b = -.598, p < .10$), which supports this hypothesis. We conducted a slope-difference test one standard deviation above and below the mean. The findings show a significant positive and strong moderating effect at all three levels of uncertainty avoidance (at low levels of uncertainty avoidance $b = 3.811^{***}$ [.380 std. error], 95% confidence interval between 3.060 and 4.562; at average levels $b = 3.347^{***}$ [.317 std. error], 95% confidence interval between 2.720 and 3.973; at high level of uncertainty avoidance $b = 2.749^{***}$ [.507 std. error], 95% confidence interval between 1.748 and 3.750). Because the effect was in the opposite direction specified, the relation was slightly stronger when organizational context was one standard deviation below the mean and became slightly weaker, but still positive, when organizational context was one standard deviation above the mean. Figure 5.2 illustrates this finding graphically.

Figure 5.2: Organizational Context x Uncertainty Avoidance



5.5 Discussion and Conclusion

Research has shown that leadership plays an important role by enabling ambidexterity in firms (e.g., Gibson & Birkinshaw, 2004; Jansen et al., 2006; Smith & Tushman, 2005) and SMEs in particular rely on their top management to encourage employees' ambidextrous behaviour (Chang & Hughes, 2012; Lubatkin et al., 2006). The ability of leaders to influence the behaviour of their subordinates, however, also depends on the cultural environment in which the firm is embedded (Hofstede, 1980). Scholars suggest that a national culture's dimensions of power distance and uncertainty avoidance shape not only the functioning of organizations, but also the attitudes of individuals within these organizations toward innovation and change (House et al., 2004; Mueller et al., 2013; Nakata & Sivakumar, 1996). Nevertheless, because most empirical research has neglected the impact of national culture on ambidexterity prior research has told us little about how antecedents, such as leadership, affect the success of firm ambidexterity in different cultural contexts.

Therefore, the results of this study contribute to current research in several ways. First, they emphasize the importance of leadership for developing an organizational context that positively influences ambidexterity in SMEs. In addition, our findings demonstrate that high power distance positively influences ambidexterity, whereas high uncertainty avoidance has a strongly significant negative effect on ambidexterity. Finally, findings also show that the relationship between organizational context and ambidexterity is negatively moderated by uncertainty avoidance, while power distance shows no significant effect.

Hence, our study's findings enhance existing research on contextual ambidexterity in a number of ways: First, they show that leadership creates an appropriate behavioural organizational context that enables ambidexterity. Because SMEs often have fewer options for balancing exploitation and exploration because of their scarce resources, they are likely to rely on their leadership to influence their firm members' behaviour (Lubatkin et al., 2006). Because it is unclear from previous research how leadership can shape an organizational context to enable ambidexterity, this study expands on the findings of previous studies by showing how the interdependent management styles of goal setting, risk taking, and supportive leadership influence employees' ambidextrous behaviour in SMEs. Therefore, this research further elucidates the role of leadership in achieving ambidexterity, especially in the context of SMEs.

Second, this study provides evidence about how national culture influences ambidexterity by showing that power distance positively affects ambidexterity and uncertainty avoidance negatively affects it. In times of increasing globalisation, it is crucial to understand how socio-environmental factors influence firm-level activities such as leadership processes and employees' innovative behaviour (Lavie et al., 2010). As each national culture provides distinct social norms, rules, and procedures which affect entrepreneurship and innovative behaviour (House et al., 2004), our findings show that power distance and uncertainty avoidance have a major impact on ambidexterity and might explain certain cross-national differences firms (and the managers working in them) experience as they try to

balance exploration and exploitation. Thus, this study deepens our understanding of different effects of socio-environmental factors on innovative behaviour and contextual approaches of ambidexterity, and helps to explain the variety of results in previous studies which have often neglected the influence of national culture. In this respect, this study cautions that empirical findings which are not linked to the cultural environment should be carefully interpreted, because their implications might not be applicable under all cultural conditions.

Third, we shed light on the interaction of organizational context and national culture and their combined impact on ambidexterity. While previous research has suggested that social norms, rules, and procedures contained in national culture affect organizations and their members' behaviour (Hofstede, 1980; House et al., 2004), the role of antecedents, and specifically the role of leadership and its influence on the success of ambidexterity in different cultural contexts, has been understudied. Our findings suggest that leadership, as a culturally constructed and carried out, can partially explain why the efficacy of ambidexterity differs from country to country. Thus, this study might help to explain why different leadership strategies are useful to meet differing cultural requirements and offers promising insights for scholars and practitioners. Our findings should be a springboard for other researchers, who should include national culture in their research design to explore the cultural effects of leadership in more detail. Moreover, future research might further investigate additional cultural dimensions such as institutional collectivism that might have an impact on the relationship between an organizational context and ambidexterity.

Our study includes a number of limitations, and while we acknowledge them below, we also recognize that they might provide fruitful links for future research. First, we use self-reported data by senior firm managers to measure organizational context and ambidexterity. Although we observed the rules of good research practice in the design and testing phases of the survey, key-informant bias and common bias cannot be completely excluded. Therefore, future studies might draw on multiple informants and apply additional objective data sources to measure organizational context and ambidexterity. A further limitation might stem from the

measurement of exploration and exploitation variables. Although we applied established scales from He and Wong (2004) and Jansen et al. (2006) and we conducted additional analyses to evaluate the validity of these measures, our measurement is to some degree exploratory and should be addressed and tested by future studies. Second, this study uses cross-sectional data, which can only demonstrate relationships between the constructs, but cannot demonstrate causality. Because exploitation outcomes are less distant than exploration outcomes (March, 1991), it seems crucial to examine ambidexterity at distinct points in time. Hence, longitudinal studies should be carried out to illustrate how organizational context and national culture influence ambidexterity over time. Finally, firms in our sample are small and medium-sized biotechnology firms from Australia, Germany, and India. Thus, our findings might not apply to large firms that can rely on more slack resources and hierarchical administrative systems to balance exploitation and exploration. On the contrary, it is very likely that larger firms use a combination of leadership styles and organizational mechanisms to establish a supportive organizational context. Hence, further cross-national studies are required to examine the impact of national culture on the ambidexterity of larger firms.

Despite these drawbacks, this study enhances our understanding of how SME leadership can shape an organizational context that enables ambidexterity and describes the effects of goal setting, risk taking, and supportive leadership on exploitation and exploration. It also examines how national culture—as measured by power distance and uncertainty avoidance—influences ambidexterity. All in all, it shows how SMEs can use leadership and its various forms and manifestations to overcome some of the drawbacks of size and resource levels to remain viable and competitive in the long run.

5.6 Appendix: Confirmatory Factor Analysis of Measures

Exploitation		
$\chi^2/df = 1.806$ ($p = .164$); RMSEA = .066; CFI = .996; $\alpha = .885$		
Variable	Scale Items	SRW ^a
Exploitation (He & Wong, 2004; Jansen et al. 2006)	We optimize more incremental new products compared to our major competitor.	.731
	We distinctly improve the flexibility of our item development processes.	.777
	We optimize the costs in our development processes.	.861
	We significantly improve the performance of our development processes.	.886
Exploration		
$\chi^2/df = .827$ ($p = .508$); RMSEA = .000; GFI = .993; CFI = 1.000; $\alpha = .893$		
Variable	Scale Items	SRW ^a
Exploration (He & Wong, 2004; Jansen et al. 2006)	We enter new technology fields.	.632
	We appreciate more radical new products compared to our major competitor.	.741
	We distinctly extend our product / product technology range.	.861
	We initiate a greater percentage of new radical product innovation compared to our major competitor.	.838
	We open up new markets.	.829

Note: ^aStandardized regression weights

5.6 Appendix: Confirmatory Factor Analysis of Measures (continued)

Organizational Context			
$\chi^2/df = 1.214$ (p = .164); RMSEA = .034; GFI = .956; CFI = .987			
Variable	Scale Items	α	SRW ^a
Goal-setting Leadership (Chang & Hughes, 2012)	Our management issues creative challenges to our people, instead of narrowly defining tasks.	.679	.686
	Our management is more focused on people getting the job done well than on getting promoted.		.681
	Our management makes a point of stretching our people.		.575
Risk-taking Leadership (Chang & Hughes, 2012)	Our management repeatedly tells employees that this firm's survival depends on its adapting to market trends.	.777	.800
	Our management often tells employees to be sensitive to the activities of our competitors.		.600
	Our management keeps telling people around here that they must gear up now to meet customers' future needs.		.805
Supportive Leadership (Chang & Hughes, 2012)	Our management devotes considerable effort to developing their subordinates.	.810	.691
	Our management gives everyone sufficient authority to do their jobs well.		.722
	Our management works hard to develop the capabilities needed to execute our overall strategy / vision.		.712
	Our management bases decisions on facts and analysis, not politics.		.700
	Our management treats failure (in a good effort) as a learning opportunity, not something to be ashamed of.		.577

6 Chapter 6. Summary of Findings, Implications and Conclusion

This dissertation examines capabilities that help SMEs to profit from externally and internally balancing exploration and exploitation. The four conceptual and empirical studies that comprise it explore alliance ambidexterity, contextual ambidexterity, and absorptive capacity in SMEs and develop new insights regarding the role of alliances, leadership and context, social integration mechanisms, and national culture. Specific insights from this dissertation are that (1) a tailored approach to absorptive capacity enhances the effect of ambidexterity in small firms; (2) national culture and its impact on leadership and firm member's behaviour affects the level of ambidexterity; and (3) incorporating social-integration measures boosts potential and realized absorptive capacity and their complementary effects on firm performance.

This dissertation theoretically refines the concepts of ambidexterity and absorptive capacity by showing that it is both multifaceted and context dependent. It exhibits that absorptive capacity can help firms leverage alliance ambidexterity by resolving internal contradictions, intensifying the speed of knowledge sharing, and reducing operational redundancy resulting from balancing explorative and exploitative alliances. This dissertation is also one of the first empirical studies to examine the influence of national culture on ambidexterity and the results indicate that national culture, and the leadership styles and expectations within a culture, are empirically relevant. These results might also explain why firms in different countries have different outcomes, and they have implications for researchers comparing outcomes results of cross-national firms. Furthermore, they indicate the limits of leadership: as much as leaders within an organization might want to manage in a novel way, they are bounded by the culture (and its institutions) in which they lead. They also indicate that an accurate picture of firm performance requires that researchers include these measurements in their research design in order to provide a better understanding of the results from different countries.

6.1 Theoretical Implications

This dissertation contributes to current research on organizational learning in several ways. First, the capability-based framework and its integrative perspective provide a theoretical reasoning of how contextual ambidexterity and absorptive capacity can influence the relationship between alliance ambidexterity and firm performance in SMEs. By uncovering the links between these two concepts, this study shows that alliance ambidexterity is dependent on organizational context and a firm's characteristics. In contrast to prior research, it shows a more complex relationship is at work and that these prior results might not tell the whole story. These findings can alter the direction of future research by expanding the number of dimensions that researchers look for in their studies, to more completely explain the interaction between inputs and outcomes.

Second, the research in this dissertation provides first evidence of the performance effects of balancing explorative and exploitive alliances in SMEs. The findings confirm the assumptions of previous research (Lavie et al., 2011; Lin et al., 2007) and show that alliance ambidexterity in SMEs is negatively related to firm performance. These results also demonstrate, however, that by increasing the efficiency of certain capabilities and resolving certain contradictions related to them, a small firm can reverse the impediments associated with alliance ambidexterity, and furthermore, that firms can actually profit from alliance ambidexterity. The findings from this dissertation complement those from prior research findings on alliance ambidexterity and highlight the role of absorptive capacity as a beneficial firm-level and partner-related capability. Hence, this study gives future researchers a sound base for designing research studies that combine ambidexterity and absorptive capacity, meaning that the results of this study can affect the future direction of research and results in this discipline.

Third, this dissertation shows the importance of intra-organizational antecedents and how they affect the level of potential and realized absorptive capacity. These findings confirm

those of previous studies and strengthen the view that the dimensions of absorptive capacity emerge from distinct antecedents, and that they have unique and complementary effects on performance outcomes such as innovation and financial performance (e.g., Ebers & Maurer, 2014; Jansen et al., 2005a; Zahra & George, 2002). More concretely, the results show that potential absorptive capacity benefits from participation in decision finding but is negatively affected by informal communication, whereas realized absorptive capacity profits from formalized knowledge sharing and participation in decision finding. Moreover, this study confirms previous studies and shows that potential and realized absorptive capacity not only have individually but also complementary effects on a firm's innovativeness and financial performance. Thus, this study underscores that potential and realized benefit differently from intra-organizational antecedents and helps to explain the unique but complementary roles of both dimensions in the value creation. In addition, the scales for social integration mechanisms developed here give future researchers a valuable tool that overcomes issues from using proxies and strengthens the explanatory power of future investigations.

Fourth, this dissertation is one of the first studies to empirically show that national culture affects the balance of exploration and exploitation: power distance is positively related to ambidexterity, whereas uncertainty avoidance is negatively related to ambidexterity. In addition, the results show that uncertainty avoidance negatively affects the relationship between organizational context and ambidexterity. They also show that a combination of leadership styles creates an appropriate context that positively influences the balance of exploration and exploitation. Thus, these findings complement previous research by linking leadership and contextual drivers of ambidexterity and help to explain different effects of socio-environmental factors on innovative behaviour and contextual approaches of ambidexterity.

Finally, this dissertation reinforces the view that studies of SMEs and larger firms needs to be uniquely and separately designed in order to account for the separate effects of

exploration and exploitation in SMEs and to generate comparable results about the advantages of ambidexterity.

6.2 Managerial Implications

The findings of this dissertation have important implications for practicing SME managers as they attempt to balance exploration and exploitation.

First, this dissertation shows that absorptive capacity can help firms to use their limited resources more efficiently to facilitate the integration from distinct knowledge sources. Results also show that if firm resources are too scarce, it might be more beneficial to focus on either exploration or exploitation, but not both (Cao et al., 2009; Lavie et al., 2011; Lin et al., 2007). A decision-making basis for the question when it is better to be ambidextrous offers the research by Gulati and Puranam (2009) who explored under which conditions pursuing the two poles of each duality is more preferable to a focus on one of the poles alone.

Second, SMEs benefit from investing in social integration mechanisms. Specifically, participation in decision finding and formalized knowledge sharing can increase the benefits of absorptive capacity by increasing the variety of alternative views in the assimilation and transformation processes. Moreover, employees of small high-tech firms often hold specialized expertise in different knowledge fields, and thus their involvement into decision finding and knowledge sharing can help firms identify new opportunities (Starbuck 1992). In addition, practicing managers of SMEs should invest in *both* potential and realized absorptive capacity because each one complements the other, implying that to create value, firms need to employ both.

Thirdly, this dissertation underscores that goal-setting, risk-taking, and supportive leadership creates an appropriate organizational context that influences employees' ambidextrous behaviour, which in turn leads to higher levels of ambidexterity. The results

also demonstrate that a firm's environment is important and that cultural differences may impact the efficiency of management approaches. Hence, top SME managers should adapt their leadership style to the characteristics of their national culture.

In sum, developing firm capabilities can advance performance outcomes and enhance the competitiveness of SMEs. This finding comes with a caveat, though: developing capabilities is very time consuming and explorative returns are often distant and uncertain. Managers must therefore be patient with returns on their investments in firm capabilities and not immediately rescind previous investments in capability development at the first sign of failure. One way to successfully develop capabilities is by benchmarking their capabilities with industry peers.

6.3 Limitations and Future Research Directions

This dissertation includes a number of limitations, and while acknowledging them below, we also acknowledge that they might present fruitful opportunities for future researchers to study.

First, the data used in this dissertation is self-reported by senior firm managers of biotechnology SMEs. Although I followed several steps of good research practice in the design and testing phases of the survey to reduce concerns related to single-informant bias and common bias, neither of these issues can be fully ruled out. One step for reducing bias was to restrict artificially inflated or disguised responses of the participants by integrating strong interrater agreement and reliability measures. Additionally, I ensured confidentiality for all participants. I also used Harman's one-factor (Podsakoff & Organ, 1986) and the Chi-Square test (Podsakoff et al., 2003) to disprove the presence of one common factor. While the results of these tests indicate that common method variance in the data is unlikely, bias concerns are not completely eliminated. One way to prevent or eliminate these bias concerns in the future would be to use multiple informants and additional objective data sources to measure the dependent and independent variables.

Second, the cross-sectional studies in this dissertation can only illustrate relationships between constructs, but cannot capture capability origins and evolution over time. Because prior research has argued that exploitation outcomes are less distant in time than exploration outcomes are (Levinthal & March 1993; March 1991), longitudinal studies and large-scaled meta-analyses are required to overcome the limitations of cross-sectional research designs and examine ambidexterity and its performance effects at distinct points in time.

Third, this dissertation focuses on biotechnology SMEs in Australia, Germany, and India and might not be directly transferable to larger firms that can rely on more slack resources, well-developed hierarchical administrative systems, and broader networks to balance exploitation and exploration (e.g., George, 2005; Voss & Voss, 2013). Thus, it is most likely that larger firms benefit differently from their firm capabilities (Chang & Hughes, 2012; Lavie et al., 2011; Lin et al., 2007). Future studies could address this limitation by examining how increasing firm size affects the efficacy of firm capabilities.

Another limitation of this dissertation is that it concentrates on the biotechnology industry. This narrow focus is useful to avoid significant industry-specific effects, but further empirical studies are required to confirm and generalize my findings. Furthermore, data reflects the contemporary situation of biotechnology SMEs in Australia, Germany, and India. As findings of Study 4 indicate, cultural differences might influence the choice and application of firm capabilities as well as their effectiveness. Thus, additional cross-national studies are required to further clarify and explain the role of national culture in balancing exploration and exploitation.

Other opportunities for future research include developing a combined perspective of multiple levels of ambidexterity, including a focus on boundary conditions and simultaneous analysis of multiple organizational levels, to advance the ambidexterity concept (Birkinshaw & Gupta, 2013; O'Reilly & Tushman, 2013; Raisch et al., 2009). Apart from the close relation between individual-unit level ambidexterity and unit-firm level ambidexterity, it is most likely

that these levels are closely interrelated in their effects on the balance of exploration and exploitation at the network level. For instance, Im and Rai (2008) indicate that contextual ambidexterity is positively related to explorative and exploitative knowledge sharing in long-term inter-organizational relationships, whereas Kauppila's (2010) framework offers a complementary perspective of inter- and intrafirm ambidexterity. Both of these findings offer a promising starting point for developing a holistic understanding of the ambidexterity approach.

In addition, future research could continue the auspicious combination of the concepts of ambidexterity and absorptive capacity. Scholars have indicated that both approaches are closely linked in enhancing competitive advantage (e.g., Fernhaber & Patel, 2012; Jansen et al., 2005a; Jansen et al., 2005b; Rothaermel & Alexandre, 2009). An integrative framework, especially in the case of interfirm collaborations, would strengthen our understanding of how firms can manage and leverage the complex interplay of inter- and intrafirm knowledge sources.

Another possibility for future research is to incorporate additional antecedents and theoretical concepts related to exploration and exploitation. On the alliance level, including additional partner-related concepts and instruments could broaden our current comprehension of alliance ambidexterity. At the firm level and lower, future research could expand the study of organizational context by including formal organizational mechanisms and systems (e.g., Gibson & Birkinshaw 2004). In this manner, research could examine how employees' behaviour changes when top management aligns its management styles to distinct organizational mechanisms and systems. Future studies that examine the interplay of leadership styles and organizational mechanisms and their influence on firm members' tendency to pursue organizational ambidexterity could therefore deepen our understanding of contextual ambidexterity.

Yet another area for future research is to design studies that include additional national cultures to provide a greater understanding of how culture affects ambidexterity. In addition, expanding the cultural dimensions by including additional institutional conditions such as social welfare and collectivism and studying its impacts on ambidexterity also seems a promising avenue for future research.

Regarding absorptive capacity, future research might also examine the moderating role of firm size on the relationship between social integration mechanisms and absorptive capacity. The results of one study in this dissertation show no significant effects of trust on the dimensions of absorptive capacity, whereas previous research studies of larger firms indicate that trust is an important factor for the level of absorptive capacity (e.g., Jansen et al. 2005a). A comparative research design that includes small and large firms would shed light on how social-integration mechanisms and firm size differently affect potential and realized absorptive capacity.

To advance the absorptive capacity construct, another area worthy of additional investigation is the efficiency factor, in other words the balance between potential and realized absorptive capacity (Zahra & George 2002). Some researchers have argued that an efficiency factor might explain performance differences between firms with distinct levels of absorptive capacity (Zahra & George 2002), but a thorough investigation has yet to be carried out (Todorova & Durisin 2007).

Finally, the concept of absorptive capacity could be refined by adding an additional dimension that takes into account a firm's ability to reject absorbed knowledge. It is reasonable that firms reject knowledge that does not match well or is no longer valuable, but we still do not know what happens during the phases of assimilation and transformation if a firm absorbs knowledge that does not fit. Expanding the absorptive capacity construct to include a measurement of rejected absorbed knowledge would improve the explanatory power of the construct.

6.4 Conclusion

In conclusion, capabilities that allow SMEs to leverage the balance of exploration and exploitation activities can explain why performance varies between firms. By understanding how these interlinked elements affect firms' performance outcomes, we can better understand how firms can use their limited resources in the most profitable way. Knowing which elements of a firm's capabilities are productive and worthwhile and which ones are not means that firms avoid unproductive investments and focus on those with the best prospects of success.

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Appendices:

Appendix A: Ethic Approval

**Mrs Yanru Ouyang** <yanru.ouyang@mq.edu.au> 6/16/15   

to Dr, me 

Dear Dr Chavan,

Re: 'The balance of exploration and exploitation in inter- and intraorganizational relationships and its performance implications.'

Reference No.: 5201500442

Thank you for your recent correspondence. Your response has addressed the issues raised by the Faculty of Business & Economics Human Research Ethics Sub Committee. Approval of the above application is granted, effective "16/06/2015". This email constitutes ethical approval only.

This research meets the requirements of the National Statement on Ethical Conduct in Human Research (2007). The National Statement is available at the following web site:

http://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/e72.pdf.

The following personnel are authorised to conduct this research:

Dr Meena Chavan
Indre Maurer
Mr Rene Nicolai Abel

NB. STUDENTS: IT IS YOUR RESPONSIBILITY TO KEEP A COPY OF THIS APPROVAL EMAIL TO SUBMIT WITH YOUR THESIS.

Please note the following standard requirements of approval:

1. The approval of this project is conditional upon your continuing compliance with the National Statement on Ethical Conduct in Human Research (2007).
2. Approval will be for a period of five (5) years subject to the provision of annual reports.

Progress Report 1 Due: 16th Jun 2016
Progress Report 2 Due: 16th Jun 2017
Progress Report 3 Due: 16th Jun 2018
Progress Report 4 Due: 16th Jun 2019
Final Report Due: 16th Jun 2020

NB. If you complete the work earlier than you had planned you must submit a Final Report as soon as the work is completed. If the project has been discontinued or not commenced for any reason, you are also required to submit a Final Report for the project.

Progress reports and Final Reports are available at the following website:

http://www.research.mq.edu.au/for/researchers/how_to_obtain_ethics_approval/human_research_ethics/forms

3. If the project has run for more than five (5) years you cannot renew approval for the project. You will need to complete and submit a Final Report and submit a new application for the project. (The five year limit on renewal of approvals allows the Committee to fully re-review research in an environment where legislation, guidelines and requirements are continually changing, for example, new child protection and privacy laws).

Appendix A: Ethic Approval (continued)

4. All amendments to the project must be reviewed and approved by the Committee before implementation. Please complete and submit a Request for Amendment Form available at the following website:

http://www.research.mq.edu.au/for/researchers/how_to_obtain_ethics_approval/human_research_ethics/forms

5. Please notify the Committee immediately in the event of any adverse effects on participants or of any unforeseen events that affect the continued ethical acceptability of the project.

6. At all times you are responsible for the ethical conduct of your research in accordance with the guidelines established by the University. This information is available at the following websites:

<http://www.mq.edu.au/policy/>
http://www.research.mq.edu.au/for/researchers/how_to_obtain_ethics_approval/human_research_ethics/policy

If you will be applying for or have applied for internal or external funding for the above project it is your responsibility to provide the Macquarie University's Research Grants Management Assistant with a copy of this email as soon as possible. Internal and External funding agencies will not be informed that you have approval for your project and funds will not be released until the Research Grants Management Assistant has received a copy of this email.

If you need to provide a hard copy letter of approval to an external organisation as evidence that you have approval, please do not hesitate to contact the FBE Ethics Committee Secretariat, via fbe-ethics@mq.edu.au or 9850 4826.

Please retain a copy of this email as this is your official notification of ethics approval.

Yours sincerely,

Dr. Nikola Balnave
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Appendix B: About the author

René Nicolai Abel (b. Fulda, Germany, 1984) is pursuing double degree PhD in Strategic Management at the Department of Organization and Corporate Development at Goettingen University in Goettingen (Germany) and the Department of Marketing and Management at Macquarie University in Sydney (Australia). He is a class of 2012 graduate of the Diploma program of Business Administration (M.Sc. equivalent) at Philipps-University in Marburg (Germany) and completed his studies with his thesis “*Challenges of formalization strategies in innovation processes under conditions of ambidexterity: An exploratory analysis on the pharmaceutical industry*” (graduation with honors).

René specializes in organizational learning, strategic innovation and knowledge management, particularly relating to exploration, exploitation, ambidexterity, and absorptive capacity. His research focuses on inter- and intrafirm knowledge creation in small and medium-sized biotechnology firms. Title of his dissertation is “*Capitalizing the balance of exploration and exploitation: Evidence from Australian, German, and Indian biotechnology firms*”.

Further, Rene won the Most Promising Paper Award at the ANZAM Year-End Doctoral Workshop 2015 in Queenstown (New Zealand) and was finalist of the Doctoral Colloquium Best Paper Awards at the EURAM 2016 conference in Paris (France).