

- CONNECTING THE DOTS -

**STUDIES ON BOUNDARY-SPANNING AMBIDEXTERITY AT THE INDIVIDUAL,
PROJECT, FIRM AND ALLIANCE LEVEL**

DISSERTATION

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St.Gallen, October 26, 2011

The President:

Prof. Dr. Thomas Bieger

To my parents, in great gratitude for the life they have rendered possible for me through their unconditional love, support and generosity.

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List of Abbreviations

*	significance (level of 10%)
**	significance (level of 5%)
***	significance (level of 1%)
3-D	three dimensional
Abs.	absolute
B-Pillar	beta-pillar (middle achsis in a car)
BMW	Bayrische Motoren Werke
CII	cross-industry innovation
Coeff.	Coefficient
Co. KG	Cooperative Kapitalgesellschaft
Ed./Eds.	Editor/Editors
e.g.	for example, for instance (Latin <i>example grandi</i>)
et al.	and other people (Latin <i>et alii/alia</i>)
etc.	et cetera
F	degrees of freedom
FMCG	Fast moving consumer goods
GICS	global industry classification standard
GmbH	Gesellschaft mit beschräkter Haftung
H	hypothesis
i.e.	that is (Latin <i>id est</i>)
IPO	initial public offering
IT	information technology
min.	minimum
max.	maximum
MSA	Metropolitan Statistical Areas
N	number
n.a.	not applicable
No.	number
NPD	new product development
obs	observations
OLS	Ordinary least square
P	Proposition
p	level of significance
Prob	probability

R ²	squared multiple correlation coefficient
R&D	research and development
SD	standard deviation
SE	standard error
S&P	Standard and Poor's
SPF	sun protection factor
T	time
UV-A /-B	ultraviolet light
vs.	versus

Abstract

Markets change – relentlessly. Yet, what makes some firms fail and disappear while others survive and prosper? To one of the most enduring questions in management research, ambidexterity has developed into a strategic response, asserting that firms need to engage in innovations that stretch between leveraging existing competencies while simultaneously adjusting to future needs, termed exploitation and exploration. However, both activities comprise markedly different features that surface through the need for distinct processes, structures and organizational cultures. Nonetheless, research has emphasized that particularly this paradox of merging two conflicting activities creates a nexus where potential synergistic benefits are located.

To alleviate the tension, inherent to the paradox of ambidexterity, research suggests joint mechanisms of separating and integrating both activities. In that respect, benefits of integrating the external environment through boundary-spanning have been voiced. While first studies on boundary-spanning ambidexterity provide a valuable basis on the mechanisms in place, two major shortcomings remain. First, most findings remain on the firm level of analysis and concentrate foremost on the separation aspect of exploitation and exploration. This raises several concerns, which provide the basis for the contributions made in this dissertation. First, ambidexterity is a multi-level phenomenon that needs to stretch throughout the entire organization in order to leverage its potential. Only if mechanisms at all levels and across are defined, well founded assumptions on the effects of ambidexterity can be made. Second, separation alone does not suffice to reveal the synergistic effects of ambidexterity, as only under the integration of both activities the ambidexterity paradox originates.

Therefore, this dissertation contributes to the rising field of boundary-spanning ambidexterity by addressing four central gaps in existing research. This dissertation significantly extend the concept of boundary-spanning ambidexterity to (1) the individual, project, firm and alliance level, thereby reflecting mechanisms in place on each hierarchical level, (2) connects effects across multiple levels, (3) reveals critical separation and integration mechanisms and links them back together, and in doing so, (4) provides the first findings on dynamic processes on how ambidexterity evolves as opposed to previous static snapshot analyses. Finally, managers obtain guidelines that unfold the practices of boundary-spanning ambidexterity, which help them to connect the dots that lead to a sustained innovation strategy.

Zusammenfassung

Märkte wandeln sich – unaufhaltsam. Was führt jedoch dazu, dass manche Firmen scheitern und vom Markt verschwinden während andere den Wandel überleben und florieren? Zu einer der ältesten Fragen in Management hat sich das Konzept von Ambidextrie (die Beidhändigkeit) als strategische Antwort behauptet. Demgemäß müssen Firmen im Spannungsfeld zwischen exploitativen und explorativen Innovationen bestehende Fähigkeiten ausbauen, während sie sich zeitgleich auf zukünftige Bedürfnisse einstellen. Beide Aktivitäten weisen jedoch spezifische Facetten auf, die sich durch unterschiedliche Prozesse, Strukturen und Unternehmenskulturen äußern. Nichtsdestotrotz behält sich die Wissenschaft vor, dass genau diese paradoxe Zusammenführung zweier so unterschiedlicher Aktivitäten einen Nexus schafft in dem synergetische Mehrwerte geschaffen werden.

Um den Konflikt zu mindern, der Ambidextrie unterliegt, schlägt die Wissenschaft Differenzierungs- und Integrationsmechanismen vor, die besonders unter Einbezug des externen Umfeldes Vorteile schaffen sollen. Während erste Studien auf Basis firmenübergreifender Tätigkeiten Einblicke zu vorliegenden Mechanismen schaffen, verbleiben zwei Schwachpunkte. Zunächst leisten existierende Studien vordergründig Beiträge, die sich auf die Firmenebene beschränken und auf die Differenzierung von exploitativen und explorativen Tätigkeiten fokussieren. Dies erweckt Bedenken, die zugleich die Basis für die Beiträge dieser Dissertation schaffen. Erstens, Ambidextrie ist ein vielschichtiges Phänomen, welches sich durch die gesamte Unternehmung ziehen muss um seinen Mehrwerte zu entfalten. Nur wenn die Mechanismen auf und hindurch alle Unternehmensebenen definiert werden, können fundierte Annahmen über die Auswirkung von Ambidextrie getroffen werden. Zweitens, die Differenzierung beider Aktivitäten alleine ist nicht ausreichend, um synergetische Auswirkungen von Ambidextrie zu bestimmen, da nur unter Einbezug von Integrationsmechanismen der Nexus von Ambidextrie geschaffen wird.

Durch Aufgreifen von vier konkreten Lücken, trägt diese Dissertation zum wachsenden Feld der firmenübergreifenden Ambidextrie bei. Diese Dissertation erweitert das Feld maßgeblich durch (1) die Analysen von firmenübergreifender Ambidextrie auf der Individual-, Projekt-, Firmen-, und Allianz-Ebene welche die Offenlegung von Mechanismen auf jeder Unternehmensebene ermöglicht, und erlaubt (2) Wirkungen hindurch multipler Unternehmensebenen zu bestimmen (3), das

Zusammenspiel von Differenzierung und Integration offenlegen, und (4) hierdurch erstmals Erkenntnisse zu dynamischen Prozessen generiert, die der Entstehung von Ambidextrie unterliegen. Dies steht im Gegensatz zu existierenden Beiträgen, die statische Momentaufnahmen erforscht haben. Manager, die die Wichtigkeit von firmenübergreifender Ambidextrie erkannt haben, erhalten Richtlinien, die es Ihnen ermöglichen Beziehungen herzustellen, die zu einer langfristigen Innovationsstrategie führen.

The most powerful natural species are those that adapt to environmental change without losing their fundamental identity which gives them their competitive advantage.

- Charles Darwin

1 Introduction

One of the most enduring questions in management research remains the question what makes companies survive and prosper. Inherent to this question is the understanding that market conditions change, requiring firms to either adapt or vanish. Ample evidence like PanAm, Polaroid or Sears has been highlighted as examples how former market leaders and highly successful firms vanish from the market at some point in time (O'Reilly & Tushman, 2008; Sobel, 1999; Sull, 1999). Indeed, Louca and Mendonca (2002) further substantiate this anecdotal evidence with their study on the largest U.S. manufacturing firms, highlighting that only 28 of an initial list of 266 companies survive over the period 1917–1997.

However, there are companies that seem to manage changes that originate outside their organization's boundaries. In an attempt to answer the question what differentiates these companies from failure, literature has frequently referred to the concept of ambidexterity (Levinthal & March, 1993; Tushman & O'Reilly, 1996). Emphasizing that firms need to engage in innovations that stretch between leveraging existing competencies while simultaneously adapting and modifying their competencies, ambidexterity allows firms to meet current demands while preparing for future market developments (Gibson & Birkinshaw, 2004; Lavie & Rosenkopf, 2006). Pertaining to March's (1991) seminal article, exploitation has been coined by activities that center on improving current skills and procedures through the "refinement, choice, production, efficiency, selection, implementation, [and] execution" (March, 1991:71). Consequently, these activities deepen and complement present knowledge and capabilities (Bontis, Crossan & Hulland, 2002; Floyd & Lane, 2000). On the contrary, multiple contributions have highlighted the generation and acquisition of novel knowledge to foster exploration (e.g., Grant & Baden-Fuller, 2004; Rothaermel & Deeds, 2004). Activities characterized by new and uncertain opportunities through "search, variation, risk taking, experimentation, play, flexibility, discovery, [and]

innovation” (March, 1991:71), may foster the generation of future business opportunities.

Traditionally, research on ambidexterity has emphasized the conflict, which the simultaneous pursuit of both activities entails. As research assumes, their opposing needs on structural, procedural and cultural levels creates tension for the organization, as both activities compete for attention and scarce resources (March, 1991). The underlying assumption to these concepts is the understanding that ambidexterity operates as a continuum, where the concentration on one activity comes at the expense of the other. This has been well summarized by Uotile, Maula, Keil, and Zahra, who stated that, “viewing exploration and exploitation as a continuum, and regarding achieving a balance among the two essentially as a trade-off among conflicting goals, would seem particularly relevant when studying situations in which firms are pressured to make trade-offs in resource allocations at the firm level” (2009: 228).

To alleviate this tension, research has distinguished three concepts – structural, contextual and temporal – along which ambidexterity can be obtained. Rooted in the work by Duncan (1976) and originally established by Tushman and O’Reilly (1996), structural ambidexterity assumes both activities to operate in isolated business units, whose coordination relies on top management. Acknowledging the difficulties of integrating two isolated activities at the top, Gibson and Birkinshaw (2004) introduced contextual ambidexterity, to explain how exploitation and exploration can be simultaneously conducted in a favorable contextual environment, where individual managers have the choice on whether to engage in exploitation or exploration. Finally, some scholars promote the concept of temporal cycling of both activities, where long periods of exploitation are punctuated with short periods of exploration, also referred to as punctuated equilibrium (Benner & Tushman, 2003; Gupta, Smith, & Shalley, 2006).

However, for firm’s to leverage the benefits of ambidexterity, the coexistence of both activities is not a sufficient condition, yet separation needs to be followed by integration that facilitates synergistic effects of both activities (O’Reilly & Tushman, 2004/2008). This is essentially where the benefits of ambidexterity are rooted. Only if the firm is able to positively leverage the tension created through exploitation and exploration, the firm will be in the position to derive positive performance effects. This was echoed by Andriopoulos and Lewis, when stating that “influential treatise on

exploitation-exploration tensions spurred a gradual movement from a trade-off to a paradoxical mindset” (2009: 702). This notion of ambidexterity very much embodies the concept of complex adaptive systems, where systems benefit from the seeming contradiction of fusing conflicting activities. Broekstra (1996: 56) provides a fitting explanation of the concept at work in ambidexterity when outlining the workings in a complex, adaptive system:

“A complex non-linear system may essentially exhibit three classes of behavior: (1) relatively frozen and (2) entirely chaotic separated by (3) a small ‘edge of chaos’ (Lewin, 1992: 53). The later narrow transition region between order and chaos is the more interesting as it constitutes the no-man’s land, where chaos and stability pull in opposite directions’ (Lewin, 1992: 51). This edge of chaos appears to be analogous to a phase transition and also appears to be the locust of maximum creativity for the system”.

This idea of the ‘edge of chaos’ resembles with what has been frequently referred to as paradoxical thinking for the firm pursuing ambidexterity (Poole & Van de Ven, 1989). As Andriopoulos and Lewis highlight, “managing paradox does not imply resolution or eliminating the paradox, but tapping into its energizing potential” (2009: 702). Indeed, tension is the source to paradoxes that arise from the polarity of two simultaneously operating, yet mutually exclusive forces (Cameron, 2008; Lewis, 2000). Consequently, it is assumed that in embracing this tension, rather than trying to resolve it, allows exploitation and exploration to nurture each other. This moves literature on ambidexterity away from the assumption that both activities inherently exist in a zero sum game to more synergistic thinking, where the sum is more than the individual parts.

1.1 Moving Beyond Firm Boundaries

While originally applied to the intra-organizational level, ambidexterity literature has increasingly reflected firm’s needs to connect with the external environment. Termed in the following as ‘boundary-spanning ambidexterity’, it delineates the simultaneous engagement both in exploitation and exploration with the inclusion of the external environment. This summarizes extant literature in the field of ambidexterity, which has acknowledged that the inclusion of the external environment may vary from basic knowledge absorption (Rowley, Behrens, & Krackhardt, 2000) to

close collaborations (Rosenkopf & Nerkar, 2001; Rothaermel & Deeds, 2004) and may be located on multiple levels of the organization (Lavie, Stettner, & Tushman, 2010). Through boundary-spanning, firms may address (1) the need to stay on par with market developments, but also (2) seek out complementary knowledge or capabilities needed to address present and future market demands, i.e. exploitation and exploration (Rosenkopf & Nerkar, 2001; Santos & Eisenhardt, 2005).

First, as firms compete in highly dynamic and increasingly technologically complex markets research has increasingly referred to the need to span boundaries in conducting both exploitative and exploratory (e.g., Hoang & Rothaermel, 2010; Lavie, Stettner, & Tushman, 2010). McGrath (2001) further specified that boundary-spanning becomes a tool that allows firms to anticipate market changes. More particularly, in market environments characterized by resource dispersion and high levels of uncertainty, firms find themselves forced to reach out and develop innovations by spanning their organizational boundaries (e.g., Davis, Furr, & Eisenhardt, 2006). Researchers have recently highlighted the need to engage in inter-firm relationships to access, create and transfer knowledge from sources external to the firm, as a response to market complexity (Hamel, Doz & Prahalad, 1989; Kogut & Zander, 1992; Powell, Koput & Smith-Doerr, 1996; Sieg, Wallin & von Krogh, 2010). Thus, boundary-spanning has received increased attention in the quest to define how to leverage insights on market developments to 'connect the dots' that may help firms to 'paint the picture' of ambidexterity (i.e., Grant & Baden-Fuller, 2004).

Second, in the literature on boundary-spanning, it is recognized that boundary-spanning nurtures ambidexterity through access to novel information and leverage of existing knowledge in novel endeavors (Dyer & Nobeoka, 2000; Grant & Baden-Fuller, 2004; Kale et al., 2000). Further, research on ambidexterity has brought the sourcing and employment of external knowledge to the forefront of recent contributions (e.g., Laursen & Salter, 2006; Rosenkopf & Nerkar, 2001). Inkpen (2001) provides evidence that collaboration with external partners can serve to develop complementary resources between both partners toward exploitative ends. In this way, an organization is able to detect and integrate knowledge artifacts that further refine or extend existing knowledge or capabilities (Cohen & Levinthal, 1990). Henderson and Cockburn further substantiate this point by highlighting "the ability to access new knowledge from outside the boundaries of the organization and the ability to integrate knowledge flexibly across boundaries within the organization" (1994: 66). On the

other hand, ample research has referred to the benefits of increasing exposure to knowledge-variety by crossing firm boundaries (Raisch et al., 2009; Rosenkopf & Nerkar, 2001). In particular, the access to diversified knowledge has been acknowledged as one of the main drivers that allow firms to divert from potential inertia and myopic thinking (Rosenkopf & Nerkar, 2001). Such knowledge, which questions existing beliefs and perceptions, may lead to entrepreneurial ventures and testing of novel approaches (i.e., Holmqvist, 2004; Rivkin & Siggelkow, 2003).

In sum, literature at present has highlighted the effects of boundary-spanning on the conduct of both exploitation and exploration in order to achieve ambidexterity (Lavie & Rosenkopf, 2006; Rothaermel & Alexandre, 2010; Rothaermel & Deeds, 2004). Underlying is the assumption that the knowledge accessible beyond a firm's boundaries is valuable in complementing internal competencies with externally available knowledge (Grant & Baden-Fuller, 2004), serving both a need to keep up with market developments, as well as the creation of capabilities that help serve current and future market needs (Rosenkopf & Almeida, 2003). Important to leverage the value inherent to a firm's boundaries-spanning efforts in generating ambidexterity is to define the right knowledge input (Beckman, Haunschild, Philips, 2004; Colombo, Grilli, & Piva, 2006), leverage the singular pieces through appropriate processes (Rothaermel & Deeds, 2004; Zimmermann & Raisch, 2009), in order to derive the synergies attributed to ambidexterity. Consequently, to put things in perspective, the structure of the following chapter will be guided by an input-process-output (IPO) model (Simsek, 2009).

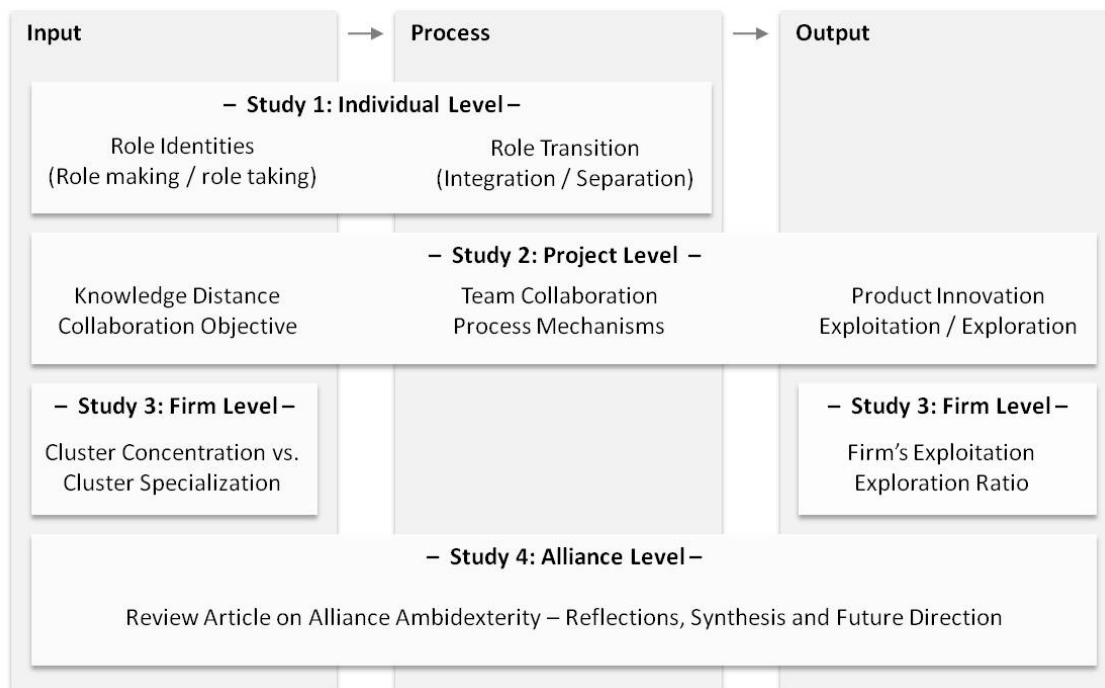
Section 1.2.1 will introduce the *input* phase, which focuses on the need of integrating the notion of ambidexterity throughout the firm, emphasizing the importance reflection on the different hierarchical levels involved to leverage ambidexterity throughout the firm. This echoes previous research, which has repeatedly emphasized that exploitation and exploration need to be reflected on multiple organizational levels in order to subsequently interact (Raisch & Birkinshaw, 2008; Simsek, 2009). The *process* phase (sub-section 1.2.2) will highlight how a firm's connection with external sources alleviates the inherent tension of exploitation and exploration through separation, while begin able to reintegrate both activities at a later stage to generate the potential synergistic benefits their interaction holds. Finally, the *output* phase (sub-section 1.2.3) outlines how the whole is more than the sum of its parts. Here, the focus will lie on the potential performance implications, but also stress

the contingency of negative ambidexterity effects. This section further highlights the added complexity when leveraging external sources in the conduct of ambidexterity and how this might alter the implication of the ambidexterity construct.

1.2 Merits of Boundary-Spanning Ambidexterity

In order to better locate the concept within the broader field of ambidexterity, the following section will outline its conduct through the input-process-output model. Figure 1 shows the link between each phase and provides insights on how each of the studies in this dissertation will contribute to the understanding of input-process-output model.

Figure 1: Dissertation Outline by an Input-Process-Output Model



1.2.1 Input – Creating a nested, multi-level design

In order for a firm to become ambidextrous, literature provides ample reference that ambidexterity evolves as a multifaceted phenomenon that needs to be incorporated throughout an entire organization in order to generate its full potential (Raisch et al., 2009). This notion originates from the awareness that the alleged tension generated by the paradoxical nature of ambidexterity needs resolution one level below its

occurrence in separating out exploitation and exploration activities (Raisch & Birkinshaw, 2008). Previous research has highlighted how firm-level ambidexterity is driven by exploitation and exploration oriented business units (Benner & Tushman, 2003), while project or team-level ambidexterity originates from the engagement of individuals in exploitative and exploratory activities respectively (Dyck, Starke, Mischke, & Mauws, 2005; Vera & Crossan, 2004). The notion that both innovation activities need reflection throughout the organization was summarized by West et al., who proclaim that while firm level analysis provides relevant macro-level insights, “innovations are created by individuals or groups of individuals [...] so the sub-firm level of analysis is particularly salient in understanding the sources of innovation” (2006: 287).

While this idea of multi-level presence is novel in the setting of ambidexterity, it reflects mechanisms that have been previously promoted in the field of organizational management. When introducing the image of organizations as brains, Morgan (1986) anchored the concept to a core function of what he called ‘holographic design’: “Holography demonstrates in a very concrete way that it is possible to create processes where the whole can be encoded in all the party, so that each and every part represents the whole” (Morgan, 1986: 80). Further, he assumes that through a holographic design a firm will inherit the ability to consciously respond to different impulses by evaluating the appropriateness of established activities and initiate adjustments, if needed. Thus, translating this notion to ambidexterity implies that a holographic design allows a firm to respond consciously to impulses that require them to act exploitative and/or exploratory accordingly.

Boundary-spanning ambidexterity has to adhere to the same fundamental mechanisms and requires engagement of members on every level of the organization. In fact, in the case of boundary-spanning ambidexterity the multi-level existence is essential due to the added complexity of knowledge integration from the external environment. Being granted access to knowledge allows for reinvigorating existing knowledge or generating novel competencies (Gavetti & Levinthal, 2000; March, 1991). However, in order to effectively span boundaries, the firm must facilitate both the ability to identify and obtain external knowledge as well as the ability to integrate and incorporate it subsequently (Miller, Fern & Cardinal, 2007). Research on boundary-spanning has frequently highlighted that the incorporation of knowledge from the external environment must span through all levels of the organization, to

activate the knowledge acquired. While Tushman (1977) has been instrumental in highlighting the functions the individual boundary spanner embodies, Ancona and Caldwell (1992) have highlighted the strategies boundary-spanning teams incorporate in order to manage knowledge integration both vertically and horizontally throughout the organization. Finally, Rosenkopf and Nerkar (2001) provide insights into the firm level engagement in boundary-spanning, indicating that firms differentiate boundaries both in accordance to geographic and technological boundaries. In sum, boundary-spanning ambidexterity needs reflection on all appropriate levels to enable boundary-spanning to actively function both as a scouting and absorption mechanism to exploitation and exploration.

However, the mere presence of exploitation and exploration on multiple organizational levels is not sufficient to explain how a firm can leverage its synergistic benefits (Jansen et al., 2009). Organizational ambidexterity literature has highlighted that nested effects, i.e. the interaction of multiple organizational layers, facilitate ambidexterity (Simsek, 2009). Indeed, previously Smith and Tushman (2005) highlighted that exploitation and exploration generated tensions that are nested within the organization as a whole. Further, Andriopoulos and Lewis underscore that “a multilevel approach is vital to managing nested paradoxes of innovation” (2009: 12). This reflects aspects highlighted in the introduction to this dissertation, where research has increasingly highlighted the importance of the integrative nature of ambidexterity that presumably need to span across all levels of the organization. Indeed, boundary-spanning ambidexterity adds an additional layer of nesting. Consistent with Gupta et al. (2006) and further emphasized by Simsek (2009), boundary-spanning requires to evaluate the nesting effects within the broader environment beyond the internal environment. In that sense, a firm’s permeability with its environment not only needs to reflect exploitation and exploration on diverse internal hierarchical levels, but incorporate “influences emanating from the firm-, interfirm- and environmental-level” (Simsek, 2009: 620).

1.2.2 Process – Operating separation vs. integration

Central to the discussion on ambidexterity has been the processes of separation and integration. Most fundamentally it is assumed that the simultaneous conduct of exploitation and exploration causes stress due to the fundamentally differing operating mechanisms that underlie both innovation activities (Raisch et al., 2009). In order to

allow both activities to function, separation mechanisms have taken the forefront of research in the past decades. In that sense, boundary-spanning ambidexterity was originally a means of alleviating a company from the burden of operating exploitation and exploration within the organizational boundaries. However, lately research has acknowledged the particular difficulty to reintegrate externally leveraged knowledge into the firm. Indeed, Benner and Tushman (2003), highlight that the externalization of exploitation or exploration processes may lead to difficulties when seeking to reintegrate across a firm's boundaries. This reflects the fundamental notion in ambidexterity that reintegration of both activities is core to the concept as the mere coexistence of both activities is a necessary, however, insufficient condition to generate ambidexterity (Eisenhardt & Martin, 2000; O'Reilly & Tushman, 2008). Rothaermel and Alexandre (2009) as well as Sirmon, Hitt and Ireland (2007) provide evidence that firms sourcing exploration and exploitation externally, require integrative efforts to appropriate the full potential performance effect embedded in ambidexterity.

An often quoted example for the consequences of a lack of integration between exploitation and exploration has been the case of Polaroid. In their in-depth case-study, Tripsas and Gavetti (2000) showed how Polaroid as a market leader failed to integrate existing competencies in hardware with the ever increasing importance of software. As O'Reilly and Tushman (2008) emphasize, "Polaroid had developed an array of new digital imaging competencies, but that rigidity in existing processes and management's inability to implement a new business model stopped them from successfully entering new markets" (2008: 188). Indeed, Polaroid had historically developed strong competencies in the arena of hardware development, while at the same time being one of the first inventors in the field of digital imaging. As such, Polaroid owned both exploitative and exploratory elements. However, this case does not only demonstrate the importance of integrating separate exploitation and exploration activities, but further emphasizes the importance of incorporating the external environment. In the case of Polaroid, senior management's cognition was prone to path dependency and myopia. Through a lack of actively scouting and integrating knowledge sources from outside the firm, tendencies and existing needs in the market remained disconnected from the internal strategic decision-making process.

First attempts to evaluate the possibility to integrate both exploitation and exploration in boundary-spanning ambidexterity have been on the firm level of

analysis. Building on the original idea of Koza and Lewin (1998, 2000), recent contributions further develop the understanding of how alliances may simultaneously focus on exploitation and exploration within a singular, boundary-spanning setting (In & Rai, 2008; Zimmerman & Raisch, 2009). Recently, research has further elaborated this point and proposed that ambidexterity can also be achieved within single inter-firm collaborations. Im and Rai (2008) indicate that single collaborations can accomplish alliance ambidexterity through the concept of contextual ambidexterity. In a different vein, Lavie and Rosenkopf (2006) conceptualize ambidexterity to be balanced in alliance functions across domains, and over time. In sum, these findings provide first indicators that different integration processes might be at work when integrating information from external sources. These two studies reflect three different mechanisms at work (contextual, structural and temporal) on the firm level. Reflecting back on the previous chapter, the question arises how these mechanisms permute into processes on the individual and project level.

1.2.3 Output – Leveraging paradox to the benefit of performance

The fundamental understanding of why ambidexterity is vital to a firm's short- and long-term survival has frequently been attributed to the performance effects both exploitation and exploration activities generate. This is because firms are able to align themselves around adaptability (Gibson & Birkinshaw, 2004) in order to capture market shifts and generate an organization that revolves around constant change, both incremental and radical. However, existing research also assumes that operating both activities bears risks of overload and the threat of what Porter (1980) called 'being stuck in the middle'. As such, the superior performance of ambidexterity can only be harvested if a firm leverages the paradox of exploration and exploitation and reconciles the tension through cross-fertilization in adaptive systems, structures and processes. Indeed, as He and Wong propose, "implicit in their argument is that, unless these tensions are well managed, firms that try to pursue both exploration and exploitation may actually end up worse off, i.e., the interaction effect between exploration and exploitation may turn out to be negative rather than positive" (2004: 483). While ambidexterity holds the potential to generate superior performance, empirical results also substantiate the complexity of capturing these benefits.

Translating these assumptions to the field of boundary-spanning ambidexterity define two further aspects that require consideration. While existing literature on

boundary-spanning ambidexterity has highlighted the importance of external knowledge sourcing in order to overcome myopia from sole internal innovation conduct (Lavie & Rosenkopf, 2006), research has also stressed that external integration dramatically increases the cost of integration (a function that was previously demonstrated to be core to the existence of ambidexterity) and in complexity related with operating multiple external relationships (Katila & Ahuja, 2002). As Simsek emphasizes, “to the extent that managing heterogeneous partners requires a different set of skills and expertise, procedural differences and communication barriers will make it harder to exploit synergies across them” (2009:610).

To mitigate the risks associated with the increased complexity of boundary-spanning, existing research provide evidence that firms not only learn over time to deal with the burdens of multi-partner interactions, but also increase the ability to extract complex benefits (Reagans & McEvily, 2003). In sum, boundary-spanning alleviates the tension of both exploitation and exploration by integrating the external environment; however, in the same vein it potentially increases the problems of reintegrating both activities to the synergistic benefits of ambidexterity. For that reason, it is essential to determine the particular mechanisms that operate in boundary-spanning ambidexterity on all organizational levels in order to make profound decisions to the benefit of superior firm performance.

1.3 Integrated Overview of the Dissertation

The preceding input-process-output model has provided both an overview on the current stage of research and highlighted questions that remain underexplored. To these questions, findings of this dissertation will derive first insights that not only progress the current state of research, but provide the basis to further analysis in fields that have not been addressed to date. Each individual paper of this dissertation provides contributions that will enhance the understanding of boundary-spanning ambidexterity. However, there are overarching areas this dissertation addresses, which go beyond the sum of its pieces.

1.3.1 Areas of contribution and research aim

Present research on boundary-spanning ambidexterity has generated valuable insights that provide both a basis, which further investigation can build upon and

identify gaps that define areas of research, which require further attention. In order to contribute to present research, this dissertation addresses four areas in the following ways, which are outlined in table 1:

Table 1: Summary of overarching contributions

Nr.	Contribution	Description	Study
1	Extending boundary-spanning ambidexterity to different hierarchical levels	Research highlights the need to reflect ambidexterity on every hierarchical levels of the organization to leverage its full potential. Yet, insights on boundary-spanning ambidexterity remain largely on the firm level of analysis. Lacking a gross understanding at the individual, project or alliance level, this dissertation uncovers mechanisms on every level of analysis and allows the comparison between them.	1, 2, 4
2	Understanding multi-level settings and nested effects of boundary-spanning ambidexterity	Research assures ambidexterity to be a nested, multi-level construct that can only be captured if interaction effects between hierarchical levels are defined. However, no study at present determines these effects for boundary-spanning ambidexterity. This significant gap is addressed by linking multiple levels, highlighting contextual affects that impose contingencies on the conduct of boundary-spanning ambidexterity.	1, 3
3	Highlighting mechanisms of separation and integration that drive boundary-spanning ambidexterity	Essential to the paradox of ambidexterity are the dynamics between separation and integration of activities. Still, research on boundary-spanning ambidexterity has focused on separation mechanism, pertaining only to one side that creates the synergistic benefits of ambidexterity. Integration of external partners adds complexity to the process and inflicts constrains on the benefits of ambidexterity, which are exposed in this dissertation.	1, 2, 4
4	Distinguishing dynamic features in boundary-spanning ambidexterity as opposed to static accounts	Research agrees that much of the concept of ambidexterity revolves around the ability to continuously change. However, most research at present provides static snapshot accounts of what might turn firms ambidextrous. As a first within the field of boundary-spanning ambidexterity, this dissertation addresses the dynamics that evolve over time, acknowledging that the generation of ambidexterity is a recurring process.	1, 2, 3

First, boundary-spanning ambidexterity has mainly been analyzed at the firm level of analysis, acknowledging both firm's innovation conduct in conjunction with external partners and the upsurge in alliances over the past decades. However, literature on ambidexterity has emphasized that ambidexterity is a mechanism that needs to be reflected on every organizational level. Indeed, Raisch et al. (2009) highlight that in order to achieve ambidexterity exploitation and exploration activities need to be reflected on every hierarchical level. However, boundary-spanning ambidexterity has only started to cut through the different layers that define a firm's engagement in ambidexterity with external partners (e.g., Rothaermel & Deeds, 2004), information sourcing (e.g., Katila & Ahuja, 2002) or the scouting of the external environment in general (e.g., Rowery, et al., 2000). To understand more about how ambidexterity can be generated through boundary-spanning on all organizational levels, papers on the individual, project, firm and alliance level of analysis will provide first insights and a valuable basis for future research. (Contribution 1 – Papers 1, 2, 4)

Second, ambidexterity results out of complex mechanisms that require coordination throughout an entire firm. However, aside from assertions that ambidexterity needs to cut through multiple organizational levels (Gibson & Birkinshaw, 2004; O'Reilly & Tushman, 2008), there has been no contribution made at present – both intra- or inter-organizational – that reveal the interaction effects of multiple organizational levels on the emergence of ambidexterity. Most studies concentrate on singular levels of analysis (Raisch et al., 2009), consequently, we have little insight on how ambidexterity is institutionalized across the firms. Yet, this constitutes a pivotal aspect to understanding the mechanisms of ambidexterity. In highlighting nested, multi-level effects that stimulate the generation of ambidexterity in boundary-spanning settings, this dissertation tabs into a significant topic and yields unique insights. (Contribution 4 – Papers 1, 3).

Third, while extant research acknowledges that both separation and integration are mechanisms that lead to ambidexterity, boundary-spanning ambidexterity has so far concentrated on the separation of exploitation and exploration in inter-firm settings. Yet, according to the ambidexterity literature the mere coexistence of exploitation and exploration is a necessary yet insufficient condition of ambidexterity. Only through the integration of both activities the alleged synergistic benefits are generated. However, contributions so far provide only limited insights on the potential of balancing exploration and exploitation simultaneously. As such, this dissertation further extends

this string of research by uncovering structural and procedural integration mechanisms that facilitate boundary-spanning ambidexterity (Contribution 3 – papers 1, 2, 4).

Finally, ambidexterity reflects innovation processes in the form of exploitation and exploration. However, extant literature on boundary-spanning ambidexterity has so far only generated findings that reflect static snapshots, which neglect that a dynamic environment will most likely require ambidexterity to evolve over time. With the notable exception of Rothaermel and Deeds (2004), no process analysis has been conducted to investigate how ambidexterity emerges through the interaction processes with external partners. This dissertation will address this gap in conducting three studies that analyze dynamic features in generating ambidexterity, thus, considerably moving research forward on how ambidexterity evolves and develops over time. (Contribution 3 – papers 1, 2, 3)

In line with the aspired contributions and the gaps this dissertation addresses, the overarching question this dissertation aims to answer is:

How does a firm's management of activities across firm boundaries affect its conduct of ambidexterity at multiple organizational levels and what direct implications do the integration of external knowledge sources hold for exploitation and exploration?

1.3.2 Outline of the dissertation

This dissertation consists of four studies. In the following, each study is shortly introduced to provide an overview by connecting the dots back together that define the overarching picture of this work. Each study distinctly contributes in its own way to the emerging field of boundary-spanning ambidexterity, by addressing one or more of the overarching areas to which this dissertation claims to contribute. The theoretical grounding of all studies is the learning perspective, while each study builds upon a distinct phenomenon within the input-conduct-output model, and concentrates on different levels of analysis – individual, project, firm, and alliance. Figure 2 provides a summary of the core aspects defining each individual study.

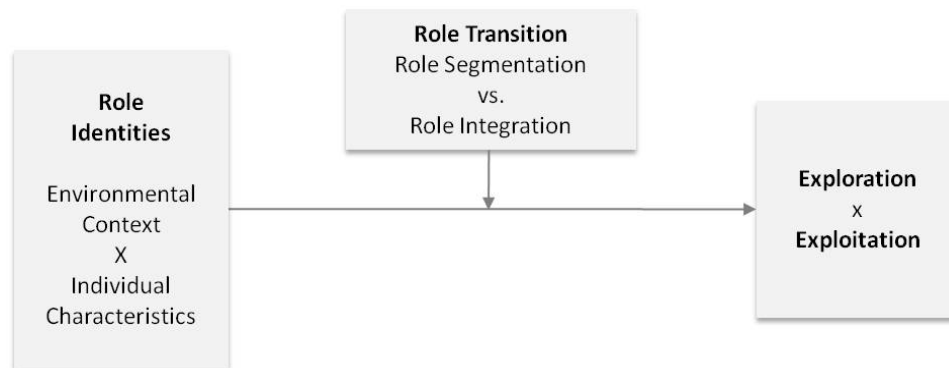
Figure 2: Summary of all four studies on boundary-spanning ambidexterity



Paper 1 – Individual level. In the first paper, *“When Boundary Spanners Shift Gears: Role Identities and Their Impact on Exploitation and Exploration”*, the focus is set on the individual level of analysis. Scholars have highlighted the positive effects of boundary spanning on the conduct of exploration, exploitation, and ambidexterity. However, less research in organizational ambidexterity is concerned with investigating the role of individual boundary spanners as enactors of ambidextrous behavior. It is argued that opposed to previous research the context not sufficiently explains whether and why managers are able to engage in ambidexterity. Conversely, it is assumed that manager’s autonomy in interpreting and enacting their position within the firm will impact their engagement in exploitation or exploration. Drawing on social psychology,

role theory offers a concept of how individuals differentiate their action in accordance to an inherent role understanding, driven by personal characteristics and contextual attributes. Applied to the field of boundary-spanning ambidexterity, this study suggests that the contextual cues of boundary-spanning interact with the managers personality traits in an fashion that determines what activities the boundary-spanner will feel inclined to engage in.

Figure 3: The Effect of Role Identities and Role Transition on Ambidexterity



Further, role theory indicates that within a multi-role position, like that of a boundary-spanner, individuals need to make deliberate choices on how to manage potentially conflicting role engagements. Such choices fall within a range of role segmentation or integration, also referred to as boundary management, which indicates an individual's preference to overlap different roles. This study assumes that the ease with which boundary spanners are able to switch between their roles through role transitions, moderates the inclination of a boundary-spanner to engage in either exploitation, exploration or both. This is the first study to define mechanisms that allow an individual to impact the decision to act ambidextrous as opposed to previous research, which has merely defined what effects may lead to exploitation or exploration (Mom et al., 2007) or provide anecdotal accounts on which characteristics a manager might hold in order to be ambidextrous (Floyd & Lane, 2000; Gibson & Birkinshaw, 2004; Smith & Tushman, 2005). As such this study provides a decisive building block to the understanding in boundary-spanning ambidexterity. Understanding the activities of the individual manager has been frequently highlighted in research as a fundamental element to define, how ambidexterity might subsequently be escalated up to higher levels of the organization.

Paper 2 – Project level. Study 2, “When Distant Partners Become Your Closest Friends: Ambidexterity in Cross-Industry Collaboration”, engages in the project level of analysis. Ambidexterity research has repeatedly emphasized the merits of inter-firm collaboration in the conduct of exploitation and exploration. Prior studies address attributes of inter-firm exploitation and exploration but not whether and how both innovation types may originate simultaneously in single project settings. This paper analyzes how the implementation of particular process features in open new product developments (NPD) projects impact firm’s ambidexterity. Focusing on cross-industry innovation - existing solutions from one industry are employed to invention processes in another industry setting - we analyze eleven case studies on their NPD projects.

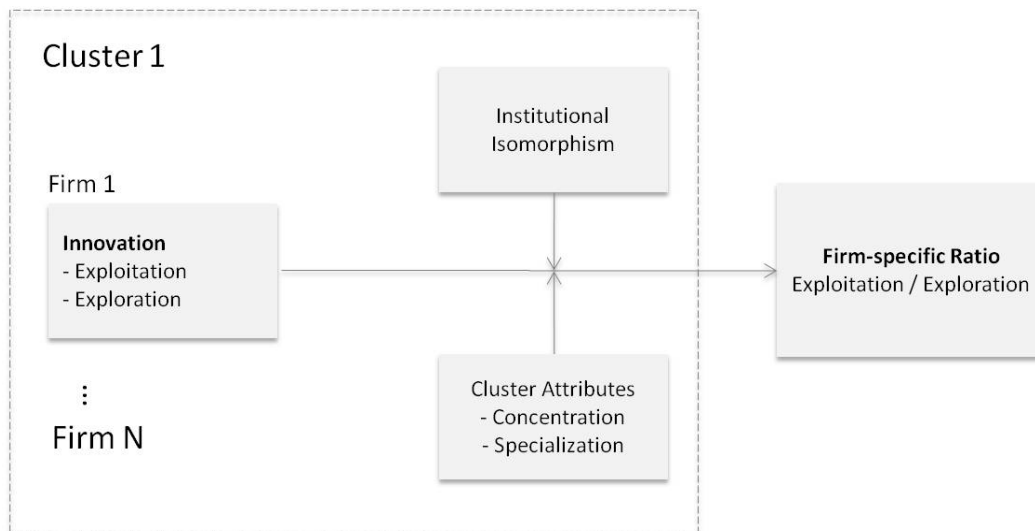
Figure 4: Innovation Patterns in Cross-Industry Innovation Projects

		Collaboration Process	
		Integrated Cross-functional teams / parallel	Modular Functional teams / sequential
Collaboration Objective	Defined Clear target / distant knowledge	Exploration	Exploitation
	Open Fuzzy target / close knowledge	Ambidexterity	n/a

Findings of this study suggest that individual learning potentials differ for the collaboration partners, acting as a function of the initial knowledge distance, project role and subsequent process architecture. This analysis has significant implications for research on inter-firm ambidexterity by exposing the potential for balanced exploitative and exploratory learning in collaboration processes. This moves research significantly beyond previous research findings that have in contrast promote structural, temporal or contextual separation of both innovation types (Koza & Lewin, 1998; Purnam, Singh, & Zollo, 2006; Tiwana, 2008). Finally, this study is the first one to date that elaborates on every single step of the input-process-output model, identifying crucial interrelations between each step. Particularly, this study contributes in further clarifying the interrelation of process and outcome features in ambidexterity on the level of inter-firm exploitation and exploration projects. Separation and integration dynamics are exposed that affect learning mechanisms, which in turn allow the generation of exploitation and exploration.

Paper 3 – Firm level. The third paper, “*Great Minds Think Alike: Isomorphism in Organizational Ambidexterity*”, concentrates on the firm level of analysis. The simultaneously pursuit of exploitation and exploration, namely incremental and discontinuous innovation, has been acclaimed to determine firms’ success or even survival. The organizational ambidexterity literature has ascribed a firm’s environment large influence on the conduct of both innovation types. Prior studies, however, have been limited to assume competitiveness and market dynamism to be the predominant grounds for a firm to vindicate either exploitation or exploration. To examine the impact of a local environment on a firm’s ambidexterity, this study focuses on industrial clusters, defined as robust groupings of related or interconnected firms of a particular industry concentrated in a geographical location. Building upon institutional theory, a model is developed that highlights the effects of cluster environments, captured through the concentration and specialization of firms in the cluster, impacts a firm’s innovation activities through mimetic and coercive isomorphism. The mechanism in place is outlined in figure 5.

Figure 5: Impact of the Cluster Environment on Exploitation and Exploration



Using panel data, this study tests two hypotheses on a global sample of biopharmaceutical clusters (1998–2007). Driven by isomorphic processes, the findings support that firms converge towards and replicate cluster specific balances. While it is assumed that the balance between exploitation and exploration to tilt towards exploitation in clusters of high concentration and towards exploration in highly

specialized clusters, results reveal that firms show emphasis on exploration both in highly concentrated and specialized clusters. Although, research on boundary-spanning ambidexterity has benefited mostly from studies on the firm level, this study complements existing research in two major ways. First, the finding is both important and surprising on the multi-level effects that impact a firm's engagement in ambidexterity. Second, this is until now the first study to capture the entire biopharmaceutical industry allowing an in depth analysis with high validity.

Paper 4 – Alliance level. Finally, the fourth paper, “*Alliance Ambidexterity: When Exploration and Exploitation Cross Firm Boundaries*”, reviews the current stage of ambidexterity when pursued in collaboration with external partners. It is agreed that ambidexterity has emerged as a ubiquitous phenomenon with scholars highlighting its substance in affecting organizational conduct and performance. While traditionally applied to the intra-organizational level, ambidexterity research has recently burgeoned around how strategic alliances affect a focal firm in this respect. Literature streams such as innovation management, knowledge management, organizational learning, and adaptation draw implications on the antecedents and contingency factors that allow for the conduct of exploitation, exploration and/or both through inter-firm settings. Despite its seeming simplicity, findings remain controversial and fundamental assumptions to the concept remain ambiguous. Framed by a context – conduct – outcome model, this review article outlines the existing literature on inter-firm ambidexterity, critically analyses 23 articles on their conceptual and empirical conduct and provides direction for future research. This is an important fundament to further develop the field of boundary-spanning ambidexterity. Review articles have the benefits of both highlighting the strength of the field, uncover irregularities in research conduct and direct future studies to address gaps that need further attention. Consequently, this study essentially contributes to the development of a future research agenda and provides guidance to researchers in how to strengthen the validity, generalizability and reliability of research findings.

1.3.3 Empirical data and statistical methods

Each study of this dissertation addresses a different way on how to contribute to research – review of the existing literature, conceptual groundwork, qualitative analysis, and quantitative analysis. These approaches address different research questions and reflect the current state of the literature. Both the review articles and the

conceptual paper provide for an overview and a theoretical basis for future qualitative and quantitative analysis. The empirical studies represent analyses that contribute both through inductive and deductive research.

Table 2: Sample Data, Collection Process, Statistical Analysis

Nr.	Data Collection	Sample Data	Statistical Method
Study 2 (Chapter 3)	Semi-structured interviews Workshop observations Archival data	11 Case Studies <u>Industries:</u> Automotive, Chemical, Construction, FMCG, IT , Media, Packaging, Sports Utilities, Telecommunication	Multiple Case-Study Analysis
Study 3 (Chapter 4)	Bloomberg® Standard & Poor’s global industry classification standard (GICS) Thomson Reuters Web of Knowledge database Derwent Biotechnology Abstracts database	Between 1999-2007: 167 public biopharmaceutical companies 123 private biopharmaceutical companies	Longitudinal Panel Data Analysis Ordinary Least Square (OLS) Regression with Driscoll-Kraay standard error estimators

Study 2 applies inductive theory building through multiple case study analysis. This is an appropriate approach to the presented research question as it allows us to define patterns of relationships that quantitative data would not easily reveal. Study 3, on the other hand, aims at identifying detailed contextual effects to explain ambidexterity within a particular industry context. This requires a method that is sensitive towards the long-term developments, which needs to be reflected both in the nature of the data and the mechanics of the analysis. Table 2 summarizes the data collection process, the sample data characteristics and the statistical methods employed for the empirical studies of this dissertation.

1.4 Concluding Remarks

This introductory section was intended to provide a framework within which the individual studies of this dissertation will be embedded. Yet, each of the four studies in chapter 2, 3, 4, and 5 are self-contained and as such represent distinct studies that are intended as individual contributions to the field of boundary-spanning ambidexterity. As such, this introductory chapter might contain replications of the phenomena and

theoretical grounding that each singular study will reflect upon. Insights on the findings and how they relate back to the intentions voiced in this first chapter will be summarized in the final section of this dissertation. The findings will further be translated to derive managerial implications while acknowledging for limitations, future research venues before concluding this dissertation with some closing remarks.

In summary, this dissertation provides a comprehensive multi-level analysis, which allows for the development of a deeper understanding on boundary-spanning innovation activities. This enables a broad yet detailed discussion of inferences for conditions that support a firm's pursuit of simultaneously exploitation and exploration. Thereby, this dissertation makes valuable contributions to present academic research while developing recommendations for managerial practice that enable managers to render a well-founded decisions about appropriate configurations of boundary-spanning for innovative activities, both incremental and radical.

Ambidexterity research once started as a concept that intended to determine what makes firm's cope with continuous market change, increased market complexity and information dispersion (Raisch & Birkinshaw, 2008, Tuschman & O'Reilly, 1996). Boundary-spanning ambidexterity moves this field of research one step further by connecting firms with their environment in an attempt to stay on par with market developments. This connects to most recent developments in the field of innovation management. Indeed, boundary-spanning defines the link between the field of ambidexterity and the concept of open innovation (Enkel, Gassmann, & Chesbrough, 2009; Sieg, Wallin & von Krogh, 2010). Both form burgeoning fields that address the need to better understand how firms connect with their external environment in the pursuit to incorporate external knowledge into the innovation process. In line with Enkel and Gassmann (2010), and Sieg, Wallin and von Krogh (2010), the external environment provides the context to which innovations will be intrinsically linked in the future. In the same vein, researchers like Rosenkopf and Almeida (2003), Lavie, Kang, and Rosenkopf (2009), Tempelaar and van de Vrande (2010) or Rothaermel and Alexandre (2010) have takes these insights and connect the dots that will lead to comprehensive innovation strategies that entails today's and tomorrow's market needs.

2 When Boundary Spanners Shift Gears: Role Identities and Their Impact on Exploitation and Exploration¹

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Abstract: Scholars have highlighted the positive effects boundary spanning has on the conduct of exploration, exploitation, and ambidexterity. However, less is known on the individual boundary spanners enacting ambidextrous behavior. We intend to answer why some managers might be able to act ambidextrously and complement this question with how managers operate the conflicting activities of exploitation and exploration. *Why* - Applying role theory, we hold that roles are frameworks that direct individual's behavior resulting from an interaction of an individual's personality traits (role making) and contextual cues (role taking). Depending on whether or not role taking and role making align, boundary spanners may perceive a divide between the firm's expectations and personal inclination. Such a divide may be a driving force for ambidextrous behavior. *How* – boundary spanners embody multiple roles raising the question on role transition and the effect on manager's performance. We suggest that role segmentation or integration, the intent to blur or separate role domains in managing the boundaries that delineate roles from each other, impacts the above relation. We assume that boundary spanners who integrate roles to overlap activities lead to ambidextrous behavior, while segmenters will concentrate on either exploitation or exploration through focused activities.

¹ This paper Rosenkranz, N. 2011. "When Boundary Spanners Shift Gears: Role Identities and Their Impact on Exploitation and Exploration", is currently submitted to the Academy of Management Review. Further, an empirical study testing the concept developed in this paper is currently conducted in co-authorship with Michiel Tempelaar, Rotterdam School of Management. An earlier version of this study has been presented at the Academy of Management Conference 2010, Montreal, as 'Rosenkranz, N. (2010). Boundary Spanner's Degree of Role Autonomy and its Impact on Exploitation and Exploration.'

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2.1 Introduction

Ambidexterity – the simultaneous pursuit of a firm to innovate both through short-term refinement, as well as long-term adaptation – is important for the success or failure of a firm (March, 1991; Tushman & O'Reilly, 1996). However, with increased information dispersion and market complexity firms increasingly find themselves forced to integrate external knowledge into their innovation processes, be it for exploitation or exploration (Faems et al., 2005; Noteboom et al., 2007; Rothaermel 2001). In order to identify and acquire external knowledge, companies must span firm boundaries (Miller, Fern, & Cardinal, 2007). Indeed, ambidexterity research provides conceptual and empirical evidence that boundary spanning influences knowledge transfer both into distant and related areas (Rosenkopf & Nerkar, 2001), complements the innovation process (Rothaermel & Deeds, 2004; Sidhu, Commandeur, & Volberda, 2007) and impacts firm performance (Menguc & Auh, 2008).

While these studies assume boundary spanning to be a core function to ambidexterity, the influence of individual boundary spanner's exploratory and exploitative behavior remains under researched. Yet, Gibson and Birkinshaw stress that “ambidexterity manifests itself in the specific actions of the individuals throughout the organization” (2004: 211). Previous studies assume that the ability to act ambidextrously is rooted within the person (i.e., Floyd & Lane 2000; Mom, van den Bosch, & Volberda, 2007). In sum, however, Raisch et al. point out that while previous studies observe managers' ability to operate contradictory tasks, “they fail to explain why these managers— as opposed to others—are able to do so” (2009: 3). We intend to provide one answer to *why* some managers might be able to act ambidextrously and complement this question with *how* managers operate the conflicting activities of exploitation and exploration.

Why – Literature on individual ambidexterity provides two alternate positions for why some managers may be inclined to act ambidextrously – through individual traits and a firm's context. Gibson and Birkinshaw (2004), for example, describe in their analysis how the context within a business unit may encourage managers to take on tasks both exploitative and exploratory in nature. This notion, like subsequent studies on contextual ambidexterity assume a cultural influence enforced upon the individual manager. On the other hand, studies suggest that ambidextrous behavior is driven by individual-level characteristics (Smith and Tushman, 2005). In particular, managers

seeking ambidexterity are supposed to be able to handle multiple conflicting exploitative and exploratory roles (Floyd & Lane, 2000).

Role enactment has its roots in social psychology literature, which holds that roles are frameworks that direct behavior as a result of an interaction of *both* an individual's personality traits and contextual cues (Ashforth, 2001; Graen, 1976). The forces in place are termed *role making* (personality traits) and *role taking* (firm context) (Perrone et al. 2003). Role taking is driven by an organizational context which shapes individual behavior through ascribing roles (Shapiro, 1987). However, such a context does not define a set of rules that is unquestioningly adhered to, but “are often open to wide latitude in interpretation and are frequently subject to multiple and conflicting pressure” (Perrone et al., 2003: 422). This implies that the enactment of roles is fostered by a combination of organizational context and personal preference. The management of roles is especially salient for boundary spanners, who find themselves in different roles when engaging in relationships with external parties while at the same time orchestrating internal objectives (Cross & Parker, 2004; Pawlowski & Robey, 2004). Thus, boundary spanners typically face a multi-role environment, within which they enact their roles as a function of both expectations as defined by their organizational context (role taking) as well as individual inclination (role making). Depending on whether or not role taking and role making align, boundary spanners may perceive a divide between the organization's expectations and personal inclination. Such a divide may be a driving force for ambidextrous behavior. Past research has delineated that ambidexterity requires a combination of counterbalancing centripetal and centrifugal forces that focus on collective action as well as individual action (Mom et al. 2009; Sheremata 2000). We propose that the right combination of role taking and making provides just such counterbalancing forces beneficial for ambidextrous behavior, whereas one-sided, aligned forces emphasize either exploratory or exploitative action. Still, next to the inclination of acting ambidextrously, the question remains how a boundary spanner may operate conflicting tasks and moves between roles.

How – Research on role identity theory has conceptualized that the ease with which individuals can switch between their roles, referred to as role transition, is an important source of performance in a multi-role environment (Ashforth, 2001). Acknowledging that individual managers face increasingly overlapping, yet conflicting role demands, raises the question on how managers operate role transition

and the effect it has on the manager's performance (Makarius, Rothbard, & Wilk, forthcoming). Past research has also indicated that the ability to handle multiple roles plays a non-trivial part in bringing together exploration and exploitation (Floyd & Lane, 2000). Especially in a boundary-spanning setting, we expect that the way individuals transition between roles will have a strong impact their conduct of exploitation and exploration, and ability to behave ambidextrously.

This paper contributes to literature on individual ambidexterity in three ways. First, ambidexterity literature has ignored the individual in cross-boundary analysis of ambidexterity. By investigating individual boundary spanners' exploratory and exploitative behavior, we expand the literature on individual ambidexterity. Second, this is, to our knowledge, the first time social psychology research is used to explain how individual exploitation and exploration can be managed and nurtured simultaneously. By combining notions on role identity and role transition, we are able to explain both why and how individuals are behaving both exploratory and exploitative. Finally, modeling the effects of role transition as a moderator to innovation behavior provides a new perspective on the transition between exploitation and exploration, as this complements the literature on both contextual and structural approaches to ambidexterity. In conceptualizing individual preference and conduct, we bring the individual level of analysis to the forefront. This marks a departure from previous literatures, which largely considers individuals to be a conduit of solutions at higher levels of analysis.

The next section shortly presents the relevant literature on ambidexterity and role theory to develop a theoretical framework on the impact of the role enactment on a manager's pursuit of ambidexterity, which is then followed by the development of this paper's propositions. The final section summarizes our contribution, discusses limitations, as well as potential for future research.

2.2 Theory and Propositions

2.2.1 Ambidexterity at the individual level

Ambidexterity has been claimed to be the keystone to a firm's survival and prosperity, allowing firms to exploit their current potential while simultaneously exploring new competencies (March 1991; Tushman & O'Reilly, 1996). However, configuring and reconfiguring a firm's resources – to capture existing as well as future

market opportunities – presents firms with a tension which originates from the fundamentally different focus and latitude of both activities (Gibson & Birkinshaw, 2004; Raisch & Birkinshaw, 2008; Tushman & O’Reilly, 1996). While past research has largely focused on organizational or unit level solutions (Benner & Tushman 2003; Gibson & Birkinshaw 2004; O’Reilly & Tushman 2008), less attention has been paid to the role of the individual in becoming ambidextrous (Raisch et al. 2009). This is surprising, since the consensus is that ambidexterity starts with individual ability to approach exploration and exploitation even-handedly (Gibson & Birkinshaw 2004; Smith & Tushman 2005).

The extent to which individuals engage in ambidexterity has been linked to concepts such as paradoxical thinking (Andrioupolos & Lewis, 2009), operating conflicting and partially contradicting tasks (Smith & Tushman, 2005), and finally, the engagement in multiple roles (Floyd & Lane, 2000). However, as Raisch et al. note: “ambidexterity is likely to be a function of closely interrelated individual and organizational effects” (2009: 4). As such, a function of both personality and firm context, which have at present not been analyzed in conjunction, seems an appropriate way of describing individual ambidextrous behavior. Therefore, we believe it is essential to extend present literature by capturing the interaction effect of firm context and personality traits to determine the emergence of individual ambidextrous behavior. As Lynch emphasizes, “what is needed is a more integrated approach where it is recognized that persons affect situations and situations affect persons” (2007:380). Consequently, we apply role theory to the concept of ambidexterity, and provide an interactive framework of both forces – firm context and personality traits – through the concepts of role taking and role making respectively.

2.2.2 Role taking, role making and ambidexterity

In accordance with social psychology, role theory defines individual’s behavior and attitudes as an enactment of a role linked to a particular social position (Turner, 1990). A role is defined as a “set of recurrent behaviors appropriate to a particular position in a social system” (Polzer, 1995: 495). As such, individual behavior is impacted by expectations, norms, and rights ascribed by the context the person operates in. Managers are positioned through roles in an organizational context that is defined by relations, systems, and structures that enable and constrain their role behavior (Barley, 1990). “While a job (i.e. the set of task elements assigned to a single employee) is the

component of an individual's work experience that is relatively fixed, formal, and derived from the structural properties of an organization, a role is the more emergent, dynamic, and socially defined component of the very same experience” (Perrone et al., 2003: 423-424). Indeed, Kahn et al. (1964) point out that roles are not straitjackets, but emerge as a result of interpreting and modifying through an individual’s perspective and influence.

The processes by which roles emerge have been termed role taking and role making (Graen, 1976). Role taking describes the passive compliance of managers with the expectations and norms of the organizational environment, thereby limiting or enabling the maneuverability of individual managers in performing their position (Griffin & McMahan, 1994). As such, role taking creates a level of direction in the anticipation of an individual’s response (Lynch, 2007). Role making, on the other hand, concerns the interpretation of the assigned role from the subjective viewpoint of the recipient of the role. The resulting role identity is affected both by role making and taking effects of the individual manager and the organization respectively (Tsui et al., 1995; Welbourne, Johnson, & Erez, 1998).

Previous literature has operationalized role taking by means of organizational culture and structure as decisive contextual influences on the extent to which individual managers are able to exert their roles (Ashforth, Saks, & Lee, 1988; Barley, 1990; Perrone et al., 2003). Organizational structure is defined by the opposing ends of mechanistic and organic, while organizational culture ranges from bureaucratic to autocratic. The underlying assumption is that different levels of role taking (ranging from high to low) will impose different levels of decision-making limitations on a manager performing activities. With respect to ambidexterity, these directive measures reflect the organizational influence on a boundary spanners engagement in either exploitation and/or exploration.

On the other hand, individual role making is influenced by personality traits. Building on the works of Ashforth (2001) and Graen (1976), personality traits that determine a person’s inclination to actively mold ones role definition are uncertainty avoidance and the level of self esteem. Uncertainty avoidance as termed by Hofstede (1980) reflects a person’s comfort or discomfort in unstructured, ambiguous situations. Self esteem has been highlighted for it reflects individuals’ evaluations of the ability to affect their environment in negative or positive terms (Burke & Tully, 1977;

Rosenberg, 1979). Similarly to role taking, different levels of role making (ranging from high to low) inflict different levels of motivation to define ones activities to perform. This means that based on the personality traits described above, managers will be more or less inclined to deviate from established modus operandi.

To conceptualize the joint influence of role taking and role making on exploration, exploitation, and ambidexterity, we turn to the literature on the influence of counterbalancing forces that drive innovation processes. Sheremata (2000) outlines that the interaction experienced in innovation processes can be qualified as centrifugal and centripetal, comparable to the forces in place to make the earth orbit the sun. Centrifugal forces drive a firm away from its current center of operation – they lead to options for future developments, or exploration. On the contrary, to capture those opportunities, centripetal forces, like structure and integrative processes, operate to bundle activities, or exploitation. These forces can be directly applied to the concepts of role making and role taking. For example, if a person characterized by high self esteem it is likely that this person will execute a high level of role making. High levels of role making imply that this person will act upon his or her personal interpretation of the embodied role, which leads to deviation from the norm – a centrifugal force. Likewise, an organization that is exemplified by a strong bureaucratic culture is more likely to enforce its norms and expectations, resulting in a centripetal force. While these examples concern separate effects of individual and contextual forces, they may work jointly as a centripetal or centrifugal force, as is highlighted in Table 3.

Table 3: Centripetal vs. Centrifugal forces of role making and role taking

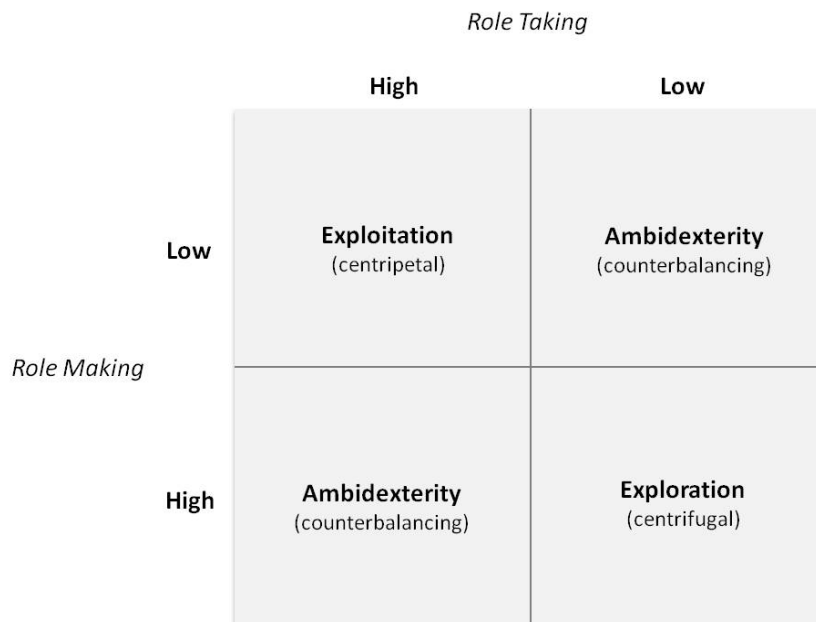
	Centrifugal	Centripetal
Role Taking		
Organizational Context		
Organizational culture	Adhocratic.....	Bureaucratic
Organizational structure	Organic.....	Mechanistic
Role Making		
Individual Personality		
Self-Esteem	High self-esteem.....	Low self-esteem
Uncertainty Avoidance	Low uncertainty avoidance.....	High uncertainty avoidance

As such, while a focus on the organization as whole, or collective action, tends to emphasize exploitation over exploration, a focus on deviation and individual role interpretation tends to emphasize exploration (Mom et al., 2009). Consequently, we propose that when role making and role taking are aligned in their emphasis (both centrifugal, or both centripetal), they will provide a drift towards either exploration or exploitation. However, when role taking and role making are counterbalanced (one centripetal and one centrifugal), individuals are stimulated to seek out both exploration and exploitation, and therefore may behave ambidextrously.

2.2.3 Role identities: Four archetypes

In line with previous literature, we stress that the engagement of boundary spanners in either exploitation, exploration or both is dependent upon the joint effects of role taking and role making (Lynch, 2007). In Figure 6, four types of innovation activities are generated by considering whether role making is high or low (based on personality traits) and whether role taking is high or low (based on organizational context). We assume that unidirectional forces, i.e. fully centripetal or centrifugal will induce behaviour that is concentrated on either exploitation or exploration respectively. On the other hand, when role taking or role making counterbalance, i.e. high (low) role making paired with high (low) role taking, we expect them to behave ambidextrously.

Figure 6: Role Identities: Four Archetypes



Centripetal forces: High Role Taking – Low Role Making. We expect boundary spanners with role identities that are characterized by high levels of role taking and low levels of role making to be the recipient of centripetal forces that induce them to behave exploitatively. As previously defined, organizations that show high levels of role taking tend to operate by bureaucratic cultures and mechanistic structures. Thus, such organizations impose routine behavior, compliance and standard operating procedures. At the same time, the boundary spanner, exemplified by low role making, is characterized by low self-esteem paired with high levels of uncertainty avoidance. Thus, we assume that boundary spanners in this setting are strongly inclined to execute and implement routines and standard operating procedures that are set by the organization. Two prominent reasons lead us to reason towards this centripetal working, a) limited decision-making autonomy and organizational inclination to enforce anticipated behavior paired with b) limited efforts of the boundary spanner to question corporate policies or diverge from expectations.

Bureaucratic cultures operate by strict target orientation and emphasize the importance of obeying predefined rules in order to foster stability and control (Cameron & Quinn, 1999). To a large extent, this type of cultural environment will execute control by means of explicit monitoring (Kerr, & Slocum, 1987). As Jones (1983) described, organizational culture provides individual managers with “a transactions framework that governs the expectations individuals may form in their dealings with others and that specifies the rights and obligations of each party” (1983: 458). Translated into bureaucratic culture, this conveys a limited operational range on the boundary spanner, while facing contingencies with rules of conduct in place to secure reliability in the activities that are performed. More specifically, this culture is geared towards efficiency and execution. Boundary spanners operating in this environment will experience pre-defined targets that are strictly coordinated internally to gear predictability. As such, boundary spanners will be expected to comply with expectations in order to avoid deviation. This type of organizational culture will therefore drive boundary spanners to operate strictly according to standard operating processes, limiting flexibility and provides fixed measures of efficiency.

Mechanistic structures can be largely described by centralized authority, formalized practices, and specialized functional areas. The centralization of mechanistic structures imposes strong dependence, as defined by the degree to which an activity can only be operated in line with top-down decision making. Implicit to this operational conduct is

manager's work separation and specialization to singular tasks. As proclaimed by Conger and Kanungo (1988) high degrees of operational constraint lead managers to operate in passive, low responsive manners. As such, boundary spanners are limited in their operational conduct in order to comply with requirements imposed by functional specialization and integration mechanisms that are driven by hierarchies and authority. Indeed, as Lynch points out, "In this way, role taking permits role players to anticipate the consequences of their own and others' plans of action, to monitor the results of those plans as they are carried out behaviorally, and to sustain or redirect one's behavior on the basis of monitoring (2007: 384).

These centripetal contextual forces may be complemented by personality traits that lead individuals to adhere to the organization's expectations. In keeping with work by March and Shapira (1987), we reference a boundary spanner's degree of uncertainty avoidance. Uncertainty avoidance measures the intolerance for uncertainty and ambiguity about a potential outcome (Hofstede, 1980). From the boundary manager's perspective, high levels of uncertainty avoidance are therefore linked to a negative attitude towards activities that entail risks due to limited or partial information. This means that a boundary spanner feels comfortable with a potential departure from existing operating frameworks and procedures only when provided with clear guidelines for such activities. Risk avoiding boundary spanners will refrain from vague situations by obeying operating standards and rules that allow for clear execution. Shane highlights that managers, perceiving high levels of uncertainty avoidance, "believe that they should not take initiative on their own ideas without approval from their superiors" (1995: 52).

In similar fashion, boundary spanners' levels of self-esteem have a distinct impact on the compliance with organizational routines for two reasons. First, low levels of self-esteem imply that the boundary spanner experiences an overall low evaluation of his or her worth. Underlying this perspective is the manager's confidence in his or her competences. Presumably, low levels of self-esteem will provide little ground for experimentation and divergence from agreed organizational procedures as they encompass a higher risk of failure. Hoskisson, Hitt, and Hill (1991) emphasized this point by stating that choices about activities that departure from established operating routines and procedures contain the threat of a very poor outcome. As the boundary spanner must assume a high personal risk for failure to begin with, the boundary spanner will be motivated to mitigate any further potential to increase such risk.

Second, in accordance with Ashforth, Harrison, Corley (2008) individuals that show low levels of self-esteem will be inclined to enhance one's perception through collective identification, meaning that they identify with their environment to think of themselves in a more positive light. In this light it must be assumed that in order to identify with the collective activities will be conducted in accordance with one's environment, in the sense of standard operating procedures.

Linking the above argumentation back to the conceptualization of centrifugal and centripetal forces (Mom et al. 2009; Sheremata, 2000), a role identity that is dominated by high role taking, i.e. an imposing organization that can be classified as mechanistic and bureaucratic, paired with a low role making personality leads to dominance of centripetal forces, and hence to exploitative activities. This reasoning leads us to the first proposition:

P1: Role identities that foster centripetal forces, in the form of low role making and high role taking, stimulate boundary-spanners to behave exploitatively.

Centrifugal forces: High Role Making – Low Role Taking. We claim that boundary spanners with role identities that are dominated by low levels of role taking and high levels of role making to be influenced by centrifugal forces that stimulate them to behave exploratory. As previously defined, an organization exemplified by low levels of role taking imposes limited to no routines or rigid structures. If this is paired with individuals that show high levels of role making, i.e. high levels of self-esteem paired with low levels of uncertainty avoidance, such personality traits are further amplified. Thus, we assume that boundary spanners in this setting are more stimulated and inclined to freely interpret their roles, and consequently engage in exploration. Two prominent reasons lead us to reason towards this centrifugal working, a) liberal decision-making autonomy and a flexible operating environment and b) an inclination to question predetermined frameworks, operating procedures and organizational routines complemented by a great likelihood to experiment.

An adhocratic culture is directed towards flexibility and discretion (Cameron & Quinn, 1999). As the origin from 'ad hoc' implies is the underlying assumption to operate on the spot. As such, tasks and expectations are loosely expressed and express more a character of guidelines and recommendations, leaving the majority of decision

making to the boundary spanner. This implies that the boundary spanner experiences a great deal of individual judgment in conducting business with internal and external partners, allowing operational autonomy. With respect to decision-making authority this type of culture will grant the boundary spanner a high level of authority for a lack of clearly defined hierarchical elements (Sheremata, 2000). The understanding is much more that the boundary spanner is a specialist in his or her field of operation and justifies autonomous decision making rights.

If such an organization is also exemplified by an organic structure, individual members are given more operational freedom. Such a context fosters functional interdependence and cooperation for a lack of predefined functional specialization. As Thompson (1967) pointed out, functional interdependence for a lack of clearly defined tasks creates room for coordination and negotiation between all parties involved. As such, other lateral, functional areas in the organization have the ability to influence the actions of the boundary spanner (Perrone, Zaheer, & McEvily, 2003). This does not imply that these units must have adverse intentions; however, an increased coordination demand provides multifaceted, creative input and allows the boundary spanner to change the orientation of the process on the fly. Very important in this respect is the simultaneous conduct of activities in different capacities over time as a result of the organization's fluid rather than stringent character (Sheremata, 2000).

When defining their role profile, boundary spanners find themselves in a bargaining process for the rights and limits to their operative conduct. Boundary spanners with low levels of uncertainty avoidance and high self esteem will be more inclined to alter existing role facets in order to better match their own role anticipation and perceive the potential risk in the light of potential higher returns. Under this assumption, boundary spanners with low uncertainty avoidance and confidence in their personal abilities will search for experimentation, drive variation in processes and deviation from routines.

Boundary spanners face an environment of potential role ambiguity through conflicting internal and external expectations (Friedman & Podolny, 1992), with a lack of pre-defined role patterns. Low levels of uncertainty avoidance paired with high levels of self-esteem will allow boundary spanners to perceive conflicting expectations as a means to actively moderate potential outcomes. As such, boundary spanners will be less inclined to adhere to pre-defined role patterns in order to flexibly adjust to changing demands. Therefore, boundary spanners with high levels of self-esteem are

more flexible and open-minded towards exploratory activities that break away from their organization's existing practices and values, feeling comfortable with the ambiguity entailed. Previous literature has termed this kind of behavior 'role innovation' where managers are generally liberated to actively alter goals and scope of held roles (Miner 1987; Perrone et al., 2003; Van Maanen & Schein 1979).

In line with the conceptualization of centrifugal and centripetal forces, the above argument supports the centrifugal argument by Sheremata (2000). When individuals that are comfortable with individual and deviating action are placed in an environment that stimulates them to do so, they will be even more inclined to act upon their personal preferences for independent action. As a result, both individual preference and organizational context reinforce each other in creating a role identity that revolves around experimentation, variation and exploratory action. Therefore, we propose the following:

P2: Role identities that foster centrifugal forces, in the form of high role making and low role taking, stimulate boundary-spanners to behave exploratory.

Counterbalancing Forces: High (Low) Role Taking and Role Making. We expect boundary spanners that operate in a context that is defined by either both high or both low levels of role taking to be influenced by counterbalancing forces that makes them behave ambidextrously. We predict that boundary spanners in these settings are required to make conscious decisions to address an inherent paradox to their role identity. In more specific terms, boundary spanners will be motivated to both obey organizational guidelines while simultaneously pursuing individual preferences in a high/high environment, while role identities characterized by low role making and role taking will lead to imposed ambidexterity for lack of existing frameworks and individual propensities. As such, the counterbalancing argument developed in the following builds upon arguments made by Poole and Van den Ven (1989) that paradox is inherent through the interplay of organizational context and individual human beings.

This argument builds on the notion of simultaneous presence of centripetal and centrifugal forces as defined by Sheremata (2000), and applied in the field of ambidexterity by Mom et al. (2009), inherently provide means by which exploitation

and exploration operate simultaneously. It involves the existence of conflicting drivers that presumably lead to activities that assemble and drive integration of contrasting activities. In the context of ambidexterity, we can draw a link between the activities boundary spanners decide to perform and their role making inclination by which they develop ideas, novel procedures and/or knowledge. Whereas the organization might inflict on this process through role taking measures at a later stage to incorporate these inputs and processes in an efficiency oriented way. As Sheremata points out, “Conceptually, the intellectual material centrifugal force makes available can be considered a potential, or store, upon which centripetal force then acts. Centripetal force transforms this potential into collective action through integration” (2000: 390). As Roberts (1988) pointed out, novel ideas are required to solve problems throughout an innovation process, not just in the concept phase. In the context of ambidexterity this might translates into exploratory activities that lay the foundation for subsequent exploitation of the generated ideas.

As such, a counterbalance in high centripetal and high centrifugal, i.e. when an organization that can be characterized as bureaucratic, and mechanistic, i.e. conveys high role taking, is paired with a personality that is considered risk seeking, and high on self-esteem, i.e. high role making, might allow boundary spanners to perform both exploitative and exploratory activities. This assumption reflects the notion that ambidexterity builds on the individual’s paradoxical thinking ability (Smith & Tushman 2005). This insinuates the boundary spanner to acknowledge the contradictions between exploration and exploitation yet appreciates their combined value and brings them together in a meaningful way (Cameron 2008). In reference to previous sections high role making (centrifugal force) has implied that individuals will show a high motivation to question standard operating features. Sheremata posited in this respect, “Centrifugal forces, in the context of new product development, are structural elements and processes that increase the quality and quantity of ideas, knowledge, and information an organization can access” (2000: 395). However, in an environment where an organization demands standard operating procedures and aspires collective action, centripetal forces equally apply. Moreover, role taking and role making forces will be found in a bargaining process for latitude and control (Perrone et al, 2003). In this situation, activities will be defined on a case by case basis and provide little predictability. As Poole and Van de Ven highlight, a paradoxical situation like the one generated by both strong contextual and individual forces provides a unique situation to “ present opportunities to discover different

assumptions, shift perspectives, pose problems in fundamentally different ways” (1989:564).

On the contrary, on the case of combinations of both low centripetal and low centrifugal, i.e. when an organization that can be characterized as adhocratic, and organic, i.e. conveys low role taking, is paired with a personality that is considered risk averse, and low on self-esteem, i.e. low role making individual boundary spanners will find themselves in a context that does not automatically support neither frameworks or routines. Such an organization predominantly stimulates centrifugal forces. As Tushman and Nadler highlight, “organismic structures consume more time, effort, energy and are less amenable to management control” (1978: 618). Building upon the notion that low role making boundary spanners are defined as risk averse and potentially lacking self-esteem, a lack of role taking facilitation will lead to ‘forced experimentation’: the organization pushes the individual boundary spanner outwards, while low levels of individual role making induce behavior towards collective action (Sheremata 2000). As such, it can be assumed that the boundary spanner will search for application potential (exploitation) while being stimulated to engage in exploratory behavior.

In line with the conceptualization of centrifugal and centripetal forces, the above argument supports the simultaneous existence of centrifugal and centripetal forces, leading to a counterbalancing effect that stimulates individual ambidextrous behavior. This leads us to the following propositions:

P3: Role identities that foster counterbalancing forces, in the form of high (low) role making and high (low) role taking, stimulate boundary-spanners to behave ambidextrously.

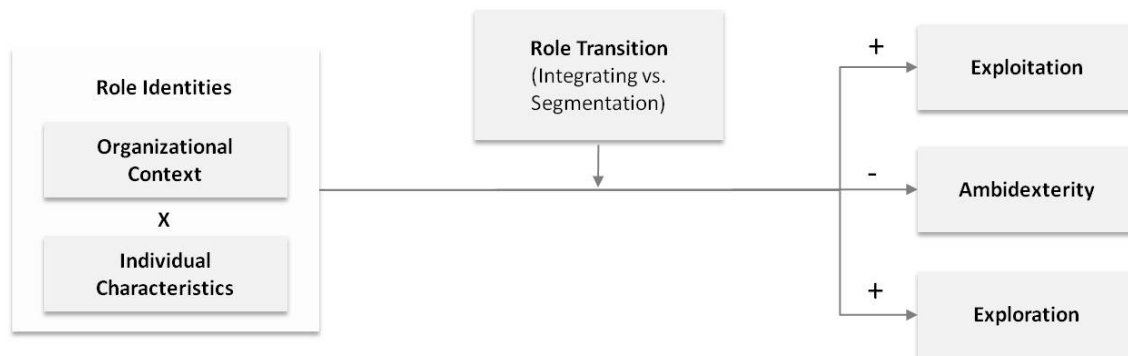
2.2.4 Individual role transition: Shifting gears

The logic developed above distinguished between two contrasting forces – *role making* and *role taking* – influencing the conduct of individual ambidexterity. In the following, we propose that the relation between the independent and dependent variable is moderated by the effort the boundary spanner experiences in transitioning between different roles.

Research on role identity theory has conceptualized the alignment of multiple roles and their respective boundary management to nurture the ease with which individuals can switch between their roles, referred to as role transition. Traditionally, it defines the transitions between work and home related roles (Ashforth, 2001). Lately however, the concept has found its application also in the work-work environment, acknowledging that individual managers find themselves increasingly in functions that show overlapping role demands (Makarius, Rothbard, & Wilk, forthcoming). What makes role identities relevant to role transitions is the contrast between role features - that is, role identities are social constructs (as previously defined by role taking and role making effects) assigning boundary features to a role (Ashforth, Kreiner, & Fugate, 2000). The effort needed to transit between roles is affected by the contrast of different role features. The closer roles are to each other, the higher the overlap in features, the easier it is to move between them, referred to as integrated roles. As a counterpoint, role integration makes it more difficult to uphold multiple roles at the same time (Ashforth, 2001). Contrarily, high differentiation requires more effort to move between roles due to the large variation in features, which is termed segmented roles. On the other hand, segmented roles also allow individuals to juggle multiple roles more efficiently and effectively (Ashforth, 2001).

While previous work has not focused on the direct relationship between role identities and role transition, we will analyze the degree to which role transition influences the ease with which individual boundary-spanners may handle multiple, counterbalancing roles or make the most of aligned roles. We expect the degree of role integration (or segmentation) to have a moderating effect on the extent to which individuals engage in exploration, exploitation or both. Figure 7 outlines the full model of how role transition amplifies a boundary spanner's inherent motivation to engage in exploitation, exploration and/or both through his or her role identities.

Figure 7: The Effect of Role Identification on Exploitation and Exploration under the Moderating Effect of Role Transition



2.2.5 Integration vs. separation and their effect on exploratory, exploitative, and ambidextrous behavior

While role identities describe why boundary spanners might be inclined to behave in a certain way, how they handle their multiple roles is dependent on individual role boundary management. Acknowledging that each individual holds more than one role, role boundaries delineate the way one operates the different roles either through role integration or role segmentation. The motivation to either integrate or segment roles lies in the strategic intent to actively overlap domains of operation or distinctively separate roles to isolate domains from each other (Rothbard, Phillips, & Dumas, 2005). We assume that these tendencies to actively integrate or separate roles from each other may have implications on the way the boundary spanner engages in exploitative, exploratory or ambidextrous activities. Consequently, we propose that the preference of boundary spanners to segment their roles positively moderates the conduct of either exploitation or exploration, while integrate roles will positively moderate the engagement in ambidexterity, while role integration will positively moderate the engagement in ambidexterity. This ties naturally back to the literature of ambidexterity, which highlights that the simultaneous existence of exploitation and exploration is a necessary yet insufficient condition, as the integration of both activities provides for the synergistic effect of ambidexterity.

Role segmentation – Individuals that prefer role segmentation favor to reduce interruptions from potentially conflicting requirements and concentrate on one responsibility at a time (Ashforth et al., 2000; Edwards & Rothbard, 2000; Rothbard et al., 2005). Indeed, boundary spanners that prefer to operate along role segmentation

might use this modus operandi to shield themselves from role conflict and reduce interruptions (Makarius, Rothbard, & Wilk, forthcoming). Further, segmentation may foster certainty due to a distinct boundary delineation, which allows the manager to align the fit between situational context and role (Edwards & Rothbard, 2000; Kreiner, 2006; Rothbard, 2001; Rothbard et al., 2005). Through the potential to prioritize and focus on singular tasks in assigned contexts, a boundary spanner will be more able to concentrate distinct tasks that that can be either exploratory or exploitative in nature. Knowing that exploitation and exploration are very distinct activities, roles segmentation leads to a clear focus on one of the two activities while hindering the link between both activities by fencing off potential overflows. For that reason, segmentation will allow the boundary spanner to assign distinct value sets and a more direct focus on the task at hand (Ashforth et al., 2000). In line with previous research we hold that the underlying values and schemata through which the boundary spanner segments different roles are non-overlapping, which entails that the boundary spanner will refrain from switching between different roles within one context. This provides for a reasonably uniform, repetitive way of operating in a given situation. In line with focused exploitation or exploration, this leads us to assume that a particular role will trigger the boundary spanner to perform in a consistent fashion of either exploitation or exploration.

Role integration - A person that is inclined to integrate tends to blur role domains, leading to an overlap between activities performed in different domains (Ashforth, Kreiner, & Fugate, 2000; Edwards & Rothbard, 2000; Nippert-Eng, 1996). The effectiveness of blurred boundaries that are the result of role integration depends on the extent to which the underlying values that constitute each role are congruent (Ashforth, Kreiner, & Fugate, 2000). If the underlying values and schemata with which the boundary spanner differentiates between roles overlap to a great extent, it is likely that the boundary spanner may switch between different roles within one context. As such, a boundary spanner's preference for integration indicates a "desire to reduce role transitions and enable greater flexibility in enacting multiple roles" (Makarius et al. forthcoming: 6). This has implications for the conduct of exploitation and exploration. While it is acknowledged in the literature that both exploitation and exploration have diverting orientations, it has also been postulated that in order to leverage the full potential of ambidexterity integration of both activities is needed (Mom et al. 2009; O'Reilly & Tushman, 2008). Boundary-spanners that seek to integrate their roles are more able to bring exploratory and exploitative activities

together in a relatively homogenous manner. As a result, it is more likely that they will see merit in the diversity that underlies their multi-role context. A role integrator in this respect should be better able to engage in paradoxical thinking. Through such mechanisms, boundary-spanners may be better able to capture synergies among the different roles they perform. While role integration provides benefits in terms of flexibility to enact roles and a facilitated transition between different roles (Kreiner, 2006; Rothbard, 2001; Rothbard et al., 2005), it has also been proposed that role integration increases role conflict. While integration increases role conflict, because more than one role could be applied in any given situation, this aspect is a major driver of the integration between exploitation and exploration and allows each activity to benefit and nurture from each other. Role integrators as such experience role conflict created through multiple simultaneous not in a negative way. As Makarius et al. highlight, “those who prefer to integrate may realize the benefits of synergy from bridging people, ideas, and activities across multiple roles and find the greater interruptions and intrusions of doing so less costly than someone who prefers to segment roles” (forthcoming: 8). Consequently, role integration will positively influence the ability of boundary-spanners to handle counterbalancing forces in a way that brings combines centripetal and centrifugal elements in their role identities, and behave ambidextrously.

Finally, Meyerson and Scully (2005) provide one of a few examples where role theory and role transition between roles is applied to the multi-role work environment. In particular they provide evidence for the existence of individuals in the organizational context that operate on diverging and partially conflicting role identities. Referring to what Meyerson and Scully (2005) term ‘tempered radicals’, provides evidence that in order to operate both exploitative and exploratory, managers need to hold multiple distinct role sets. Tempered Radicals are defined as organizational members with varied values, beliefs, and commitments based on multiple identities that become salient in different circumstances (Demo 1992; Gecas 1982; Meyerson & Scully, 2005). “Tempered radicals experience tensions between the status quo and alternatives, which can fuel organizational transformation” (Meyerson & Scully, 2005: 586). Linking this to the conduct of boundary spanners, we propose that role integration, which allows for movement between different roles flexibly, moderates the conduct of ambidexterity, while separation enforces the orientation towards either exploitation or exploration. This leads to the following two propositions:

P4a: High role integration positively moderates the relationship between centripetal or centrifugal role identities and the conduct of exploitation or exploration respectively

P4b: High role segmentation positively moderates the relationship between counterbalancing role identities and the conduct of ambidexterity

2.3 Discussion and Conclusion

2.3.1 Theoretical contribution

Ambidexterity has been the topic of an extensive body of research (i.e. Raisch & Birkinshaw, 2008; Raisch et al., 2009). While this research has predominantly focused on an analysis on firm and business level, there is a lack in conceptually and empirically validated insight on exploration and exploitation on individual level and how individual's actions are influenced. The purpose of this study was to analyze why and how boundary spanners engage in exploitation and exploration. Literature on individual ambidexterity provides two alternate positions for why some managers may be inclined to act ambidextrously – through individual traits and a firm's context. Poole and Van de Ven summarize both effects by stating that “organizations are relatively stable, enduring features of life, yet when we look closely they do not appear stable at all. They are continuously changing, continuously being produced and renewed by member activities” (1995: 564). Captured by role theory, a concept translated from social psychology, we therefore outline the interaction effect of personality traits (role making) and firm context (role taking) in generating role archetypes that capture the individual inclination towards exploratory and exploitative activities. In a second step we postulated how the transition – a preference to either integrate or segment roles – moderates the ability to act ambidextrous.

In this, we have proposed that managers acting as boundary spanners find themselves operating in a role setting that is dominated centripetal forces, i.e. high role taking paired with low levels of role making, are more inclined towards exploitation. On the other hand, boundary spanners with role identities that are exemplified by dominance by centrifugal forces, i.e. high role taking and low role taking, tend to stimulate exploration. Finally, a counterbalance between centrifugal and centripetal

forces, i.e. high (low) role making and high (low) role taking, induces ambidextrous behavior. Finally, we proposed that the ability to transit between roles, shaped by the level of role integration or role segmentation, moderates the engagement in ambidextrous behavior. In line with extent literature on ambidexterity, which emphasizes that integration is an important facet in order to leverage the full potential of exploitation and exploration we assume integrated roles to facilitate the response to altering demands as in the case of ambidexterity. Segmented roles, on the contrary, allow boundary spanners to deliberately switch between roles setting and separate demands out from each other to the benefit of either exploitation or exploration.

This paper contributes to existing research in three ways. First, in focusing on the individual level of exploitation and exploration, this study intends to fill a gap on conceptual insight in ambidexterity in the smallest organizational unit (Mom, van den Bosch, & Volberda, 2007; Raisch & Birkinshaw, 2008). Second, we contribute to the ambidexterity literature by theorizing a model within which the individual is no longer a passive conduit for contextual solutions to ambidexterity. Rather, we portray the individual boundary spanner as an actor that takes an active role in shaping his or her conduct of exploration and exploitation. The insights developed in this paper echo earlier research on combinations of counterbalancing forces to drive individuals simultaneously towards exploration and exploitation (Sheremata 2000; Mom et al. 2007). Third, this is the first attempt to link social psychology in the form of role theory to the concept of ambidexterity. Answering to the research call by Raisch et al. (2009) for an integrated view of individual characteristics and organizational features, the interaction of both role taking and role making provides comprehensive insight in the determinants of individual ambidexterity.

2.3.2 Managerial contribution

It is not only researchers who would benefit from these insights, but practical implications in the form of normative guidelines for management could enhance individual capacity to engage in exploration, exploitation and ambidexterity. The level of role taking will either allow boundary spanners a more integrated or isolated position, or foster their involvement with the company and with internal partners. Organizational openness and leverage in defining the role of boundary spanners will potentially extend the exploratory activities managers may pursue. On the other hand, narrow exposure and rigid guidelines will direct the interaction for activity towards

exploitation. Finally, understanding that role definition from the perspective of the firm is only one side of the coin might help stakeholders to understand why different people will enact the same position within a firm in a different fashion. Firms should be aware that there are trade-offs that can and must be managed when matching personalities within certain organizational context. Firms seeking to become ambidextrous through boundary spanning activities could shape ‘push or pull’ type situations, depending on the personality of the boundary spanner. Boundary spanners that are risk-seeking (i.e. high role making) should be complemented with an emphasis on guidelines and structured decision-making (i.e. high role taking), and vice versa. Our propositions suggest better control on targeted knowledge exchange, generation and application to further innovation.

2.3.3 Limitations and future research

We recognize that this study faces limitations which suggest the potential for further research. Those charged with the responsibilities of boundary spanning may experience ‘role overload’, something that has also been demonstrated through existing research. This means that the multiple and partially conflicting roles boundary spanners have to live up to may overburden them. In this light, it could be of further interest to analyze whether boundary spanners are capable of living up to the assumptions made in this contribution on a long-term basis. Building on this, it would be interesting to see whether boundary spanners that shift over time between role emphasis and the degree of role integration are better able to produce effective results from a financial perspective on the longer run. Finally, whereas previous studies have asked for multi-level analysis this study is only a first step into this direction. While we acknowledge the interaction between individual level effects and the organizational context, it will be up to test for the interactions proposed here.

3 **When Distant Partners Become Your Closest Friends: Ambidexterity in Cross-Industry Collaboration²**

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Abstract: Inter-firm collaboration has become central to the value creation in large firms' innovation processes. In particular, research on ambidexterity has prescribed inter-firm collaboration the ability to alleviate the tensions the simultaneous conduct of radical and incremental innovation bears. However, while prior research stipulates their structural, temporal or contextual separation in inter-firm projects, we ask whether and how both innovation types may originate simultaneously in single project settings. Focusing on cross-industry innovation, we analyze eleven case studies on new product development (NDP) projects. Our findings suggest that individual learning potentials differ for the collaboration partners, acting as a function of the initial knowledge distance, project objective and subsequent process architecture. We contribute to research on ambidexterity, organizational learning and particular how balanced exploitation and exploration evolves in collaboration processes.

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3.1 Introduction

In today's volatile markets adaptability determines the survival or failure of an organization (Bettis & Hitt, 1995). As presented by Foster and Kaplan (2001), the lifespan of S&P 500 organizations has dropped by 75%. Whereas these companies still faced an average lifespan of 90 years in 1935, results McKinsey published in 2005 revealed an average current life expectancy of only 15 years (O'Reilly & Tushman, 2007). Despite this rather disillusioning perspective, there are companies that seem to manage high levels of change that originate outside their organization's boundaries.

In the attempt to clarify the factors that differentiate these companies, the concept of ambidexterity has generated considerable theoretical and managerial significance (Li, Vanhaverbeke, & Schoenmakers, 2007; Raisch & Birkinshaw, 2008). By ambidexterity we denote the balance of exploiting existing knowledge for incremental innovation and exploring novel impulses to develop more radical innovations as a decisive factor of a firm's survival and performance (March, 1991). Research on ambidexterity has drawn on multiple theoretical lenses, however, most prevalent the organizational learning perspective assumes the ability to absorb knowledge and adapt subsequently to maintain a competitive advantage (March, 1991). Consequently, maintaining competitiveness is profoundly determined by the firm's ability to source beyond the corporate environment and to complement its knowledge with external sources. As a result, inter-firm collaboration has received increased attention to define how to leverage external knowledge sources to drive organizational ambidexterity (Lavie & Rosenkopf, 2006).

We define inter-firm ambidexterity as the pursuit of exploitative and exploratory activities through collaboration to generate both incremental and radical innovation. As Grant and Baden-Fuller (2004) highlight, a prominent objective of collaborations is the presumed access to resources beyond a firm's existing resource base. Particularly the promise of external knowledge access has been highlighted in several studies (Gulati, 1999; Rosenkopf & Almeida, 2003; Rothaermel, 2001), while the significant upsurge of alliances in R&D intensive industry sectors over the last decades has reaffirmed knowledge access to be a primary justification for inter-firm collaborations (e.g., Dyer & Singh, 1998; Hagedoorn, 2002; Rothaermel & Deeds, 2004). The prevailing belief from the resource based view and the organizational learning perspective is that firms access and transfer knowledge from sources outside their

boundaries to create value for a firm's exploitative and exploratory innovation activities (Koza & Lewin, 1998; Rosenkranz & Rosenkopf, 2011). The central arguments is that collaboration allows (1) the combination of distinctive yet complementary capabilities in a value adding way (Lei & Slocum, 1991), (2) alleviates the inherent tension of simultaneous pursuits of exploitation and exploration (Lavie & Rosenkopf, 2006). As Kyriakopoulos and Moorman substantiate, interaction with the external environment "reduces the tensions between exploration and exploitation strategies and creates the opportunity for cross-fertilization and complementary learning between the two strategies" (2004:220).

While existent research provides great insight, unresolved topics remain. First, with the notable exception of Im & Rai's (2008) study there is no insight into whether exploitation and exploration can be generated in single inter-firm collaborations. However, ambidexterity requires reintegration of exploitation and exploration (O'Reilly & Tushman, 2004, 2007). As Sirmon, Hitt and Ireland (2007) indicated, integrative efforts are crucial to appropriate the full potential value embedded in both spatially separated activities. Second, the empirical support for the presumed positive effect of collaboration on a firm's ambidexterity remains limited. Most findings provide not only conflicting but contradicting results (Lavie, Stettner, & Tushman, 2010). Third, literature has presently focused on firm-level variables that determine structural or temporal separation of inter-firm ambidexterity; however, the process architecture which enables or impedes the conduct of ambidexterity has been neglected so far.

In sum, the raised issues suggest that notwithstanding the relevance of collaboration for firm's innovation, research lacks insights into the processes that promote or inhibit the generation of exploitation and/or exploration. Thus, we raise the question *What promotes ambidexterity in collaboration and how does exploitation and exploration evolve on the process-level*. To address the gaps stated above, we conduct a multiple-case study analysis. In particular, we will concentrate on cross-industry collaborations which highlight the innovation opportunities with unrelated market participants (Enkel & Gassmann, 2010). Cross-industry innovation integrates external knowledge, technological artifacts, or systemic practices outside the value chain from industries other than the focal firm's into its innovation process (Gassmann, Zeschky, Wolff, & Stahl, 2010; Herstatt & Engel, 2006; Kalogerakis, Lüthje, & Herstatt, 2010). The core logic is that radical innovation predominantly resides in recombining established

knowledge artifacts in a new context or constellation (Hargadon, 2002, 2003). Thus, we claim that cross-industry collaborations provides a particular suited setting for this study as it provides both exploratory and exploitative elements to the innovation process.

This study contributes to research on ambidexterity by offering guidance on process features that allow ambidexterity to be created within single inter-organization collaborations with partners from different industries. Second, we find that partners experience different learning potentials for exploitation and exploration from the collaboration, acting as a function of the initial knowledge distance, project role and subsequent process features. Our key insight is that a more holistic perspective on the overall innovation process allows identifying insights that go beyond the perspective of previous findings that promote structural or temporal separation in ambidexterity and promote the integration of both activities.

The next section reviews the relevant literature on ambidexterity and open innovation. Based on exploratory case study analysis we deduce findings and outline the impact of the initial collaboration's intention on related procedural features of exploitation and exploration. The final paragraph summarizes our contribution, discusses limitations, as well as potential for future research.

3.2 Conceptual Background

3.2.1 Inter-firm ambidexterity

Ambidexterity has been the subject of ample research and the concept has found wide recognition in management practices (Duncan, 1976; Holmqvist, 2004). Though it is accepted that exploration as well as exploitation are central to the survival and prosperity of organizations, it has been proposed that their simultaneous pursuit inflicts difficulties due to their fundamentally different resource foci and latitudes (Gibson & Birkinshaw, 2004; Raisch & Birkinshaw, 2008). March proclaimed that “exploration includes things captured by terms such as search, variation, risk taking, experimentation, play, flexibility, discovery, and innovation. Contrarily, exploitation includes aspects such as “refinement, choice, production, efficiency, selection, implementation, execution” (1991:71). While the latter is associated with mean seeking by leveraging existing knowledge, the former is charged with variance seeking through complementary knowledge generation.

Traditionally applied to intra-organizational perspectives, recent research on ambidexterity has extended to inter-firm learning. Organizations collaborate in order to access, create, and transfer knowledge from sources outside an organization's boundaries (Powell, Koput, & Smith-Doerr, 1996; Smith, Carroll, & Ashford, 1995). Empirical findings and conceptual work indicate that innovation processes have adopted an open approach as a result of increased information dispersion and market complexity (Davis, Furr, & Eisenhardt, 2006; Noteboom et al., 2007). This is supported by the upsurge of alliances over the past decades, which suggest that inter-firm relationships are a particularly valid unit of analysis (e.g., Dyer & Singh, 1998; Rothaermel & Deeds, 2004). Literature on ambidexterity has provided evidence that organizations engage in alliances with the aim to drive exploitation and exploration (Lavie & Rosenkopf, 2006). Researchers have proposed a number of organizational models to articulate how organizations should address inter-firm ambidexterity (e.g., Beckman, Haunschild, & Phillips, 2004; Dodgson, Gann, & Salter, 2008). A common feature of all these models is the development of structural separation, designed to facilitate the seemingly contradictory demands of exploitation and exploration. Consistent with this logic, organizations engage in alliances that leverage existing knowledge, while separate exploratory alliances engage in NPD (Koza & Lewin, 1998). A predominant view is a portfolio logic according to which organizations engage in alliances that either drive exploitation to leverage existing knowledge, while separate explorative alliances engage in new product development (NDP) (Koza & Lewin, 1998; Rothaermel & Deeds, 2004). Other studies have defined classifications according to vertical and horizontal alliances along the value chain (Dodgson, Gann, & Salter, 2008), with vertical partners driving exploitation and horizontal partners being responsible for exploratory innovations. Finally, the delineation of old and novel collaboration partners (Beckman, Haunschild, & Phillips, 2004) indicates that well-established partners drive exploitation while exploratory innovations are fostered by novel partners. A common denominator to all of these contributions is that they emphasize separation of exploratory and exploitative inter-firm relationships in order to cope with the inherent tensions of resource allocation, path dependency and organizational demands (Gupta et al, 2006; Im & Rai, 2008).

While these first findings have contributed to our understanding of inter-firm ambidexterity, Im and Rai (2008) proposed more recently that single collaborations can accomplish alliance ambidexterity through the concept of contextual ambidexterity. According to this perspective, actions and initiatives driven by senior

management induce a supportive organizational context that simultaneously instigates exploitation and exploration (Gibson & Birkinshaw, 2004). On a different note, Lavie and Rosenkopf (2006) conceptualized ambidexterity as balanced in single alliance functions across domains and over time. Finally, Lin, Yang and Demirkan (2007) provided evidence that undertaking both innovation types simultaneously has the greatest performance impact.

All these contributions provide only partial insight into the potential of balancing exploration and exploitation within single inter-firm collaborations, as all insight succumb to the analysis of direct value chain partners. This paper intends to extend this string of research by combining ambidexterity with the new paradigm of cross-industry innovation. In particular, we propose distinct structural and procedural features based on recent empirical results in ambidexterity research that allow exploitation and exploration in cross-industry collaboration. We expect cross-industry collaboration to be an appropriate setting, as its inherent logic lies in applying existing technology and exercised competencies from one industry in an exploratory way to a new context or constellation (Enkel & Gassmann, 2010; Hargadon, 2002, 2003).

3.2.2 Open Innovation

Over the past few years, open innovation developed as a result of shorter innovation cycles, industrial research, and escalating development cost in the light of resource shortages (Chesbrough, 2002; Enkel et al., 2009; Gassmann, 2006). Leveraging the potential presented in the market implies “transforming a company’s solid boundaries into a more semi-permeable membrane to enable innovation to move more easily between the external environment and the company’s internal innovation process” (Gassmann & Enkel, 2004:1). While there is no shortage of theory on open innovation with value chain partners, research has only started to identify or systematize the concept of knowledge or technologies with partners at high cognitive distance, called cross-industry innovation (Gassmann et al., 2010). Analogical thinking, as a source of competitive advantage, (Dahl & Moreau, 2002; Gassmann & Zeschky, 2008; Kalogerakis, Lüthje, & Herstatt, 2010) and radical innovation (Holyoak & Thagard, 1995), while restraining the potential risks of uncertainty (DeBono, 1990), are central to cross-industry innovation.

To date, research has emphasized the importance of analogies for radical product innovation (Keane, 1987; Dahl & Moreau, 2002) and increased firm performance (Gavetti, Levinthal & Rivkin, 2005). Non-obvious analogies may require highly novel solutions, because the combination of more distant pieces of knowledge is associated with a higher innovative potential (Hargadon & Sutton, 1997; Holyoak & Thagard, 1995). Theory suggests that a higher cognitive distance between alliance partners functions as a precondition to exploration, resulting from the gap between a solution's source and the applying company (e.g., Gassmann & Zeschky, 2008). Nevertheless, in their empirical analysis of 25 cases, Enkel and Gassmann (2010) provide evidence that there is no significant correlation between higher cognitive distance and a superior innovation performance in terms of radical innovation. Research in this field has so far failed to analyze whether, in cross-industry innovation, cooperation efforts can also lead to different results in terms of exploration and exploitation for the collaborating partners. Applying cross-industry innovation to analyze organizations' NDPs will shed light on the applicability of this type of innovation to generate incremental and radical innovations.

The successful search for analogical solutions and their retranslation and multiplication require new or adapted processes, tools and competencies in technology and innovation management (Herstatt & Engel, 2006; Kalogerakis, Lüthje, & Herstatt, 2010). Cross-industry innovation holds distinct characteristics in respect to its resource endowments, knowledge structure, strategic intent, and collaboration function in the overall value chain. The project learning potential of NPD plays a crucial role in the investigation of cross-industry ambidexterity. Consequently, two important assumptions can be drawn from this brief review. First, cross-industry innovation provides a unique setting within which companies use their cognitive distance to generate innovation through collaborative ventures (Enkel & Gassmann, 2010). Central to this idea is the application of distinct radical or incremental innovations according to a company's particular needs.

3.3 Research Method

This paper will draw on inductive theory building through multiple case study analysis to provide insight in the structural and procedural mechanisms that underlie cross-industry collaborations to generate organizational ambidexterity. Following the specifications of previous researchers, we consider this methodology an appropriate

approach to our research question as the field is defined by limited theoretical knowledge of cross-industry collaboration and its application to the research domain of simultaneous exploration and exploitation (Siggelkow, 2007). We propose that this research design will allow us to define patterns of relationships that quantitative data would not easily reveal (Eisenhardt & Graebner, 2007). As such, this paper follows existing research based on multiple case studies to address socially complex constructs through rich, field-based findings in order to develop interesting, accurate, and testable theory (Bartunek, Rynes & Ireland, 2006; Yin, 1994). Following replication logic (Eisenhardt, 1989), each case is considered a single experiment in its natural, real-world context that will confirm or disconfirm facts and findings when compared to other cases (Yin, 1994). This will not only provide a stronger base for our theory, but will ultimately lead to more generalizable and robust findings.

Table 4: Case Study Summary

Firm	Industry Background Focal Firm	Collaboration Partner	Industry Background Collaboration Partner	Collaboration Initiative	Data Collection
Mammut	Sports utilities	Ascom	Information Technology	Mammut Barryvox, Avalanche tranceiver	5 Interviews, 5 CII Workshops, Archival Data
BMW	Automotive	Immersion	High Tech	iDrive	9 Interviews, 5 CII Workshops, Archival Data
Ciba	Chemical	Rode & Rau Dürr	Construction	Ultra strong varnish finishing	8 Interviews, 4 CII Workshops, Archival Data
Alcan	Packaging	Audi	Automotive	B-Pillar Hydroform Laser technology	6 Interviews, 3 CII Workshops, Archival Data
Beiersdorf	Consumer Goods	Ciba	Chemical	UV-A/UV-B Sun Protection	2 Interviews, Archival Data
Alcan	Packaging	Canon	Photography Print Media	Pharamceutical Fine-Print	12 Interviews, 4 CII Workshops, Archival Data
Böchning	Sports Utilities	Schmitz-Werke GmbH & Co KG	Markise	Awning Fiber Threads	7 Interviews 1 CII Workshop, Archival Data
Metro	Retail	Deutsche Telecom	Telecommunication	Couponing System	9 Interviews 1 CII Workshop, Archival Data
Procter & Gamble	FMCG	Institute for ground water currents	Research Institute, Liquid Behavior	Pampers Dry Max	8 Interviews 1 CII Workshop, Archival Data
Schmitz-Werke GmbH & Co KG	Markise	Susper	Automotive Supplier	Polo Fox Trunc Hydraulics	7 Interviews 1 CII Workshop, Archival Data
BASF	Chemical	Procter & Gamble	FMCG	Mr Clean Magic Eraser	8 Interviews 1 CII Workshop, Archival Data

CII = Cross-Industry Innovation

We have collected data from eleven cross-industry NPD projects in different industries, as shown in table 4. The cases were chosen for their companies' acknowledged outstanding innovation performance and specific recognition of their cross-industry developments. All case studies were undertaken within a seven year timeframe from 2005 to 2011. We conducted a total of 81 interviews, using open and semi-structured interview guideline. In approximately three joint workshops per company, we discussed interview transcripts, conducted additional site visits to each of the company analyzed for this study, and supplement our analysis with internal documents. We reported our findings back to the interviewed companies and integrated their feedback to correct for possibly erroneous interpretations. Following our logic of differentiation between collaboration objective, process and learning, we were able to cluster the cases and develop archetypes that support ambidexterity in each type of collaboration.

3.3.1 Research context

When selecting the cases, we complied with theoretical sampling (as opposed to random or stratified sampling) in order to provide settings that are particularly suited to illuminate our proposed relationships and that create logic between the constructs (Eisenhardt & Graebner, 2007; Yin, 1994). The driving criteria for the industry, company, and project selection were the acknowledged pursuit of both incremental and radical innovation, as well as a dominant reliance on inter-firm collaboration to accomplish both innovation targets. Thus, we carefully selected industries that are particularly adequate settings for research on innovation in general and ambidexterity in particular. Lin, Yang, and Demirkan (2007) suggest that ambidexterity is especially relevant for large firms in uncertain market environments. Thus, we opted for the automotive, chemical, pharmaceutical, IT, and fast-moving consumer goods industries, which are all classified as mature, yet volatile, markets dominated by large market players. Open innovation is considered important in these industries (e.g., Enkel & Gassmann, 2009).

In line with prior research, our choice of firms in our target industries was based on proxies of ambidexterity. Each company had demonstrated consistent profitability generated with an established client base (an indicator of successful exploitation), while at the same time receiving prominent innovation awards and/or being ranked among *Business Week's* 50 most innovative companies in 2009, which is evidence of

successful exploration (Andriopoulos & Lewis, 2008). All of the selected companies have a large portfolio of inter-firm collaborations to drive NDPs.

For our study, we define collaborative NDP projects as the level of analysis. The NPD context is considered relevant for studying innovation processes and their management (Robertson & Swan, 2003; Sutton & Hargadon, 1996). We selected the adequate NPD projects by reverting to publicly available announcements that recognized the products as joint inter-firm developments in which the technology was explicitly drawn from two or more differing industry backgrounds. Finally, companies were approached to confirm that all the cases were representative cross-industry collaborations.

3.3.2 Sample data

While case studies can accommodate a variety of sourcing techniques, we relied on semi-structured interviews as the primary data source, triangulating them with archival data and workshop observations to refute or reinforce findings made through the interview data (Forster, 1994). Interviews provide an efficient technique to gather rich, empirical data that works particularly well when the research subject is episodic (Eisenhardt & Graebner, 2007), as new product development is. While interviews can be considered the prevalent technique for gathering case study information, they have inherent shortcomings. Interview data is often considered biased due to interview partners' impression management and retrospective sense-making (Eisenhardt & Graebner, 2007). To mitigate these potential limitations, we carefully composed the interview pool by means of two mechanisms. First, we drew from diverse hierarchy levels of the companies involved in the collaboration project to provide a multilevel account of the specific project. We also included interview partners from diverse functional areas with important project responsibilities. During the project, we were in the position to generate an expert group on the project, reducing the need to assess the reliability of the information provided (McGrath, 2001). Second, we complied with the 'snowball' approach, which has also been recognized by previous research (Adler, Goldoftas, & Levine, 1999). We chose interview partners based on reference, which would presumably lead us to the most knowledgeable project informants. This provided evidence of perceptual data on which the respondents based their decision-making, as it has been proven that people act on perception rather than on objective data (McGrath, 2001; Weick & Roberts, 1993).

The interviews were mainly conducted per telephone, while workshop material substantiated our research through personal interactions. In cases where the respondents were difficult to reach, we drew on questionnaires that represented the interview questions in order to ensure uniformity in the information base. The interviews lasted between 45 and 60 minutes on average, and were tape-recorded and transcribed verbatim to ensure information reliability (Bourgeois & Eisenhardt, 1988). Following a tripartite structure, we first gathered general information: we asked about the collaboration partner selection, the NPD project, and about the interview partner's responsibilities. This provided us with a general context of reference. In a second step, specific questions provided insight in the collaboration process and structure. Finally, to determine the innovation potential, we asked questions about the generated knowledge flows and learning. In accordance with Glaser and Strauss (1967), we started with a broad research aim, further specifying our data collection as the data analysis unfolded. Information gathering was pursued until no additional information could dispute existing findings or reveal novel constructs. This was considered the point of theoretical saturation (Corbin & Strauss, 1990).

As previously mentioned, we triangulated our findings with (1) additional archival data (publicly available information as well as internal documentation), and (2) workshop observations. Archival data was collected via desk research leading up to the interviews in order to establish a fundamental understanding of the project contexts. In addition, if provided by the companies, internal documentation, studies and reports were used to verify the generated project knowledge (Rowley, 2002). Documentary observations through workshops supported further insight in the collaboration context.

3.3.3 Data analysis

The theory-building process was defined by a recursive cycling of the provided case data, emerging theoretical constructs, and extent literature (Eisenhardt & Graebner, 2007). Consistent with Glaser and Strauss (1967) and Miles and Huberman (1994), we applied the accepted four-stage process to move from raw interview data to the definition of constructs that guide exploration and exploitation. First, we transcribed every single case individually for each NPD project, using obtained interview data. To increase the reliability of the analysis, we reverted to triangulation via archival data and observations made on site. Having confirmed the case report with company

representatives, we identified innovation patterns. To categorize each case's raw data, we applied conceptual coding, using in vivo codes, as advocated by Van Maanen (1979). These offered general insight in the relationship mechanisms of innovation processes and corresponding learning mechanisms, as described by the respondents. Next, we analyzed the case content with respect to potential linkages, which allowed them to be grouped in overarching concepts. We allowed concepts and relationships to emerge from the data, rather than imposing a priori hypotheses, which is central to the inductive process (Andriopoulos & Lewis, 2008; Corbin & Strauss, 1990). To assess the reliability of the generated codes and groupings, we involved a second coder. Following Cohen's Kappa (1960), we verified the consistency through an inter-coder reliability of 89%. Dissents were resolved through in-depth discussion.

In a third step, we conducted standard cross-case analysis techniques (Eisenhardt, 1989; Miles & Huberman, 1994) to identify patterns between all the conducted case studies, comparing the concepts produced in the previous step. In particular, we searched for similarities between each set of concepts to define whether there were differences between the case sets. This allowed us to generate aggregate dimensions that served as the basis of the emerging theoretical framework.

The last step was devoted to the framework development. By linking all the defined concepts in an overarching theoretical model, we could deduct propositions. By iteratively circulating among case study material, extant research, and further secondary data, we refined and deepened our understanding of the emerging framework, which allowed us to strengthen construct precision and theory development. Drawing on research in the fields of ambidexterity, inter-firm collaboration, and the emerging field of cross-industry innovation, we could fit this paper's contribution in the larger concept of existing theory (Eisenhardt & Graebner, 2007).

3.4 Findings and Proposition development

The synthesis of the data from our case studies serves as the basis to explain how companies employ different collaboration processes to derive distinct exploitative and exploratory learning mechanisms. Our analysis suggests that there are three distinct components that influence the overall collaboration outcome. First there is the *collaboration objective*, within which the focal organization defines its strategic intent

for the collaboration. In this phase, we found that collaboration decisions were defined in accordance with both partners' body of knowledge and the precision of the problem statement anteceding the collaboration. Second, during the actual *collaboration process*, team structure and process mechanisms were particularly highlighted as collaboration differentiators. As Madhavan and Grover (1998) assert, learning can be described as a function of project design. We apply this logic to cross-industry collaborations and suggest that both innovation objective and the process architecture influence the potential to generate exploitative and exploratory learning within single inter-firm projects. Finally, the *learning outcome* varies as a function of each partner's initially defined process features and individual knowledge distance.

3.4.1 Collaboration objective

The argument from extant research on open innovation and inter-firm ambidexterity holds that companies form R&D relationships to combine own capabilities with those of partners to develop or revamp products and services, or access markets (Im & Rai, 2008; Lavie & Rosenkopf, 2006). Underlying this argument is Schumpeter's proposition (1939) that innovation is largely a function of recombining existing knowledge. Extant research on collaborative innovation further specifies that companies' orientation to collaborate is either driven by knowledge which is close and builds tightly on existing knowledge to accomplish incremental innovation (i.e., Laursen & Salter, 2006, Beckman, Haunschild, & Phillips, 2004) or notably distant knowledge, which promises radical innovation jumps (i.e., Gassmann & Enkel, 2004; Gassmann, 2006). Indeed, it is widely assumed that large innovation leaps correlate with ever greater distance in knowledge and novelty of the collaboration partner.

To our surprise our data indicates towards opposite mechanisms. For the eight NPD projects that chose to collaborate with partners on specific problem statements of an existing product category, there was large knowledge distance when measured by the overlap in industry know-how and background. Further, with the exception of the collaboration of Alcan and Audi, none of the collaboration partner had previous collaboration engagements. Contrarily, the four remaining companies, which entered collaborations with a broader innovation objective showed two prototypical distinctions. First, in two of the four cases both collaboration partners had indeed works on innovation project previous to the one in our analysis. In the case of BASF and Procter & Gamble collaboration went as far as to an extend partnership agreement

in place. For the two remaining cases, though no previous collaboration had taken place, both partners showed large knowledge overlaps in terms of related industry know-how. For example, in the case of Canon partnering with Alcan, though distinct from each other, Alcan as a packaging company is well endowed with printing technologies due to the packaging imprints. As one manager explained, “*Here at Alcan, we often invest in technological know-how, which is not internally needed, However, which facilitate the collaboration with partners and allow meeting on common ground*”. While all companies entered the collaboration with some sort of problem statement, our data showed that those companies with clear-cut problem statements generated exploitations only, while a broader or no concrete problem statement facilitated both an exploratory product innovation with exploitative by-products. To identify the mechanisms that underlie the choice in collaboration partner and why those conflict with findings in existing literature, we analyzed both the *problem statement* and the *knowledge distance* in more detail.

Problem statement. We identified whether the distinction between our cases was driven by the precision of the problem statement anteceding the collaboration initiation. The interview partners from our cases were able to distinguish between two objectives, to either target a concrete problem within an existing product category or market segment, or the holistic renewal of a product category or market segment. All the cases we obtained showed some degree of problem statement character, while the solution blueprint varied largely in its degree of detail (table 2). Most apparently, all collaborations with a concrete problem-statement showed strong solution orientation, with the focal firm being decisive on the outcome and the expertise a partner needed to possess. A good example is BMW; Like most car manufacturers, BMW acknowledged the challenge of an ever-increasing number of functionalities within a car’s dashboard (Herrler, 2001), which had resulted in almost 200 different knobs or switches by the turn of the millennium (Gassmann et al., 2010). The iDrive was a result of a solution transfer of TouchSense™ technology, which Immersion had previously incorporated in fields like telecommunication, industrial controls, and medical equipment. As such, BMW was insightful on the features and the applicability Immersion’s technology would provide for. In a similar vein, when Mammut designed its avalanche transceiver Barryvox, its partner Ascom was chosen because it had an existing technology that served Mammut’s needs and required only limited adjustments to design the smallest and lightest transceiver on the market. Similarly, Böchning had approached the automotive supplier Susper due to an expert report that allowed analogies for the

applicability of automotive trunk hydraulics to marquis. As one interviewee however highlighted, *“We made clear that the pursuit of the project was dependent on a clear signaling from our partner that the project was feasible”*.

On the other hand, the remaining four cases in our sample showed a quite different collaboration objective. In line with existing research, the problem statement can be a fuzzy front end (Martin & Eisenhardt, 2010; Rice, Kelley, Peters, & O’Connor, 2001). An example, which shows this, is Alcan’s motivation to collaborate with Canon. Fostered by the intention to prevent imitations of pharmaceutical packaging and their subsequent commercialization on grey and black markets, Alcan aimed at generating a new packaging technology. With its particular knowledge in printing technology Canon was approached in order to develop a technology that would supersede packaging imprints on the market. Similarly, the collaboration between Ciba and Beiersdorf was fueled by the objective to develop a new generation sunscreen: *“The intent was to develop an efficient and photostable UV-A filter together for the human body which was novel to the market at the time of the collaboration’s launch”*. Accordingly, these collaborations showed an exploratory intent, with both partners having a vision of their collaboration’s potential value add, although neither one partner would be in the position to initially pinpoint their contribution.

Table 5 outlines the collaboration objective and the corresponding knowledge endowments of the collaboration partners. The definition of the problem statement offered two findings. First, the type of problem statement initiating the collaboration defined the selection process of the collaboration partner. More specifically, a concrete problem statement led the focal firm to select a partner with specific knowledge artifacts, while a broad, fuzzy objective led the focal firm to select a partner with strong industry know-how within the potential solution arena. Second, in hand with the problem statement and the correlated partner selection, collaboration partners took specific functions up front in the collaboration. In concrete problem-statements partners operated as knowledge suppliers, while wide collaboration statements left the partners on even terms. In sum, this led us to assume that the knowledge distance of the collaboration partners would be a further tangible differentiation attribute.

Table 5: Advocating Collaboration Objectives

Firm	Collaboration Objective	Collaboration Initiatives	Partner Role of Project Collaboration	Knowledge distance	Quotes
Mammut	Narrow problem definition Solution to an existing product on the market	Mammut Barryvox, Avalanche transceiver	Knowledge supplier Singular problem solution	No previous collaboration Distant knowledge, target of particular knowledge artifact	"This was in-line with the objective to make the 210g, personal organizer-sized Barryvox the smallest and lightest avalanche transceiver to use both analog (acoustic signal) and digital technology on the market." (AE)
BMW	Narrow problem definition Solution to an existing product on the market	iDrive	Knowledge supplier Singular problem solution	No previous collaboration Distant knowledge, target of particular knowledge artifact	"Our priority was to have a roadmap approach that would allow us to reuse chips in whole or in part."
Ciba	Narrow problem definition Solution to an existing product on the market	3-D Ultra strong varnish finishing	Knowledge supplier Singular problem solution	No previous collaboration Distant knowledge, target of particular knowledge artifact	"While our collaboration partners were able to patent the newly developed equipment, we had limited options due to the fact that the chemical composition was not new to the market as such."
Alcan	Narrow problem definition Solution to an existing product on the market	B-Pillar - Hydroform Laser technology	Knowledge supplier Singular problem solution	Previous collaboration Knowledge on partner needs	"This project defined a product that needed to be further developed. While the particular "druckussverfahren" was already in use in other business units of Alcan it was a new introduction to the productions for the Audi B-pillar."
Beiersdorf	Wide problem definition Potential replacement or complement an existing market	UV-A/UV-B Sun Protection	Equal collaboration partner Holistic product development	No previous collaboration Complementary, analogous knowledge	"We were addressed due to the reason that sun screen needs to reach ever higher protection levels both in terms of factor and wave length. However traditional products based on Titandioxides reached its limits."
Alcan	Wide problem definition Potential replacement or complement an existing market	Pharamceutical Fine-Print	Equal collaboration partner Holistic product development	No previous collaboration Complementary, analogous knowledge	"We were approached by a banknote manufacturer to incorporate this newly developed technology for their national currency production."

Firm	Collaboration Objective	Collaboration Initiatives	Partner Role of Project Collaboration	Knowledge distance	Quotes
Böching	Wide problem definition Potential replacement or complement an existing market	Awning Fiber Threads	Equal collaboration partner Holistic product development	Previous collaboration Knowledge on partner needs	"Our supplier approached us with the idea to use the fiber threads from awning borders in the hydraulic system."
Metro	Narrow problem definition Solution to an existing product on the market	Couponing System	Knowledge supplier Singular problem solution	No previous collaboration No knowledge overlap	"Historically we are involved with other institutes – like the BMBF cluster- the technology trend and services were there (i.e. grouppons) and it was an opportunity."
Procter & Gamble	Wide problem definition Potential replacement or complement an existing market	Pampers Dry Max	Equal collaboration partner Holistic product development	No previous collaboration Complementary, analogous knowledge	"We were interested in the diffusion of liquid in porous materials. After testing with watering systems for flowers, we understood that we needed a partner to develop measures for tumescent characteristics of absorber substances."
Schmitz-Werke GmbH & Co KG	Narrow problem definition Solution to an existing product on the market	Polo Fox Trunc Hydraulics	Knowledge supplier Singular problem solution	No previous collaboration Distant knowledge, target of particular knowledge artifact	"Through a publication in an expert journal we became aware of the automotive supplier Susper. We contacted Susper and requested whether the hydraulic of the Polo Fox was able to be adjusted for markise."
BASF	Wide problem definition Potential replacement or complement an existing market	Mr Clean Magic Eraser	Equal collaboration partner Holistic product development	Previous collaboration Knowledge on partner needs	"We were trying to generate porous plate with special characteristics within the Homecare department. By chance we became aware of a report on Melamin foam. This foam has a certain stiffness, breaks through rubbing and through that generates a cleaning effect."

Knowledge distance. We analyzed what effect the knowledge distance of the collaboration partners was having on the overall project outcome. Existing literature both on innovation and also in particular on inter-firm ambidexterity hold that radical innovation is driven by novel partners that provide for path-breaking knowledge artifacts (Lavie & Rosenkopf, 2006; Lin et al., 2007). The underlying logic is those close partners, particularly those with previous collaboration histories, follow path dependency in their collaboration as a result of ever increasing insights into the partner's business (Beckman et al., 2004). To our surprise, our findings did not support the assumptions made in preceding research. On the contrary, our findings suggest that partners that have either operated or share a broad knowledge overlap facilitate exploratory, ground-breaking innovations. Contrarily, all cases that pursued narrow problem statements collaborated with partners from distant industry backgrounds and generated exploitative innovation.

In the case of Ciba, the joint collaboration with Beiersdorf resulted in a completely new generation sunscreen that fused knowledge from the plastics industry with that of the cosmetics industry. While Ciba had unique UV-A filter technical competencies, their technology was attuned to industrial material and usage. Beiersdorf, a leading cosmetics company, provided knowledge on sun protection for the human body, but technological developments had until then only covered UV-B radiation. Both collaboration partners had a particular knowledge pattern that was distinct for each partner, but provided sufficient overlap on sun shielding. As highlighted in one interview: *“Much more than only the integration of UV-A filters, this new sunscreen provided a switch from titanium dioxide which left a milky texture on the skin to clear spray on products with an oil basis.”* Likewise, Alcan the market leader in pharmaceutical packaging has accumulated knowledge on analogical printing mechanisms that can be applied in other operational areas. When Alcan decided to move into a new generation of pharmaceutical packaging, Canon provided technological know-how on digital printing which had not yet been applied in packaging, which in turn was dominated by analog printing. However, the initial knowledge bases, though distinct, provided a shared understanding of printing technologies. As mentioned by one manager: *“The new technology gained international recognition to the degree that it attracted the attention of a national currency producer seeking to evaluate a technology transfer to its currency production”*. Our findings offer insight that both collaboration partners had a distinct

knowledge pool that was fundamental to the innovation project. Yet, only jointly both partners were able to achieve their mutual project goal.

On the contrary, clearly defined collaboration projects were grounded in distinct knowledge that provided little overlap in content or context. In the case of the BMW iDrive, the collaboration with Immersion meant dealing with a completely new knowledge pool. While many of today's automotive systems are IT-supported, touch-screen technology was new ground. While Immersion had also provided its technology to divers' industrial contexts, the automotive industry had not been one. However, previous attempts to find a feasible solution for a new man-machine interface with established suppliers had limited success (Gassmann et al., 2010). Similarly, Proctor and Gable's development of the magic eraser was equally distinct. Triggered by an expert article on melanin foam employees of P&G had proposed a potential analogy between melanin foam's characteristics and its potential application in the field of cleaning devices. However, the transfer from its usual field of application, the construction industry, highlights the rather distinct gap in knowledge background that was solely bridged by analogies. Alcan's collaboration with Audi on the new B-pillar technology and, subsequently, the hydroform and laser technology, was the only exception where both partners assumed a general understanding of the innovation due to previous collaborations. The transformation from multiple single pieces to a production system that would generate the B-pillar in one single piece needed Alcan's expert knowledge which was distinct from what Audi knew about aluminum processing. Likewise, Alcan needed various coordination steps to meet the automotive context's needs. In addition, the subsequently resulting hydroform and laser technology originated from knowledge that was distinct to Alcan.

To summarize, the strategic intentions that drive collaboration processes are decisive for the subsequent collaboration type. The more concrete the objective was, the clearer firms chose partners that function as a knowledge supplier, which connect only on the problem at hand. In cases where a broad problem statement drove the collaboration initiative, partners were chosen to collaborate on even terms. Interestingly enough, collaborations based on broadly stated objectives were dominantly pursuit with partners that the firm had previously engaged in with. This might affirm existing research in that trust plays an important role in collaboration with external partners on innovation project, particularly in higher risk initiatives that involves tacit knowledge. In conclusion, our proposition summarizes:

P1: Collaborations driven by partners' analogous, complementary knowledge structures and a broad problem statement of a product category or market segment are more likely to generate exploration only than collaborations which built on distinct knowledge artifacts that seek specific problem-solving in existing product or market segment.

3.4.2 Collaboration process

In analyzing our cases, we attempted to understand the collaboration process that underlay the innovation project. As the findings showed, particular collaboration types formed the basis of subsequent process characteristics. Our observations were particularly salient regarding *process mechanisms* and *team structures*. In new product development, research distinguishes between sequential/modular and integrated/parallel processes. While the former is associated with projects that can be divided into distinct sub-processes, the latter relates to process overlap and interdependencies (e.g., Iansiti, 1995; Minguela-Rata & Arias-Aranda, 2009). Prior research indicates that the process structure impacts the coordination between project phases, interaction effects, and decision-making processes (Schilling & Hill, 1998).

Process mechanisms. Consistent with previous research, our analysis assumed that the process structure impacts the learning process through the degree of interaction over the course of the new product development process. As in the case of Alcan, our interview partner substantiated that both partners formed a core project team that worked jointly on the innovation process. As one manager stated, “*We went as far as to isolate the project team from both companies and move them to a separate location to focus on the development – from conception to marketable solution*”. Multiple functional backgrounds were needed to identify how different materials would interact with the new printing technology. The collaboration between Beiersdorf and Ciba also illustrated that communication processes and close interaction were necessary for Ciba to learn about the toxicological details that were new to the transfer process of their established knowledge about sunscreen for the human body. We found that coupled processes showed a high degree of integrated team structures by the partners coordinating closely on the development process. Reflecting on the initial finding that loosely defined innovation processes build on complementary knowledge bases, our findings indicated that nonetheless close cooperation was essential to transfer and combine knowledge from both collaboration partners. The identified integrative

processes suggest that the limited outcome definition and the distinct knowledge competencies demand close project coordination.

In contrast, the project patterns were markedly different regarding clearly defined problem-solution collaboration projects. Developing the automotive microwave to develop the first generation three-dimensional varnishing, both Roth&Rau and Dürr contributed their particular share to the overall process. However, not all the partners were equally involved at all times. It was emphasized that the prototype construction was undertaken in separate phases, in which Ciba – beyond financial support – was at first not involved, only engaging late in the construction process. Similarly, both Audi and Alcan's collaboration on the B-pillar technology and Böchning and Schmitz-Werke GmbH & Co KG's development of the Fiber Thread Awnings required considerable coordination, both partners provided distinct competencies that allowed them to operate on different steps of the development process by means of their own, separate focus teams. *“Coordination meetings and feedback loops allowed both collaboration partners to explain problems and next steps to bridge production interfaces. While cooperation was close and required coordination”*, the interviewees explained, *“the project could still be described as modular”*. In the case of the iDrive, BMW cultivated a close alignment of their project road map with their suppliers. However, operations were structured along stepwise solutions that would allow BMW to change partners, if that were to become necessary. The limited enthusiasm of BMW's engineers and a continued level of skepticism showed the difficulties of linking the two distant knowledge backgrounds. Telecom's development of the couponing system with Metro went as far as that Telecom incorporated information initially single handed and only incorporated Metro at the point where on side prototyping became necessary. This indicates that within clearly defined collaborations, the independence and modularity of the process is also considered a low-risk engagement and provided the partner incorporating the innovation with high levels of flexibility.

Team structure. With respect to team structures, two types of teams have prevailed in research, functional and cross-functional teams. A characteristic of the functional team is the prior definition of the project target and the assignment of responsibilities for distinct subtasks within the overarching project (Clark & Wheelwright, 1992). Whereas functional teams work predominantly autonomously and only interact occasionally, multifunctional teams allow the creation of interrelationships between

activities by different functions and hierarchies that share responsibility for the process as a whole and have high levels of interaction as well as joint decision-making (e.g., Pinto, Pinto, & Prescott, 1993).

When analyzing the four sample projects with a broadly defined problem statement, all cases shed a strong tendency to operate with multifunctional teams. In the case of Alcan and Canon, the team structure showed an extreme both in structure and cooperation. As previously indicated, both companies created a joint team that was subsequently isolated from the daily operations of both companies in order to function in a separately installed facility on the assigned project. This provides an extreme case of multifunctional and hierarchical team settings. However, for the success of the project, Alcan stated it was necessary to provide a special setting in order to focus on the task at hand. With respect to the knowledge distance, it was further needed to integrate activities and link each step in order to provide a setting in which knowledge transfer would be possible. A manager related: *“As both teams operated across hierarchies and functional specifications, the involved risk was equally distributed and responsibility shared”*. Analogous Ciba and Beiersdorf operated with teams covering multiple hierarchical levels and functional specifications supporting the project’s development. Experts needed to cooperate closely in order to transfer the specifications that were needed in order to understand the highly sensitive specifications of toxicology in order to make the new sun screen technology applicable to the human body. Finally, both projects conducted by P&G on the Magic Eraser® and Pampers Dry Max were so distant in their knowledge outlay that in both cases interdisciplinary and intense collaboration was mandatory. As one manager elaborated, *“The particularities of porous material as needed for Pampers Dry Max required hiring a full time post doctoral student with the partner on the analysis and transfer of the diffusion of liquid materials to the setting of a baby’s diaper”*. As such, while all companies shared a common understanding on the underlying product and problem statement, the specifications in the particular industrial settings, the particularities of analogous transfer of complementary knowledge make cross-functional and cross-company teams indispensable.

All the firms operating on clear problem-solution definitions approached the question of team composition with functional team. In the context of our previous findings, this seems reasonable. Projects based on clear problem-statements showed a clear definition of risk distribution, task separation and process alignment. Distinct for

these projects is that for each step one company would work in an isolated and function-specific way. As such, coordination was limited and allowed the teams to concentrate on their competencies and prepare steps individually to merge over the course of the projects development. In summary this shows that each project was able to work on individual, functional teams that split the overall project into sub-phases. This also meant that within teams there was concentration of team members for a specific task, i.e. construction phases would be defined by teams of technological expertise, while later phases would be dominated by teams that provided expertise in supply chain management, sales, or marketing backgrounds.

Table 6 outlines the different process architectures the sample firms used to coordinate their innovation process. The team structures as well as the coordination mechanisms in the development project were crucial to the innovation's overall success. Our cases indicate that concrete problem-solution collaborations have sequential process features that allow both partners to focus on their particular competences. The latter seems driven by the collaboration partner's limited contribution to a predefined problem statement, as well as the flexibility to switch partners if needed. Conversely, loosely defined innovation projects are characterized by high degrees of integration as well as multifunctional teams. This seems logical in the light of the knowledge distance paired with the overall project outcome uncertainty. We experienced an equal level of risk sharing, which materialized in mixed, tightly knit project teams. Therefore, we present the following proposition:

P2: Collaborations based on integrated project processes with multifunctional teams are more likely to generate exploration, while collaborations based on modular processes that operate with functional teams lead to exploitation.

Table 6: Collaboration Process Architecture

Firm	Team Work Structure	Process Structure	Actions	Learning Consequences Focal Firm	Learning Consequences Collaboration Partner	Quotes
Mammut	Singular teams that meet with each other, but separate teams in each organization.	No extensive collaboration, modular process structure	n.a.	Limited potential to acquire knowledge beyond the application of the particular problem solution due to restricted interaction and collaboration	Explorative knowledge acquisition due to application of knowledge in a new setting and market	n.a.
BMW	Singular teams that meet with each other, but separate teams in each organization.	No extensive collaboration, modular process structure	High levels of sceptis from BMW team. Low levels of cooperation, sticky communication	Limited potential to acquire knowledge beyond the application of the particular problem solution due to restricted interaction and collaboration	Explorative knowledge acquisition due to application of knowledge in a new setting and market	"We talked with silicon suppliers, told them what we would like to do, and did our best to align our roadmap with theirs. We wanted solutions that would allow us to change partners, if that became necessary."
Ciba	Singular teams that meet with each other, but separate teams in each organization.	No extensive collaboration, modular process structure	Little direct interaction. Only coordination and adjustment meetings.	Limited potential to acquire knowledge beyond the application of the particular problem solution due to restricted interaction and collaboration	Limited potential to acquire knowledge beyond the application of the particular problem solution due to restricted interaction and collaboration	"The model was mobil so that it was possible to relocate it over the course of the different development phases to each partner that was presently working on the next step."
Alcan	Singular teams that meet with each other, but separate teams in each organization.	No extensive collaboration, modular process structure	Difficult collaboration and limited interaction. Only coordination and adjustment meetings	Limited potential to acquire knowledge beyond the application of the particular problem solution due to restricted interaction and collaboration	Limited potential to acquire knowledge beyond the application of the particular problem solution due to restricted interaction and collaboration	"The prototype was produced only by Alcan before integrating Audi in further steps. We met on a weekly basis, sometimes up to 2-3 times a week to discuss problems and define the next steps. However, we did not have any residence engineers."
Beiersdorf	Integrated teams Members from different function and hierarchical levels	Extensive collaboration, joined process phases	Intense learning from collaboration partner. Expertise transfer as basis to collaboration	Explorative learning based on knowledge acquisition from partner. Application to firms exploitative targets and exploratory by-products.	Limited knowledge generation due to knowledge transfer to focal firm direction. Expert support.	"This project formed the first venture into the field of home and personal care. We were in need to close coordination with our partner as we did not have any competences in this field and our missing knowledge in the field of toxicology for human appliances. We established radically new competences that were none existed leading up to this project."
Alcan	Integrated teams Members from different function and hierarchical levels	Extensive collaboration, joined process phases	Intense learning from collaboration partner. Expertise transfer as basis to collaboration	Explorative learning based on knowledge acquisition from partner. Application to firms exploitative targets and exploratory by-products.	Limited knowledge generation due to knowledge transfer to focal firm direction. Expert support.	"We build a core project team from both companies, hired a factory hall and started operating on the potential printing methodologies together."

Firm	Team Work Structure	Process Structure	Actions	Learning Consequences Focal Firm	Learning Consequences Collaboration Partner	Quotes
Böching	Singular teams that meet with each other, but separate teams in each organization.	No extensive collaboration, modular process structure	Little direct interaction. Only coordination and adjustment meetings.	Limited potential to acquire knowledge beyond the application of the particular problem solution due to restricted interaction and collaboration	Explorative knowledge acquisition due to application of knowledge in a new setting and market	"We needed various iterations to define which fiber strength would go through the masses and would still provide the strength needed to hold the markise. However, this was not a close and direct collaboration. The financing was split between both partners."
Metro	Singular teams that meet with each other, but separate teams in each organization.	No extensive collaboration, modular process structure	Little direct interaction. Only coordination and adjustment meetings.	Limited potential to acquire knowledge beyond the application of the particular problem solution due to restricted interaction and collaboration	Limited knowledge generation due to knowledge transfer to focal firm direction. Expert support. And not particular learning for Metro as the technology was too early for them.	"Telecom developed it to the largest part, however, in the end phase the user premises the prototype was only tested on the grounds of Metro."
Procter & Gamble	Integrated teams Members from different function and hierarchical levels	Extensive collaboration, joined process phases	Intense learning from collaboration partner. Expertise transfer as basis to collaboration	Explorative learning based on knowledge acquisition from partner. Application to firms exploitative targets and exploratory by-products.	Explorative knowledge acquisition due to application of knowledge in a new setting and market	"Monthly talks were arranged to share the generated knowledge and coordinate in addition to regular reports. Employees from P&G had to fine tune the algorithm and validate it on the application. Our partner provided two full time employees for this project while we had 2-3 fulltime employees selected."
Schmitz-Werke GmbH & Co KG	Singular teams that meet with each other, but separate teams in each organization.	Extensive collaboration, joined process phases	Little direct interaction. Only coordination and adjustment meetings.	Limited potential to acquire knowledge beyond the application of the particular problem solution due to restricted interaction and collaboration	Limited knowledge generation due to knowledge transfer to focal firm direction. Expert support.	"We had defined a team with 2 constructors from Susper as well as our Head of R&D and constructors from our side joined the team. As such we had regular meetings and contact."
BASF	Integrated teams Members from different function and hierarchical levels	Extensive collaboration, joined process phases	Intense learning from collaboration partner. Expertise transfer as basis to collaboration	Explorative learning based on knowledge acquisition from partner. Application to firms exploitative targets and exploratory by-products.	Explorative knowledge acquisition due to application of knowledge in a new setting and market	"To reach the targets we had envisioned, we had to set up a project team with employees from both partners that had to work together either with us or at our partners offices. Given that BASF worked as a knowledge supplier, all rights remained with P&G."

Table 3 outlines the different process architectures the sample firms used to coordinate their innovation process. The team structures as well as the coordination mechanisms in the development project were crucial to the innovation's overall success. Our cases indicate that concrete problem-solution collaborations have sequential process features that allow both partners to focus on their particular competences. The latter seems driven by the collaboration partner's limited contribution to a predefined problem statement, as well as the flexibility to switch partners if needed. Conversely, loosely defined innovation projects are characterized by high degrees of integration as well as multifunctional teams. This seems logical in the light of the knowledge distance paired with the overall project outcome uncertainty. We experienced an equal level of risk sharing, which materialized in mixed, tightly knit project teams. Therefore, we present the following proposition:

P2: Collaborations driven by integrated project processes that operate on the basis of multifunctional teams are more likely to generate ambidexterity than collaborations which built on modular processes that operate on the basis of functional teams.

3.4.3 Collaboration learning

Considering the predictors of the learning potential that these projects allow, specific collaboration processes and team structures define the learning potential for both collaboration partners. As illustrated by the eleven cross-industry innovation projects, companies favor coupled processes for projects with a broadly defined intent. Where partners were chosen for problem solving, the focal firm employed clearly defined project settings. Consequently, the degree of integration between the collaboration partners inherently defined the collective and individual learning potential. Besides the project's leading orientation, in broad stated project objectives that operated on intense interaction both partners were able to generate individual learning from the projects that went beyond the direct project outcome.

When Beiersdorf approached Ciba to collaborate on a new generation of sunscreen, Ciba had extensive knowledge of chemicals due to its work on industrial materials in paints and coatings. However, in order to meet the demanded requirements (e.g., photostability, SPF performance, formulability, skin feeling, and human safety), close collaboration with industry leaders was mandatory. While the core collaboration was

explorative in the development of new UV absorbers, the application of Ciba's UV-B absorbers was exploitative in nature from its previous application in the plastics industry, which made an existing knowledge pool and a developed product base accessible to a new industry. Comparable learning properties were distinguished in the case of the pharmaceutical packaging developed by Alcan and Canon. While the project outcome was rather exploratory, both the new packaging result as well as the definition of a new money manufacturing technology, each side's individual learning potential was exploitative as packaging and digital printing were no new ventures for either one of the collaboration partners. Canon applied digital print technology to packaging; the technology already existed and was only developed further in order to create a protective packaging feature. Similar, P&G's collaboration on the algorithm for Papers Dry Max resulted in knowledge on the diffusion of liquid in porous material; however, the adaptation of the previous algorithm was exploitative for the Institute for ground water currents. Further one responded from P&G outlined, "*For us internally was apparent that we would further exploit the prototype by integrating other business units in the development process, for example the business unit Healthcare was involved both in detail development and peer reviews*". Coupled collaborative projects generate collective exploratory knowledge generation, while each side also gained exploitative insight by applying and developing their specific skills.

While Ciba had worked with Roth&Rau and Dürr on a radical new varnishing system for the automotive industry, they had only made incremental changes to their existing chemical product range. The B-pillar project, in which Audi collaborated with Alcan, provides further clear evidence of distinct learning potentials. Alcan had long been acknowledged as an expert in aluminum production, and the production of the B-pillar for the automotive industry already had a long history. The project explained a logical next step in the development of technologically advanced products. However, to generate the B-pillar in one single piece, Audi was forced to extend individual learning in exploratory fields due to subsequent adjustments in their overall production interfaces. As one interviewee described, Audi needed to adjust extensive aspects of their Audi A4 production to respond to the new B-pillar. The BMW iDrive production was a necessary step in the already overloaded passenger dashboard so typical of the time. While the technology incorporated was new to the automotive industry, the interface feature was established in other industries. Immersion classified the need for adjustments as rather incremental due to the widely existing knowledge. BMW's incorporation of the iDrive drastically changed in the way BMW and the automotive

industry would address technologically supported features in the passenger dashboard. How difficult however the learning process can be in the case of distant partners from industries with little to no overlap shows the case of Deutsche Telecom's collaboration with the Metro Handelsgruppe. As one manager voiced, "*For Deutsche Telecom, the technology and the application were important, however the fundamental idea was already on the market. Still, for Metro the project was too early therefore the commercialization was realized in later periods*". Here it became apparent how much the initial distance can also fail if one partner is not yet ready for the development, though the technology was in the market. The surprising other exception held for the exploitative oriented project of Böchning with Schmitz-Werke GmbH & Co KG. While the project was targeted at the concrete problem to solve the erosion of metal cables in marques particularly in Mediterranean areas, the developments of fiber based threads would eventually lead to, as one interviewee stressed, to become: "*Market leader in France with no competitor being able to copy our innovation even after all this time*". The development in itself constituted an exploitative project that did not intend to generate a new market product.

The case evidence shows that clear defined problem settings provided the basis for collective exploitative knowledge generation, while the partner incorporating had limited additional learning. Coupled projects generate exploratory knowledge generation while they generate exploitative learning for both partners simultaneously. Resuming the argument, we propose the last set of propositions:

P3: Broadly defined problem statements that operate on integrated collaboration teams lead to ambidexterity based on collective exploratory project learning with simultaneous individual exploitative learning for both project partners.

P4: Clearly defined problem statements that operate on individual collaboration teams lead to collective exploitative project learning with no additional learning for the individual partners

In sum, we assume that companies differentiate their innovation projects according to the collaboration objective defined by their process characteristics. Our findings indicate that project progress contributes to the emergence of particular process characteristics based on team structures and coordination mechanisms. Finally, the

combination of process typology and process design defines the collective learning potential and the extent to which the individual partners may experience ambidexterity. The innovation efforts pursued by all the companies in the sample are presumably typical for most global companies to generate innovation through an open innovation process. In particular, our findings propose that open innovation offers companies the best opportunity to combine exploitative and exploratory learning if combining knowledge from diverse, yet related industry backgrounds.

3.5 Discussion

3.5.1 Theoretical contribution

In this paper, we developed a holistic understanding to explain how organizations balance exploration and exploitation in single collaboration architectures. Applying the concept of cross-industry innovation, the empirical findings suggest that exploration and exploitation require the configuration of the new product development process to differ with respect to the inter-firm collaboration's function and the collaboration partners' attributes. The majority of research assumes that exploitation and exploration are at opposing ends of a continuum, competing for scarce resources and managerial attention (Ahuja, 2000; Davis, Furr & Eisenhardt, 2006). This paper contributes to the limited perspective that proclaims that exploitation and exploration can indeed nurture each other rather than being mutually exclusive (Im & Rai, 2008; Lavie & Rosenkopf, 2006; Raisch & Birkinshaw, 2008). Linking the established ambidexterity discussion with the new field of cross-industry innovation contributed to our understanding of how partners from different knowledge domains can contribute to exploratory and exploitative results.

At the process level, this paper contributes towards a clearer understanding of how processes, collaboration objective, and learning interact in order to nurture inter-firm ambidexterity (Beckman, Haunschild, & Phillips, 2004; Dodgson, Gann, & Salter, 2008; Rothaermel & Deeds, 2004). It illustrates that collaborations based on broad problem statements benefit from integrated, continuous innovation processes, thereby nurturing secondary individual exploratory learning for both collaboration partners. While Lavie and Rosenkopf (2006) found that alliance partners may generate ambidexterity over a long-term perspective, we provide evidence that the right setting and partners from distinct industries yet potentially overlapping knowledge structures may induce both exploitation and exploration on single projects. This is due to each

partner learning from the project's overall activities to develop their individual knowledge endowment. Conversely, clearly defined problem-oriented collaborations feature modular, sequential processes that prohibit a potentially extended learning effect.

Our results pertaining to the knowledge possessed by collaboration partners, particularly complementary knowledge in exploratory processes, and distinct knowledge pools in exploitative processes are counterintuitive. While theory suggests that absorptive capacity (Cohen & Levinthal, 1990) decreases with a higher degree of cognitive distance between partners (Nooteboom et al., 2007), our results illustrate that partners with distinct knowledge backgrounds typical of a large cognitive distance reach exploitative results. In the same vein, the generation of exploratory innovation with partners, which provide for a common knowledge base questions earlier results regarding the correlation between partner distance and innovation performance and degree of radicalism.

This paper also provides evidence that universal propositions on innovation process architectures do not reflect the diversity and complexity of innovation processes. These propositions provide insights into the context dependency of particular innovation types in accordance with tailored collaboration architectures that allow the inherent learning potential to be leveraged (Madhavan & Grover, 1998). These rich results could only be obtained through qualitative data instead of quantitative analysis, as these data are established in ambidexterity literature (Davis et al., 2006; Dussauge et al., 2000; Gulati, 1995).

Finally, the exceptional case of Böchning's fiber threading provides evidence of cases under which exploitation can be the core function providing exploratory impulses. While this may seem counter-intuitive, it supports existing literature on innovation as well as new cross-industry literature which show that mature knowledge can indeed be the initiator of exploratory endeavors when moved into new contexts (Enkel & Gassmann, 2010; Gassmann & Zeschky, 2008; Schumpeter, 1943). We have illustrated how collaborative cross-industry innovation takes place and which learning results can be expected, complementing work by Enkel and Gassmann (2010), and Kalogerakis et al. 2010.

3.5.2 Managerial contribution

While these insights hold clear benefits for research, they also hold practical implications in the form of normative guidelines for management. The propositions we put forward suggest that there is no universal approach to innovation collaboration and that the characteristics of particular innovation projects require different processes. As our findings suggest, ambidexterity can be achieved in single inter-firm collaborations, providing management with a further indication that driving incremental and radical innovation requires multiple parallel collaborations. The findings support previous research that shows that organizations generate higher performance impacts through exploration and exploitation within single inter-firm collaborations than through single focus alliances. Most importantly, the framework indicates that management can leverage the cost and time-frame involved in exploration projects by linking them to exploitative innovations, thereby increasing the output generated from exploration objectives. On the other hand, exploitation-oriented collaborations provide the basis for nurturing exploratory ideas that are the basis of future developments.

3.5.3 Limitations and future research

We acknowledge that this first study faces limitations which also suggest the potential for further research. From a methodological standpoint, we sought to systematically control the potential limitations inherent to case studies. However, all our selected cases are retrospective accounts. To mitigate the potential of retrospective sense-making and related shortcomings, we suggest extending the case basis with real-time NPD projects, as suggested by Leonard-Barton (1990).

While the generalizability and richness of our study greatly benefits from the large sample size of eleven case studies, future research may want to analyze how the different factors of collaboration objective, collaboration process and collaboration learning effect performance and the success rate of innovation. As this study reflects on successful NPD projects only, we ask whether these projects reflect an overall successful innovation project type or whether our analysis is bound to selection bias.

From the perspective of theory-building potential, there are limitations to the generalizability of our findings. First, this paper solely concentrated on dyadic inter-firm relationships. While the findings provide promising insights for academia as well as management practice, our findings fall short to make any contribution to multi-

partner collaboration. There is room for future studies to deepen our understanding of how the mechanics of multi-partner interactions change the underlying dynamics of the innovation process. This is in line with the recent research by Ozcan and Eisenhardt (2009) which indicated that a more holistic approach to alliance portfolios provides richer findings.

Ultimately, the relevance of this study could be further advanced if the impact of simultaneous inter-organization exploitation and exploration in cross-industry collaborations on overall organizational performance were analyzed. In summary, it would be appreciated if researchers would challenge and refine the framework presented here.

4 Great Minds Think Alike: Isomorphism in Organizational Ambidexterity³

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Abstract: A firm's environment has great influence on the conduct of exploitation and exploration. In particular, competitiveness and market dynamism drive a firm's innovation decision. Building upon institutional theory, we propose geographically local industry environments as a third driver impacting a firm's innovation activities through institutional isomorphism. We focus on industrial clusters, defined as groupings of related or interconnected firms of an industry concentrated in a geographical location. Using panel data on a global sample of biopharmaceutical clusters (1999–2007), our results show that firms converge toward and replicate cluster-specific balances of exploitation and exploration, driven by isomorphic processes.

³ This study in co-authorship Rosenkranz, N., Sydler, R. & von Krogh, G., 2011. "Great Minds Think Alike: Isomorphism in Organizational Ambidexterity", is currently under review with the Academy of Management Journal. An earlier version of this study will be presented at the Academy of Management Conference 2011, San Antonio.

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4.1 Introduction

In today's volatile markets, a firm's adaptability determines its survival or failure (Bettis & Hitt, 1995). Accordingly, how the firm creates, transfers, and uses knowledge impacts its ability to compete within an industry (Dierickx & Cool, 1989). In an attempt to clarify the factors that differentiate successful firms from failures, organizational literature has often referred to the concept of organizational ambidexterity (Li, Vanhaverbeke, & Schoenmakers, 2007; Raisch & Birkinshaw, 2008). Organizational ambidexterity assumes that exploiting existing knowledge allows the firm to generate incremental innovations, whereas exploration tends to generate radical innovations that foster new opportunities. The concept of ambidexterity emphasizes balancing exploration and exploitation in the quest for both short-term efficiency and long-term effectiveness.

In the literature on organizational ambidexterity, a firm's local environment has been frequently assumed to be a moderator of its choice between exploitation and exploration. Lewin, Long, and Carroll (1999) pioneered a model of the interaction of the organizational environment that relates firm-level exploitation and exploration to the level of competition in a firm's environment. Further, Auh and Menguc (2005) and Jansen et al. (2005) have provided evidence that organizational ambidexterity is contingent on the dynamics within the firm's market environment. Most extant research has been limited to assume that competitiveness and market dynamism are the predominant grounds for a firm to justify either exploitation or exploration. While these contributions greatly advanced our understanding of conditions that foster exploitation and exploration, competition and market dynamism provide only two facets of a firm's environment. In a different line of argumentation, institutional theory assumes that firms that operate with varying degrees of social and physical proximity tend to develop structural or procedural similarities over time through institutional isomorphism (Oliver, 1991). Because structures and processes constitute organizational ambidexterity (Raisch & Birkinshaw, 2008), a question emerges whether such proximity also impacts their organizational ambidexterity and corresponding portfolio of exploration and exploitation activities. An analytical device for examining micro-behavior and multiple dimensions of proximity are industrial clusters of firms, defined as robust groupings of related or interconnected firms of a particular industry concentrated in a geographical location (Iammarino & McCann, 2006; Morgan, 2004). They tend to emerge in research and innovation-intensive

industries, such as the biotechnology, pharmaceutical and chemical industries (Pouder & St. John, 1996), as they represent an environment where both exploitative and exploratory innovation is focal to a firm's survival (Giuliani & Bell, 2005).

Over the last two decades, scholars examining industrial clusters of firms have taken a strategic posture, highlighting the importance of knowledge creation and diffusion (Giuliani & Bell, 2005). Cohen and Levinthal (1990) substantiate that 'borrowing' knowledge from the direct environment becomes a catalyst for innovation and as such is driven predominantly by the absorption of knowledge from the firm's environment. Other contributions emphasize the role of knowledge access enabled through pooled expert labor and the social and geographical proximity of firms for incremental and radical innovation (i.e., Audretsch & Feldman, 1996; Baptista, 2000; Belussi & Gottardi, 2000; Maskell & Malmberg, 1999; Saxenian, 1994). Therefore, there are reasons to believe that a relationship exists between firms' innovation activities and their knowledge absorption processes in industrial clusters.

In prior work, two attributes of clusters have been shown to impact the effect of institutional isomorphism on firms, namely cluster specialization and concentration (Lomi, 1995; Nooteboom, 2006; Pouder & St. John, 1996). Cluster concentration provides a close-knit structure of companies with similar backgrounds. In line with previous literature on organizational ambidexterity, it can be assumed that close proximity to related firms allows for intense knowledge exchange and will drive exploitation (Oinas, 2001; Tiwana, 2008). As March points out, "the effects extend, through network externalities, to others with whom the learning organization interacts [...] imitation inhibit experimentation. This is not an accident but is a consequence of the temporal and spatial proximity of the effects of exploitation, as well as their precision and interconnectedness" (1991: 73). Cluster specialization describes a setting of firms with related yet distinct backgrounds along the value chain. In specialized clusters, this study follows the assumption by Nooteboom (2006) that, particularly in biotechnology, novel medically active substances are generated due to divergence from mainstream developments and sufficient cognitive distance between cluster participants that allow for experimentation and diversity as grounds for exploration.

To summarize, our study is motivated by the conjecture that organizational ambidexterity, understood as a balance in innovation activities in firms operating in industrial clusters, will be subject to environmental influence through forces of

institutional isomorphism. Ultimately, as a result of institutional isomorphism, firms are prone to replicate each other's structures and processes. Moreover, we explore the idea that clusters exert influence on organizational ambidexterity through either concentrations or specializations. Consequently, clusters may exert two competing influences on a firm's innovation conduct that impact a firm's ambidexterity. Aside from a firm-level effect, we posit that institutional isomorphism will force firms to converge toward a cluster specific level of exploitation and exploration over time.

The current study contributes to the burgeoning literature on organizational ambidexterity. The current literature benefits from a broadened perspective on the potential impact of the environment on a firm's conduct of exploitation and exploration. In focusing on a global sample of biopharmaceutical clusters (1999 - 2007), we show that the environment strongly impacts the balance found between exploitation and exploration. The biopharmaceutical industry, defined by its generation of biopharmaceutical drugs that are identical, similar, or partly similar to native biological proteins or nucleic acids, is one example of an industry that operates to a large degree in industrial clusters around the world. Furthermore, its clear differentiation between basic and applied research provides a fruitful setting to differentiate between exploration and exploitation.

The paper is structured as follows. The next section presents the relevant literature on organizational ambidexterity and institutional isomorphism to develop a theoretical framework for the impact of the industry cluster environment on a firm's organizational ambidexterity. Next, we develop hypotheses and discuss the research design. Employing panel data analysis, we examine the impact of two cluster attributes, namely concentration and specialization, on the conduct of exploitation and exploration of single firms. The final section summarizes the contribution, discusses the limitations, and presents avenues for future research.

4.1 Theoretical Background

4.1.1 Organizational Ambidexterity

An organization's ability to be efficient and effective at addressing present demands, while simultaneously extending and adapting its potential to future needs, is a recurrent theme in organization theory and strategic management, referred to as organizational ambidexterity (Duncan, 1976; Gibson & Birkinshaw, 2004; Raisch &

Birkinshaw, 2008; Tushman & O'Reilly, 1996). According to Jim March's landmark article, "maintaining an appropriate balance between exploration and exploitation is a primary factor in system survival and prosperity" (March, 1991:71). Although it is accepted that both concepts are central to the performance and survival of a firm, their simultaneous pursuit creates difficulties due to their fundamentally different focus and scope (March, 1991). In the competition for limited managerial attention and scarce firm resources, trade-offs are inevitable and most often tilt managerial attention toward exploitation, where success is found in the short-term (e.g., Benner & Tushman, 2002; Gupta, Smith, & Shalley, 2006; Ocasio, 1997).

Recently, scholars have asked how the firm's environment impacts its organizational ambidexterity. Prior studies have indicated competitiveness and market dynamism to be important environmental conditions for firms to select either exploitation or exploration in coping with a changing environment (i.e., Gibson & Birkinshaw, 2004; Levinthal & March, 1993; Siggelkow & Levinthal, 2003; Volberda, 1998). The success of a firm's exploitation and exploration hinges on different conditions; as competition intensifies and the pace of change in the environment accelerates, firms are increasingly confronted with a tension between incremental innovation in the form of relatively minor adaptations of existing products, processes, and business concepts, and radical innovation, which requires a switch from existing products, processes, or concepts to completely new ones (Raisch & Birkinshaw, 2008: 4). In an early contribution, Lewin, Long, and Carroll (1999) proposed that organizations and their environment co-evolve; across geographical regions, firm-level exploitation and exploration are driven by changes in the population of competing firms and vice versa. Auh and Menguc (2005) showed that increasing intensity of competition in the market shapes the firm's concurrent exploitation and exploration activities. Similarly, Jansen, van den Bosch, and Volberda (2005) found empirical support that firms are more inclined to operate ambidextrously when its environment is characterized by high market dynamism and competitiveness. Jansen et al. (2006) later refined these findings by showing exploration to be more effective in dynamic environments and the pursuit of exploitation to be more favorable in competitive environments.

These contributions greatly advanced the understanding of conditions that foster exploitation and exploration, but they also leave open some issues that will be addressed in this paper. Research on organizational ambidexterity has so far focused

on market competition and dynamics to explain environmental effects on exploitation and exploration. However, in aggregate, the findings are equivocal and partially conflicting. Whereas Lewin, Long and Carroll (1999) show that high market dynamics and complexity increases exploration and that stable market conditions foster exploitation, Jansen et al. (2005) found that firms operating in a competitive environment characterized by high levels of change and instability are more likely to simultaneously pursue both types of innovation and thus become more ambidextrous. Finally, Gupta, Smith, and Shalley (2006) assert that capital-intensive firms are most successful in dynamic markets pursuing exploitation. A prudent assertion is that there are environmental attributes beyond market dynamism and competitiveness that influence a firm's exploration and exploitation.

The present study seeks to contribute to this emerging perspective by drawing upon institutional theory and the analytical device of industrial clusters to explore a broader set of similar environmental attributes facing firms in a cluster and its assumed importance for a firm's conduct of exploitation and/or exploration (DiMaggio & Powell, 1983; Poudier & St. John, 1996).

4.1.2 Neoinstitutional Theory and Isomorphism

Many studies of institutions, belonging to the so-called "neo-institutionalist perspective", argue that organizations in an institutional field grow alike over time. Institutional fields are characterized by organizations mutually accounting for and influencing each other in a variety of ways (e.g., Angst, Agarwal, Sambamurthy, & Kelley, 2010). Starr (1980) points out mimicry in the development of the hospital industry, whereas Tyack (1974) and Katz (1975) provide evidence that processes in public school systems bear resemblance. The concept that has been acknowledged to depict this process of homogenization is institutional isomorphism (DiMaggio & Powell, 1983). Institutional isomorphism is a process by which firms facing a common set of environmental conditions grow increasingly alike over time. As DiMaggio and Powell point out, "at the population level, such an approach suggests that organizational characteristics are modified in the direction of increasing comparability with environmental characteristics" (1983: 149). The authors propose three distinct mechanisms by which firms potentially resemble each other, namely a) coercive isomorphism, driven by expectations of legitimacy and political influence; b) mimetic isomorphism, as a response to market uncertainty, and c) normative isomorphism, as a

means of professionalization. For this study, we focus on coercive and mimetic isomorphism, as it can be assumed that the biopharmaceutical industry provides a high degree of professionalism that will not show significant variation among firms.

Meyer and Rowan (1977) argue that the inter-organizational context is the most significant determinant of isomorphism. The organizational context is assumed to provide both the strongest coercive influence and the most directly linked point of mimetic reference for firms. Accordingly, authors have analyzed how geographical location may facilitate institutional isomorphism (Pouder & St. John, 1996). Mesquita and Lazzarini (2006) suggest that firms in industrial clusters gain collective benefits by decision makers, which enhance the collective competitiveness of all firms within the cluster by coordinating their actions (see also Martin & Sunley, 2003). Recently, scholars have taken an interest in the collective benefits incurred in so-called “hotspots”: fast-growing, technologically driven, and geographically clustered groups of competing firms (Pouder & St. John, 1996). Hot-spot clusters form within fast-growing research and development-driven industries, such as biopharmaceuticals. Here, pressure to conform is proposed to result from the need to gain legitimacy in the cluster or geographical area. By definition, such clusters experience intense market dynamics and uncertainty and as a response conduct mimetic isomorphism (Pouder & St. John, 1996). Therefore, industrial clusters grow and develop through mimetic and coercive isomorphism (DiMaggio & Powell, 1983; Suire & Vincente 2009; Tan, 2006).

Two relevant cluster attributes building on, for example, Paul Krugman’s work (1991) are industry cluster concentration and specialization. First, cluster concentration is the number of firms in a geographical area composing the structure of a cluster (see also Lazzarini, 2006, for a parallel notation of density). It is based on the notions that geographical proximity is endogenous and geographical advantages ease the interaction of firms (Falcioglu & Akgüngör, 2008). It is consistent with the idea that geographically close firms benefit from positive externalities, labor market pooling effects (Freeman, 1988), relationships between buyers and sellers, the easier diffusion of innovation among firms (Greve, 2009) and informal knowledge sharing (von Hippel, 1987). Cluster concentration is of relevance because it captures the regional concentration of firms. Along the argument of mimetic and coercive isomorphism, a higher concentration will provide a stronger enticement to imitate (reference group). Further, with increased concentration within a cluster, most direct

competitors will constitute the environment, also increasing legitimacy through both informal and formal standard operating procedures.

Second, a long-standing debate in regional studies has examined the reasons for regional specialization and its effects (Helburn, 1962; Barabas, 1965), such as those found in manufacturing, where economic integration between buyers and sellers matters extensively (Falcioğlu & Akgüngör, 2008), or in the life-sciences industry, where specialization is driven by strong firm-university collaboration or the access to drug manufacturing capabilities (Owen-Smith et al., 2002; Cooke, 2005). Karlsen (2005) suggests that firms within clusters may draw advantages from specializing in the same types of activities along the value chain, often reinforced by entrepreneurial activity. Firms operating in a highly-specialized industrial cluster provide an environment of expertise (Owen-Smith et al., 2002). Therefore, from a labor market pooling perspective, expertise emerges, and its supply becomes abundant where it is linked with a firm's specialized activities. This access to expertise benefits cluster members that may adapt to make use of it. In addition, if firms in the cluster succeed through specialization, it is likely that other firms mimic their structures and processes (DiMaggio & Powell, 1996). Therefore, firms in specialized industrial clusters generate superior performance by mimicking these competitors. Further expert recognition goes hand in hand with an implicit legitimization of conduct.

In keeping with institutional theory, the general argument of this paper is that processes of institutional isomorphism are embedded in the innovation conduct of firms in industrial clusters and consequently shape these firms' exploitation and exploration activities.

4.2 Hypotheses Development

In the following, we develop a model accounting for institutional isomorphism and the conduct of exploitation and exploration of firms in a setting of geographically bound industrial clusters. The model references established influencing factors from the cluster literature, namely cluster concentration and specialization, which are proposed to influence the type of balance between exploitation and exploration that firms generate in a cluster over time.

4.2.1 Cluster Concentration

Previous research emphasizes that a firm's location in a geographical cluster enables it to benefit from knowledge flows from other cluster participants through the formal and informal interaction of employees, the exchange of research results, and pooled labor markets (Jaffe et al., 1993). Geographic proximity has a particularly strong influence within industrial clusters, as decision makers can access comparative information on conduct and the performance outcome of single competitors at lower costs. Building on research in economic geography (e.g., Malecki, 1985), DeCarolis and Deeds (1999) developed the variable "munificence of location" and identified clusters as a knowledge flow channel. Porter (1998) further emphasized this as a distinctive condition under which information exchange is facilitated, while rivalry is maintained. This information access through close proximity or concentration within clusters is likely to have a twofold impact on the decisions between exploration and exploitation.

First, with amplified information flow, firms are increasingly aware of competitive activities. In particular, the conduct of innovation activities is of primary importance for research-intensive industries, such as the biopharmaceutical industry; being exposed to rich industry-specific information on rivals' innovation activity will likely induce a firm to use this information to its advantage. The literature provides evidence, however, that firms do not necessarily use such information to differentiate themselves from their environment and instead do so to mimic their competitors' activities (DiMaggio & Powell, 1983; Goes & Park, 1997). Firms seek to mimic the structures and process of successful competitors and avoid the unsuccessful competitors, assuming that replicated processes and structures will be of economic benefit to the firm. For example, Galaskiewicz and Wasserman find that firms tend to mimic other firms they know or trust and suggest that organizational decision makers "will try what others have done and have found to work" (1989: 476). According to DiMaggio and Powell (1983), organizations tend to imitate structures and processes of similar organizations in their field because they perceive them to be more legitimate or successful. Moreover, a high concentration may allow firms to "disentangle" the causal relationship between sources of firms' competitive advantage and their performance effect (Barney, 1991) and thus more successfully replicate a technology (Greve, 2009). For example, chemical engineers may reverse engineer an efficient fermentation process of a competitor if they hold expertise in the same area and

receive process-related information through informal channels. The characteristics of an industrial cluster promote similar strategies, mental models and industry experience (Prahalad & Bettis, 1986; Spender, 1989). Along these lines, proximity within the geographic cluster makes information about local firms more available to allow activities of local competitors to be scanned and evaluated (Pouder & St. John, 1996). Therefore, the incentive for firms to replicate initiatives to generate new developments may drive exploitation. Consequently, this mechanism of replication may lead firms to “reinvent” established innovation activities while limiting uncertain experimentation.

The second effect of cluster concentration relates to the experience of coercive isomorphism. Due to the dense environmental conditions of the cluster, firms may experience an artificial market environment that isolates itself from the remaining industrial environment (Greenwood & Hinings, 1996). This isolation within the cluster inflicts relatively limited exposure to ideas from either the industry outside the cluster or other institutional arenas. However, through such tightly structured contexts within the cluster, due to pressure for conformity, there may be a tendency to promote standardization and the acceptance of dominant operating procedures employed by other firms (Oliver, 1988). Aside from normative guidelines of operation that define an industrial environment as a common standard, scholars suggest that isolated geographic settings, such as clusters, promote informal ‘rule-like’ standards, which become diffused and acquired because their social validity is largely unquestioned. As Greenwood and Hinings (1996) point out, alternative operating templates surface rather infrequently. For example, in the biopharmaceutical industry, clinical trials necessary to move the product from research, via lead and target development, to the market, require a particular set of skills and processes to work intimately with patients and hospitals, as well as plan and conduct testing procedures (Dixon-Woods & Tarrant, 2009). Compliance and standardized practice force firms to conduct their research activities in similar ways and perhaps specialize in particular parts in the value chain (Cooke, 2005). In this way, operations are steered to comply with informally agreed-upon innovation activities that promote exploitation rather than exploration. Firms replicate processes, structures and potentially products from their competitors, assuming the positive performance effects of doing so. These arguments lead to the following hypotheses:

H1a,b: An increase (decrease) in cluster concentration will negatively (positively) impact the balance of exploitation and exploration, tilting the combined ratio towards exploitation (exploration).

4.2.2 Cluster Specialization

As the previous line of argument highlighted, the concentration of clusters provides for mimetic and coercive isomorphism. Whereas concentration drives similarity, which is a matter of having comparable processes and structures that define established operating procedures (Pouder & St. John, 1996), specialization presumably promotes distinction for two reasons. First, from a mimetic standpoint, specialization, when in the form of nascent industry offshoots, seems to shield itself from mimetic tendencies. Specialization allows access to people with restricted, specific knowledge to work on innovation-related problems across distinct business areas, whereas the related techniques and base knowledge apply. Further, specialization generates a superior base for the understanding of knowledge that other firms in the cluster create, leading firms to be able to choose to work on non-overlapping innovation problems or to explore entirely new fields. This is particularly relevant in science-based industries, where firms race to generate novel components. It is possible that specialization creates more rivalry, which in turn leads to pressure to gain early mover advantages (rent), which may also be supported by the race to create new base scientific research. Second, from a coercive standpoint, it can be assumed that the particularities of a nascent industry and the differentiating features of the product will distinguish themselves from yet to be established overarching informal or formal industry standards (Greenwood & Hinings, 1996; Tolbert and Zucker, 1983).

First, although it is acknowledged that both an established industry and a nascent offshoot share the underlying knowledge within an industry, for example, on the base compounds and treatments of different diseases in the pharmaceutical and biopharmaceutical industry, the applications and products generate unique knowledge for specialized firms. As Malmberg and Maskell point out, “firms which already have a large stock of R&D- or experience-based know-how and a specialized labour force, etc. are often in a better position to make further breakthroughs and add to their existing stock of knowledge than firms which have a small initial supply of such factors” (1997: 28). As such, specialized clusters grant a fruitful environment for radical innovations as cluster participants possess distinct knowledge pools from

which other participants can learn and build upon. For example, in the biopharmaceutical industry, biologists are often involved in the development of compounds targeted to genetic compounds, whereas chemists are involved in the formulation of drug manufacturing. A high concentration of specialized firms within an industry attracts more expertise in this area of basic research, tilting ambidexterity toward exploration rather than exploitation. Further, as experts provide a very competitive environment, specialized clusters breed competition to stay on top of developments both to be successful but likewise out of the fear of falling behind. Due to the expertise and high investment that go along with specialization, these firms cultivate their absorptive capacity to be able to detect and grasp new concepts and apply them to their developments (Cohen & Levinthal, 1991). It can thus be assumed that cluster concentration fosters the mimicry of exploitation, whereas the specialization of clusters promotes distinction through exploration. Consequently, a dominance of specialized firms in a cluster will drive each firm's innovation activities toward exploration.

Second, Tolbert and Zucker (1983), as well as Baron, Dobbin, and Jennings (1986), postulate that novel industries do not show clear patterns of industry leadership, as found in mature industries. Greenwood and Hinings further substantiate, "in the early (youthful) development of an organizational field, technical performance requirements are more important than in later (mature) stages of the field, at which point institutional pressures become more salient" (1996: 1029). Applied to the clusters with high shares of biopharmaceutical companies, it can be assumed that the originality of reengineering identical, similar, or partly similar products or processes that can be found in nature leads to unique processes and product development. As such, the distinctiveness of generic developments could lead to their detaching themselves from the pressures that standardized developments would entail. Further, firms in nascent industry branches are on average rather small, leading to the assumption that there are still no stipulated templates or norms developed for organizing large-scale innovation processes in the form of industry standards and thus pressures for conformity within the specialized cluster. Consequently, coercive isomorphism in the form of "rule-like" principles and procedures within an industrial cluster, as assumed for most clusters in mature industries, does not hold in the case of high specialization. Therefore, it is assumed that the high level of specialized knowledge and the application of individual firm-specific processes, structures and products will drive exploration. Therefore, we define the following hypotheses:

H2a,b: An increase (decrease) in cluster specialization will positively (negatively) impact the balance of exploitation and exploration, tilting the combined ratio towards exploration (exploitation).

4.3 Research Design

4.3.1 Sample and Data

The identification of the final sample of 167 public firms operating in the biopharmaceutical industry between 1999-2007 relied on a multi-step process. The nine-year time span was introduced to account for the maturing state of the biopharmaceutical industry during this period. Furthermore, with this time frame, the study can draw on a proper, publicly available and solid set of data points to achieve significant measures.

The sample of public pharmaceutical firms was derived using the Bloomberg® database. Standard & Poor's global industry classification standard (GICS) was applied to identify all companies belonging to the four-digit industry segment Pharmaceuticals, Biotechnology & Life Sciences (GICS: 3520) (effective August 29, 2008). Subsequently, the original sample was corrected for double entries and stock derivatives entries, resulting in 1,260 public companies of which 527 (41.8%) belonged to the Biotechnology industry classification (GICS: 352010), 572 (45.4%) to the Pharmaceutical industry (GICS: 352020) and 161 (12.8%) to the Life Science Tools & Services classification (GICS: 352030). This list was then coded according to Rader's definition of a biopharmaceutical firm (2008; coding information in the appendix). Three independent coders with backgrounds in biological science (BSc or higher) were trained face-to-face in the coding procedures according to the coding criteria using the firms' websites, financial information services, such as Yahoo!® Finance, and other publicly available information from annual reports. A firm was considered a public biopharmaceutical company if at least two out of three coders agreed that it met the criteria. To test for consistency in inter-coder reliability, the canonical measure, Cronbach's alpha, was employed (Nunnally, 1978). After the first coding, the inter-coder reliability remained at 0.712. To resolve cases of major disagreement, all coders had a plenary discussion, investigating the cases subject to greatest variance, thereby increasing the reliability measure to an appropriate level of 0.973. This coding led to a list of 233 public biopharmaceutical firms. In a next step, a condition was imposed, by

which a firm's initial public offering (IPO) had to have happened before January 1, 2003 to ensure at least five years of available, consistent, and longitudinal data for the period of 2003-2007. Firms without a clear IPO date or firms that executed a reverse takeover transaction during the period of 2003-2007 were also dropped from the sample. These measures finally left a sample of 167 firms, representing 13.3% of the initial sample population. As this study pursues a single industry focus, differences in environmental factors beyond those recorded here for the biopharmaceutical industry are considered insignificant and will not be further examined in this study.

To derive a list of all privately held biopharmaceutical firms worldwide, which were needed for the calculation of the cluster-specific variables, the BioScan® database was consulted. Accordingly, all firms with the BioScan categorization “privately held”, “privately owned”, “privately held, family owned”, and “filed for IPO (privately held)” were recorded (as of June 12, 2009). From the resulting list of 1109 firms, those not belonging to the industry group Pharmaceuticals, Biotechnology & Life Sciences (GICS: 3520) were removed, resulting in a sample of 824 private firms. The same three coders as for the public firms then coded this sample using the definition of a biopharmaceutical firm. The recorded inter-coder reliability (Cronbach's Alpha) reached 0.754. Corresponding to the procedure with public firms, major disagreements were discussed in plenum, which increased the reliability to 0.981. The final sample represented a set of 123 private biopharmaceutical companies.

4.3.2 Innovation Conduct

This study uses two measures for a firm's innovation conduct. The count of patents serves as a measure of exploitation, whereas the count of scientific publications references exploration (Agrawal & Henderson, 2002; Martin & Irvine, 1983). Both measures provide firms and the market with timely feedback about their research and developmental impact and are classified as “success indicators” of the market acceptance of basic scientific research and new product development.

Exploration. In biotechnology, innovation depends strongly on basic scientific activities (Pisano, 1994). An approximation in the field of ambidexterity has been scientific publications (Ambos, Mäkelä, Birkinshaw, & D'Este, 2008). Scientific publications are characterized as breakthrough ideas with long-term horizons and less predictability in outcomes (Di Gregorio & Shane, 2003; Stern, 2004). Biotechnology

firms tend to publish the results of their basic and preclinical research activities in scientific journals. Quality is reflected in frequent citations of these papers by other publications. DeCarolis and Deeds (1999) reasoned that the number of citations of a firm's published research papers positively impacts firm performance and found evidence supporting this argument. Recent investigations lend further support to the use of this proxy (see Han, 2007); firms with more citations display a higher stock of scientific knowledge, and we expect this general result to hold for biopharmaceutical firms. However, citations can only be observed after some time and thus are not always an effective predictor of the future potential of the paper cited. Citations accumulate over time and at any point, measures may be biased toward older articles. To provide a more complete assessment of basic research, it is useful to observe publications in "high-impact" journals within a given scientific field or subfield. A journal's impact factor is a measure of the frequency with which an average article in the journal has been cited over a certain period. A paper published in a journal with a higher impact factor has a greater likelihood of being cited by future publications, compared to papers published in lower impact journals.

Exploitation. Patents are an established measure of innovation conduct (DeCarolis & Deeds, 1999). For example, Ernst (2001) investigated 50 German machine tool manufacturers between 1984 and 1992 and found that patent applications lead to sales increases with a time lag of only two to three years. In line with the definition of exploitation, innovation needs to show short-term horizons, application orientation, and efficiency. Investment in scientific research may not increase firm performance unless the firm converts that research to an applied technology (Gittelman, 2007). Therefore, innovation, when taken to mean the commercialization of patented knowledge, can be used as a proxy for incremental innovation, especially for science-based industries such as biotechnology, where patents protect new compounds that are developed for specified medical indications during preclinical research and clinical trials (Kang & Lee, 2008).

Organizational Ambidexterity. Ambidextrous balance is constructed as the subtraction of an exploration term minus an exploitation term to normalize values and adjust for the quantitative difference in annual publication and patent outputs. As a result of this, the values per firm vary between 1, representing total dedication to exploration, and -1, representing total dedication to exploitation. A firm is shown to provide an equal balance of both exploration and exploitation if the calculation results

in a value of 0. This is in line with previous ambidexterity literature that constructs exploitation and exploration as a continuum (Lavie, Stettner, & Tushman, 2009).

The exploration term itself is composed of the accumulated number of a firm’s publications over time, divided by the sum of the accumulated number of publications plus the patents the firm holds up to the specified point in time. The exploitation term consists of the accumulated number of patents granted to the company, divided by the sum of the accumulated number of publications plus the patents a firm holds up to the specified point in time. Therefore:

$$Balance_{Firm,t} = \left(\frac{\sum_1^t Publications_n}{\sum_1^t (Publications_n + Patents_n)} \right)_{Exploration} - \left(\frac{\sum_1^t Patents_n}{\sum_1^t (Publications_n + Patents_n)} \right)_{Exploitation}$$

For the number of publications, we searched for each firm’s publication track record within the maximum time span of the Thomson Reuters Web of Knowledge database. We developed a list of all possible firm names, taking into account possible misspellings and full subsidiaries, and entered these names as a search item in the address field.

To calculate the second term of the balance equation, we obtained each firm’s patent history from the Derwent Biotechnology Abstracts database, which lists patents from 40 patent-issuing authorities worldwide. As a first step, we developed a list of search terms for each firm, taking into account possible misspellings of firm names (in the field “patent assignee”) as well as patent assignees that were full subsidiaries of a firm in our sample in the respective years. The second step was to record detailed information of the patents issued by all firms in our sample as stated within the maximum time span of the Derwent Biotechnology Abstracts database.

4.3.3 Cluster Attributes

Industrial clusters are defined as robust groupings of related or interconnected firms within an industry and institutions concentrated in a geographical location (Baptista, Swann, 1998; Porter, 1998). This study followed Krugman’s (1991) conceptualization that clusters define a local specialization of particular industrial activities that define

their advantage through access to specialized labor and intermediate goods and the benefit of knowledge externalities. As argued above, a firm's location in a geographical cluster enables it to benefit from information exchange while maintaining rivalry. As Porter further accentuates, "clusters mitigate the problems inherent in arm's-length relationships without imposing the inflexibilities of vertical integration or the management challenges of creating and maintaining formal linkages such as networks, alliances, and partnerships" (1998: 80).

Concentration. For the measurement of cluster concentration, the overall number of public and private pharmaceutical, biotechnology, and life science firms in a given cluster was divided by the cluster area. Recent literature mostly uses Metropolitan Statistical Areas (MSA) to identify cluster boundaries (Decarolis & Deeds, 1999; Folta et al., 2006). However, MSA clustering does not necessarily provide accurate information on the clusters in a specific industry and is therefore conceptually problematic; a cluster might consist of more than one MSA, or one single MSA might be too large to capture knowledge spillover due to clustering (Wallsten, 2001). To gather more precise information about clusters, we collected unique geo-location data for all of the firms in our sample – private and public – and subsequently conducted a cluster analysis. We based the extraction of the geo-location on the headquarter addresses of the 2084 firms in our sample and used the Google Maps algorithm to generate the exact geocode (longitude and latitude) of the firms' location. Because the cluster concentration varies due to the emergence of new firms, we obtained the year of foundation for each firm, as stated in annual reports on its website or from publicly available financial services. If a firm did not have a clear address or identifiable geocode or had no identifiable year of foundation (in case of private companies), it was removed from the clustering sample, which resulted in a total of 1777 firms. For the next step, we grouped all of the companies into five regions to account for the regional circumstances for cluster formation, based on the following geocodes: Africa (2), Americas (1022), Asia (285), Australia and New Zealand (76), and Europe – Middle East (392). After this grouping, we ran a hierarchical clustering algorithm (Ward's linkage method) on the point-to-point distance matrix of the companies existing in 2007. The firms in each region were then grouped into a defined number of clusters, based on the clustering results (Africa 2, Americas 45, Asia 31, Australia-New Zealand 7, and Europe-Middle East 30 clusters). To simplify the area calculation, we approximated the area to be a rectangle with the geocodes of the outermost firms in the respective cluster as its boundaries. To account for the evolution of the cluster

size over time, the companies were retroactively deleted in the years before their IPO. The boundaries of the cluster areas were adjusted accordingly for each year, and the concentration was calculated anew for each year prior to 2007.

Specialization. In each cluster, specialization was calculated as the number of companies coded as biopharmaceutical, divided by the total number of public and private firms belonging to the industry segment Pharmaceutical, Biotechnology & Life Sciences. To account for the changing number of firms in each cluster, the specialization was calculated individually for each cluster each year, excluding the companies that had an IPO later than the respective year.

4.3.4 Firm Attributes

Three variables pertain to firm attributes: R&D investment, firm size, and firm age. Consistent with existing research (Rothaermel & Deeds, 2004; Soh, 2010), we use these variables as controls in the analysis. Furthermore, we introduce alliances as a measure for the dynamics and the competitiveness of the industry (Calabrese, Baum, & Silverman, 2000), and we use the number of patents and publications as a verification for our dependent variable.

Firm age. The firm age variable relies on the IPO date as derived from Bloomberg® database. It is measured as the number of years since the firm disclosed its initial public offering. This control was included because prior studies provide evidence that older firms tend to yield to path dependence on their innovation conduct, myopia, and operational rigidity. This leaves firms unable to react to rapidly changing market demands (Christensen & Rosenbloom, 1995; Tushman & Anderson, 1986). At the same time, there is evidence that a firm's accumulated assets may influence market signaling, which leads to the recognition of a firm's R&D efforts (Rothaermel & Hill, 2005; Suarez & Utterback, 1995). For this study, the variable age controls for the possession of accumulated knowledge over time, which impacts their future capacity to absorb knowledge (Cohen & Levinthal, 1990).

Firm size. The market value of the total annual assets of a firm controls for firm size. Previous studies have provided evidence that firm size has a significant influence on innovation conduct (Hagedoorn & Duysters, 2002; Rothaermel & Deeds, 2004; Thornhill, 2006). In particular, the ambidexterity literature acknowledges that firm size

may moderate the conduct of both exploitation and exploration (He & Wong, 2004). In line with this argument, Christensen and Rosenbloom (1995) provide evidence that firms with higher annual revenues are more inclined to pursue innovation and growth strategies in existing technological domains.

R&D expenditures. The control for R&D expenditures accounts for the extent a firm is committed to maintain and develop new and existing products and processes. Firms with smaller R&D expenditures might need to concentrate on either of the two extremes to be competitive, whereas firms with higher R&D expenditures have more possibilities to invest in both exploration and exploitation. Furthermore, competing firms tend to survey R&D related announcements by others to adjust their own spending levels (Soh, 2010). We used the Bloomberg® database to record market values of total assets and R&D expenditures on December 31 of each year for the period 1997–2007. Market values of total assets and R&D expenditures in foreign currencies were converted into U.S. dollars, based on the annual average currency exchange rate for each foreign currency in the respective years.

Alliances. To account for the impact market dynamics and competition has on a firm's innovation activities; we include alliances as a compound control. In line with findings by Calabrese, Baum, Silverman (2000), we hold that alliances generate systematically different levels of competitive intensity in an industry among competitors. As Silverman and Baum (2002) further show, competitive intensity increases with the increased occurrence of alliance. Similarly, the engagement in alliances alters the market dynamics in an industry due to the consolidation effect that these alliances encompass. Each firm's alliance history was extracted from the BioScan® database, which reports and classifies press releases by biotechnology and pharmaceutical firms. We included all information on every specific form of collaboration, alliance and license agreement, which was reported by the companies in our sample within the maximum time span of available data in the BioScan® database (starting from 1999).

Number of patents and publications. These controls were introduced to analyze whether the calculation of the balance is rightly influenced by the variables it is composed of and to determine the degree of this influence.

4.3.5 Statistical Analysis

We tested the balance model using a longitudinal panel research design with $N = 167$ companies over $T = 9$ time periods from the years 1999 – 2007. Longitudinal panel data models are estimated by methods that are consistent with possible Gauss-Markov assumption infringements. According to Sayrs (1989), panel data models can be estimated by ordinary least square (OLS) regression for fixed or random effects models, as long as no group-wise or other heteroskedastic effects are present on the dependent variable (i.e., firm balance). Therefore, the characteristics of our data concerning the standard error estimators (i.e., fixed or random) were subject to a Hausman test. The Hausman test investigates the null hypothesis that the preferred model is the random effects model (Green, 2008). The results suggested the use of a fixed effects model for our data ($\text{Prob} > \chi^2 = 0.0000$).

Following the Hausman test, we tested for the presence of any heteroskedastic effects. The data set can be analyzed for this purpose by a modified Wald test for group-wise heteroskedasticity (Laskar & King, 1997). This test showed significant results for our sample, which indicates that there are heteroskedastic effects present ($\text{Prob} > \chi^2 = 0.000$). To determine whether the panel also shows first-order autocorrelations, we therefore applied the Wooldridge test. Additionally, in this case, our results were significant, suggesting first-order autocorrelation in our sample ($\text{Prob} > F = 0.0000$). According to both tests an OLS estimator in a fixed effect panel model would be biased.

Because our N is greater than T , we focused on standard error estimators that are consistent for this sample setup as well as for any case of heteroskedasticity and first-order autocorrelation. There are mainly two estimators that cover all three conditions, namely the Rogers (Rogers, 1994) and the Driscoll-Kraay standard error estimators (Driscoll & Kraay, 1998). Furthermore, the panel data should be tested for cross-sectional dependence to provide robust results. This test was not feasible with the data available, but the Driscoll-Kraay estimator provides robust results in case any cross-sectional dependence is present. In the case that all of the cross-sections are independent from each other, the results of the Rogers and the Driscoll-Kraay standard errors should only differ slightly (Hoechle, 2007). Therefore, we compared the results of the fixed effects models with either the Rogers or the Driscoll-Kraay standard error estimators. To account for the autocorrelation we detected in our model, we set the lag

of both models to one year. After comparing the regressions with Rogers’s standard errors and Driscoll-Kraay standard errors, it became evident that some standard errors of the coefficients changed on a scale of more than one magnitude between the models. This is in contradiction to the assumption of only slightly different results (Hoechle, 2007), which led us to conclude that there is cross-sectional dependence in our panel data. We thus decided to test our hypotheses using the Driscoll-Kraay estimators for standard errors in a fixed panel model with a lag (of the moving-average type) of one year, as provided by the xtsc Stata module (Hoechle, 2007).

4.4 Results

The descriptive statistics of our model predictors of firm ambidexterity are shown in Table 7.

Table 7: Summary Statistics and Correlation Table

Variables	Obs	Mean	SD	Min	Max	1	2	3	4	5	6	7	8
1. Firm Balance	1161	0.3500	0.6567	-1	1								
2. Cluster Concentration	1406	87.04	179.01	0	2617.66	0.0271							
3. Cluster Specialization	1408	0.2441	0.1215	0.0455	1	-0.1961	-0.053						
4. Firm’s IPO Age	1405	23.42	37.22	0	180	0.3100	-0.0584	-0.0199					
5. R&D Expenditures	1240	420.99	1146.48	0	8089	0.2668	-0.0823	-0.0996	0.6752				
6. Total Assets	1331	4590.12	14077.86	0	123684	0.2399	-0.0651	-0.1011	0.6757	0.9410			
7. No of Alliances	1503	2.11	4.26	0	36	0.1822	-0.0064	0.0636	0.4988	0.5725	0.5223		
8. No of Publications	1503	39.03	120.41	0	857	0.2924	-0.0582	-0.0657	0.6066	0.8476	0.7764	0.6775	
9. No of Patents	1503	7.60	50.15	0	1789	-0.0203	0.0364	-0.0243	0.1034	0.1355	0.1540	0.1728	0.1514

In the period from 1999–2007, the average firm balance value was 0.350, showing slightly higher exploration activity. The average cluster concentration value was 87.04 life science companies, pharmaceutical, or biotechnological per unit cluster, 24.4% of which were well specialized in biopharmaceuticals. These companies have been publicly traded on average for 23.42 years and provide an average book value of total assets of US\$ 4.590 billion. On average, the biopharmaceutical companies spent US\$ 421 million for research and development, published 39.0 scientific articles, received 7.6 patents and formed 2.11 alliances per year over the 9-year period.

Table 8: Panel regression results

Dependent Variable: Firm Balance	Model 1		Model 2		Model 3		Model 4	
	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
<i>Explanatory Variables</i>								
Cluster Concentration							0.3875	(0.0595)***
Cluster Specialization							0.1771	(0.0299)***
<i>Control Variables</i>								
Firm's IPO Age			-0.9167	(0.2348)***	-0.9112	(0.2296)***	-1.0228	(0.2071)***
R&D Expenditures			0.0535	(0.0207)*	0.0362	(0.0199)*	0.0441	(0.0207)*
Total Assets			-0.0051	(0.0043)	-0.0050	(0.0039)	-0.0069	(0.0041)*
Alliances			-0.0051	(0.0050)	-0.0075	(0.0053)	-0.0138	(0.0064)*
No. of Publications	0.0169	(0.0070)*			0.0403	(0.0109)***	0.0532	(0.0105)***
No. of Patents	-0.0198	(0.0099)*			-0.0181	(0.0396)*	-0.0187	(0.0085)*
<i>Intercept</i>	-0.0007	(0.0245)	0.1954	(0.0393)***	0.1914	(0.0396)***	0.2381	(0.0369)***
<i>Observations</i>	1161		1001		1001		999	
<i>Within R²</i>	0.0038		0.036		0.041		0.116	

Note: Standardized regression coefficients with two-tailed tests. Driscoll-Kraay standard errors in parentheses. + = p<0.1 level; * = p<0.05 level; ** = p<0.01 level; *** = p<0.001 level.

The regression model was set up with the stepwise introduction of regressors to test the cluster variables' impact on the firm balance. The results of the fixed effects panel data regression with Driscoll-Kraay standard errors (lag of one year: first-order autocorrelation of the moving-average type) are shown in Table 8. In Model 1, we entered firm balance and the base variables – number of publications and number of patents – of the balance calculation to assess the correct behavior of the firm balance. The results indicate the significance of both the number of publications and the number of patents with the correct signs for the coefficients. The results show that the balance is influenced by both variables by approximately the same amount, which excludes the weighting biases in the dependent variable. Model 2 tests the influence of the firm attributes on the firm balance. In this case, only the R&D expenditures and the IPO age of the firm show significant results. This shows that IPO age as well as R&D expenditures play a role in the firms' ambidextrous conduct, as can be expected from the literature (Raisch & Birkinshaw, 2008). For Model 3, all of the control variables were tested to exclude any significant interference between the controls. Here, all variables remain in the same state of significance, as in the two previous models. Given no significant change compared to the two separate models, any possible interaction effects can be neglected. In Model 4, the explanatory variables were introduced along with all of the controls. This model turns out to produce the most significant results for all of the variables. Both the cluster concentration and the cluster

specialization are significant at the 0.1% level, whereas the significance level for the controls ranges from the 10% to the 0.1% level. Comparing the four models, it is clear that the robustness of the magnitude and signs of the regression are increasing heavily. Nevertheless, the within-R2 value of 11.6% is still low, which may be due to missing values in the panel or missing variables.

To confirm the hypotheses, the coefficients have to be significantly different from zero ($p < 0.05$), with a negative sign/value for hypotheses 1a and 1b and a positive sign/value for hypotheses 2a and 2b. This demonstrates that cluster concentration forces the balance of the firms in the direction of -1 and thus in the direction of exploitation. Meanwhile, the cluster specialization forces the balance of the firm in the direction of 1 and thus in the direction of exploration. If this condition is unfulfilled, the hypothesis cannot be confirmed. Hypothesis 1, which states that an increasing concentration of a cluster skews the balance in the direction of exploitation, could not be confirmed. Although the cluster concentration is highly significant ($p < 0.01$), the sign of the coefficient is positive, which tilts the balance in the direction of exploration. However, Hypothesis 2, which states that a higher specialization of a cluster skews the balance towards exploration, could be confirmed ($p < 0.01$).

4.5 Discussion

The sustained interest in organizational ambidexterity has been demonstrated by extensive research and the range of contributions in recent years (i.e., Raisch & Birkinshaw, 2008; Raisch et al., 2009). Whereas research has predominantly focused on firm- and business-level analysis, there is a lack of conceptually and empirically validated insight into the impact of environmental factors on the firm's conduct of exploration and exploitation. Following the call for a more nuanced analysis beyond market dynamics and competitiveness (Raisch et al., 2009), we have analyzed the impact of industrial clusters on both innovation types in light of institutional theory. The purpose of this study was to identify whether and how geographical concentration and specialization as two relevant dimensions of industrial clusters impact a firm's innovation conduct. The study complements existing research on environmental factors in the analysis of organizational ambidexterity (i.e., Gibson & Birkinshaw, 2004; Siggelkow & Levinthal, 2003). Focusing on industrial clusters is valid for two reasons. First, the conduct of exploitation and exploration has been found to be of particular interest to science-based industries and fast-paced markets (Giuliani & Bell,

2005), which also show a high rate of cluster developments (hot spots). Second, clusters have been acknowledged to be an important institutional frame in fast-paced and competitive industries, such as the pharmaceutical industry (Pouder & St. John, 1996).

Our findings show a balance between exploitation and exploration for all firms in the sample. However, whether the conduct was tilted towards exploitation or exploration was significantly dependent upon the level of concentration and specialization within the cluster. We proposed high geographical concentration within clusters to induce firms to concentrate on exploitation as a result of assimilation processes, either due to pressures of conformity to established operational standards within a cluster or as an effect of replicating processes and/or products from direct competitors for assumed superior performance effects (DiMaggio & Powell, 1983; Galaskiewicz and Wasserman, 1989). However, this was not supported by our sample. A reason might be that competitive pressures outweigh institutional pressures. Whereas the institutional environment might provide operating standards, the need to differentiate themselves within a concentrated environment seems to be higher, thus driving exploration as a means of achieving a competitive advantage. It should be noted that the biopharmaceutical industry is dynamic and involves fast-paced competition for which firms need to create unique sources of competitive advantage through basic research (Pisano, 1994). In spite of concentration within a cluster and the assumed access to information, most developments are secured by patents. Therefore, the benefit of using existing knowledge is limited and offset by costly replication. Firms instead need to either experiment to develop an alternative to existing products by competitors or develop an entirely new compound or process. Therefore, concentration might work in favor of a firm's exploration activity, as knowledge about new developments may diffuse rapidly in the industrial cluster, providing a fruitful environment to use this knowledge as a guideline on which to further build.

Further, we proposed that high levels of specialization within a cluster induce firms to concentrate more on exploration. This hypothesis was supported by our sample, and it can be assumed that the explanation lies in potential labor market pooling effects and the linkages formed between cluster participants. According to prior work, highly specialized clusters will provide for expert labor, which will allow for complementary effects if they are exposed to either knowledge agglomeration or labor transfer

(Malmberg & Maskell, 1997). Further, horizontal linkages that form between likeminded firms in specialized industry clusters (i.e., research-intensive firms) drive the conduct of further basic research, as opposed to vertical linkages down the value chain with customers, which will emphasize applied research. Finally, this could be a reflection of the generally high level of exploration in the industry, which clearly might not hold for other industries.

This study contributes to the literature on organizational ambidexterity and potentially provides answers to institutional questions raised in the literature on cluster analysis. First, this study provides a new facet of the environment beyond a moderating function as an antecedent to decision making in exploitation and exploration. We provide insights into the effects that industrial clusters have on both innovation activities, particularly how cluster dimensions, namely concentration and specialization, impact the degree of ambidexterity between exploitation and exploration. To our knowledge, this is the first paper to apply institutional isomorphism to the problem of organizational ambidexterity. Of particular interest is that the cluster environment has a much stronger influence on exploitation and exploration than expected. Showing firms' innovation conduct within a cluster implies that firms do not make unilateral decisions but instead strongly incorporate their direct environment.

Moreover, our results lead to an unexpected assumption compared to the assumptions generally made in the literature on industrial clusters. Lately, researchers have focused on the high failure rate of hot spots and why once shining stars fail at some point (Pouder & St. John, 1996). The link to ambidexterity might provide answers. Authors on organizational ambidexterity frequently warn that a dominant focus on either exploitation or exploration will harm firms in the short or long run (March, 1991; Raisch et al. 2009). By having a cluster profile tilted strictly toward one or the other innovation type, a trap in the form of the compound firm and cluster "path dependence" may emerge. Future work should examine whether firms in the cluster might be more exposed to the risk of failure if they mimic their direct local cluster environment.

4.5.1 Managerial Contribution

The hypotheses put forward suggest that a firm's innovation conduct leverages the institutional environment deliberately and/or non-deliberately. As our findings suggest, a firm's conduct of exploitation and exploration is largely driven by mimicking the direct environment, which is in line with the existing literature on institutional isomorphism (DiMaggio & Powell, 1983; Garcia-Pont & Nohria, 2002; Pouders & St. John, 1996). Conceding that because most larger firms in the biopharmaceutical industry are spread across geographic locations through their subsidiaries means that their integration in different geographical clusters could be leveraged to place an emphasis on exploitation or exploitation. This could circumvent the complications that simultaneous exploitation and exploration impose on a firm when conducted within singular operational settings, such as one cluster (see March, 1991).

4.5.2 Limitations

This study faces limitations that suggest avenues for further research. Whereas we tested the data for any potential bias, such as heteroskedasticity or serial autocorrelation, and applied a regression model, which takes these tests into account, the low R-squared value remains. This could point to omitted variables. An indication that there might be other – not observable – variables is that the R-squared value strongly increases when more variables are introduced. Moreover, the ten-year time frame could be questioned regarding cluster development cycles and the economic downturn in 2008. However, we include the time of the dotcom bubble into our sample, as it also affected the industry under investigation and did not lead to significant changes in cluster concentration or specialization. We thus assume that the effect of the economic development in 2008 was of no significance for this study but acknowledge that future research should extend the timeframe to ensure that no significant differences exist. Finally, our explanation for Hypothesis 2 lies in potential labor market pooling effects and the linkages formed between cluster participants, which could not be directly measured with the current dataset. These effects should be explicitly tested in future work.

Whereas the findings provide promising insights for academia as well as management practice, there are limitations to the applicability from a conceptual perspective. First, although the industry-specific analysis is a strength in terms of the depth of data gathering and contextual understanding, inferences made from the data

cannot be transferred to other industrial settings and pose limits to generalizability. Second, this paper concentrated solely on the implications stemming from the geographical density of firms within industrial clusters. However, there may be other factors that could play into the relationship between the cluster environment and the impact on exploitation and exploration, such as alliances between firms within clusters. Previous work has shown that alliances have an instrumental influence on the conduct of a firm's exploitation and exploration (Rothaermel & Deeds, 2009) and have been alluded to as well in the neo-institutional perspective (Garcia-Pont & Nohria, 2002).

4.5.3 Conclusion

This study provides evidence that geographic positioning in one industrial cluster versus another might lead to exploitation- or exploration-driven innovation conduct. Therefore, cluster membership is a mechanism that influences organizational ambidexterity. This is further emphasized by the very nature of the cluster, namely the degree of specialization. We further link the individual innovation conduct of firms to their competitors' conduct and provide evidence that firms do not operate in isolation, as previously assumed. So far, the literature on organizational ambidexterity has focused on individual firms or the networks in which firms operate when analyzing the conduct of ambidexterity. However, clusters fill a gap between the individual firm and the network level in showing that other firms impact the conduct of exploitation and exploration not necessarily actively but instead through operational proximity and industrial background.

5 Alliance Ambidexterity: When Exploration and Exploitation Cross Firm Boundaries⁴

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Abstract: Research on the concept of ambidexterity is increasing at a rapid pace, with scholars highlighting its antecedents, forms, and consequences. Traditionally applied at the intra-organizational level, recent ambidexterity research has recognized firms' propensity to integrate information sources external to the firm in the innovation process by means of strategic alliances. Studies have drawn implications on the antecedents and contingency factors that allow for the conduct of exploitation, exploration and/or both beyond a firm's boundaries, henceforth termed alliance ambidexterity. Despite the surge in attention to alliance ambidexterity, findings are controversial and fundamental assumptions about the concept remain ambiguous. We seek to develop a framework in which researchers may examine alliance ambidexterity in a consistent manner. Through the lens of a context – conduct – outcome model, this review article outlines the existing literature on alliance ambidexterity, critically reviews conceptual and empirical research, and provides an agenda for future research.

⁴ This study in co-authorship Rosenkranz, N., & Rosenkopf, L. 2011. "Alliance Ambidexterity: When Exploration and Exploitation Cross Firm Boundaries" is currently in its second revise and resubmit review with the Journal of Management.

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5.1 Introduction

Ambidexterity – the ability of an organization to pursue both short-term efficiency, or exploitation, as well as long-term adaptability, termed exploration – has been promoted in management research for several decades (Duncan, 1976; Holmqvist, 2004; March, 1991). Originating in the organizational learning literature, exploration is associated with search, risk taking, and experimentation, whereas exploitation includes activities such as refinement, choice, efficiency, and execution (March, 1991:71). While the latter extends a firm's current path by leveraging existing knowledge, the former is charged with deviating from this path through new knowledge generation. Though it is accepted that combining exploration with exploitation is vital to the survival and prosperity of organizations, it has been proposed that their simultaneous pursuit poses difficulties for firms due to their fundamentally different resource foci and requirements (Gibson & Birkinshaw, 2004; Levinthal & March, 1993). However, the normative assumption about the benefits of ambidexterity (Tushman & O'Reilly, 1996) has advanced paradoxical thinking in research, since benefits come from balancing seemingly contradictory tensions (Eisenhardt, 2000; Katila & Ahuja, 2002).

While the majority of research on ambidexterity has focused on its manifestations within organizations, a burgeoning stream of research shifts the focus of ambidexterity to a firm's use of strategic alliances in pursuit of exploration and exploitation. Empirical and conceptual papers suggest that firms' innovation processes have adopted an open innovation approach in response to increased information dispersion and market complexity (Faems et al., 2005; Noteboom et al., 2007). Grounded in literature streams such as innovation management, knowledge management, and organizational learning, studies have examined antecedents and contingency factors that allow for the conduct of exploitation and exploration beyond a firm's boundaries, henceforth termed alliance ambidexterity. Despite the surge in attention to alliance ambidexterity, findings are controversial and fundamental assumptions about the concept remain ambiguous. Therefore, this review raises two questions – First, what constitutes alliance ambidexterity? Second, does alliance ambidexterity truly benefit a firm or would a focused approach towards exploitation or exploration be preferred? We examine current research to generate a more comprehensive account of the advances in alliance ambidexterity, allowing us to highlight gaps in our current understanding.

The remainder of this paper is structured as follows. First, we portray the rationale for research on exploration and exploitation at the alliance level. Second, the main body of the review will follow the logic of the context – conduct – outcome model. Specifically, we will outline the variety of antecedents that have been proposed to affect a firm’s engagement in exploitation and exploration with external partners. Then, we will identify the different modes of conduct of exploitation and exploration in present research, before considering the presumed performance implications of alliance ambidexterity. We conclude by reflecting on the above questions, highlighting gaps in the existing research and providing an agenda for future research.

5.1.1 Why Discuss Alliance Ambidexterity?

While there are many motives for alliance formation, the most prominent in the literature is that alliances grant access to resources beyond a firm’s existing resource base (Grant & Baden-Fuller, 2004). Several studies have highlighted the importance of external knowledge access (Gulati, 1999; Rosenkopf & Almeida, 2003; Rothaermel, 2001), while the significant upsurge of alliances in R&D intensive industry sectors over the last decades has reaffirmed knowledge access to be a key factor in alliance formation (e.g., Dyer & Singh, 1998; Hagedoorn, 2002; Rothaermel & Deeds, 2004). As alliance research gained momentum within the wider field of strategic management; scholars extended the application of the concept of alliances to literature streams such as knowledge management, change management, and the organizational learning perspective. It is well accepted that firms collaborate in order to access, create, and transfer knowledge from sources outside their boundaries to apply them to a firm’s innovation activities (Powell, Koput, & Smith-Doerr, 1996; Smith, Carroll, & Ashford, 1995). As such, alliances provide an extension to organizational learning, in that the firm is no longer sourcing knowledge solely internally. Alliances, however, generate different learning conditions that need to be taken into consideration. In particular, when applying the concept of alliance ambidexterity, the inherent difference in exploitative and exploratory learning amplify the challenges of transferring knowledge from external sources into the firm. Beyond this altered learning context, the interpretation of exploitation and exploration in alliances is particularly challenging.

Koza and Lewin (1998) first connected alliances directly to the organizational learning literature on exploration and exploitation. Building on March’s

conceptualization of both learning types, Koza and Lewin derived a co-evolutionary theory of strategic alliances, where “theory distinguishes between two basic logics for entering alliances. First, alliances can offer a source of incremental revenue from pooling complementary resources that neither partner is interested in [...] Alliances, however, can also be useful as the strategic and organizational vehicle for probing or co-developing new markets, products or technological opportunities. These exploration alliances are generally implemented as open-ended co-development joint venture projects” (2000: 147-148). Subsequently, ambidexterity in alliance formation has been conceptualized in multiple ways, for example, as the function of the alliance or the familiarity of the alliance partner (Lavie & Rosenkopf, 2006; Lin, Yang, & Demirkan, 2007). In essence however, Dittrich, Duysters, and de Man point out that while “March (1991) provides examples of exploration and exploitation, he does not provide an operational definition that can be used for empirical research in the field of alliances” (2007: 1497). As a result, research at present offers an eclectic variety of conceptualizations and theoretical frameworks, as well as methodological approaches. This review intends to provide a critical reflection on the differences of the learning conditions that alliances create and to highlight avenues scholars can pursue to overcome the lack of conceptual distinction of exploitation and exploration in alliances.

5.2 Concepts and Empirics of Alliance Ambidexterity

Researchers have acknowledged that external partners facilitate accessing knowledge residing outside a firm’s boundaries, either by collaboratively leveraging existing knowledge or by developing concepts beyond each partner’s separate knowledge stock. As a result, alliances are acknowledged as noteworthy vehicles for exploration and exploitation (Koza & Lewin, 1998; Lavie & Rosenkopf, 2006). While consensus exists that a balance of exploiting existing knowledge and exploring future opportunities is beneficial, clarity on the modus operandi of the firm is lacking.

In the following section, we will outline the conceptual inferences made by applying the concept of ambidexterity to the alliance level. This generates a two-step problem: the first lies in the actual conceptual and methodological treatment of the exploitation-exploration dichotomy in alliance ambidexterity, while the second is reflected in the governance implications that the alliance setting bears. Table 9 recaps current conceptualizations of exploitation and exploration in alliances.

Table 9: Conceptualizations of Alliance Ambidexterity

	Alliance Exploration	Alliance Exploitation
Timeframe	Long-term Open-ended horizon	Short-term Pre-determined duration
Performance Criteria	Generation of new patents Sales of new product Innovation pipeline (long-term)	Use of existing patents Increased sales of existing products Innovation output (short-term)
Partner Competences	Upstream oriented Tacit Knowledge Diverging technological background Complementary knowledge New alliance partner Horizontal partners or non-corporate	Downstream oriented Explicit knowledge Similar technological background Overlapping knowledge Known alliance partner Vertical partners and corporate
Alliance Type	Non-equity alliances; few equity alliances Spinn-offs, new market entrants Loose alliance Limited use/ no use of contracts Relation-based trust	Equity alliances Incumbents Formal alliances Use of contracts Institution-based trust
Network Structure	Dense, open networks Informal, flexible ties Limited size, high entry and exit High frequency of interaction	Non-dense, more exclusive network Formal, structured ties Stable, low entry and exit Low frequency of interaction

5.2.1 Conceptualizations of Alliance Ambidexterity

The original definition of exploitation and exploration refers to learning constructs at the intra-organizational level, as classified by March (1991). Research has sought two solutions to the challenge of converting the concept of ambidexterity to the alliance context: First, research on alliance ambidexterity has applied proxies for the exploitation and exploration constructs. Second, researchers make deliberate design choices on how to alleviate the tension underlying the simultaneous conduct of exploitation and exploration within and across alliances.

The first challenge researchers face is how to conceptualize exploratory and exploitative alliances. In their seminal article, Koza and Lewin (1998) defined exploitation alliances by the intent to achieve joint maximization of related knowledge, whereas exploration alliances serve to leverage complementary knowledge to unlock new opportunities. In their succeeding paper, both authors went one step further assuming that a hybrid, namely ambidextrous alliance, may attain both learning types within single alliance settings (Koza & Lewin, 2000). While these authors import

March's original definition of exploitation and exploration to the alliance setting, subsequent studies have applied broader abstractions for both concepts; most fundamentally scholars have drawn analogies to functions along the value chain (Rothaermel, 2001; Rothaermel & Deed, 2004), familiarity of collaboration partners (Beckman et al., 2004), tie strength (Dittrich et al., 2007; Dyer & Nobeoka, 2000), partner diversity (Kang, Morris, & Snell, 2007), and knowledge properties (Colombo, Grilli, Piva, 2006; Noteboom et al., 2007). While all above-mentioned studies utilize the dichotomy of exploitation and exploration, they apply both concepts to idiosyncratic contexts. While the original definition by March (1991) characterized learning activities in firms, the majority of studies on alliance ambidexterity use proxies to represent the distinction between exploitative and exploratory learning. As pointed out by Rosenkopf and McGrath (forthcoming), given these varied contexts on which novelty is defined, conflicting research results are obtained. More specifically, it is an open question if the differentiation of an old and a new partner, for example, suffices to denote exploitation and exploration respectively. We argue that this kind of abstraction will lead to ambiguity and a lack of generalizability of the research conclusions. Numerous conflicting findings in existing research, based on inconsistent conceptualizations, serve as an indicator of this problem, which the detailed analysis in this review will further substantiate.

A second challenge is to identify specific exploitation and exploration activities within alliances as opposed to separating exploitation and exploration out across an alliance portfolio. The majority of studies have taken a portfolio perspective; whereby assuming ambidexterity is generated through the sum of all alliances a firm holds. While performing exploitation and exploration is a necessary condition for ambidexterity, it is not a sufficient one (i.e. Gilbert, 2006). Separating exploitation and exploration helps firms in addressing the inconsistent demands of both activities; however, in line with the critics of this demarcation approach we maintain that both learning types have to be integrated in order to generate ambidexterity (i.e., O'Reilly & Tushman 2008; Raisch et al., 2009). One way to address this issue would lie in the strategic management at a portfolio level akin to the suggested top management integration in intra-organizational ambidexterity (i.e. Raisch & Birkinshaw, 2008). Another way scholars have proposed to alleviate the exploitation-exploration tension is the use of lower-level integration mechanisms such as role assignments on the project (meso) level, and the use of cognitive frameworks on the individual (micro) level (Raisch et al., 2009). However, with current analysis focusing on firm level constructs

only, scholars neglects a material consideration to define exploitative and exploratory learning as lower level constructs. To define which activities drive exploitation and exploration in alliances, the analysis needs to be drawn to the level of the single alliance, project or individual. As Raisch and Birkinshaw pointed out, “the level of analysis is vitally important, because choices about how to resolve the tension at one level of analysis are often resolved at the next level down” (2008: 396). With a proper level of analysis, the actual conduct of exploitation and exploration can be analyzed to provide evidence of whether partner diversity, tie strength or value chain position are in fact drivers of exploitation or exploration, rather than suboptimal proxies.

5.2.2 Methodological Treatment of Alliance Ambidexterity

Researchers must contend with the underlying tension that simultaneous conduct of exploitation and exploration breeds. However, capturing the tension between exploitation and exploration requires a distinction between both learning activities; the question is whether scholars differentiate exploitation and exploration as complementary or conflicting activities. Some scholars have conceptualized exploitation and exploration as two orthogonal activities, meaning a choice between discrete, contradictory options (Gupta, Smith, & Shalley, 2006; Katila & Ahuja, 2002) while others have assumed exploitation and exploration to be at opposing ends to of continuum, classifying exploitation and exploration as a degree of the same learning activity (Gupta, Smith, & Shalley, 2006). Lavie, Stettner and Tushman propose treating exploitation-exploration as a continuum, given that the “distinction between exploration and exploitation is often a matter of degree rather than kind” (2010: 114); however, the majority of alliance studies have applied the orthogonal assumption.

Many studies have assumed alliances to concentrate on one innovation type or the other, treating exploitation and exploration as two distinct, orthogonal, activities, which operate isolated from each other. For instance, scholars have associated exploration with upstream R&D alliances, while exploitation of existing knowledge is associated with downstream marketing and production alliances (Grant & Baden-Fuller, 2004; Park, Chen, & Gallagher, 2002; Rothaermel, 2001; Rothaermel & Deeds, 2004). This assumption is problematic, however, as Lavie et al (2009) rightfully pointed out that this dichotomy fails to capture the conflict of exploration–exploitation, given that R&D alliances may involve varying degrees of basic research and incremental development, representative of exploration and exploitation respectively.

Likewise, studies that assume a functional separation of exploitation and exploration (Lavie & Rosenkopf, 2004; Rothaermel & Deeds, 2004) apply an orthogonal concept. Yet, those that advocate a temporal separation of exploitation and exploration (Colombo et al., 2006) or those assuming simultaneous conduct of both activities follow a continuum logic (Holmqvist, 2004).

Consistent with the assumption of orthogonal or continuous treatments, empirical measures show a clear distinction. Im and Rai translate the conceptualization of exploitation and exploration in line with Gibson and Birkinshaw (2004) from organizational ambidexterity to the alliance level, assuming a “multidimensional construct comprised of the non-substitutable combination of alignment and adaptability (that is, as the multiplicative interaction of the two capacities)” (2008: 216). Lin et al. (2007) construct a hybrid measure, with the assumption of orthogonal activities, linking exploitation and exploration to the distinction between old and new partners, and operating the methodological treatment as a continuum with ambidextrous alliances on an index with range between 0.2 and 0.8 – 0 indicating exploitation and 1 indicating exploration orientation. Similarly, Lavie et al. (forthcoming) measure exploration and exploitation with a single variable that ranges from 0 to 1, representing the continuum from exploitation alliances to exploration alliances assuming ambidextrous alliances to be ranging at a count of 0.5 in the middle of both extremes. Contrarily to the aforementioned studies, Dittrich et al. (2007) conceptualize product innovation using two independent measures of exploration and exploitation assuming each innovation type with distinct, conflicting features. These two diverging conceptualizations and methodological treatments, illustrate the inconsistency of how the exploitation-exploration dichotomy is measured preventing synthesis and comparability of present findings.

5.2.3 Defining “Alliance” in Alliance Ambidexterity

Following previous research, this review article applies the term “alliance” broadly to refer to any formal collaborative relation between two autonomous companies that align their future conduct, which may affect any part of both firms’ activities (see Hagedoorn, 1993; Gulati, 1995; Oxley, 1997; Colombo, 2003). Consequently, alliance setups include collaboration in the form of joint technological and/or commercial agreements that may be based on equity governance structures or mere contractual agreements; mergers and acquisitions are excluded from this definition (Colombo,

Grilli, and Piva, 2006). Alliances are beneficial as they combine a market's incentive structures while upholding the monitoring power attributed to organizational hierarchy (Mowery, Oxley, & Silverman, 1996), thereby providing a superior means to gain access to resources while minimizing risk.

Following the above logic, research on alliance ambidexterity makes the assumption that alliance governance structures impact the conduct of exploitation and exploration. More specifically, current studies draw on two distinctions, one being the differentiation between an equity position and mere contractual agreements (Arora & Gambardella, 1996; Koza & Lewin, 1998; Zimmermann & Raisch, 2009), the other being a differentiation between contractual governance and relational governance mechanisms (Gilsing & Noteboom, 2006; Gulati, 1995; Kale, Singh, & Perlmutter, 2000). Yet, only a few studies explicitly define the particular type of alliance governance structure under consideration, decoupling the specificities of the alliance from the actual conduct of exploitation and exploration. For example, while Rothaermel and Deeds aspire “to characterize the type of search and the type of alliances firms are pursuing” (2004: 203) their classification provides only a differentiation between upstream and downstream alliances, while the actual alliance governance typology is not further specified. For Dittrich, Dysters, de Man (2007), on the contrary, exploitation alliances usually take an equity position to specify agreed upon targets, while exploratory alliances tend to be loose collaborations for the lack of contractual specification. Inconsistencies of the term ‘alliance’ in the context of alliance ambidexterity prohibit linking alliance governance specificities to particular learning activities, resulting in a lack of generalizability of research findings and comparability.

5.3 Theoretical Lenses in Alliance Ambidexterity

Researchers studying alliance ambidexterity have drawn on a wide range of theoretical lenses both in the field of strategic management and organizational theory. Table 10 summarizes the most common theories found in research on alliance ambidexterity.

Table 10: Theoretical Lenses Used in Alliance Ambidexterity

Theoretical Lens	Publication
Resource based View	Colombo, Grilli & Piva (2006), Dyer & Singh (1998), Grant & Baden-Fuller (2004), Kan, Morris & Snell (2007), Rothaermel (2001), Rothaermel & Deeds (2004)
Social Networks Theory	Beckman, Haunschild, & Phillipe (2004), Dittrich, Dysters, & de Man (2007), Lavie & Rosenkopf (2006), Lavie, Kang & Rosenkopf (2011), Lin, Yang, & Demirkan (2007), Powell & Koput, & Smith-Doerr (1996), Rowley, Behrens, & Krackhardt (2000), Tiwana (2008), Vanhaverbeke et al (2007)
Organizational Learning Perspective	Bercovitz & Feldman (2007), Faems, Van Looy, Debackere (2005), Gilsing & Nooteboom (2006), Heimeriks, Duysters, & Vanhaverbeke (2007), Hoang, Rothaermel (2010), Holmqvist (2004), Im & Rai (2008), Kang & Rosenkopf (2011), Kauppila (2010), Koza & Lewin (1998), Lavie & Rosenkopf (2006), Lavie, Powell, Koput, & Smith-Doerr (1996), Vurro & Russo (2009)
Transaction Cost Theory	Cassiman & Valentini (2009), Colombo, Grilli, & Piva (2006), Pisano (1991), Powell, Kopt Smith-Doerr (1996), Rothaermel, Alexandre (2010)
Competence and Contractual Perspective	Doganova et al. (2010)
Agency Theory	Doganova et al. (2010)
Social Capital	Kan, Morris, & Snell (2007)
Resource Dependence Theory	Beckman, Haunschild, Phillipe (2004), Park, Chen, & Gallangher (2002), Rothaermel & Deeds (2004)
Evolutionary Theory	Park, Chen, & Gallangher (2002)

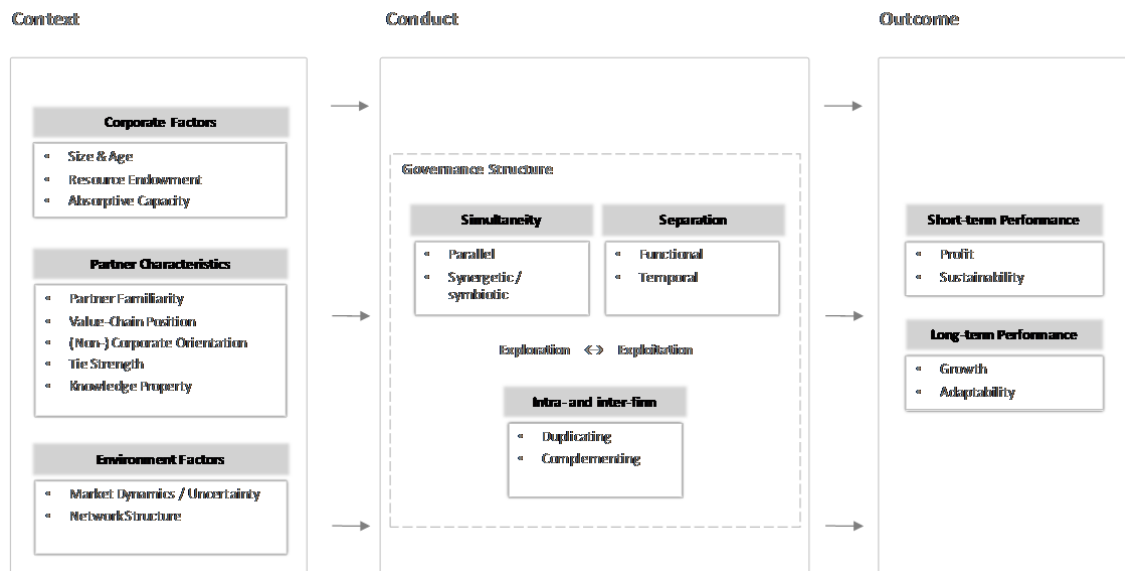
In the majority of studies in this review, researchers chose to integrate two or more theoretical lenses to examine the phenomenon under analysis. Interestingly, four theories that have been integrated in a significant number of studies are the organizational learning perspective (Bercovitz & Feldmann, 2007; Gilsing & Nooteboom, 2004; Holmqvist, 2004; Powell, Koput, & Smith-Doerr, 1996; Rowley, Behrens, & Krackhart, 2000), social network theory (Lavie et al., 2009; Rowley et al., 2000; Tiwana, 2008; Vanhaverbeke et al., 2007), the resource-based view of the firm, including the knowledge based view, (Colombo, Grilli, & Piva, 2006; Grant & Baden-Fuller, 2004; Kang, Morris, & Snell, 2007), and transaction cost economics (Colombo, Grilli, & Piva, 2006; Powell, Koput, & Smith-Doerr, 1996). Other theoretical lenses that have been applied are agency theory (Doganovan et al. 2010), social capital perspective (Kale, Singh, & Perlmutter, 2000; Kang, Morris, Snell, 2007), resource dependency theory (Park, Chen, Gallagher, 2002), and the competence and contractual perspective (Doganova et al., 2010).

Researchers have examined the phenomenon of alliance ambidexterity through a range of different theoretical lenses; however, some theories seem particularly suited to address specific research questions. In reviewing the literature, the majority of studies examining antecedents to alliance ambidexterity drew on social network theory (Lavie et al., 2009; Rowley et al., 2000; Tiwana, 2008; Vanhaverbeke et al., 2007), while almost all studies on the conduct of ambidexterity focused on the organizational learning perspective (Bercovitz & Feldmann, 2007; Gilsing & Nooteboom, 2004; Holmqvist, 2004; Rowley et al., 2000). These theory groupings demonstrate a pattern in what frameworks and proxies are used to understand alliance ambidexterity. Specifically, the proxies and constructs utilized in operationalizing the research question heavily influence or drive the theoretical grounding drawn upon to explain the phenomenon in question. For example, when focusing on the conduct of alliance ambidexterity, a number of concepts are borrowed from the organizational learning perspective, such as incremental and radical innovation. A concise way to illustrate face validity is to relate these concepts in a similar manner to how they would be used in the learning literature. Thus, when studies on antecedents use proxies exhibiting a strong resemblance to concepts from alliance and network literatures, certain relationships between parts of the theory can already be established. The question remains though if this approach is always optimal; studies on the performance implications of alliance ambidexterity do not show any dominant theoretical grounding.

5.4 Scope of the Review

In this review we will focus on studies of alliance ambidexterity that have been published in leading management journals such as *Academy of Management Journal*, *Academy of Management Review*, *Journal of Management*, *Journal of Management Studies*, *Research Policy*, *Strategic Management Journal* and *Organization Science* between 2000 and 2010, when the research field expanded dramatically. As an exception, we will also include the seminal paper by Koza and Lewin (1998) due to its importance to the overall development of this research stream. We provide a short outline of the core set of 23 articles on alliance ambidexterity in Table 11. However, to be comprehensive, we also may reference earlier publications and those that use the concepts of exploitation and exploration without specifically being labeled as such, as well as selected discussion papers yet to be published.

Figure 8: Framework of Alliance Ambidexterity



Our review is structured by a context-conduct-outcome framework (see Figure 8) that integrates the antecedents, operational means, and performance outcomes of alliance ambidexterity. As our review will show, most of the reviewed studies focus on partner characteristics as drivers of alliance ambidexterity and structural separation of exploitation and exploration of alliance ambidexterity. Further, with the exception of a few studies (Hoang & Rothaermel, 2010; Tiwana, 2008), the majority of papers take a firm level perspective, limiting the findings we have so far on drivers at the meso and micro levels of alliance ambidexterity. More complex relationships moderated by additional variables or multi-level analysis are scarce and will be addressed in the section on promising future research venues. Nonetheless, our framework attempts to provide researchers in the field of alliance ambidexterity with a comprehensive perspective.

Table 11
Selected Studies on Alliance Ambidexterity (2000-2011)

Author (s) (Year)	Research Focus	Theoretical Lens	Def. of exploitation / exploration	Alliance type	Key Finding
Beckman, Haunschild, Phillips (2004)	Antecedents <i>Partner Typology</i> <i>Environmental Factors</i>	Social Network Theory Resource Dependence Theory	Exploitation: Alliance or interlock with existing partner Exploration: Alliance or interlock with a new partner	n/a	Analyzing the pattern by which firms choose alliances, the authors provide evidence that firms form relationships with new partners as a form of exploration, while additional relationships with existing partners serve as a form of exploitation. Further, firms choice to engage in exploration or exploitation alliances depends on the nature of uncertainty that firms experience: firm-specific or market-level uncertainty.
Bercovitz, Feldman (2007)	Antecedents <i>Partner Typology</i>	Organizational Learning Perspective	Exploitation: Percentage of R&D dollars to refinement and extension of firm's existing competencies and products, Exploration: Percentage of R&D dollars to search, discovery, and development of new knowledge and products	n/a	Focussing on universities-firm alliances, the authors argue that firms pursuing internal R&D strategies more heavily weighted toward exploratory activities and those firms with more centralized internal R&D organizations will make greater use of exploratory university-based research alliances and engage in more multifaceted relationships.
Colombo, Grilli, Piva (2006)	Antecedents <i>Partner Typology</i> <i>Corporate Factors</i>	Resource based View Transaction Cost Theory	Exploitation: commercial / downstream partner Exploration: technological / upstream partner	n/a	In light of firm-specific characteristics (asset complementarity and firm size), the authors make a distinction between start-ups engaging in exploitative commercial alliances and explorative technological alliances. Moreover, patent holding affects positively the engagement in commercial alliances, however, this propensity is found to rapidly decrease with increase in firm size by the start-up.
Dittrich, Dysters, de Man (2007)	Antecedents <i>Partner Typology</i> <i>Environmental Factors</i>	Social Network Theory	Exploitation: Equity alliances existing partner Exploration: Non (few) equity alliances with a new partner	equity vs. non-equity	The study analyzes how IBM managed a radical redirection from an exploitation strategy towards an exploration strategy by involving new partners in their network while loosening ties with its existing partners.

Author (s) (Year)	Research Focus	Theoretical lens	Def. of exploitation / exploration	Alliance type	Key Finding
Faems, Van Looy, Debackere (2005)	Antecedents <i>Partner Typology</i> Performance	Organizational Learning Perspective	Exploitation: existing product whose performance has been significantly enhanced or upgraded. Exploration: product whose technological characteristics / intended uses differ significantly from those of previously produced products	n/a	This study showed that collaboration with customers and suppliers, termed exploitative, coincide with product improvement, while collaboration with universities and research center, termed exploratory, lead to performance increase through new product development. It can be concluded that the more firms engage in a variety of different inter-organizational collaborations, the more likely they are to create new and improved products that are commercially successful.
Hoang, Rothaermel (2010)	Conduct Inter- and intra-firm Performance	Organizational Learning Perspective	Internal Exploitation: cumulative percentage of sales from therapeutic class External Exploitation: percentage of licensing and manufacturing agreements Internal Exploration: R&D projects in a particular therapeutic domain. External Exploitation: percentage of R&D alliances	n/a	While the authors maintain with previous literature that exploitation and exploration alliances are used by firms to compensate for lack of resources and complement their abilities, they further provide evidence that internal and external exploitation and exploration emphasize each other. In that sense, a firm's internal exploration experience enhances the benefits that are accrued from engaging in exploitation alliances, while internal exploration experience benefits a firm's absorptive capacity, thereby enhancing the screening ability to recognize external opportunities from new technological developments.
Holmqvist (2004)	Conduct <i>Simultaneity</i> <i>Inter- and Intra-firm</i>	Organizational Learning Perspective	Exploitation: behaviors such as refinement, routinization, reproduction, fine tuning, modification, and sophistication Exploration: behaviors such as experimentation, novelty, risk taking, trialing, and innovation	n/a	The findings of an in-depth case study suggest that intra-firm experiential learning processes of exploitation and exploration generate inter-firm exploitation and exploration and vice versa. Triggered by dissatisfaction with existing learning routines two mechanisms opening-up and focusing drive circulation between exploration or exploitation. Opening-up describes how exploitation generates exploration, focusing how exploration generates exploitation. Finally, the authors define two intermediary learning processes that link intra- and inter-firm learning together: extension and internalization.
Im, Rai (2008)	Conduct <i>Simultaneity</i> Performance	Organizational Learning Perspective	Exploitation: 3-item on alignment Exploration: 3-item on adaptability Measures adapted from Gibson, Birkinshaw (2004)	n/a	Under the consideration of both the length of a relationship and the ontological commitment, the authors show that both exploratory and exploitative knowledge sharing lead to relationship performance gains, measured by efficiency, effectiveness, and service quality.

Author (s) (Year)	Research Focus	Theoretical lense	Def. of exploitation / exploration	Alliance type	Key Finding
Kauppila (2010)	Antecedents <i>Partner Typology</i> Conduct <i>Inter- and Intra-firm</i>	Organizational Learning Perspective	Exploitation: Discipline / experienced employees / market pull / weak ties Exploration: Chaos / un-experienced employees / technology push / weak and strong ties	contractual vs. relational governance	The author illustrates through an in-depth field study how a firm can build and manage an organizational setting that internally balances exploitation and exploitation while leveraging exploitation and exploration through structurally separate inter-firm alliances. The author further illustrates that exploitation alliances show more contractual governance elements, while exploratory alliances build largely on relational elements.
Koza, Lewin (1998)	Antecedents <i>Environmental Factors</i> Conduct <i>Separation</i>	Organizational Learning Perspective	Exploration and exploration conceptualization in line with March (1991)	Equity vs. co-participating alliances	The authors propose a framework to appropriate when a firm is inclined to engage in an exploitation or exploration alliance. It is assumed that stable markets foster exploitation alliances, while increased competitiveness will lead to both exploitation and exploration alliances. Past success in one type of alliance will drive future similar engagements and finally, equity engagement is assumed to drive exploitation, while exploration is conducted in co-participating alliances.
Koza, Lewin (2000)	Conduct <i>Separation</i> <i>Simultaneity</i>	Organizational Learning Perspective	Exploration and exploration conceptualization in line with March (1991)	n/a	The authors extend and build upon their previous dichotomy between exploitation and exploration concluding that a third alliance form exists, the hybrid (ambidextrous) alliance. Subsequently the authors define five criteria - loyalty, control, ability to absorb knowledge, time horizon, and success criteria - by which all three alliances types can be classified.
Lavie, Kang, Rosenkopf (2009)	Conduct <i>Separation</i> <i>Simultaneity</i> Performance	Social Network Theory Organizational Learning Perspective	Exploitation: knowledge-leveraging / prior partners Exploration: knowledge-generating / new partners	n/a	The findings of this study reveal, resource allocation tradeoffs and conflicting organizational routines undermine performance when firms balance exploration and exploitation within the function (knowledge-generating vs. knowledge-leveraging alliances) and structure domains (new vs. prior partners). In turn, domain separation can balance exploration and exploitation. Hence, the authors provide evidence that some forms of balance are more effective than others.

Author (s) (Year)	Research Focus	Theoretical lens	Def. of exploitation / exploration	Alliance type	Key Finding
Lavie, Rosenkopf (2006)	Conduct <i>Separation Simultaneity</i>	Social Network Theory Organizational Learning Perspective	Exploitation: knowledge-leveraging / prior partners / similar partner Exploration: knowledge-generating / new partners / dissimilar partner	n/a	The authors of this study demonstrate how firms in the software industry simultaneously balance exploration and exploitation in alliance formation across the (1) value chain function of alliances, (2) specific partner attributes, and (3) the partners' network positions. Findings support that firms balance their tendencies to explore and exploit over time and across domains.
Lin, Yang, Demirkan (2007)	Antecedents <i>Corporate Factors Environmental Factors</i> Performance	Social Networks Theory	Exploitation: Alliance with existing partner Exploration: Alliance with new partner	n/a	This study reveals that while an ambidextrous formation of alliances benefits large firms, a focused formation of either exploratory or exploitative alliances benefits small firms. Moreover, in an uncertain environment an ambidextrous formation enhances firm performance but so does a focused formation in a stable environment. Finally, a firm's centrality and structural hole positions in network relations can moderate the relationships between alliance formation choices and firm performance, and that the ambidexterity hypothesis may be limited to the earlier stage of the network development.
Park, Chen, Gallagher (2002)	Antecedents <i>Corporate Factors Environmental Factors</i>	Resource Dependence Theory	Exploitation: manufacturing, marketing, technology-licensing, second-sourcing, and funding agreements Exploration: Joint R&D	n/a	This authors find that, in turbulent industries, a firm's propensity to enter exploration or exploitation alliances relates to its resource endowment, with resource-poor firms preferring exploitation over exploration alliances. However, in stable markets, this relationship reverses, and resource-poor firms become more active in alliance formation.
Rothaermel (2001)	Antecedents <i>Corporate Factors Partner Typology</i>	Resource Based View Resource Dependency Theory	Exploitation: market delivery of existing products Exploration: new product development	n/a	The paper provides evidence that incumbents exploiting complementary assets are more successful than those focusing on exploring a new technology development. However, there are diminishing marginal returns to alliance intensity.

Author (s) (Year)	Research Focus	Theoretical lens	Def. of exploitation / exploration	Governance type	Key Finding
Rothaermel, Alexandre (2010)	Conduct <i>Inter- and intra-firm</i> Performance	Organizational Learning Perspective	Exploitation: known technologies that are with the firm for considerable time and are neither new to the firm or the industry Exploration: new technologies are measured as the inverse of known technologies, unknown = new		Based on a multi-industry sample of U.S. manufacturing companies, the authors provide evidence that firm's overall technology innovation strategy consists of pursuing exploration and exploitation through combining internal and external knowledge sources. The findings show that a curvilinear relationship exists between a firm's technology sourcing mix and its performance, while a firm's absorptive capacity positive moderates this relationship.
Rothaermel, Deeds (2004)	Antecedents <i>Corporate Factors</i> <i>Partner Typology</i>	Resource Based View Resource Dependency Theory	Exploitation: products on the market Exploration: Products in development	n/a	The authors present that biotechnology firms that are able to implement an alliance strategy along the value chain based on exploration and exploitation alliances to form an integrated system of new product development are rewarded with enhanced performance. However, findings highlight that this integrated product development path is moderated negatively by firm size.
Rowery, Behrens, Krackhardt (2000)	Antecedents <i>Environment</i> <i>Partner Typology</i>	Social Networks Theory	Exploitation: limited number of PhD specialists in different fields of operation / process innovation Exploration: large number of PhD specialists in different fields of operation / product innovation	contractual vs. relational governance	In the light of exploitation and exploration, the authors evaluate under conditions strong and weak ties (relational embeddedness), and closed and sparse networks (structural embeddedness) are sources of competitive advantage. While strong ties have a negative performance impact in a highly interconnected network in the semiconductor industry, both weak and strong ties have positive impact in the steel and semiconductor industry.
Tempelaar, Van de Vrande (2011)	Conduct <i>Inter- and intra-firm</i> Performance	Organizational Learning Perspective	Internal Exploitation: citing own patents, the focal firm has cited before External Exploitation: citing other firm's patents, the focal firm has cited before Internal Exploration: citing own patents, the focal firm hasn't cited before External Exploration: citing other firm's patents, the focal firm hasn't cited before	n/a	Both external sourcing of exploitation and exploration and boundary-spanning sourcing of internal exploitation and external exploration have a positive effect on performance over time. Internal sourcing of exploitation and exploration has a negative effect on firm financial performance over time, whereas boundary-spanning sourcing of external exploitation and internal exploration has an insignificant relationship with performance.

Author (s) (Year)	Research Focus	Theoretical lens	Def. of exploitation / exploration	Governance type	Key Finding
Tiwana (2008)	Antecedents <i>Environment</i> <i>Partner Typology</i>	Social Networks Theory	Exploitation = item on alignment Exploration = item on adaptability Measures adapted from Gibson, Birkinshaw (2004)	n/a	The authors of this study examine the tensions and complementarities between structural hole-bridging ties and strong ties in influencing ambidexterity in innovation-seeking project alliances. Notwithstanding their tensions—strong ties complement bridging ties in enhancing alliance ambidexterity at the project level. While bridging ties provide access to diverse, structural hole-spanning perspectives and capabilities, strong ties help integrate them to realize an innovation.
Vanhaverbeke, Gilsing, Beerkens, Duysters (2007)	Antecedents <i>Environment</i> <i>Partner Typology</i>	Social Networks Theory	Exploitation: Patenting in the same technological areas as \emptyset 5 year background Exploration: Patenting in an area not among the \emptyset 5 year areas	n/a	Based on an analysis of three different industries, this study finds evidence that two types of redundancy in a focal firm's ego network affect its ability to create new technologies in its technology core areas (exploitation) and/or non-core areas (exploration).
Vurro, Rosso (2009)	Conduct <i>Inter- and intra-firm</i> Performance	Organizational Learning Perspective	Internal Exploitation: Patenting in the same technological areas External Exploitation: downstream partner (i.e. marketing) Internal Exploitation: Patenting in a novel area External Exploitation: upstream partner (i.e. R&D)	n/a	Firms that engage in internal exploitation tend to balance such learning orientation with explorative interorganizational agreements. Consistently, those firms engaged in external exploitation tend to balance it with an internal focus on exploration, at least in the case of exploitative alliances involving familiar partners. Moreover, results confirm that such complementary cross-boundary strategies improve a firm's innovative performance.

5.5 Antecedents of Alliance Ambidexterity

Scholars assume that factors both within the organization and outside its boundaries impact the exploitation-exploration dichotomy (Lavie, et al., 2010; Kauppila, 2010). The literature on alliance ambidexterity can be broadly clustered into three categories of antecedents that facilitate firms to become ambidextrous through alliances: the corporate factors that incentivize a firm to orient beyond the corporate boundaries to operationalize and balance both activities, the partner characteristics that provides ex-ante features by which a firm judges an exploitation or exploration opportunity, and the environment within which the organization operates. Hereafter, we will outline the antecedents in each of the three categories that condition a firm's choice between exploitation and exploration in order to alleviate the pressures that their simultaneous conduct causes.

5.5.1 Corporate Factors

While there is ample literature on drivers that induce organizational ambidexterity, literature on alliance ambidexterity has so far concentrated on three categories that drive a firm to reach out to external partners for exploitation and/or exploration: a firm's size and age, the firm's resource endowment, and the absorptive capacity to detect and absorb information from external partners.

Organizational size and age / Resource endowment. The majority of papers control for both firm size and/or age, but only a limited number of studies have made those antecedents the phenomenon under analysis. In determining whether a firm's size and age provide compelling arguments to pursue exploitation or exploration, the literature at present has provided rather conflicting results. With respect to firm size, large established incumbents purportedly are better positioned to engage in both exploitation and exploration due to resource access and an established market position. Lin, Yang and Demirkan (2007) show that although an ambidextrous formation of alliances benefits large firms; small firms must remain focused on forming either exploratory or exploitative alliances due to a lack of resources. Park, Chen, and Gallagher (2002) provide evidence that resource-rich firms exhibit U-shaped relationships between growth of market competitiveness and the formation of exploitation and exploration alliances. Accordingly, resource-rich firms smooth revenue streams in growing as well as declining markets through exploitation alliances that facilitate better use of existing

resources; at the same time they are able to employ current resources in exploration alliances in volatile markets to secure future returns and long-term viability.

Contrary to the above studies, researchers have also argued that large established firms run the risk of inertia, which manifests itself “when the speed of reorganization is much lower than the rate at which environmental conditions change” (Hannan & Freeman, 1984: 151). Lavie and Rosenkopf (2006) provide empirical evidence that firms with previous experience and success in either exploitation or exploration will continue on either trajectory operating as self reinforcing mechanisms. However, the authors note that firms are able to overcome inertia through alliance activities with external partners. Arora and Gambardella (1990) support the notion that large incumbents have a tendency to exploit internally, while forming alliances with start-ups and universities in an exploratory manner, as a means to catch up with market progress.

With respect to a firm’s age, studies have focused on the liability of newness argument, in that young firms that are new on the market have higher risks of failure compared with old ones. Stuart (2000) argues that start-ups are associated with lower status, which may limit their flexibility in alliance formation and respective access to resources. Colombo, Grilli, and Piva (2006) analyze the alliance engagements of start-ups along the value chain, saying that small firms complement their mostly exploratory assets with downstream commercial avenues to deliver a product or service to market. In this sense, start-ups outsource exploitative functions that cannot be internalized due to financial constraints. The author’s analysis substantiates the liability of newness argument by further highlighting that patent holding start-ups have greater success in establishing exploitation alliances, implying that patents provide evidence of legitimation for potential external partners. This however conflicts with findings by Baum et al. (2000) who illustrate that start-ups show higher survival rates from engaging in exploitation and exploration alliances that complement each other, as a result of access to information and resources with low redundancy, while allying with potential rivals that offer learning opportunities while minimizing risk of intra-alliance rivalry.

Absorptive capacity. A firm’s access and subsequent internalizing of external resources, in particular knowledge, is determined by a firm’s absorptive capacity. This ability reflects the possession of accumulated knowledge in a firm over time, and

influences how the firm can recognize the value of external knowledge and utilize it accordingly (Cohen & Levinthal, 1990). While the majority of papers do not explicitly test for absorptive capacity, most studies refer implicitly to a firm's absorptive capacity. Bercovitz and Feldman (2007) however, explicitly argue that firms with more elaborate and centralized internal R&D organizations will make greater use of exploratory, mostly university-based research alliances, and engage in more multifaceted relationships, thereby further developing their absorptive capacity. Developing this capability is in line with literature in organizational ambidexterity, which has referred to internal R&D engagements being critical to external information absorption (i.e., Rothaermel & Alexandre, 2009).

5.5.2 Partner Characteristics

While research on intra-organizational ambidexterity has strongly advocated the structural separation of exploration and exploitation (Gibson & Birkinshaw, 2004), alliance ambidexterity has used an analogy where firms separate out both activities by use of different partners. Assuming portfolio logic, organizations engage in alliances that drive exploitation to leverage existing knowledge, while separate explorative alliances engage in new product development (Koza & Lewin, 1998; Rothaermel & Deeds, 2004) which cumulatively generate ambidexterity across the alliance portfolio.

Partner familiarity. A firm's familiarity with its partner has been used as a proxy for the exploitation-exploration dichotomy, assuming that firms establish specific relationships whose purpose lie in exploitative or exploratory goals. As Beckman et al. (2004) point out, firms seek to reconcile this tension between exploitation and exploration by engaging in collaborations with new partners as a form of exploration, while strengthening additional relationships with existing partners as a form of exploitation. Similarly, Gilsing and Noteboom (2006) argue that known partners have experienced special investments in building up mutual understanding and relation-specific trust to engage in exploitation; as such, generating knowledge overlap and mutual understanding providing the two firms with common grounds. Grant and Baden-Fuller (2004) refer in their paper to 'knowledge application' alliances that foster knowledge sharing to exploit complementarities while firms use 'knowledge generation' alliances to transfer and absorb the partner's knowledge through exploration.

Value-Chain position. Generally, studies classify alliances according to vertical and horizontal alliances along the value chain (Rothaermel & Deeds, 2004), with vertical partners driving exploitation and horizontal partners being responsible for exploratory innovations. According to this logic, Kauppila (2010) asserts exploration partnerships are those that focus on value creation associated with upstream activities like R&D, and exploitation partnerships focus on creating value that is generally associated with the downstream activities like marketing and commercialization. Rothaermel and Deeds went even further in proposing an integrated product development path where “a technology venture’s exploration alliances predict its products in development, while a venture’s products in development predict its exploitation alliances, and where its exploitation alliances in turn lead to products on the market” (2004: 202). Finally, Faems et al. (2005) describe vertical and horizontal collaborations in that vertical partners like customers and suppliers are labeled as exploitative alliances, assuming they are associated with higher returns stemming from improved products, while horizontal collaborations like universities and research organizations drive higher output of new product development, qualifying as exploratory.

(Non-) Corporate orientation. Going beyond the differentiation between corporate partners, researchers have lately concentrated on the differentiation between corporate vs. non-corporate partners in alliance ambidexterity. The assumption made is that non-corporate partners, particularly in research intense industries like biotechnology, pharmaceuticals and technology, choose partners that are outside the value chain to break path-dependency. Arora and Gambardella (1990) provide an elaborate distinction of incumbents partnering with small biotech firms and university research centers. Their findings provide a distinction of four strategies by which downstream development agreements with small start ups provide for pure exploitation, while basic research with universities is considered exploration. Interestingly, once equity investments are assumed between the incumbent and the start up, the alliance shows both exploitation and exploration activities. Important to notice is that the activities with the start up and the university do not cannibalize each other, which could be assumed given their orientation towards exploratory activities. In a similar vein, Knudsen (2007) and Rothaermel and Deeds (2004) proclaim that exploration alliances are generally assumed with universities and other research institutions.

Tie strength. Applied from the general innovation literature, alliance ambidexterity research has adopted the logic of strong vs. weak ties, linking them to different

learning types and environmental conditions (Dittrich et al., 2007). However, much like the network literature, research on alliance ambidexterity is not fully consistent on the directionality of weak and strong ties and how the redundancy of ties or structural holes might influence the effects of firms' decisions regarding exploitation and/or exploration activities.

Dyer and Nobeoka (2000) as well as Rowley et al.(2000) proclaim that highly interconnected, strong tie networks are well suited for the diffusion (exploitation) of existing knowledge rather than exploration of new knowledge, which is the strength of a 'weak tie' network. Kang, Morris, Snell (2007) highlight that strong and dense social connections provide access to fine-grained and in-depth knowledge, while weak and non-redundant social connections are likely to provide employees with exploratory learning. In a similar vein, Gilsing and Noteboom (2006) refer to tacit knowledge, which gets transferred through ties classified by high frequency of interaction and short duration of relationships, while explicit knowledge gets transferred by ties classified by low frequency of interaction yet long duration of relationships. Whereas explicit knowledge was linked to single-loop learning because the partners concentrate on current technologies, improvements, and adapting existing product or procedures; double-loop learning in exploration alliances would involve tacit knowledge channeled through mostly weak tie alliances. The differentiation between strong and weak ties has further been linked to environmental conditions. Rowley et al. (2000) provide evidence that the assumption of strong ties for exploitation is plausible when exposed to low levels of competition and environmental dynamism. Moreover, under conditions of rapid technological change where the need for explorative learning is highest, weak ties allow access to new innovations and alternative strategic directions.

Aside from differentiating between weak and strong ties and linking them to specific learning types, authors have also started to analyze how both types of ties may interact with each other. Tiwana (2008) and Simsek (2009) found that strong ties complement bridging ties in enhancing alliance ambidexterity in that bridging ties provide access to diverse, structural hole-spanning insights and capabilities, while strong ties help integrate them to realize an innovation. Similarly, Vanhaverbeke et al. investigated the link between network centrality and tie strength, emphasizing that the distinction between "redundancy that links as yet unconnected partners together (ego redundancy) and redundancy that intensifies the relations among partners that were already linked to each other (component density)" (2007: 239). Leading to the overall

assumption that exploration and exploitation can be combined, not only at the same time but also by making use of the same network structure of direct and indirect ties.

Knowledge property. Knowledge properties define the degree to which the knowledge structure of the firm and the alliance partner complement or overlap. Most scholars assume that with increasing degrees of diversity in knowledge learning, the firm steers towards exploration (Grant & Baden-Fuller, 2004; Rothaermel, 2001), but a minimum level of commonality in knowledge structures is needed.

Nooteboom et al. (2007) identified a correlation between explorative or exploitative outcomes and the cognitive distance, the distance of industries and technological knowledge, between the cooperation partners. Contingent upon absorptive capacity, the authors provide evidence that small overlaps or increasing knowledge distance will lead to exploration, while large overlaps of both technology and industry background will foster exploitation. Similarly, Colombo, Grilli and Piva (2006) assume a link between knowledge complementarity and exploitative alliances. At the same time, the authors found a negative correlation with increased firm size, assuming that while small firms are inclined to use partners for downstream, exploitative steps, an increase in firm size provides means to internalize these steps.

In contrast, Gilsing and Nooteboom (2006) link knowledge distance to learning types, assuming double-loop learning in exploration alliances, while exploitation alliances facilitate single-loop learning as the latter concentrates on current technologies, process improvements and adapting existing procedures. Knudsen summarized these findings by proclaiming that “If the theoretical expectation is correct, that complementary knowledge is a source of success in the long term, then the challenge for managers will be to include knowledge compatibility as a decision variable and accordingly to balance the exchange of supplementary and complementary knowledge requiring a balance of short- and long-term payoffs” (2007: 134). In sum, this suggests that varying degrees of knowledge novelty drive exploration and exploitation in alliance settings under the assumption of the absorptive capacity of the firm.

5.5.3 Environmental Factors

Multiple scholars have pointed towards systemic responses of firm's engagement in exploitation and exploration activities that reflect specific industry conditions. Most notably industry dynamics and uncertainty are conditions that drive firms' innovation activities. Furthermore, isolated from the industry context, the alliance ambidexterity literature assumes network settings to impact the engagement in exploitation and exploration.

Market dynamics / Uncertainty. Arguing that unstable environments' demand diversification of abilities, Haagedorn and Duysters (2002) provide evidence that more dynamic environments lead to more exploration, while stable markets foster exploitation. On the contrary, Grant and Baden-Fuller (2004) attested that uncertainty discourages investments in exploration, while exploitation remains unaffected. Stable environments on the other hand even increase the value of learning according to Grant and Baden-Fuller's study. Finally, Koza and Lewin (1998) assume to find both exploitation and exploration alliances to serve existing market demands while being conscious of and preparing for changing market conditions. Park, Chen, and Gallagher (2002) further refined the above notion by demonstrating that in volatile markets, resource-rich firms access external resources through exploitation and exploration alliances whereas resource-poor firms are less likely to do so. However, in relatively stable markets, this relationship reverses, and resource-poor firms become more active in alliance formation. While these studies concentrate purely on the industry level of uncertainty, Beckman et al. (2004) differentiate between uncertainties that are classified as market-level vs. those that are firm-specific. This differentiation goes in line with the assumption that not every environmental change is perceived alike by each firm, due to heterogeneous organizational endowments.

Network structure. Does the position of a firm within its network of collaboration partners influence the inclination of the firm to engage in alliances with an exploitative or exploratory orientation? Gilsing and Noteboom (2006) assume that the inclination to engage in exploratory alliances is fostered by open networks characterized by high fluctuation of network partners, while the opposite holds true for exploitative alliance. Rowley et al. (2000) who stated that densely inter- connected ego networks provide the firm with access to redundant information sources, claim that this network feature

also is a means for evaluating and mapping information overall from external sources thereby fostering exploitation.

5.6 Conduct of Alliance Ambidexterity

In the context of organizational ambidexterity, alliance ambidexterity is concerned with how a firm and its collaboration partner may participate in exploitation and exploration while alleviating the conflict between these opposing demands. Scholars claim that alliances can either have an exploitative, explorative, or ambidextrous orientation. As Lavie, Stettner and Tushman (2010) outline, literature in the field of alliance ambidexterity has drawn parallels from the organizational ambidexterity literature in assuming conduct by means of both separation and simultaneity. Most recently scholars have made the attempt to link the inter- and intra-firm perspective of ambidexterity. In sum, previous studies have (1) highlighted separation of exploitation and exploration in separate alliances, on either functional or temporal grounds, (2) defined conditions under which exploitation or exploration may be generated simultaneously in singular alliance settings, and (3) provided first insights into how organizational and alliance ambidexterity might interact with each other. Finally, scholars acknowledge the governance aspect of alliances in light of ownership and control rights.

5.6.1 Ambidexterity through separation

Functional separation. Core to the separation of exploitation and exploration by a functional domain is the assumption that the functional differentiation allows the collaborating partners to concentrate on one singular task at hand, as well as to operate in their field of expertise. De Propriis (2000) provides evidence that companies differentiating their collaborations along the supply chain, to specific functions, will be more successful in being innovative. Similarly, Rothaermel and Deeds (2004) distinguish exploration and exploitation alliances based on their functional purpose to reflect a product development path initiated by exploration alliances, and further developed through subsequent exploitation alliances. Focused on the software industry, Lavie and Rosenkopf (2006) extend the spatial separation to three criteria that simultaneously balance the tension between exploitation and exploration. Their findings provide evidence that it is not the functional domain singularly, but in combination with the attributes of partners, and partners' network positions that lets firms engage in the exploitation-exploration dichotomy. While previous studies apply

the firm level of analysis, Hess and Rothaermel (2011) offer one exception in analyzing the interaction effect between an individual scientist and exploitative and exploratory alliances. Based on data from the pharmaceutical industry, this finding illustrates that alliances and individual scientists should serve as complements in the value chain, one concentrating on exploitation, while the other is concentrating on exploration, rather than substitutes in order to generate superior performance.

Temporal separation. Temporal separation of alliance ambidexterity involves cyclical conduct of exploitation and exploration in the sense that two firms may concentrate on exploitation at a given point in time while being able to switch over to the conduct of exploration as needed. Powell et al. (1996) were the first to state that strong emphasis on R&D alliances (exploration) will drive more non-R&D alliances (exploitative) subsequently. The authors assume that the conduct of exploration in time period one will not only provide grounds for exploitation but also diversify the alliance portfolio, operating as a multiplication factor to the diversity of alliances in time period two. According to Lavie and Rosenkopf (2006), inter-temporal switching between exploitation and exploration alleviates the challenges of operating conflicting demands simultaneously, however, over time, an overall trend of fewer R&D alliances and more downstream alliances shows. Through activity sequencing, firms match current market demands, while switching over to exploratory activities if needed. Gilsing and Noteboom (2006) extend this thought further in developing a self-contained system that outlines how the conduct of exploration provides for diversification that is executed through subsequent exploitative endeavors. Finally, Colombo et al. (2006) make a different discovery that while over time the exploitation orientation in alliances might decline, the exploratory orientation remains steady, possibly due to the differences in timeframes that exploitation and exploration encompass.

5.6.2 Ambidexterity through simultaneity

Parallel conduct. In contrast to previous contributions in alliance ambidexterity that assume organizations need to structurally differentiate between exploratory and exploitative alliances, subsequent studies made the assumption that both may also co-exist in single alliance settings. However, existing literature on ambidexterity highlights that exploitation and exploration also need to be assimilated (O'Reilly & Tushman, 2008). As Sirmon, Hitt and Ireland (2007) indicated, integrative efforts are

necessary to appropriate the full potential value embedded in both spatially separated exploitation and exploration activities. Recently, research by Im and Rai (2008) elaborated on this point and proposed that ambidexterity can also be achieved within single alliances driven by contextual features, such as incentives, internal planning and review mechanisms to govern both alignment and adaptability (Gibson and Birkinshaw; 2004). However, this contribution analyzes the firm level, and limited insight is derived regarding the interplay between knowledge of cooperation partners, knowledge exchange, and the integration process that generates the potential of balancing exploration and exploitation simultaneously within single alliance collaborations.

Synergetic / symbiotic conduct. When talking about a symbiotic or synergetic conceptualization of exploitation and exploration in alliances the assumption is made that both activities nurture each other and benefit from the simultaneous existence of the other within one singular alliance setting. As Koza and Lewin (2000) point out, exploitation and exploratory features within one alliance provide grounds to generate the highest learning output. As in the case of the Novartis Ciba Geigy alliance, early success of reaching defined exploitative goals led to a stronger learning platform from which additional exploratory learning was derived. In their multiple case study analyses, Zimmermann and Raisch (2009) found that alliances may contain collective knowledge processes, within which both partners exploit each other's knowledge bases, while engaged in the mutual exploration of each other's knowledge bases that may go beyond both partners' aggregated knowledge domains.

5.6.3 Ambidexterity through intra- and inter-firm ambidexterity

Complementing conduct. More recently scholars have made the attempt to link inter- and intra-firm ambidexterity, through which the organization connects its internal and external innovation activities towards exploitation and exploration. Holmqvist (2004) provides evidence based on an in depth case study that internal exploitation and exploration trigger external collaboration for both activities and vice versa. Interestingly, the author determines dissatisfaction either with existing exploitative or exploratory processes to be the driving mechanism behind these dynamics. Hess and Rothaermel (2008) subsequently build upon the assumption of linking exploitative and exploratory innovation through internal mechanisms and external alliances and provide empirical evidence that if spread over different activities both mechanisms

complement each other, while focusing on the same activity substitute each other. Vurro and Russo further substantiated that “firms that engage in internal exploitation tend to balance such learning orientation with explorative interorganizational agreements. Consistently, those firms engaged in external exploitation tend to balance it with an internal focus on exploration, at least in the case of exploitative alliances involving familiar partners. Moreover, results confirm that such complementary cross-boundary strategies improve a firm’s innovative performance” (2010: 30). Based on a longitudinal data-set over 23 years, Tempelaar and Van de Vrande (2011) analyze the effects of combining internal and external ambidexterity under consideration of local and distant knowledge types. Finally, Kauppila (2010) derived evidence from an in depth case study that firms’ ambidexterity rests on two mechanisms: structurally separate external maximization and internal organizational balance.

Duplicating conduct. While all previous studies assume a collaborative, additive nature between exploitation and exploration, Parmigiani (2007) proclaims a partially duplicative nature of external exploitative and exploratory alliance and internal exploitation and exploration. The author provides two reasons for this kind of replication. First, the greater the uncertainty on the outcome within alliances, the greater the inclination to duplicate similar activities internally to diversify and buffer potential risks. Alternatively, the author applies the absorptive capacity argument in that firms internally replicate the knowledge to be acquired in order to learn from the interaction with the external partner more efficiently.

5.6.4 Governance Structures in Alliance Ambidexterity

Aside from the overall distinction of simultaneous or separate conduct of exploitation and exploration, research has repeatedly highlighted the effect of governance structures on the conduct and performance implications of alliance ambidexterity. While the implicit assumption holds that different governance mechanisms will impact the conduct of exploitation and exploration, much less is known on the nuances. Two prevalent foci can be distinguished in existing research, on the one hand scholars classify ownership between equity engagement as opposed to contractual agreements, while on the other hand studies differentiate control mechanisms through either contractual or relational governance mechanisms.

Ownership. A central consideration for alliance ambidexterity is whether to engage in equity involvement or mere contractual agreements. Equity involvement provides more direction in developments, internalization of market developments, and defense from market competitors. As Arora and Gambardella (1996) pointed out, holding a minor share in a start-up, as opposed to project-based collaboration, offers the opportunity of preempting rivals in the commercialization of potentially relevant discoveries made. The authors further postulate that the equity involvement provides active influence on the direction and generation of particular products and as means of a large incumbent to catch up with market developments. As such, incumbents use the internalization of exploration-driven activities of small start-ups to exploit the findings and commercialize them effectively. Koza and Lewin (1998) as well as Dittrich et al. (2007), note that exploitation generally stems from equity engagement while loose co-practicing R&D alliances function as examples of exploration alliances. The reason why exploration alliances presumably are associated with loose contractual agreements was provided by Doganova et al., according to which “exploration alliances are particularly exposed to contractual hazards because the results of exploration are uncertain and distant in time and in their organizational locus, which impedes the design of complete contracts” (2010: 12). Conversely, Bercovitz and Feldman (2007) maintain that incumbents prefer to engage in long-term (equity-like) engagements with universities when the incumbent foresees potential problems protecting the knowledge created through alliances. Interestingly, the authors further postulate that not only do exploitation alliances show tendencies for equity involvement, but so do ambidextrous alliances. To ensure a partners reliability, it is assumed that the tangible targets of exploitation provide leverage for retaliation in case of opportunistic behavior by the partner due to the ambiguity of initial expectation and final achievements of exploration.

Control mechanisms. The second focus of governance structures in alliance ambidexterity taps precisely into this problem of ambiguity by contrasting contractual versus relational governance mechanisms. Here, the majority of authors take the stance that relational governance mechanisms provide grounds for exploration that contractual means lack due to the inability to have complete contracts. Gilling, Noteboom (2006) as well as Kale, Singh, and Perlmutter (2000) claim that relational capital functions as a protector to potentially opportunistic behavior as well as a facilitator to learning through close engagements between alliance partners. The authors apply the role of trust from the alliance literature (Gulati, 1995), assuming that

opportunistic behavior in one period will severely harm the firm in the future through negative reputation effects and potential loss of other alliance partners in fear of similar behavior.

5.7 Performance Implications of Alliance Ambidexterity

While one stream of research highlights that organizations that pursue either exploration or exploitation in alliances outperform those that combine these activities, more recent studies report that the pursuit of both activities simultaneously enhances performance. To generalize from those fundamentally diverging findings on firm performance is problematic.

Rothaermel (2001) was the first to link the environment to the performance of alliance ambidexterity. He provided evidence that exploitative alliances have a stronger impact on the innovation output after technological change than do exploratory alliances, based on the assumption that the output is more directly visible. Findings by Rothaermel and Deeds (2004) suggest that biotechnology firms that design and implement an alliance strategy along singular exploration and exploitation alliances are rewarded with enhanced performance results. Similarly, Lavie, et al. (forthcoming) consider two domains of exploitation and exploration simultaneously, as a function of the partner familiarity and value chain, demonstrating that balance within the domains is negatively related to firm performance, while balance across domains is positively related to firm performance. Similarly, Faems et al. (2005) illustrate that diversified alliance portfolios over exploitation and exploration positively impact innovation output and result in performance increases. Doganova et al. (2010) support that despite alleged tensions between exploration and exploitation, ambidextrous alliances are not less efficient than alliances specialized in either exploration or exploitation.

Tempelaar and Van de Vrande (2011) find that external sourcing of exploitation and exploration and a combination of sourcing of internal exploitation and external exploration have a positive effect on performance over time. However, internal sourcing of exploitation and exploration has a negative effect on firm financial performance over time, whereas the combination of sourcing external exploitation and internal exploration shows no insignificant relationship with performance. Laursen and Salter (2006) define a firm's external engagement in exploitation and exploration by

search width and depth, and find support for increased innovation in case of concurrent conduct. However, these reported benefits are subject to decreasing returns, indicating that there is a threshold point with respect to a firm's engagement in both innovation activities. When taking into account contingency factors such as the industry environment, Lin, Yang and Demirkan (2009) found that ambidextrous alliances enhance firm performance in uncertain environments, but so does a focused concentration on either exploitation or exploration alliances in stable environments. Further, the authors emphasize that the age of the network, a proxy for its maturity, affects the performance implication in a firm's engagement in both exploitation and exploration alliances. While ambidextrous alliances are more beneficial in early stages of the network formation, at a later stage focused strategies on either exploitation or exploration drive positive performance results. Finally, Vurro and Russo (2010) conducted the only analysis into the performance effects when conducting exploitation and exploration, both internal and external to the firm. Results confirm that asset complementarity across firm boundaries improve a firm's innovative performance.

5.8 Directions for Future Research

Overall, research in the field of alliance ambidexterity has greatly expanded over the past decade. Yet, much is needed to establish a more consistent account for alliance ambidexterity. Entreaties for clarity on constructs and methodological transparency in the organizational ambidexterity literature (i.e. Raisch et al. 2009; Lavie et al, 2010) also hold true for the analysis of alliance ambidexterity. To a great extent research remains fragmented and the contextuality of the different studies prevents generalizability or comparability between different research findings. In particular research will need to a) refine definitions of terms and conceptualizations across research streams, b) identify additional antecedents while empirically substantiating the influence of those factors already identified in previous research, c) further clarify the understanding of balance vs. trade-offs of exploitation and exploration, and finally d) refine empirical modeling of exploitation and exploration measures. Table 12 provides an overview of present considerations and pressing questions for future research that can potentially enhance our understanding in the different areas of context-conduct-outcome in alliance ambidexterity.

Table 12: Summary of Current Considerations & Future Research Opportunities

Current Considerations

- Can the exploration–exploitation dichotomy be translated broadly to proxies, e.g. partner characteristics, or should it be considered narrowly in the learning and knowledge domain?
- Should the exploration-exploitation dichotomy be conceptualized orthogonally or on a continuum?
- Do firms always achieve superior performance via alliance ambidexterity or are its performance implications contingent?
- Should firms follow a concentrated strategy separating exploitation and exploration out in different alliances or should both activities be simultaneously performed in single alliances?
- How should exploitation and exploration be treated methodologically? Should alliance ambidexterity be captured by one compound measure or two separate measures?
- How do organizational and alliance ambidexterity co-evolve and co-perform?
- What is the impact of different governance types, on the continuum of loose collaborations to equity engagements, on the exploitation-exploration dichotomy?
- How does exploitation and exploration in alliances play out on different levels of analysis? How do projects and individuals generate ambidexterity in alliances?
- Should alliance ambidexterity be generated simultaneously or should alliances be used sequentially to support internal strategies?
- How do firms internalize alliance exploitation and exploration and when is it sufficient to rely on external alliances for ambidexterity?

Future Research Opportunities

Context

- Specify legitimate proxies of antecedents to alliance exploration–exploitation
- Contrast single alliance versus alliance portfolio as unit of analysis
- Explore and consider national and industrial influences and specifications on alliance

Conduct

- Explore multipartner alliance versus bilateral alliance settings
- Define integration measures to internalize findings from alliances to the firm level
- Study different modes of balancing exploitation and exploration in alliances
- Analyze different governance structures and their impact on alliance ambidexterity
- Shift from static view to longitudinal studies to capture the evolution to alliance

Outcome

- Explore short-term and long-term performance impact of alliance ambidexterity
- Determine types of firms that benefit from alliance ambidexterity and under which conditions
- Define alliance specific measures for performance outcomes of ambidexterity
- Specify performance differences between organizational ambidexterity and alliance ambidexterity

5.8.1 Context - Antecedents to Exploitation and Exploration

Whereas each individual antecedent provides intriguing explanations on the conduct of exploitation and exploration decisions, a comprehensive picture of how a firm can create ambidexterity in alliance settings is missing. With some exceptions, most categories provide not only conflicting but contradicting findings. This suggests that the inconsistencies in conceptualizations and methodological approaches may have given rise to these conflicting findings. While an extensive list of antecedents have been considered, future research needs to emphasize the establishment of conceptual and methodological standards that allow for generalizability of findings, as the following considerations outline.

First, scholars seek evidence for which corporate factors impact a firm's inclination to engage in exploitation or exploration alliances. However, existing studies fail to provide consistency towards a directional cause-effect relationship. The broader issue at hand is that the discrepancies in findings may be a result of varied contexts and/or operationalizations of the independent variable. Aside from the ambiguity in constructing exploitation and exploration as orthogonal or continuum variables, the conceptualization of independent variables show comparable inconsistencies. While Lin, Yang, and Demirkan (2007) and Lavie and Rosenkopf (2006) conceptualize firm size by one year lagged assets, Park, Chen and Gallagher (2002) and Arora and Gambardella (1990) measured firm size by annual sales. Finally, Rothaermel and Deeds (2004) estimate firm size by the number of employees. Future research must address whether divergent findings are a result from these varied independent variable operationalizations.

Second, our examination of partner characteristics as antecedents to exploitation and exploration provides evidence that while in some areas consensus is achieved in operationalizations of constructs, i.e. partner familiarity, some other typological features remain ambiguous. One overarching taxonomy provided by Lavie and Rosenkopf (2006), classifies different partner characteristics and how equilibrium between exploration and exploitation may be achieved across three different interpretations of alliance exploitation and exploration: function (marketing or R&D), structure (recurrent partner or new partner), and attribute (similar or dissimilar partner). However, most studies in the field of alliance ambidexterity operationalize the exploitation-exploration dichotomy by separating out the activities along only one

of above enumerated proxies. This, however, provides potential for conflict and again may give rise to the inconsistency on effects of exploitation and/or exploration. Moreover, future research might benefit from considering responses to environmental uncertainty while considering firm size, or other firm characteristics such as organizational structure and culture (Beckman et al., 2004: 272-273). We need further thought and research to understand why, in the case of alliances, firms react differently to firm-specific and market-specific uncertainties (Beckman et al., 2004).

Furthermore, little is known about the relative importance of social ties versus business logic in networks; both have been recognized as relevant influences, but to what extent they strengthen or contradict each other when conducting exploitation and exploration remains unclear (Dittrich et al., 2007). Finally, in a related field, Knudsen (2007) requests further research into the links that the relationship type, and particularly the strength of ties to the learning impact, have subsequently to the application of exploitation and exploration.

5.8.2 Conduct - Operating Exploitation and Exploration

Research has not addressed the operational dichotomy of exploitation and exploration beyond the firm level perspective. This is somewhat surprising, since the organizational ambidexterity literature has repeatedly emphasized that ambidexterity needs to be analyzed one level below its occurrence. Accordingly, in order to define whether a single alliance encompasses both exploitation and exploration, the project level needs to be analyzed. This means however, that the limited analysis of the firm level at present allows only weak inferences on how to generate ambidexterity on the portfolio or network level of alliances. Answering questions about how the group, business unit, or individual level operationalize exploitation and exploration across firm boundaries offer an opportunity to make an important contribution.

Research on organizational learning must develop conceptual models that will help to address complex experiential learning processes of exploitation and exploration empirically, both within and between organizations (Christensen & Overdorf, 2000). Laursen and Salter (2006) underline this point by proposing that innovation does not function in clear cut modules. Lavie and Rosenkopf on the other hand go a step further, by proposing to juxtapose intra- and inter-organizational exploration-exploitation. This would address the fundamental pressure of limited resource

allocation, how to overcome trade-offs in resource allocation (Cheng & Kesner, 1997) and knowledge creation (Rosenkopf & Nerkar, 2001) within and across organizational boundaries. Similarly, Vurro and Russo (2010) emphasize that the intra- and inter-organizational research streams have developed separately, neglecting the potential contributions of considering both learning trajectories as two related elements and their joint impact on performance. Multiple researchers have assumed that internal R&D intensity and orientation will drive engagement in alliance ambidexterity (Bercovitz & Feldman, 2007; Cassiman & Valentini, 2009). Along this line, Bercovitz & Feldmann (2007) have raised the question as to the centrality of both the R&D function and investments in a firm for engaging in alliance. Overall, this does not only call for a better understanding of learning processes that underlie incremental and radical innovation, but also how these processes change over time to accommodate the information needed in a complex innovation setting.

A further step in the analysis of alliance ambidexterity is from single alliances to multi-alliance analysis (Kale & Singh, 2009). Ahuja et al. (2008) recognize that many industries have fragmented innovation tasks where the overall conduct is conducted by multiple interconnected firms such that the appropriate locus of innovation is no longer the individual alliance, but the network of interconnected firms. More specifically, “while all inter-firm networks are ultimately composed of individual inter-firm linkages (and hence all advantages of cooperation that are valid for a dyadic linkage remain valid for a network composed of many such linkages), there are nevertheless distinctive effects that arise additionally from the network as a collective entity” (Ahuja et al. 2008: 14).

While present research has enhanced our understanding of the affects of governance structures on the exploitation-exploration dichotomy in alliance ambidexterity, much remains to be clarified. First, the aforementioned studies provide exceptions to the majority of studies conducted, which provide no distinction on the governance mechanisms in their sample. Moreover, studies make implicit assumptions or neglect the impact of governance structures. Second, the distinction of two extremes (equity vs. non-equity and contractual vs. relational) captures very limited information, that the nuances of governance structures may provide for. Zimmermann and Raisch (2009) make one of the first attempts in this direction by examining how different governance structures supported different types of alliance relationships. Based on in-depth case study analysis, the authors come to the conclusion that vertical relationships

with suppliers or customers maintain autonomous governance structures, while integrated governance structures pertain to horizontal inter-organizational relationships, i.e. competitors. The concerns raised here, however, tie back to the level of analysis concern, highlighting that more conduct is needed beyond the firm level of analysis. Research on the implications of governance structures will be better served, if individual projects and single alliances receive the much needed attention, and relational governance structure analysis focuses more on the individual level of analysis.

5.8.3 Outcome - Performance impact of Exploitation and Exploration

Moving beyond existing research on firm performance, Hagedoorn and Dysters (2002) request further studies in order to substantiate the assumption that alternative forms of networking behavior result in better technological performance of companies. Lavie, Kang and Rosenkopf (forthcoming) call for recognizing the multidimensionality of balancing exploitative and exploratory alliances across domains, thus enhancing firm performance without facing the adverse consequences of introducing organizational buffers or constantly modifying organizational structures. Rowley, Behrens and Krackhardt (2000) request more emphasis on interaction of structural and relational embeddedness and alliance motives when explaining firm performance results. There are several calls for more insights into the performance implications of alliance ambidexterity, particularly to determine which types of firms benefits from alliance ambidexterity and under which conditions. Further, under the assumption that the learning environment differs between intra-firm settings and alliances, the question arises, whether specify performance differences between organizational ambidexterity and alliance ambidexterity exist.

5.9 Conclusion

The sustained interest in ambidexterity research has been demonstrated by the extensive application and range of contributions in recent years. Despite significant progress in the conduct of exploration and exploitation research, several challenges remain. Whereas research on the intra-organizational level of exploration and exploitation has received much attention, ambidexterity from an alliance perspective is still in an infant stage. Most pressingly, research at present seems to lack agreement on what constitutes alliance ambidexterity. Both the variety of conceptualizations of exploitation and exploration in the alliance setting, and the general disagreement

whether alliance ambidexterity really increases firm performance lead to us to believe theoretical and methodological clarifications are needed. Increasing the generalizability and reliability of findings will allow scholars to build on each other's constructs with the rigor needed to fill remaining gaps; particularly to provide consistent evidence for the assumed positive performance effects alliance ambidexterity has been claimed to have.

In this paper, we developed a more comprehensive understanding of the present alliance ambidexterity literature by framing it in a context-conduct-outcome model. We highlighted the various antecedents, conduct and performance implications of exploitation, exploration, and the pursuit of appropriately balanced forms. Specifically, we outlined how environmental factors such as competitive intensity and dynamism, network structures, organization factors like size and age, resource endowment, absorptive capacity, and partner characteristics can induce organizations to engage in alliances to conduct exploration and/or exploitation.

Furthermore, we underscored the multiple facets that exploitation-exploration can take in an alliance setting, providing insight into the avenues to balance the tensions that the conduct of both inflicts. Our review clarifies the different approaches found in ambidextrous alliance settings; either separated in alliances along temporal and functional features or balanced in single alliances by means of parallel or symbiotic/synergetic conduct. Finally, more recent papers have started to link the organizational and alliance perspective of ambidexterity assuming that activities can be either duplicative or complementary across the intra- and inter-firm level.

Finally, we outlined gaps and provide an agenda for future research to substantiate and extend the conceptual foundations of the exploitation-exploration dichotomy in the alliance setting. Overall, the interest in March's concepts of exploitation and exploration has proven its viability and substance in management research, and can only benefit from its continued application to the alliance level.

6 Overall Discussion and Conclusion

The sustained interest in ambidexterity has been demonstrated by the extensive research conducted and range of contributions made in recent years (e.g., Raisch & Birkinshaw, 2008). In particular for the field of innovation management, research acknowledges that “exploitation and exploration are particularly apt for describing different types of innovation activities, and their appropriate integration presents a consistent dilemma for innovating organizations” (Chen & Katila, 2008: 197). While initially research has focused on ambidexterity generated within firm boundaries, recently inter-firm collaboration and external knowledge sourcing has moved to the center of attention (e.g., Lavie & Rosenkopf, 2006, Rothaermel & Deeds, 2004). This dissertation provides a comprehensive, yet detailed analysis and discussion of inferences for a firm's pursuit to simultaneously foster exploitation and exploration through establishing appropriate boundary-spanning conditions. Thereby, this dissertation does not only advance research conceptually but also tests developed hypotheses through both qualitative and quantitative research. This dissertation further develops present academic research on boundary-spanning ambidexterity but also develops recommendations for managerial practice that enable managers to render a well-founded judgment about appropriate configurations of boundary-spanning for incremental and radical innovation activities. To put it in the theme of this dissertation, the following chapter will serve as a platform where all the dots of the individual papers are connected to generate an overarching picture.

6.1 Contributions to research

Innovation plays a crucial role in corporate renewal and adaptation which are considered an indicator of firm survival and overall market performance (Banbury & Mitchell, 1995). While innovation is well accepted as an indicator to why firms perform differently within an industry, the means by which innovation becomes a differentiator of competitive advantage is still under-researched, and presents grounds that require further attention (Ahuja & Katila, 2004). Translating the concept of ambidexterity to include the external environment presents such an effort. While innovation has developed into a set of activities that largely depend on the interaction with external partners, much less is understood on the effects of locus, knowledge type, and procedure that boundary-spanning ambidexterity encompasses. This dissertation contributes in four important ways to present research on boundary-

spanning ambidexterity. The findings in the four studies in this dissertation allow us to further define, under which conditions boundary-spanning ambidexterity can be generated on the individual, project, firm and alliance level.

6.1.1 Contribution 1: Extending boundary-spanning ambidexterity to different hierarchical levels

Intentionally, each of the four studies of this dissertation concentrate on different hierarchical levels of the organization to provide valuable insights into the mechanisms in place that allow boundary-spanning ambidexterity to be generated throughout the organization. As Raisch and Birkinshaw highlight, “the level of analysis is vitally important, because choices about how to resolve the tension [of ambidexterity] at one level of analysis are often resolved at the next level down” (2008: 22). However, the majority of existing research has addressed the firm level of analysis (e.g., Rosenkopf & Nerkar, 2001; Rothaermel & Deeds, 2004). For that matter, the findings of this dissertation extend research on boundary-spanning ambidexterity by shedding light on how mechanisms operate on the project and individual level of the organization.

Most essentially, the findings provide insight that boundary-spanning ambidexterity is operated along different mechanisms at different levels of analysis that reflect and extend existing research in the field of ambidexterity. Study 1 focuses on the individual manager and provides insight on how the boundary-spanner’s multi-role environment allows exploitation and exploration activities to be conducted. This reflects findings by Gibson and Birkinshaw (2004), who have termed contextual ambidexterity, thereby granting a manager’s environment the ability to steer innovation conduct. While this dissertation builds upon this notion, it also takes the concept one step further through the integration of the manager’s personality traits. These insights present an important first step to develop an understanding how individual are able to act ambidextrous. This represents an important departure from a stream of research, which has emphasized the locus of ambidexterity at a higher level of analysis, yet acknowledging the role of the individual in achieving it (O’Reilly & Tushman, 2008). Unlike the individual level, where contextual ambidexterity facilitates the engagement in exploitation and exploration, the project level in study 2 highlights both structural and temporal separation of exploitation and exploration. Of the eleven cases analyzed, not all project settings were able to generate both

exploitative and exploratory outcomes. However, those projects that operated ambidextrously, showed clear structural separation of activities that would be reintegrated by means of team collaboration and the project architecture of both project partners.

The second insight that can be derived from the analysis of different hierarchical levels emphasizes the differential effect boundary-spanning has on the conduct of ambidexterity. As highlighted in the introduction, boundary-spanning might take any form from non-committal external scouting to close collaboration between a firm and external partners (Katila & Ahuja, 2002; Rosenkopf & Almeida, 2003; Rowery, et al., 2000). Indeed, the findings of this dissertation provide evidence that depending on the level of analysis the degree of external integration might vary. Individual boundary-spanners in study 1 limit their integrated of the external environment to the incorporation in the definition of their individual role understanding (role taking). Contrarily, findings in study 2 clearly demonstrate that for boundary-spanning to be effective in the case of new project developments with partners, close collaboration was indispensable. Accordingly, in cases where project partners functioned like knowledge suppliers without operating as integrated collaboration partners led to one-sided outcomes that either served exploitative or exploratory outcomes. This mirrors O'Reilly and Tushman (2008) in their assertion that ambidexterity needs a combination of sensing – activities that include scouting and scanning of the environment – and seizing – actual decision-making mechanisms and execution – to be effective. Translating these two functions to findings in this dissertation implies that boundary-spanner's scouting function as well as knowledge collaborations at the project level are more related to sensing opportunities in the market, whereas one-sided projects are more reflected by seizing opportunities. While this might provide insights into the mechanics that differ governance modes in place, this dissertation has not taken this stance throughout this research, but the explicit incorporation of both sensing and seizing modes can be taken into account in future research.

To summarize, the outcomes of this dissertation highlight that depending on the level of analysis, the mechanisms for ambidexterity and the degree to which these mechanisms are applied may vary. As such, this dissertation contributes to our understanding of some of the contingencies that determine the differential application of such mechanisms at different hierarchical levels. These insights as well as study 4

hint at potential contingencies and complementarities that cannot be explained without analyzing ambidexterity on every single level of analysis.

6.1.2 Contribution 2: Understanding multi-level settings and nested effects of boundary-spanning ambidexterity

Raisch and Birkinshaw accentuate that ambidexterity research needs to “be explicit about the levels of analysis it addresses and the ways in which those levels interact with one another” (2008: 23). Indeed, previous literature has highlighted that ambidexterity should be examined as a multi-level phenomenon (March, 1991; Rivkin & Siggelkow, 2003). This ties back to the metaphor of organizations operating as holographic designs as introduced in the beginning of this dissertation (Morgan, 1986). While only one study at present has analyzed how the interactions of multiple levels operate in the field of organizational ambidexterity (Jansen, Simsek, & Cao, forthcoming), extant literature has frequently emphasized the need for multi-level analysis of ambidexterity (Raisch & Birkinshaw, 2008; Rivkin & Siggelkow, 2003). Indeed, findings by Lubatkin et al., accentuate that the “level of behavioral integration directly influences how its members deal with the contradictory knowledge processes that underpin the attainment of an exploitative and exploratory orientation, such that greater integration enhances the likelihood of jointly pursuing both” (2006: 647). While these findings concentrate on the meso level of integrating individual behavior through team level mechanisms, O’Reilly and Tushman (2008) echo this request on the firm level of analysis.

It can be assumed that comparable mechanisms hold for boundary-spanning ambidexterity. Indeed, by virtue of including the external environment, boundary-spanning ambidexterity increases the number of levels from which ambidexterity originates, thereby accentuating the need to observe nested effects of exploitation and exploration. Consequently, this dissertation not only considers as a first the multi-level phenomenon in boundary-spanning ambidexterity, but moves research beyond singular level insights and provides an important first contribution by addressing how exploitation and exploration operate across multiple organizational levels under consideration of the external environment.

Study 1 captures important insights on the interactive effects between the individual manager’s personality effects (role making) and the organizational context (role

taking), which in turn is further moderated by individual level boundary preferences between different roles (role transitions). So far, both firm level and individual level effects have been analyzed independently from each other; however, this study provides insights to how the individual both personality facets and the organization in the definition of singular roles. In this, we propose similar dynamics that play *across* levels to dynamics previously asserted at *single* levels of analysis. The counterbalancing effects of (firm-level) role taking and (individual-level) role making on ambidexterity reflect single level notions of similar counterbalancing forces that previously have been shown to guide ambidextrous conduct at the firm-, business-unit, and individual level separately (Gibson & Birkinshaw, 2004; Mom et al., 2009; Tushman & O'Reilly, 1996). In a similar vein, study 3 found that the environmental condition, depicted by the specific cluster a firm found itself in, effects a firm in its decision to exploit or explore. Contrary to the conventional assumption that knowledge in a competitive environment will be used to distinguish the firm from its direct competitors, findings in this study highlight that firms integrate knowledge and align with their cluster environment. As such, the firm reflects similar exploitation and exploration patterns over time that imitate the general conduct in their direct competitive environment. Again, firm level analyses have predominantly highlighted the conduct of both exploitation and exploration as internal decision making processes. The direct environment has thus only been addressed as an information pool and an indicator of degrees of competitiveness. However, in line with network literature, this study shows that firms do not make isolated decision but are directly affected and reflect their cluster environment, indicating an intricate multilevel interrelationship between the firm and its cluster.

Analyzing the impact of the context, as experienced both on the individual and firm level, there seem to be idiosyncratic effects in place when compared. In the case of study 3, findings clearly indicate that the context indirectly imposes a directive force on the firm's engagement in exploitation and exploration. In referring back to Sheremata (2000), the cluster environment exerts centripetal forces to homogenize the cluster over time. On the contrary, in the case of the individual level, the context can both exert centrifugal and centripetal forces that may drive the activity of the individual to either concentrate on one-sided activities or ambidexterity. Consequently, effects may vary depending on which hierarchical levels interact with each other.

In sum, “it is also important for researchers to distinguish between the level at which ambidexterity is held (i.e., where the tension between exploration and exploitation is felt) and the level at which it is resolved (e.g., where structural separation occurs)” (Raisch & Birkinshaw, 2008: 22). Research on ambidexterity should take this into account and investigate other multilevel contexts to further extend this first contribution.

6.1.3 Contribution 3: Highlighting mechanisms of separation and integration that drive boundary-spanning ambidexterity

Separation and integration define core mechanisms to the concept of organizational ambidexterity (Raisch & Birkinshaw, 2008). First, separation allows alleviating the tensions between exploitation and exploration, while integration realigns efforts to generate synergies between both activities (Jansen et al., 2005). Boundary-spanning ambidexterity has originally served only as a mechanism to support organizational ambidexterity in alleviating exploitation and exploration tensions by separating both activities in reaching beyond firm boundaries as a means of structural ambidexterity. This has, however, led to a one-sided concentration on the separation mechanism in publications in this field of research at the expense of integration (Dittrich et al., 2007; Lavie & Rosenkopf, 2006). Study 4 of this dissertation further demonstrate that for the most part exploitation and exploration remain separated in present alliance ambidexterity research, while integrative mechanisms take a back seat. However, central to understand how boundary-spanning might support ambidexterity is the reintegration of both activities. To this understanding, this dissertation contributes in two ways.

First, study 1 highlights the importance of integration by the mechanism of role integration – the trait by which an individual actively seeks to overlap different role domains in order to leverage information, contacts and insights within two different fields of activity. As previous literature on social psychology and organizational behavior have highlighted, role integration is a vastly undervalued mechanism that might explain an individual’s effectiveness in the organizational context (Makarius et al, forthcoming). In linking this back to the ambidexterity literature, these findings however contradict existing assumptions that integration and separation operate on different organizational levels (Raisch & Birkinshaw, 2008), i.e. where tensions of ambidexterity on the team level are resolved by assigning different roles to individuals

the next hierarchical level down. Further these findings also stays in contrast with the understanding of the multi-level mechanism as described in the last section. Commonly, multi-level mechanisms have been reflective of the interaction between hierarchical level that allow the previously separated activities to be reintegrated (e.g., Rivkin & Siggelkow, 2003). While both assumption for hierarchical separation followed by multilevel integration might hold for other levels of analysis, as in the case of this dissertation for the project level of analysis, the individual seems to define an exception to this rule.

Second, study 2 also highlights that cross-industry collaborations leverage the knowledge pool of both partners by means of integrative measures of cross-functional teams and integrated process mechanics to combine exploitation and exploration. This extends findings by Tempelaar (2009), who found that individual level divergent inputs led to ambidexterity only under the joint umbrella of the team setting. Findings at the project level indicate that individual corporate inputs from both partners were only able to be leveraged under the joint umbrella of an integrative collaboration mechanism. However, something that has not been determined in existing literature is whether directionality exists between separation and integration. When analyzing the cases in this dissertation, findings provided for no unanimous result on sequencing of separation and integration. In fact, to generate ambidexterity from cross-industry projects a broad, separately defined collaboration objective (separation) had to be matched with very tight, integrative collaboration mechanisms (integration) were needed. Interesting, when analyzing the opposing setting of a narrow, joint collaboration objective (integration) combined with modular, loose collaboration (separation), projects did not lead to ambidexterity. When looking at the combination of separation and integration in place, this should lead to ambidexterity. This further substantiated the assumption that there is a directionality between separation and integration at play for ambidextrous projects.

In sum, the findings described above hint at very specific dynamics between separation and integration in different contexts. While these findings provide further evidence that separation and integration are indeed mandatory mechanisms for the generation of ambidexterity, they also indicate that the interplay between separation and integration may be more contextual and intricate than previously asserted. This is also highlighted in the literature review of study 4, where an in-depth analysis of the

pursuit of separation and integration mechanisms is provided and complemented with further venues for research.

6.1.4 Contribution 4: Distinguishing dynamic features in boundary-spanning ambidexterity as opposed to static accounts

Boundary-spanning ambidexterity fosters a firm's ability to integrate the external environment in its innovation activities in order to stay on par with the environmental status quo and flexibly adjust to environmental changes. Keeping this in mind, it is surprising to see that most contributions made in present research provide static accounts of boundary-spanning ambidexterity. Some studies have highlighted how partner characteristics define exploitative or exploratory activities (Beckman, Haunschild, & Philips, 2004), other studies depict both innovation activities by the position collaboration partners take within the value chain (Park, Chen, & Gallagher, 2002), again others differentiate between novel and known partners (Dittrich, Dysters, & de Man, 2007). However, none of these contributions actually reflect the concepts of exploitation and exploration as activities that shape innovation over time, i.e. the actual process underlying ambidexterity is not considered in these analyses.

This dissertation provides first time insight into this black box and accounts for the actual activities that drive ambidexterity in boundary-spanning settings. In study 1, both the process of role identification as well as the mechanism underlying role transition dynamically affects a manager's ability to act ambidextrous. First, the process of role identification is an interactive process between organizational context and personality traits that develops over time and as such does not reflect a static decision. While this study concentrates on the initial process of both role identification and role transition, it can be assumed that over time, dynamics that underlie role identification and preferences for role transition change, leading to altered activity patterns of exploitation and exploration at the individual level. This echoes an assertion made by Simsek, who stated that "new opportunities (and threats) are constantly created by the organization's internal and external dynamics, an organization might constantly attempt to balance exploitation and exploration, but may never achieve a lasting balance" (2009: 618).

Study 2 not only partially contradicts present findings on boundary-spanning ambidexterity, but provides valuable insights into project collaborations that are novel

in this field of research. As previously highlighted, extant research holds that the degree of familiarity a firm has with its collaboration partner defines whether a collaboration may foster exploitation (long-term partner) or exploration (novel partner) (Ditrich, Dysters, & de Man, 2007; Lin, Yang, & Demirkan, 2007). However, what findings in this dissertation reveal, is that both long-term and novel partners may very well be involved in both exploitative and exploratory innovation. Our findings provide first time indication that indeed not the familiarity of the partner, but the interaction of project objectives and collaboration process is decisive on the outcome. Consequently, this emphasizes that static snapshots and proxies, i.e. partner familiarity, overlook dynamic mechanisms that determine a more accurate definition of boundary-spanning ambidexterity.

Overall, study 4 substantiates the above findings and stresses that more research the actual activities is required, i.e. reflecting the original concepts of exploitation and exploration as introduced by March (1991), in order to capture the dynamics in place to generate ambidexterity.

6.2 Managerial implications

This dissertation does not only provide valuable contributions to present research but also provides useful recommendations to management practice. Innovation is central to organizational survival both in the short- and long-term. However, management needs to be able to differentiate and control their action in accordance with the strategic aim behind the innovation. Incremental innovation requires substantially different procedures than radical innovation; consequently, it is fundamental to understand the conditions that drive each innovation type. As boundary-spanning moves to the forefront of today's innovation activities, much needs to be understood with respect to the effect the external environment has on the conduct of exploitation and exploration. This dissertation shows that there is no panacea to innovation, rather a selection of influencing factors that can be attuned to distinct innovation objectives.

The first overarching take-away for management practice lies in the necessity to implement counterbalancing forces within the organizational set-up at the nexus between exploitation and exploration. Study 1 highlights the role environment within which there is a mismatch of organizational and personality traits induces managers to

operate both exploitative and exploratory. This means, for example, that a strong organizational culture, focused on clear structures (integration) will have the most potential to leverage ambidexterity through managers that hold strong personalities with individualistic traits (separation). This is interesting in cases where organizations promote organizational identification and fit between managers and their organizational culture. The assertions made in this dissertation indicate that contradictions between culture and personality are indeed beneficial to promote ambidexterity, while the alignment of both organizational context and individual's personality leads to a one-sided conduct of either exploitation or exploration. Regardless of the intended innovative focus, this underlines that personality has to be considered jointly with the design of an organizational orientation.. A concrete measure for firms to incorporate is the integration of personality traits in the hiring process in order to match or deliberately mismatch organizational and individual orientations and preferences. In sum, this implies that organizations should be more open to the paradox between personality and design features, and allow contradiction to arise in order to nurture the traction to generate ambidexterity.

Second, study 2 indicates that companies have certain discretion over learning patterns in inter-firm collaboration. Contrary to previous assumptions, the findings presented here highlight that both exploitation and exploration can be generated within single new product development projects and do not need to be separated out in singular alliances with diverse partners. Further, the particular engagement in cross-industry collaboration provides a concrete venue for companies to leverage existing knowledge for both exploratory and exploitative ends. As such, the findings presented also contradict the consensus that firms need to branch out and collaborate with distant partners, which has been proven to lead to higher failure rates. Moreover, interview partners in this study have highlighted that the selection of collaboration partners is crucial in order to make cross-industry collaboration work. When asked to name what process would lead to the highest success, most partners stated: Analogies. Firms aiming at cross-industry collaboration do best in looking for analogies in business models, product features, production processes and the like to generate common ground. As such, interviewees highlighted that cross-industry partners are indeed not always as far away from the own operations and provide common knowledge to build upon even if the industry background might divert as far as a violin player working with a ski manufacturer or the collaboration between a car manufacturer and a joystick

developer (see study 2). As the title so rightfully emphasized: sometimes (perceived) distant partners are indeed your closest friends.

Finally, the third paper provides guidance for a firm's use of environmental data in support of competitive analyses. While most firms incorporate industry measure to capture market changes and developments, the direct environment, i.e. particularly in cluster driven industries, remains underrepresented. However, findings of the study provide evidence that general industry-wide measures do not rightfully capture the impact the environment has on the conduct of exploitation and exploration. On the contrary, firms should include cluster specific information in order to capture the local competition dynamics. For example, the study shows that all clusters within the biopharmaceutical industry (worldwide), engaged in some ratio of exploitation and exploration, however, these ratios greatly varied from highly exploitation driven to highly exploration driven clusters at the extreme. While a firm's strategic response in each case should be in line with the direct competitive environment, industry-wide measure would not capture these indicators and provide little guidance.

A related consequence of the findings in study 3 lie in the translation of an industry analysis into strategic action. As the results show, firms do not actually use their knowledge on their competitive environment to differentiate themselves from their competitors. On the contrary, over a nine year period, most clusters revealed a homogenization of exploitation and exploration ratios within their cluster, leading to the assumption that we face a 'me too' syndrome. In order to benefit from the available information on direct competitors, firms should scout carefully to determine how this knowledge can be used to differentiate themselves from the local market developments in order to generate a sustainable competitive advantage.

6.3 Limitations of the dissertation and future research

I acknowledge that this dissertation has inherent limitations that provide potential for future research. However, while there are specific limitations to each study in this dissertation, this section will concentrate on overarching limitations that provide an agenda for future research.

First, this dissertation is one of the first to provide not only insights to the different hierarchical levels in conducting boundary-spanning ambidexterity, but also to link

different organizational levels into nested models that uncover effects between different hierarchical levels of the firm. However, while study 1 provides a stepping stone, it only conceptualizes how the effect of multiple role environments may facilitate the engagement of boundary spanners in ambidexterity. However, to substantiate the propositions raised in this dissertation empirical analysis is needed. Also, study 3 limits its conduct to incorporating environmental effects into a multi-level analysis, while not conducting a true interactive analysis. As previous researchers highlight, however, multi-level interactive analysis that span various levels of analysis are needed. Indeed, research has only begun to enter the black box of multi-level effects and nested phenomena. Thus, in order to better understand the mechanisms underlying boundary-spanning ambidexterity, future research will need to move away from singular levels of analysis, and provide detailed empirical analyses that capture such multilevel phenomena that drive boundary-spanning ambidexterity.

Second, I acknowledge that the concept of boundary-spanning ambidexterity is abstracted from the original concept of organizational ambidexterity. Originally introduced as a mechanism to alleviate firm-internal tension of simultaneous exploitation and exploration, boundary-spanning ambidexterity has developed into an equal counterpart to internal innovation conduct. In that, however, the urge arises to connect both fields of research. Most companies nowadays do not innovate either internally or externally, but both. In that this dissertation fails to reflect these real-life conditions in concentrating on externally orientated innovation conduct only. For example, Holmqvist (2004) conducted an in-depth case study suggesting that intra-firm experiential learning processes of exploitation and exploration generate inter-firm exploitation and exploration and vice versa. Triggered by dissatisfaction with existing learning routines two mechanisms opening-up and focusing drive circulation between exploration or exploitation. Opening-up describes how exploitation generates exploration, focusing how exploration generates exploitation. In a similar vein, Kauppila (2010) is one of the first contributions in this direction. The author illustrates through an in-depth field study how a firm can build and manage an organizational setting that internally balances exploration and exploitation, while leveraging exploitation and exploration through structurally separate inter-firm alliances. Finally, Tempelaar and Van de Vrande (2010) are the first to analyze the performance effects of connecting internal and external ambidexterity highlighting that both external sourcing of exploitation and exploration and boundary-spanning sourcing of internal exploitation and external exploration have a positive effect on performance over time.

Consequently, there is a first attempt to link findings from the intra-organizational level to ambidexterity activities with the external environment. While the previously highlighted studies demonstrate a first step to link both concepts back together, more empirical analysis is needed that goes beyond the largely anecdotal evidence to substantiate the qualitative findings with quantitative analysis.

Third, while the interaction with external partners is essential to a firm's innovation conduct, a major shortcoming of present research, including this dissertation, is the artificial limitation of singular, dyadic collaboration analysis. While the findings provide valuable micro insights into the conduct of ambidexterity through the exchange of information, interaction patterns and collaboration mechanisms, the reality holds that collaborations often involve more than just one partner. Further, partners involved in a project may change over time, depending on their function within the overall project. As a final point, going beyond the singular alliance-level, an analysis of a firm's overall alliance portfolio will potentially generate further insights into project patterns, partner interaction and the ability to generate ambidexterity through the portfolio of alliances a firm holds.

Finally, the relevance of the studies conducted in this dissertation could be further advanced, if the implications of inter-firm exploitative and exploratory activities on overall firm performance were analyzed. While I provide insights on the intermediary step of individual, project, firm and alliance level learning – which inherently hold the ability for a firm to generate positive financial results – no study explicitly addresses performance outcomes. Essentially, given the acclaimed impact boundary-spanning ambidexterity holds on the short-term and long-term success of a firm, future research should build upon the findings in this dissertation and take them to the next level.

6.4 Overall Conclusion

Referring back to the opening quote, this dissertation firmly supports that the most powerful organizations are those that understand how to leverage and strengthen their core competencies through incremental improvements, while at the same time adapting to environmental changes that define the market place of tomorrow. However, in mastering accelerated change and increased market dispersion will increasingly force firms to span organizational boundaries in order to leverage internal competencies, while complementing them with those of external partners. Essential in

mastering the ever increasing complexity of innovation, particularly, through the integration of external partners, will force companies to embrace paradox. This engagement, however, in paradoxical setups of simultaneous exploitation and exploration, makes it more apparent than ever that generating an overarching picture, by connecting the dots of all activities involved, will drive the success or failure of leveraging the value ambidexterity provides.

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- Zimmermann, A., & Raisch, S. 2009. Ambidexterity in Inter-Firm Relationships: Governance Structures and Knowledge Processes. *Academy of Management Proceedings*, 1-7.

Curriculum Vitae

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EDUCATION

University of St.Gallen **Ph.D. in Management** Sep 2007 – Jun 2011

Dissertation: Connecting the Dots – Studies on Boundary-spanning Ambidexterity at the Individual, Project, Firm, and Alliance Level.

Dissertation Committee: Peter Gomez (Chair),
Ellen Enkle (Co-Chair)

The Wharton School,
University of Pennsylvania **Visiting PhD Student** Aug 2010 – Jul 2011
Sponsor: Lori Rosenkopf

European Business School,
Schloss Reichartshausen **MBA (Diplom-Kauffrau)** Sep 2002 – Jul 2006
Majors: Finance & Real Estate
Management

Hong Kong University **Visiting MBA Student** Aug 2003 – Jan 2004

HEC Geneva **Visiting MBA Student** Feb 2004 – Jul 2005

RESEARCH INTERESTS

My research explores how organizations develop technological innovation by means of boundary-spanning activities with their external environment. To understand the underlying mechanisms to this phenomenon, I examine how firms leverage internal competencies, while complementing them with those of external partners. I am fascinated with how this interaction may yield exploitative and exploratory innovation and their impact on both firms' performance and their competitive advantage. In analyzing firms' management of activities across their boundaries at multiple organizational levels, I am trying to contribute to answering the question, why some firms fail and disappear while others survive and prosper in today's complex and interrelated market conditions.

ARTICLES UNDER REVIEW

- Rosenkranz, N. 2011. When Boundary Spanners Shift Gears: Role Identities and Their Impact on Exploitation and Exploration, Academy of Management Review – *revise and resubmit*.
- Rosenkranz, N., & Enkel, E. 2011. When Distant Partner Become Your Closest Friends: Ambidexterity through Cross-Industry Collaboration, Organization Science – *under review*.
- Rosenkranz, N., & Rosenkopf, L. 2011. Alliance Ambidexterity: When exploration and exploitation cross Firm Boundaries. Journal of Management – *second revise and resubmit*.

WORKING PAPERS

- Rosenkranz, N., Sydler, R., & von Krogh, G., 2010, Great Minds think Alike: Idiosyncratic Behavior Amongst Cluster Companies – *in preparation for submission to Organization Science*.
- Rosenkranz, N. & Tempelaar, M. 2010. Peering Underneath the Multiple Hats of the Boundary-Spanner – Role Identities and the Transition Between Them – *in preparation for submission to the Academy of Management Journal*.

WORK IN PROGRESS

- Rosenkopf, L., Wiesenfeld, B., & Rosenkranz 2010. Multi-level analysis on the network and individual effects in innovation diffusion – *data collection stage*.
- Enkel, E., & Rosenkranz, N. 2011. When Distant Partner Become Your Closest Friends. Large Scale Analysis – *conceptual stage*.

CONFERENCE PAPERS

- Rosenkranz, N, Sydler, R., & von Krogh, G., 2011, Great Minds think alike: Idiosyncratic Behavior Amongst Cluster Companies. Empirical Paper, presented at Academy of Management Conference 2011, San Antonio, USA.
- Rosenkranz, N. 2010. Exploitation and Exploration at the Individual Level: The impact of Boundary Spanner's Role Autonomy. Conceptual paper, presented at Academy of Management Conference 2010, Montreal, Canada.

Rosenkranz, N., & Enkel, E. 2010. When Distant Partner Become Your Closest Friends: Ambidexterity in Cross-Industry Collaboration. Empirical paper, presented at Academy of Management Conference 2010, Montreal, Canada.

Rosenkranz, N. 2009. Something Old, Something New, Something Borrowed: The Effect of Triadic Network Ties on Exploitative and Exploratory Learning. Conceptual paper presented at the Strategic Management Society Annual Conference 2009, Washington D.C., USA.

Rosenkranz, N. 2008. Leveraging Emerging Market Potential through Boundary-Spanning: Customer Collaboration at the Bottom of the Pyramid. Conceptual paper presented at the Strategic Management Society Special Conference 2008, Hyderabad, India.

BOOK CHAPTER

Rosenkranz, N., Enkel, E., & Foltin, E. 2010. Bayer MaterialSciences Market-Pull und Technology-Push Prozesse durch Open Innovation, Symposium Publishing GmbH: Düsseldorf.

CASE STUDIES

Napolitano, L., Rosenkranz, N., & Tietz, M. 2008. Global Customer Solutions at DHL.
Napolitano, L., Rosenkranz, N., & Tietz, M. 2007. Driving Customer-Centricity at Henkel.

ACADEMIC SERVICE, AWARDS & HONORS

Academic Awards & Honors

- Research Fellowship, Mack Center for Technological Innovation, The Wharton School, 2011 - 2012
- Research Fellowship, Swiss National Science Fund (SNF), 2010-2011
- Finalist, TIM Division Best Student Paper “When Distant Partner Become Your Closest Friends: Ambidexterity through Cross-Industry Collaboration”, Academy of Management 2010
- Academic Honors Certificate, St. Mary’s Academy Portland, 1999
- Top 10 Academic All State, Oregon, 1999

Academic Service

- Ad hoc reviewer for *Research Policy, Organization Science, and Organization Studies*
- Member and Reviewer, Academy of Management (AoM), since 2006
- Member, Strategic Management Society (SMS), since 2006

TEACHING EXPERIENCE

The Wharton School,
University of Pennsylvania
Sep 2011 – May 2012

Teaching Assistant (Undergrad)
MGMT 101: Introduction to Management
(teaching two own sections of course)
Instructor: Lori Rosenkopf & Martine Haas

Columbia Business School
& University of St.Gallen
Feb 2007 – Aug 2009

Program Manager (Executive Education)
Global Account Manager Certification Program
Instructor: Noel Capon & Christoph Senn

European Business School
Sep 2003 – Jan 2004

Teaching Assistant (MBA)
Management – Corporate Simulation
Instructor: Frank Siemes

PROFESSIONAL EXPERIENCE

Credit Suisse

Strategic Management Support
Private Banking EMEA

Aug 2009 – Aug 2010

- Support on the annual strategic conference on EMEA Private Banking, facilitating upfront analysis and organizational coordination
- Analysis on strategic orientation and financial development of individual business segments, both investment and divestment cases

Account
Management
Center (AMC)

Strategy Consultant

Feb 2007 – Aug 2009

- Analyzed/developed recommendations to a global chemical corporation on their strategic customer program (largest corporate clients)
- Initiation of a regular information tool for clients on market developments, i.e. benchmarks, key topic analysis
- Case study development of a global fast moving consumer goods and logistics industry as industry benchmarks

Arthur D. Little **Post Graduate Intern Consultant**

Oct 2006 – Jan 2007

- Developed a change strategy to the knowledge management process for large corporation in the travel and hospitality industry
- Innovation initiative for a global insurance corporation after successfully pitching in bidding process
- Process streamlining for information channeling on innovation projects for global retail corporation
- Strategic market analysis for new business segment introduction for a global financial institution

LANGUAGE SKILLS

German	Mother tongue
English	Fluent
French	Advanced
Spanish	Basic