The Growth of Academic Spin-offs

The Management Team's Absorptive Capacity and Facilitator Support

Hanieh Khodaei

Thesis committee

Thesis supervisor
Prof. Dr S.W.F. Omta
Professor of Management Studies
Wageningen University

Thesis co-promotors
Dr E.F.M. Wubben
Associate professor, Management Studies Group
Wageningen University

Dr V.E. Scholten
Assistant professor, Department of Values, Technology and Innovation
Delft University of Technology

Other members
Prof. Dr M. Mulder, Wageningen University
Prof. Dr T. Elfring, Vrije University Amsterdam
Prof. Dr A.J. Groen, University of Twente
Prof. Dr M.S. van Geenhuizen, Delft University of Technology

This research was conducted under the auspices of Wageningen School of Social Sciences (WASS)

The Growth of Academic Spin-offs

The Management Team's Absorptive Capacity and Facilitator Support

Hanieh Khodaei

Thesis
Submitted in fulfilment of the requirements for the degree of doctor
at Wageningen University
by the authority of the Rector Magnificus
Prof. Dr. A.P.J. Mol,
in the presence of the
Thesis Committee appointed by the Academic Board
to be defended in public
on Tuesday 13 October 2015
at 4 p.m. in the Aula.

Hanieh Khodaei
The Growth of Academic Spin-offs
The Management Team's Absorptive Capacity and Facilitator Support
155 pages

PhD thesis Wageningen University, Wageningen, NL (2015)
With references, with summaries in English and Dutch

ISBN: 978-94-6257-488-5

Preface and acknowledgements

Entrepreneurship is the result of the combination of strengths possessed by different people. The ideas and results from the present research could not come into effect without the common endeavour and support of several individuals. Therefore, I would like to thank a number of people who have helped and supported me during this research trajectory.

I would like to thank my supervisors, Prof. Dr Onno Omta and Dr Emiel Wubben, and Dr Victor Scholten, for their guidance and advice during the years of my PhD work at the Management Studies Group.

Thanks Onno for your thoughtful guidance. You always stimulated me to look more critically and precisely at the data, analyses and drafts of my papers. Thanks to Emiel, he was always patient and willing to spend time and effort in rather long discussions about the structure and conceptual developments of the research and the process of the writing of the papers. He was always available, whenever I needed advice or discussion to solve a problem. I would like to thank Victor for his warm encouragement, and critical comments, which always encouraged me to get the best of my intelligence and potential. He was more than supervisor; I appreciate all his support and help specifically for my stay as a guest researcher at Delft University of Technology.

In addition, I would like to acknowledge and thank Ron Kemp. He provided specific information about statistical analysis. I would also like to thank Gitte Schober and Arnoud Jullens, for enabling a set of interviews with facilitators and spin-offs founders; they have generated valuable insights about university facilitating processes which I used in my research.

I would also like to thank the members of my dissertation committee, including, Prof. Dr M. Mulder, Prof. Dr T. Elfring, Prof. Dr A.J. Groen, and Prof. Dr M.S. van Geenhuizen for the evaluation of and participation in the defence of the present thesis.

Special thanks and acknowledgement go to the members of the Management Studies Group who have been pleasant colleagues over the years. Many of these colleagues, were of great value, not only for discussions about the research topics addressed in this thesis, but also in terms of further development of ideas about research in general, ideas about experiences and growth through career development and cultural differences and similarities.

Especial thanks go to Eva, Etriya and Silvia my nice roommates. Also, I would like to thank Frances, Ina, Anne and Johnnatan for their support and help throughout the years.

I would like to express my gratitude to the members of Values, Technology and Innovation department of Faculty of Technology, Policy and Management at Delft University of Technology, who host me and for their support offered in many different ways.

Furthermore, I would like to acknowledge the financial support provided by Iranian Ministry of Science, Research, and Technology (MSRT) and faculty of entrepreneurship in Tehran University for my project. Special thanks go to Dr Jahangir Yadolahi Farsi, Dr Mostafa Razavi and Dr Mohammad Reza Zali from faculty of entrepreneurship in Tehran University for all their support and encouragements.

I would like to thank the Iranian community at Wageningen and Delft for their support and friendship. Special thanks go to my paranymphs Afshin and Lisa.

Back to my family, I would like to thank my closest family, my father, my mother, sister, brother and my grandparents for all of their support and encouragement, especially my father Prof. Dr Mohammad Mehdi Khodaei who is my hero in my academic career.

Last, but not least, I would like to express my appreciation to share my life with Mahyar. My husband, Mahyar has been a great support for many years, and especially during the time of my PhD research with our little angel Hana.

Hanieh Khodaei August 2015

Table of contents

Chapter 1 Introduction

1.1 Introduction

1.2 Challenges to be addressed

The emergence of new ideas and the way in which they can lead to new business opportunities are central to the field of entrepreneurship (Shane and Venkataraman, 2000; Zahra et al., 2006; Keh et al., 2007; Gray, 2006). A university can engage across a spectrum of 'hard' and 'soft' entrepreneurial activities. Hard activities such as patenting, licensing, and spin-off creation are generally perceived to be the more tangible outputs (Rasmussen et al., 2006) of mature entrepreneurial universities (Klofsten and Jones-Evans, 2000), compared to soft activities, such as education and training, which are generally perceived as the traditional activities of universities. Most of the recent research on the entrepreneurial university has focused on the university's capability to produce outputs at the 'harder' end of this spectrum (Ratinho and Henriques, 2010). Besides, the high cost and expertise necessary for developing a discovery has encouraged universities to commercialize their knowledge by creating academic spin-offs (Markman et al., 2008; Rasmussen, 2011). Academic spin-offs are a particular mode in knowledge commercialization that have received increasing attention from researchers and policymakers alike because of their ability to create wealth (Mustar et al., 2006; Fini et al., 2011), but also because substantial financial outlays are directed towards their development and growth (Lockett et al., 2005).

Academic spin-offs are the subject of this manuscript. They are defined as new start-up firms that commercially exploit research developed within an academic environment to the benefit of economic, social, and regional development (Pirnay et al., 2003; Steffensen et al., 2000). These start-ups can be initiated by university employees, students or graduates, but also by external individuals grasping the opportunity to bring new knowledge to market. In this study, we focus on opportunity recognition as a growth indicator of high-tech academic spin-offs (Vohora et al., 2004). The success of these start-ups depends on the number of entrepreneurial opportunities, since a higher number of opportunities leads to a higher the chance of high-quality opportunities with significant potential (Anderson and Eshima, 2013).

Academic spin-offs might face difficulties in translating their initial idea to a business opportunity due to a lack of dynamic capabilities (Vohora et al., 2004; Bjørnåli and Gulbrandsen, 2010; Rasmussen et al., 2011) as well as due to an absence of an entrepreneurial orientation (Iacobucci et al., 2011). Entrepreneurship scholars have increasingly paid attention to the role of dynamic capabilities in helping academic spin-offs to overcome such difficulties when they evolve through various phases of growth (McKelvie and Davidsson, 2009; Vohora et al., 2004; Zahra et al., 2006; Zahra et al., 2009). To recognize new opportunities, companies should promote their entrepreneurial orientation (EO) to the benefit of their performance (Covin and Lumpkin, 2011). For example, Iacobucci et al. (2011), argued that academic spin-offs might have difficulties in translating their initial business idea to sustainable business due to the lack of EO. EO is manifested through a company's innovativeness and proactivity, and through its exploration and exploitation of new products and processes (Lumpkin and Dess, 1996; Rosenbusch et al., 2013). Entrepreneurial firms are typically more successful than non-entrepreneurial firms since entrepreneurial firms are able to pursue high-quality opportunities in the marketplace (Lumpkin and Dess, 1996).

The effectiveness of entrepreneurial characteristics and dynamic capabilities in high-tech academic spin-offs remains an unexplored issue that we seek to address in this study. We

posit that these firms may be more successful by developing their dynamic capabilities and entrepreneurial characteristics. According to the resource-based view, firms create resource heterogeneity that persists over time and provides a basis for firm performance (Barney, 1991a). However, research has recognized certain shortcomings of the RBV, especially for firms that act in turbulent environments (Covin and Slevin, 1989), such as academic spin-offs. Due to these shortcomings, the dynamic capabilities approach was developed to extend the RBV. Various researchers agree that absorptive capacity is an important dynamic capability (George and Zahra, 2002; Jansen et al., 2005). Zahra and George (2002) introduced the dynamic capabilities perspective on absorptive capacity (AC) and defined it as "*a set of organizational routines and processes by which firms acquire, assimilate, transform, and exploit knowledge to produce a dynamic organizational capability*" (Zahra and George, 2002: 186). AC plays an important role for academic spin-offs to signal, build, and acquire knowledge and resources (Bøllingtoft and Ulhøi, 2005; Lockett et al., 2005; Wright et al., 2007; Sirmon et al., 2007; Holcomb et al., 2009; Zahra et al., 2009). So far relatively little research has been conducted on absorptive capacity, especially among new ventures (Zahra et al., 2009; Hayton and Zahra, 2005). More research is important since the factors leading to their respective development may be different for new ventures compared to more established firms (Zahra et al., 2006).

In this manuscript, we also develop a theoretical rationale for how entrepreneurial orientation interacts with absorptive capacity to increase firm performance. AC has been defined as the "*key means for linking entrepreneurial orientation to firm opportunity exploitation and subsequent performance*" (Covin and Lumpkin, 2011: 861), but it requires closer examination (Engelen et al., 2014). Since start-up teams are responsible for building such capabilities (Sirmon et al., 2007; Holcomb et al., 2009), we study how these teams can be organized to seek and absorb external knowledge which contributes to higher AC in order to better identify and pursue opportunities (Zahra et al., 2009). Therefore, we study AC at the level of the high-tech academic spin-off's team, answering related calls to study AC at the team-level (Volberda et al., 2010). This leads us to the main objective and the main research question of part 1 of this manuscript.

Main objective of part 1: *To analyze the role of the absorptive capacity and entrepreneurial orientation of the management team of high-tech academic spin-offs to better identify and pursue opportunities.*

Main research question of part 1*: What is the impact of the absorptive capacity and entrepreneurial orientation of the management team of high-tech academic spin-offs on the identification and pursuit of opportunities?*

Academic spin-offs are known to differ from other ventures with respect to their academic origin, human capital, resource demands, and, importantly, availability of facilitating support (Shane, 2004; Wright et al., 2007; Patzelt and Shepherd, 2009). In order to better understand their growth, we need to consider the role of various facilitators such as incubators, technology transfer offices, and science parks (Rasmussen et al., 2006) because they expedite the creation and growth of academic spin-offs. University facilitators are part of the overall high-tech regional cluster which provides resources, including social and human capital that connect to other resources and capabilities (Fetters et al., 2010). Little is known about the impact of facilitators on the growth of academic spin-offs, as there is neither conclusive literature on their effectiveness over time (van Geenhuizen and Soetanto, 2009) nor a systematic framework to understand and identify the nature of their support (Hackett and

Dilts, 2004; Phan et al., 2005). More specifically, we aim to explore the role of facilitators in developing the dynamic capabilities of academic spin-offs during their growth stages. A key element of support activities is related to the ability of university facilitators to enable the initiation of entrepreneurial activities (Rasmussen and Borch, 2010) that focus on identifying and exploiting opportunities (Zahra et al., 2006). This leads us to the main objective and the main research question of part 2 of this manuscript.

Main objective of part 2: *To analyze the role of the facilitators, such as university incubators, science parks and technology transfer offices, so that they can help academic spin-offs to grow and induce them to stay in the region of the parent university.*

Main research question of part 2*: How can facilitators assist the growth of high-tech academic spin-offs and develop and maintain a high-tech regional cluster?*

We examine the management of high-tech academic spin-offs at the level of the spin-off's management team and at the level of the parent university. This manuscript can be used by universities and spin-offs managers to improve and foster spin-off growth. Given the relevance of our results for universities and for policymakers who seek to facilitate technology transfer and subsequent economic growth via academic spin-offs, we contribute to a better understanding of how a university can act as a conduit for knowledge transfer that can lead to economic prosperity. From a theoretical point of view, the study adds to the entrepreneurship and AC literature by providing evidence of mechanisms that enable high-tech academic spin-offs to benefit from facilitating support and to develop the management team's AC to foster the process of identifying and pursuing opportunities. The manuscript is divided into several chapters, and applies various theoretical perspectives in part 1 and 2. By combining part 1 and 2, the present manuscript has the following objective:

- *To analyze how academic spin-offs address the challenge of opportunity identification and pursuit by building their absorptive capacity and by receiving facilitator support.*

1.3 Theoretical perspectives

We present our theoretical framework and discuss the theories used in this thesis. The theoretical framework in which this thesis is embedded is the resource-based view (RBV) and the related knowledge-based view and the dynamic capabilities perspective (Acedo et al., 2006), combined with theories regarding entrepreneurship and regional clusters. The resource-based view, the dynamic capabilities view and entrepreneurship theory are used to analyze the performance of high-tech academic spin-offs (Part 1: Chapters 2 and 3). The resource-based view, the dynamic capabilities view, and regional cluster theory are used to analyze the role of facilitators on the growth of academic spin-offs (Part 2: Chapters 4 and 5).

The resource-based view posits that firms can only achieve sustainable competitive advantage if they possess valuable, rare, inimitable, and non-substitutable resources (Barney et al., 2001). It evolved with the claim that tangible resources, such as physical and financial assets, and intangible resources, such as human capital and reputation, are important for the competitive advantage of the firm (Grant, 1996). Accordingly, firms should allocate their investments in resources and capabilities consistent with their strategic postures (Teece, 2012). In other words, strategic orientation (in our case, EO) describes the strategic position of the firm, and the capabilities capture how this strategy can be implemented and deployed (Slater et al., 2006). This is stated in the Habbershon et al. (2010: 21) notion that "*resources and entrepreneurial orientation taken on their own are necessary but not sufficient conditions*

for long-term success. Without resources, entrepreneurial orientation lacks the means to be realized."

The resource-based view further identifies knowledge as the key resource of the company (Barney, 1991b; Barney, 2001; Barney et al., 2011), while highlighting that even complex physical technology is not inimitable, in contrast to the knowledge embedded in humans. This calls for a shift from the RBV to the knowledge-based view (KBV). The resource-based view of the firm explains and predicts why some firms are able to establish positions of sustainable competitive advantage. The KBV, as an extension of the RBV (Grant, 1996), explains the competitive advantage of a firm by focusing on human capital and prior knowledge as the key resource to be managed (Grant, 1996; Winter, 1998; Kogut and Zander, 1992). Therefore, this study investigates the prior knowledge of the spin-off's management team as an internal knowledge resource. The growth of academic spin-offs depends on their human capital (Vohora et al., 2004)', which resides in the management team's prior knowledge and characteristics to learn new skills and develop new capabilities (Zahra et al., 2009).

In particular, this applies to the case of academic spin-offs since the management team plays a critical role in acquiring and absorbing new knowledge effectively in order to build capabilities (Wright et al., 2007; Sirmon et al., 2007). The KBV is used in Chapter 2 to explain the role of the management team's prior knowledge and its external knowledge absorption in enhancing the performance of academic spin-offs.

The resource-based view holds that higher performance is due to effective deployment of firm-specific valuable resources and capabilities (Barney, 1991; Carmeli, 2004; Peteraf, 1993; Roos and Victor, 1999; Teece et al., 1997). Dynamic capability enables a firm to radically alter how it currently makes its living (Helfat and Winter, 2011). Eisenhardt and Martin (2000) emphasize that organizational resources are considered less productive in themselves and more as working through a firm's ability to assemble, integrate, and manage them via organizational capabilities. Dynamic capabilities are different from "ordinary" resources and capabilities, as they allow the firm to reconfigure its existing resource and capability base (Teece et al., 1997). Firm dynamic capabilities enable the redeployment and coordination of different resources to identify and pursuit opportunities (e.g., Von Hippel, 1994) in a turbulent environment, common for high-tech start-ups (Teece et al., 1997). The literature has largely agreed that the firm's absorptive capacity (AC) is a major dynamic capability (Floyd and Lane, 2000; van den Bosch et al., 1999; Zahra and George, 2002). The research on AC stems theoretically from the RBV (Grant, 1996).

1.4 Thesis setup and research framework

In this section, we discuss the constructs used in the chapters in the research framework presented in Figure 1.1 Chapters 2-5 present empirical analysis into the internal and external factors that foster the growth of academic spin-offs, and is conducted through the lenses of the theories discussed in Section 1.2. Figure 1.1 provides an overview of the research framework. It is divided into two parts. Part 1 focuses on the internal factors and part 2 focuses on the external factors.

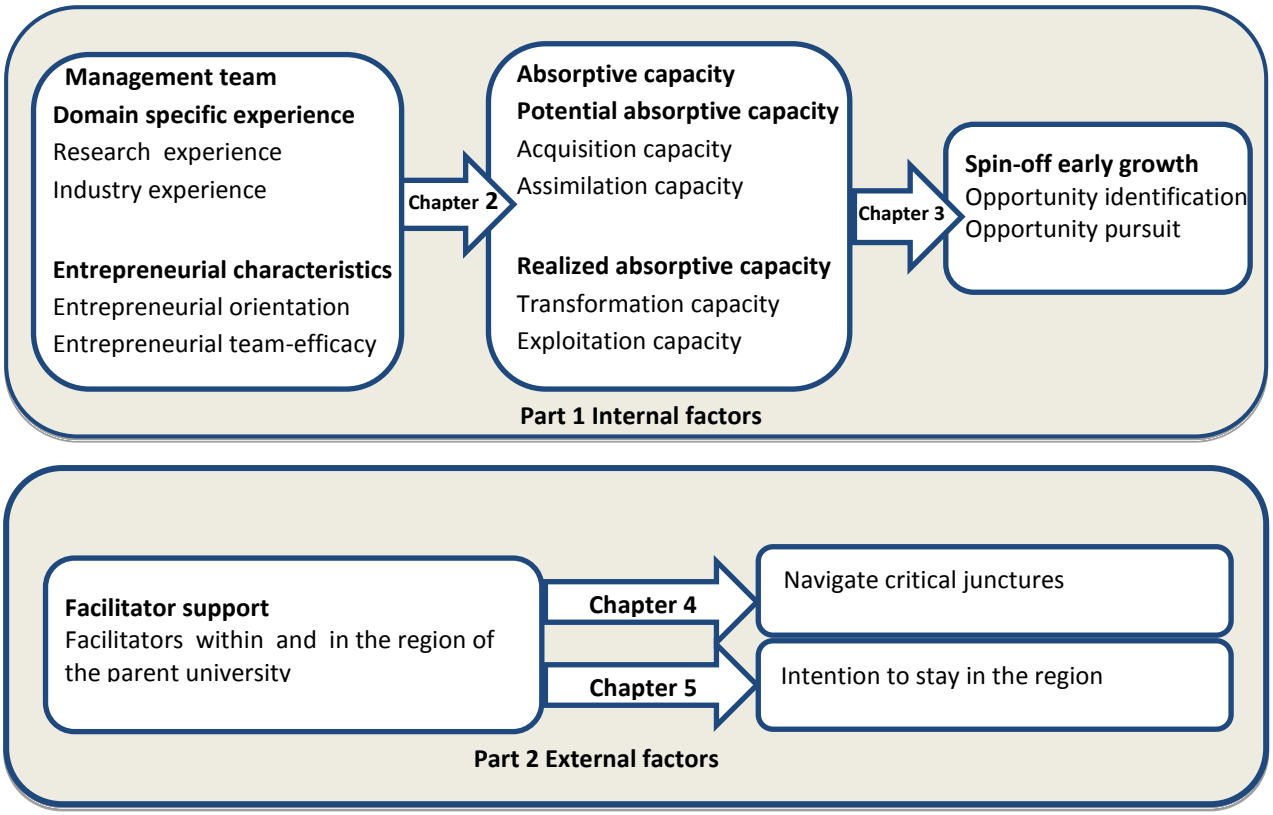


Figure 1.1 Research framework and thesis chapters

The constructs in Figure 1.1 are discussed below.

Part 1 Internal factors

The management team's domain specific experience

Entrepreneurship literature has focused on domain specific experience in terms of domain specific research and domain specific industry experience (Agarwal et al., 2004; Kor, 2003; Shane and Venkataraman, 2000).

Domain specific research experience

Domain-specific research experience affects the team's access to scientific experience and expertise in other research areas (Corolleur et al., 2004, Murray, 2004, Shane and Stuart, 2002) and advances the discovery of opportunities (Shane, 2000). Spin-off teams that have been involved in scientific discovery possess a great deal of non-codified knowledge that can be useful to identify and evaluate external knowledge, which is needed for the further development and implementation in practice (Clarysse and Moray, 2004).

Domain specific industry experience

Domain specific industry experience is related the team's market-pioneering know-how and affects the team's capability to identify and pursue market opportunities in high-tech markets (Agarwal et al., 2004). This kind of knowledge is established through learning by doing and can be measured by the job experience of the spin-off's management team (Vinding, 2004).

The management team's entrepreneurial characteristics

Previous literature on entrepreneurship has defined essential parameters or roles of entrepreneurs in performing entrepreneurial endeavors (Sardeshmukh et al., 2011). For example, entrepreneurs have to be proactive and they have to make rapid decisions under uncertainty and in a resource constraint environment and they have to be willing to work harder than most employees (Sarasvathy, 2001; Shane, 2003). Essential parameters or characteristics of entrepreneurs in succeeding entrepreneurial endeavors can be gauged by entrepreneurial orientation (Naman, 1993; Covin and Slevin, 1990), and entrepreneurial team-efficacy (Baum and Bird, 2010; Drnovajek et al., 2010). Both concepts of entrepreneurial team-efficacy and entrepreneurial orientation have been discussed in Chapter 2 as antecedents of AC.

Entrepreneurial orientation

Entrepreneurial orientation has become an important concept within strategic management and entrepreneurship literature in the last three decades (Covin and Lumpkin, 2011; Miller, 2011; Covin and Wales, 2012). Rauch et al. (2009: 778) suggested, "*It is reasonable to conclude that entrepreneurial orientation represents a promising area for building a cumulative body of relevant knowledge about entrepreneurship*." Entrepreneurship scholars have attempted to explain performance by investigating a firm's EO (Dess and Lumpkin, 2005). To recognize new opportunities, companies should promote their EO to the benefit of their performance (Covin and Lumpkin, 2011), that is a receptiveness to external information and a willingness to act on it, as evidenced in innovative, risk-taking and proactive behaviors (Miller, 1983). A firm's EO is manifested through in its innovativeness and proactivity, and its exploration and exploitation of new products and processes (Lumpkin and Dess, 1996; Rosenbusch et al., 2013).

Given the importance of entrepreneurship for firm performance, EO could be an important measure of the way a firm is organized, one that enhances the performance benefit of a firm's knowledge-based resources by focusing attention on the utilization of these resources to discover and exploit opportunities (Wiklund and Shepherd, 2003). It is argued that start-ups should have founders that are creative, proactive and risk-taking when they seek innovative information and utilize the acquired information (Walter et al., 2006; Keh et al., 2007). Entrepreneurial orientation improves firm performance through intensifying information acquisition and exploitation efforts (Keh et al., 2007) and advances the knowledge creation processes (Li et al., 2009). Many entrepreneurship studies postulate a strong EO–performance relationship, especially in hostile and/or technologically sophisticated environments (e.g., (Naman, 1993) such as high-tech academic spin-offs. EO is important for the growth and profitability of academic spin-offs and for their pursuit of competitive advantages (Walter et al., 2006).

Therefore, the present study extends research on how firm capabilities increase firm performance by arguing that dynamic capabilities play a central role in converting EO into improved performance. We argue that the existing resources or capabilities need to be reconfigured in order to implement inherently uncertain entrepreneurial activities smoothly, as the inertia of stable, "ordinary" resources and capabilities may not allow the full potential of an EO to be realized (Eisenhardt and Martin, 2000). We discuss the role of EO in Chapters 2 and 3.

Entrepreneurial team-efficacy

Entrepreneurial team-efficacy is considered to be essential for spin-offs to succeed in their entrepreneurial process (Baum and Bird, 2010; Drnovšek et al., 2010). Entrepreneurial team-efficacy is related to the motivation and confidence of team members in their ability to successfully perform the various roles and tasks of entrepreneurship (Hmieleski and Baron, 2008) leading to the start-up performance (Hmieleski and Baron, 2008; McGee et al., 2009, Durham et al., 1997; Bandura, 1997). Similarly, various researchers have suggested that entrepreneurial self-efficacy has a positive and significant impact on the performance of start-ups (Baum et al., 2001; Hmieleski and Baron, 2008; McGee et al., 2009).

Several conceptions of individual differences, other than self-efficacy, also reflect confidence (e.g., locus of control, self-esteem). However, they are applied in more general contexts (Bandura, 1997), not in the context of start-ups. As Chen et al. (1998: 301) succinctly point out, "*the same entrepreneurial environment could be assessed as replete with opportunities by people with high entrepreneurial self-efficacy but fraught with costs and risks by people with low entrepreneurial self-efficacy*." This indicates that entrepreneurs with greater belief in their abilities to undertake entrepreneurial activities are more likely to engage in such endeavors and perceive new opportunities (Sardeshmukh et al., 2011). We discuss the role of entrepreneurial team-efficacy in academic spin-offs in Chapter 2.

Absorptive capacity

Zahra and George (2002) introduced the dynamic capabilities perspective on AC and defined AC as "*a set of organizational routines and processes by which firms acquire, assimilate, transform, and exploit knowledge to produce a dynamic organizational capability*" (Zahra and George, 2002: 186). These four dimensions have a complementary role in explaining how AC influences organizational outcomes. Acquisition and assimilation enable firms to identify, acquire, and assimilate new, and transformation and exploitation enable firms to benefit from knowledge application and to achieve short-term profits.

Potential and realized absorptive capacity

Building on Cohen and Levinthal's (1990) original contribution, Zahra and George (2002) conceptualize AC as a multidimensional construct and distinguish between potential absorptive capacity and realized absorptive capacity. Potential absorptive capacity (PAC) is based on knowledge acquisition and assimilation and is the ability to identify, acquire, and assimilate new external knowledge. Realized absorptive capacity (RAC) is based on knowledge transformation and exploitation, and is the ability to arrive at new insights from the combination of existing and newly-acquired knowledge, and to incorporate transformed knowledge into the firm's operations (Zahra and George, 2002). The two types of AC have a different but complementary role. Companies not only need to develop capabilities to recognize, acquire, and assimilate useful external knowledge (PAC), but also need to develop their ability to transform and exploit that knowledge (RAC) to achieve their goals. Zahra and George (2002) argue that despite the importance of PAC, RAC is the primary source of performance improvements. Thus, firm performance can be improved by efficiently acquiring and assimilating external knowledge (PAC), and by integrating, transforming, and exploiting this knowledge (RAC).

A high degree of AC in entrepreneurial firms gives new ventures constant access to new knowledge and information about opportunities (as our growth indicator) (Engelen et al., 2014; Rothaermel and Alexandre, 2009), increasing the number and the quality of

opportunities entrepreneurial firms can pursue (Engelen et al., 2014). We discuss the role of AC in academic spin-offs in Chapters 2 and 3.

Spin-off growth

Opportunity identification and pursuit

Entrepreneurship involves discovering new ideas, translating them into new business opportunities, and exploiting them (Shane, 2003; Gray, 2006; Keh et al., 2007, Shane and Venkataraman, 2000; Zahra et al., 2006). Recognizing opportunities is the key for entrepreneurial start-ups to spark off the engine and start new business (Shane and Venkataraman, 2000). Shane (2003: 4) stated: "*Entrepreneurship is an activity that involves the discovery, evaluation, and exploitation of opportunities.*" Recognizing opportunities that spark off entrepreneurial ventures is the key to the engine that starts new business; opportunity recognition is the progenitor of both personal and societal wealth (Venkataraman, 2000). This opportunity recognition is very critical for spin-offs that originate from an academic environment, and they need to evaluate external knowledge and combine it with their scientific findings to develop opportunities (Walter et al., 2006; Vohora et al., 2004). Academic spin-offs often operate in turbulent markets and usually face difficulties in opportunity recognition (Vohora et al., 2004). Chapter 3 investigates the role of EO and AC on opportunity identification and pursuit.

Part 2 External factors

Facilitator support

The postulations "entrepreneurship is primarily a regional event" from Feldman (2001) and "entrepreneurial university" by Etzkowitz (Etzkowitz, 2004) has increased recognition of universities in stimulating regional economic development (Boucher et al., 2003; Sternberg, 2009; Sternberg, 2014). Therefore, many universities are creating localized spillover benefits, through assembling, combining, and delivering their core mission by the means of academic spin-off (Boucher et al., 2003). The technology transfers directly into a new academic spin-off is a great advantage over other transfer mechanisms of the creation of research-based clusters (Sternberg, 2014). A cluster is defined as a geographic concentration of interconnected companies, in particular, fields that compete but also co-operate (Porter, 2008, Porter, 1998). Such a region with geographical proximity that has been built over time stimulates knowledge diffusion and integration, which could lead to cluster competitive advantages (Porter, 2000) Moreover, region-specific academic facilitators such as university officials, TTOs, and incubators can play an important role in signaling, building, and acquiring entrepreneurial resources for start-ups in need of specific resources, managerial skills, and organizational systems (Bøllingtoft and Ulhøi, 2005; Lockett et al., 2005). The success of region-specific facilitators, such as TTOs and incubators, is strongly influenced by academic spin-offs that decide to stay or leave the region. We discuss facilitator support in Chapters 4 and 5.

Navigate critical junctures

Academic spin-offs face various challenges during their growth stages (Vohora et al., 2004). Since academic spin-offs originate in a university and research setting, which is often less focused on business-related activities, they tend to face particular barriers in acquiring and configuring resources and capabilities for commercialization (Lockett and Wright, 2005). Stage-gate models have been used frequently to describe technology development and spin-off development (Scott and Bruce, 1987; Vohora et al., 2004). These models describe various stages of growth. Research on the growth stages of academic spin-offs has identified typical

challenges, or critical junctures (Vohora et al., 2004), which spin-offs have to overcome before they can continue to grow and mature (Clarysse and Bruneel, 2007). We discuss the role of the facilitator support in Part 2, helping spin-offs to navigate critical junctures, in Chapter 4, and stimulating them to stay in the region of the parent university, in Chapter 5.

Intention to stay in the region

This activity has been credited with the creation of high-tech clusters such as Silicon Valley and Detroit, Michigan (Saxenian, 1996). The role of facilitator support and the regional cluster are discussed in part 2 (Chapters 5). We discussed their influence on spin-off growth and their influence on the academic spin-offs intention to stay in the region of the parent university. The intention of academic-spin-off to stay in the regional cluster is also related to the resource-based view, which is particularly relevant when new ventures have poor initial resources. This connection is also discussed in Chapter 5.

1.5 Research questions

Recently entrepreneurship scholars have paid increasing attention to the role of capabilities to explain performance differences between new ventures (McKelvie and Davidsson, 2009; Sapienza et al., 2006; Zahra et al., 2006). It seems important to relate management team characteristics not directly to performance (McKelvie and Davidsson, 2009), but to the suspected performance-enhancing mechanism dynamic capabilities. The research involved investigated the process by which these capabilities develop, emerge or evolve in new ventures (Rosenbloom, 2000; Zahra et al, 2006) in particular the academic spin-offs. In entrepreneurship literature, the drivers of absorptive capacity are primarily concerned with prior related knowledge in terms of domain specific research and industry experience (Kor, 2003; Shane and Venkataraman, 2000; Agarwal et al., 2004), while on other set of studies argue that the extent to which a start-up is successful at exploiting new innovations is primarily dependent on the entrepreneurial orientation (Walter et al., 2006) and entrepreneurial team-efficacy (Drnovajek et al., 2010; Baum and Bird, 2010; Arnold et al., 2001).

In Part 1, we examine the domain specific experience of the start-up's management team, and investigate the entrepreneurial orientation and team-efficacy that enable managers to better absorb and utilize the new external information. Chapter 2 proposes a preliminary method to assess the effect of domain specific experience, entrepreneurial orientation, and team-efficacy on the absorptive capacity of the spin-off's management team by addressing the following research question:

Research question 1: *To what extent do domain specific industry and research experience (RQ 1a) and entrepreneurial characteristics i.e., entrepreneurial orientation and team-efficacy (RQ 1b) of the management team of high-tech academic spin-offs lead to a higher absorptive capacity of the management team?*

To answer research question 1, we conducted a multiple regression-analysis on a sample of 95 Dutch high-tech academic spin-offs. We delineated the population of spin-offs on the basis of three criteria: the spin-off is located on or near the campus of high-tech universities; the spin-off was established within the past 10 years (Covin and Slevin, 1990; Pirolo and Presutti, 2010); the spin-off is connected to university programs or incubators and use at least one type of support from the university. In total, we identified 205 spin-offs. First, we targeted 10 potential spin-offs, recommended by university incubators, to pre-test our questionnaire. Next,

we sent the final questionnaire to 205 academic spin-offs from three prominent technical universities in Netherlands; Delft University of Technology, Wageningen University and Research Center and Eindhoven University of Technology. We conducted our survey in the period December 2011 through March 2012. In total, 105 questionnaires were returned of which 95 were complete and useful for analyses.
Entrepreneurship can be conceptualized as the entrepreneurial process which proceeds from identifying opportunities to achieving venture growth (Baron, 2006; Shane and Venkataraman, 2000). Entrepreneurship is not limited to the "discovery side" of the process but also relates to the "exploitation side" (Shane, 2000; Shepherd and DeTienne, 2005; Pirnay and Surlemont, 2003; Steffensen et al., 2000; Huber, 1991). Previous studies demonstrate that the ability to recognize opportunities is not only dependent on internal knowledge (Shane, 2000), but also depends on the process of acquiring and transferring external knowledge (Corbett, 2007; Li et al., 2009), on how decisions are made (Acs, 2005), and on how creativity and innovation are combined (Vaghely and Julien, 2010; Li et al., 2009). These studies suggest that the way companies acquire external knowledge, learn, and develop new capabilities is important for the extent to which opportunities are recognized. We continue this line of reasoning and propose that absorptive capacity and entrepreneurial orientation are required to recognize opportunities. Therefore, Chapter 3 studies the role of absorptive capacity and entrepreneurial orientation on the performance of spin-offs by addressing the following research question:

Research question 2: *To what extent do the (potential and realized) absorptive capacity and entrepreneurial orientation of the management team positively impact the opportunity identification and pursuit capabilities of the high-tech academic spin-off?*

To answer research question 2, we conducted a survey to arrive at a sample of 95 Dutch high-tech academic spin-offs in Chapter 3. The data analysis follows a two-step procedure: assessing measurement models (using exploratory factor analysis), followed by assessing structural modeling using a nonparametric approach, namely the partial least squares (PLS) approach (Chin, 1998) with the software package SmartPLS 2.0 (Ringle et al., 2010).

The diversity in academic spin-off research topics has increased substantially and covers spin-off performance, but also focuses on facilitators such as incubators, technology transfer offices, and science parks in fostering spin-off creation and growth. Little is known about the impact of facilitators on academic spin-offs, as there is neither conclusive literature on their effectiveness over time (van Geenhuizen and Soetanto, 2009) nor a systematic framework to understand and identify the nature of their support (Hackett and Dilts, 2004; Phan et al., 2005). Besides, there is the overrepresentation of studies on growth and maturity phases of firms and only a limited number of studies emphasize the earliest development stages.

Prompted by these consideration, Chapter 4 investigates the academic spin-offs growth stages, their critical junctures and the facilitators support that help spin-offs to navigate critical junctures. This research contributes to the field of academic spin-offs by investigating the growth stages of their development process. We use academic spin-off literature, and apply the capability perspective and stage-gate model theories combined with case studies to better understand the parent university's role in fostering spin-offs growth. More specifically, we explore the growth process of academic spin-offs and the barriers that they encounter during their development process. We examine the role of facilitators in overcome these barriers, resulting in a policy-oriented view that links facilitator support to the growth stages at which

the barriers occur. The objective of the study presented in Chapter 4 is to investigate how the support activities by university facilitators can foster spin-off growth. This leads to the following research question:

Research question 3: *What are the main critical junctures in the growth path of high-tech academic spin-offs (RQ 3a)? And in which ways can facilitator support academic spin-offs to overcome these critical junctures (RQ 3b)?*

To answer research question 3, we conducted an empirical study, consisting of 18 in-depth interviews with spin-off facilitators and nine spin-off founders. The combination of the two kinds of viewpoints sheds light on the ways in which facilitators' support and resources can help spin-offs to navigate the critical junctures during their development process. We selected three prominent Dutch technical universities with a high number of patents and spin-offs, which have a clear and explicit strategy for establishing and developing spin-offs, and selected three cases per university. We conducted in-depth interviews with the representatives of the supportive institutions, such as directors of incubators, science parks, TTOs and IP managers who help spin-offs to create and foster their growth. We also conducted in-depth interviews with the founders of nine spin-offs and asked them about their views the role of facilitator support.

Chapter 5 focuses on the role of facilitator support in attracting spin-offs and affecting their intention to keep their location near the parent university. In recent years, increased attention has been paid to the location of high technology firms as technical innovation and clusters of innovative firms have become engines of economic growth (Doeringer and Terkla, 1995). While the general efficiency of attracting academic spin-offs close to the parent university is well documented, we know relatively little about the corresponding efficiency of the university region and the facilitators and their effect on the founders' intention to stay in this location. More specifically, the few studies that have analyzed the location choice of academic spin-offs (Audretsch and Stephan, 1996; Zucker et al., 1998; Egeln et al., 2004) have focused on the initial location choice. Academic spin-offs might not stay in their initial location in the area of university and might decide to relocate. Chapter 5 fills this gap by studying the role of facilitator support on the intention of spin-offs to stay in the region and by addresses the following research question:

Research question 4: *To what extent can facilitators stimulate high-tech academic spin-offs to stay in the region of the parent university?*

For our empirical analysis, Chapter 5 constructs a novel dataset on the factors that characterize the environment where firms are established, including universities, university facilitators and other start-ups in the area of the parent university. In the present study, we try to answer this question by providing additional insights into the regional characteristics (Beugelsdijk, 2007) that induce academic spin-offs to stay in the university region, and we contribute to the existing literature on location preferences of spin-offs and cluster development (Lejpras and Stephan, 2011; Patton and Kenney, 2010; Stenberg 2014). Thus, we suggest an empirical strategy that complements previous research on academic spin-off location. We conduct an ordered probit regression employing a survey of 70 Dutch high-tech academic spin-offs. The survey was administered among firm founders and we investigated whether these founders intended to continue locating in the region of the parent university. We also gauged the level of perceived support provided by the parent university, the intensity of collaboration of their spin-offs with the university and other start-ups in the same region.

1.6 Data and methods

The nature of this manuscript (exploratory research in combination with a large-scale quantitative study) gives it a mixed-method character, where exploratory qualitative research is combined with large-scale quantitative research. The methodology of this study can be grouped into a qualitative research and a quantitative research. The qualitative research comprises the exploratory case studies aimed at gaining knowledge and insights through interviews with diverse experts (entrepreneurs, technology transfer managers, incubators, and researchers), university facilitators, and academic spin-offs founders. It encompasses 18 personal interviews with experts from several sub-domains and with university facilitators from the three high-tech universities in Netherlands. These interviews, lasting between one and three and a half hours, enabled us to fine-tune and complement insights from practice. Later, we conduct nine case studies to explore the high-tech academic spin-offs. Two interviewers talked to the active founders of each spin-off (mostly the main founder) to gain insights about the development process and about the most important university and facilitator support during the stage of the spin-offs. The interviews took place in the period 2010-2011. The quantitative research, as the heart of this thesis comprises a pre-test of the questionnaires with ten academic spin-offs, aimed at evaluating and adjusting the survey questionnaire. These pre-test interviews took place with spin-offs founders recommended by university incubators. The firm's founder filled out the questionnaire in the presence of the first author of this study. Afterwards, ambiguities in wording and meaning were discussed with scientific experts, which led to final adjustments of the semi-structured questionnaire. Each individual hypothesis is related to one or more closed-end questions and where possible questions have been added for reasons of triangulation and consistency checks. The final online-questionnaire consists of 31 questions. We sent the questionnaire to 205 academic spin-offs in Netherlands in the period December 2011 through March 2012. In total, 105 questionnaires were returned. After rejecting 10 incomplete questionnaires, we had a sample of 95 academic spin-offs, yielding a response rate of 46%, which is acceptable for this type of survey (Baruch, 1999).

Delineation of the target sample, Dutch technical universities and academic spin-offs

Dutch universities are considered to be entrepreneurial and very active in simulating and fostering academic spin-offs. Based on the recent study in the period of 2004-2010, conducted by the Netherlands Patent Office at 10 universities and four medical centers, an average of 6.7 academic spin-offs are created each year, of which 2.7 are based on a university patent. More specifically, this means an average of 1.86 spin-offs is established annually per 1,000 researchers (NL Patent Office, 2013). At more general universities, the average number of transfer patents to spin-offs is about 45%, whereas at the technical universities in our case studies, Eindhoven University of Technology (TUE), Wageningen University and Research Center (WUR), and Delft University of Technology (TUD), this number is around 98 % (NL Patent Office, 2013). These three are similar types of universities with 7,000 to 10,000 students. They have a relatively well-developed institutional infrastructure, have eight to 10 patent based spin-offs a year, and have various spin-offs support systems. The technical universities were chosen because they have a high number of patents and spin-offs and are thus more likely to have a clear and explicit strategy for the establishment and development of spin-offs than general universities.

Delft University of Technology (TUD)

Delft is located in a highly urbanized area in the western part of the Netherlands (Randstad), a densely populated region with about seven million inhabitants. Although the Randstad accounts for only about 20 per cent of the country's surface, more than 40 per cent of the

Dutch population lives in this area, and a large number of firms are located here. Delft is located between the agglomeration of The Hague, the administrative capital of the Netherlands, and the agglomeration of Rotterdam, the international center of port activities and a petro-chemical complex. In 1998, Delft University of Technology (TUD) adopted a policy to support academic entrepreneurship. The initiative was built on a national program named 'Techno-starters' which provided a set of support measures for academic entrepreneurs. To strengthen the initiative, in 2005, TU Delft and the Municipality of Delft set up an incubator program called (YES!Delft) which supports techno-starters to set up or further develop their company. The help includes strategic advice, personal coaching, and access to facilities in TU Delft to develop a prototype, product, or process.

Eindhoven University of Technology (TUE)
Eindhoven is located in the south of the Netherlands. Until the late 1990s, Eindhoven University of Technology (TUE) strongly focused on applied technology research and education, with strong linkages to several multinational firms in high-tech industries in the region. With the appointment of a new chairman of the board in 2002, an external professional was hired to set up a spin-off support unit (called Innovation Lab), involving spin-off advisors and intellectual property (IP) support professionals. The Innovation Lab is the technology transfer office of this university. The staff of the spin-off support unit initiated the creation and implementation of a number of key solutions, including education and training programs, a protocol for transferring IP to spin-off creation, and a regional network, involving eight organizations. In addition, various recent incubation initiatives such as Techno- partner and Incubator 3+ offer start-ups some degree of autonomy in the spin-off process.

Wageningen University and Research Center (WUR)
Wageningen is located in in the central part of the Netherlands. Wageningen University (WUR) has achieved a prominent position within the agricultural sciences. On Until 1981, efforts to commercialize research findings were primarily made by individual researchers, staff, and students. At that time, there hardly was any attention for creating new ventures. In the late 1990s, new venture support started receiving more attention as an instrument for transferring technology and a business support office was founded. The goal of this business support office was to commercialize university inventions by selling patents and licenses and supporting (new) companies to commercialize these inventions. In 2004, the Wageningen Business Generator (WBG) was founded to increase these activities and to enable investments in new university ventures. In 2005, a larger network consortium was created to promote entrepreneurship in the field of food production. Later, WBG changed to Start-Life, a foundation established in 2010, focusing on enhancing the entrepreneurial skills of students and employees of the WUR and facilitating the start-up of mostly high tech life sciences companies. Today, WUR start-ups are also supported by Food Valley. They provide support through extensive national and international contact and communication.

To keep the sample of investigated ventures homogeneous (and thus enhance comparability of the findings with other studies on the subject), this thesis exclusively focuses on young Dutch high-tech academic spin-offs. For our survey, we listed all relevant spin-offs, with names provided mainly by university facilitators such as university incubators. We used the following three criteria to guide our selection of firms: 1) the spin-off is located in the regional cluster of one of the three high-tech universities; 2) the spin-off was established within the past 10 years (Covin and Slevin, 1990; Pirolo and Presutti, 2010), and 3) the spin-off is connected to a university program or incubator uses at least one type of university

support. Our survey is comparable with other studies on academic spin-offs in Europe. For example, the Delft incubator reported a 90% survival rate after six years of existence (van Geenhuizen and Soetanto, 2009) and the Wageningen incubator reported a 78% survival rate after six years of existence (Source: Wageningen incubator director). These survival rates are even higher than the percentage that (Clarysse et al., 2007) found for the EU at large (75% after 6 years). This indicates that potential bias due to the exclusion of non-survivors is rather small. The average company age was 3.3 years, with a slightly skewed distribution towards younger spin-offs (63.2% of spin offs less than three years old). The spin-offs had an average of six employees, which is in line with the general slow growth in the European Union (Mustar et al., 2008). The average age in the management teams was 34.5 years. Team members had an average of four years of industry experience before starting up the spin-off, which is consistent with spin-off literature (Ensley and Hmieleski, 2005; Clarysse et al., 2011b). The spin-offs were mainly active in information technology (31%), medical technology (26%), clean technology (27%), and agribusiness and food (16%).

1.7 Concluding remarks

The ideas and aims presented in this introductory chapter provide a foundation for the main body of this manuscript (Chapters 2, 3, 4, and 5). These chapters represent separate studies intended as individual contributions to the entrepreneurship and AC literature. As such, the introductory sections of each study may contain repetitions of the concepts and theoretical linkages presented in the previous chapter. Chapter 6 concludes, brings together the results from these four chapters, and provides an overview of the internal and external factors that influence the absorptive capacity of academic spin-off and which lead to venture growth indicators such as opportunity identification and pursuit. Chapter 6 discusses managerial implications for university and management teams and gives recommendations for policymakers. It also provides specific implications for practitioners, discusses limitations, and gives suggestions for future research. Following figure presents the outline of the thesis (Figure 1.2).

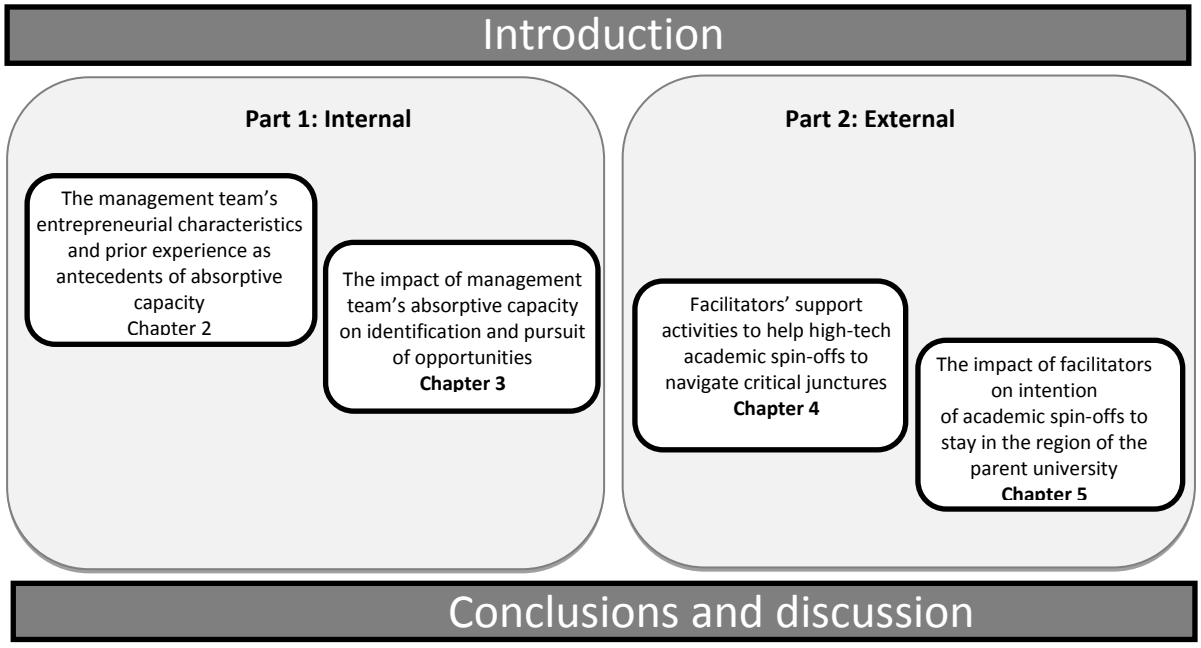


Figure 1.2 Thesis outline

Part 1 The management team's absorptive capacity

Chapter 2 The management team's entrepreneurial characteristics and prior experience as antecedents of absorptive capacity

Chapter 2 answers Research Question 1:

To what extent do domain specific industry and research experience (RQ 1a) and entrepreneurial characteristics i.e., entrepreneurial orientation and team-efficacy (RQ 1b) of the management team of high-tech academic spin-offs lead to a higher absorptive capacity of the management team?

This Chapter is based on: H. Khodaei, V.E. Scholten, E. Wubben, S.W.F. Omta. Entrepreneurship and prior experience as antecedents of absorptive capacity of high-tech academic spin-offs.An earlier version of the paper has been presented in NetGrow seminar, Lasalle-Beavais University, France.This version of the paper is in the second round of submission for the Journal of Chain and Network Science.

2.1 Introduction

Many entrepreneurship scholars studied the role of dynamic capabilities as antecedents of innovation, value creation in new ventures (Sapienza et al., 2006; Zahra et al., 2006, McKelvie and Davidsson, 2009) and the role of absorptive capacity (AC) to explain differences in the growth of new ventures (Gray, 2006; Hayton and Zahra, 2005; Larraneta et al., 2007; Rothaermel and Thursby, 2005; Fosfuri and Tribo, 2008; Zahra et al., 2009). Zahra and George (2002) introduced the dynamic capabilities perspective on AC and defined AC as "*a set of organizational routines and processes by which firms acquire, assimilate, transform, and exploit knowledge to produce a dynamic organizational capability*" (Zahra and George, 2002: 186). AC in entrepreneurial firms help them with constant access to new knowledge and information about opportunities (Engelen et al., 2014; Rothaermel and Alexandre, 2009).

While research has substantially investigated the consequences of AC for firm performance (Lane et al., 2006; Van Den Bosch et al., 1999; Zahra et al., 2009; Zahra and George, 2002), so far relatively limited research has focused on the antecedents of absorptive capacity, especially within new ventures (Zahra et al., 2009; Hayton and Zahra, 2005). The present study proposes a framework assessing the AC antecedents in high-tech new ventures, so called high-tech academic spin-offs, which are defined as new ventures founded by academics who exploit technical and scientific findings from universities in commercial environments (Pirnay et al., 2003).

AC plays an important role for academic spin-offs to signal, build and acquire knowledge and resources (Bollingtoft and Ulhoi, 2005; Lockett et al., 2005; Wright et al., 2007; Sirmon et al., 2007; Holcomb et al., 2009; Zahra et al., 2009). Previous studies focused on prior experience as an antecedent of AC (Argote et al., 2003; Cohen and Levinthal, 1990; Van den Bosch et al., 1999) with a focus on prior related experience (Cohen and Levinthal, 1990a; Zahra and George, 2002; Lane et al., 2006). In entrepreneurship literature, the success of such new ventures is typically explained by prior related knowledge in terms of domain specific research and industry experience (Kor, 2003; Shane and Venkataraman, 2000; Agarwal et al., 2004). However, other studies argue that the extent to which new ventures are successful at exploiting new opportunities and new innovations is dependent on the management team's EO (Walter et al., 2006; Keh et al., 2007; Clarysse et al., 2011c) and entrepreneurial team-efficacy (Drnovajek et al., 2010; Baum and Bird, 2010; Arnold et al., 2001). Academic spin-offs might face difficulties in translating their initial idea to sustainable business due to the lack of EO (Iacobucci et al., 2011). EO leads to better opportunities identification that might lead to new venture ideas (Clarysse et al., 2011c). EO is a decision making style that emphasizes a focus on innovation, proactivity and a willingness to take risks (Covin and Slevin, 1990). It is argued that new ventures with founders who are more creative, proactive and risk-taking seek information that is more novel and are better at exploiting the acquired information (Keh et al., 2007; Walter et al., 2006). Hence, EO is thought to improve firm performance through intensifying the acquisition of information and its exploitation efforts (Keh et al., 2007) thereby advancing the knowledge creation processes (Li et al., 2009).

Entrepreneurial team-efficacy is the degree of team members motivation and confidence in their ability to successfully perform the various roles and tasks of entrepreneurship (Hmieleski and Baron, 2008) leading to start-up performance (Hmieleski and Baron, 2008; McGee et al., 2009; Durham et al., 1997; Bandura, 1997). Several conceptions of individual differences, other than self-efficacy, also reflect confidence (e.g., locus of control, self-esteem); however, they are applied in more general context (Bandura, 1997). To concentrate on high-growth

entrepreneurs such as high-tech academic spin-offs, we apply entrepreneurial self-efficacy at the team level, known as entrepreneurial team-efficacy since in these typical start-ups the founding of a company is a joint effort. In sum, in the present manuscript, we investigate both domain specific experience (Shane and Venkataraman, 2000; Kor, 2003; Agarwal et al., 2004), the role of team EO (Covin and Slevin, 1990), and entrepreneurial team efficacy (Drnovajek et al., 2010; Baum and Bird, 2010; Arnold et al., 2001), as antecedents of AC of high-tech academic spin-offs.

Chapter 2 aims to contribute to AC and entrepreneurship literature in three ways. First, following the suggestions to broaden the search for antecedents of AC (Volberda et al., 2010), we study AC antecedents at the level of the high-tech academic spin-offs team, thereby answering the calls to apply the notion of AC at the team-level (Volberda et al., 2010). Since new ventures teams themselves are responsible for building such capabilities (Sirmon et al., 2007; Holcomb et al., 2009), we study how the spin-offs teams can be organized to seek and perceive external knowledge as opportunities. Second, besides the team's domain specific experience, Chapter 2 also contributes to the debate in literature about team's micro-level antecedents such as motivation, notably absent in the literature (Minbaeva et al., 2003; Volberda et al., 2010) reflecting the way team respond to external knowledge and their ability to exploit it successfully. Finally, we study the antecedents of the different dimensions of AC (Volberda et al., 2010; Greve, 2008; Jansen et al., 2005; Salvato et al., 2009; Zahra and George, 2002), in particular potential absorptive capacity (PAC), reflecting the ability of a firm to acquire and assimilate external knowledge (Zahra and George, 2002; Todorova, and Durisin, 2007; Fosfuri, and Tribó, 2008), and realized absorptive capacity (RAC), referring to the extent to which a firm can realize commercial benefits from that knowledge and is related to the routines of knowledge transfer and exploitation (Zahra and George, 2002). It has been recognized that different antecedents may have different effects on the dimensions of AC (Zahra and George 2002; Jansen et al., 2005; Todorova and Durisin, 2007).
The following section presents the theoretical basis and hypotheses for our conceptual framework that depicts the relationships between management team characteristics, PAC and RAC, (see Figure 2.1). It unfolds along the following lines. Section 2.2 reviews the relevant literature to derive hypotheses on the determinants of absorptive capacity. Sections 2.3 and 2.4 present the methods of empirical data collection and the operational measures, respectively the results and discussion on the tested hypotheses. Finally, section 2.5 presents the conclusions and implications.

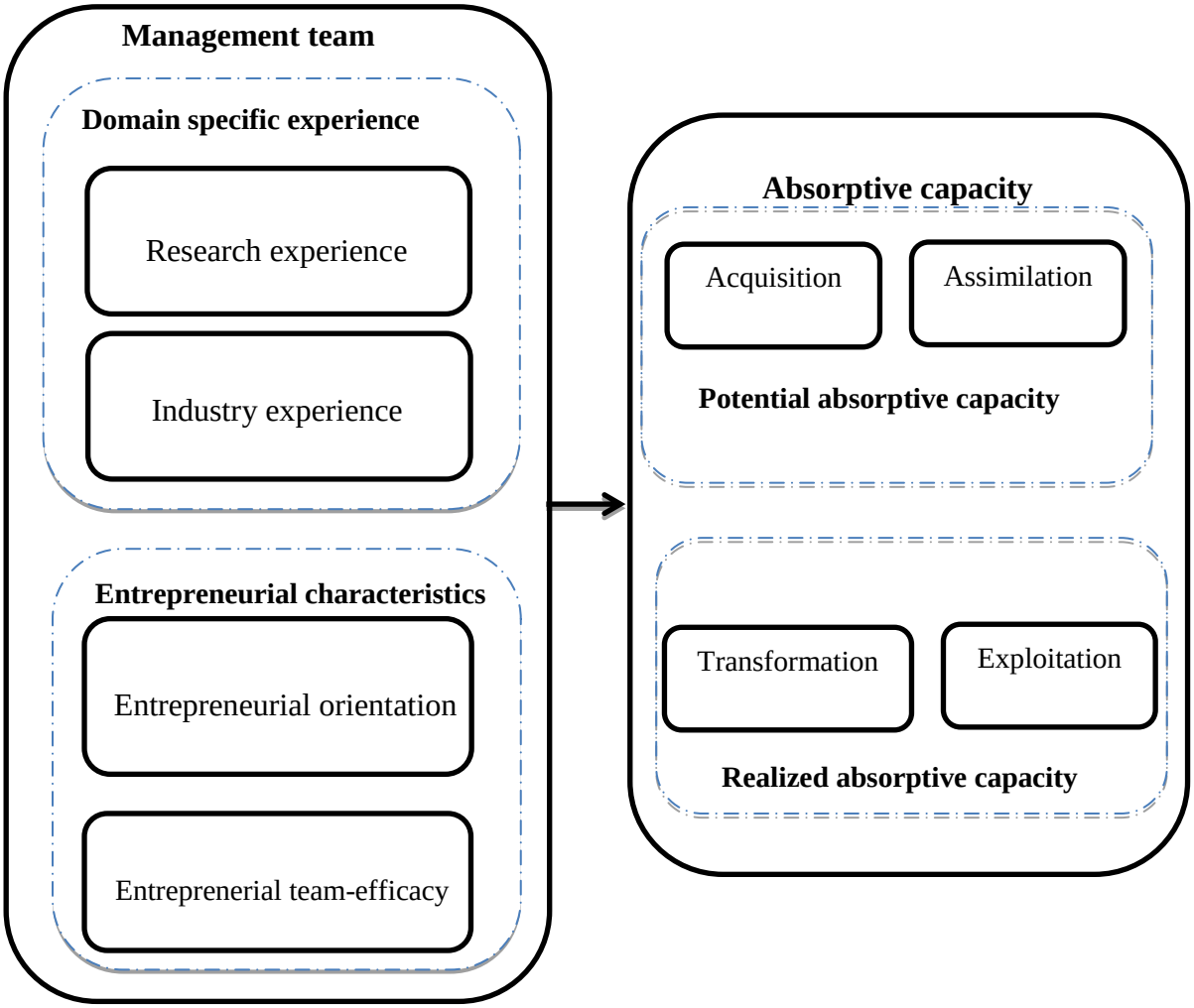


Figure 2.1 Theoretical model

2.2 Theoretical framework

Absorptive capacity (AC), conceptualized by Cohen and Levinthal (1989), has received considerable interest in organizational research (Lane et al., 2006). AC comprises of routines to acquire, assimilate, transform and exploit new external knowledge, in order to build, maintain or renew other capabilities (Cohen and Levinthal, 1990a; Todorova and Durisin, 2007; Zahra and George, 2002). The prior possession of knowledge and skills is considered important to the development of learning when new knowledge is combined with existing knowledge. However, Covin and Levinthal (1990) argue that for an effective absorptive capability capacity, the intensity of effort is crucial. Thus, effort and purposeful action is needed to make novel associations and linkages. Fabrizio (2009) found that biotechnological and pharmaceutical firms that invest more in their internal basic research and engage in collaborations with university scientists do in fact experience additional search benefits, thereby supporting his argument that "*effort, experience, expertise, and purposeful action among members are required to identify, assimilate, and exploit this external knowledge*" (Fabrizio, 2009: 257). However, most studies on AC have investigated the role of required skills and experience of firm members, and neglected studying the micro-level antecedents of AC such as motivation that members may have (Minbaeva et al., 2003; Volberda et al., 2010). In this section, we develop hypotheses investigating teams' domain specific experience next to entrepreneurial antecedents of academic spin-offs team as antecedents of the two dimensions of absorptive capacity.

Domain specific research and industry experience

Previous literature indicates that the employment history and experiences of the entrepreneur are crucial for entrepreneurial success (Sandberg and Hofer 1988; Starr and MacMillan, 1990; Wright et al., 2007). Entrepreneurship literature has focused on domain specific experience in terms of domain specific research and domain specific industry experience (Kor, 2003; Shane and Venkataraman, 2000; Agarwal et al., 2004).

Domain specific research experience

Academic scientists need different sets of skills and expertise to pool technological opportunities and exploit entrepreneurial opportunities (D'Este et al., 2012). In fact they need to conduct further research before they can exploit their scientific findings (Clarysse et al., 2005).

Knowledge acquisition capacity refers to identifying value and acquiring externally generated knowledge that is critical to firm operations (Zahra and George, 2002). Spin-off teams that have been involved in a scientific discovery possess a great deal of non-codified knowledge that can be useful to identify and evaluate external knowledge which is needed for the further development and implementation in practice (Clarysse and Moray, 2004). Indeed, domain-specific research experience affects the team's access to scientific experience and expertise in other research areas (Corolleur et al., 2004; Murray, 2004; Shane and Stuart, 2002) and advances the discovery of opportunities (Shane, 2000).

Domain specific research experience facilitates the search for new innovations by suggesting possible solutions and allowing researchers to focus their search in the most likely areas of opportunity and eliminate areas of search that would have proved fruitless (Sorenson and Fleming, 2004, Fabrizio, 2009), which eventually will result in a higher knowledge acquisition capacity.

Assimilation refers to analyzing, interpreting and understanding the information obtained from external sources (Szulanski, 1996). During assimilation, new external knowledge is connected to existing knowledge within the firm, which requires the identification of similarities. Firms need prior related knowledge to assimilate new knowledge (Cohen and Levinthal, 1999). A management team with high research experience will be more efficient in combining and assimilating diverse externally sourced knowledge to its internal knowledge base (Sapienza et al., 2004). The dimensions of knowledge acquisition and assimilation together define PAC (Zahra and George, 2002; Jansen et al., 2006). In conclusion, we postulate that spin-off teams with a higher level of domain specific research experience will exhibit a higher level of PAC, acquisition and assimilation capacity, which leads to our first hypothesis:

H1: *Spin-off teams with an overall higher level of domain specific research experience will show a higher acquisition and assimilation capacity (that is, higher PAC).*

Transformation refers to developing and refining routines that facilitate recognizing opportunities and consequences of new external knowledge for existing operations, structures, and strategies (Jansen et al., 2006; Zahra and George, 2002). It refers to maintaining and subsequently reactivating knowledge (Walsh, 1991). The more prior knowledge a firm has in a given field, the easier it is to maintain and reactivate additional knowledge (Garud et al., 1998). Knowledge transformation covers the efforts to arrive at new insights from the combination of existing and newly acquired knowledge (Zahra and George, 2002). The

benefits from prior knowledge indicate path-dependencies in knowledge retention (McGaughey, 2002; Pandza and Holt, 2007). Domain-specific research experience is particularly critical to the translation of research into commercial opportunities. Especially when it concerns complex or non-codified knowledge components, the translation requires common language and frequent face-to-face interaction to understand the opportunity and implement the scientific finding in practice (Agrawal, 2006).

The exploitation process refers to refining, extending and elaborating existing competencies or creating new ones by incorporating acquired and transformed knowledge into its operations (Zahra and George, 2002). It is most efficient when individuals integrate highly specialized knowledge (Grant, 1996) in its primary operations (Zahra and George, 2002). The dimensions of knowledge transformation and exploitation together define RAC (Jansen et al., 2006; Zahra and George, 2002). Thus, we postulate that spin-off teams with a higher level of domain specific research experience will exhibit a higher level of realized absorptive capacity, transformation and exploitation capacity, which leads to our second hypothesis:
H2: *Spin-off teams with an overall higher level of domain specific research experience will show a higher transformation and exploitation capacity (RAC).*

Domain specific industry experience
The prior related knowledge comprises not only domain specific research experience but also the accumulation of domain specific industry experience (Kor, 2003; Shane and Venkataraman, 2000). Industry-specific experience may impact both knowledge acquisition and knowledge assimilation (Romijn and Albaladejo, 2002). The knowledge acquisition capacity depends on how a management team pays attention to new knowledge and recognizes opportunities. Prior knowledge of a specific industry has an effect on opportunity recognition, as it influences the locus of search (Shane, 2000; Zahra and George, 2002). Entrepreneurs tend to search in areas that they already know, where they had their earlier successes (Zahra and George, 2002). This kind of knowledge established through learning by doing may be measured by job experience of the managers (Vinding, 2004). Academic spin-off management teams with specific industry experience are endowed with market-pioneering know-how, that will help them to better seize market opportunities in high-tech markets (Agarwal et al., 2004), leading to higher acquisition capacity.

Assimilation capacity refers to the extent to which firms are able to analyze and understand new external knowledge (Jansen et al., 2006; Zahra and George, 2002). Entrepreneurs with domain specific industry experience can adapt more easily to the habits of that industry (Chandler, 1996). Entrepreneurs that are experts in a very specialized knowledge field tend to search in-depth for new knowledge that is related to their existing knowledge base (Chandler, 1996; Laursen and Salter, 2006), which leads to higher assimilation capacity. Accordingly, we postulate that spin-off management teams with a higher level of domain specific industry experience will exhibit a higher level of acquisition and assimilation capacity, which leads to our third hypothesis:
H3: *Spin-off teams with an overall higher level of domain specific industry experience will show a higher acquisition and assimilation capacity (PAC).*

Domain specific industry experience is critical for academic spin-offs to overcome the difficulties of commercializing academic output (Wright et al., 2006). More complex innovations involve more specialized knowledge. The integration and transformation of knowledge from these specialists requires a certain degree of common language (Hargadon

and Sutton, 1997; Cohen and Levinthal, 1990a; Grant, 1996). In turn, this common language requires a certain level of prior related knowledge in a given field. In sum, domain-specific knowledge helps to improve the efficiency of knowledge transfer (Lane and Lubatkin, 1998).

Furthermore, when the current industry of the spin-off firm is closely related to that of the entrepreneurs' previous employment, then the entrepreneurs can better than others exploit market knowledge and benefit from their previous contacts with potential customers and suppliers (Shepherd, 2000). It is generally believed that entrepreneurs with related industry sector experience will have a better understanding of any underdeveloped technological and marketing opportunities in that specific sector (Shane, 2000). Such entrepreneurs are able to seize market opportunities and to position their new products (Colombo and Grilli, 2005). Moreover, experience in similar markets benefits a firm through the presence of past relationships with suppliers/customers, and a familiarity with the appropriate sales techniques and capital requirements (Marvel, 2007). It was verified that industry-specific experience has a positive effect on performance: companies whose current products, technologies and markets are related to the entrepreneurs' previous companies show higher rates of growth (Feeser, 1990; Bruderl and Preisendorfer, 2000). Consequently, domain specific industry experience could provide a management team with a higher exploitation capacity. Thus, we postulate that spin-off management teams with a higher level of domain specific industry experience will exhibit a higher level of transformation and exploitation capacity, which leads to our next hypothesis:

H 4: *Spin-off teams with an overall higher level of domain specific industry experience will show a higher transformation and exploitation capacity (realized absorptive capacity).*

Entrepreneurial orientation and entrepreneurial team-efficacy

Previous literature on entrepreneurship has made great strides to define essential parameters or roles of entrepreneurs in performing entrepreneurial endeavors (Sardeshmukh et al., 2011). For example, entrepreneurs have to detect and exploit opportunities, be proactive and they have to make rapid decisions under uncertainty and in a resource constraint environment, they have to be willing to work harder than most employees, and thus they have to possess a wide variety of skills, knowledge, and abilities (Sarasvathy, 2001; Shane, 2003).

Essential parameters or characteristics of entrepreneurs in succeeding entrepreneurial endeavors can be gauged by EO (Naman, 1993; Covin and Slevin, 1990), and entrepreneurial team-efficacy (Baum and Bird, 2010; Drnovajek et al., 2010).

Entrepreneurial Orientation

Many firms attribute their success and performance to EO (Dess and Lumpkin, 2005). Core of the general notion of EO is that such firms are more likely to embrace the creation and pursuit of new entries (Lumpkin and Dess, 1996). Regarding academic spin-offs, it has been verified that EO has a highly significant effect on their ability to access to external knowledge and realization of competitive advantages (Walter et al., 2006). EO is defined as firm's strategic orientation and willingness in capturing specific entrepreneurial antecedents of decision-making styles, methods, and practices (Lumpkin and Dess, 1996, Wiklund and Shepherd, 2003). Wiklund and Shepherd, 2003 stated that "*EO can enhance the performance of a firm's knowledge-based resources by focusing attention on the utilization of these resources to discover and exploit opportunities*" (Wiklund and Shepherd, 2003: 1308).

Acquisition processes refer to the collection of primary or secondary information (Moorman, 1995) which involves environmental scanning, intelligence activities and the integration of

those information for the firm (Keh et al., 2007). Higher levels of EO help management teams to scan and monitor their environment in order to find new opportunities and strengthen their competitive positions (Keh et al., 2007) and identify trends and opportunities and deploy knowledge-based resources earlier than competitors (Wales et al., 2012). A management team with a more proactive orientation is expected to be more responsive to externally acquired knowledge (Liao et al., 2003). During assimilation new external knowledge is connected to existing knowledge within the firm. Entrepreneurial oriented teams have higher levels of proactivity and creativity (Unsworth, 2001b), identify opportunities, and act on them, until meaningful change occurs, which may lead to higher assimilation capacity. Therefore, the EO of a team may contribute to higher performance levels by strengthening a team's capacity to identify innovative opportunities and gain first mover advantages (Wiklund and Shepherd, 2003; Stam and Elfring, 2008). In sum, we argue that spin-off management teams with substantial EO will do better in acquisition and assimilation. This expectation is captured in the following hypothesis:
H5: *Spin-off teams with an overall higher level of entrepreneurial orientation will show a higher acquisition and assimilation capacity (PAC).*

Next to their impact on PAC, EO motivates and supports firm efforts to leverage absorbed knowledge into so called value-creating resource bundles (Griffith et al., 2006; Wiklund and Shepherd, 2003). It helps combining new knowledge with existing knowledge to generate new ideas (Zahra and George, 2002), leading to higher transformation capacity. Moreover, EO in terms of proactive behavior is important to exploitative learning routines, to utilize knowledge in ways that will meet future requirements (Gilstrap and Hart, 2012). With higher levels of EO, firms may improve their performance through intensifying their information exploitation efforts (Keh et al., 2007). As such, EO enhances the commercialization of firm knowledge that is the exploitation dimension in a firm's AC (Wales et al., 2012). To conclude, an entrepreneurially oriented spin-off management team is expected to have a higher transformation and exploitation capacity. Accordingly, we posit the following hypothesis:
H6*: Spin-off teams with an overall higher level of EO will show a higher transformation and exploitation capacity (RAC).*

Entrepreneurial team-efficacy
Entrepreneurial team-efficacy is the extent to which team members are motivated and are confident in their ability to produce consistently high levels of performance in entrepreneurship specific tasks (Chen et al. 1998). The knowledge acquisition and assimilation capacity depends on how a management team pays attention to new knowledge and recognizes opportunities. It refers to the collection of primary or secondary information (Moorman, 1995) which involves environmental scanning, intelligence activities and the integration of resulting information into the firm (Keh et al., 2007). As Chen et al. (1998: 301) stated that, "*the same entrepreneurial environment could be assessed as replete with opportunities by people with high entrepreneurial self-efficacy but fraught with costs and risks by people with low entrepreneurial self-efficacy*." Since opportunity recognition depends on self-efficacy (Krueger and Dickson, 1994), teams with greater belief in their abilities to undertake entrepreneurial activities will be more likely to engage in entrepreneurial endeavors and perceive new opportunities (Sardeshmukh and Corbett, 2011). Also Barbosa, Gerhard, and Kickul (2007) observed a connection between entrepreneurial self-efficacy for opportunity identification (Barbosa et al., 2007).

Hence, scholars have shown that self-efficacy leads to a higher propensity to scan their environment and evaluate new information upon valuable opportunities (Neck and Manz, 1992; Krueger and Dickson, 1994). Therefore, we argue that a spin-off management team with higher entrepreneurial team-efficacy will do better in acquisition and assimilation capacity.

H7: *Spin-off teams with an overall higher level of entrepreneurial team-efficacy will show a higher acquisition and assimilation capacity (PAC).*

Transformation and exploitation capacity is expected to be related to the level of motivation of employees (Liao et al., 2007). Shane et al. (2003) considered entrepreneurial team-efficacy as the entrepreneurial motivation and confidence for entrepreneurial endeavors in new ventures. Self-efficacy has been considered as an effective predictor of teams' motivation and learning (Zimmerman, 2002). Entrepreneurial team-efficacy reflects team members' confident in their ability to successfully accomplish the different roles and tasks of entrepreneurship (Hmieleski and Corbett, 2008) and teams' beliefs on innovation and marketing (Baum and Bird, 2010; Hmieleski and Baron 2008; McGee et al., 2009) and ability to visualize success (Shepherd and Krueger, 2002). Team members with high levels of entrepreneurial self-efficacy are more likely to exhibit high level of persistence and concentration which enhances start-ups (Forbes, 2005; Prodan and Drnovsek, 2010; Hmieleski and Corbett, 2008) performance. Thus, it improves the transformation and opportunity exploitation capacity, critical to successfully commercializing an entrepreneurial idea. Therefore, we postulate that management teams with higher entrepreneurial team-efficacy will do better in transformation and exploitation, which leads to our last hypothesis:

H8: *Spin-off teams with an overall higher level of entrepreneurial team-efficacy will show a higher transformation and exploitation capacity (RAC).*

2.3 Data and methods

Sample and data collection

For this research, we developed a list of spin-offs, which was provided mainly by university facilitators, such as university incubators. We delineated the population of spin-offs on the basis of three criteria, namely, located on or near the campus of universities of technology, studying only spin-offs that are younger than 10 years old (Pirolo and Presutti, 2010), and that these spin-offs are connected to a university program or incubators and use at least one type of support from the university. In total, 205 spin-offs were identified. First, we targeted 10 potential spin-offs in our pilot study, recommended by university incubators, to pre-test our questionnaire. The firm's founder filled out the questionnaire in the presence of one of the researchers, which led to final adjustments of the semi-structured questionnaire. Second, we sent the final questionnaire to 205 academic spin-offs from three prominent technical universities in the Netherlands; Delft University of Technology, Wageningen University and Research Center and Eindhoven University of Technology, between December 2011 and March 2012, from which 105 questionnaire were returned. Ten incomplete questionnaires were rejected and we ended with a sample of 95 useable questionnaires of academic spin-offs, yielding a response rate of 46%, which is quite acceptable for this type of survey (Baruch, 1999).

To assess the quality of the data, we tested for various potential biases, but found no anomalies. For example, we tested for non-response effects by comparing the group of respondents to the group of late respondents (Armstrong and Overton, 1977) and we found no

significant differences between the two groups. One other potential source of bias resides in the fact that our findings are derived from spin-offs that survived to the time of the survey. Spin-offs that had failed to survive fell outside our ability to observe. This is a common problem in studies on young firms. However, failure among academic spin-offs from technical universities is generally low. For example the incubator in Delft witnesses 90% survival after six years of existence (van Geenhuizen and Soetanto, 2009). This is slightly higher than the average in the EU at large which is 75% after six years of founding (Clarysse et al., 2007), indicating a rather small potential bias in the results due to excluding non-survivors.

Table 2.2 provides descriptive information on the dataset regarding company age and size, management team age and size, research experience and industry experience. The average company age was 3.3 years, with the distribution skewed towards younger spin-offs, (63.2% of spin offs under three years). The average age in management teams was 34.5 years. The average number of employees was six employees which fit into the general slow growth in the European Union, employ less than 10 persons (Mustar et al., 2008). The average years of industry experience among team members before starting the spin-off was just over four years, which is consistent with other literature on spin-offs (Ensley and Hmieleski, 2005, Clarysse et al., 2011b). Finally, with regard to sectors, the spin-offs firms were mainly active in information technology (31%), medical technology (26%) clean technology (27%), and agribusiness and food (16%).

Although the data was self-reported, previous studies show that founder-reported results can be considered reliable when she or he is asked to report about start-up team members (Brush and Vanderwerf, 1992). This procedure is considered adequate when collecting detailed information regarding prior experience of start-up team members (Davidsson and Wiklund, 2006) and it is less suited for questions on past opinions or beliefs, but especially suited for data-gathering on simple facts and events, as is the case in our study (Golden, 1992b). Complementary data on past experiences regarding domain research and industry experience was gathered from secondary sources, such as LinkedIn to reduce the potential of single source bias. Furthermore, the use of retrospective reporting is a viable research method when the measures used are reliable and valid (Miller et al., 1997).

Data analysis

The data analysis follows a two-step procedure: assessing measures (using exploratory factor analysis), followed by multi hierarchical regression. We performed a multi hierarchical regression analysis, in STATA, to assess the effects of the various antecedents on AC (see Table 2.3). The hierarchical approach is appropriate when the focus is on theoretically based decisions to investigate the change in variations as a result of entering independent variables in the analysis over and above that contributed by independent variables entered initially in the analysis (Cohen, 1983). The analysis takes PAC and RAC as dependent variables. In each step of the hierarchical analysis the two factors for prior related knowledge and two factors for entrepreneurial antecedents as EO and team-efficacy are added, to the six control variables.

Measures

We measured the relevant constructs (see appendix A) using multi-item scales, based on existing literature, with their reliability and validity being assessed through various analyses.

Dependent variables

We used existing literature on the dependent variables of potential and realized AC to develop measurements for each of the four constructs on or dimensions of AC- acquisition, assimilation, transformation and exploitation. Measurements were partially based on existing items and measures of related constructs, using seven-point Likert-scales (Jansen et al., 2005; Zahra et al., 2007; Schleimer and Pedersen, 2013). Since relevant previous research was mainly directed at large companies, we adapted the measures to the academic spin-offs. For example, we replaced the term 'units of organization' by 'management team'.

The items used in the exploratory factor analysis are presented in Table 2.1. The table presents three items from Schleimer and Pedersen (2013), four items from Zahra et al. (2007) and nine items from Jansen et al. (2005). The exploratory factor analysis with varimax rotation and Kaiser Normalization (Hair and Black, 2006) resulted in a four-factor solution with clean loadings for the items on their respective constructs. The initial results led to the elimination of one item. The dependent variable PAC comprises the acquisition and the assimilation of external knowledge. Three items loaded on knowledge acquisition (α=.82). In addition, five items measured the assimilation of external knowledge (α=.82). The dependent variable RAC comprises the transformation and exploitation of external knowledge. Three items loaded on knowledge transformation (α=.66), and four items together measure knowledge exploitation, or the ability of spin-offs to incorporate new external knowledge into their operations (α=.75). The respective Cronbach alpha shows that each of the four constructs of the dependent variables performed satisfactory (Table 2.1).

Independent variables

The antecedents of AC consist of the management teams' prior related knowledge and EO and team-efficacy. To measure prior related knowledge, in terms of domain specific research and industry experience, we adapted respectively the average number of years of doing research and work experience of management team in the specific field or technology of the start-up (Shane and Stuart, 2002; Scholten, 2006; Florin et al., 2003; Westhead et al., 2001). To obtain normally distributed variables we used square root transformation for the domain specific experience.

The measurement for EO was based on the Covin and Slevin (1989) scale (Covin and Slevin, 1989). The analysis leads us to exclude one item of proactiveness, so the scale examines innovativeness (three items), risk taking (three items), and proactiveness (two items), resulting in a reliable scale (α=.67). Since these three subscales are manifestations of EO, we use the measure for the combined construct instead of individual subscales (Keh et al., 2007), since the subscales are highly correlated (Wiklund and Shepherd, 2005).

To measure team-efficacy we deployed a used scale (Kickul et al., 2009; McGee et al., 2009). The scale uses 7 items or statements to measure ability of the start-up team to perform the instrumental functions in the entrepreneurial process. For each statement, the respondents rated the extent to which they felt confident that their team could successfully complete tasks, actions, and processes that contribute to successful performance. To reduce the dimension based on common variance we used explorative factor analysis that extracted one factor and the loadings for indicators ranged from .73 to .82, suggesting construct validity. The construct has a Cronbach's alpha of .91, which indicates a good level of reliability.

Table 2.1 Results of the Exploratory Factor Analysis for absorptive capacity (N=95)

Variables	Mean	SD	Potential absorptive capacity Acquisition	Potential absorptive capacity Assimilation	Realized absorptive capacity Transformation	Realized absorptive capacity Exploitation
1. We frequently scan the environment for new technologies	5.11	1.621	**.783**	.171	.333	-.007
2. We thoroughly observe technological trends	5.37	1.360	**.848**	.270	.055	.153
3. We observe in detail external sources of new technologies	5.04	1.436	**.752**	.179	-.107	.318
4. We thoroughly collect industry information	5.32	1.273	.490	**.538**	.146	.238
5. We can quickly interpret changing market demands	5.31	1.272	.326	**.727**	.311	.025
6. New opportunities to serve our clients are quickly understood	5.14	1.411	.087	**.714**	.247	.116
7. We analyze various combinations of attributes for our products	5.30	1.295	.186	**.771**	-.041	.253
8. We analyze different sequences for new product development	5.31	1.305	.176	**.634**	.180	.382
9. We record and store newly acquired knowledge for future reference	5.10	1.422	-.109	.261	**.688**	.089
10. We determine how customers will use our technologies	5.44	1.373	.295	-.014	**.686**	.201
11. We Identify different customer groups that might have an interest in our products	5.29	1.304	.176	.405	**.583**	.046
12. We have a clear division of roles and responsibilities	5.46	1.285	-.068	.105	.491	**.657**
13. We easily implement technologies in new products	5.43	1.267	.131	.170	.008	**.715**
14. We have a common language regarding our products and services	5.61	1.132	.110	.220	.377	**.754**
15. We constantly consider how to better exploit knowledge	5.69	.968	.291	.146	-.023	**.628**
Eigenvalue			6.13	1.66	1.33	1.04
Variance explained			38.34	10.93	8.71	6.92
∑ Variance explained			38.34	49.13	57.95	64.85
Cronbach α			0.82	0.82	0.66	0.75

Control variables

The research included six control variables, namely spin-off size, spin-off age, start-up team age, start-up team size, environmental turbulence and sector. First larger spin-offs may have more resources, yet they may lack the flexibility to acquire and assimilate new external knowledge. To obtain normally distributed variables we included the natural log for spin-off size and age and for management team size and age (Jansen et al., 2005).

Second, one would expect older firms, with their accumulated experience, to be better at exploitation (Acs and Audretsch, 1988; Brouwer and Kleinknecht, 1999). Third, spin-off team age is a control variable because age and capabilities might be correlated (Kor, 2003; Hambrick and Mason, 1984). Fourth, in line with previous studies (Mihalache, 2012), we control for spin-off team size by including the natural log of the number of start-up team members. Fifth, also environmental turbulence is claimed to influence PAC (Zahra and George, 2002; Jansen et al., 2005). The related construct consists of four items (α=.83), it is

based on Jaworski and Kohli (1993), and it was used in many other studies (Sethi and Iqbal, 2008). Sixth and final, considering prior studies that have reported different knowledge strategies in different industries (Salavisa et al., 2012), we controlled for industry effects. We included industry dummies for spin-offs focused on medical technology (used as the base group), clean technology, information technology, or agriculture and food.

2.4 Results

Table 2.2 provides the descriptive statistics and zero order correlations among the variables used in the regression analyses. We examined multicollinearity between the predictors, by calculating the variance inflation factor (VIF)-index and tolerance statistics. The VIF-indices varied between 1.09 and 2.18, far below the VIF-index threshold value of 10 (Field, 2009). The tolerance statistics showed values between .45 and .89, all well above .20. Finally, also the maximum correlation value of .62 indicates absence of serious threats to multicollinearity (Field, 2009).

Table 2.2 Descriptive statistics and correlations (N=95)

Variables	Mean	S.D	1	2	3	4	5	6	7	8	9	10	11
1. Potential AC	5.23	1.01	1.00										
2. Realized AC	5.41	.82	.62**	1.00									
3. Domain specific research experience (Years)	6.40	.78	.13	.28**	1.00								
4. Domain specific industry experience (Years)	4.68	1.66	-.09	.23*	.49**	1.00							
5. Entrepreneurial orientation	4.89	1.09	.28**	.45**	.09	-.06	1.00						
6. Entrepreneurial team-efficacy	4.74	5.64	.21*	.52**	.09	.02	.19	1.00					
7. Environmental turbulence	5.71	6.10	.26*	.07	-.08	-.05	.09	.07	1.00				
8. Academic spin-off size (FTE)	5.9	10.0	.05	.08	.06	-.18	.04	.11	-.06	1.00			
9. Academic spin-off age (Years)	3.3	2.0	-.20	-.01	.37**	.49**	-.14	-.02	-.08	-.01	1.00		
10. Management team size (FTE)	2.7	1.2	.04	.04	-.03	-.11	.01	.18	-.03	.11	.05	1.00	
11. Average age of management team (Years)	34.5	8.1	-.12	-.17	-.08	-.08	-.11	-.01	-.04	.02	.11	.41**	1.00

* P < 0.05, ** P < 0.01

The results of the hierarchical multiple regression analyses are reported in Table 2.3. To distinguish between the relative effects of different antecedents of prior knowledge and entrepreneurial antecedents on PAC and RAC, we determined the relative importance of each set of antecedents, performing F-tests involving both the full and restricted models (Kotha and Nair, 1995).

For both PAC and RAC we examined a base model and main effects-models. We regressed the dependent variable on the control variables to create a baseline model (Model A1 and Model B1 in Table 2.3), then entered the direct effects to test Hypotheses 1, 2, 3 and 4 about domain specific experience (Model A2 and Model B2 in Table 3), and finally entered EO and team-efficacy to test Hypotheses 5, 6, 7 and 8 (Models A3 and B3 in Table 3).

The control variables of management size and age, spin-off size and age and environmental turbulence explain 16% of the variation in PAC but only 5% of the variation in RAC. The next step of analysis includes the two variables for prior related knowledge as displayed in Models A2 and B2. These two variables account for an additional 5% of the variation in PAC and 14% of variation in RAC. Domain specific research experience has a statistically significant positive relationship with both PAC (ß=.25, p<.01) and with RAC (ß=.25, p<.05). The results in Models A2 and B2 support both Hypothesis 1 and Hypothesis 2. A higher level of domain specific research experience of management team members has a significant and positive effect on PAC, and RAC. However, for the domain specific industry experience we did not find significant statistical relationships, thus neither Hypothesis 3 nor Hypothesis 4 is supported by the data.

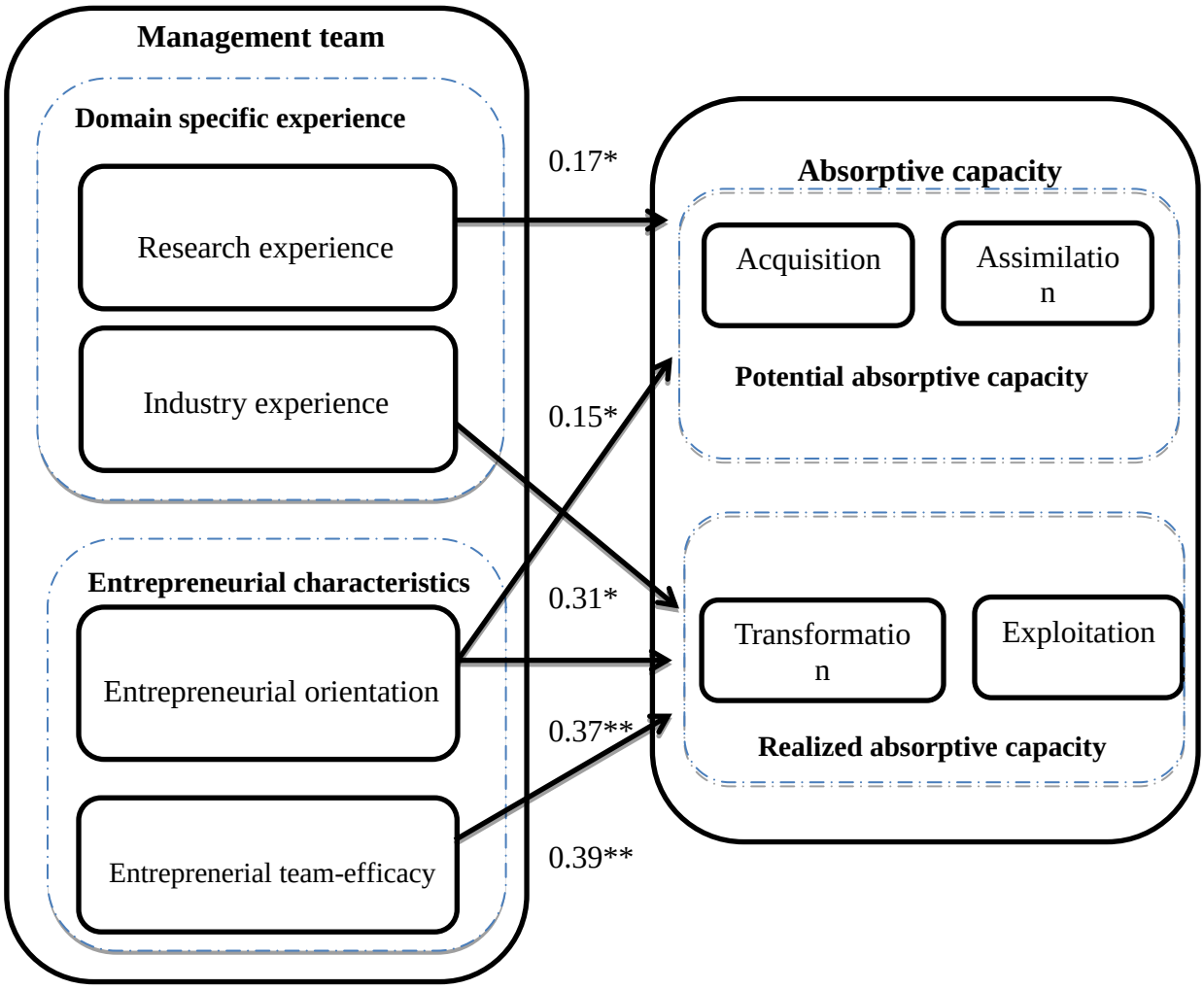
Models A3 and B3, the full models, introduces the variables of EO and team-efficacy, and significantly increases the amount of explained variance. The increase of variation for PAC is 6%, whereas for the RAC the increase is 32%. After adding the entrepreneurial aspect variables, the effect of domain specific research experience became less significant in Model A3 and disappears in Model B3. Domain specific industry experience is not statistically significant in Model B3, and only has a statistically significant effect on RAC (ß=.15 p<.05). Models A3 and B3 reveal that EO has a statistically significant positive relationship with both PAC (ß=.31, p<.05) and realized AC (ß=.37, p<.01) supporting respectively Hypothesis 5 and Hypothesis 6. Finally, in contrast to Hypothesis 7, Hypothesis 8 received substantial significant statistical support (ß=.39, p<.01), indicating a strong positive effect of team-efficacy on RAC. Figure 2.2 illustrates the significant relationships.

The management team's entrepreneurial characteristics and prior experience as antecedents of absorptive capacity

Table 2.3 Potential and realized absorptive capacity: prior knowledge and entrepreneurship (STATA)

	Potential absorptive capacity						Realized absorptive capacity					
Model	**A 1**		**A2**		**A3**		**B1**		**B2**		**B3**	
	Beta	**S.E**	**Beta**	**S.E**	**Beta**	**S.E**	**Beta**	**S.E**	**Beta**	**S.E**	**Beta**	**S.E**
Domain specific experience												
Domain specific research experience			0.25**	0.10	0.17*	0.10			0.25*	0.11	0.07	0.06
Domain specific industry experience			-0.11	0.09	-0.08	0.10			0.09	0.08	0.15*	0.07
Entrepreneurial antecedents												
Entrepreneurial orientation					0.31*	0.14					0.37**	0.08
Entrepreneurial team-efficacy					0.11	0.10					0.39**	0.07
Controls												
Environmental turbulence	0.31**	0.10	0.32**	0.10	0.29**	0.11	0.06	0.08	0.08	0.07	0.01	0.06
Management team size	0.11	0.20	0.05	0.19	0.01	0.17	0.25	0.21	0.27*	0.16	0.13	0.12
Management team age	-0.72*	0.37	-0.96*	0.42	-0.69	0.45	-0.05	0.41	-0.77*	0.38	-0.20	0.29
Spin-off size	-0.08	0.15	-0.08	0.15	-0.12	0.13	0.04	0.11	0.06	0.11	-0.03	0.08
Spin-off age	-0.10	0.15	-0.08	0.15	-0.03	0.14	-0.16	0.15	-0.11	0.13	-0.07	0.10
Constant	7.87**	1.30	8.35**	1.38	6.37**	1.62	5.47**	1.37	7.17**	1.24	3.85**	1.03
Model F-statistic		4.09**		4.57**		5.55**		1.24		4.57**		18.15**
R2		0.16		0.21		0.27		0.05		0.19		0.51
Adjusted R2		0.12		0.14		0.20		0.001		0.13		0.46
R2 change				0.05*		0.06*				0.14**		0.32**

Notes: N = 95; robust standard errors,* $p < 0.05$, ** $p < 0.01$; Sectors (IT, Clean-technology, medical technology and agriculture have also been controlled)



* Significant path at p<0.05
**Significant path at p<0.01
Only the significant paths are shown

Figure 2.2 Statistically significant model paths

2.5 Discussion and conclusions

The composition and capabilities of entrepreneurial teams may be especially important for the development of technology-based ventures (Wright et al., 2007; Ensley and Hmieleski, 2005) such as high-tech academic spin-offs. In light of the scant evidence on the factors that shape start-ups absorptive capacity, Chapter 2 investigated how absorptive capacity (AC) in high-tech academic spin-offs is influenced by the spin-offs team' domain specific industry and research experience and team entrepreneurial orientation (EO) and team-efficacy. Our findings confirm previous studies on prior experience as an antecedent of AC (Cohen and Levinthal, 1990a; Van Den Bosch et al., 1999; Argote et al., 2003). In line with the literature on managerial ability in start-ups (Holcomb et al., 2009), we show that spin-off team characteristics have a critical role in building absorptive capacity.

We specified the effects of both domain specific research and industry experience on both PAC and RAC. The finding shows that domain specific research experience is a predictor for both PAC and RAC while domain specific industry experience is only a predictor for RAC. This result can be explained by the notion of Lazaric et al., (2008) that the passage from PAC to RAC is not only a period that goes beyond a simple discovery of knowledge base, but also is a stage where management team can gain competencies regarding to their work experience in that specific industry (Lazaric et al., 2008). In other words, while specific research experience is relevant for opportunity discovery and the exploration aspects of entrepreneurial opportunities, something more than excellent science is needed for exploitation (D'Este et al., 2012).

Chapter 2 provides evidence that next to prior experience, team EO and team-efficacy are keys for shaping AC in high-tech academic spin-offs team. Our results suggest strong support for the effects of domain specific experience and team entrepreneurial antecedents on both dimensions of PAC and RAC. More specifically, the domain specific research experience of academic spin-offs team and willingness to take risks or EO (Covin and Slevin, 1990) are positively related to PAC and domain specific industry experience and the confidence, motivation or entrepreneurial team-efficacy (Hmieleski and Corbett, 2008) are positively related to RAC.

Our findings show significant effects of team entrepreneurial antecedents on PAC and RAC. The findings indicate that a team with high levels of EO enhances a spin-off's PAC as well as its RAC. However, managers also need high levels of entrepreneurial team-efficacy to enhance their realized absorptive capacity. This confirms studies that appreciate the role of team motivation and confidence on RAC (Liao et al., 2007). Finally, our results reveal the importance of environmental dynamics in relation to PAC. In line with other scholars (e.g. Jansen et al., 2005), we show that in turbulent environments PAC was higher.

Implications

Chapter 2 contributes to research on AC and entrepreneurship and hold important implications for high-tech academic spin-offs management teams in several ways. It contributes to scholars' understanding as to how spin-off management team are able to acquire and assimilate new external knowledge, and also how they transform and exploit it successfully, since AC antecedents may follow different developmental paths (Jansen et al., 2005). The findings show that next to research experience, management team should seek and acquire the new knowledge while industry experience is needed for selecting the one with commercial potential and transferring the technology and knowledge to commercial ends. Therefore it is recommended that at least one member of a management team has industry experience in order to better absorb and utilize the external knowledge.

Besides, our findings indicate that academic entrepreneurs can benefit from having an EO; e.g. to be more willing to take risk, be more proactive and innovative during the process of absorbing knowledge. This is in line with Keh et al., (2007), it seems that a creative, proactive and risk-taking posture is important for start-up teams when they seek and utilize information.

Furthermore, the findings suggest that teams with higher levels of EO have more PAC but to increase their RAC, they need an effective entrepreneurial team. Entrepreneurial team efficacy is

more critical in RAC relating more to the implementation and exploitation of the technology or product. Management teams must be confident in performing entrepreneurial activities in particular related to product commercialization such as writing a formal business plan and raising money to start a business. Therefore, to have both potential and realized AC management team should balance between the dimensions of AC (Todorova and Durisin, 2007). Zahra and George (2002: 191) argue that "*firms can acquire and assimilate knowledge but might not have the capability to transform and exploit the knowledge*."

In other words, PAC and RAC are distinct dimensions, with complementary roles that should be balanced. Better understanding the role of EO and team self-efficacy may help founders of spin-off teams in recruiting and adding new members to their team in order to reach higher absorptive capacity. Venture capitalists and other investors can be advised to analyze not only the experience of teams, but also their team entrepreneurial antecedents such as EO and team-efficacy before making an investment decision.

Limitations and implications for future research

Although the Chapter 2 provides some interesting findings, several limitations should be noted. Our study used a single key informant approach, which is a common practice in entrepreneurial research in start-up teams (Walter et al., 2006). We have chosen the academic founders as key informants, people we assume are well informed about their start-up management team. Future research may benefit from conducting interviews with more than one informant in each spin-off (Pettersen and Tobiassen, 2012).

Several productive avenues for future research exist. The discrepancies in past research may have partly arisen from failure to distinguish between different types of domain specific experience. For instance, some knowledge sources and experience might be more easily shared among the start-up team than others, e.g. the codifiability of knowledge. Therefore, further theory development should focus on which types of knowledge and experience are best suited for developing AC in the context of high-tech academic spin-offs. As our study was cross-sectional in nature, it would be worthwhile to investigate the long-term effects of AC on performance, which calls for a longitudinal study complete with more control variables. Fine-grained, qualitative approaches may be needed to discover what factors may foster or inhibit PAC and RAC in spin-offs. Future research can study different antecedents of AC which are relevant for the context of academic spin-offs, for instance the network of advisors, coaches and facilitators that may help them to better understand and absorb external knowledge.

Appendix A: Questionnaire items

Domain specific experience
Domain specific research experience: Management team members' average number of years of doing research in the same industry, as the spin-off is active in
Domain specific industry experience: Management team members' average number of years of experience in the same field as the spin-off is active in
Please provide us information about the members of the management team.

Who are the management team?	Name	.....	.....	.....	.....
Age at founding*	Year	... year	... year	... year	... year
Highest education	PhD MSc BSc MBA				
Before joining the start-up, how many Years of experience has this person in	The same industry as the start-up is in				
	Doing on research in the same technology of the start-up				

Entrepreneurial orientation (Covin and Slevin, 1989)
To what extent do you agree or disagree with the following statements (Encircle 1 = completely disagree, 7 = completely agree).

Innovativeness		
In general we favour a strong emphasis on the marketing of tried and true products and services	1 2 3 4 5 6 7	In general we favour a strong emphasis on R&D, technological leadership, and innovations
Over the last years we had few new lines of products or services	1 2 3 4 5 6 7	Over the last years we had many new lines of products and services
Changes in product or service lines have been mostly of a minor nature	1 2 3 4 5 6 7	Changes in product or service lines have usually been quite dramatic
Proactiveness		
In dealing with competitors, we typically respond to actions which competitors initiate	1 2 3 4 5 6 7	In dealing with competitors, we typically initiate actions
It is very seldom that we are the first to introduce new products/ services, operating technologies	1 2 3 4 5 6 7	In general we favour a strong emphasis on the marketing of tried and true products and services
We typically seek to avoid competitive clashes, preferring a 'live-and-let-live' posture	1 2 3 4 5 6 7	We typically adopt a very competitive, 'undo-the-competitor' posture

Risk taking		
In general we have a strong proclivity for low risk projects (with normal and certain rates of return)	1 2 3 4 5 6 7	In general we have a strong proclivity for high risk projects (with chances of very high returns)
We believe that owing to the nature of the environment, it is best to explore it gradually via careful, incremental behaviour	1 2 3 4 5 6 7	We believe that owing to the nature of the environment, bold, wide-ranging acts are necessary to achieve the firm's objectives
We typically adopt a 'wait-and-see' posture in order to minimize the probability of making costly decisions	1 2 3 4 5 6 7	We typically adopt a bold, aggressive posture in order to maximize the probability of exploiting potential opportunities

Absorptive capacity (Jansen et al. 2005; Schleimer and Pedersen, 2013; Zahra et al. 2007)

To what extent do you agree or disagree with the following statements (Encircle 1 = completely disagree, 7 = completely agree).

Potential absorptive capacity (Acquisition and assimilation)	
We frequently scan the environment for new technologies	1 2 3 4 5 6 7
We thoroughly observe technological trends	1 2 3 4 5 6 7
We observe in detail external sources of new technologies	1 2 3 4 5 6 7
We thoroughly collect industry information	1 2 3 4 5 6 7
We can quickly interpret changing market demands	1 2 3 4 5 6 7
New opportunities to serve our clients are quickly understood	1 2 3 4 5 6 7
We analyze various combinations of attributes for your products	1 2 3 4 5 6 7
We analyze different sequences for new product development and introduction	1 2 3 4 5 6 7
Realized absorptive capacity (Transformation and exploitation)	
We regularly consider the consequences of changing market demands in terms of new product and services.	1 2 3 4 5 6 7
We record and store newly acquired knowledge for future reference	1 2 3 4 5 6 7
We determine how customers will use our technologies	1 2 3 4 5 6 7
We identify different customer groups that might have an interest in our products	1 2 3 4 5 6 7
We have a clear division of roles and responsibilities	1 2 3 4 5 6 7
We easily implement technologies in new products	1 2 3 4 5 6 7
We have a common language regarding our products and services	1 2 3 4 5 6 7
We constantly consider how to better exploit knowledge	1 2 3 4 5 6 7

Entrepreneurial team-efficacy (Kickul et al., 2009; McGee et al., 2009)

How confident are you that the team members can execute the following activities? (1 = not confident... 7 = very confident)

Conceive a unique idea for a business	1 2 3 4 5 6 7
Identify market opportunities for a new business	1 2 3 4 5 6 7
Write a formal business plan	1 2 3 4 5 6 7
Raise money to start a business	1 2 3 4 5 6 7

Convince others to work for you in your new business	1 2 3 4 5 6 7
Manage a small business	1 2 3 4 5 6 7
Grow a successful business	1 2 3 4 5 6 7

Environmental turbulence (Jaworski and Kohli, 1993)

To what extent do you agree or disagree with the following statements (Encircle 1 = completely disagree, 7 = completely agree).

The technology in our markets is changing rapidly	1 2 3 4 5 6 7
Technological changes provide big opportunities in our market	1 2 3 4 5 6 7
In our industry customers' needs change rapidly	1 2 3 4 5 6 7
In our industry market conditions change frequently	1 2 3 4 5 6 7

Chapter 3 The impact of the management team's absorptive capacity on opportunity identification and pursuit

Chapter 3 answers Research Question 2:

To what extent does the (potential and realized) absorptive capacity and entrepreneurial orientation of the management team positively impact the opportunity identification and pursuit capabilities of the high-tech academic spin-off?

This Chapter is based on: H. Khodaei, V.E. Scholten, E. Wubben, S.W.F. Omta. Absorptive capacity: the mediating factor between entrepreneurial orientation and opportunity identification and pursuit: evidence from Dutch academic spin-offs. This paper has been submitted to the Journal of Technology Transfer

3.1 Introduction

Entrepreneurship involves discovering new ideas, translating them into new business opportunities, and exploiting them (Gray, 2006; Keh et al., 2007; Shane and Venkataraman, 2000; Zahra et al., 2006; Shane, 2003). Recognizing opportunities is the key for entrepreneurial start-ups to spark off the engine and start new business (Shane and Venkataraman, 2000). In general, it is believed that if firms act more entrepreneurially, they will generate more new ideas, novelty, experimentation, and creative processes (Lumpkin and Dess, 1996).

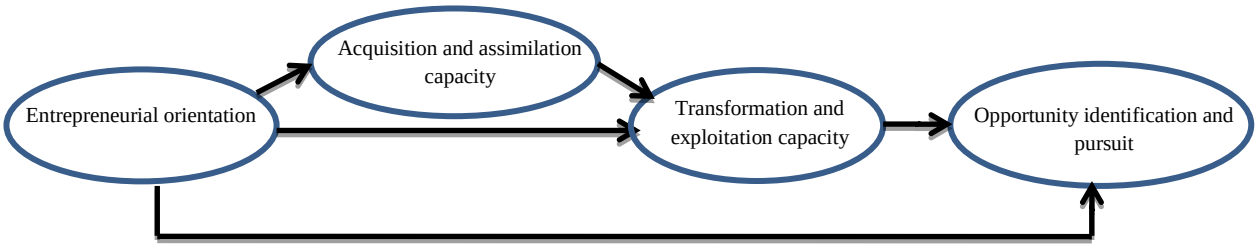
The entrepreneurial orientation (EO) of a firm reflects its willingness to innovate and develop new market offerings, take more risks to exploit them, and be more proactive than competitors toward new marketplace opportunities (Covin and Slevin, 1991). However, research is inconclusive about the direct effect of EO on performance (Wiklund and Shepherd, 2005). It is suggested that the performance implications of EO are context specific and depend on the characteristics of the external environment (Lumpkin and Dess, 2001) as well as on the internal resources and capabilities of the firm (Garcia-Villaverde et al., 2013, Wiklund and Shepherd, 2005). Recent research has found that the relationship between EO and performance varies with industry characteristics (Sciascia et al., 2014) and firm-level capabilities and resources (Wiklund and Shepherd, 2005; Engelen et al., 2013). In particular, the concept of absorptive capacity (AC) is brought into the equation because it captures how firms integrate new knowledge from external sources with internal knowledge and transform and exploit it to commercial ends (Cohen and Levinthal, 1990b).

Researchers studying entrepreneurial start-ups have found that opportunity recognition depends on human capital (Davidsson and Honig, 2003; Bhagavatula et al., 2010; Lumpkin and Dess, 1996), social capital (Ozgen and Baron, 2007; Bhagavatula et al., 2010), alertness (Kirzner, 1973, Tang et al., 2012), creativity (Hills et al., 1997), risk (Daft and Weick, 1984; Mullins and Forlani, 2005), and organizational learning (Corbett, 2005; Corbett, 2007; Covin and Slevin, 1990; Ravasi and Turati, 2005). These studies have shown that the ability to recognize opportunities is not only dependent on EO but also on the ways entrepreneurs process knowledge (Shane, 2000) and on their ability to acquire and transform external knowledge (Corbett, 2007; Li et al., 2009). The process of opportunity identification and pursuit often requires entrepreneurs to recognize new external knowledge, assimilate it, and combine it with their existing knowledge in order to exploit it commercially (Zahra and George, 2002). AC helps a firm to leverage its current resources and to exploit the opportunities that have been identified (Keh et al., 2007; Li et al., 2009). It provides entrepreneurs with constant access to new knowledge (Rothaermel and Alexandre, 2009, Engelen et al., 2014), which increases the number and quality of opportunities that entrepreneurial firms can pursue (Engelen et al., 2014). EO influences the extent to which firms acquire and utilize marketing knowledge and information. Firms with higher EO more actively scan and monitor the market to find new opportunities (Covin and Miles, 1999). EO helps them to look for information that better meets the needs of their customers, to cope with risk, to deal with competitors (Keh et al., 2007), and it facilitates the reconfiguration of skills and talents (Wang, 2008; Jantunen et al., 2005). Hence, we argue that both EO and AC lead to higher opportunity identification, but we believe that the firm's AC. mediates the relationship between EO and the extent to which start-ups identify and pursue new opportunities.

This is particularly true for new and entrepreneurial firms (Wales et al., 2013). Academic spin-offs are new entrepreneurial firms founded by academics who commercialize scientific findings (Pirnay et al., 2003; Steffensen et al., 2000; Siegel et al., 2007). These academic spin-offs originate from an academic environment and to develop opportunities, they need to evaluate external knowledge and combine it with their scientific findings (Walter et al., 2006; Vohora et al., 2004). Academic spin-offs often operate in turbulent markets and usually face difficulties in opportunity recognition because they lack EO (Iacobucci et al., 2011) and AC (Vohora et al., 2004). AC plays an important role in their ability to identify, build, and acquire knowledge and resources (Bollingtoft and Ulhoi, 2005; Lockett et al., 2005; Wright et al., 2007; Sirmon et al., 2007; Holcomb et al., 2009; Zahra et al., 2009). It enables start-ups to identify technological trends and take advantage of emerging opportunities before competitors recognize them (Cohen and Levinthal, 1990b).

In this research, we investigate the mediating role of absorptive capacity in the relationship between entrepreneurial orientation and opportunity identification and pursuit in a sample of 95 Dutch academic spin-offs. In doing so, we contribute to three discussions in literature. First, we contribute to the literature on opportunity recognition by responding to a recent call by Covin and Lumpkin (2011) for more research on the value of dynamic capabilities to link the role of EO to firm opportunity recognition and exploitation (Covin and Lumpkin, 2011; Engelen et al., 2014). Second, we investigate the two dimensions of potential absorptive (PAC) and realized absorptive capacity (RAC), which may have distinct effects on opportunity identification and pursuit. Third, we contribute to the literature of academic spin-offs and add knowledge to how these start-ups identify and pursue opportunities in a commercial environment while their internal knowledge base stems from an academic environment.

The following section presents the theoretical basis and hypotheses for our conceptual framework that depicts the relationships between EO, PAC, RAC, and opportunity identification and pursuit (see Figure 3.1). The subsequent section on methods summarizes our research design and methodology. This is followed by the empirical analyses and results, and we conclude by discussing the implications of our findings and suggestions for future research.



Control variables: Spin-off age, Spin-off size, environmental turbulence

Figure 3.1 Theoretical model

3.2 Theoretical framework

Entrepreneurial orientation (EO) is one of the most extensively researched topics in entrepreneurship and strategic management literature (Wales et al., 2013; Covin and Lumpkin, 2011; Rauch et al., 2009). It refers to the decision-making style of the company and its processes and practices (Lumpkin and Dess, 1996) vis-à-vis its pursuit of new opportunities for organizational growth (Ireland et al., 2009; Mustar et al., 2008; Unsworth, 2001b).

A company's EO can be discerned in its innovative, risk-taking, and proactive behaviors (Miller, 1983). Innovativeness is reflected in a company's willingness to pursue a leading role in technology and in the development of new products. Risk-taking is reflected in the willingness of entrepreneurs to commit considerable resources to new projects and to incur heavy debt in the pursuit of opportunities (Keh et al., 2007). Proactiveness is the ability of businesses to take the initiative in the pursuit of marketplace opportunities (Miller, 2011; Lumpkin and Dess, 1996). Companies with a strong EO tend to constantly scan and monitor their operating environment for new opportunities (Lumpkin and Dess, 1996) and so strengthen their competitive positions (Covin and Miles, 2006). EO is what prompts businesses to identify trends and opportunities to leverage their knowledge-based resources before their competitors do, and to take the risks necessary to pioneer new offerings in prospective markets (Covin and Wales, 2012). This leads us to formulate our first hypothesis:
H1: EO is positively associated with opportunity identification and pursuit.

Entrepreneurial orientation and performance

Prior research has uncovered variables that influence the relationship between EO and firm performance (Chirico et al., 2011; Wang, 2008; Wiklund and Shepherd, 2005; Rauch et al., 2009; Walter et al., 2006; Keh et al., 2007). These studies emphasize the general importance of firm-level capabilities in facilitating the relationship between EO and performance with specific reference to new start-ups. In this Chapter, we suggest that AC, as a firm-level capability, links EO with opportunity identification and pursuit. Higher levels of EO help firms to actively scan and monitor the market for new opportunities (Covin and Miles, 1999). However, before EO can be exploited, the firm needs to acquire the knowledge, understand, and integrate it with its existing knowledge. It requires the reconfiguration of skills and talents (Wang, 2008, Jantunen et al., 2005), which is why we suggest that absorptive capacity may have a mediating role.

We argue that firms that have higher levels of EO will adopt more innovative, proactive, and risk-taking ways to acquire and utilize new knowledge (Keh et al., 2007), which in turn will help them to identify more workable opportunities. EO influences organizational learning by stimulating firms to develop new skills and talents or to reconfigure them (Wang, 2008). Entrepreneurial firms create opportunities through their actions. This is related to a firm's ability to build new capabilities, transform its asset base, and reconfigure its processes and structures in order to achieve new valuable resource combinations (Jantunen et al., 2005). As such it is not only the firm's EO, but also its ability to create new asset configurations that have an effect on the firm's performance (Jantunen et al., 2005). To take advantage of these opportunities, entrepreneurial-oriented firms often need to reconfigure their resource base, and dynamic capabilities are the enabling mechanisms for doing this (Covin and Lumpkin, 2011). Therefore, we propose that AC mediates the relationship between EO and performance, here opportunity identification and

pursuit. Research has evidenced the effect of AC on new venture performance (Fosfuri and Tribo, 2008; Gray, 2006; Hayton and Zahra, 2005; Larraneta et al., 2007; Rothaermel and Thursby, 2005; Zahra et al., 2009).

AC consists of the routines to acquire, assimilate, transform, and exploit new external knowledge (Zahra and George, 2002). Building on Cohen and Levinthal's (1990) original contribution, Zahra and George (2002) conceptualized AC as a multidimensional construct and they distinguish between potential absorptive capacity and realized absorptive capacity. Potential absorptive capacity (PAC) is based on knowledge acquisition and assimilation and is the ability to identify, acquire, and assimilate new external knowledge. Realized absorptive capacity (RAC) is based on knowledge transformation and exploitation, and is the ability to arrive at new insights from the combination of existing and newly-acquired knowledge, and to incorporate transformed knowledge into the firm's operations (Zahra and George, 2002). The two types of AC have a different but complementary role. Companies not only need to develop capabilities to recognize, acquire, and assimilate useful external knowledge (PAC), but also to develop their ability to transform and exploit that knowledge (RAC) to achieve their goals. Zahra and George (2002) argue that despite the importance of PAC, RAC is the primary source of performance improvements. Thus, firm performance can be improved by efficiently acquiring and assimilating external knowledge (PAC), and by integrating, transforming, and exploiting this knowledge (RAC).

Entrepreneurial orientation and absorptive capacity

EO creates a fertile internal environment for organizational learning (Wang, 2008). Miles et al. (1978) concluded that the more entrepreneurial a company is, the more proactively and extensively it scans its environment for new opportunities (Miles et al., 1978). Sinkula (1994) found evidence for a positive correlation between EO and the extent to which a company is involved in knowledge acquisition and dissemination. Knowledge assimilation, the second constituent part of PAC, takes place when a company identifies and assimilates new external knowledge to its existing knowledge. This requires entrepreneurs to identify similarities and articulate the initial idea or insight. Entrepreneurially-oriented people show more proactivity and creativity (Unsworth, 2001a) in identifying opportunities and acting on them. They show initiative and persevere until meaningful changes occur.

However, before new knowledge can be exploited, the company must establish routines in which this knowledge becomes embedded (Zahra and George, 2002). While entrepreneurially-oriented companies tend to be creative and seek the highest possible returns from their available resources (Stevenson and Jarillo, 1989), it is their capability to acquire, convert, and combine new knowledge with existing knowledge which is important for transferring and exploiting the new knowledge. In other words, EO increases the ability of a company to commercialize the knowledge it has generated (Keh et al., 2007). Therefore, the influence of EO on RAC is mediated by PAC, which is postulated by the following hypothesis:

H2: PAC mediates the relationship between EO and RAC

Absorptive capacity and opportunity identification and pursuit

In line with other studies, such as Leal-Rodriguez et al. (2013) and Chang et al. (2012) we propose that a firm's outcomes (here opportunity identification and pursuit) are mainly the result of the existence of higher realized absorptive capacity in the firm (Leal-Rodriguez et al., 2013; Chang et al., 2012). RAC is the ability to transform and exploit external knowledge that has been acquired and assimilated (Zahra and George, 2002). Transformation is the further development of the knowledge acquired, for example, this could involve a feasibility study in which ideas are subjected to preliminary market testing, financial viability analysis, feedback from business associates, and other forms of assessment (Bhave, 1994; Corbett, 2005). If the business idea is still considered viable, it can be further elaborated. For example, this could include detailed planning aimed at reducing uncertainty (Lumpkin and Lichtenstein, 2005). If an identified opportunity passes this stage, it can be exploited. To exploit an opportunity, a company refines, expands, and elaborates existing competencies and creates new ones by incorporating acquired and transformed knowledge into its operations (Zahra and George, 2002). RAC refers to developing and refining routines that help the company to better evaluate and develop opportunities, and to understand the consequences of exploiting new external knowledge (Jansen et al., 2005; Zahra and George, 2002). In short, RAC refers to all efforts to arrive at new insights by combining existing and newly acquired knowledge (Zahra and George, 2002). Therefore, we believe that the extent to which opportunities are identified and given pursuit depends on whether a company can make the transition from PAC to RAC. Accordingly, we postulate the following hypothesis:

H3: RAC mediates the relationship between PAC and opportunity identification and pursuit

3.3 Data and methods

Sample and data collection

We tested our hypotheses by conducting our study among a sample of 95 academic spin-offs from various high-tech industries (including medical technology, information technology, clean technology, and biotechnology) in the Netherlands, between December 2011 and March 2012. We started by targeting ten potential spin-offs recommended by university facilitators and incubators, in order to pre-test our questionnaire. The individual company founders filled out the questionnaire in the presence of this study's first author and adjusted the questionnaire accordingly. This final questionnaire was then mailed to the principal entrepreneurs of 205 academic spin-offs.

We used the following two criteria to guide our selection of firms: (i) the spin-off commercializes knowledge created at the university; and (ii) the spin-off was established within the past 10 years (Song et al., 2008; Pirolo and Presutti, 2010). We identified 205 spin-offs at three technical universities in The Netherlands: Delft University of Technology, Wageningen University and Research Center, and Eindhoven University of Technology. We sent the final, English language questionnaire to these 205 spin-offs and received 105 responses. After rejecting ten incomplete questionnaires, we had 95 responses, yielding a response rate of 46%, which is acceptable for this type of research (Baruch, 1999). Firm age ranged between one and seven years with 63% of the firms less than 3 years old, indicating a slightly skewed distribution towards younger spin-offs. The spin-offs had an average of six employees, which is in line with the general slow growth in the European Union (Mustar et al., 2008).

One potential source of bias lies in the fact that our findings are derived from spin-offs that remained in business up to the time of the survey. We did not include any spin-offs that had ceased operations. This is a common problem in studies on young companies. Interestingly, however, failure among academic spin-offs from these technical universities is low. For example, the Delft incubator reported a 90% survival rate after six years of existence (van Geenhuizen and Soetanto, 2009) and the Wageningen incubator reported a 78% survival rate after six years of existence (Source: Wageningen incubator director). These survival rates are even higher than EU (75% after 6 years) (Clarysse et al., 2007). This indicates that potential bias due to the exclusion of non-survivors is rather small. To assess the quality of the data, we tested for the potential effects of non-response by comparing the group of respondents to the group of late respondents (Armstrong and Overton, 1977) on the variables of opportunity identification and pursuit, size, and age. Statistically, the two groups did not differ significantly. We used retrospective reporting, which is considered a viable research method if the measures used are reliable and valid (Miller et al., 1997). Although the data collected was self-reported, previous studies have shown that founder-reported results can be considered reliable (Brush and Vanderwerf, 1992), particularly in cases where questions refer to simple facts and events, rather than past opinions or beliefs (Golden, 1992a).

Statistically, we applied three different techniques to analyze and control for the effect of common method bias (Podsakoff, 2003). First, we carried out Harman's one-factor test (1976) by using principal axis factoring (Harman, 1976). Common method variance is not a problem if items load on multiple factors and one factor does not account for most of the covariance (Podsakoff, 1986). Factor analysis of our 29 items resulted in nine factors with eigenvalues greater than one, which explains 69% of the variance among the items. The first factor only accounted for 12% of the variance. This suggested that common method variance did not pose a serious threat to the interpretation of the results. Second, we tested for the existence of common method variance by analyzing whether the model fit improved when the complexity of the research model was increased. Other studies recommend this technique over Harman's one-factor test (Iverson, 1999; Podsakoff, 2003). We compared the single-factor model to the original and more complicated research model and found that the research model obtained a better goodness-of-fit index (0.30) than the single-factor model (0.20). This suggested that the research model provides a better fit to the data than the single-factor model, indicating that common method variance was not a problem in this dataset. Third, we applied the marker variable approach, which has been described as a good method to control for the effect of common method variance (Podsakoff, 2003; Sirén et al., 2012). We applied environmental dynamism as a marker variable to control for the common method effects on dependent variables during the analysis. We used environmental turbulence because it was measured in a similar way to the main variables and was therefore likely to include the same method variance (Sirén et al., 2012). The application of the marker variable did not seriously affect the results. Based on these results, we concluded that common method variance posed no threat to the interpretation of our results.

Data analysis

Our data analysis follows a two-step procedure. In the first step, we assessed the measurement models using exploratory factor analysis. In the second step, we assessed the structural model

using a non-parametric approach, namely the Partial Least Squares (PLS) approach (Chin, 1998), and SmartPLS 2.0 software (Ringle et al., 2010). We decided in favor of the PLS approach because of its non-parametric nature, which makes it suitable for analyzing relatively small datasets with non-normally distributed variables (Chin, 1998). While covariance-based methods of structural equation modeling require relatively large sample sizes (Jareskog and Sarbom, 1982), PLS requires a minimum number of cases equal to ten times the number of independent variables that affect the dependent variable (Chin, 1998). This meant that our sample size of 95 was sufficient, considering the number of variables in our conceptual model.

Reliability and validity of first-order constructs

We examined the individual item reliability (factor loading, λ), internal consistency (composite reliability, CR) and discriminant validity for each first-order construct (AVE) (Fornell and Larcker, 1981). Table 3.1 shows the item reliability, the internal consistency, and discriminant validity of first-order constructs. The factor loading of most individual items is higher than the preferable 0.7, except for three items, each still scoring an acceptable individual reliability (ranging from 0.63 to 0.89) (Gotz et al., 2010). The composite reliability (CR) for all constructs exceeds 0.7 , indicating robust internal consistency of all constructs (Pries and Guild, 2007).

Table 3.1 Mean, Standard Deviation (SD), factor loading (λ), Average Variance Extracted (AVE), and Composite Reliability (CR) of all measurements

Second-order construct	First-order construct	Items	Mean	SD	λ
Entrepreneurial orientation (Covin and Slevin, 1989) (AVE: 0.40, CR: 0.80)			4.89	.78	
	Innovativeness		4.67	1.16	**.59**
	CR 0.81	In general, we favor a strong emphasis on R&D, technological	4.97	1.58	.81
	AVE 0.67	leadership, and innovation			
		Changes in product or service lines have usually been quite dramatic	4.47	1.42	.84
	Proactiveness		5.43	1.04	**.70**
	CR 0.81	In dealing with competitors, we typically initiate actions before	5.19	1.30	.78
	AVE 0.68	competitors			
		We typically adopt a very competitive, 'undo-the-competitor' posture	4.34	1,40	.88
	Risk-taking		4.56	1.07	**.83**
	CR 0.79	In general, we have a strong proclivity for high risk projects	4.96	1.30	.75
	AVE 0.56	(with chances of very high returns)			
		We believe that, bold, wide-ranging acts are necessary to achieve the firm's objectives	3.99	1.51	.67
		We typically adopt a bold, aggressive posture in order to maximize the probability of exploiting potential opportunities	4.79	1.34	.82
Absorptive capacity (Jansen et al. 2005, Schleimer and Pedersen, 2013; Zahra et al. 2007)					
Potential absorptive capacity (AVE: 0.51, CR: 0.9)			5.23	1.01	
	Acquisition		5.18	1.27	**.89**
	CR 0.88	We scan the environment for new technologies frequently	5.11	1.62	.79
	AVE 0.66	We observe technological trends thoroughly	5.37	1.36	.89
		We observe external sources of new technologies in detail	5.04	1.43	.81
		We collect industry information thoroughly	5.32	1.27	.77
	Assimilation		5.28	1.02	**.89**

	CR 0.88				
	AVE 0.63	We can quickly interpret changing market demands	5.31	1.27	.82
		We can quickly understand new opportunities to serve our clients	5.14	1.41	.76
		We analyze various combinations of attributes for our products	5.30	1.29	.79
		We analyze different sequences for new product development	5.31	1.30	.78
Realized absorptive capacity (AVE: 0.50, CR: 0.84)			5.41	0.82	
	Transformation		5.27	1.03	**.86**
	CR 0.79	We record and store newly acquired knowledge for future reference	5.10	1.42	.73
	AVE 0.56	We determine how customers will use our technologies	5.44	1.37	.70
		We identify different customer groups that might have an interest in our products	5.29	1.30	.70
		We regularly consider the consequences of changing market demands in terms of new products and services	5.23	1.27	.70
	Exploitation		5.54	0.89	**.89**
	CR 0.86	We have a clear division of roles and responsibilities	5.46	1.28	.81
	AVE 0.68	We easily implement technologies in new products	5.43	1.26	.68
		We have a common language regarding our products and services	5.61	1.13	.90
		We constantly consider how to better exploit knowledge	5.69	0.97	.63
Opportunity identification and pursuit (Ucbasaran et al., 2008; Sardeshmukh and Corbett, 2011)			5.24	7.27	
CR 0.79	Number of identified potential market opportunities		7.47	17.1	.89
AVE 0.66	Number of pursued opportunities		5.74	16.5	.73
Environmental turbulence (Jaworski and Kohli, 1993)			5.71	1.09	
CR 0.88	The technology in our markets is changing rapidly		4.83	1.81	.88
AVE 0.64	Technological changes provide big opportunities in our market		5.60	1.34	.80
	In our industry, customers' needs change rapidly		4.00	1.76	.74
	In our industry, market conditions change frequently		4.58	1.58	.77
Academic spin-off size	Number of full-time employees		5.94	10.00	
Academic spin-off age	Number of years since founding		3.30	2.03	

All the scales, except for opportunity identification and pursuit are subjective 1-7 Likert scales

Reliability and validity of second-order constructs

The second-order constructs of entrepreneurial orientation (EO), potential absorptive capacity (PAC), and realized absorptive capacity (RAC), were measured by the first-order constructs of innovativeness, proactiveness and risk-taking, acquisition and assimilation, and transformation and exploitation. All second-order constructs had a composite reliability higher than 0.75, which indicates robust internal consistency. The (AVE) scores indicate that more than 50% of the variance is explained for every second-order construct except for EO which had an AVE of 0.4. In addition, the factor loading of each second-order construct ranged between 0.59 and 0.89 with significance at the 1% level, which shows good discriminant validity (see Table 3.1).

Table 3.2 presents the correlations between the second-order constructs and control variables, revealing that the highest correlation between the independent variables (potential and realized

absorptive capacity) is 0.67. This suggests that the data were not affected by potential multicollinearity. We also tested for multicollinearity using the variance inflation factor (VIF) index. The values for each independent variable were far below the value of 10 (Field, 2009). This result suggests that the research model was free of multicollinearity. Table 3.2 also reflects, the square root of the average variance extracted (AVE) on the diagonals which should be greater than all second-order construct correlations. This suggests a satisfactory construct discriminant validity (Cool et al., 1989; Chin, 1998). Overall, the evaluation of the reflective measurement models reveals that all constructs have satisfactory reliability and validity for the purposes of this analysis.

Table 3.2 Correlation among the construct and control variables

Variables	1	2	3	4	5	6	7
1. Entrepreneurial orientation	**0.63**[1]						
2. Potential absorptive capacity	.215*	**0.71**					
3. Realized absorptive capacity	.341**	.676**	**0.70**				
4. Opportunity identification and pursuit	-.018	.051	.161	**0.77**			
5. Environmental turbulence	.043	.266**	.078	.141	**0.80**		
6. Age of academic spin-offs	-.089	-.046	-.011	.312**	-.011	1.000	
7. Size of academic spin-offs	-.054	.169	.121	.282**	.074	.351**	1.000

*Significant at p<0.05
**Significant at p<0.01
1 The bold numbers on the diagonal are the square roots of the variance shared between the constructs and their measures (square root of average variance extracted).

Entrepreneurial orientation

EO was measured based on the Covin and Slevin (1989) scale, which examines innovativeness (3 items), risk-taking (3 items), and proactiveness (3 items) (see Appendix B).We tested the construct's dimensional structure using exploratory factor analysis. Again, the test revealed a three-dimensional factor structure that followed the theoretical dimensions. The analysis leads to the elimination of one item from innovativeness and one item of proactiveness (Table 3.1). We considered the items satisfactory because, as Table 3.1 shows, their loadings ranged from 0.67 to 0.88, and the values for Average Variance Extracted (AVE) and composite reliability (CR) were 0.67 (AVE) and 0.81 (CR) for innovation, 0.68 (AVE) and 0.81 (CR) for proactiveness, and 0.56 (AVE) and 0.79 (CR) for risk-taking, exceeding the threshold values set by prior studies (AVE= 0.5 and CR= 0.7) (Chin, 1998).

Absorptive capacity

To measure PAC and RAC, we used the literature on AC to develop items for each of the four dimensions: acquisition, assimilation, transformation, and exploitation. Items were partially based on existing items, (Jansen et al., 2005, Zahra et al., 2007, Schleimer and Pedersen, 2013), but we adapted the measures to new ventures because previous research is mainly directly at large

companies, and these companies may differ sharply from new ventures with regard to value-creating dynamic capabilities and the factors leading to their development (Zahra et al., 2006; Chen and Hambrick, 1995). For example, we replaced the term "units of organization" by "the company" in our questions. Moreover, we incorporated the insights from the ten spin-offs that we pre-tested and from the feedback we received in response to the questionnaire.

To measure AC, we used nine items from Jansen et al. (2005), four items from Zahra et al. (2007), and three items from Schleimer and Pedersen (2013). An exploratory factor analysis with Varimax Rotation and Kaiser Normalization (Hair et al., 2006) resulted in a four-factor solution with the items showing loadings that followed the theoretical dimensions for acquisition, assimilation, transformation, and exploitation. Four items assessed the intensity and direction of efforts to acquire knowledge. In addition, four items measured assimilation and gauged the extent to which spin-offs were able to analyze and understand new external knowledge. Four items measured transformation, and four items gauged the extent to which spin-offs were able to exploit new external knowledge. The loadings of the items on their theoretical factor were considered satisfactory, ranging from 0.63 to 0.90 (see Table 3.1). The (AVE) and (CR) values were 0.66 (AVE) and 0.88 (CR) for knowledge acquisition, 0.63 (AVE) and 0.88 (CR) for assimilation, 0.56 (AVE) and 0.79 (CR) for transformation, and 0.68 (AVE) and 0.86 (CR) for exploitation.

Opportunity identification and pursuit

The opportunity identification and pursuit construct was measured by two items on (a) "the number of identified potential market opportunities" in the last five years and (b) "the number of pursued opportunities". These questions are consistent with extant research (Sardeshmukh and Corbett, 2011; Gruber et al., 2008; Hills et al., 1997; Ucbasaran et al., 2008; Ucbasaran et al., 2009). In our study, we aggregated the two questions and log-transformed them to arrive at a single measure of opportunity identification and pursuit (Sardeshmukh and Corbett, 2011).

Control variables

We included three sets of control variables: spin-off age, spin-off size, and environmental turbulence. Spin-off age relates to the number of years since the firm was founded. Spin-off size relates to the number of full-time employees. We included size because it has been argued that larger spin-offs may have more resources, but may also lack the flexibility to acquire and assimilate new external knowledge (Jansen et al., 2005). Our third control variable was environmental turbulence, which we included because prior studies suggest that it influences AC (Jansen et al., 2005; Zahra and George, 2002). The environmental turbulence construct in our study consisted of four items (Jaworski and Kohli, 1993). Factor analysis revealed that the construct exhibited a unidimensional factor structure. In the research model, the construct's AVE (0.64) and CR (0.88) values were satisfactory. In addition, the item loadings were also satisfactory, ranging from 0.74 to 0.88. Overall, the evaluation of the measurement models revealed that all constructs were reliable and valid (see Table 3.1).

3.4 Results

Assessment of the structural model

To test the model, this study draws on SmartPLS 2.0 (Ringle et al., 2010), applying the path weighting scheme that explicitly considers the direction of the probable relationships between exogenous and endogenous variables (Chin, 1998). The bootstrapping procedure draws 95 cases and 500 samples, using the no sign change option. In evaluating and reporting the results, we followed recent guidelines for PLS-SEM, for example, given by Hair et al. (2014).

Figure 3.2 and Table 3.3 present the results of this structural model analysis. The average variance explained (R^2) was used to evaluate the explanatory power of the structural model. R^2 for potential absorptive capacity (0.19), realized absorptive capacity (0.52), and opportunity identification and pursuit (0.18) are accepted for explanatory power at the 0.05 significance level. Moreover, the Q2 values associated with the Stone-Geisser criterion are considered as a measure of out of sample prediction (Sarstedt et al., 2014). As a rule of thumb, Q2 values larger than zero for a particular endogenous construct indicate that the path model's predictive accuracy is acceptable for that particular construct. Q2 values are consistently higher than zero, indicating that the prerequisites of predictive relevance for the model are fulfilled (Chin, 1998). Finally, the model's overall goodness-of-fit is 0.30. Researchers propose the goodness-of-fit index as a means to validate a PLS path model globally (Tenenhaus et al., 2005) and only include latent variables with multi-item measurement with reflective indicators (Henseler and Sarstedt, 2013).

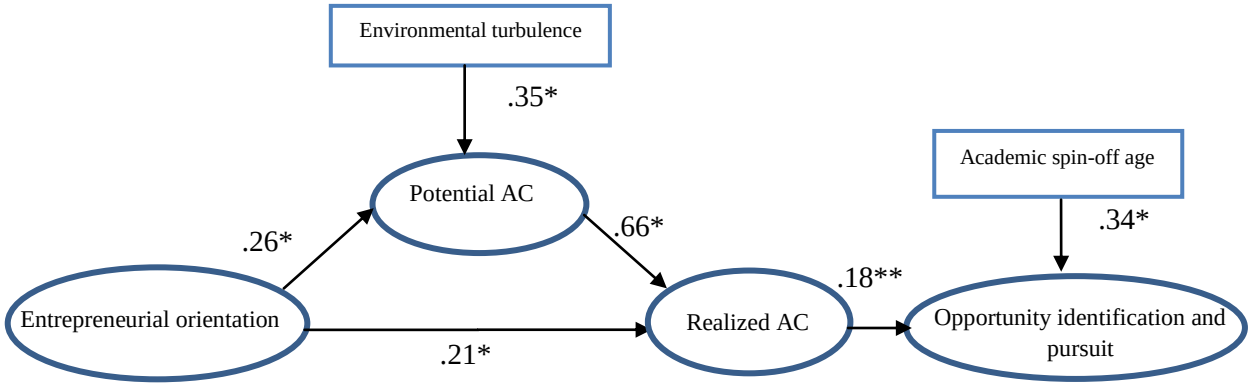
Table 3.3 Results of the partial least square analysis - Path coefficients and significance levels

Path from	To	Research model	
		Path coefficient	(t)
Entrepreneurial orientation	Opportunity identification and pursuit	-.05	(.07)
Entrepreneurial orientation	Potential absorptive capacity	.26*	(2.23)
Entrepreneurial orientation	Realized absorptive capacity	.21*	(2.52)
Potential absorptive capacity	Realized absorptive capacity	.66**	(9.51)
Realized absorptive capacity	Opportunity identification and pursuit	.18*	(1.93)
Academic spin-off age	Opportunity identification and pursuit	.34*	(2.82)
Environmental turbulence	Potential absorptive capacity	.35**	(3.27)
R^2 Potential absorptive capacity		.19	
R^2 Realized absorptive capacity		.52	
R^2 Opportunity identification and pursuit		.18	
Goodness of fit***		.30	

**p<0.01, and *p<0.05 ***SQRT of (average of the R Square of all endogenous latent variables*average of the Communality of all the exogenous latent variables)

Our PLS path model analysis reveals no statistically significant direct relationship between EO and opportunity identification and pursuit (β=-0.05; n.s.), rejecting H1. However, EO does show a statistically significant positive effect on PAC (β=0.26; p<0.05) and on RAC (β=0.21; p<0.05). PAC has a statistically significant positive effect on RAC, supporting H2, which states that PAC

mediates the relationship between EO and RAC. RAC has a statistically significant positive impact on opportunity identification and pursuit (β=0.18; P<0.05), supporting H3, which posits that RAC mediates the relationship between PAC and opportunity identification and pursuit. The results also show that environmental turbulence has a statistically significant impact (β=0.35; P<0.01) on PAC, and that spin-off age has a positive significant effect (β=0.34; P<0.05) on opportunity identification and pursuit. Figure 3.2 illustrates this mediating effect.



* Significant path at p<0.05
**Significant path at p<0.01
Only the significant paths are shown

Figure 3.2 Statistically significant model paths

Bootstrapping results for testing the mediating role of PAC and RAC

The SEM approach has been strongly recommended for testing mediation (MacKinnon and Fairchild, 2009) and is now widely used in management research (Lejpras and Stephan, 2011). To provide a more rigorous test of the mediation hypotheses (H2 and H3), we conducted bootstrapping analyses (Preacher and Hayes, 2008, Shrout and Bolger, 2002) to check if the indirect effect via the mediator variable is significant. The significance of this indirect effect is determined by the Variance Accounted For (VAF) Statistic (Shrout and Bolger, 2002), which calculates the influence of indirect effects on a dependent variable, or measures how much of the dependent variable is explained by the indirect effects through mediators. A VAF that is above 80% is considered full mediation, a VAF between 20% and 80% is considered partial mediation, and a VAF that is less than 20% is considered no mediation (Hair et al., 2014).

To test the mediating role of PAC, we first excluded PAC from the path model and ran the bootstrapping routine with the previously described specifications. The direct effect between EO and PAC is 0.243 and is significant at p<0.05. We then determined the relative size of the mediating effects by running the bootstrapping routine again, but this time we included PAC in the full model and tested the significance of the indirect effect. Regarding the mediating role of RAC on the relationship between PAC and opportunity identification and pursuit the direct effect between EO and PAC is 0.257 (p<0.05). The direct effect between PAC and RAC is 0.21

($p<0.05$) and the direct effect between PAC and RAC is 0.67 ($p<0.01$). Therefore, the indirect effects are 0.267*0.67=0.17 and the total effect is 0.21+ (0.17) =0.38. Therefore, VAF = indirect effect /total effect, 0.17/0.38=0.45. With the VAF result of 0.45, we can conclude that PAC partially mediates the relationship between EO and RAC.

To test the mediating role of RAC, first we exclude RAC from the path model and run the bootstrapping routine, the direct effect between PAC and opportunity identification and pursuit is 0.02 and none significant. Next, we determine the relative size of mediating effects. We run the bootstrapping routine this time with RAC the full model (with the mediator included) and testing the indirect effect's significance. Regarding to the RAC mediation role on the relationship between PAC and opportunity identification and pursuit, the, the direct effect between PAC and RAC is 0.67 , $p<0.01$. The direct effect between PAC and opportunity identification and pursuit is -0.15 and none significant and the direct effect between RAC and opportunity identification and pursuit is 0.26, $p<0.05$. Therefore the Indirect effects =0.26*0.67=0.17 and total effect is = -0.15+ (0.17) =0.02. Finally the VAF = indirect effect /total effect, 0.17/0.02=8.5. If VAF is above 1, then the mediating effect of RAC acts as a reverse suppressor on the direct effect and according to Hair et al. (2014: 225), "…*this kind of situation always represents full mediation*."

3.5 Discussion and conclusions

Our empirical study of 95 Dutch academic spin-offs contributes to entrepreneurship literature by providing evidence of the mechanisms that enable academic spin-offs to benefit from entrepreneurship orientation (EO) and absorptive capacity (AC) in opportunity identification and pursuit. This chapter develops theoretical arguments on how dynamic capabilities like absorptive capacity facilitate the relationship between EO and performance, thereby addressing Covin and Lumpkin's (2011) call for research on the value of dynamic capabilities to link EO to firm opportunity recognition. Our contribution to the EO literature is the empirical validation of the theoretical argument that the relationship between a firm EO and its performance is mediated by the dynamic capabilities of AC. Entrepreneurially oriented firms such as academic spin-offs that operate in turbulent markets usually face difficulties in opportunity recognition due to a lack of EO (Iacobucci et al., 2011) and AC (Vohora et al., 2004). Therefore, academic spin-offs provide an interesting context for expanding our knowledge of entrepreneurial orientation and absorptive capacity.

Our study shows that a company's ability to identify and pursue opportunities not only depends on its decision-making style, which is defined by its EO, but also on its ability to acquire and transform information and knowledge. Our findings did not reveal a direct relationship between EO and opportunity identification and pursuit, but showed that the effect of EO was mediated by AC. In other words, EO can only be effective if spin-offs can develop the ability to absorb external knowledge, and combine it with their internal knowledge. We found that AC is the missing link between EO and opportunity identification and pursuit. AC enables spin-offs to develop new competencies to better respond to changes in the business environment. As a company-level strategic posture, EO motivates and supports a company to identify business opportunities, and AC combines external and internal knowledge and converts it into valuable opportunities. For example, a proactive strategic orientation makes companies more responsive to

external knowledge (Liao et al., 2010). In line with a recent study by Sciascia et al. (2014), we further detailed AC in potential absorptive capacity (PAC) and realized absorptive capacity (RAC) to study the relationship between EO and performance (Sciascia et al., 2014). We found that PAC has a strong influence on RAC, and that RAC has a positive relationship with opportunity identification and pursuit. This finding can be explained by the nature of PAC. 'Potential' entails taking inventory of, and analyzing the stock of knowledge as a preliminary stage for subsequent knowledge integration (Corbett, 2005). RAC involves assessing ideas and testing initial feasibility as part of opportunity identification and pursuit. Our results are in line with other findings in related fields (Keh et al., 2007). This mediation effect is in line with Leal-Rodríguez et al. (2013) who argue that higher levels of PAC lead to RAC enhancement that may improve performance. In other words, a high capacity of knowledge acquisition and assimilation implies higher performance, via realized absorptive capacity (Leal-Rodriguez et al., 2013).

In line with other studies (Engelen et al., 2014), we specify market and technology turbulence as an important boundary condition to the AC. Our results also show the importance of environmental dynamics in relation to AC. Operating in high-tech industries and in volatile environments where change is frequent and rapid, start-ups are aware of the need to repeatedly reconfigure their capabilities in order to compete (Zahra et al., 2009). Under these conditions, companies often actively seek out external knowledge because they lack the in-house resources to respond to technological and market developments (Figueiredo et al., 2002). This is in line with our result that shows that PAC levels are higher in turbulent business environments. Finally, in line with many studies on the role of age and experience in opportunity identification and pursuit, our results show that the age of academic spin-offs positively affects opportunity identification and pursuit.

Managerial implications

Our findings have several practical insights for entrepreneurs of academic spin-offs. Academic spin-offs may face particular barriers during their growth that are related to their small size and youth, which represents increased liability for investors. Therefore, academic spin-offs may have to reconfigure their resources, capabilities, and networks (Bjornali and Gulbrandsen, 2010; Rasmussen and Borch, 2010). The results of this study indicate that a firm's dynamic capabilities and its proactive, innovative, and risk-seeking strategic orientation are significant internal determinants of opportunity identification and pursuit. Therefore, entrepreneurs working for academic spin-offs should develop a strong absorptive capability so that they can benefit from proactive, innovative, and risk-taking behavior, and eventually identify and pursue more opportunities. Our study draws attention to the crucial role of external knowledge and shows that entrepreneurs of academic spin-off can benefit by developing their ability to absorb external knowledge and by adopting an entrepreneurial decision-making style in order to recognize and exploit new opportunities. From this, we infer that these entrepreneurs should comprehensively and accurately acquire and utilize information about customers and competitors to improve their company's performance.

Limitations and future research

While the results of this chapter are instructive in a number of ways, they are nonetheless subject to limitations. Its main contribution is that it provides empirical evidence for the indirect impact of EO on the opportunity identification and pursuit capacity of academic spin-offs' via the mediating role of AC. First, the results are based on academic spin-offs and further research is needed to see whether these results hold for start-ups in general. More specifically, the findings provide a unique theoretical angle on the relationship between EO and performance, but more research is needed to test whether the effect of AC on this relationship is generalizable to other start-ups. A second limitation of our study is that it is cross-sectional in nature and draws on data collected at one moment in time. Because we believe that opportunities need work and emerge over time, it would be worthwhile to investigate the long-term effects of AC on opportunity identification and pursuit in a longitudinal study. Future research can focus specifically on successful opportunities or can separate opportunity identification and opportunity pursuit. Finally, we are aware that data from one survey that measure both an independent variable and a dependent variable might introduce a common method bias. However, we took several measures to reduce this, and our tests for common method bias reveal no threats in this regard.

Appendix B: Questionnaire items

Opportunity identification and pursuit (Sardeshmukh and Corbett, 2011; Ucbasaran et al., 2008)

Number of identified potential market opportunities

Number of pursued opportunities

Absorptive capacity (Jansen et al. 2005, Schleimer and Pedersen, 2013; Zahra et al. 2007)

To what extent do you agree or disagree with the following statements (Encircle 1 = completely disagree, 7 = completely agree).

Potential absorptive capacity (Acquisition and assimilation)	
We frequently scan the environment for new technologies	1 2 3 4 5 6 7
We thoroughly observe technological trends	1 2 3 4 5 6 7
We observe in detail external sources of new technologies	1 2 3 4 5 6 7
We thoroughly collect industry information	1 2 3 4 5 6 7
We can quickly interpret changing market demands	1 2 3 4 5 6 7
New opportunities to serve our clients are quickly understood	1 2 3 4 5 6 7
We analyze various combinations of attributes for your products	1 2 3 4 5 6 7
We analyze different sequences for new product development and introduction	1 2 3 4 5 6 7
Realized absorptive capacity (Transformation and exploitation)	
We regularly consider the consequences of changing market demands in terms of new product and services.	1 2 3 4 5 6 7
We record and store newly acquired knowledge for future reference	1 2 3 4 5 6 7
We determine how customers will use our technologies	1 2 3 4 5 6 7
We identify different customer groups that might have an interest in our products	1 2 3 4 5 6 7
We have a clear division of roles and responsibilities	1 2 3 4 5 6 7
We easily implement technologies in new products	1 2 3 4 5 6 7
We have a common language regarding our products and services	1 2 3 4 5 6 7
We constantly consider how to better exploit knowledge	1 2 3 4 5 6 7

Entrepreneurial orientation (Covin and Slevin, 1989)

To what extent do you agree or disagree with the following statements (Encircle 1 = completely disagree, 7 = completely agree).

Innovativeness		
In general we favour a strong emphasis on the marketing of tried and true products and services	1 2 3 4 5 6 7	In general we favour a strong emphasis on R&D, technological leadership, and innovations
Over the last years we had few new lines of products or services	1 2 3 4 5 6 7	Over the last years we had many new lines of products and services
Changes in product or service lines have been mostly of a minor nature	1 2 3 4 5 6 7	Changes in product or service lines have usually been quite dramatic
Proactiveness		
In dealing with competitors, we typically respond to actions which competitors initiate	1 2 3 4 5 6 7	In dealing with competitors, we typically initiate actions
It is very seldom that we are the first to introduce new products/ services, operating technologies	1 2 3 4 5 6 7	In general we favour a strong emphasis on the marketing of tried and true products and services
We typically seek to avoid competitive clashes, preferring a 'live-and-let-live' posture	1 2 3 4 5 6 7	We typically adopt a very competitive, 'undo-the-competitor' posture
Risk taking		
In general we have a strong proclivity for low risk projects (with normal and certain rates of return)	1 2 3 4 5 6 7	In general we have a strong proclivity for high risk projects (with chances of very high returns)
We believe that owing to the nature of the environment, it is best to explore it gradually via careful, incremental behaviour	1 2 3 4 5 6 7	We believe that owing to the nature of the environment, bold, wide-ranging acts are necessary to achieve the firm's objectives
We typically adopt a 'wait-and-see' posture in order to minimize the probability of making costly decisions	1 2 3 4 5 6 7	We typically adopt a bold, aggressive posture in order to maximize the probability of exploiting potential opportunities

Environmental turbulence (Jaworski and Kohli, 1993)

To what extent do you agree or disagree with the following statements (Encircle 1 = completely disagree, 7 = completely agree).

The technology in our markets is changing rapidly	1 2 3 4 5 6 7
Technological changes provide big opportunities in our market	1 2 3 4 5 6 7
In our industry customers' needs change rapidly	1 2 3 4 5 6 7
In our industry market conditions change frequently	1 2 3 4 5 6 7

Part 2 Facilitator support

Chapter 4 Key support activities of facilitators to navigate critical junctures

---

Chapter 4 answers Research Question 3:

What are the main critical junctures in the growth path of high-tech academic spin-offs (RQ 3a)? And in which ways can facilitator support academic spin-offs to overcome these critical junctures (RQ 3b)?

This Chapter is based on: H. Khodaei, E. Wubben, V.E. Scholten, S.W.F. Omta. Key Support for High-Tech Academic Spin-Offs: Navigating Critical Junctures during Growth Stages. An earlier version of the paper has been presented at the Academy of Management Conference, in Boston, USA. This version of the paper has been submitted to the Journal of Industry and Innovation.

4.1 Introduction

Academic spin-offs commercialize technology which is developed through university research (Rasmussen and Borch, 2010). These spin-offs are believed to be beneficial to local and national economies and social development (Steffensen et al., 2000). To start, grow, and accelerate, academic spin-offs receive support from various facilitating organizations such as universities, technology transfer offices (TTOs), entrepreneurship centers, seed funds, development agencies, and new business incubation centers (Rasmussen et al., 2014). However, because only a small number of spin-offs thrive and grow (Mustar et al., 2006; Wright et al., 2006) one may questions the effectiveness of the support activities these facilitation organizations (Siegel et al., 2003b; Wright et al., 2006; Zahra et al., 2007). A large amount of research has focused on the role of specific facilitators such as universities (Di Gregorio and Shane, 2003; Lockett et al., 2005), TTOs (Siegel et al., 2003a; Siegel et al., 2003b; Wright et al., 2012), faculty staff, and venture capital investors (Wright et al., 2006). Our research takes a more holistic approach to analyze the role of multiple facilitators during the stages of spin-off growth (Rasmussen, 2011). Furthermore, the support available for academic spin-offs not only varies across facilitators, it may also vary across the stages of spin-off growth. During the initial founding of the new company, spin-off founders often seek support, for example, to evaluate various business opportunities or for intellectual property protection (Shane, 2003). During later growth phases, the spin-off substantiated its internal organization , and support is needed to decide on the necessary resources and capabilities (Vohora et al., 2004). There is a need to better understand how the support activities of various facilitators are geared towards accelerating academic spin-off growth (Anderson et al., 2010; Markman et al., 2008; Lockett et al., 2005).

The aim of our study is to develop a support framework that can help facilitators to attain the aspired objectives of spin-off growth and wealth creation. First, this framework draws on the literature that has analyzed new firm development in terms of a stage-gate approach, dividing the growth of a new firm into a number of stages. Entrepreneurs have to change behavior and practices to deal with the main business activities of the next growth stage (Ndonzuau et al., 2002; Vohora et al., 2004). Such transitions are viewed as barriers which need to be overcome. Second, we analyze the support activities, from a capability perspective (Rasmussen et al., 2011), to better understand how resources and capabilities are linked to the growth stages (Sirmon et al., 2007; Sirmon et al., 2011; Maritan and Peteraf, 2011; Wright et al., 2012). Our study particularly focuses on the support activities that enable the transition from one growth stage to the next.

We collect data from both facilitators and spin-offs founders on the support of academic spin-offs by facilitating organizations (Rasmussen and Borch 2010). We investigate three universities and interview 18 representatives of prominent facilitators to find out what support activities they consider important for academic spin-offs at each growth stage. We also interview nine academic spin-off founders and asked them what support activities they considered important during their growth stages.

Section 4.2 reviews the literature on the stage-gate models of academic spin-offs. Section 4.3 presents the methods used to collect and analyze the data Section 4.4 presents the results in conjunction with our analysis. Finally, section 4.5 provides our conclusions, practical implications for facilitators, and opportunities for future research.

4.2 Theoretical framework

Stage-gate models have been used frequently to describe technology development and spin-off development (Scott and Bruce, 1987; Vohora et al., 2004). These models describe various stages of growth. Each stage is a relatively calm period of growth that ends with a period of substantial turmoil during which entrepreneurs have to take adaptive actions and to change their behavior and practices before they can progress to the next stage. During the development of the new firm, these periods of evolution and revolution take turns. Research on the growth stages of academic spin-offs has identified typical challenges, or critical junctures (Vohora et al., 2004), which spin-offs have to overcome before they can continue to grow and mature (Clarysse and Bruneel, 2007). Although the challenges have been identified in previous literature, the way in which spin-offs overcome them and how this affects the development of both business and innovation needs more careful examination (van Geenhuizen and Soetanto, 2009; Lehoux et al., 2014).

We follow the phases of growth and the critical junctures identified by Vohora et al. (2004) to investigate how specific support activities from facilitating organizations help academic spin-offs to navigate these junctures (Wright et al., 2012). Researchers have identified various types of related support activities, such as infrastructural or financial support (Wright et al., 2012; Heirman and Clarysse, 2004; Patzelt and Shepherd, 2009; Rasmussen and Borch, 2010).

Support activities are synchronized resources and competencies (Wright et al., 2012) that help academic spin-offs to develop the capabilities they need to overcome certain barriers that are typical for the growth stage they are in. These capabilities refer to "*the ability of an organization to perform a coordinated set of tasks, utilizing organizational resources, for the purpose of achieving a particular end result*" (Helfat and Peteraf, 2003: 999). Therefore, we propose that facilitators' support activities can strengthen the capabilities that enable academic spin-offs to navigate the particular challenges that hamper their growth. The combination of the capability perspective with stage-gate models helps us to identify the challenges spin-offs face at critical junctures, and to better grasp the complex set of support activities needed to help them navigate these junctures.

Critical junctures

Stage-gate models have provided insight into how the challenges, strategies, and structures of a company change along with the stages that the company is going through (Kazanjian, 1988, Dodge et al., 1994; Jawahar and McLaughlin, 2001). The literature mainly deals with rapidly growing high-tech businesses in general (Kazanjian, 1988; Phelps et al., 2007). Research on academic spin-offs has highlighted the lack of relevant human capital, venture capital funding, network contacts, and research-based technology (Clarysse et al., 2011a; Mosey and Wright, 2007).

Stage-gate models of academic spin-offs typically refer to Vohora et al. (2004), who investigated the challenges or barriers that separate their growth stages, suggests the following classification of five broad growth stages: 1) research; 2) opportunity framing; 3) pre-organization; 4) re-orientation; and 5) sustainable returns (Vohora et al., 2004). Between each two stages, Vohora et al. (2004) identified barriers, which they refer to as critical junctures, respectively: opportunity

recognition, entrepreneurial commitment, credibility, and sustainability. Before the spin-off can proceed to the next stage, it needs to overcome these critical junctures (Rasmussen, 2011; Bjornali and Gulbrandsen, 2010).

Opportunity recognition is the first critical juncture and refers to the ability to recognize the need of an unfulfilled market (Hackett and Dilts, 2004; Ucbasaran et al., 2003) and requires the spin-off to acquire the capabilities to identify opportunities (Wright et al., 2012). As Vohora et al. (2004:161) put it, "*without developing, acquiring or accessing the capability to combine scientific knowledge with a commercially feasible offering that satisfies an unfulfilled market need, academic scientists [will] not be able to proceed towards commercializing their technologies*."

Entrepreneurial commitment is the second critical juncture and refers to ability to recognize the skills required to establish, and manage the spin-off. At this point in their growth trajectory, spin-offs need an entrepreneurial champion who has the skills, knowledge, and commitment to start the new company (Wright et al., 2012). Vohora et al. (2004:163) suggest, "*the critical juncture of entrepreneurial commitment arises due to the conflict between the need for a committed venture champion to develop the academic spin-offs and the inability to find an individual with the necessary entrepreneurial capabilities*."

Credibility is the third critical juncture and refers to the ability to recognize that the spin-off needs to gain sufficient credibility to access and acquire the key resources (funding and staffing) to start to function (Vohora et al., 2004). Finding investors is a key challenge for most new ventures (Bryson et al., 1997; Honjo and Harada, 2006; Vohora et al., 2004). Academic spin-offs often hit this challenge at the point between prototype development and production and sales (Wright et al., 2006).

Sustainability is the fourth critical juncture and refers to the ability to recognize that the spin-off needs to develop entrepreneurial competencies that enable them to reconfigure deficiencies from earlier stages into resource strengths, capabilities, competencies, and social capital (Vohora et al., 2004; Wright et al., 2012). We use these five stages of growth and the four critical junctures to identify the specific resources and capabilities that are needed to overcome these junctures and to examine the extent to which facilitators' support contribute to the learning and development of academic spin-offs.

Facilitator support activities

Academic spin-offs face various challenges during their growth stages (Vohora et al., 2004). Since these spin-offs originate in a university and research setting, which is often less focused on business-related activities, they tend to face particular barriers in acquiring and configuring resources and capabilities for commercialization (Lockett and Wright, 2005). Academic facilitators such as university officials, TTOs, and incubators can play an important role in signaling, building, and acquiring entrepreneurial resources for start-ups in need of specific resources, managerial skills and organizational systems (Bøllingtoft and Ulhøi, 2005; Lockett et

al., 2005). Previous research has identified a variety of support activities that are available for spin-offs, some of which are provided by various facilitators.

The literature distinguishes between five support categories. First, infrastructural support refers to the provision of office and laboratory space, equipment, and shared services often in one building or in buildings in close proximity. Such support can provide start-ups with flexible rent structures and a polished professional image. It can also bring together start-ups, which find themselves in a similar situation, and can thus stimulate and help each other and act as positive peer role models.

Second, financial support includes direct or indirect funding and venture capital (Bøllingtoft and Ulhøi, 2005; Sofouli and Vonortas, 2007; Aerts et al., 2007). Network support includes access to a network of professional contacts. These include business people, industry, other start-ups, clients, and big companies. This can reduce the cost of searching for partners (Nicolaou and Birley, 2003) and is beneficial in terms of references, endorsement and recognition. Spin-offs ultimately benefit greatly from being linked to the most appropriate networks because this helps them build their social capital (Bøllingtoft and Ulhøi, 2005).

Fourth, business support includes activities such as mentoring, coaching and counseling (Chan and Lau, 2005), business plan development, and personal training (Aerts et al., 2007). Business support is critical during the growth stages of academic spin-offs. A well-written business plan, in particular, is crucial to help generate interest among potential investors (Delmar and Shane, 2003).

Finally, legal support includes activities such as developing clear rules and procedures governing the exploitation of university technology (Van Burg et al., 2008) and providing access to professional business services for arranging and managing specific advice on IP regulation.

The next section describes our research design and approach of examining how these five types of facilitators' support (infrastructure, financial, networks, business and legal support) can help academic spin-offs navigate the four critical junctures, (opportunity recognition, entrepreneurial commitment, credibility, and sustainable returns). Results are presented in section four, concluding on the variation of critical junctures and facilitators' at different stages of growth.

4.3 Data and methods

Research design

We drew our data from cases of nine comparable spin-offs and eighteen university facilitators at three technical university campuses in the Netherlands: Eindhoven University of Technology (TUE), Wageningen University and Research Center (WUR), and Delft University of Technology (TUD). Each university has over 10,000 students, a well-developed institutional infrastructure, and formalized support programs for roughly eight to ten new academic spin-offs each year. We selected these technical universities because of their relatively large number of spin-offs, and because they have a clear and explicit strategy for establishing and developing spin-offs. We gathered data from multiple sources, including both semi-structured interviews (n=9) with CEOs and/or high-level executives of nine spin-offs, and semi-structured interviews (n=18) with

acknowledged university facilitators. We checked if each facilitator had been actively involved in spin-off support for over five years. Among the facilitators we interviewed were IP managers, incubator directors, TTO managers, and science park directors. We used multiple informants in order to mitigate subjective bias and to create a richer result (Miller et al., 1997). To capture a range of market and industry contexts, we included spin-offs from three disciplines: information technology, clean technology, and medical/bio-technology. Most spin-offs occur within these industries (Shane, 2004).

In line with earlier studies on academic spin-offs (e.g., Lehoux et al., 2014), we selected spin-offs in high-tech industries that had won awards, had managed to acquire funding, had at least one patent, and had been founded within the past decade (Pirolo and Presutti, 2010). Since these spin-offs have successfully crossed multiple critical junctures, we can assess the effectiveness of the support they received during their growth stages. Because our interviews involved asking the spin-off founders to draw on their memory, and to recall and reflect on the support they received during their growth, we included only spin-offs that had been established in the last decade (two to ten years). Additionally, to ensure they had passed enough growth stages, we only included spin-offs that had reached the point of selling products to customers. In our preliminary analysis, we identified the current stage the spin-off was in and the junctures it had passed. Table 4.1 provides a description of each case and its main characteristics.

We conducted semi-structured interviews based on a narrative approach (Polkinghorne, 1988), which combined a structured agenda with the flexibility of asking additional questions. The interviewer kept interruptions to a minimum and invited the facilitators to describe their involvement in the development process from its inception to the present. This interviewing technique is aimed at gaining a better understanding of the actual events, avoiding personal views and theoretical perspectives to dominate data collection (cf. Rasmussen and Borch, 2010). After informing and inviting potential participants by e-mail, two researchers visited the participants to conduct face-to-face interviews in their professional environments. We deliberately started with an open question to enable participants to express their views in their own words. Miller et al. (1997) reported that this leads to higher accuracy in retrospective reports. The interviews lasted one hour on average. The audio-recorded interviews were transcribed for detailed analysis.

We first asked the university facilitators questions (see Appendix C) on two issues: (1) the critical junctures that academic spin-offs encounter during growth stages, and (2) the support they provided to the spin-offs to overcome these critical junctures. We asked open questions such as "Please describe the main barriers that spin-offs encounter during their growth." Next, we asked the academic spin-off founders questions on the same two issues: (1) the critical junctures they had experienced during growth stages, and (2) the support they had received from facilitators to overcome these critical junctures. We asked open questions such as "Please describe the support you received from facilitators." Finally, we asked the spin-off founders to rank the critical junctures and to rank facilitator support as mentioned by the facilitators on a 7-point Likert scale.

Table 4.1 Characteristics of academic spin-Offs

	Case 1- WUR	Case 2- WUR	Case 3- WUR	Case 4- TUD	Case 5- TUD	Case 6-TUD	Case 7-TUE	Case 8- TUE	Case 9-TUE
Founding date	2006	2008	2010	2005	2010	2010	2005	2007	2010
Founder(s)	2 university researchers	2 university graduates	1 PhD graduate	1 university graduate 1 professor	2 university researchers	2 university researchers	2 university researchers	1 PhD graduate	1 graduate 1 professor
University ownership	30%	35%	-	-	-	30%	50%	-	10%
No. of employees	14	3	3	60	2	2	2	2	4
Growth Stage	Sustainable return	Re-orientation	Pre-organization	Sustainable return	Opportunity recognition	Pre-organization	Re-orientation	Sustainable return	Pre-organization
Initial fund	Seed-funding	Public sources	Seed-funding grant	Seed-funding university finding	Seed-funding grant	Seed-funding grant	Public sources	Public sources	Seed-funding university funding
Additional funding sources	Private investor	Private investor		Private investor Government investor Subsidies			Private investor	Private investor	Private investor
Industrial sector	Biotechnology	Information technology	Clean technology	Clean technology	Clean technology	Information technology	Information technology	Medical technology	Medical technology
Product	Fruit maturity testing	Online screening video camera	Plant electricity	Fast charging electric vehicle	Solar panels	Digital distance solutions for disabilities	architectural acoustics	Digital diagnostic test	Pregnancy monitoring machine
Performance	2 patents 2-3 awards Innovation award High revenue	1 patent 1award Moderate revenue	1 patent 1 award Low revenue	2-3 patents; 12 pending 2 new venture awards High revenue	1 patent 3 awards No revenue	1 patent 1 awards Low revenue	1 patent 1 award Moderate revenue	1 patent 1 award High revenue	1 patent 1 award No revenues yet

Data analysis

This content analysis of the transcribed interviews was based on two approaches. First, we assigned codes to text fragments using a bottom-up approach, i.e. without strong a priori assumptions. This approach allowed us to move back and forth between the transcribed interviews (Glaser and Strauss, 1967) and to identify themes and codes in order to arrive at a more accurate inductive and explorative analysis. This is known as conventional content analysis (Aldrich, 1999). Subsequently, we adopted a more top-down approach, known as directed content analysis (Aldrich, 1999), in which we related our codes to the academic literature. To derive systematic explanations for the processes we observed, we identified observations that matched theoretical concepts in an interactive process (Rasmussen and Borch, 2010). For example, we were able to relate all answers to five support activities found in the literature. The following example illustrates how this sequential approach works: a respondent might say, "Usually when we visit clients, we go together to make better deals." We coded this text fragment as 'LINK TO CLIENTS'. This might be a code that was used for similar content in another interview, or a new code, when the opinion expressed has not yet been voiced by anybody else in the sample. Next, we reduced the data by combining several codes into 'family codes', similar to econometric factors, representing codes that are related at a more generic level. Building on the example above, we combined the 'LINK TO CLIENTS' code and the 'LINK TO BUSINESS PEOPLE' to form an overarching 'NETWORK SUPPORT' code. In other words, we assigned the same code to multiple quotes in various data sources, and then group these codes into broader family codes. Note that any code was assigned to one interviewee only once to prevent interviewees who voiced a very strong opinion from having a disproportionate influence on the overall results. The data was processed by two people in order to fully understand and thoroughly analyze each case and maximize external validity. Atlas.ti, a software package for qualitative analysis, was used to facilitate the systematic combined interpretation of the interviewees' wide-ranging statements.

4.4 Results

Analysis of critical junctures

The facilitators and entrepreneurs we interviewed talked about the critical junctures during the growth stages of the spin-offs and ranked them in importance. We grouped their statements based on the 'family codes' of conceptually similar challenges. We now present the findings from our interviews with facilitators and with entrepreneurs and then compare their answers.

Critical junctures according to facilitators

Table 4.2 presents the most critical junctures identified by the spin-off facilitators. We include both the most mentioned codes, the number of facilitators who mentioned a particular code, which they considered critical for the development of the spin-off, and the ratio in relation to the total number of facilitators interviewed.

The first critical juncture identified by our facilitators is lack of opportunity recognition, which was specified as the inability to arrange IP protection, the inability to think commercially and to write the business plan, and the lack of an industry network. This juncture is encountered by many spin-offs that were initiated by university researchers (Vohora et al., 2004; Wright et al., 2012). In aggregate, 17 quotes related to four challenges were about opportunity recognition. One

of the facilitators claimed: *"Every single academic spin-off that I meet, without exception, has great trouble drawing up a business plan. They don't have a clue what should be in it."*

The second critical juncture is lack of entrepreneurial commitment. There were 28 quotes related to eight challenges, with lack of entrepreneurial skills, the inability to find market applications, and the absence of a role model, as the three most frequently mentioned ones (Table 4.2). For example: *"… I would say the biggest problem is too few entrepreneurial skills to actually find clients, to make that first sale."*

The third critical juncture is lack of credibility or the inability to attract funding, the lack of a well-balanced managerial team, and lack of legitimacy. This juncture is mentioned most often, with 37 quotes relating to nine challenges that belong to this family. The main challenge, mentioned no less than 18 times, was the company's inability to attract finance from investors, so it could continue developing its product and fully establish itself. One facilitator stated: *"… They couldn't convince investors to put up the money and there was an inability to attract finance in the second and third round going from prototyping to mass production…"* Another facilitator stated: *They are unable to achieve a balanced managerial and scientific team…"*

The fourth and final critical juncture identified by our facilitators in the later growth stages is the lack of sustainability, specified, for example, as the inability to get to the market, , and the lack of ambition to grow. As one facilitator put it: *"…There are not so many … innovative high-growth companies. It is [due to a] lack of ambition and that is not a good motivator to become a world leader."*

In sum, we conclude that the facilitators perceived the most crucial critical junctures to be credibility issues (37 mentions), particularly in terms of the inability to attract funding from investors (18 mentions), and entrepreneurial commitment issues (28 mentions), particularly in terms of the lack of entrepreneurial skills (9 mentions).

Critical junctures according to founders

Table 4.2 presents the most critical junctures identified by the spin-off founders. We include both the number of founders who mentioned a particular code, which they considered critical for the development of their spin-off, and the ratio in relation to the total number of founders interviewed.

The first critical juncture identified by the founders is opportunity recognition, specified as the inability to write business plan, the inability to think commercially, the lack of an industry network, and the inability to arrange IP protection. Their second critical juncture is entrepreneurial commitment. Founders particularly emphasized the lack of entrepreneurial skills and the inability to find market applications. The third critical juncture is credibility. Founders referred to their failure to attract funding from investors, as much as to their lack of a well-balanced managerial team as critical. As one founder explained: "*It became a problem that we lacked commercial experience just around the same time that we were running out of initial funding.*" When the lack of legitimacy was mentioned, founders also stated that, in the later

stages of their company's development, they derived such legitimacy from their university's reputation and network.

The fourth critical juncture is sustainability in the later stages of development. High-tech spin-offs often face a long development period before the products based upon their technology gets adopted by markets. Although only three of the spin-offs in our study had reached this stage of development, all of them face this issue. "*It was more difficult than I expected to create sufficient revenue to invest in new product development. We needed additional investment rounds to overcome that.*"

To sum up, we find that more than half of the spin-off founders we interviewed mentioned the following issues as critical in their company's development: the inability to write a business plan (7 mentions), the inability to think commercially, and the inability to find market applications (both 6 mentions). Furthermore, the lack of an industry network, the lack of a well-balanced managerial team, the lack of entrepreneurial skills, and the inability to attract funding from investors were each mentioned 5 times.

Table 4.2 Important growth barriers

Critical junctures	(#Codes*, #Times mentioned**)	Most mentioned codes	Facilitators (n=18) (#Times mentioned as critical Abs (ratio) ***)	Founders (n=9) (#Times mentioned as critical Abs (ratio) ****)
Opportunity recognition	(4; 17)	Inability to arrange IP protection	6 (0.33)	4 (0.44)
		Inability to think commercially	5 (0.28)	6 (0.66)
		Inability to write business plan	4 (0.22)	7 (0.78)
		Lack of industry network	2 (0.11)	5 (0.55)
Entrepreneurial commitment	(8; 28)	Lack of entrepreneurial skills	9(0.50)	5 (0.55)
		Inability to find market application	5(0.28)	5 (0.55)
		Lack of role model	3(0.16)	2(0.22)
Credibility	(9; 37)	Inability to attract finance	18(1)	5(0.55)
		Lack of a well-balanced managerial team	5(0.28)	5(0.55)
		Lack of legitimacy	5(0.28)	4(0.44)
Sustainable return	(4;10)	Inability to get to market	3(0.16)	3(0.33)
		Lack of ambition to grow larger	3(0.16)	-
		Lack of exit strategy	2(0.11)	-

*This is the number of codes within a family code

**This is the number of times that facilitators mentioned specific codes that fit in with a specific family code. For example, opportunity recognition is linked to 4 specific codes and those codes were mentioned 6, 5, 4 and 2 times respectively, adding up to a total of 17.

Number of times that a specific code is mentioned by facilitators, both the absolute number and as a ratio of all facilitators interviewed .*Number of times founders referred to the challenges as critical; scores over 5 based on 1-7 Likert scale; both the absolute number and as a ratio of all founders interviewed

Comparative analysis of critical junctures

The largest perceptual differences between facilitators and founders can be observed at the opportunity recognition and the credibility junctures. On the former, seven out of nine founders ranked the ability to write a business plan as crucial, compared to only four out of 18 facilitators. In contrast, five founders (0.55) rated industry networks as crucial, compared to only two out of 18 facilitators (0.11). Regarding the credibility juncture, the largest disparity was in the perceived spin-offs' inability to attract funding from investors; only half of the founders view this as critical, compared to all 18 facilitators identifying investor funding to be crucial challenge. At the entrepreneurial commitment juncture, the main difference in perception was the ability to find market applications. Five out of nine founders (0.55) identified this as critical compared to only five out of 18 facilitators (0.28). We had insufficient observations to analyze the answers somehow related to the sustainable returns juncture. Overall, the founders considered problems related to writing a business plan, the lack of an industry network, and the inability to find market applications more important than facilitators, whereas facilitators found the inability to raise funds more problematic than founders.

Analysis of support activities

Important support activities according to facilitators

We first asked facilitators to mention the support activities they provided to foster spin-off growth. Based on conceptual similarity, these activities are grouped together into families to form five main types of support: infrastructural, financial, network, business and legal support (see Table 4.3).

Facilitators play a significant role in the growth stages of spin-offs by helping them to develop their business plan, and to shape their business by providing market-oriented advice. According to an incubator director: *"…We have a look at the proposition or plan, we comment on things that are not developed very well. I give some help and advice to come to a viable business plan…*." Facilitators also provide legal advice to start-ups on how to valuate and protect intellectual property, because they know how to manage patents and other intellectual property rights. A TTO-manager: "*Almost all new ideas will be patented by the university and should be reported to the TTO. The vast patent base is screened and the ones with a high potential are selected*."

Spin-off founders rely on coaches and consultants to screen market opportunities and identify potential markets. University incubators claim to enhance founders' skills by providing education and training programs in accordance with founders' personal needs. As the director of an incubator explained: *"We have a kind of personal development program. … So we started a peer review group, just like they do in hospitals where doctors get together every two weeks to discuss a case."*

Facilitators also connect entrepreneurs with coaches, seasoned entrepreneurs who have created, developed, and sold spin-offs before. As a university, business developer put it: "…*We just offer them a platform with all kinds of programs … they can be assigned a coach, who is always a serial entrepreneur*."

One incubator director deliberately houses various spin-offs together: "*I think it's most important for the start-ups that they're here together, in this building. We house all kinds of companies from start-ups to booming businesses*." Bringing spin-offs together makes it easier for them to access the various resources available in such networks. Alternatively, as one facilitator put it, "*we establish a network among the university's spin-off companies. …. The network is useful for information sharing, but also for members' to prepare a joint presentation to the market*."

Facilitators help spin-offs to contact with external financers, potential customers, and investors who want proof of market, proof of concepts, and the credentials of the entrepreneurs they invest in. *"What we do is [to] put them in touch with business people, business minds…*" In this respect, facilitators play a key role by building networks and attracting finance from investors (mentioned 18 times) such as business angel networks and venture capitalists. A university facilitator, previously active as venture capitalist, elaborated: "*In my network I have contacts with informal investors, with banks... Sometimes I accompany someone while they negotiate a deal with an investor or the bank…*"

Based on our interviews with facilitators, we find that facilitators most often provided financial support (32 mentions), particularly in the sense of attracting funding by linking spin-offs to investors (18 mentions) and by providing seed funds (10 mentions 10). Other often-stated types of assistance are network support, and business support (respectively 28 and 27 mentions). Regarding the type network support, the two prevalent support activities were linking start-ups to business people (8 mentions) and to industry networks (6 mentions). Finally, as for business support, facilitators most often provided coaching, and education and training (both codes mentioned 8 times), as Table 4.3 shows (all founders). Seed funds as financial support (all founders), and business support especially in developing their business plan (eight founders) are the three most important types of received facilitator support.

Table 4.3 Important support activities

Main types of support	(# Codes, # times mentioned)	Most mentioned codes	Facilitators (n=18) (#Times mentioned, Abs (ratio))	Founders (n=9) (#Times mentioned as critical, Abs (ratio))
Infrastructural support	(5; 22)	Accommodation	6 (0.33)	7(0.78)
		Office space	4(0.22)	4(0.44)
		Lab space	3 (0.16)	3(0.33)
Financial support	(6; 32)	Attract finance by linking to investors	18(1)	7(0.78)
		Provide seed funds	10(0.55)	9(1)

Network support	(6; 28)	Link to business people	8(0.45)	9(1)
		Link to industry network	6(0.33)	9(1)
		Link to other start-ups	5(0.28)	9(1)
		Link to clients	4(0.22)	4(0.44)
		Link to big companies	3(0.16)	3(0.33)
Business support	(8; 27)	Coaching	8(0.45)	4(0.44)
		Education and training	8(0.45)	4(0.44)
		Developing business plan	5(0.28)	8(0.89)
Legal support	(4; 12)	Collaboration agreement	5(0.28)	6(0.67)
		Arranging and managing IP	5(0.28)	5(0.55)

Comparative analysis of support activities

The largest perceptual differences between facilitators and founders concern network support. All spin-off founders ranked as very important the three most mentioned codes related to network support (links to business people, industry networks and other start-ups), whereas merely one-third (on average) of the facilitators mention these three support activities as important. Similarly, all nine founders ranked seed funding as financial support, as crucial, while only roughly half of the facilitators mention this activity. In contrast, all 18 facilitators claim the importance of linking to investors, as financial support, more than founders (0.78), and seven founders valued the help they got from facilitators in approaching investors during their growth stages.

The spin-off founders and facilitators gave similar assessments for business support, except for the importance of developing a business plan: surprisingly almost all founders (0.89) mentioning the importance of this support, strongly contrasting with only a quarter (0.28) of the facilitators. One founder voiced this disparity in valuation as follows: "*I had to ask for advice, from [the] university incubator, on writing a business plan, and especially on the financial part*."

Finally, more founders appreciate legal support (0.55) more than facilitators (0.28), as they do with accommodation as infrastructural support (0.78 versus 033). In sum, we conclude that facilitators and founders do not fully agree on the junctures, which are the most critical, and/or the support activities perceived most conducive to the growth of academic spin-offs.

Analysis of support activities in navigating critical junctures

We turn focus to the key support activities that can best help academic spin-offs navigate individual critical junctures during the transition from one growth stage to the next stage. Table 4.4 presents the summary extracted from our findings. It presents the key support activities and related actors, related examples mentioned by the founders, and the spin-off founders that mentioned such support activity as critical.

Table 4.4 Example of support activities mentioned by founders as critical

(Key support activities and actors)	Example of support activities mentioned by the founders	case #
Opportunity Recognition		
Infrastructural support *(Incubators and science parks)*	• Accommodation and facilities o Provide accommodation o Provide customized infrastructure designed to help test and develop product	**7 cases cases 1,4 5**
Financial support *(Incubators)*	• Provide seed funds o Provide seed funds for prototype technology or product	**all cases**
Network support *(TTOs and incubators)*	• Link to businesspeople and industry network o Link spin-offs to various industrial partners and commercial contacts to assess the product's market potential	**all cases**
Business support *(Business developers, incubators, TTOs)*	• Develop business plan o Help spin-offs write business plan by identifying business opportunities and translating these into cl articulated and commercially viable business plan	**8 cases**
Legal support *(IP managers and TTOs)*	• Arrange and manage IP o Pay for patent as an indirect loan	**cases1,2,4,9**
Entrepreneurial Commitment		
Network support *(Incubators and business developers)*	• Link to other start-ups o Bring start-ups together so they can access all the resources in such networks	**all cases**
Business support *(Business developers, coaches, incubators)*	• Educate and training o Develop balanced teams with technical and commercial members	**cases 1,4,5,9**
	• Coaching o Introduce a serial entrepreneur to coach the start-up	**cases 4,5,6,9**
	• Developing business plan o Help write commercial application and targets for a product	**8 cases**
Credibility		
Financial support *(Universities, TTOs ,incubators)*	• Link to funding sources o Link to business partners, big companies, industry and venture capitalists to attract investment	**all cases**
Network support *(TTOs and Incubators)*	• Link to businesspeople and industry network o Link to business people, industry and expertise	**case 4,9**
Legal support *(Universities, TTOs, incubators)*	• Collaboration agreements o Enhance credibility, making it easier for start-ups to get access to external resources	**cases1,8,7**
Sustainable Returns		
Network support *(TTOs and incubators)*	• Link to businesspeople and industry network o Link to businesspeople, industry network and venture capitalists to help them reach the market	**cases 1,4,5**

Support that helps to navigate the opportunity recognition juncture

Considering the first critical juncture opportunity recognition, founders mentioned the inability of spin-offs to think commercially, to write a business plan, and their lack of an industry network as the main challenges. To navigate this juncture founders appreciated especially network support

and financial support. All spin-off founders stated how helpful it was to meet other business people and expand their network in order to develop their business opportunity. We observed that these support activities are primarily important with the juncture opportunity recognition.
Concerning financial support, all founders strongly valued receiving seed funding, for prototyping. Almost all founders appreciate practical help with developing their business plan. Finally, accommodation and facilities on campus was considered a critical infrastructural support (seven out of nine founders). IP management support was less crucial.

To summarize, to navigate the opportunity recognition juncture, academic spin-offs benefit from seed funding, assistance by business developers, incubators and TTOs in writing their business plan, introductions to business people and industry networks, specific infrastructural facilities by university science parks and incubators, and IP protection.

Support that helps to navigate the entrepreneurial commitment juncture

Considering the second critical juncture entrepreneurial commitment, founders stress the lack of entrepreneurial capabilities, and the inability to find a market application, as the main challenges.
To navigate this juncture, all spin-offs founders appreciated network support to realize close contacts with other spin-offs, allowing them to share common infrastructure and to advance networks for sharing knowledge and providing mutual help. Facilitators can provide network support by bringing together spin-offs and by stimulating knowledge transfer and experience sharing. This corresponds with Bergek and Norman (2008) who observed a role for peer and social input throughout all incubation activities. Next, in terms of business support, professional training and education lead to more entrepreneurial commitment (Egeln, 2003; Vohora et al., 2004) and helps to acquire the business knowledge (Djokovic and Souitaris, 2008; Meyer, 2003). Facilitators' networks can also help address the difficulties spin-offs experience in forming a well-balanced managerial team. Eight out of nine founders claim that support in terms of helping them set commercial goals and foregrounding market application in their business plan was a key type of business support. Commercial experts, coaches and business developers, invited or contracted by incubators, development agencies or TTOs can help spin-offs to formulate these goals in a business plan.

While previous studies have mentioned the importance of such support throughout the growth stages, they did not specify when it was more important. Our study shows that entrepreneurial capabilities can be improved by serial entrepreneurs and commercial experts helping spin-offs to set clear market goals in their business plan, to strengthen their management team, and to bring them into contact with other spin-offs. This increases the ability of spin-offs to navigate successfully the second juncture of entrepreneurial commitment.

Support that helps to navigate the credibility juncture

Third, considering the credibility juncture, founders mentioned the inability to attract funding from investors, insufficient legitimacy, and the lack of a well-balanced managerial team as their main challenges. Financial support by linking them to venture capitalists was appreciated by each and every spin-off we interviewed, since it give them access to resources beyond their financial

capacity (Larson, 1992) and helped them to enhance their credibility (Nicolaou and Birley, 2003). Spin-offs often encounter problems with their legitimacy when competing with older, more established companies. This limits their opportunities to acquire resources and decreases their likelihood of survival (Hannan and Freeman, 1984). Intensive facilitator support can reflect positively on a spin-off's credibility and legitimacy. Endorsement strengthens the spin-off's reputation and raises chances of survival and growth (Baum and Silverman, 2004). For spin-offs, network building by facilitators leads to greater credibility (Nicolaou and Birley, 2003; Bøllingtoft and Ulhøi, 2005), more legitimacy (Elfring and Hulsink, 2003), and access to resources, complementary assets and sources of knowledge (Hulsink et al., 2007). Facilitators pointed to the importance of formal contracts in terms of shareholding or coaching, which help to increase a spin-off's credibility (Egeln, 2003; Zahra et al., 2007). However, almost half the spin-off founders we interviewed emphasized that their initial lack of legitimacy was later compensated through university support, especially for companies located at incubators. Incubators help start-ups gain external legitimacy by expanding their network, introducing them to business partners, large companies, and venture capitalists. For example, spin-off #4 was able to raise venture capital with the help of the university incubator and TTO. Three of the interviewed spin-off founders also mentioned that collaboration agreements provide credibility, making it easier for them to access external resources. To sum up, to navigate the credibility juncture, academic spin-offs benefit from universities, incubators, and TTOs support an important role by enhancing academic spin-offs' legitimacy and improving their access to funds.

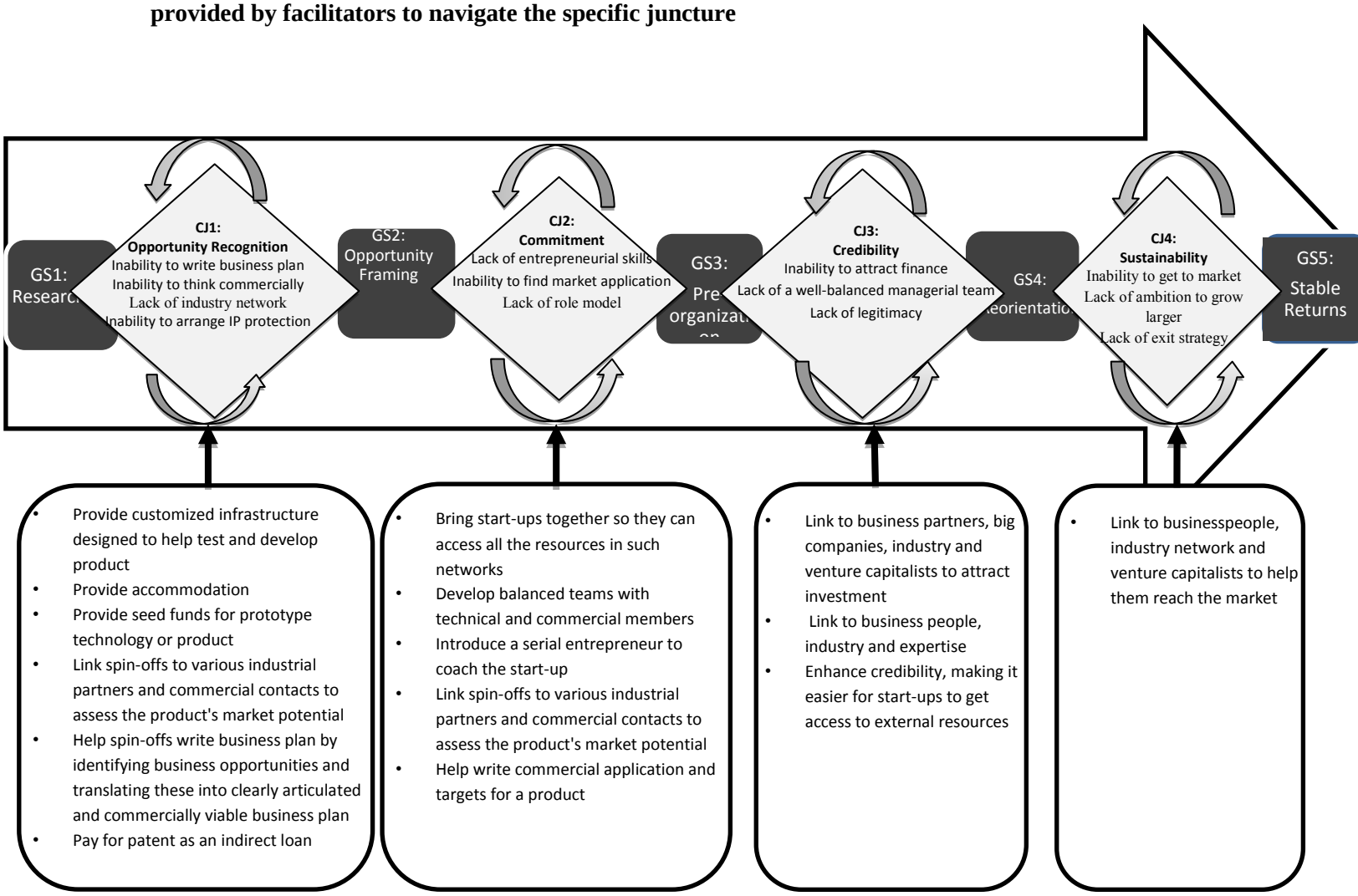
Support that helps to navigate the sustainability juncture

The fourth and final critical juncture that spin-offs face later in their development is sustainability. Note that only three of our nine cases had reached this stage, when we interviewed them. In general, high-tech spin-offs face a long period of development before the market adopts products based upon their new technology (Agarwal and Bayus, 2002), negatively impacting growth in company revenues (Wright et al., 2012). One solution is to network with other companies in the marketplace, which increases survival chances (Aldrich and Fiol, 1994). To reach the sustainability stage, spin-offs founders stated that they needed an extra expert on their team. One of the spin-offs we interviewed hired a financial manager with ten years of industry experience, which greatly helped the company to raise its second round of funding, and enabled it to increase turnover. Another spin-off recruited a serial entrepreneur sales manager and a financial expert to attract more investors. Facilitators, particularly TTOs, incubators, and business developers can help spin-offs navigate this juncture by introducing or linking them to businesspeople, venture capitalists, and other industry networks so they can raise sufficient funds.

Figure 4.1 presents the spin-offs growth stages, detailed barriers in each critical junctures and the main support activities received from facilitators by spin-offs during their growth stages. It provides useful insights about the support activities that are crucial at individual critical junctures, and points to paths through which facilitators can tailor their support for academic spin-offs.

Key support activities of the facilitators to navigate critical junctures

Figure 4.1 Academic spin-offs growth stages (GS), critical junctures (CJ) and support activities (SA) provided by facilitators to navigate the specific juncture



4.5 Discussion and conclusions

This study has provided new scientific insights into the entrepreneurship process with the aim of clarifying the role university facilitators in helping academic spin-offs to navigate critical junctures, and move to the next growth stage. While a large amount of research exists on the role of specific facilitators, little research has taken a more holistic approach to analyze the role of multiple facilitators during the different stages of spin-off growth. Moreover, few studies specify how facilitators can best support spin-offs to overcome certain critical junctures. This study developed an analytical framework based on the literature of stage-based models and the capability perspective that enabled us to link the critical junctures in start-ups' growth stages, as defined by (Vohora et al., 2004) with the support that is considered important to navigate these critical junctures. In line with Druilhe and Garnsey (2004), van Geenhuizen and Soetanto (2009), and Wright et al. (2012), we concluded that the critical junctures in the growth stages of academic spin-offs require university facilitators to provide capabilities and support adapted to the specific requirements of these start-ups. Chapter 4 contributes to this research stream through a more detailed analysis of the role of various facilitators during the spin-off growth stages. We investigated the experiences of both spin-off founders and facilitators and identified the support activities that are essential to overcome certain critical junctures. In this way, we have added new, useful empirical insights to the relatively few studies that take both founders and facilitators into account.

Regarding the first two critical junctures, opportunity recognition and entrepreneurial commitment, founders identified the following support activities as critical for overcoming the opportunity recognition juncture: seed funding, infrastructural facilities, IP management, support in writing a business plan, and being introduced into various networks. Our analysis shows that founders ranked the inability to write a coherent business plan and lack of industrial network to be more critical than facilitators did.

During the entrepreneurial commitment juncture, founders valued introductions to coaches and commercial experts to help them commercialize their business plan (e.g., setting market goals). This finding is in line with Shane and Delmar (2004) and Patzelt and Shepherd (2009) who concluded that facilitators can guide academic entrepreneurs to meet their strategic development goals such as finding market application and increasing their commitment to develop their ventures (Shane and Delmar, 2004; Patzelt and Shepherd, 2009). Founders also value support in strengthening their management team and bringing them into contact with other spin-offs. This increases their entrepreneurial skills and motivates them to be committed to venture. This finding is in line with Bergek and Norrman (2008).

With regard to the critical junctures of credibility and sustainability, founders greatly appreciated the intermediary role of facilitators, linking them to venture capitalists and seasoned entrepreneurs. This strengthens the spin-offs expertise and network. We also found that affiliation with the university helps spin-offs building the necessary networks and credibility, legitimacy, and reputation, making it easier for them to access external resources. This finding is in line with studies by (Grandi and Grimaldi, 2003; Rasmussen and Borch, 2010; Pettersen and Tobiassen, 2012). In this study, we showed that introductions by facilitators to new contacts (Hulsink et al., 2007) increases spin-offs' legitimacy and improves their access to funds, which helps them to

overcome the credibility juncture. By introducing spin-offs to financial experts and venture capitalists, or encouraging them to hire a serial entrepreneur, facilitators can help spin-offs to rise additional funding needed to reach the point where they overcome the final critical juncture to achieve sustainability.

Our study expands entrepreneurship research in several ways. Firstly, although there is a substantial body of literature about the effects university facilitating programs have on the creation of new ventures, little is known about the effects of facilitator support on the actual growth process of high-tech academic spin-offs. Secondly, while previous studies have proven the overall positive impact of different types of support on spin-offs' development, few pay attention to the founders' experience and assessment of these support programs. Our study therefore complements existing studies on entrepreneurship policy by focusing on entrepreneurs' experience and by contrasting them with facilitators' views. Thirdly, prior empirical research on academic spin-offs and the role of facilitator has focused mainly on a single type of support provider, such as incubators or TTOs. Our study is different in that we include different types of facilitators, and we investigated how this support was geared towards, and affected, different stages in their development. By focusing on the distinct support activities facilitators provide, this study contributes to a better understanding of how entrepreneurial processes interact with and benefit from key support actors. Finally, our study also contributes to the theoretical discussion on how university spin-offs' attempts to marshal initial resources (Ahuja and Katila, 2004) are synchronized with university facilitators' support aimed at building spin-offs' capabilities in order to successfully navigate the critical junctures during their growth (Wright et al., 2012).

Managerial implications

Apart from its contribution to entrepreneurship research, Chapter 4 also has significant policy implications. This study offers specific insight into the development stages of academic spin-offs and the role of facilitators in providing different types of support at different stages as part of the overall supportive entrepreneurship ecosystem (Fetters et al., 2010). Our findings suggest specific ways in which facilitators can foster academic spin-off growth by offering support that helps spin-offs find their way through particular critical junctures. Facilitators should be aware that support aimed at business plan writing, IP arrangement, seed funding, and network building are crucial ways to help spin-offs overcome the critical junctures of opportunity recognition and entrepreneurial commitment. During later stages of a spin-off's development, facilitators should switch to acting more as intermediaries between spin-offs, venture capitalists, and business coaches, in order to deal with the subsequent junctures of credibility and sustainability.

Based on our findings, we recommend that facilitators match their support portfolio to the needs and critical junctures that spin-offs face during their growth. Before designing or redesigning a support program, universities should first clarify the target spin-off's growth stages and corresponding critical junctures and identify which resources are needed at every juncture, because these needs change over the course of a spin-off's development. At the same time, spin-off founders should be aware of the constraints and benefits related to the university context and should take advantage of the fact of being an academic spin-off (Rasmussen and Borch, 2010).

Given the relevance of our results for both universities and policy-makers, effective policies and initiatives should be embedded in and treated as legitimate efforts at multiple levels, including universities, science parks, incubators, TTOs, and entrepreneurship centers. From an economic policy point of view, it would be wise to assess the effectiveness of these support programs, especially given the increasingly large amount of public funding invested in programs that stimulate the founding of new companies. In this way, universities can provide an effective 'homegrown' solution to sustainable and knowledge-based local economic development (Feldman and Francis, 2004).

Limitations and future research

Although our study sheds light on barriers to academic spin-off growth and on the type of facilitator support that is critical in overcoming this, we must draw attention to some limitations and possible future research questions. Firstly, future research should verify our findings using larger databases, ideally including longitudinal data (Rasmussen, 2011). For example, facilitators' support of academic spin-offs might differ considerably from region to region due to regional characteristics. There is a widely recognized need to study the development of academic spin-offs (Lockett et al., 2005; Mustar et al., 2006; Wright et al., 2004), and we hope our study may function as a catalyst. Secondly, our methodology relies on the accuracy of one single informant's report of past events per spin-offs. Future research may benefit from conducting interviews with more than one informant per spin-off (Pettersen and Tobiassen, 2012). Thirdly, great care must be taken when generalizing our results to non-academic spin-offs. Academic spin-offs differ from other start-ups both in terms of their origin and, more importantly, in terms of the availability of facilitator support (Shane, 2004; Wright et al., 2007). Future research could focus on the extent to which our results also hold true for non-academic spin-offs. Fourthly and finally, Chapter 4 has focused on explaining founder assessment of support programs based on the activities these programs provide. We did not take into account the background of the founders and how this might affect their assessment (Patzelt and Shepherd, 2009). Future research could focus on how the prior experience of founders in terms of industry experience and education might influence the value they attach to the support activities of facilitators.

Appendix C: Questionnaire items for facilitators

Role of facilitators
What is <name of facilitators> role in helping academic spin-offs in developing process? What kinds of support you provide for them?

Academic spin-off barriers
Can you describe the main barriers that spin-off encounter as they are going from one stage to the other.

Questionnaire item for spin-offs founders

Academic spin-offs barriers

Can you describe the main barriers that you faced during your development process?

Please indicate the most important problems that you faced during your development process. (1 = not critical... 7 = very critical)

Opportunity recognition	Inability to arrange IP protection	1 2 3 4 5 6 7
	Inability to think commercially	1 2 3 4 5 6 7
	Inability to write BP	1 2 3 4 5 6 7
	Lack of industry network	1 2 3 4 5 6 7
Entrepreneurial commitment	Lack of entrepreneurial skills	1 2 3 4 5 6 7
	Inability to find market application	1 2 3 4 5 6 7
	Lack of role model	1 2 3 4 5 6 7
Credibility	Inability in attract finance from investors	1 2 3 4 5 6 7
	Lack of a well-balanced managerial team	1 2 3 4 5 6 7
	Lack of legitimacy	1 2 3 4 5 6 7
Sustainable return	Inability to get to the market	1 2 3 4 5 6 7
	Lack of ambition to grow larger	1 2 3 4 5 6 7
	Lack of exit strategy	1 2 3 4 5 6 7

Facilitator support

What is the role of facilitators in helping your academic spin-offs in developing process? What kinds of support you received from your facilitators during your development process?

Please indicate the most important support activities that you received from facilitators during your development process. (1 = not critical... 7 = very critical)

Infrastructure	Accommodation	1 2 3 4 5 6 7
	Office space	1 2 3 4 5 6 7
	Lab space	1 2 3 4 5 6 7
Financial support	Attract finance by linking to investors investors	1 2 3 4 5 6 7
	Provide seed funds	1 2 3 4 5 6 7
Network support	Link to business people	1 2 3 4 5 6 7
	Link to industry network	1 2 3 4 5 6 7
	Link to other start-ups	1 2 3 4 5 6 7
	Link to clients	1 2 3 4 5 6 7
	Link to big companies	1 2 3 4 5 6 7
Business support	Coaching	1 2 3 4 5 6 7
	Education and training	1 2 3 4 5 6 7
	Developing business plan	1 2 3 4 5 6 7
Legal support	Collaboration agreement	1 2 3 4 5 6 7
	Arranging and managing IP	1 2 3 4 5 6 7

Chapter 5 The impact of facilitators on the intention of academic spin-offs to stay in the region of the parent university

---

Chapter 5 answers Research Question 4:

Research question 4: *To what extent can facilitators stimulate high-tech academic spin-offs to stay in the region of the parent university?*

This Chapter is based on: H. Khodaei, V.E. Scholten, E. Wubben, S.W.F. Omta. Factors affecting the intention of academic spin-offs to stay in the region of the parent university. An earlier version of the paper has been presented at the WiCaNem Conference, Capri, Italy. This version of the paper has been submitted to the Journal of European Planning Studies.

5.1 Introduction

Universities are recognized as potential driver of regional economic development (Boucher et al., 2003, Sternberg, 2009; Sternberg, 2014), creating and disseminating knowledge and information via spin-offs, students, and networks (Boucher et al., 2003). Technology transfer to academic spin-offs (Sternberg, 2014) has been credited for the establishment and growth of high-tech clusters (Saxenian, 1996), and substantial public funds have been invested (Minniti, 2008; Manjon-Antolin and Arauzo-Carod, 2011) to encourage academic spin-offs to locate in the university region (Rasmussen et al., 2006). However, when it comes to the lasting impact of academic spin-offs on regions, we know relatively little about the influence of the university, nearby companies, the reputation of regions, and the effect of support programs on the intention of spin-offs to stay in the region.

Substantial activities, by facilitators, such as incubators and science parks, support the growth of academic spin-offs in the vicinity of the focal university (Lockett et al., 2005). The extant literature on the location choice of academic spin-offs has focused primarily on the factors that influence the initial location choice of those firms (Audretsch and Stephan, 1996; Egeln, 2003; Egeln et al., 2004; Heblich and Slavtchev, 2013; Kolympiris et al., 2015; Zucker et al., 1998). Academic spin-offs indeed often opt for an initial location nearby the university (Astebro and Bazzazian, 2011; Baltzopoulos and Brostrom, 2011; Egeln, 2003; Egeln et al., 2004) as close proximity between the firm and the university offers a number of advantages, such as knowledge transfer and increased research collaboration, easier access to academic key players, and readily available research infrastructures (Audretsch et al., 2005; Lofsten and Lindelof, 2005).

For a lasting impact on regional development academic, spin-offs should stay in the region close to the parent university. However, while numerous studies have analyzed determinants of new firm formation and location, the intention of spin-offs to stay in the region has remained comparatively under investigated (Kronenberg, 2012). Studies suggests that the intention of start-ups to stay in the region or cluster may not be explained by the same set of location characteristics that explained their initial location decision (Manjon-Antolin and Arauzo-Carod, 2011; Weterings and Knoben, 2013).

This research aims to contribute to the existing literature on location preferences of spin-offs and cluster development (Patton and Kenney, 2010; Stenberg 2014), by providing additional insights into the factors that induce academic spin-offs to stay in the university region. Chapter 5 addresses the following question: What regional characteristics and types of support impact the intention of the academic spin-off to stay in the region of the parent university?

To answer this question, we follow the stream of studies that focuses on regional clusters and regional resources. A regional cluster is defined as a geographic concentration of interconnected organizations in particular fields that compete but also co-operate (Porter, 1998, 2008). We expect academic spin-offs to express an intention to stay in the regional cluster if they appreciate the available knowledge and support. This expectation is based on the notion that regional characteristics can act as a resource that may result in competitive advantages for academic spin-offs (Boasson et al., 2005). Being located in a regional cluster stimulates knowledge diffusion and integration, which could lead to cluster competitive advantages (Porter, 2000) and success of the

clustered innovative firms (Breschi and Malerba, 2005). Chapter 5 investigates if easy access to knowledge and various types of support from the university, other facilitators, and nearby companies, as well as the reputation of the regional cluster influence the academic spin-off's intention to stay in the region of the parent university.

We conducted a survey on 70 Dutch high-tech academic spin-offs in two regions active in different industries in the Netherlands. We used the survey, which was oriented at firm founders, to inquire whether they intended to stay in the region of the university, and how they appreciated various types of access and support.
This Chapter is organized along the following lines: Section 5.2 provides an overview of the relevant literature and the hypotheses. Section 5.3 describes the data and measurements. Section 5.4 presents the results of the analysis, and section 5.5 discusses and concludes the Chapter.

5.2 Theoretical framework

Starting from the premise that regional cluster location advantages may enhance firm performance (e.g., Barney, 1991; Boasson et al., 2005; Penrose, 1959), we expect that academic spin-offs will express an intention to stay located in the region of the parent university if they deem the access and support offered in the region conducive to firm growth. We therefore draw on regional sciences and the resource-based view to specify the variables related to access and support in regional clusters. Studies on the location intention of academic spin-offs are mostly based on regional characteristics (Egeln et al., 2004; Figueiredo et al., 2002; Weterings and Knoben, 2013). Several authors (e.g., Arauzo-Carod and Viladecans-Marsal, 2009; Weterings and Knoben, 2013) have mentioned the benefits that firms experience from being located in regions where many other firms are concentrated , he university, other facilitators, and companies in the region may provide access to knowledge and information, considered to be an important determinant of the establishment and growth of academic spin-offs (Hindle, 2010; Sternberg, 2009, 2014).

Academic spin-offs originate from non-commercial university environments, facing particular barriers in acquiring and configuring resources and skills for commercialization (Lockett and Wright, 2005). In line with the resource-based view, the academic spin-off needs considerable time to gain financial independence, since lengthy research cycles can constrain its development. Facilitators in a regional cluster, such as the focal university, incubators, and support centers can play an important role in recognizing, acquiring, and offering infrastructural support and business support to academic spin-offs in need of specific resources and managerial skills (Bøllingtoft and Ulhøi, 2005; Lockett et al., 2005).

Access to knowledge and information of the university

The local university is the most critical institution in many high-tech regions (Etzkowitz, 2004; Sternberg, 2009, 2014). Universities develop knowledge and human resources, and they bring money into the local economy. Being located in the vicinity of a university gives start-ups financial advantages in accessing academic knowledge and information especially through social ties between academic entrepreneurs and university researchers (Heblich and Slavtchev, 2013). Cooperation with nearby universities may bring significant benefits, such as higher annual growth figures, for start-ups within clusters versus those outside clusters (Ferguson and Olofsson, 2004).

The development of formal and informal contacts among spin-offs and academic institutions facilitates the exchange of knowledge and information, enriching the knowledge base of spin-offs (Audretsch and Lehmann, 2005a, 2005b).

We conclude that the availability of knowledge and information from the parent university contributes to the spin-off's intention to stay in the region of the parent university. This leads to the following hypothesis:
H1: Perceived access to the knowledge and information available at the university is positively related to the intention of spin-offs to stay in the region of the parent university.

Access to knowledge and information of other companies
Access to the information and knowledge available at other companies in the same regional cluster is recognized as intra-company knowledge spillovers, that may lead to beneficial cost factors (Acosta et al., 2009). Geographically bounded mechanisms (Dahl and Sorenson, 2009; Kolympiris and Kalaitzandonakes, 2013; Weterings and Knoben, 2013) for such knowledge spillovers are labor mobility, and informal knowledge and resource exchanges among employees of different firms (Almeida and Kogut, 1999). These mechanisms bring access to local knowledge, and facilitate the transfer of tacit knowledge (Asheim and Gertler, 2005). Such knowledge transfers can generally benefit from the cluster of firms in their own sector, since firms located in such clusters can take advantage of localization economies arising from the exchange of knowledge and workers, or from the existence of specialized suppliers nearby (Arauzo-Carod and Viladecans-Marsal, 2009; Figueiredo et al., 2002; Frenken et al., 2007; Holl, 2004; Weterings and Knoben, 2013). In this setting, academic spin-offs can source knowledge and information from companies in their regional cluster and access labor pools through local professional networks (Huggins and Johnston, 2010).

We conclude that the availability of knowledge and information from other companies in the regional cluster contributes to the spin-off's intention to stay in the region of the parent university. This leads to the following hypothesis:
H2: Perceived access to the knowledge and information available at local companies is positively related to the intention of spin-offs to stay in the region of the parent university

Facilitator support
Academic institutions are increasingly commissioned to encourage the establishment of academic spin-offs in their region, and to help them overcome obstacles associated with their liability of newness (Etzkowitz, 2004). Spin-off founders typically receive support from various facilitating organizations to establish and grow their company. These facilitators include the parent university, technology transfer offices, entrepreneurship centers, venture capital funds, development agencies, and incubation centers (Rasmussen et al., 2014). Academic spin-offs can leverage these regional services, yielding substantial benefits to their innovativeness and growth (Anselin et al., 2000; Fischer and Varga, 2003; Fritsch and Slavtchev, 2007).

The two most common types of support facilitators offer is access to infrastructures and business support (Lockett et al., 2005; Wright et al., 2012). Infrastructural support, such access to office space (Aerts et al., 2007), and laboratories and equipment (Grimaldi and Grandi, 2005) is often critical to business incubation (Bergek and Norrman, 2008; Chan and Lau, 2005; Lee and

Osteryoung, 2004). Business support includes support in identifying new market opportunities, in developing and marketing new technologies (Aerts et al., 2007), and in accessing professional networks (Hansen et al., 2000). It is also related to coaching (Chan and Lau, 2005), and support and training for business plan development (Aerts et al., 2007) which is often seen as a tool to gain access to potential investors (e.g., Delmar and Shane, 2003).

We conclude that the availability of infrastructural and business support from facilitators contributes to the spin-off's intention to stay in the region of the parent university. This leads to the following hypothesis:
H3: Perceived value of infrastructure support (3a) and business support (3b) from facilitators is positively related to the intention of spin-offs to stay in the region of the parent university

University reputation
Besides access to information from various sources and support from facilitators, the spin-off can benefit from the reputation of the parent university and of the regional cluster. A positive reputation can signal quality to investors and potential partners, and create credibility and legitimacy for spin-offs (Zahra et al., 2007; Zimmerman and Zeitz, 2002). Having well-known affiliates is often considered a signal of new venture quality (Stuart et al., 1999). The quality of the parent organization's regional cluster is relevant for spin-offs' location choice (Berchicci et al., 2011). An affiliated well-known research university can signal that the spin-off is a reliable company (Stuart et al., 1999), can add credibility so that it can more easily access and acquire key resources (Grandi and Grimaldi, 2003; Rasmussen et al., 2011) such as external financing and technological and commercial resources. As a result, the signaling effect can facilitate growth potential (Zahra et al., 2007).

We conclude that the availability of a reputable university in the regional cluster (hereafter: university reputation) contributes to the spin-off's intention stay in the region of the parent university. This leads to the following hypothesis:
H4: Perceived benefits from university reputation, due to being located in the university region, are positively related to the intention of spin-offs to stay in the region of the parent university

5.3 Data and methods

Sample and data collection
To test our four hypotheses, we gathered survey data from two university-related regional clusters In particular, we collected data from academic spin-offs located near the regional cluster that includes Delft University of Technology, located in the west of the Netherlands, and from spin-offs located near the regional cluster that includes Wageningen University and Research Center, located in the east of the country. These two universities are known as entrepreneurial universities, with many spin-offs in high-tech sectors and in the life sciences, and with different types of facilitator programs. Both universities actively stimulate the establishment and growth of academic spin-offs, and contribute to the development of their regional cluster.

We listed all spin-offs in these two regions, with names provided mainly by university-related facilitators, such as university incubators. We used the following three criteria to guide our selection of firms: 1) the spin-off is located in the regional cluster of the technical university of either Delft or Wageningen; 2) the spin-off was established within the past 10 years (Covin and Slevin, 1990; Pirolo and Presutti, 2010), and 3) the spin-off uses at least one type of university support. We pretested our questionnaire at five academic spin-offs. The founders filled out the questionnaire in the presence of the first author. Pretesting led to small adjustments in the semi-structured questionnaire. We sent the final questionnaire to 178 academic spin-offs from the two regional clusters.

We conducted our survey in the period December 2011 through March 2012. The questionnaire was mailed to the academic spin-offs of Delft University (102) and Wageningen University (76), addressed to their (main) founder. The founder may be considered to be the significant unit of analysis for spin-offs, according to the literature (Aldrich, 1999; Gartner et al., 2003; McKelvey, 2004).

In total, 94 questionnaires were returned, 60 from Delft and 34 from Wageningen. After rejecting 24 incomplete questionnaires, we reached at a sample of 70 academic spin-offs (46 from Delft and 24 from Wageningen), yielding a response rate of about 40% ,which is acceptable for this type of survey (Baruch, 1999).

We checked the data for various potential biases. One potential source of bias resides in the fact that our findings are derived from spin-offs that survived at least until the survey date. Spin-offs that had failed to survive fell outside our ability to observe, a common problem in studies on young companies. However, the failure rate among academic spin-offs from the two universities is low. For example, the Delft incubator reported a 90% survival rate after six years of existence (van Geenhuizen and Soetanto, 2009), and the Wageningen incubator reported a 78% survival rate after six years of existence. These survival rates are higher than average for the EU at large (75% after six years of existence; Clarysse et al., 2007), indicating a rather small potential bias in the results due to excluding non-survivors.

Next, non-response effects were tested by comparing the group of respondents to the group of late respondents (Armstrong and Overton, 1977). We found no significant biases between the two groups. The average spin-off age in the dataset was around 2.5 years and the number of employees ranged between one and 19, with an average of three employees. This picture roughly matches the general pattern in the EU, namely that many academic spin-offs remain small, i.e., 80% of the survivors after six years employ fewer than 10 people (Clarysse et al., 2007).

Operationalization

Dependent variables

Previous articles measured the location intention by binary options—stay or leave the parent university region-, or ordered outcomes (Aw and Lee, 2008; Brouwer et al., 2004; Heblich and Slavtchev, 2013; Van Dijk and Pellenbarg, 2000). We measured the spin-off's intention to stay in the region of the parent university by the following statement: "In the future, our spin-off will

stay in the region of the university," measured on a seven-point Likert scale (1 = completely disagree, 7 = completely agree).

Independent variables

Access to knowledge and information available at the university
We measured access to university knowledge and information with the following statement "Being located in the region of the university gives us easy access to the knowledge and information available at the university." This item was measured on a seven-point Likert scale (1 = completely disagree, 7 = completely agree).

Access to knowledge and information available at other companies
We measured access to the knowledge and information of other companies with the following statement: "Being located in the region of the university gives us easy access to the knowledge and information available at other local companies." This item was measured on a seven-point Likert scale (1 = completely disagree, 7 = completely agree).

Facilitator support
We measured facilitator support with several items. This item was measured on a seven-point Likert scale (1 = completely disagree, 7 = completely agree). Hypothesis 3 distinguishes between infrastructural support and business support. We measured infrastructural support with the statement: "We get access to laboratories, machines, and equipment." We measured business support with the following four statements: "We get support in synthesizing scientific knowledge with an understanding of the market"; "We get support in evaluating the appropriate market or applications for our technology"; "We get support in negotiating or convincing clients"; and "We get support in networking with people in the industry." These items were measured on seven-point Likert scales (1 = completely disagree, 7 = completely agree). The mean score, calculated as the average of the four items, is the business support indicator.

University reputation
We measured university reputation by with the following statement: "Being located in the region of university gives us a stronger reputation." This item was measured on a seven-point Likert scale (1 = completely disagree, 7 = completely agree).

Control variables
The questionnaire included the following four control variables; spin-off location, spin-off size, spin-off age, and the founder's living location. First, regional contexts within the same country may be different, and may lead to significant differences in entrepreneurial activities between regions (Sternberg, 2014). Delft University is located between Rotterdam and The Hague, a highly urbanized area in the western part of the Netherlands. Firms situated in that area and the wider region (*Randstad*) are more likely to relocate (Capasso et al., 2010), either to an alternative, potentially attractive nearby region, or to a peri-urban or rural area, where land, offices, and houses are considerably cheaper (Kronenberg, 2012; Van Dijk and Pellenbarg, 2000). Wageningen University is located in a peri-urban area in the eastern part of the country. Spin-off location was measured as a dummy (1 = located in Delft; 0 = located in Wageningen.

Second, smaller firms are more likely to relocate than larger firms (Weterings and Knoben, 2013). Relocation costs are considerably higher for larger firms (Van Dijk and Pellenbarg, 2000; Brouwer et al., 2004; Knoben and Oerlemans, 2008), so the propensity to relocate can be assumed to decrease with the size of the firm (Kronenberg, 2012). Spin-off size was measured in full time equivalents.

Third, older firms might be more embedded in their environment, as they may have established long-term, trust-based relationships in the regional cluster. Thus, the likelihood to relocate decreases with firm age (Brouwer et al., 2004). Spin-off age was measured by the years since the spin-off was founded. To obtain normally distributed variables, we included the natural log for both spin-off size and spin-off age.

Fourth, entrepreneurs tend to establish their companies in their regions of birth (Egeln et al., 2004; Michelacci and Silva, 2007) or near their homes (Dahl and Sorenson, 2009; Dahl and Sorenson, 2012). Spin-off founders prefer to locate their start-up in the area where they have their strongest social ties (Dahl and Sorenson, 2009). They may also enjoy a significant amount of trust from their customers and local peers based on past relations, potentially affecting their intention to stay in the region (Parwada, 2008). These considerations suggest the need to control for social ties. Therefore, we control for this social effect with a dummy variable for at least one member of the team management who lives in the regional cluster (1 = located in the region of the parent university; 0 = not located in the region of the parent university) (see Table 5.1).

Table 5.1 Questions and the scales

Items	Questions	Scales
Intention to stay	In the future, our spin-off will stay in the region of the university	Likert 1-7
Infrastructural support	We receive support to access laboratories, machines and equipment	Likert 1-7
Business support	Mean of : We get support in synthesizing scientific knowledge with an understanding of market; We get support in evaluating the appropriate market or applications for our technology; We get support in negotiating or convincing clients; and We get support in networking with people in the industry	Likert 1-7
Access to the knowledge and information of the university	Being located in the region of the university gives us easy access to the knowledge and information available at the university	Likert 1-7
Access to the knowledge and information of other companies	Being located in the region of the university gives us easy access to the knowledge and information available at other local companies	Likert 1-7
University reputation	Being located in the region of university gives us a stronger reputation	Likert 1-7
Spin-off location	1 = located in Delft; 0 = located in Wageningen	Dummy
Spin-off size	The number of employees (FTE) in the spin-off	
Spin-off age	The number of years since the spin-off was founded	
Social effect	1 = located in the region of the parent university; 0 = not located in the region of the parent university	Dummy

Data analysis

We used Ordered Probit regression models in STATA to test our hypotheses regarding the intention of academic spin-offs to stay in the region of their parent university. The intention to stay in the region is our dependent variable, and access to the knowledge and information available at the university, access to the knowledge and information available at other companies, infrastructural support, business support, and university reputation are our independent variables. Our four control variables are spin-off location, spin-off size, spin-off age, and the founder's living location

Table 5.2 Descriptive statistics and correlations (N=70)

		Mean	S.D	1	2	3	4	5	6	7	8	9	10	
1.	Intention to stay	4.84	1.65	1.000										
2.	Infrastructural support	3.04	1.64	.092	1.000									
3.	Business support	3.59	1.65	.243*	.700**	1.000								
4.	Access to the knowledge and information of the university	4.77	1.49	.463**	.140	.178	1.000							
5.	Access to the knowledge and information of other companies	4.69	1.67	.467**	.263*	.254*	.647**	1.000						
6.	University reputation	4.86	1.56	.351**	.147	.162	.440**	.433**	1.000					
7.	Spin-off age	2.48	1.43	-.039	-.052	-.171	-.076	-.067	.146	1.000				
8.	Spin-off size	3.48	3.39	-.085	.266*	.169	.133	.014	.084	-.022	1.000			
9.	Spin-off location	0.67	0.47	-.007	-.409**	-.229	-.078	-.213	.057	.195	-.059	.177	1.000	
10.	Social effect	0.34	0.41	.080	-.026	.091	.089	.006	-.034	.101	-.034	.266*	.018	1.000

Notes: N = 70; * p < 0.05, ** p < 0.01

5.4 Results

Table 5.2 provides the descriptive statistics and the zero order-correlations among the variables in the regression analyses. The correlation table indicates substantial correlations between the variables. We thus examined multicollinearity between the independent variables, by calculating the variance inflation factor (VIF)-index and the condition number-index. The mean VIF-indices varied between 1.11 and 1.67, far below the VIF-index threshold value of 10 (Field, 2009). The condition number-index is also below the threshold level of 30. Both scores suggest that the research model was not affected by potential multicollinearity.

The results of the Ordered Probit regression models are reported in Table 5.3. To distinguish between the relative effects of the different factors influencing the intention to stay, we determined the relative importance of each set, performing step-wise models involving both the full and the restricted models. We analyzed the dependent variables on the control variables to

create a baseline model, and then entered the direct effects of the independent variables to test the hypotheses.

Table 5.3 Ordered Probit Regression

Intention to stay	Model 1 Knowledge access	Model 2 Facilitator support	Model 3 University reputation
	Beta (S.E.)	Beta (S.E.)	Beta (S.E.)
Controls			
Social effect	.16 (.32)	.12 (.32)	.15 (.32)
Spin-off size	-.26 (.37)	-.38 (.38)	-.36 (.38)
Spin-off age	.03 (.23)	.19 (.24)	.09 (.24)
Spin-off location	.18 (.29)	.09 (.30)	-.06 (.31)
Knowledge access			
Access to the knowledge and information of the university	.22^{+} (.12)	.21^{+} (.12)	.15 (.13)
Access to the knowledge and information of other companies	.28* (.11)	.25* (.11)	.19 (.12)
Facilitator support			
Infrastructural support		-.23(.14)	-.29* (.14)
Business support		.34* (.15)	.39** (.15)
University reputation			
			.24* (.10)
Chi-square X^2	27.23	32.69	38.08
Prob > Chi^2	0.000	0.000	0.000
Log pseudo-likelihood	-109.4	-106.7	-104.0
Pseudo R2	0.11	0.13	0.15
Number of Observations	70	70	70

N = 70; + p < 0.10, * p < 0.05, ** p < 0.01

The first main effects-model includes the control variables and the variables for knowledge access or spill-over-effects (Model 1), followed by inclusion of the variables for facilitator support (in Model 2) and variables for university reputation (in Model 3). The four control variables are insignificant in all three models., Access to the knowledge and information available at the parent university (Hypothesis 1) shows moderately significant and positive effects on the spin-off's intention to stay in the region (ß = 0.22, p <0.10) in Model 1, and (ß = 0.21, p <0.10) in Model 2. However, Hypothesis 1 is only partially supported because access to the knowledge and information available at the parent university is no longer significant when university reputation is introduced (Model 3). Similarly access to the knowledge and information available at other companies (Hypothesis 2)shows significant and positive effects on the spin-off's intention to stay in the region (ß = 0.28, p <0.05) in Model 1, and (ß = 0.25, p <0.05) in

Model 2. However, Hypothesis 2 is no longer supported when university reputation is introduced (Model 3). The results refute Hypothesis 3a, but strongly support Hypothesis 3b. Infrastructural support has a significant, but negative effect in Model 3 (ß = 0.30, p <0.05). In contrast, business support has a significant and positive effect on a spin-off's intention to stay in the region of the parent university (ß = 0.34, p <0.05) in Model 2, and (ß = 0.40, p <0.01) in Model 3. Model 3 shows that the university reputation has a significant, positive effect on the spin-off's intention to stay in the region (ß =0.24, p <0.05), supporting Hypothesis 4. In sum, the explanatory power of knowledge access in the intention to stay, is fully substituted by facilitator support and reputational effects in the full model

5.5 Discussion and conclusions

This Chapter has examined whether different kinds of knowledge access, types of facilitator support, and university reputation impact the intention of the academic spin-off to stay in the region of the parent university. Our results show that this intention to stay in the region is impacted by facilitator business support, infrastructural support, the university's regional reputation, and access to knowledge and information of other companies. The four control variables remain insignificant across the three models.

We have advanced our understanding of the factors affecting the intention of spin-offs to stay in the region of the parent university. Our findings show that spin-offs significantly benefit from business support. This includes support in synthesizing scientific knowledge with an understanding of the market, support in evaluating the appropriate market or technology applications, support in negotiating with clients, and support in networking with people in the industry. It shows that spin-offs' founders who perceived the value of business support have a higher intention to stay in the region of the parent university.

Our findings show that access to the knowledge and information of other companies in the region is quite significant, but only until university reputation is introduced in the full model. This access relates to the concentration of start-ups accelerating knowledge spillovers and the transfer of experienced workers and information, thus giving rise to Marshallian externalities (Arauzo-Carod, 2009; Figueiredo et al., 2002; Frenken et al., 2007; Holl, 2004). Interestingly, across the models, access to the knowledge and information developed at the university is less significant for the decision to stay in the region. Growing spin-offs are likely to focus on commercial activities, making both business support and access to commercial knowledge and information more important than infrastructural support and access to university-based knowledge and information.

The study also confirms the significant impact of the reputation of the parent university. It may signal the reliability of the spin-off company (Stuart et al., 1999), its legitimacy (Zahra et al., 2007; Zimmerman and Zeitz, 2002) and/or its credibility to outsiders (Rasmussen et al., 2011; Grandi and Grimaldi, 2003). Our findings indicate that spin-off founders who value this signaling effect have a higher intention to stay in the region. The introduction of reputation in the full model lowers the impact and the significance levels of the variables related to access to knowledge and information.

Finally, a rather puzzling finding in the full model is the significant negative relation with infrastructural support; more infrastructural support seems to lower the intention to stay in the region. Other models that we explored (e.g., ordered logit regressions) also confirm this negative relationship.

Implications and future research

Chapter 5 adds to our understanding of the intention of academic spin-off's to stay in a region, and has implications for both academic spin-offs and regional development policies. First and foremost, the study confirms the benefits of business support. University reputation may be a catchall phrase, as the variables related to access to knowledge, either private or public, become insignificant when reputation enters the model.

Our results imply that only business support and the university's reputation can promote sustainable regional development. Infrastructural support does not seem to be important incentive for start-ups to stay in the region. More generally, this Chapter suggests that the founder's intention to stay is significantly impacted by the support provided by facilitators and by the reputation experienced and capitalized by companies. Universities can act on such variables to stimulate regional development (Heblich and Slavtchev, 2013). We need to deepen our understanding of the linkages that academic spin-offs establish and maintain in and/or later stages.

Appendix D: Questionnaire items

Future intention

To what extend do you agree or disagree with the following statements (Encircle 1 = completely disagree; 7 = completely agree).

In the future our spin-offs will stay in the region of the university	1 2 3 4 5 6 7

Facilitator support

To what extend do you received different types of support from university-related facilitators (Encircle 1 = completely disagree; 7 = completely agree).

We get access to important labs, machines and equipment	1 2 3 4 5 6 7
We get support in synthesizing scientific knowledge with an understanding of the market	1 2 3 4 5 6 7
We get support in evaluating the appropriate market or applications for our Technology	1 2 3 4 5 6 7
We get support in negotiating or convincing clients	1 2 3 4 5 6 7
We get support in networking with people in the industry	1 2 3 4 5 6 7

University reputation

To what extend do you agree or disagree with the following statements (Encircle 1 = completely disagree; 7 = completely agree).

Being located in the region of the university gives us a stronger reputation	1 2 3 4 5 6 7

Access to the knowledge of university and other start-ups

To what extend do you agree or disagree with the following statements (Encircle 1 = completely disagree; 7 = completely agree).

Being located in the region of the university gives us easy access to the knowledge and information available at the university	1 2 3 4 5 6 7
Being located in the region of the university gives us easy access to the knowledge and information available at other companies	1 2 3 4 5 6 7

Chapter 6 Discussion and conclusions

Academic spin-offs are a particular mode in knowledge commercialization contributing to regional growth, which have received increasing attention from researchers and policymakers. We have witnessed a surge in research in this area focusing on their growth indicators. Academic spin-offs are known to differ from other ventures with respect to their academic origin, human capital, resource demands, and, importantly, availability of facilitating support (Patzelt and Shepherd, 2009; Shane, 2004; Wright et al., 2007). As a result, high-tech academic spin-offs face particular challenges during their growth. Researchers have analyzed these challenges and identified various growth barriers (van Geenhuizen and Soetanto, 2009; Vohora et al., 2004) and have concluded that a lack of dynamic capabilities (Bjørnåli and Gulbrandsen, 2010; Rasmussen et al., 2011; Vohora et al., 2004) and limited entrepreneurial orientation (Iacobucci et al., 2011) constrain spin-offs to translate their initial idea into a viable business opportunity.

This manuscript explores how high-tech academic spin-offs address the growth challenges, focusing on their management team's characteristics, in particular its entrepreneurial orientation (EO) and dynamic capabilities of absorptive capacity (AC). From an academic standpoint, it advances our understanding of the influence of entrepreneurial characteristics on the growth of academic spin-offs and on how they develop capabilities based on their management team characteristics (Part 1 of the manuscript) and on the support provided by their parent university and other organizations (Part 2 of the manuscript).

This thesis analyzes how specific internal and external factors impact and support the growth of academic spin-offs (see Figure 1.2.). In this research, we focused on the spin-off team's absorptive capacity (AC) to identify and translate ideas into business opportunities that can be exploited commercially. AC plays an important role in signaling, developing, and acquiring knowledge and resources for academic spin-offs (Holcomb et al., 2009; Wright et al., 2007; Zahra et al., 2009). However, relatively little research has been conducted on how new ventures develop absorptive capacity (Hayton and Zahra, 2005; Zahra et al., 2009), and especially research on the role of management team characteristics on the development of AC has been scant (Volberda et al., 2010). Besides, due to the unique characteristics of academic spin-offs, we also need to consider the role of university facilitators such as incubators, technology transfer offices, and science parks (Rasmussen et al., 2006) for a thorough understanding of how academic spin-offs face the challenges of the growth phases. Facilitators foster academic spin-off creation and growth by providing guidance and help (Fetters et al., 2010), thereby strengthening the resources and capabilities of these spin-offs. Yet, from the perspective of the regional influence on academic spin-off development, relatively little is known about the impact of facilitators on spin-offs growth, as there are neither conclusive findings about their effectiveness over time (van Geenhuizen and Soetanto, 2009) nor a systematic framework to understand and identify the nature of their support (Hackett and Dilts, 2004; Phan et al., 2005).

On the basis of the above-mentioned unique characteristics of high-tech academic spin-offs, we posited that these start-ups can benefit from receiving support from various external organizations, which we refer to as spin-off facilitators. The finding of this paper can help university policymakers to develop measures to simulate academic spin-off growth. Our findings give practitioners guidelines for facilitator support during various phases of firm development. We formulated a set of research questions to develop a framework for analyzing factors that affect the growth of spin-offs. Each chapter corresponds to one of the research questions and

addresses the research problem mainly through the theoretical lens of the resource-based view and the related dynamic capabilities perspective (more specifically, absorptive capacity, AC).

The objective of the first part of the thesis is to analyze the role of the management team's absorptive capacity and entrepreneurial orientation (EO) to better identify and pursue opportunities. Chapter 2, building mainly on the dynamic capabilities view, provides insight into the management team-related AC antecedents. In particular, we study the role of the management team's domain specific experience and entrepreneurial characteristics on developing potential absorptive capacity (PAC) and realized absorptive capacity (RAC). Chapter 3 expands the research to the spin-off's performance, in terms of opportunity identification and pursuit. It provides a better understanding of the interaction among EO, PAC, and RAC, and their effect on opportunity identification and pursuit. Chapters 2 and 3 add to the existing literature on entrepreneurship and absorptive capacity, focusing on the role of management teams in building AC to enhance spin-off performance.

The objective of the second part of the thesis is to analyze the support mechanisms that can be used by university facilitators, such as technology transfer offices, science parks, and incubators to foster the growth of high-tech academic spin-offs. Chapter 4 studies how facilitators can help spin-offs overcome the growth barriers, which they face during their development. Chapter 5 examines the role of the university to induce spin-offs to stay in the region of the parent university, thereby developing regional clusters of high-tech spin-offs and contributing to regional growth. By applying the resource-based view, the dynamic capabilities view, and cluster literature theory, Chapters 4 and 5 discuss the activities provided by universities and facilitators to support the growth of academic spin-offs. The findings of these chapters aim at deriving recommendations to be applied at university and regional levels.

Chapter 6 discusses our findings and contributions, acknowledges the limitations of our study, and outlines directions for future research. Importantly, we provide recommendations for managers and policymakers. Section 6.1 answers our research questions. Section 6.2 brings together the results of our studies to arrive at our overarching scientific contribution, and reviews our approaches and methodologies. The section further presents the limitations of the present study and possible directions for further research. This chapter closes with recommendations for high-tech academic spin-offs managers, university facilitators and policymakers in Section 6.3.

6.1 Answers to the research questions

Academic spin-offs are considered to act as local growth engines, but they usually start with some major disadvantages related to their liability of newness, smallness and their university origination (Etzkowitz, 2004; Bjørnåli and Gulbrandsen, 2010). Academic spin-offs can overcome their challenges of growth stages by enhancing their absorptive capacity and by taking advantage of the guidance and resources provided by supporting organizations.

As a consequence, the objective of the present manuscript is:

- *To analyze how academic spin-offs address the challenge of opportunity identification and pursuit by building their absorptive capacity and by receiving facilitator support.*

Part 1 The management team's absorptive capacity

Chapter 2 and 3 contribute to the research objective by investigating how academic spin-offs can build their absorptive capacity to improve the capability to recognize new opportunities. Within the context of academic spin-offs, management teams are responsible for building the firm's dynamic capabilities (Holcomb et al., 2009; Sirmon et al 2007). Harreld et al. (2007) argue that managers need to be able to accomplish two tasks: *"first, they must be able to accurately sense changes in their competitive environment, including potential shifts in technology, competition, customers, and regulation'* (2007: 24) and *'second, they must be able to act on these opportunities and threats; ... by reconfiguring both tangible and intangible assets"*(2007: 25). The specific capability involved has been labelled absorptive capacity: *"a set of organizational routines and processes by which firms acquire, assimilate, transform, and exploit knowledge to produce a dynamic organizational capability"* (Zahra and George, 2002, 186). Evidently, firms possessing considerable knowledge-based resources can identify and pursue more opportunities. They can assess and extract the value from these opportunities (Cohen and Levinthal, 1990), *"but unless the firm is willing to grasp and enthusiastically pursue these opportunities, then the knowledge-based resources are likely to be underutilized*"(Wiklund and Shepherd, 2003: 1308). Studies on AC have mainly addressed the required skills and experience of members, and have largely neglected the motivation and willingness that members may have (Minbaeva et al., 2003; Volberda et al., 2010). Therefore, Part 1 focuses not only on the knowledge based view and the capability view but also on entrepreneurship theory, to study how spin-offs teams can be organized to seek and perceive external knowledge as opportunities. It addresses the following main research question:

Main research question of part 1*: What is the impact of the absorptive capacity and entrepreneurial orientation of the management team of high-tech academic spin-offs on the identification and pursuit of opportunities?*

Chapters 2 and 3 contribute to answering this question. Chapter 2 examines the AC antecedents by focusing on the domain specific experience and entrepreneurial characteristics of the management team. Chapter 3 focuses on the role of AC on the performance of the spin-off, in particular, the ability to identify and pursue opportunities.

Chapter 2:

The management team's entrepreneurial characteristics and prior experience as antecedents of absorptive capacity

Chapter 2 studies the management team's characteristics such as prior knowledge, entrepreneurial orientation, and team-efficacy and their effect on AC. Entrepreneurship literature has focused on domain specific research and industry experience as drivers of AC (Agarwal et al., 2004; Kor, 2003; Shane and Venkataraman, 2000). Other studies argue that the extent to which a start-up is successful at exploiting new innovations is also dependent on EO (Walter et al., 2006) and on entrepreneurial team-efficacy (Arnold et al., 2001; Baum and Bird, 2010; Drnovajek et al., 2010). We therefore combine these streams of literature by proposing the following research question:

Research question 1: *To what extent do domain specific industry and research experience (RQ 1a) and entrepreneurial characteristics i.e., entrepreneurial orientation and team-efficacy (RQ 1b) of the management team of high-tech academic spin-offs lead to a higher absorptive capacity*

of the management team?

To answer this research question, we conducted a multiple regression-analysis on a sample of 95 Dutch high-tech academic spin-offs in the Netherlands in the period December 2011 through March 2012. The data analysis follows a two-step procedure: assessing measures (using exploratory factor analysis), followed by regression analysis. We used Regression in STATA, to test our hypotheses. We performed a hierarchical regression analysis to assess the effects of the various antecedents on absorptive capacity. In the light of the scant evidence on the combined factors that shape the absorptive capacity of start-ups, Chapter 2 confirms the relevancy of prior experience as an antecedent of AC (Argote et al., 2003; Cohen and Levinthal, 1990; Van Den Bosch et al., 1999). It extends this research by distinguishing the effects of domain specific research and industry experience in the two dimensions of potential and realized absorptive capacity (PAC and RAC).

Next, in line with the literature on managerial ability in start-ups (Holcomb et al., 2009), we conclude that team characteristics have a critical role in building absorptive capacity. In line with our theoretical expectations, findings show that domain specific research experience is a predictor for both PAC and RAC, while domain specific industry experience is only a predictor for realized absorptive capacity. Lazaric et al., (2008) explains that the passage from PAC to RAC is not only a period that goes beyond a simple discovery of knowledge base, but is also a stage when the management team can benefit from competencies related to their work experience in a specific industry (Lazaric et al., 2008). In other words, while specific research experience is relevant for the discovery and exploration of entrepreneurial opportunities, something more than excellent science is needed for exploitation (Este et al., 2012).

Interestingly, Chapter 2 provides new insights into the role of team EO and team-efficacy in developing AC in high-tech academic spin-offs. In the related full models, the results suggest support for team entrepreneurial antecedents on both dimensions of PAC and RAC. Entrepreneurial orientation (Covin and Slevin, 1990) is positively related to PAC, and the team confidence and motivation, translated in entrepreneurial team-efficacy (Hmieleski and Baron, 2008), is positively related to RAC.

In sum, Chapter 2 shows significant effects of team entrepreneurial antecedents on PAC and RAC. Our findings indicate that a management team EO is related to a spin-off's PAC as well as to its RAC. However, findings show that entrepreneurial team-efficacy relate to team RAC . This confirms the studies that appreciate the effect of team motivation and confidence on RAC (Liao et al., 2007).

Chapter 3:

The impact of the management team's absorptive capacity on opportunity identification and pursuit

Chapter 3 expands the study to entrepreneurial activity that involves the identification and pursuit of opportunities. We call this spin-off performance (Shane and Venkataraman, 2000). Previous studies have demonstrated that the ability to recognize opportunities is not only dependent on internal knowledge (Shane, 2000), but also depends on the process of acquiring and transferring

external knowledge (Corbett, 2007; Li et al., 2009). The process of opportunity identification and pursuit often requires entrepreneurs to recognize new external knowledge, assimilate it, and combine it with their existing knowledge in order to exploit it commercially (Zahra and George, 2002). This AC provides entrepreneurs with access to new knowledge (Engelen et al., 2014; Rothaermel and Alexandre, 2009), which increases the number and quality of opportunities that entrepreneurial firms can pursue (Engelen et al., 2014). EO also helps firms to look for information that better meets the needs of their customers, to cope with risk, to deal with competitors (Keh et al., 2007), and EO facilitates the reconfiguration of skills and talents (Jantunen et al., 2005; Wang, 2008). Hence, Chapter 3 argues that both EO and AC lead to higher opportunity identification and pursuit, and proposes that AC is a missing link and mediating variable between EO and spin-off performance (cf. Covin and Lumpkin, 2011). Therefore, we propose the following research question for Chapter 3:

Research question 2(Chapter 3) : *To what extent do the (potential and realized) absorptive capacity and entrepreneurial orientation of the management team positively impact the opportunity identification and pursuit capabilities of the high-tech academic spin-off?*

We answered the question by testing our hypotheses and conducting a survey, resulting in a sample of 95 high-tech academic spin-offs in the Netherlands. The data analysis follows a two-step procedure: assessing measurement models (using exploratory factor analysis), followed by structural modeling using a nonparametric approach, namely the partial least squares (PLS) approach (Chin, 1998) with software package SmartPLS 2.0 (Ringle et al., 2010).

Our empirical study provides evidence of the mechanism that enables academic spin-offs to benefit from EO. AC fully mediates the relationship between EO and opportunity identification and pursuit. In other words, EO can only be effective if spin-offs can develop the ability to absorb external knowledge and combine it with their internal knowledge. AC enables spin-offs to develop new competencies to better respond to changes in the business environment. As a company-level strategic posture, EO motivates a company to identify business opportunities, and AC combines external and internal knowledge and converts it into valuable opportunities. Further, in line with previous studies (Sciascia et al., 2014), we distinguished between potential and realized AC to elaborate the relationship between EO and the performance of spin-offs. We found that PAC has a strong influence on RAC, and that RAC has a positive relationship with opportunity identification and pursuit. This finding can be explained, as 'Potential' entails inventorizing and analyzing the stock of knowledge, as a preliminary stage for subsequent knowledge integration (Corbett, 2005). RAC involves assessing ideas and testing initial feasibility, related to part of opportunity identification and pursuit. The mediation effect is in line with Leal-Rodríguez et al. (2013) who argue that higher levels of PAC lead to increased RAC, and may improve performance. In other words, a high capacity of knowledge acquisition and assimilation is related to higher opportunity recognition via RAC.

Part 2 Facilitator support

The second part of the manuscript aims to explore the role of various facilitators in fostering academic spin-off growth and to examine how the region of parent university and facilitators influence the spin-off's decision to stay in the region.

Main research question of part 2*: How can facilitators assist the growth of high-tech academic spin-offs and develop and maintain a high-tech regional cluster?*

Chapters 4 and 5 contribute to answering the main question of the second part of the manuscript. By focusing on the stage-gate model, resource-based view, the dynamic capabilities view, and regional cluster literature, the second part of the thesis aims to study the parent university support in fostering spin-off growth, and to identify the regional characteristics that induce spin-off founders to remain located in the vicinity of the university region.

Chapter 4:

Key support activities of facilitators to navigate critical junctures

The role and efficiency of facilitators in supporting spin-offs to overcome the barriers during their growth phases needs further investigation (Wright et al., 2012). Chapter 4 examines how academic spin-offs can benefit from facilitator support in navigating the critical junctures they face during their development process. It also addresses the theoretical gap of how the initial resources for a new venture are assembled (Ahuja and Katila, 2004) and synchronized through the support of university facilitators (Wright et al., 2012). We use the stage-gate model theory to structure the challenges and related critical junctures across time (Vohora et al., 2004) by addressing the following research question:

Research question 3 (Chapter 4): *What are the main critical junctures in the growth path of high-tech academic spin-offs (RQ 3a)? And in which ways can facilitator support academic spin-offs to overcome these critical junctures (RQ 3b)?*

To answer the research question, we draw data from academic spin-offs related to one of three large technical university campuses in the Netherlands: Eindhoven University of Technology (TUE), Wageningen University and Research Center (WUR), and Delft University of Technology (TUD). More specifically, we conducted in-depth interviews with 18 spin-off facilitators and nine spin-off founders.

The first critical juncture identified by the founders is opportunity recognition. They emphasized the inability of the management team to identify business opportunities and translate them into cl articulated and commercially viable business plans, the inability to think commercially, the inability to arrange IP protection, and the lack of an industry network. Spin-off founders valued seed funding, infrastructural support by university science parks and incubators, assistance from business developers, incubators and TTOs in writing their business plan, support in IP protection, and introductions to businesspeople and industry networks (Table 4.4).

The second critical juncture identified by our founders is entrepreneurial commitmen. They emphasized the lack of entrepreneurial skills, and the inability to find market applications. Founders valued introductions to coaches and commercial experts to help them commercialize their business plan (e.g., setting market goals). Founders also valued support in strengthening their management team and bringing them into contact with other spin-offs. This increases their entrepreneurial skills and motivates them to be committed to venture.

The third critical juncture identified by our founders is credibility. They emphasized the management team's inability , inability to attract funding from investors, and lack of a well-balanced managerial team. To attract funding, founders greatly appreciated the intermediary role of facilitators, linking them to venture capitalists, industry (networks), and seasoned entrepreneurs so that spin-offs can strengthen their expertise and their network. Maybe to some surprise, founders stated that especially in the later stages of development, affiliation with the university helps spin-offs develop credibility, legitimacy, and reputation, making it easier for them to access external resources.

The fourth critical juncture identified by our founders is sustainability. They emphasized the management team's inability to attract further finding, the lack of growth ambitions, and the lack of an exit strategy. High-tech spin-offs face a long period of development before the market adopts products based upon their new technologyFounders hope that links to businesspeople, industry networks, and venture capitalists will help these start-up to reach the market more quickly (Table 4.2).

Chapter 5:

The impact of facilitators on intention of academic spin-offs to stay in the region of the parent university

Finally, the research focus shifts to the academic spin-off's location and the role of the university in stimulating spin-offs to stay in the region of the parent university. While the general efficiency of attracting academic spin-offs close to the parent university is well documented, we know relatively little about the corresponding efficiency of the university region and the facilitators and their effect on the founders' intention to stay in this location. Academic spin-offs might not stay in their initial location in the area of university and might decide to relocateThe studies on the location choice of academic spin-offs (Audretsch and Stephan, 1996; Egeln et al., 2004b; Zucker et al., 1998b) have predominantly focused on the initial location choice. Relatively little is known about the factors that influence spin-offs to remain close to the parent university. Therefore, Chapter 5 aims to provide empirical insights into the motives of academic spin-offs to stay in the region. Furthermore, the research may contribute to the debate about what regional characteristics attract spin-off founders (Weterings and Knoben, 2013). The objective of Chapter 5 is to study the role of the university and facilitator support in inducing spin-offs to stay in the region of the parent university by addressing the following question:

Research question 4 (Chapter 5): *To what extent can facilitators stimulate high-tech academic spin-offs to stay in the region of the parent university?*

To answer this research question, we conducted an ordered probit regression-analysis on a sample of 70 Dutch high-tech academic spin-offs. The survey was administered among firm founders and investigated whether these founders intended to continue to stay in the region of the parent university and whether this decision was influenced by the level of perceived support provided by the parent university, the intensity of collaboration of their spin-offs with the university and other start-ups in the same region.

Prompted mainly by the resource-based view and regional cluster development, we argue that the level of university support, the benefits from knowledge spillovers, and the positive image of

being located on or near the university campus have a positive effect on the decision of the spin-off to continue to stay in the region of the parent university. The empirical research indicates that both business support and knowledge spillovers emanating from nearby located firms explain a large part of the variance of the spin-off's location intention. Along the same lines, firm founders that value the signaling effect of being located on campus are more likely to stay in the region. Interestingly, infrastructural support has only limited effect on the founders' intentions.

6.2 Discussion and main conclusions

The overview of our main conclusions is presented in Section 6.2.1. From an academic perspective, Section 6.2.2 discusses our theoretical contributions to absorptive capacity and entrepreneurship literature in light of the resource-based view and its extension. Section 6.2.3 acknowledges the main limitations of the present research and outlines future perspectives.

*6.2.1 Main conclusion*s

This manuscript offers new insights on the growth of academic spin-offs and examines both the internal factors (entrepreneurial characteristics, domain specific experience, and absorptive capacity) and the external factors (facilitator support, stay in region) that foster growth. The study emphasizes the importance of a well-balanced management team in developing essential capabilities, and the importance of facilitator support to overcome growth critical junctures.

In Part 1 (Chapters 2 and 3 on the management team), this manuscript provides evidence of the critical importance of entrepreneurial orientation (Walter et al., 2006) and entrepreneurial team-efficacy (Arnold et al., 2001) in developing absorptive capacity. Realized absorptive capacity is of importance as knowledge is transformed and exploited to promote spin-off growth. The entrepreneurial orientation of the management team is considered critical for both PAC and RAC. As such, Chapter 3 shows that absorptive capacity is the missing link. In other words, AC fully mediates the relationship between entrepreneurial orientation and opportunity identification and pursuit (see Covin and Lumpkin, 2011). In particular, in the growth phases of academic spin-offs, firms experience high environmental turbulence. Developing a high level of potential absorptive capacity (PAC) within the management team is considered critical for survival; it involves frequently scanning the environment for opportunities and new (sources of) technologies, and collecting in-depth industry information about technology trends and changing market demands. A clear entrepreneurial orientation is required, focused on technological leadership, with a strong proclivity for high-risk projects. Critical success factors in the later growth phases include a high level of realized absorptive capacity with a strong customer focus, a clear division of roles and responsibilities within the management team, combined with a high level of entrepreneurial orientation, a high level of management team efficacy, and a can-do mentality based upon a balanced competence profile.

In Part 2 (Chapters 4 and 5 on facilitator support), the manuscript examines facilitator support and how this is valued during the growth phases of the spin-off firm. We examined different types of support (infrastructure, finance, network, business, and legal support) (Fetters et al., 2010), four critical junctures (Vohora et al., 2004), and the role of various facilitators. Prior research has predominantly focused on individual facilitators. We found that academic spin-off founders highly appreciate the full set of support only in their first growth phase (to navigate the opportunity recognition juncture). Business, financial and legal support are important to

overcome critical junctures (the entrepreneurial commitment juncture, and the credibility juncture) related to the next two growth phases. However, only network support is considered important to overcome each of the four critical junctures. We can conclude that university facilitators and incubators are important for spin-off growth, but that at some point around growth phase 3, they should step back, because the spin-off has to bridge the gap between the university and the business world itself. This is in line with earlier research by Scholten et al. (2015) who found that research experience has a positive effect on spin-off growth, especially when it bridges to other business networks.

Finally, on a topic of regional cluster development, we found that the spin-off's intention to stay in the region is strongly related to the business support provided by facilitators (in particular TTOs and incubators), and to the reputation of the region of the university. In strong contrast, infrastructural support is negatively related to advancing a cluster, assumed to benefit from spin-offs staying in the region. Indeed, technical universities complain that the most successful spin-offs leave the region, making investments in facilitators, such as incubators, less profitable. We conclude that, in the later stages of development, spin-off founders appreciate affiliation with the university because it creates credibility, legitimacy, reputation, and access to networks, but moreover, supported by evidence in different chapters, they appreciate business support to help the spin-off reach markets. This study thereby contributes to the debate about what kind of regional characteristics are actually beneficial for, and therefore preferred by founders of academic spin-off (Weterings and Knoben, 2013).

6.2.2 Academic contributions

In this section, we provide a synthesis of academic contributions of our four findings in Chapters 2-5.

Internal factors

The manuscript addresses one of the key factors affecting the growth of academic spin-offs: dynamic capabilities of AC. It emphasizes the responsibility of the management team to develop AC capabilities. Expanding previous research on the effect of prior knowledge, Chapter 2 provides evidence that besides domain specific research experience, which most spin-offs teams possess, domain specific industry experience is required to better assimilate and exploit external knowledge. The importance of a well-balanced management team is also presented in Chapter 4, which is one the main challenges that spin-offs have in their growth stages. Chapter 2 and 3 distinguishes between PAC and RAC to better understand the AC capabilities function. The influence of domain specific experience and entrepreneurial characteristics on both dimensions of PAC and RAC are illustrated in Chapter 4. Chapter 2 shows that the management team must have entrepreneurial characteristics such as entrepreneurial orientation and entrepreneurial self-efficacy. In particular, Chapter 2 provides evidence that EO has a high significant effect on both PAC and RAC. Chapter 3 follows this point and studies the relationship between EO, AC and identification and pursuit as the growth indicator.

Chapter 4 studies the growth stages of academic spin-offs and proposes that opportunity identification and pursuit during the first growth stage needs greater attention in the study of academic spin-offs. Besides, it focus on both EO and AC since academic spin-offs operate in turbulent markets facing difficulties in opportunity recognition due to a lack of EO (Iacobucci et

al., 2011) and AC (Vohora et al., 2004). Interestingly EO does not have a direct effect on opportunity identification and pursuit in our model, but has an effect through AC. Chapter 4 shows that AC is the missing link between EO and AC. Distinguishing between PAC and RAC, Chapter 3 shows that EO influences opportunity recognition first through PAC and then RAC.

External factors

The manuscript addresses the role of facilitators in developing the capabilities of academic spin-offs. The study finds evidence that spin-off founder perceive facilitator support critical mainly in the growth stages. Therefore, the spin-offs growth is highly dependent on the facilitator's support. Facilitators provide critical support that help spin-offs to develop their capability to navigate their critical growth junctures. The main support activities are discussed in Chapter 4 and are mostly related to providing external knowledge and information. Chapter 4 shows that support in business plan development, seed funding, and access to networks are crucial for overcoming the critical junctures of opportunity recognition and entrepreneurial commitment. During the credibility and sustainability junctures, facilitators act more as intermediaries, linking spin-offs to venture capitalists and experienced entrepreneurs to develop expertise and expand the spin-off's network. We found that some support activities are appreciated more by spin-offs founders than by facilitators. For example, spin-off founders appreciate business plan development, network support, and seed funding more than expected by facilitators.

Chapter 5 discusses the support activities that induce founders to stay in the region. However, interestingly, the tangible support that was perceived critical in the growth stages of academic spin-offs, was not considered important to keep them in the region of the parent university. Business support, connections with other start-ups, and university signaling were the most important factors inducing spin-offs to stay in the region of the parent university. This improves our understanding of the role that universities play in facilitating the transmission of knowledge both through the universities themselves and through the connections that they make among their spin-offs. The findings show that spin-offs seem to benefit more from other start-ups in the region than from the university itself.

6.2.3 Limitations and directions for further research

While acknowledging scientific contributions of the present manuscript, our study also has its limitations. The main limitation of this study is caused by the characteristics of data collected for our empirical analysis: (1) data collected from single respondents in the firm and (2) subjective perceptual data.

Although the data is self-reported, previous studies show that founder-reported measures can be considered reliable (Brush and Vanderwerf, 1992), especially in cases when questions are asked about simple facts and events, as is the case in our study. We asked the founders about prior experience and entrepreneurial activities, rather than about past opinions or beliefs (Golden, 1992). Therefore, using data from single respondents in the firm is a common practice in entrepreneurial research on start-up teams (Walter et al., 2006).

Although subjective perceptual data are of great value, they are associated with a number of limitations discussed by both economists and psychologists. Example of these limitations are (1) common method bias that induces artificial covariance between the items because they are

collected from the same source with the same method; (2) respondents characteristics such as memories and perceptions affecting the response style such as the tendency to perceive things negatively or to agree irrespective of the content; (3) social desirability due to respondents' willingness to create a positive image of themselves or of their firm; (4) item and scale characteristic such as common scale format; (5) the context in which the items are presented and measured (Podsakoff et al., 2003; Podsakoff et al., 2012).

However, to overcome these limitations, follow-up studies should realize that objective data also have many drawbacks. When measuring AC, many studies rely on its proxy such as R&D intensity, expertise of employees (Escribano et al., 2009; Grimpe and Sofka, 2009), or number of patents (Nooteboom et al., 2007), etc. These proxies are widely disputed because of ignorance of AC multidimensionality (Flatten et al., 2011). Following existing literature (Jansen et al. 2005, Schleimer and Pedersen, 2013; Zahra et al. 2007), we measured four capabilities of AC: acquisition, assimilation, transformation and exploitation capabilities.

Future research may benefit from conducting interviews with more than one informant in each spin-off (Pettersen and Tobiassen, 2012). Furthermore, our data are mostly cross-sectional. Future longitudinal studies could further deepen the causal relationships between the various constructs. In particular, related to Chapter 4, future research can study different antecedents of AC, which are relevant for the context of academic spin-offs. For instance the network of advisors, coaches, and facilitators that may help them to better understand and absorb external knowledge. Future work could examine the effect of AC on the relationship between EO and financial performance, and could research this among low and medium tech spin-offs as well.

In addition, the findings presented in Chapter 4 should be regarded with some caution. Since the findings are based on three high-tech universities only with nine cases, further research based on a larger number of cases will be needed. The aim of the research was not, however, to provide generalizable results, but to gain a better understanding of the barriers that spins-off face, the growth stages they go through, and the key actors involved by using a qualitative approach, for a certain group of less-studied firms, namely academic spin-offs.

Future research could examine how other factors such as individual preferences (Figueiredo et al. 2002), firm characteristics, or location characteristics (Van Dijk and Pellenbarg 2000) influence a spin-off's location intention.

6.3 Implications

The aim of this manuscript is to increase our understanding of how academic spin-offs address growth challenges. Our findings can assist young spin-offs founders to develop their management team capabilities. Our results can also guide university facilitators to optimize their support activities toward such start-ups. Policymakers can increase their insight into how to create successful academic spin-offs and how to keep them in the region of the university.

6.3.1 Implications for managers

The findings of this manuscript illustrate that the development of academic spin-offs requires management teams to develop their capabilities. Our findings show that besides academic and research experience, management teams have to seek and acquire new knowledge and

technology, and that industry experience is needed to select information with commercial potential and to exploit technology and knowledge for commercial purposes. Therefore, a well-balanced management team with experience to better absorb and utilize the external knowledge is essential

Our findings also indicate that academic entrepreneurs need to have high EO, willing to take risks, and to be proactive and innovative during the process of absorbing knowledge. Management teams must be confident in their entrepreneurial activities, in particular, related to product commercialization such as writing a formal business plan and raising money to start a business. Better understanding the role of EO and team-efficacy may help spin-off founders to recruit new staff in order to increase absorptive capacity. Venture capitalists and other investors should analyze the experience of their management team, but should also assess their team's entrepreneurial characteristics such as EO and team-efficacy before making an investment decision.

We listed a number of challenges that academic spin-offs could encounter during their development process. Acknowledging that these barriers exist, and that support is available to help them to navigate the barriers will help entrepreneurs to foster their growth. Spin-off entrepreneurs should be aware of the constraints and resources related to the university context to take advantage of their company being a university venture.

6.3.2 Implications for university facilitators and policymakers

This manuscript can be used by universities and policymakers. Chapters 4 and 5 discuss the relevance of our findings for the entrepreneurial university as well as for policymakers who seek to facilitate technology transfer and subsequent economic growth via academic spin-offs. In particular, they contribute to a better understanding of how the entrepreneurial university can act as a conduit for knowledge transfer that can lead to economic prosperity.

The findings from Chapters 4 suggest that university capabilities and support need to be adapted to the unique processes that academic spin-off go through. University facilitators must be more aware of which critical support activities are most valued by spin-offs founders. In growth stages, the founders appreciate more direct involvement of facilitators, whereas in later stages, facilitators should adopt an intermediary role by linking spin-offs to venture capitalists and external entrepreneurs to strengthen the team's expertise and networks. Before designing (redesigning) a support program, the growth stages and associated critical junctures need to be clarified to be able to target support and resources effectively.

The Chapter 5 suggests that universities and policymakers that aim at contributing to local and regional economic growth should pay attention to the characteristics that induce spin-offs to stay in a region. Therefore, our findings may be relevant to the ongoing debate about policies designed for entrepreneurial universities to act as local growth engines. Our results in Chapter 5 show that access to the knowledge and information available at other start-ups in the region and the university reputation are beneficial to start-ups and may induce them to stay in the region of university. Stimulating links between spin-offs and other start-ups in the region may develop trust and loyalty, thus facilitating the local commercialization of academic knowledge and resources.

Summary

Summary

The postulations “entrepreneurship is primarily a regional event” from Feldman (2001) and "entrepreneurial university" by Etzkowitz (2004) have increased recognition of universities in stimulating regional economic development (Boucher et al., 2003; Sternberg, 2009, 2014). Universities are nurturing localized spillover benefits, through establishing and supporting academic spin-offs (Boucher et al., 2003). Academic spin-offs are the subject of this manuscript. They are defined as new start-up firms that commercially exploit research developed within an academic environment to the benefit of economic, social, and regional development (Pirnay et al. 2003; Steffensen et al., 2000). However, academic spin-offs might face difficulties in translating their initial idea to a business opportunity due to the lack of dynamic capabilities (Bjørnåli and Gulbrandsen, 2010; Rasmussen et al., 2011; Vohora et al., 2004) as well as an absence of an entrepreneurial orientation (Iacobucci et al., 2011). Academic spin-offs can overcome these challenges by enhancing their absorptive capacity and by taking advantage of the guidance and resources provided by supporting organizations. As a consequence, the research objective of the present manuscript is:

- *To analyze how academic spin-offs address the challenge of opportunity identification and pursuit by building their absorptive capacity and by receiving facilitator support.*

This manuscript has two parts in which the research objective is addressed through different theoretical perspectives, this is mainly done through the theoretical lens of the resource-based view, its related knowledge-based view and dynamic capability perspective (Acedo et al., 2006) and combined with theories regarding entrepreneurship and regional clusters.

Part 1 The management team’s absorptive capacity

Chapter 2 and 3 contribute to the research objective by investigating how academic spin-offs can build their absorptive capacity (AC) to recognize new opportunities. Within the context of academic spin-offs, management teams are responsible for building firm dynamic capabilities (Sirmon et al 2007; Holcomb et al., 2009). Studies on AC have mainly addressed the required skills and experience of organizational members, and have largely neglected the motivation and willingness these members may have (Minbaeva et al., 2003; Volberda et al., 2010). Therefore, Part 1 focuses not only on the knowledge-based view and the dynamic capability view but also on entrepreneurship theory, to study how spin-offs teams perceive external knowledge as opportunities. It addresses the following main research question:

Main research question of part 1*: What is the impact of the absorptive capacity and entrepreneurial orientation of the management team of high-tech academic spin-offs on the identification and pursuit of opportunities?*

Chapters 2 and 3 contribute to answering this question. Chapter 2 examines the AC antecedents by focusing on the domain specific experience and entrepreneurial characteristics of the management team. Chapter 3 focuses on the role of AC on the performance of the spin-off, in particular, the ability to identify and pursue opportunities.

Chapter 2:

The management team's entrepreneurial characteristics and prior experience as antecedents of absorptive capacity

Chapter 2 studies the management team characteristics such as prior knowledge, entrepreneurial orientation, and team-efficacy and their effect on AC. Entrepreneurship literature has focused on domain specific research and industry experience as drivers of AC (Agarwal et al., 2004; Kor, 2003; Shane and Venkataraman, 2000). Other studies argue that the extent to which a start-up is successful at exploiting new innovations is also dependent on their entrepreneurial orientation (Walter et al., 2006) and on entrepreneurial team-efficacy (Arnold et al., 2001; Baum and Bird, 2010; Drnovajek et al., 2010). We therefore combine these streams of literature by proposing the following research question:

Research question 1: *To what extent do domain specific industry and research experience (RQ 1a) and entrepreneurial characteristics i.e., entrepreneurial orientation and team-efficacy (RQ 1b) of the management team of high-tech academic spin-offs lead to a higher absorptive capacity of the management team?*

To answer this research question, we conducted a multiple regression-analysis on a sample of 95 Dutch high-tech academic spin-offs in the Netherlands in the period December 2011 through March 2012. We performed a hierarchical regression analysis in STATA to assess the effects of the various antecedents on AC. Chapter 2 confirms the relevancy of prior experience as an antecedent of AC (Argote et al., 2003; Cohen and Levinthal, 1990; Van Den Bosch et al., 1999). This research distinguishes the effects of domain specific research and industry experience on the two dimensions of potential and realized absorptive capacity (PAC and RAC).

Next, in line with the literature on managerial ability in start-ups (Holcomb et al., 2009), we conclude that team characteristics have a critical role in building AC. Findings show that domain specific research experience is a predictor for both PAC and RAC, while domain specific industry experience is only a predictor for realized AC. Lazaric et al., (2008) explains that the passage from PAC to RAC is not only a period that goes beyond a simple discovery of knowledge base, but is also a stage when the management team can benefit from competencies related to their work experience in a specific industry. In other words, while specific research experience is relevant for the discovery and exploration of entrepreneurial opportunities, something more than excellent science is needed for exploitation (Este et al., 2012). Interestingly, Chapter 2 provides new insights into the role of team entrepreneurial orientation and team-efficacy in developing AC in high-tech academic spin-offs. In the related full models, the results suggest support for team entrepreneurial antecedents on both dimensions of PAC and RAC. Entrepreneurial orientation (EO) (Covin and Slevin, 1990) is positively related to PAC, and the team confidence and motivation, translated in entrepreneurial team-efficacy (Hmieleski and Baron, 2008), is positively related to RAC. This confirms the studies that appreciate the effect of team motivation and confidence on RAC (Liao et al., 2007). Chapter 2 suggests that the management team must have entrepreneurial characteristics such as entrepreneurial orientation and entrepreneurial self-efficacy.

Chapter 3:

The impact of the management team's absorptive capacity on opportunity identification and pursuit

Chapter 3 expands the study to entrepreneurial activity that involves the identification and pursuit of opportunities. We call this spin-off performance (Shane and Venkataraman, 2000). Previous studies have demonstrated that the ability to recognize opportunities is not only dependent on internal knowledge (Shane, 2000), but also depends on the process of acquiring and transferring external knowledge (Corbett, 2007; Li et al., 2009). The process of opportunity identification and pursuit often requires entrepreneurs to recognize new external knowledge, assimilate it, and combine it with their existing knowledge in order to exploit it commercially (Zahra and George, 2002). This AC provides entrepreneurs with access to new knowledge (Engelen et al., 2014; Rothaermel and Alexandre, 2009), which increases the number and quality of opportunities that entrepreneurial firms can pursue (Engelen et al., 2014). EO also helps firms to look for information that better meets the needs of their customers, to cope with risk, to deal with competitors (Keh et al., 2007), and EO facilitates the reconfiguration of skills and talents (Jantunen et al., 2005; Wang, 2008). Hence, Chapter 3 argues that both EO and AC lead to higher opportunity identification and pursuit, and proposes that AC is a missing link and mediating variable between EO and spin-off performance (cf. Covin and Lumpkin, 2011). Therefore, we propose the following research question for Chapter 3:

Research question 2: *To what extent do the (potential and realized) absorptive capacity and entrepreneurial orientation of the management team positively impact the opportunity identification and pursuit capabilities of the high-tech academic spin-off?*

We answered the question by testing our hypotheses and conducting a survey, resulting in a sample of 95 high-tech academic spin-offs in the Netherlands. The data analysis follows a two-step procedure: assessing measurement models (using exploratory factor analysis), followed by structural modeling using a nonparametric approach, namely the partial least squares (PLS) approach (Chin, 1998) with software package SmartPLS 2.0 (Ringle et al., 2010).

Our empirical study provides evidence of the mechanism that enables academic spin-offs to benefit from EO. AC fully mediates the relationship between EO and opportunity identification and pursuit. In other words, EO can only be effective if spin-offs can develop the ability to absorb external knowledge and combine it with their internal knowledge. AC enables spin-offs to develop new competencies to better respond to changes in the business environment. As a company-level strategic posture, EO motivates a company to identify business opportunities, and AC combines external and internal knowledge and converts it into valuable opportunities. We found that PAC has a strong influence on RAC, and that RAC has a positive relationship with opportunity identification and pursuit. This finding can be explained, as 'Potential' entails making an inventory of the stock of knowledge and analyze it, as a preliminary stage for subsequent knowledge integration (Corbett, 2005). RAC involves assessing ideas and testing initial feasibility, related to part of opportunity identification and pursuit. The mediation effect is in line with Leal-Rodríguez et al. (2013) who argue that higher levels of PAC lead to increased RAC, and may improve performance. In other words, a high capacity of knowledge acquisition and assimilation is related to higher opportunity recognition via RAC.

Part 2 Facilitator support

The second part of the manuscript aims to explore the role of various facilitators in fostering academic spin-off growth and to examine how the region of parent university and facilitators influence the spin-off's intention to stay in the region.

Main research question of part 2*: How can facilitators assist the growth of high-tech academic spin-offs and develop and maintain a high-tech regional cluster?*

Chapters 4 and 5 contribute to answering the main question of the second part of the manuscript. By focusing on the stage-gate model, resource-based view, the dynamic capabilities view, and regional cluster literature, the second part of the thesis aims to study the parent university support in fostering spin-off growth, and to identify the regional characteristics that induce spin-off founders to remain located in the vicinity of the university region.

Chapter 4:

Key support activities of facilitators to navigate critical junctures

The role and efficiency of facilitators in supporting spin-offs to overcome the barriers during their growth phases needs further investigation (Wright et al., 2012). Chapter 4 examines how academic spin-offs can benefit from facilitator support in navigating the critical junctures they face during their development process. It also addresses the theoretical gap of how the initial resources for a new venture are assembled (Ahuja and Katila, 2004) and synchronized through the support of university facilitators (Wright et al., 2012). We use the stage-gate model theory to structure the challenges and related critical junctures across time (Vohora et al., 2004) by addressing the following research question:

Research question 3: *What are the main critical junctures in the growth path of high-tech academic spin-offs (RQ 3a)? And in which ways can facilitators support academic spin-offs to overcome these critical junctures (RQ 3b)?*

To answer the research question, we draw data from academic spin-offs related to one of three large technical university campuses in the Netherlands: Eindhoven University of Technology (TUE), Wageningen University and Research Center (WUR), and Delft University of Technology (TUD). More specifically, we conducted in-depth interviews with 18 spin-off facilitators and nine spin-off founders.

Chapter 4 examines facilitator support and how this is valued during the growth phases of the spin-off firm. We examined different types of support,e.g. infrastructure, finance, network, business, and legal support (Fetters et al., 2010), four critical junctures (Vohora et al., 2004), and the role of various facilitators. It shows that support in business plan development, seed funding, and network contacts are crucial for overcoming the critical junctures of opportunity recognition and entrepreneurial commitment. During the credibility and sustainability junctures, facilitators function more as intermediaries, linking spin-offs to venture capitalists and experienced entrepreneurs to develop expertise and expand the spin-off's network. Spin-off founders appreciate some support, such as business plan development, network support, and seed funding, more than expected by facilitators.

Prior research has predominantly focused on individual facilitators. We found that academic spin-off founders highly appreciate the full set of support only in their first growth phase (to navigate the opportunity recognition juncture). Business, financial and legal support are important to overcome critical junctures (the entrepreneurial commitment juncture, and the credibility juncture) related to the next two growth phases. However, only network support is considered important to overcome each of the four critical junctures. We can conclude that university facilitators and incubators are important for spin-off growth, but that at some point around growth phase 3, they should step back, because the spin-off has to bridge the gap between the university and the business world itself.

Chapter 5:

The impact of facilitators on the intention of academic spin-offs to stay in the region of the parent university

Finally, the research focus shifts to the academic spin-off's location and the role of the university in stimulating spin-offs to stay in the region of the parent university. While the general efficiency of attracting academic spin-offs close to the parent university is well documented, we know relatively little about the corresponding efficiency of the university region and the facilitators and their effect on the founders' intention to stay in this location. Academic spin-offs might not stay in their initial location in the area of university and might decide to relocateThe studies on the location choice of academic spin-offs (Audretsch and Stephan, 1996; Egeln et al., 2004b; Zucker et al., 1998b) have predominantly focused on the initial location choice. Relatively little is known about the factors that influence spin-offs to remain close to the parent university. Therefore, Chapter 5 aims to provide empirical insights into the motives of academic spin-offs to stay in the region and analyzes the role of the university and facilitator support in inducing spin-offs to stay in the region of the parent university by addressing the following question:

Research question 4: *To what extent can facilitators stimulate high-tech academic spin-offs to stay in the region of the parent university?*

To answer this research question, we conducted an ordered probit regression-analysis on a sample of 70 Dutch high-tech academic spin-offs. The survey was administered among firm founders and investigated whether these founders intended to continue to stay in the region of the parent university and whether this decision was influenced by the level of perceived support provided by the parent university, the intensity of collaboration of their spin-offs with the university and other start-ups in the same region.

Finally, on the topic of regional cluster development, we found that the spin-off's intention to stay in the region is strongly related to the business support provided by facilitators (in particular TTOs and incubators), and to the reputation of the region of the university. In strong contrast, infrastructural support is negatively related to advancing a cluster, assumed to benefit from spin-offs staying in the region. Indeed, technical universities complain that the most successful spin-offs leave the region, making investments in facilitators, such as incubators, less profitable. We conclude that, in the later stages of development, spin-off founders appreciate affiliation with the university because it creates credibility, legitimacy, reputation and access to networks, but moreover, supported by evidence in different chapters, they appreciate business support to help

the spin-off reach markets. This study thereby contributes to the debate about what kind of regional characteristics are actually beneficial for, and therefore preferred by founders of academic spin-off (Weterings and Knoben, 2013).

Overall, this research shows clear differences between critical success factors in the early versus the later growth phases of academic spin-offs. Initially, evidence was found that spin-off growth is not directly dependent on domain specific experience and entrepreneurial characteristics, but requires absorptive capacity to become productive. Absorptive capacity fully mediates the relationship between the management team, especially their entrepreneurial orientation, and opportunity identification and pursuit. Subsequently, it was found that during the different growth phases, founders appreciate different types of facilitator support to overcome different critical junctures, next to the ongoing appreciation for network support. Facilitators are advised to change, and even reduce, their support over the different growth phases, as the (later) spin-off intention to stay in the university-region is negatively influenced by infrastructural support and positively impacted by university affiliation and business support to help the spin-off reach markets.

Samenvatting

De stelling dat "ondernemerschap voornamelijk regionaal gericht is" (Feldman, 2001), en het labellen van de ondernemende universiteit (Etzkowitz, 2004) indiceren de rol die universiteiten spelen in het stimuleren van regionale economische ontwikkeling (Boucher et al., 2003; Sternberg, 2009, 2014). Universiteiten stimuleren lokale externe effecten of *spillovers* door middel van het vestigen en ondersteunen van academische spin-offs (Boucher et al., 2003). Academische spin-offs zijn het onderwerp van dit boek. Deze zijn gedefinieerd als nieuwe start-up bedrijven die academisch onderzoek commercieel gebruiken, ten gunste van economische, sociale, en regionale ontwikkeling (Pirnay et al. 2003; Steffensen et al., 2000). Echter, door het ontbreken van dynamische vaardigheden, *dynamic capabilities* (Bjørnåli en Gulbrandsen, 2010; Rasmussen et al., 2011; Vohora et al., 2004) alsook matige ondernemerschapsoriëntatie (Iacobucci et al., 2011) moeten academische spin-offs hindernissen trotseren die gekoppeld zijn aan het vertalen van een origineel idee naar zakelijke kansen. Academische spin-offs kunnen deze uitdagingen overwinnen door hun absorberend vermogen (*absorptive capacity*, hierna: AC) te vergroten, geholpen door ondersteunende organisaties.

Het onderzoeksdoel van dit boek:

- Het analyseren van de wijze waarop academische spin-offs omgaan met de uitdagingen verbonden aan het identificeren en nastreven van kansen, door middel van het vergroten van hun *absorptive capacity* en geholpen worden door ondersteunende organisaties.

Dit boek is opgedeeld in twee delen waarin het onderzoeksdoel geadresseerd wordt op basis van verschillende theoretische perspectieven, voornamelijk door de theoretische lens van de *resource-based view*, en het hieraan gerelateerde kennis-gebaseerde perspectief (Acedo et al., 2006), gecombineerd met theorieen over ondernemerschap en regionale clusters.

Deel 1 De *absorptive capacity* van het management team

Hoofdstukken 2 en 3 dragen bij aan het onderzoeksdoel door te onderzoeken hoe academische spin-offs hun AC kunnen vergroten om zo nieuwe kansen te kunnen herkennen. Binnen de context van academische spin-offs is het management teams (MT) verantwoordelijk voor het bouwen van vaardigheden (Sirmon et al 2007; Holcomb et al., 2009). Tot nu toe hebben AC studies zich voornamelijk gericht op de benodigde ervaringen en vaardigheden van de MT-leden, zonder (diepgravend) in te gaan op de motivatie van deze leden (Minbaeva et al., 2003; Volberda et al., 2010). Derhalve is het doel van Deel 1 het bestuderen hoe spin-off MT kennis van buitenaf gebruiken om kansen te herkennen. Hiervoor wordt de volgende hoofdonderzoeksvraag gesteld:

***Hoofdonderzoeksvraag van deel 1**:* Wat is de invloed van het *absorptive capacity* en de ondernemingsoriëntatie van het MT van high-tech academische spin-offs op het identificeren en nastreven van kansen?

Hoofstukken 2 en 3 beantwoorden deze vraag. Hoofstuk 2 bestudeert de AC antecedenten door zich te richten op de domein specifieke ervaring en de ondernemings-karakteristieken van het MT. Hoofdstuk 3 bestudeert de rol van de AC op de prestatie van de spin-off, meer specifiek op de mogelijkheid van het identificeren en nastreven van kansen.

Hoofdstuk 2:
Ondernemings-karakteristieken en eerdere ervaring van het management team als

antecedenten van** absorptive capacity**.
Hoofdstuk 2 bestudeert karakteristieken van het MT, zoals aanwezige kennis, ondernemingsoriëntatie en MT-gebonden effectiviteit, en hun effect op AC. Literatuur over ondernemerschap heeft zich voornamelijk gericht op domein specifieke onderzoekservaring en de ervaring binnen de sector (Agarwal et al., 2004; Kor, 2003; Shane en Venkataraman, 2000). Andere studies argumenteren dat de mate waarin een start-up succesvol zal zijn in het exploiteren van nieuwe innovaties afhankelijk is van hun ondernemingsoriëntatie (EO) (Walter et al., 2006) en de effectiviteit van het management team (Arnold et al., 2001; Baum en Bird, 2010; Drnovajek et al., 2010). Om beide stromingen binnen de literatuur te combineren stellen we de volgende onderzoeksvraag:

Onderzoeksvraag 1: In welke mate leiden domein specifieke sector en onderzoekservaring (RQ 1a) en de ondernemings-karakteristieken, met name ondernemingsoriëntatie en effectiviteit van het management team (RQ 1b), tot een hoger *absorptive capacity* van het management team?

Om deze vraag te beantwoorden hebben we op basis van informatie, verzameld in de periode december 2011 tot en met maart 2012, van 95 high-tech academische spin-offs die in Nederland waren gevestigd, een meervoudige hiërarchische regressie analyse in STATA uitgevoerd om het effect te beoordelen van verschillende antecedenten op AC. Hoofdstuk 2 bevestigt de relevantie van aanwezige kennis van het MT als een antecedent van AC (Argote et al., 2003; Cohen en Levinthal, 1990; Van Den Bosch et al., 1999). Het hoofdstuk verbreedt dat onderzoek door de effecten van domein specifiek onderzoek en ervaring binnen de sector op te splitsen in twee dimensies: potentieel en gerealiseerd *absorptive capacity* (PAC en RAC).

In lijn met de literatuur over managementcapaciteiten binnen start-ups (Holcomb et al., 2009), hebben we geconcludeerd dat team specifieke karakteristieken een belangrijke rol spelen in het opbouwen van AC. Conform onze theoretische verwachtingen, tonen de onderzoeksresultaten aan dat domein specifieke onderzoekservaring een voorspeller is voor zowel PAC als RAC, terwijl domein specifieke sector ervaring alleen een voorspeller is voor gerealiseerde AC. Lazaric et al. (2008) legt uit dat de overgang van PAC naar RAC verder gaat dan simpelweg de opbouw van een kennis-basis; dit is ook het stadium waarbinnen het MT profiteert van hun competenties die gerelateerd zijn aan hun werkervaring binnen een specifieke sector. Met andere woorden, ondanks dat specifieke onderzoekservaring relevant is voor de ontdekking van ondernemingskansen, is er meer dan excellente wetenschap nodig in de exploitatie van kansen (Este et al., 2012).

Hoofdstuk 2 biedt ook nieuwe inzichten in de rol van team EO en effectiviteit van het MT in het ontwikkelen van AC binnen high-tech academische spin-offs. De resultaten van de modellen suggereren het belang van team-gerelateerde ondernemingsantecedenten binnen zowel het PAC als het RAC domein. Ondernemingsoriëntatie (Covin en Slevin, 1990) is positief gerelateerd aan PAC, terwijl MT vertrouwen en motivatie, vertaald in MT gebonden effectiviteit (Hmieleski en Baron, 2008), gerelateerd is aan RAC. Dit bevestigt studies die het belang van team-motivatie en vertrouwen op RAC benadrukken (Liao et al., 2007).

Hoofdstuk 3:
De invloed van het** absorptive capacity **van het management team op het identificeren en nastreven van kansen.

Hoofdstuk 3 breidt het onderzoek uit naar ondernemerschapsactiviteiten die gericht zijn op het identificeren en nastreven van kansen. Dit noemen we het resultaat van het spin-off bedrijf (Shane en Venkataraman, 2000). Eerdere studies hebben laten zien dat de mogelijkheid tot het herkennen van kansen niet alleen afhankelijk is van bedrijfsinterne kennis (Shane, 2000), maar ook van de processen omtrent het verkrijgen en omzetten van externe kennis (Corbett, 2007; Li et al., 2009). Het proces rondom de identificatie en het nastreven van kansen vereist dat ondernemers nieuwe kennis herkennen, assimileren, en combineren met hun bestaande kennis, om deze commercieel te kunnen exploiteren (Zahra en George, 2002). Goede AC biedt ondernemers toegang tot nieuwe kennis (Engelen et al., 2014; Rothaermel en Alexandre, 2009), hetgeen zowel de kwaliteit als de kwantiteit van de kansen die ondernemingen kunnen nastreven vergroot (Engelen et al., 2014). EO helpt bedrijven die informatie te zoeken die kan helpen om tot oplossingen te komen die de behoeften van hun klanten vervullen, en kan helpen om te gaan met risico's en concurrenten (Keh et al., 2007), EO kan bovendien de omvorming van vaardigheden en talenten ondersteunen (Jantunen et al., 2005; Wang, 2008). Zodoende stelt Hoofdstuk 3 dat zowel EO als AC tot een toename in de identificatie en het nastreven van kansen kan leiden, en dat AC een mediërende variabel is tussen EO en het resultaat van de spin-off (cf. Covin en Lumpkin, 2011). Hieruit volgt de volgende onderzoeksvraag voor Hoofdstuk 3:

Onderzoeksvraag 2: *In welke mate hebben (potentieel en gerealiseerd) absorptive capacity van het management team een positieve invloed op de identificatie en het nastreven van kansen van high-tech academische spin-offs?*

Deze vraag hebben we beantwoord door middel van het testen van onze hypotheses, middels het uitzetten van een enquête, hetgeen resulteerde in een sample van 95 high-tech academische spin-offs in Nederland. De data-analyse volgt een twee-stappen procedure: beoordelen van het meetmodel (door middel van factor analyse), gevolgd door structurele modellering door middel van een niet-parametrische aanpak, namelijk de *Partial Least Squares* (PLS) (Chin, 1998) met SmartPLS 2.0 software (Ringle et al., 2010).

Onze empirische studie geeft bewijs voor de mechanismen die academische spin-offs in staat stellen om profijt te trekken uit EO. AC blijkt de intermediërende factor te zijn tussen EO en het identificeren en nastreven van kansen. In andere woorden, EO kan alleen effectief zijn als spin-offs de vaardigheid ontwikkelen om externe kennis te absorberen, en deze weten te combineren met hun eigen kennis. AC stelt spin-offs in staat om nieuwe competenties te ontwikkelen zodat ze beter kunnen reageren op veranderingen in de bedrijfsomgeving. EO motiveert een bedrijf om bedrijfskansen te identificeren, terwijl AC de interne en externe kennis combineert en omzet in waardevolle kansen. We vonden dat RAC sterk beïnvloedt wordt door PAC, en dat RAC een positieve relatie heeft met het identificeren en nastreven van kansen. Dit MT mediërend effect in AC ligt in lijn met de argumentatie van Leal-Rodríguez et al. (2013) dat een hoger niveau van PAC leidt tot een toename van RAC, en wellicht ook het bedrijfsresultaat kan verhogen. Met andere woorden, een hoog niveau van kennisacquisitie en kennisassimilatie is gerelateerd aan een toename in de herkenning en het nastreven van kansen via RAC.

Deel 2 Ondersteuning door facilitatoren

Het tweede gedeelte van dit boek is gericht op het verkennen van de rol van verschillende facilitatoren in het stimuleren van de groei van academische spin-offs, en het onderzoeken van de manier waarop de regio van de moeder-universiteit en de facilitatoren invloed hebben op de intentie van de spin-off om in de regio te blijven.

Hoofd onderzoeksvraag voor deel 2: *Hoe kunnen facilitatoren bijdragen aan de groei van high-tech academische spin-offs, en zo een high-tech regionaal cluster bevorderen?*

Hoofdstukken 4 en 5 dragen bij aan het beantwoorden van de hoofdvraag van het tweede deel van dit boek. Door de nadruk te leggen op het *stage-gate model*, de *resource-based view* en de literatuur over regionale clusters, richt het tweede deel van dit boek zich op het onderzoeken van de invloed van ondersteuning door de moeder-universiteit op de groei van de spin-off, en om de regionale karakteristieken te identificeren die spin-off oprichters aanzetten in de regiovan de universiteit te blijven.

Hoofdstuk 4:
Belangrijke ondersteunende activiteiten van facilitatoren in het overleven van kritieke groeifasen.
Er is meer onderzoek nodig naar de rol en effectiviteit van facilitatoren bij het steunen van spin-offs om de kritieke barrières tussen hun groeifasen te overleven (Wright et al., 2012). Hoofdstuk 4 bestudeert hoe academische spin-offs profijt kunnen hebben van ondersteuning bij het overleven van de kritieke groeifasen die ze tegenkomen in hun ontwikkelingsproces. We gebruiken het *stage-gate model* om structuur te geven aan de uitdagingen en de gerelateerde kritieke groeifasen die een nieuwe onderneming tegenkomt (Vohora et al., 2004) voor het beantwoorden van de volgende onderzoeksvraag:

Onderzoeksvraag 3: *Wat zijn de belangrijkste kritieke groeifasen in het groeiproces van high-tech academische spin-offs (RQ3a)? En op welke manieren kunnen facilitatoren academische spin-offs ondersteunen in het overleven van deze kritieke groeifasen (RQ 3b)?*

Om de onderzoeksvraag te beantwoorden hebben we data verzameld van academische spin-offs die gerelateerd zijn aan een van drie grote technische universiteitscampussen in Nederland: de TU's Eindhoven en Delft, en Wageningen UR. Deze data zijn verzameld via diepte-interviews met achttien facilitatoren en negen oprichters van spin-offs.

Hoofdstuk 4 bestudeert de steun van de facilitatoren en hoe deze wordt gewaardeerd door de oprichters tijdens de verschillende groeifasen van de spin-off onderneming. We hebben verschillende vormen van steun bestudeerd, namelijk infrastructurele, financiële, netwerk gerelateerde, en juridische ondersteuning (Fetters et al., 2010), hun effect op vier kritieke groeifasen (Vohora et al., 2004), en de rol van de verschillende facilitatoren daarbij. De uitkomsten tonen aan dat hulp bij het ontwikkelen van een ondernemingsplan, het financieren van het begin van het groeiproces, en de contacten met het netwerk van de facilitator, cruciaal zijn om kritieke groeifasen te overleven. Tijdens de kritieke groeifasen die te maken hebben met de geloofwaardigheid in de markt en de duurzaamheid van de spin-off functioneren facilitatoren vooral als tussenpersoon door het koppelen van spin-offs met *business angels* en ervaren ondernemers, om zodoende de expertise bij de spin-off te vergroten en hun netwerk uit te

breiden. Oprichters van de spin-off waarderen de hulp bij het opzetten van het ondernemingsplan, de uitbreiding van hun netwerk, en de financiering ervan, in grotere mate dan de facilitatoren verwachten.

Eerder onderzoek was voornamelijk gericht op facilitatoren. We hebben gevonden dat oprichters van academische spin-offs het zeer op prijs stellen om in de eerste groeifase op alle aspecten geholpen te worden. Ondernemingsgerichte, financiële-, en juridische ondersteuning zijn belangrijk voor het overleven van de volgende twee groeifasen. Alleen ondersteuning bij het opzetten van een netwerk wordt gezien als belangrijk voor alle vier de kritieke groeifasen. We kunnen concluderen dat universitaire facilitatoren en incubatoren belangrijk zijn voor de groei van spin-offs, maar dat zij rond fase 3 terug moeten treden omdat de spin-off zelf het gat moet overbruggen tussen de universitaire en de bedrijfswereld.

Hoofdstuk 5:
De invloed van facilitatoren op de intentie van academische spin-offs om in de regio te blijven waarbinnen de moeder-universiteit is gesitueerd.
Als laatste verschuift de aandacht van het onderzoek naar de locatie van de academische spin-off en de rol van de universiteit om te stimuleren dat de spin-off in dezelfde regio als de moeder-universiteit gesitueerd blijft. Ondanks dat de effectiviteit van het aantrekken van academische spin-offs binnen de omgeving van een moeder-universiteit goed gedocumenteerd is, is er weinig bekend over de invloed van de regio en de facilitatoren op de intentie van oprichters om in de regio te blijven. Onderzoek naar de locatie keuze van academische spin-offs richtte zich voornamelijk op de oorspronkelijke keuze voor de locatie na de oprichting (Audretsch en Stephan, 1996; Egeln et al., 2004b; Zucker et al., 1998b). Relatief weinig is bekend over de factoren die spin-offs beïnvloeden om dicht bij de moeder-universiteit gevestigd te blijven. Derhalve is hoofdstuk 5 bedoeld om empirisch inzicht te krijgen in de motieven van academische spin-offs om binnen de regio te blijven, en te analyseren welke rol de universiteit en de ondersteuning van facilitatoren spelen om spin-offs te stimuleren om binnen dezelfde regio gevestigd te blijven. Hiervoor stellen we de volgende onderzoeksvraagvoor Hoofdstuk 5:

Onderzoeksvraag 4: *In welke mate kunnen facilitatoren high-tech academische spin-offs stimuleren om in de regio van de moeder-universiteit te blijven?*

Om deze onderzoeksvraag te beantwoorden hebben we een *ordered probit regression* analyse uitgevoerd op 70 Nederlandse high-tech academische spin-offs. De gerelateerde enquête was gericht aan de oprichters van deze bedrijven, en onderzocht of deze oprichters van plan waren om in dezelfde regio te blijven en of deze keuze beïnvloed werd door de mate waarin ondersteuning werd ondervonden vanuit de moeder-universiteit.

We vonden dat de intentie van spin-offs om in de regio te blijven sterk gerelateerd is aan ondersteuning die geleverd wordt door facilitatoren, alsmede de reputatie van de regio van de universiteit. Infrastructurele hulp blijkt daarbij negatief gerelateerd aan het uitbouw van het regio-cluster, aangezien oprichters van si=pin-offs de aangeboden infrastructuur niet expliciet positief waarderen in hun intentie om binnen de regio te blijven. Daarmee samenhangend klagen Technische universiteiten dat succesvolle spin-offs de regio verlaten, hetgeen investeringen in facilitatoren en incubatoren minder lucratief maakt. We concluderen dat, in de latere fasen van ontwikkeling, oprichters van spin-offs met de universiteit de link waarderen omdat het reputatie,

en toegang tot netwerken levert, maar vooral ook stellen ze dat ze die ondersteuning waarderen die de spin-off helpt om potentiele klanten te bereiken.

Samengevat laat dit onderzoek zien dat er duidelijke verschillen zitten tussen de kritieke succesfactoren in de vroege groeifasen en de latere groeifasen van academische spin-offs. In het eerste deel van dit boek werd er bewijs gevonden dat aangaf dat groei van spin-offs niet direct afhankelijk is van domein specifieke ervaring en ondernemerskarakteristieken, maar dat vooral *absorptive capacity* nodig was om kansen te exploiteren. *Absorptive capacity* is de intermediërende factor in de relatie tussen ondernemingsoriëntatie van het MT en de identificatie en het nastreven van kansen. Vervolgens vonden we dat tijdens de verschillende fasen van groei, oprichters vier soorten ondersteuning van facilitatoren op prijs stellen voor het overleven van kritieke groeifasen, waarbij met name de blijvende waardering voor de ondersteuning bij het opzetten van hun netwerk in alle vier de fasen opvalt. Facilitatoren worden geadviseerd om hun soort ondersteuning aan te passen aan de verschillende fasen van groei, en later zelfs te verminderen omdat het spin-offbedrijf zelf de markt moet bereiken. De intentie van de spin-off om binnen de regio van de universiteit te blijven wordt zelfs negatief beïnvloedt door de mate van infrastructurele steun, terwijl dat deze positief wordt beïnvloedt door de link met de universiteit en de ondervonden hulp om als spin-off bedrijf de markt te kunnen bereiken.

References

ACEDO, F. J., BARROSO, C. & GALAN, J. L. (2006) The resource-based theory: dissemination and main trends. *Strategic Management Journal,* 27**,** 621-636.

ACOSTA, M., CORONADO, D. & FLORES, E. (2009) University spillovers and new business location in high-technology sectors: Spanish evidence. *Small Business Economics,* 36**,** 365-376.

ACS, Z. J. (2005) *Handbook of entrepreneurship research: An interdisciplinary survey and introduction*, Springer Science+ Business Media.

ACS, Z. J. & AUDRETSCH, D. B. (1988) Innovation in large and small firms: an empirical analysis. *The American Economic Review***,** 678-690.

AERTS, K., MATTHYSSENS, P. & VANDENBEMPT, K. (2007) Critical role and screening practices of European business incubators. *Technovation,* 27**,** 254-267.

AGARWAL, R. & BAYUS, B. L. (2002) The market evolution and sales takeoff of product innovations. *Management Science,* 48**,** 1024-1041.

AGARWAL, R., ECHAMBADI, R., FRANCO, A. M. & SARKAR, M. B. (2004) Knowledge transfer through inheritance: Spin-out generation, development, and survival. *Academy of Management Journal,* 47**,** 501-522.

AGRAWAL, A. (2006) Engaging the inventor: exploring licensing strategies for university inventions and the role of latent knowledge. *Strategic Management Journal,* 27**,** 63-79.

AHUJA, G. & KATILA, R. (2004) Where do resources come from? The role of idiosyncratic situations. *Strategic Management Journal,* 25**,** 887-907.

ALDRICH, H. (1999) *Organizations evolving,* London; Thousand Oaks, Sage Publications.

ALDRICH, H. E. & FIOL, C. M. (1994) Fools Rush in? The Institutional Context of Industry Creation. *The Academy of Management Review,* 19**,** 645-670.

ALMEIDA, P. & KOGUT, B. (1999) Localization of knowledge and the mobility of engineers in regional networks. *Management Science,* 45**,** 905-917.

ANDERSON, A. R., DODD, S. D. & JACK, S. (2010) Network practices and entrepreneurial growth. *Scandinavian Journal of Management,* 26**,** 121-133.

ANDERSON, B. S. & ESHIMA, Y. (2013) The influence of firm age and intangible resources on the relationship between entrepreneurial orientation and firm growth among Japanese SMEs. *Journal of Business Venturing,* 28**,** 413-429.

ARAUZO-CAROD, J.-M. & VILADECANS-MARSAL, E. (2009) Industrial location at the intra-metropolitan level: the role of agglomeration economies. *Regional Studies,* 43**,** 545-558.

ARGOTE, L., MCEVILY, B. & REAGANS, R. (2003) Managing knowledge in organizations: An integrative framework and review of emerging themes. *Management Science,* 49**,** 571-582.

ARMSTRONG, J. & OVERTON, T. (1977) Estimating nonresponse bias in mail surveys. *Journal of Marketing Research,* 14**,** 396-402.

ARNOLD, K. A., BARLING, J. & KELLOWAY, E. K. (2001) Transformational leadership or the iron cage: which predicts trust, commitment and team efficacy? *Leadership & Organization Development Journal,* 22**,** 315-320.

ASHEIM, B. & GERTLER, M. (2005) The geography of innovation. *The Oxford handbook of innovation***,** 291-317.

ASTEBRO, T. & BAZZAZIAN, N. (2011) Universities, entrepreneurship and local economic development. *Handbook of research on entrepreneurship and regional development. Cheltenham: Edward Elgar***,** 252-333.

AUDRETSCH, D. B. & LEHMANN, E. E. (2005) Does the Knowledge Spillover Theory of Entrepreneurship hold for regions? *Research Policy,* 34**,** 1191-1202.

AUDRETSCH, D. B., LEHMANN, E. E. & WARNING, S. (2005) University spillovers and new firm location. *Research Policy,* 34**,** 1113-1122.

AUDRETSCH, D. B. & STEPHAN, P. E. (1996) Company-scientist locational links: The case of biotechnology. *The American Economic Review,* 86**,** 641-652.

AW, B. Y. & LEE, Y. (2008) Firm heterogeneity and location choice of Taiwanese multinationals. *Journal of International Economics,* 75**,** 167-179.

BALTZOPOULOS, A. & BROSTROM, A. (2011) Attractors of entrepreneurial activity: universities, regions and alumni entrepreneurs. *Regional Studies,* 47**,** 934-949.

BANDURA, A. (1997) *Self-efficacy : the exercise of control,* New York, W.H. Freeman.

BARBOSA, S. D., GERHARDT, M. W. & KICKUL, J. R. (2007) The role of cognitive style and risk preference on entrepreneurial self-efficacy and entrepreneurial intentions. *Journal of Leadership & Organizational Studies,* 13**,** 86-104.

BARNEY, J. (1991a) Firm resources and sustained competitive advantage. *Journal of Management,* 17**,** 99-120.

BARNEY, J., WRIGHT, M. & KETCHEN, D. J. (2001) The resource-based view of the firm: Ten years after 1991. *Journal of Management,* 27**,** 625-641.

BARNEY, J. B. (1991b) Firm resources and sustained competitive advantage. *Journal of Management,* 17**,** 99-120.

BARNEY, J. B. (2001) Resource-based theories of competitive advantage: A ten-year retrospective on the resource-based view. *Journal of Management,* 27**,** 643-650.

BARNEY, J. B., KETCHEN, D. J. & WRIGHT, M. (2011) The future of resource-based theory revitalization or decline? *Journal of Management,* 37**,** 1299-1315.

BARON, R. A. (2006) Opportunity Recognition as Pattern Recognition: How Entrepreneurs" Connect the Dots" to Identify New Business Opportunities. *The Academy of Management Perspectives,* 20**,** 104-119.

BARUCH, Y. (1999) Response rate in academic studies-A comparative analysis. *Human Relations,* 52**,** 421-438.

BAUM, J. A. C. & SILVERMAN, B. S. (2004) Picking winners or building them? Alliance, intellectual, and human capital as selection criteria in venture financing and performance of biotechnology startups. *Journal of Business Venturing,* 19**,** 411-436.

BAUM, J. R. & BIRD, B. J. (2010) The successful intelligence of high-growth entrepreneurs: Links to new venture growth. *Organization Science,* 21**,** 397-412.

BERCHICCI, L., KING, A. & TUCCI, C. L. (2011) Does the apple always fall close to the tree? The geographical proximity choice of spin-outs. *Strategic Entrepreneurship Journal,* 5**,** 120-136.

BERGEK, A. & NORRMAN, C. (2008) Incubator best practice: A framework. *Technovation,* 28**,** 20-28.

BEUGELSDIJK, S. (2007) The regional environment and a firm's innovative performance: A plea for a multilevel interactionist approach. *Economic Geography,* 83**,** 181-199.

BHAGAVATULA, S., ELFRING, T., VAN TILBURG, A. & VAN DE BUNT, G. G. (2010) How social and human capital influence opportunity recognition and resource mobilization in India's handloom industry. *Journal of Business Venturing,* 25**,** 245-260.

BHAVE, M. P. (1994) A process model of entrepreneurial venture creation. *Journal of Business Venturing,* 9**,** 223-242.

BJORNALI, E. & GULBRANDSEN, M. (2010) Exploring board formation and evolution of board composition in academic spin-offs. *The Journal of Technology Transfer,* 35**,** 92-112.

BJØRNÅLI, E. & GULBRANDSEN, M. (2010) Exploring board formation and evolution of board composition in academic spin-offs. *The Journal of Technology Transfer,* 35**,** 92-112.

BOASSON, V., BOASSON, E., MACPHERSON, A. & SHIN, H. H. (2005) Firm Value and Geographic Competitive Advantage: Evidence from the US Pharmaceutical Industry*. *The Journal of Business,* 78**,** 2465-2495.

BOLLINGTOFT, A. & ULHOI, J. P. (2005) The networked business incubator—leveraging entrepreneurial agency? *Journal of Business Venturing,* 20**,** 265-290.

BOUCHER, G., CONWAY, C. & VAN DER MEER, E. (2003) Tiers of engagement by universities in their region's development. *Regional Studies,* 37**,** 887-897.

BRESCHI, S. & MALERBA, F. (2005) *Clusters, networks and innovation,* Oxford University Press.

BRESNAHAN, T. & GAMBARDELLA, A. (2004) *Building high-tech clusters: Silicon Valley and beyond*, Cambridge University Press.

BROUWER, A. E., MARIOTTI, I. & VAN OMMEREN, J. N. (2004) The firm relocation decision: An empirical investigation. *The Annals of Regional Science,* 38**,** 335-347.

BROUWER, E. & KLEINKNECHT, A. (1999) Innovative output, and a firm's propensity to patent.: An exploration of CIS micro data. *Research Policy,* 28**,** 615-624.

BRUDERL, J. & PREISENDORFER, P. (2000) Fast-Growing Businesses: Empirical Evidence from a German Study. *International Journal of Sociology,* 30**,** 45-70.

BRUSH, C. G. & VANDERWERF, P. A. (1992) A comparison of methods and sources for obtaining estimates of new venture performance. *Journal of Business Venturing,* 7**,** 157-170.

BRYSON, J. R., KEEBLE, D. & WOOD, P. (1997) The Creation and Growth of Small Business Service Firms in Post-Industrial Britain. *Small Business Economics,* 9**,** 345-360.

CAPASSO, M., CEFIS, E. & FRENKEN, K. (2010) Spatial differentiation in industrial dynamics. Working Paper (presented at the DIME workshop ˜Industrial Dynamics and Economic Geography").

CHAN, K. F. & LAU, T. (2005) Assessing technology incubator programs in the science park: the good, the bad and the ugly. *Technovation,* 25**,** 1215-1228.

CHANDLER, G. N. (1996) Business similarity as a moderator of the relationship between pre-Ownership experience and venture performance. *Entrepreneurship Theory and Practice,* 20**,** 51-65.

CHANG, S., GONG, Y., WAY, S. A. & JIA, L. (2012) Flexibility-oriented HRM systems, absorptive capacity, and market responsiveness and firm innovativeness. *Journal of Management,* 39**,** 1924-1951.

CHEN, M.-J. & HAMBRICK, D. C. (1995) Speed, stealth, and selective attack: How small firms differ from large firms in competitive behavior. *Academy of Management Journal,* 38**,** 453-482.

CHIN, W. W. (1998) The partial least squares approach to structural equation modeling. *Modern Methods for Business Research,* 295**,** 295-336.

CHIRICO, F., SIRMON, D. G., SCIASCIA, S. & MAZZOLA, P. (2011) Resource orchestration in family firms: investigating how entrepreneurial orientation, generational involvement, and participative strategy affect performance. *Strategic Entrepreneurship Journal,* 5**,** 307-326.

CLARYSSE, B. & BRUNEEL, J. (2007) Nurturing and growing innovative start-ups: the role of policy as integrator. *R&D Management,* 37**,** 139-149.

CLARYSSE, B., BRUNEEL, J. & WRIGHT, M. (2011) Explaining growth paths of young technology-based firms: structuring resource portfolios in different competitive environments. *Strategic Entrepreneurship Journal,* 5**,** 137-157.

CLARYSSE, B. & MORAY, N. (2004) A process study of entrepreneurial team formation: The case of a research-based spin-off. *Journal of Business Venturing,* 19**,** 55-79.

CLARYSSE, B., TARTARI, V. & SALTER, A. (2011c) The impact of entrepreneurial capacity, experience and organizational support on academic entrepreneurship. *Research Policy,* 40**,** 1084-1093.

CLARYSSE, B., WRIGHT, M., LOCKETT, A., MUSTAR, P. & KNOCKAERT, M. (2007) Academic spin-offs, formal technology transfer and capital raising. *Industrial and Corporate Change,* 16**,** 609-640.

CLARYSSE, B., WRIGHT, M., LOCKETT, A., VAN DE VELDE, E. & VOHORA, A. (2005) Spinning out new ventures: a typology of incubation strategies from European research institutions. *Journal of Business Venturing,* 20**,** 183-216.

COHEN, J. (1983) The cost of dichotomization. *Applied Psychological Measurement,* 7**,** 249-253.

COHEN, M. D. & LEVINTHAL, D. A. (1990a) *Absorptive capacity: A new perspective on learning and innovation*.

COHEN, W. M. & LEVINTHAL, D. A. (1990b) Absorptive capacity: a new perspective on learning and innovation. *Administrative Science Quarterly***,** 128-152.

COLOMBO, M. G. & GRILLI, L. (2005) Founders human capital and the growth of new technology-based firms: A competence-based view. *Research Policy,* 34**,** 795-816.

COOL, K., DIERICKX, I. & JEMISON, D. (1989) Business strategy, market structure and risk-return relationships: A structural approach. *Strategic Management Journal,* 10**,** 507-522.

CORBETT, A. C. (2005) Experiential learning within the process of opportunity identification and exploitation. *Entrepreneurship Theory and Practice,* 29**,** 473-491.

CORBETT, A. C. (2007) Learning asymmetries and the discovery of entrepreneurial opportunities. *Journal of Business Venturing,* 22**,** 97-118.

COROLLEUR, C. D., CARRERE, M. & MANGEMATIN, V. (2004) Turning scientific and technological human capital into economic capital: the experience of biotech start-ups in France. *Research Policy,* 33**,** 631-642.

COVIN, J. & MILES, M. (2006) Corporate entrepreneurship and the pursuit of competitive advantage.

COVIN, J. G. & LUMPKIN, G. (2011) Entrepreneurial orientation theory and research: Reflections on a needed construct. *Entrepreneurship Theory and Practice,* 35**,** 855-872.

COVIN, J. G. & MILES, M. P. (1999) Corporate entrepreneurship and the pursuit of competitive advantage. *E Entrepreneurship Theory and Practice,* 23**,** 47-63.

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

COVIN, J. G. & SLEVIN, D. P. (1990) New venture strategic posture, structure, and performance: an industry life cycle analysis. *Journal of Business Venturing,* 5**,** 123-135.

COVIN, J. G. & SLEVIN, D. P. (1991) A conceptual model of entrepreneurship as firm behavior. *Entrepreneurship Theory and Practice,* 16**,** 7-25.

COVIN, J. G. & WALES, W. J. (2012) The measurement of entrepreneurial orientation. *Entrepreneurship Theory and Practice,* 36**,** 677-702.

D'ESTE, P., IAMMARINO, S., SAVONA, M. & VON TUNZELMANN, N. (2012) What hampers innovation? Revealed barriers versus deterring barriers. *Research Policy,* 41**,** 482-488.

DAFT, R. L. & WEICK, K. E. (1984) Toward a model of organizations as interpretation systems. *Academy of management Review***,** 284-295.

DAHL, M. S. & SORENSON, O. (2009) The embedded entrepreneur. Blackwell Publishing Ltd.

DAHL, M. S. & SORENSON, O. (2012) Home sweet home: Entrepreneurs' location choices and the performance of their ventures. *Management Science,* 58**,** 1059-1071.

DAVIDSSON, P. & HONIG, B. (2003) The role of social and human capital among nascent entrepreneurs. *Journal of Business Venturing,* 18**,** 301-331.

DAVIDSSON, P. & WIKLUND, J. (2006) 3. Conceptual and empirical challenges in the study of firm growth. *Entrepreneurship and the Growth of Firms,* 1**,** 39-61.

DELMAR, F. & SHANE, S. (2003) Does business planning facilitate the development of new ventures? *Strategic Management Journal,* 24**,** 1165-1185.

DESS, G. G. & LUMPKIN, G. T. (2005) The role of entrepreneurial orientation in stimulating effective corporate entrepreneurship. *The Academy of Management Executive,* 19**,** 147-156.

DI GREGORIO, D. & SHANE, S. (2003) Why do some universities generate more start-ups than others? *Research Policy,* 32**,** 209-227.

DJOKOVIC, D. & SOUITARIS, V. (2008) Spinouts from academic institutions: A literature review with suggestions for further research. *Journal of Technology Transfer,* 33**,** 225-247.

DODGE, H. R., FULLERTON, S. & ROBBINS, J. E. (1994) Stage of the organizational life cycle and competition as mediators of problem perception for small businesses. *Strategic Management Journal,* 15**,** 121-134.

DOERINGER, P. B. & TERKLA, D. G. (1995) Business strategy and cross-industry clusters. *Economic Development Quarterly,* 9**,** 225-237.

DRNOVAJEK, M., WINCENT, J. & CARDON, M. S. (2010) Entrepreneurial self-efficacy and business start-up: developing a multi-dimensional definition. *International Journal of Entrepreneurial Behaviour & Research,* 16**,** 329-348.

DURHAM, C. C., KNIGHT, D. & LOCKE, E. A. (1997) Effects of leader role, team-set goal difficulty, efficacy, and tactics on team effectiveness. *Organizational Behavior and Human Decision Processes,* 72**,** 203-231.

EGELN, J. (2003) *Public research spin-offs in Germany : summary report,* Mannheim, Centre for European Economic Research - ZEW.

EGELN, J. R., GOTTSCHALK, S. & RAMMER, C. (2004) Location decisions of spin-offs from public research institutions. *Industry and innovation,* 11**,** 207-223.

ELFRING, T. & HULSINK, W. (2003) Networks in Entrepreneurship: The Case of High-technology Firms. *Small Business Economics,* 21**,** 409-422.

ENGELEN, A., KUBE, H., SCHMIDT, S. & FLATTEN, T. C. (2014) Entrepreneurial orientation in turbulent environments: The moderating role of absorptive capacity. *Research Policy,* 43**,** 1353-1369.

ENGELEN, A., NEUMANN, C. & SCHMIDT, S. (2013) Should entrepreneurially oriented firms have narcissistic CEOs? *Journal of Management*.

ENSLEY, M. D. & HMIELESKI, K. M. (2005) A comparative study of new venture top management team composition, dynamics and performance between university-based and independent start-ups. *Research Policy,* 34**,** 1091-1105.

ESCRIBANO, A., FOSFURI, A., TRIBO, J.A., (2009). Managing external knowledge flows: the moderating role of absorptive capacity. Research policy 38, 96-105.

ESTE, P., IAMMARINO, S., SAVONA, M. & VON TUNZELMANN, N. (2012) What hampers innovation? Revealed barriers versus deterring barriers. *Research Policy,* 41**,** 482-488.

ETZKOWITZ, H. (2004) The evolution of the entrepreneurial university. *International Journal of Technology and Globalisation,* 1**,** 64-77.

FABRIZIO, K. R. (2009) Absorptive capacity and the search for innovation. *Research Policy,* 38**,** 255-267.

FEESER, H. R. W. G. E. (1990) Founding Strategy and Performance: A Comparison of High and Low Growth High Tech Firms. *Strategic Management Journal,* 11**,** 87-98.

FELDMAN, M. P. & FRANCIS, J. L. (2004) Homegrown solutions: Fostering cluster formation. *Economic Development Quarterly,* 18**,** 127-137.

FERGUSON, R. & OLOFSSON, C. (2004) Science Parks and the Development of NTBFs- Location, Survival and Growth. *The Journal of Technology Transfer,* 29**,** 5-17.

FETTERS, M., GREENE, P. G. & RICE, M. P. (2010) *The development of university-based entrepreneurship ecosystems: global practices*, Edward Elgar Publishing.

FIELD, A. (2009) *Discovering statistics using spss : (and sex and drugs and rock 'n' roll),* Thousand Oaks, CA, SAGE Publications.

FIGUEIREDO, O., GUIMARAES, P. & WOODWARD, D. (2002) Home-field advantage: location decisions of Portuguese entrepreneurs. *Journal of Urban Economics,* 52**,** 341-361.

FINI, R., GRIMALDI, R., SANTONI, S. & SOBRERO, M. (2011) Complements or substitutes? The role of universities and local context in supporting the creation of academic spin-offs. *Research Policy,* 40**,** 1113-1127.

FLORIN, J., LUBATKIN, M. & SCHULZE, W. (2003) A social capital model of high-growth ventures. *Academy of Management Journal,* 46**,** 374-384.

FORBES, D. P. (2005) The effects of strategic decision making on entrepreneurial self-Efficacy. *Entrepreneurship Theory and Practice,* 29**,** 599-626.

FORNELL, C. & LARCKER, D. F. (1981) Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research***,** 39-50.

FOSFURI, A. & TRIBO, J. A. (2008) Exploring the antecedents of potential absorptive capacity and its impact on innovation performance. *Omega,* 36**,** 173-187.

FRENKEN, K., VAN OORT, F. & VERBURG, T. (2007) Related variety, unrelated variety and regional economic growth. *Regional Studies,* 41**,** 685-697.

GARCIA-VILLAVERDE, P. M., RUIZ-ORTEGA, M. J. & CANALES, J. I. (2013) Entrepreneurial orientation and the threat of imitation: The influence of upstream and downstream capabilities. *European Management Journal,* 31**,** 263-277.

GARTNER, W. B., CARTER, N. M. & HILLS, G. E. (2003) The language of opportunity. *New movements in entrepreneurship***,** 103.

GARUD, R., KUMARASWAMY, A., NAYYAR, P., MCGRATH, R. G. & LEVITT, L. (1998) Dialogue. *Academy of management Review,* 23**,** 212-217.

GILSTRAP, J. B. & HART, M. M. (2012) How Employee Behaviors Contribute to Firms Absorptive Capacities. *Academy of Management Proceedings.* Academy of Management.

GLASER, B. G. & STRAUSS, A. L. (1967) *The discovery of grounded theory : strategies for qualitative research,* Hawthorne, N.Y., Aldine de Gruyter.

GOLDEN, B. R. (1992a) The Past Is the Past Or Is It? The Use of Retrospective Accounts as Indicators of past Strategy. *The Academy of Management Journal,* 35**,** 848-860.

GOLDEN, B. R. (1992b) Research Notes. The Past is the Past ”Or is it? The Use of Retrospective Accounts as Indicators of Past Strategy. *Academy of Management Journal,* 35**,** 848-860.

GOTZ, O., LIEHR-GOBBERS, K. & KRAFFT, M. (2010) Evaluation of structural equation models using the partial least squares (PLS) approach. *Handbook of partial least squares.* Springer.

GRANDI, A. & GRIMALDI, R. (2003) Exploring the Networking Characteristics of New Venture Founding Teams: A Stdy of Italian Academic Spin-off. *Small Business Economics,* 21**,** 329-341.

GRANT, R. M. (1996) Toward a knowledge-based theory of the firm. *Strategic management journal,* 17**,** 109-122.

GRAY, C. (2006) Absorptive capacity, knowledge management and innovation in entrepreneurial small firms. *International Journal of Entrepreneurial Behaviour & Research,* 12**,** 345-360.

GREVE, H. R. (2008) A Behavioral Theory of Firm Growth: Sequential Attention to Size and Performance Goals. *Academy of Management Journal Academy of Management Journal,* 51**,** 476-494.

GRIFFITH, D. A., NOBLE, S. M. & CHEN, Q. (2006) The performance implications of entrepreneurial proclivity: A dynamic capabilties approach. *Journal of Retailing,* 82**,** 51-62.

GRIMALDI, R. & GRANDI, A. (2005) Business incubators and new venture creation: an assessment of incubating models. *Technovation,* 25**,** 111-121.

GRIMPE, C., SOFKA, W., 2009. Search patterns and absorptive capacity: low-and-high-technoogy sectors in European countries. Research Policy 38, 495-506.

GRUBER, M., MACMILLAN, I. C. & THOMPSON, J. D. (2008) Look before you leap: Market opportunity identification in emerging technology firms. *Management Science,* 54**,** 1652-1665.

HACKETT, S. M. & DILTS, D. M. (2004) A Real Options-Driven Theory of Business Incubation. *The Journal of Technology Transfer,* 29**,** 41-54.

HAIR, J. & BLACK, B. B. (2006) B., Anderson, R. and Tatham, R. Multivariate Data Analysis. Upper Saddle River, NJ: Prentice-Hall.

HAIR, J. F., BLACK, W. C., BABIN, B. J., ANDERSON, R. E. & TATHAM, R. L. (2006) *Multivariate data analysis,* Pearson Prentice Hall Upper Saddle River, NJ.

HAMBRICK, D. C. & MASON, P. A. (1984) Upper echelons: The organization as a reflection of its top managers. *Academy of management Review,* 9**,** 193-206.

HANNAN, M. T. & FREEMAN, J. (1984) Structural Inertia and Organizational Change. *American Sociological Review,* 49**,** 149-164.

HANSEN, M. T., CHESBROUGH, H. W., NOHRIA, N. & SULL, D. N. (2000) Networked incubators. Hothouses of the new economy. *Harvard business review,* 78.

HARGADON, A. & SUTTON, R. I. (1997) Technology brokering and innovation in a product development firm. *Administrative Science Quarterly*, 716-749.

HARMAN, H. H. (1976) *Modern factor analysis*, University of Chicago Press.

HARRISON, R. T. & LEITCH, C. (2010) Voodoo institution or entrepreneurial university? Spin-off companies, the entrepreneurial system and regional development in the UK. *Regional Studies,* 44**,** 1241-1262.

HAYTON, J. C. & ZAHRA, S. A. (2005) Venture team human capital and absorptive capacity in high technology new ventures. *International Journal of Technology Management,* 31**,** 256-274.

HEBLICH, S. & SLAVTCHEV, V. (2013) Parent universities and the location of academic startups. *Small Business Economics***,** 1-15.

HEIRMAN, A. & CLARYSSE, B. (2004) How and why do research-based start-ups differ at founding? A resource-based configurational perspective. *The Journal of Technology Transfer,* 29**,** 247-268.

HELFAT, C. E. & PETERAF, M. A. (2003) The dynamic resource • based view: Capability lifecycles. *Strategic Management Journal,* 24**,** 997-1010.

HENSELER, J. & SARSTEDT, M. (2013) Goodness-of-fit indices for partial least squares path modeling. *Computational Statistics,* 28**,** 565-580.

HILLS, G. E., LUMPKIN, G. T. & SINGH, R. P. (1997) Opportunity recognition: Perceptions and behaviors of entrepreneurs. *Frontiers of Entrepreneurship Research,* 17**,** 168-182.

HINDLE, K. (2010) How community context affects entrepreneurial process: A diagnostic framework. *Entrepreneurship and regional development,* 22**,** 599-647.

HMIELESKI, K. M. & BARON, R. A. (2008) When does entrepreneurial self efficacy enhance versus reduce firm performance? *Strategic Entrepreneurship Journal,* 2**,** 57-72.

HMIELESKI, K. M. & CORBETT, A. C. (2008) The contrasting interaction effects of improvisational behavior with entrepreneurial self-efficacy on new venture performance and entrepreneur work satisfaction. *Journal of Business Venturing,* 23**,** 482-496.

HOLCOMB, T. R., HOLMES JR, R. M. & CONNELLY, B. L. (2009) Making the most of what you have: managerial ability as a source of resource value creation. *Strategic Management Journal,* 30**,** 457-485.

HOLL, A. (2004) Start • ups and relocations: Manufacturing plant location in Portugal*. *Papers in Regional science,* 83**,** 649-668.

HONJO, Y. & HARADA, N. (2006) SME Policy, Financial Structure and Firm Growth: Evidence From Japan. *Small Business Economics,* 27**,** 289-300.

HUBER, G. P. (1991) Organizational learning: The contributing processes and the literatures. *Organization science,* 2**,** 88-115.

HUGGINS, R. & JOHNSTON, A. (2010) Knowledge flow and inter-firm networks: The influence of network resources, spatial proximity and firm size. *Entrepreneurship & regional development,* 22**,** 457-484.

HULSINK, W., BOUWMAN, H. & ELFRING, T. (2007) *Silicon Valley in the polder? entrepreneurial dynamics, virtuous clusters and vicious firms in the Netherlands and Flanders,* Rotterdam, Erasmus Research Institute of Management, Erasmus University.

IACOBUCCI, D., IACOPINI, A., MICOZZI, A. & ORSINI, S. (2011) Fostering entrepreneurship in academic spin-offs. *International Journal of Entrepreneurship and Small Business,* 12**,** 513-533.

IRELAND, R. D., COVIN, J. G. & KURATKO, D. F. (2009) Conceptualizing corporate entrepreneurship strategy. *Entrepreneurship Theory and Practice,* 33**,** 19-46.

IVERSON, R. D. M. C. U. O. M. D. O. M. (1999) *The relationship between job and life satisfaction : evidence from a remote mining community,* Parkville, Vic., Dept. of Management, University of Melbourne.

JANSEN, J. J. P., VAN DEN BOSCH, F. A. J. & VOLBERDA, H. W. (2005) Managing potential and realized absorptive capacity: How do organizational antecedents matter? *Academy of Management Journal,* 48**,** 999-1015.

JANTUNEN, A., PUUMALAINEN, K., SAARENKETO, S. & KYLAHEIKO, K. (2005) Entrepreneurial orientation, dynamic capabilities and international performance. *Journal of International Entrepreneurship,* 3**,** 223-243.

JARESKOG, K. G. & SARBOM, D. (1982) Recent developments in structural equation modeling. *Journal of Marketing Research***,** 404-416.

JAWAHAR, I. & MCLAUGHLIN, G. L. (2001) Toward a descriptive stakeholder theory: An organizational life cycle approach. *Academy of management Review,* 26**,** 397-414.

JAWORSKI, B. J. & KOHLI, A. K. (1993) Market orientation: antecedents and consequences. *The Journal of Marketing***,** 53-70.

KAZANJIAN, R. K. (1988) Relation of Dominant Problems to Stages of Growth in Technology-Based New Ventures. *The Academy of Management Journal,* 31**,** 257-279.

KEH, H. T., NGUYEN, T. T. M. & NG, H. P. (2007) The effects of entrepreneurial orientation and marketing information on the performance of SMEs. *Journal of Business Venturing,* 22**,** 592-611.

KICKUL, J., GUNDRY, L. K., BARBOSA, S. D. & WHITCANACK, L. (2009) Intuition Versus Analysis? Testing Differential Models of Cognitive Style on Entrepreneurial Self-Efficacy and the New Venture Creation Process. *Entrepreneurship Theory and Practice,* 33**,** 439-453.

KIRZNER, I. M. (1973) Entrepreneurship and competition. Chicago: University of Chicago Press.

KLOFSTEN, M. & JONES-EVANS, D. (2000) Comparing academic entrepreneurship in Europeâ€"the case of Sweden and Ireland. *Small Business Economics,* 14**,** 299-309.

KOGUT, B. & ZANDER, U. (1992) Knowledge of the firm, combinative capabilities, and the replication of technology. *Organization Science,* 3**,** 383-397.

KOLYMPIRIS, C. & KALAITZANDONAKES, N. (2013) Geographic scope of proximity effects among small life sciences firms. *Small Business Economics,* 40**,** 1059-1086.

KOLYMPIRIS, C., KALAITZANDONAKES, N. & MILLER, D. (2015) Location choice of academic entrepreneurs: Evidence from the US biotechnology industry. *Journal of Business Venturing,* 30**,** 227-254.

KOR, Y. Y. (2003) Experience-Based Top Management Team Competence and Sustained Growth. *Organization Science,* 14**,** 707-719.

KOTHA, S. & NAIR, A. (1995) Strategy and environment as determinants of performance: evidence from the Japanese machine tool industry. *Strategic Management Journal,* 16**,** 497-518.

KRONENBERG, K. (2012) Firm relocations in the Netherlands: Why do firms move, and where do they go?*. *Papers in Regional science*.

KRUEGER, N. & DICKSON, P. R. (1994) How Believing in Ourselves Increases Risk Taking: Perceived Self-Efficacy and Opportunity Recognition. *Decision Sciences,* 25**,** 385-400.

LANE, P. J., KOKA, B. R. & PATHAK, S. (2006) The reification of absorptive capacity: A critical review and rejuvenation of the construct. *Academy of Management Review,* 31**,** 833-863.

LANE, P. J. & LUBATKIN, M. (1998) Relative absorptive capacity and interorganizational learning. *Strategic Management Journal,* 19**,** 461-477.

LARRANETA, B., ZAHRA, S. A. & GALAN, J. L. (2007) Absorptive Capacity in New Ventures: Differences Among Corporate Ventures and Independent Ventures. *Frontiers of entrepreneurship research,* 27**,** 2.

LARSON, A. (1992) Network Dyads in Entrepreneurial Settings: A Study of the Governance of Exchange Relationships. *Administrative Science Quarterly,* 37**,** 76-104.

LAURSEN, K. & SALTER, A. (2006) Open for innovation: the role of openness in explaining innovation performance among UK manufacturing firms. *Strategic Management Journal,* 27**,** 131-150.

LAZARIC, N., LONGHI, C. & THOMAS, C. (2008) Gatekeepers of knowledge versus platforms of knowledge: from potential to realized absorptive capacity. *Regional Studies,* 42**,** 837-852.

LEAL-RODRIGUEZ, A., LEAL-MILLAN, A., ROLDAN-SALGUEIRO, J. L. & ORTEGA-GUTIERREZ, J. (2013) Knowledge management and the effectiveness of innovation outcomes: The role of cultural barriers. *Electronic Journal of Knowledge Management,* 11**,** 67-71.

LEE, S. S. & OSTERYOUNG, J. S. (2004) A Comparison of Critical Success Factors for Effective Operations of University Business Incubators in the United States and Korea. *Journal of Small Business Management,* 42**,** 418-426.

LEHOUX, P., DAUDELIN, G., WILLIAMS-JONES, B., DENIS, J.-L. & LONGO, C. (2014) How do business model and health technology design influence each other? Insights from a longitudinal case study of three academic spin-offs. *Research Policy,* 43**,** 1025-1038.

LEJPRAS, A. & STEPHAN, A. (2011) Locational conditions, cooperation, and innovativeness: evidence from research and company spin-offs. *The annals of regional science,* 46**,** 543-575.

LI, Y.-H., HUANG, J.-W. & TSAI, M.-T. (2009) Entrepreneurial orientation and firm performance: The role of knowledge creation process. *Industrial Marketing Management,* 38**,** 440-449.

LIAO, J., WELSCH, H. & STOICA, M. (2003) Organizational Absorptive Capacity and Responsiveness: An Empirical Investigation of Growth • Oriented SMEs. *Entrepreneurship Theory and Practice,* 28**,** 63-85.

LIAO, S.-H., FEI, W.-C. & CHEN, C.-C. (2007) Knowledge sharing, absorptive capacity, and innovation capability: an empirical study of Taiwan's knowledge-intensive industries. *Journal of Information Science,* 33**,** 340-359.

LIAO, S. H., WU, C. C., HU, D. C. & TSUI, K. A. (2010) Relationships between knowledge acquisition, absorptive capacity and innovation capability: An empirical study on Taiwans financial and manufacturing industries. *Journal of Information Science,* 36**,** 19-35.

LOCKETT, A., SIEGEL, D., WRIGHT, M. & ENSLEY, M. D. (2005) The creation of spin-off firms at public research institutions: Managerial and policy implications. *Research Policy,* 34**,** 981-993.

LOFSTEN, H. & LINDELOF, P. (2005) R&D networks and product innovation patterns-academic and non-academic new technology-based firms on Science Parks. *Technovation,* 25**,** 1025-1037.

LUMPKIN, G. T. & DESS, G. G. (1996) Clarifying the entrepreneurial orientation construct and linking it to performance. *Academy of management Review***,** 135-172.

LUMPKIN, G. T. & DESS, G. G. (2001) Linking two dimensions of entrepreneurial orientation to firm performance: The moderating role of environment and industry life cycle. *Journal of business venturing,* 16**,** 429-451.

LUMPKIN, G. T. & LICHTENSTEIN, B. B. (2005) The role of organizational learning in the Opportunity • Recognition process. *Entrepreneurship Theory and Practice,* 29**,** 451-472.

MACKINNON, D. P. & FAIRCHILD, A. J. (2009) Current directions in mediation analysis. *Current Directions in Psychological Science,* 18**,** 16-20.

MANJON-ANTOLIN, M. C. & ARAUZO-CAROD, J.-M. (2011) Locations and relocations: determinants, modelling, and interrelations. *The Annals of Regional Science,* 47**,** 131-146.

MARITAN, C. A. & PETERAF, M. A. (2011) Invited editorial: building a bridge between resource acquisition and resource accumulation. *Journal of Management,* 37**,** 1374-1389.

MARKMAN, G. D., SIEGEL, D. S. & WRIGHT, M. (2008) Research and technology commercialization. *Journal of Management Studies,* 45**,** 1401-1423.

MARVEL, M. R. L. G. T. (2007) Technology Entrepreneurs' Human Capital and Its Effects on Innovation Radicalness. *Entrepreneurship Theory and Practice,* 31**,** 807-828.

MCGAUGHEY, S. L. (2002) Strategic interventions in intellectual asset flows. *Academy of management Review,* 27**,** 248-274.

MCGEE, J. E., PETERSON, M., MUELLER, S. L. & SEQUEIRA, J. M. (2009) Entrepreneurial Self-Efficacy: Refining the Measure. *Entrepreneurship Theory and Practice,* 33**,** 965-988.

MCKELVEY, B. (2004) Toward a complexity science of entrepreneurship. *Journal of Business Venturing,* 19**,** 313-341.

MCKELVIE, A. & DAVIDSSON, P. (2009) From resource base to dynamic capabilities: an investigation of new firms. *British Journal of Management,* 20**,** S63-S80.

MEYER, M. (2003) Academic entrepreneurs or entrepreneurial academics? research-based ventures and public support mechanisms. *R & D Management,* 33**,** 107-115.

MICHELACCI, C. & SILVA, O. (2007) Why so many local entrepreneurs? *The Review of Economics and Statistics,* 89**,** 615-633.

MIHALACHE, O. R. (2012) TMT processes as antecedents of management innovation: The moderating role of absorptive capacity. *Academy of Management Proceedings.* Academy of Management.

MILES, R. E., SNOW, C. C., MEYER, A. D. & COLEMAN, H. J. (1978) Organizational strategy, structure, and process. *Academy of Management Review,* 3**,** 546-562.

MILLER, C. C., CARDINAL, L. B. & GLICK, W. H. (1997) Retrospective reports in organizational research: A reexamination of recent evidence. *Academy of Management Journal,* 40**,** 189-204.

MILLER, D. (1983) The correlates of entrepreneurship in three types of firms. *Management Science,* 29**,** 770-791.

MILLER, D. (2011) Miller (1983) Revisited: A reflection on EO research and some suggestions for the future. *Entrepreneurship Theory and Practice,* 35**,** 873-894.

MINBAEVA, D., PEDERSEN, T., TRKMAN, I., FEY, C. F. & PARK, H. J. (2003) MNC knowledge transfer, subsidiary absorptive capacity, and HRM. *Journal of International Business Studies,* 34**,** 586-599.

MOORMAN, C. (1995) Organizational market information processes: cultural antecedents and new product outcomes. *Journal of Marketing Research***,** 318-335.

MOSEY, S. & WRIGHT, M. (2007) From human capital to social capital: A longitudinal study of technology-based academic entrepreneurs. *Entrepreneurship Theory and Practice,* 31**,** 909-935.

MULLINS, J. W. & FORLANI, D. (2005) Missing the boat or sinking the boat: A study of new venture decision making. *Journal of Business Venturing,* 20**,** 47-69.

MURRAY, F. (2004) The role of academic inventors in entrepreneurial firms: sharing the laboratory life. *Research Policy,* 33**,** 643-659.

MUSTAR, P., RENAULT, M., COLOMBO, M. G., PIVA, E., FONTES, M., LOCKETT, A., WRIGHT, M., CLARYSSE, B. & MORAY, N. (2006) Conceptualising the heterogeneity of research-based spin-offs: A multi-dimensional taxonomy. *Research Policy,* 35**,** 289-308.

MUSTAR, P., WRIGHT, M. & CLARYSSE, B. (2008) University spin-off firms: lessons from ten years of experience in Europe. *Science and Public Policy,* 35**,** 67-80.

NAMAN, J. L. S. D. P. (1993) Entrepreneurship and the Concept of Fit: A model and empirical tests. *Strategic Management Journal,* 14**,** 137-153.

NDONZUAU, F. N., PIRNAY, F. & SURLEMONT, B. (2002) A stage model of academic spin-off creation. *Technovation,* 22**,** 281-289.

NECK, C. P. & MANZ, C. C. (1992) Thought self • leadership: The influence of self talk and mental imagery on performance. *Journal of Organizational Behavior,* 13**,** 681-699.

NICOLAOU, N. & BIRLEY, S. (2003) Social networks in organizational emergence: the university spinout phenomenon. *Management Science,* 49**,** 1702-1725.

NOOTEBOOM, B., VAN HAVERBEKE, W., DUYSTERS, G., GILSING V., VAN DEN OORD, A., (2007). Optimal cognitive distance and absorptive capacity. *Research Policy* 36, 1016-1034.

O'SHEA, R. P., ALLEN, T. J., CHEVALIER, A. & ROCHE, F. (2005) Entrepreneurial orientation, technology transfer and spinoff performance of US universities. *Research Policy,* 34**,** 994-1009.

OZGEN, E. & BARON, R. A. (2007) Social sources of information in opportunity recognition: Effects of mentors, industry networks, and professional forums. *Journal of Business Venturing,* 22**,** 174-192.

PANDZA, K. & HOLT, R. (2007) Absorptive and transformative capacities in nanotechnology innovation systems. *Journal of Engineering and Technology Management,* 24**,** 347-365.

PARWADA, J. T. (2008) The genesis of home bias? The Location and portfolio choices of investment company start-Ups. *Journal of Financial and Quantitative Analysis,* 43**,** 245-266.

PATZELT, H. & SHEPHERD, D. A. (2009) Strategic entrepreneurship at universities: Academic entrepreneurs' assessment of policy programs. *Entrepreneurship Theory and Practice,* 33**,** 319-340.

PENROSE, E. (1959) *The Theory of the Growth of the Firm,* Blackwell, Oxford University Press.

PETTERSEN, I. B. & TOBIASSEN, A. E. (2012) Are born globals really born globals? The case of academic spin-offs with long development periods. *Journal of International Entrepreneurship,* 10**,** 117-141.

PHAN, P. H., SIEGEL, D. S. & WRIGHT, M. (2005) Science parks and incubators: observations, synthesis and future research. *Journal of Business Venturing,* 20**,** 165-182.

PHELPS, R., ADAMS, R. & BESSANT, J. (2007) Life cycles of growing organizations: A review with implications for knowledge and learning. *International Journal of Management Reviews,* 9**,** 1-30.

PIRNAY, F. & SURLEMONT, B. (2003) Toward a typology of university spin-offs. *Small Business Economics,* 21**,** 355-369.

PIRNAY, F., SURLEMONT, B. & NLEMVO, F. (2003) Toward a typology of university spin-offs. *Small Business Economics,* 21**,** 355-369.

PIROLO, L. & PRESUTTI, M. (2010) The impact of social capital on the start • ups' performance growth. *Journal of Small Business Management,* 48**,** 197-227.

PODSAKOFF, M. S. B. L. J. Y. P. N. P. (2003) Common method biases in behavioral research: a critical review of the literature and recommended remedies. *The Journal of Applied Psychology,* 88**,** 879-903.

PODSAKOFF, P. M., Mackenzie, S. B., PODSAKOFF, N.P., (2012) Sources of method bias in social science research and recommendations on how to control it. *Annual Review of Psychology* 63, 539-569.

PODSAKOFF, P. M. (1986) Self-Reports in Organizational Research: Problems and Prospects. *Journal of Management Journal of Management,* 12**,** 531-544.

POLKINGHORNE, D. (1988) *Narrative Knowing/Human,* Suny Press.

PORTER, M. E. (1998) *Clusters and the new economics of competition,* Harvard Business Review Watertown.

PORTER, M. E. (2000) Location, competition, and economic development: Local clusters in a global economy. *Economic Development Quarterly,* 14**,** 15-34.

PORTER, M. E. (2008) *On competition,* Harvard Business School Press.

POWERS, J. B. & MCDOUGALL, P. P. (2005) University start-up formation and technology licensing with firms that go public: a resource-based view of academic entrepreneurship. *Journal of Business Venturing,* 20**,** 291-311.

PREACHER, K. J. & HAYES, A. F. (2008) Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods,* 40**,** 879-891.

PRIES, F. & GUILD, P. (2007) Commercial exploitation of new technologies arising from university research: start-ups and markets for technology. *R&D Management,* 37**,** 319-328.

PRODAN, I. & DRNOVSEK, M. (2010) Conceptualizing academic-entrepreneurial intentions: An empirical test. *Technovation,* 30**,** 332-347.

RASMUSSEN, E. (2011) Understanding academic entrepreneurship: Exploring the emergence of university spin-off ventures using process theories. *International Small Business Journal,* 29**,** 448-471.

RASMUSSEN, E. & BORCH, O. J. (2010) University capabilities in facilitating entrepreneurship: A longitudinal study of spin-off ventures at mid-range universities. *Research Policy,* 39**,** 602-612.

RASMUSSEN, E., MOEN, Ø. & GULBRANDSEN, M. (2006) Initiatives to promote commercialization of university knowledge. *Technovation,* 26**,** 518-533.

RASMUSSEN, E., MOSEY, S. & WRIGHT, M. (2011) The evolution of entrepreneurial competencies: a longitudinal study of university spin-Off venture emergence. *J. Manage. Stud. Journal of Management Studies,* 48**,** 1314-1345.

RASMUSSEN, E., MOSEY, S. & WRIGHT, M. (2014) The influence of university departments on the evolution of entrepreneurial competencies in spin-off ventures. *Research Policy,* 43**,** 92-106.

RATINHO, T. & HENRIQUES, E. (2010) The role of science parks and business incubators in converging countries: Evidence from Portugal. *Technovation,* 30**,** 278-290.

RAUCH, A., WIKLUND, J., LUMPKIN, G. T. & FRESE, M. (2009) Entrepreneurial orientation and business performance: An assessment of past research and suggestions for the future. *Entrepreneurship Theory and Practice,* 33**,** 761-787.

RAVASI, D. & TURATI, C. (2005) Exploring entrepreneurial learning: a comparative study of technology development projects. *Journal of Business Venturing,* 20**,** 137-164.

RINGLE, C. M., WENDE, S. & WILL, A. (2010) Finite mixture partial least squares analysis: Methodology and numerical examples. *Handbook of Partial Least Squares.* Springer.

ROMIJN, H. & ALBALADEJO, M. (2002) Determinants of innovation capability in small electronics and software firms in southeast England. *Research Policy,* 31**,** 1053-1067.

ROSENBUSCH, N., RAUCH, A. & BAUSCH, A. (2013) The mediating role of entrepreneurial orientation in the task environment performance relationship a meta-analysis. *Journal of Management,* 39**,** 633-659.

ROTHAERMEL, F. T. & ALEXANDRE, M. T. (2009) Ambidexterity in technology sourcing: The moderating role of absorptive capacity. *Organization Science,* 20**,** 759-780.

ROTHAERMEL, F. T. & THURSBY, M. (2005) University-incubator firm knowledge flows: assessing their impact on incubator firm performance. *Research Policy,* 34**,** 305-320.

RUEF, M. & SCOTT, W. R. (1998) A multidimensional model of organizational legitimacy: Hospital survival in changing institutional environments. *Administrative Science Quarterly***,** 877-904.

SALAVISA, I., SOUSA, C. & FONTES, M. (2012) Topologies of innovation networks in knowledge-intensive sectors: Sectoral differences in the access to knowledge and complementary assets through formal and informal ties. *Technovation,* 32**,** 380-399.

SALVATO, C., SCIASCIA, S. & ALBERTI, F. G. (2009) The microfoundations of corporate entrepreneurship as an organizational capability. *The international journal of entrepreneurship and innovation,* 10**,** 279-289.

SANDBERG, W. R. & HOFER, C. W. (1988) Improving new venture performance: The role of strategy, industry structure, and the entrepreneur. *Journal of Business Venturing,* 2**,** 5-28.

SAPIENZA, H. J., AUTIO, E., GEORGE, G. & ZAHRA, S. A. (2006) A capabilities perspective on the effects of internationalization on firm survival and growth. *Academy of management Review,* 31**,** 914-933.

SAPIENZA, H. J., PARHANKANGAS, A. & AUTIO, E. (2004) Knowledge relatedness and post-spin-off growth. *Journal of Business Venturing,* 19**,** 809-829.

SARDESHMUKH, S. & CORBETT, A. (2011) The duality of internal and external development of successors: opportunity recognition in family firms. *Family Business Review,* 24**,** 111-125.

SARSTEDT, M., RINGLE, C. M., HENSELER, J. & HAIR, J. F. (2014) On the emancipation of PLS-SEM: A commentary on Rigdon (2012). *Long Range Planning,* 47**,** 154-160.

SAXENIAN, A. (1996) *Regional advantage: Culture and competition in Silicon Valley and Route 128,* Harvard University Press.

SCHLEIMER, S. C. & PEDERSEN, T. (2013) The driving forces of subsidiary absorptive capacity. *Journal of Management Studies,* 50**,** 646-672.

SCHOLTEN, V. E. (2006) The growth of academic spin-offs : factors influencing the growth of Dutch spin-offs in the life sciences, ICT and consulting, Phd thesis.

SCHOLTEN, V., OMTA, O., KEMP, R. & ELFRING, T. (2015). Interaction effects of start-up team capabilities and bridging ties on spin-off growth. *Technovation,* Forthcoming.

SCIASCIA, S., L D'ORIA, L., BRUNI, M. & LARRANETA, B. (2014) Entrepreneurial Orientation in low-and medium-tech industries: The need for Absorptive Capacity to increase performance. *European Management Journal,* 32**,** 761-769.

SCOTT, M. & BRUCE, R. (1987) Five stages of growth in small business. *Long Range Planning,* 20**,** 45-52.

SETHI, R. & IQBAL, Z. (2008) Stage-gate controls, learning failure, and adverse effect on novel new products. *Journal of Marketing,* 72**,** 118-134.

SHANE, S. (2000) Prior Knowledge and the Discovery of Entrepreneurial Opportunities. *Organization Science,* 11**,** 448-469.

SHANE, S. (2004) Encouraging university entrepreneurship? The effect of the Bayh-Dole Act on university patenting in the United States. *Journal of Business Venturing,* 19**,** 127-151.

SHANE, S. & DELMAR, F. (2004) Planning for the market: business planning before marketing and the continuation of organizing efforts. *Journal of Business Venturing,* 19**,** 767-785.

SHANE, S. & STUART, T. (2002) Organizational Endowments and the Performance of University Start-Ups. *Management Science,* 48**,** 154-170.

SHANE, S. & VENKATARAMAN, S. (2000) The promise of entrepreneurship as a field of research. *Academy of Management Review,* 25**,** 217-226.

SHANE, S. A. (2003) *A general theory of entrepreneurship: The individual-opportunity nexus*, Edward Elgar Publishing.

SHEPHERD, D. A. & DETIENNE, D. R. (2005) Prior knowledge, potential financial reward, and opportunity identification. *Entrepreneurship Theory and Practice,* 29**,** 91-112.

SHEPHERD, D. A. & KRUEGER, N. F. (2002) An Intentions • Based model of entrepreneurial teams social cognition*. *Entrepreneurship Theory and Practice,* 27**,** 167-185.

SHEPHERD, D. A. E. R. C. A. (2000) New venture strategy and profitability. *Journal of Business Venturing,* 15**,** 449-467.

SHROUT, P. E. & BOLGER, N. (2002) Mediation in experimental and nonexperimental studies: new procedures and recommendations. *Psychological Methods,* 7**,** 422.

SIEGEL, D. S., WALDMAN, D. & LINK, A. (2003a) Assessing the impact of organizational practices on the relative productivity of university technology transfer offices: An exploratory study. *Research Policy,* 32**,** 27-48.

SIEGEL, D. S., WESTHEAD, P. & WRIGHT, M. (2003b) Science parks and the performance of new technology-Based firms: A Review of Recent U.K. Evidence and an Agenda for Future Research. *Small Business Economics,* 20**,** 177-184.

SIEGEL, D. S., WRIGHT, M. & LOCKETT, A. (2007) The rise of entrepreneurial activity at universities: organizational and societal implications. *Industrial and Corporate Change,* 16**,** 489-504.

SIRÉN, C. A., KOHTAMÄKI, M. & KUCKERTZ, A. (2012) Exploration and exploitation strategies, profit performance, and the mediating role of strategic learning: Escaping the exploitation trap. *Strategic Entrepreneurship Journal,* 6**,** 18-41.

SIRMON, D. G., HITT, M. A. & IRELAND, R. D. (2007) Managing firm resources in dynamic environments to create value: Looking inside the black box. *Academy of Management Review,* 32**,** 273-292.

SIRMON, D. G., HITT, M. A., IRELAND, R. D. & GILBERT, B. A. (2011) Resource orchestration to create competitive advantage breadth, depth, and life cycle effects. *Journal of Management,* 37**,** 1390-1412.

SOFOULI, E. & VONORTAS, N. (2007) S&T Parks and business incubators in middle-sized countries: the case of greece. *The Journal of Technology Transfer,* 32**,** 525-544.

SONG, M., PODOYNITSYNA, K., VAN DER BIJ, H. & HALMAN, J. I. (2008) Success Factors in New Ventures: A Meta • analysis*. *Journal of Product Innovation Management,* 25**,** 7-27.

SORENSON, O. & FLEMING, L. (2004) Science and the diffusion of knowledge. *Research Policy,* 33**,** 1615-1634.

STAM, W. & ELFRING, T. (2008) Entrepreneurial orientation and new venture performance: the moderating role of intra-and extraindustry social capital. *Academy of Management Journal,* 51**,** 97-111.

STARR, J. A. & MACMILLAN, I. C. (1990) Resource cooptation via social contracting: Resource acquisition strategies for new ventures. *Strategic Management Journal,* 11**,** 79-92.

STEFFENSEN, M., ROGERS, E. M. & SPEAKMAN, K. (2000) Spin-offs from research centers at a research university. *Journal of Business Venturing,* 15**,** 93-111.

STERNBERG, R. (2009) *Regional dimensions of entrepreneurship*, Now Publishers Inc.
STERNBERG, R. (2014) Success factors of university-spin-offs: Regional government support programs versus regional environment. *Technovation,* 34**,** 137-148.
STEVENSON, H. H. & JARILLO, J. C. (1989) *A paradigm of enterpreneurship: entrepreneurial management,* [Boston, Mass.] (Soldiers Field, Boston 02163), Division of Research, Harvard Business School.
STUART, T. E., HOANG, H. & HYBELS, R. C. (1999) Interorganizational endorsements and the performance of entrepreneurial ventures. *Administrative Science Quarterly,* 44**,** 315-349.
SZULANSKI, G. (1996) Exploring internal stickiness: Impediments to the transfer of best practice within the firm. *Strategic Management Journal,* 17**,** 27-43.
TALLMAN, S., JENKINS, M., HENRY, N. & PINCH, S. (2004) Knowledge, clusters, and competitive advantage. *Academy of management Review,* 29**,** 258-271.
TANG, J., KACMAR, K. M. & BUSENITZ, L. (2012) Entrepreneurial alertness in the pursuit of new opportunities. *Journal of Business Venturing,* 27**,** 77-94.
TEECE, D. J., PISANO, G. & SHUEN, A. (1997) Dynamic capabilities and strategic management. *Strategic Management Journal,* 18**,** 509-533.
TENENHAUS, M., VINZI, V. E., CHATELIN, Y.-M. & LAURO, C. (2005) PLS path modeling. *Computational statistics & data analysis,* 48**,** 159-205.
TODOROVA, G. & DURISIN, B. (2007) Absorptive capacity: Valuing a reconceptualization. *Academy of Management Review,* 32**,** 774-786.
UCBASARAN, D., LOCKETT, A., WRIGHT, M. & WESTHEAD, P. (2003) Entrepreneurial Founder Teams: Factors Associated with Member Entry and Exit. *Entrepreneurship Theory and Practice,* 28**,** 107-128.
UCBASARAN, D., WESTHEAD, P. & WRIGHT, M. (2008) Opportunity identification and pursuit: does an entrepreneur's human capital matter? *Small Business Economics,* 30**,** 153-173.
UCBASARAN, D., WESTHEAD, P. & WRIGHT, M. (2009) The extent and nature of opportunity identification by experienced entrepreneurs. *Journal of Business Venturing,* 24**,** 99-115.
UNSWORTH, K. (2001a) Unpacking creativity. *Academy of management Review***,** 289-297.
UNSWORTH, L. (2001b) *Teaching multiliteracies across the curriculum*, Open University Press Buckingham.
VAGHELY, I. P. & JULIEN, P.-A. (2010) Are opportunities recognized or constructed?: An information perspective on entrepreneurial opportunity identification. *Journal of Business Venturing,* 25**,** 73-86.
VAN BURG, E., ROMME, A. G. L., GILSING, V. A. & REYMEN, I. M. M. J. (2008) Creating university spin-offs: A science-based design perspective. *Journal of Product Innovation Management,* 25**,** 114-128.
VAN DEN BOSCH, F. A. J., VOLBERDA, H. W. & DE BOER, M. (1999) Coevolution of Firm Absorptive Capacity and Knowledge Environment: Organizational Forms and Combinative Capabilities. *Organization Science,* 10**,** 551-568.
VAN DIJK, J. & PELLENBARG, P. H. (2000) Firm relocation decisions in The Netherlands: An ordered logit approach. *Papers in Regional science,* 79**,** 191-219.
VAN GEENHUIZEN, M. & SOETANTO, D. P. (2009) Academic spin-offs at different ages: A case study in search of key obstacles to growth. *Technovation,* 29**,** 671-681.
VINDING, A. L. (2004) Human Resources; absorptive capacity and innovative performance. *Research on Technological Innovation, Management and Policy*.
VOHORA, A., WRIGHT, M. & LOCKETT, A. (2004) Critical junctures in the development of university high-tech spinout companies. *Research Policy,* 33**,** 147-175.
VOLBERDA, H. W., FOSS, N. J. & LYLES, M. A. (2010) PERSPECTIVE-absorbing the concept of absorptive capacity: How to realize its potential in the organization field. *Organization Science,* 21**,** 931-951.

VON HIPPEL, E. (1994) "Sticky information" and the locus of problem solving: implications for innovation. *Management Science,* 40**,** 429-439.

WALES, W. J., PARIDA, V. & PATEL, P. C. (2012) Too much of a good thing? Absorptive capacity, firm performance, and the moderating role of entrepreneurial orientation. *Strategic Management Journal*.

WALES, W. J., PATEL, P. C., PARIDA, V. & KREISER, P. M. (2013) Nonlinear Effects of Entrepreneurial Orientation on Small Firm Performance: The Moderating Role of Resource Orchestration Capabilities. *Strategic Entrepreneurship Journal,* 7**,** 93-121.

WALSH, J. P. U. G. R. (1991) Organizational Memory. *The Academy of Management Review,* 16**,** 57-91.

WALTER, A., AUER, M. & RITTER, T. (2006) The impact of network capabilities and entrepreneurial orientation on university spin-off performance. *Journal of Business Venturing,* 21**,** 541-567.

WANG, C. L. (2008) Entrepreneurial orientation, learning orientation, and firm performance. *Entrepreneurship Theory and Practice,* 32**,** 635-657.

WESTHEAD, P., WRIGHT, M. & UCBASARAN, D. (2001) The internationalization of new and small firms: A resource-based view. *Journal of Business Venturing,* 16**,** 333-358.

WETERINGS, A. & KNOBEN, J. (2013) Footloose: An analysis of the drivers of firm relocations over different distances. *Papers in Regional science,* 92**,** 791-809.

WIKLUND, J. & SHEPHERD, D. (2003) Knowledge • based resources, entrepreneurial orientation, and the performance of small and medium sized businesses. *Strategic Management Journal,* 24**,** 1307-1314.

WIKLUND, J. & SHEPHERD, D. (2005) Entrepreneurial orientation and small business performance: a configurational approach. *Journal of Business Venturing,* 20**,** 71-91.

WINTER, S. G. (1998) *Knowledge and competence as strategic assets*.

WRIGHT, M., BIRLEY, S. & MOSEY, S. (2004) Entrepreneurship and University Technology Transfer. *The Journal of Technology Transfer,* 29**,** 235-246.

WRIGHT, M., CLARYSSE, B. & MOSEY, S. (2012) Strategic entrepreneurship, resource orchestration and growing spin-offs from universities. *Technology Analysis & Strategic Management,* 24**,** 911-927.

WRIGHT, M., HMIELESKI, K. M., SIEGEL, D. S. & ENSLEY, M. D. (2007) The role of human capital in technological entrepreneurship. *Entrepreneurship Theory and Practice,* 31**,** 791-806.

WRIGHT, M., LOCKETT, A., CLARYSSE, B. & BINKS, M. (2006) University spin-out companies and venture capital. *Research Policy,* 35**,** 481-501.

ZACHARAKIS, A. L., SHEPHERD, D. A. & COOMBS, J. E. (2003) The development of venture-capital-backed internet companies: An ecosystem perspective. *Journal of Business Venturing,* 18**,** 217-231.

ZAHRA, S. A., FILATOTCHEV, I. & WRIGHT, M. (2009) How do threshold firms sustain corporate entrepreneurship? The role of boards and absorptive capacity. *Journal of Business Venturing,* 24**,** 248-260.

ZAHRA, S. A. & GEORGE, G. (2002) Absorptive capacity: A review, reconceptualization, and extension. *Academy of Management Review,* 27**,** 185-203.

ZAHRA, S. A., SAPIENZA, H. J. & DAVIDSSON, P. (2006) Entrepreneurship and dynamic capabilities: a review, model and research agenda*. *Journal of Management Studies,* 43**,** 917-955.

ZAHRA, S. A., VAN DE VELDE, E. & LARRANETA, B. (2007) Knowledge conversion capability and the performance of corporate and university spin-offs. *Industrial and Corporate Change,* 16**,** 569-608.

ZIMMERMAN, B. J. (2002) Becoming a self-regulated learner: An overview. *Theory into practice,* 41**,** 64-70.

ZUCKER, L. G., DARBY, M. R. & PENG, Y. (1998) Fundamentals or population dynamics and the geographic distribution of US biotechnology enterprises, 1976-1989. National Bureau of Economic Research.

About the author

Hanieh Khodaei was born on March 27, 1982 in Kermanshah (Iran). In 2004, she received a bachelor degree in Water Engineering from Razi University (Iran). Since 2004, she joined a master program in Risk Management in Tehran University. She got her master degree in 2006. In 2008, she joined the MBA program offered by Faculty of Entrepreneurship in Iran. Later she won PhD scholarship from Iranian Ministry of Science, Research, and Technology (MSRT) and in 2009; she started her PhD project in the Department of Business Administrative at Wageningen University. She has worked as a guest researcher in Delft University of Technology. Before pursuing her PhD, she worked at Faculty of Entrepreneurship of Tehran University. Her research interest concerns academic start-up growth and the role of university facilitator support in fostering their growth.

Completed Training and Supervision Plan

Wageningen School of Social Sciences (WASS)

Name of the learning activity	Department/Institute	Year	ECTS*
A) Project related competences			
Qualitative Data Analysis, Atlas.ti : Procedures and Strategies, YRM60806	WUR	2010	6
Generalized Linear models	PE&RC	2012	0.6
Quantitative Data analysis: Multivariate Techniques, YRM 60306	WUR	2013	2
Technology, Innovation, and Strategy, MST30306	MST	2010	6
International Summer school 'Entrepreneurship and Technology Venturing'	University of Twente	2011	2
International Summer school 'Introductory Social Network Analysis'	Aarhuus University, Denmark	2013	5
Bootcamp 'Entrepreneurship'	MST	2010	2
B) General research related competences			
WASS Introduction workshop	WASS	2010	
PhD competence assessment	WGS	2010	0.3
Information Literacy, including Endnote	WGS	2010	0.6
Scientific writing	WGS	2013	1.8
Scientific publishing	WGS	2013	0.3
Voice and Presentation Skills	WGS	2010	1
Techniques for writing and presenting a scientific paper	WGS	2010	1.2
Mansholt Multidisciplinary Seminar	WASS PhD day	2011	1
Research Methodology: From Topic to Proposal	WASS	2011	4
C) Career related competences/personal development			
''The Impact of Facilitators Support on Navigating Critical Junctures in High-tech Academic Spin-offs'	AOM Conference, Boston US	2012	1
'Exploring the high-tech academic spin-off development process: from ideas to venture'	HTSF Conference, Amsterdam	2012	1
'The role of entrepreneurial behavior on absorptive capacity in high-tech academic spin-off management teams'	NetGrow seminar, Lasalle-Beavais University	2013	1
'Academic Spin-off facilitators and absorptive capacity'	PHD Workshop presentation, Twente	2011	1
Guest teacher in entrepreneurship or innovation course	MST-WASS	2011-2013	4
Total			**41.8**

*One credit according to ECTS is on average equivalent to 28 hours of study load

Printed by

Proefschriftmaken.nl

Cover design

Proefschriftmaken.nl