Dissertation

The Impact of Human and Social Capital on University Startup Performance

Evidence from European and US Entrepreneurship Ecosystems

carried out for the purpose of obtaining the degree of Doctor in Social and Economic Sciences (Dr.rer.soc.oec.), submitted at TU Wien, Faculty of Mechanical and Industrial Engineering, by

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I confirm, that going to press of this thesis needs the confirmation of the examination committee.

Affidavit

I declare in lieu of oath, that I wrote this thesis and performed the associated research myself, using only literature cited in this volume. If text passages from sources are used literally, they are marked as such.

I confirm that this work is original and has not been submitted elsewhere for any examination, nor is it currently under consideration for a thesis elsewhere.

City and Date	*Signature*

Acknowledgements

"*Even the longest journey starts with the first step*." – Lao Tzu

A long journey it has been. After eight years, I am finally writing these final words of my doctoral thesis. It was an exciting time that I spent in Vienna, New York and Silicon Valley. While I did focus exclusively at times on heads-down research, half of the time, I was also involved in hands-on management. It would be presumptuous to claim that switching between these two different work modes was not challenging at times. It definitely extended the amount of time necessary to complete my dissertation. Nevertheless, moving between research and business allowed me to become more acquainted with both worlds. Understanding the motivations and challenges of academic entrepreneurs helped to frame relevant research questions for this thesis. I am also excited to continue immersing myself in this field, fostering the exchange between the science and business community and enabling people and organizations to innovate.

However, this thesis would not have been possible, without the support and encouragement of many people. Similar to entrepreneurs, doctoral students also thrive when they are embedded in a supportive social network. Therefore, I would like to use this occasion to acknowledge the people who have accompanied me along the way.

First and foremost, I would like to thank my supervisor, Prof. Karl-Heinz Leitner. You supported my research idea from the start and were always available for feedback and helpful guidance. You also encouraged me to apply for a competitive scholarship from the Austrian National Bank (*Jubiläumsfond*) - which financed three years of my doctoral research. At the Innovation Systems Department of the Austrian Institute of Technology, I always received support and encouragement from numerous colleagues, for which I am very grateful. I would not have had the chance to teach at the New York Institute of Technology (NYIT), if it had not been for Prof. Joanne Scillitoe. Thank you again for your trust and your ongoing support, especially during my first months in New York. Through my research at NYIT, I learned about StartX, the startup accelerator of Stanford University, located in Silicon Valley. After a rigorous selection process, I was able to join the StartX team during the summer of 2013. The interaction with committed

entrepreneurs, experienced mentors, investors and the overall StartX community was an invaluable learning experience. It thought me the value of a social support structure for entrepreneurs, leading to some of the research questions in this thesis. I also met Prof. Henry Etzkowitz, when he was a research fellow at the H-STAR Institute at Stanford University. He inspired me, especially through his work on the "entrepreneurial university". I am grateful for our collaboration and your role as a reviewer of my thesis. I also want to thank the second reviewer Prof. Christian Ramsauer from Graz University of Technology, as well as Prof. Sabine Köszegi and the colleagues from the Institute of Management Sciences at the Vienna University of Technology for their support. Appreciation is also extended to the entrepreneurs who participated in the survey and the helpful colleagues at various universities, research institutes and startup support organizations in Europe and the USA.

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"*The important thing is not to stop questioning. Curiosity has its own reason for existence. One cannot help but be in awe when he contemplates the mysteries of eternity, of life, of the marvelous structure of reality. It is enough if one tries merely to comprehend a little of this mystery each day*." – Albert Einstein

Georg Fuerlinger,

Vienna, October 2020

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English Abstract

Technology and knowledge transfer from the university to the market, particularly through university startups and spin-offs, play a crucial role in innovation driven economies. The concepts of entrepreneurship ecosystems and the entrepreneurial university highlight the importance of social networks transcending the university to foster academic entrepreneurship. The objective of this empirical study is to analyze the role of human and social capital in early-stage university startup development and their impact on startup growth performance. Furthermore, this thesis explores the differences in the human, social and financial capital endowment of university startups in the USA and Europe, considering cultural and institutional factors in the surrounding ecosystems. In a first step, exploratory interviews at the Stanford University`s startup accelerator program StartX in Silicon Valley and the New York Institute of Technology were conducted. Based on those insights, combined with an extensive literature review, the conceptual model, research hypothesis and questionnaire were developed. A large-scale, web-based survey was compiled, receiving 409 responses from university startups in Austria, Germany, Sweden, Switzerland and the USA. This unique dataset forms the basis for the quantitative analyses, through descriptive and multivariate statistical methods, to verify the postulated hypotheses. In terms of human capital, the entrepreneur`s growth aspiration and prior startup experience, as well as a committed founding team, have a significant positive impact on raising financial capital and on startup growth performance overall. Empirical evidence underlies the importance of actors outside the research network to support university startup development. It also shows how intermediary organizations, like incubators and accelerators, can contribute to the development of social capital of startups. The results also shed light on the differences in human, social, and financial capital endowment of university startups in the USA and Europe and how these factors are interrelated. In conclusion, implications for academic entrepreneurs, startup support organizations and policy makers are discussed, and the thesis concludes with an agenda for future research.

Deutsche Kurzfassung

Technologie- und Wissenstransfer von der Universität auf den Markt, insbesondere durch universitäre Spin-offs und Startups, spielen eine wichtige Rolle in wissensbasierten und innovationsgetriebenen Volkswirtschaften. Sie fördern das Wirtschaftswachstum durch die Schaffung von Arbeitsplätzen, sind Quelle radikaler Innovation und bringen Technologien auf den Markt, die sonst unentwickelt bleiben würden. Der Begriff der „unternehmerischen Universität" umfasst, neben den traditionellen Aufgaben der Lehre und Forschung, vor allem die „dritte Mission" der Universität, und betont deren Beitrag zur wirtschaftlichen und sozialen Entwicklung. Universitäten werden nicht mehr als isolierte „Elfenbeintürme" gesehen, die getrennt von ihrer Umgebung agieren, sondern als eingebettete Institutionen, die mit Akteuren am Markt interagieren. Die Konzepte der Gründer- bzw. Innovationsökosysteme unterstreichen die Bedeutung von Humankapital und sozialer Netzwerke, die über die Universität hinaus reichen, um akademisches Unternehmertum zu fördern. Die jüngsten Bemühungen zur Unterstützung der Entwicklung universitärer Startups bleiben jedoch hinter ihren Erwartungen zurück. Dies gilt insbesondere für Technologietransferbüros, aber auch bis zu einem gewissen Grad für universitäre Inkubatoren und Gründerzentren.

Ziel dieser empirischen Studie ist es daher, die Rolle von Human- und Sozialkapital in der frühen Entwicklungsphase universitärer Startups aufzuzeigen und die Auswirkungen auf deren Wachstumsleistung zu analysieren. Darüber hinaus untersucht diese Arbeit die Unterschiede in der Human-, Sozial- und Finanzkapitalausstattung von Startups in den USA und Europa, unter Berücksichtigung kultureller und institutioneller Faktoren. In der explorativen Phase wurden Interviews im Silicon Valley bei StartX, der Startup-Accelerator der Stanford Universität, und am New York Institute of Technology durchgeführt. Basierend auf diesen Erkenntnissen, in Kombination mit einer umfassenden Literaturrecherche, wurden das konzeptionelle Modell, die Forschungshypothesen und der Fragebogen entwickelt. Eine groß angelegte, internet-basierte Umfrage erzielte 409 Antworten von universitären Startups aus Ökosystemen in Europa (Österreich, Deutschland, Schweden) und den USA (Silicon Valley, Boston, New York). Dieser

einzigartige Datensatz bildet die Grundlage für die quantitativen Analysen durch deskriptive und multivariate statistische Methoden zur Überprüfung der postulierten Hypothesen.

Die Ergebnisse der Studie bestätigen den signifikanten Einfluss von Human- und Sozialkapital auf die Entwicklung und Performance universitärer Startups. Auf Ebene des Humankapitals wirken sich die Wachstumsambitionen des Unternehmers, dessen vorherige Startup Erfahrung sowie ein engagiertes Gründungsteam positiv auf die Beschaffung von privatem Investitionskapital und die Wachstumsleistung des Startups aus. In diesem Zusammenhang sind signifikante Unterschiede zwischen Startups in den USA und Europa zu erkennen, die unter anderem auf die unterschiedlichen institutionellen und kulturellen Rahmenbedingungen zurückzuführen sind. Die empirische Daten belegen ausserdem die zentrale Bedeutung von Akteuren außerhalb des Forschungsnetzwerks für die Entwicklung universitärer Startups. Durch ihr komplementäres Wissen und Netzwerk unterstützten sie die GründerInnen vor allem bei der Geschäftsentwicklung, aber auch beim Aufbau einer skalierbaren Organisation. Im Bereich der Technologie- und Produktentwicklung ist die Einbindung von Akteuren aus dem Forschungsbereich als auch der Wirtschaft zentral. Auch auf der Ebene des Sozialkapitals und der Finanzierungsquellen zeigen sich signifikante Unterschiede zwischen den USA und Europa: während in den USA vor allem private Investoren und andere Unternehmen Startups unterstützen, sind es in Europa vor allem Akteure aus dem öffentlichen Bereich. Des Weiteren zeigt diese Arbeit, wie Startup Support Organisationen (Inkubatoren, Gründerzentren und Accelerators) zur Entwicklung des Sozialkapitals universitärer Startups beitragen können, indem sie eine vermittelnde Rolle zwischen den Forschungs- und Wirschaftsnetzwerken einnehmen.

Die vorliegende Arbeit trägt dazu bei, die verschiedenen Ebenen des universitären Startup Prozesses besser zu verstehen und zeigt strukturelle Unterschiede in der Unterstützungs-Infrastruktur in Europa und den USA auf. Basierend auf diesen Erkenntnissen werden Handlungsempfehlungen für akademische GründerInnen, Startup Support Organisationen und politische Entscheidungsträger abgeleitet und diskutiert. Den Abschluss dieser Arbeit bildet eine Agenda mit zukünftigen Forschungsfragen im Bereich des akademischen Unternehmertums.

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1 Introduction

1.1 Academic Entrepreneurship fostering Economic Growth

Universities play an important role in the knowledge based and innovation driven economies (Smith 1995). Brescia et al. (2016) point out that universities are central actors in producing and delivering new knowledge, the strategic resource of the "knowledge-based economy" (Lundvall & Johnson 1994). Therefore, they are playing a unique role in national and regional innovation systems. The new knowledge produced by universities is an important pillar for long-run technological development. According to Witt (2006), the research on knowledge- and technology transfer from universities into the market has considerable politico-economic importance and fostering the formation of innovative new business ventures can create benefits through the commercialization of research conducted at the universities (Matkin 1990).

Furthermore, universities provide human capital, which is one of the major input factors for innovation. Research has shown that academics are more likely to be self-employed during their careers, compared to people who did not receive some kind of formal education at a university (Robinson and Sexton 1994). Policy makers and economic experts emphasize the promotion of entrepreneurship among young and highly educated people, as well as shifting the attention towards entrepreneurship education at the university level (Franke & Lüthje 2002). In order to support economic growth through entrepreneurship, universities must increasingly recognize their central role and establish programs and especially a culture that makes entrepreneurship accessible to a wide range of students (Roberts & Eesley 2009).

In addition to developing human capital through teaching and education as well as advancing technology through research, universities are seen as an economic development partner together with market participants, as well as local, state, and national governments (Heaton et al. 2019). The term 'entrepreneurial university' was coined by Etzkowitz (1983, 1998, 2000, 2008) and encompasses the evolution of a university system that emphasizes economic development, in addition to the more traditional missions of teaching/education and research. Universities began to observe the importance of their role in knowledge management through improvements in the economic aspects (Croce et al. 2014). According to a comprehensive study in tech transfer research (Yusof & Jain 2010), the majority of scholars agree that tech transfer is a process and can happen by formal (licensing, patenting, strategic alliances, and spin-offs) or informal (knowledge transfer, consulting, and joint publications) means. The exploitation and transfer of scientific knowledge into new businesses is a core challenge for innovation and economic policy. Hence, fostering the creation of science-based startup and spin-off companies[1] has raised considerable attention in the last years in many countries around the world for good reasons.

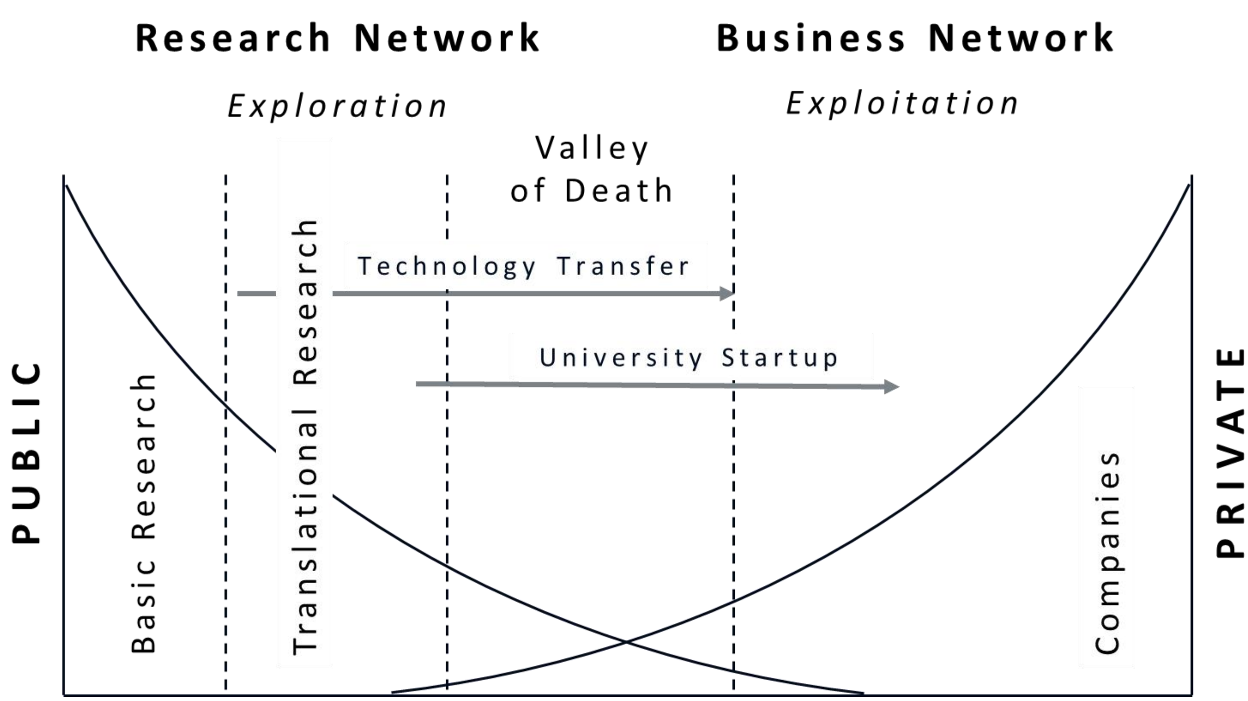
New technology-based firms are an important focus for those who deal with competitiveness policies, Minola and Giorgino (2011) argue, since they give significant stimulus to economic growth, in terms of employment (Acs 2004) and as a primary source of radical innovation (Audretsch 1995). First, since new inventions come with high uncertainty of applicability, they are often unattractive for larger, incumbent firms. Therefore, commercializing academic research through university startups brings technologies to the market that otherwise would be left undeveloped (Etzkowitz 2003). For this reason, university startups are more likely to develop more innovative products than their technology counterparts without academic origin (Blair & Hitchens 1998). Second, this results in the creation of jobs that require highly educated personnel (Shane 2004), which offers opportunities to local talents and thus can help to curb brain drain (McDevitt et al. 2014). Third, these jobs can be interpreted as being more secure than jobs in another new venture, when comparing their improved survival rates. Taking ETH Zurich, Switzerland, as an example, 90% of the 153 spin-offs founded between 1998 and 2008 were still in business after five years (Veugelers 2014).

1 In terms of definitions, one has to differentiate between a university spin-off "a new venture initiated within a university setting and based on technology derived from university research" (Rasmussen & Borch 2010) and a university startup. The latter is a wider term referring to a new company founded by people who were or are working in science or at a university, or by people who recently started to study, were studying at the time of founding or have dropped out of their studies. In comparison, those kinds of companies do not necessarily depend on new research findings or new scientific processes/methods/skills developed at the university (Egeln et al. 2007). Following those definitions, every university spin-off is also a university startup, but not the other way around.

1.2 Problem Statements and Research Gap

However, the transition from invention to innovation is not a straightforward, linear process (see Chapter 2.2.1). Many technology development projects, and especially new ventures, are not able to cross this "Valley of Death", situated between translational research at the research institution and established companies in the market. Decision makers at the university level, as well as policy makers, must understand and support the process of turning science-based 'inventions' into commercially viable 'innovations' in order to spur radical technological change (Fuerlinger et al. 2015) and convert the nation's research assets into economic assets (Auerswald & Branscomb 2003). Academic entrepreneurship in the form of university startups is a potent way to accomplish this mission, by bridging the research and business networks.

Figure 1: Valley of Death Separating Research and Business Networks



Source: Adapted from Katehi (2010)

In order to develop a successful venture out of the university context, one has to take the social context and dynamics into account, to understand which factors can foster or hinder university startup development and, ultimately, market success.

1.2.1 Structural Holes between Research and Business

To explain the success of startups and particularly university startups, the concept of the entrepreneurship ecosystems raised attention in the literature (see Chapter 2.1). It is argued that an entrepreneurship ecosystem consists of a research (or knowledge, science) and a business (or commercial, industry) sub-system or network (Rijnsoever 2020, Clarysse et al. 2014, Powell et al. 2012). Those parts are connected to different degrees, depending on regional idiosyncrasies, leading to smaller or larger gaps between them. For university startups to be successful, strong support from and linkages between these two types of networks are a necessary prerequisite. Hence, from a social network perspective, structural holes between scientific research networks (academics, scientists) and industry or business networks (financiers, professional managers, industry partners and potential customers) are barriers to successful tech transfer from the university to the market (Mosey & Wright 2007). Structural holes (Burt 1992) can be defined as unconnected parts of a social network due to missing links between, or a gap between, two actors who have complementary resources and sources of information.

Even though entrepreneurial activity is on the rise in many metropolitan areas around the world, many scholars argue that Europe, in particular, lacks entrepreneurial activity and needs a stronger focus on entrepreneurship-driven innovation to compete globally (European Commission 1998, Aho 2006, EIT 2012, OECD & European Commission 2013). However, many research-intensive universities in Europe or elsewhere display low levels of entrepreneurial activities due to various factors. These are including: structural 'division of labor' between technical and more general universities, low R&D potential of local and regional firms and weak interaction with the university, and strong cultural and language differences between the triple helix actors (government, industry and academia), among others (Etzkowitz et al. 2008). Furthermore, Rijnsoever (2020) argues that so called "weak network problems" are present in the financial support networks, consisting of startups and private investors, especially in Europe. This has considerable impact on technology transfer, since those financial support networks bridge those unconnected subsystems and, therefore, support the effectiveness of the overall innovation system.

In the USA, academic research also often does not produce useful innovation. A survey of the Association of University Technology Managers[2] (2009) in the USA showed that only $ 2.3 billion in licensing revenue was generated by $53.5 billion in sponsored research funding (most of which was provided by federal grants) paid to 181 universities and hospital research labs. Two universities are mentioned as notable exceptions: Stanford University in California and MIT (Massachusetts Institute of Technology). They succeed in combining a strong record in basic research excellence, while at the same time spinning out dozens of new startup companies each year. Their success can be traced back to their strong ties to industry and networks connecting faculty members, entrepreneurs and investors (Kanter 2012). These two institutions provide a benchmark, by which other institutions can measure the economic impact of their alumni entrepreneurs. The Stanford University and MIT entrepreneurship ecosystems consist of multiple education, research and social network institutions that contribute to an outstanding entrepreneurial output. Furthermore, the development of strong linkages to industry and encouraging faculty consulting and entrepreneurship – even before the beginning of the twentieth century – were other factors influencing entrepreneurship in the university and the region. The significant impact of these entrepreneurship ecosystems supporting startups was quantified by two large-scale surveys of entrepreneurs, for MIT (Roberts & Eesley 2009) and for Stanford (Eesley & Miller 2012). The authors conclude that if the active companies founded by their graduates were considered an independent nation, based on their revenues, they would be on the list of the largest economies in the world. These alumni-founded companies together employ millions of people and generate annual worldwide revenues of trillions of US dollars.

Best Practice: Stanford University's Startup Accelerator StartX

The author spent three months working with the startup accelerator program *StartX* at Stanford University in the Silicon Valley. He interacted with his staff colleagues, startup founders participating in the program, as well as with mentors and other stakeholders involved in the program. Research conducted by the StartX management has shown that successful

2 Association of University Technology Managers (AUTM) - a nonprofit association of academic technology transfer professionals - releases the AUTM U.S. Licensing Activity Survey: FY2009. The survey shares quantitative information about licensing activities at U.S. universities, hospitals and research institutions.

entrepreneurs – compared to those that fail – were able to build a system of people (cf. social network/capital) around themselves that helps them to get their venture off the ground and to grow it. Once they have established this system, the probability that they will succeed (multiple times) increases dramatically. StartX has recognized the importance of interpersonal relationships and - besides offering other services and resources - leverages the exchange among the founders within the program to learn from, motivate, and support one another (cf. community). Furthermore, their program provides committed and engaged mentorship from hundreds of Silicon Valley veterans, who support the entrepreneurs with know-how, feedback and contacts in the ecosystem (Fürlinger & Leitner 2017). Therefore, the main learning from StartX and Silicon Valley is that the most crucial contribution a startup support organization (cp. incubator, accelerator, etc.) can provide to its startup, is access to the most important resource overall – the right people.

1.2.2 Challenges related to Startup Support Organizations

The awareness of the importance of science-based innovation is continuing to increase. So is the number of startup support organizations at universities. In order to enhance the creation of science-based startups and spin-offs, universities form different types of organizations: Whereas entrepreneurship centers are mostly concerned with research and the teaching of entrepreneurship related topics, tech transfer offices focus primarily on intellectual property related issues. Incubators, accelerators and proof of concept centers, on the other hand, offer more direct support in the formation and development of new businesses.

The number of incubators has been increasing considerably in countries all around the world (Bøllingtoft & Ulhøi 2005). At the beginning of the new millennium, the number of incubators experienced very rapid growth. The overall incubator industry (see Chapter 2.4 for more details) has matured into an international economic-development tool with more than 5,000 programs in more than 100 different countries. However, it has been argued that incubators associated with universities generate the most positive results (Kanter 2012). However, there is still an ongoing discussion about which kind of support methods are most effective in fostering university startup and spin-off development. Even though the academic infrastructure to support university startups has received considerable attention (cf. global benchmarking of university incubators[3]) there have been questions about the effectiveness of tech transfer offices (TTOs) and university incubators.

Challenges related to Technology Transfer Offices

A report from the U.S. National Research Council (2009) describes the complex interactions between university and industry knowledge creation and the development of new information technology products. In most knowledge transfers to industry, there was little or no involvement by the TTOs. One of the reasons mentioned was that research logic and market logic are not congruent. The connecting link between the research domain and market orientation is what Faltin (2008) calls "entrepreneurial design". To develop and implement such a design is the entrepreneur's task. Technology alone is not a sufficient concept for new venture formation – this was one lesson learned from the first internet boom. The lack of this concept cannot be overcome with excellent management capabilities or capital. This also explains the low efficiency of transfer offices at universities and research and technology organizations. The transfer per se is the entrepreneurial performance itself. For this task, according to Faltin (2008), entrepreneurs are needed, not employees from universities.

Furthermore, there have been critiques of the role and skills of TTOs (Lowe 2006, Siegel et al. 2003), which argued that TTOs play only a limited effective role in creating and developing startups (Grimaldi et al. 2011). They argue that the restricted attention to technology licensing as means of university-industry relations, limits our understanding of the university's role in the technological progress of society.

According to a report from the Brookings Institution (Valdivia 2013), 130 U.S. universities did not generate enough licensing income in 2012 to cover the wages of their technology transfer staff and the legal costs for the patents they filed. Over the last 20 years, on average, 87 percent of the universities did not break even. Similarly, in Europe, despite the spread of TTOs, in several countries where universities had owned the IP, patenting activity was weak (Baldini 2009).

3 by UBI Index, http://ubiindex.com

Possible reasons for this weakness could be inadequate internal support mechanisms, the relative embryonic nature of TTOs and underdeveloped commercialization skills of TTO staff (Lockett & Wright 2005). Morsey and Wright (2007) also state that the lack of experience of TTOs in starting new ventures and their conflict of interest as representatives of the university are limiting factors to successful spin-off creation.

Challenges related to Incubators

Dane Stangler, former vice president of research and policy at the Kauffman Foundation, the world's largest entrepreneurship foundation, reported that "*multiple studies have shown that incubators don't work and, worse, they frequently subsidize companies that would otherwise fail. True, there are a handful of successful incubators, but incubators suffer from a design flaw: they are more often about real estate than entrepreneurship*."[4] Similarly, the European Court of Auditors (European Union 2014) found in their report that the provision of incubation services and, consequently, the wider impact on local businesses was rather limited throughout Europe. They attribute this situation to the lack of experience concerning incubation practices of the Member States, incubator managers and shortcomings in management systems. More specifically, the report points out, insufficient attention was paid to the effectiveness of incubators' business support functions. They were too loosely linked to the incubatees' business objectives. Furthermore, the monitoring systems within the incubators do not provide relevant management insights and there is a mismatch between the incubators' financial sustainability and the objective of providing effective incubation services. However, the report also attributes shortcomings to the European Commission, which has not taken adequate steps to facilitate the exchange of knowledge and good practices.

Regardless of these shortcomings, billions of dollars have been invested globally in proof-of-concept centers, incubators, science parks, university venture funds and other types of organizations and programs, in order to support university startups and spinoffs (Hayter 2013). It is argued, however, that if these efforts do not incorporate relevant, robust network-building elements, they not only risk being ineffectual, they may actually have a negative impact on spin-

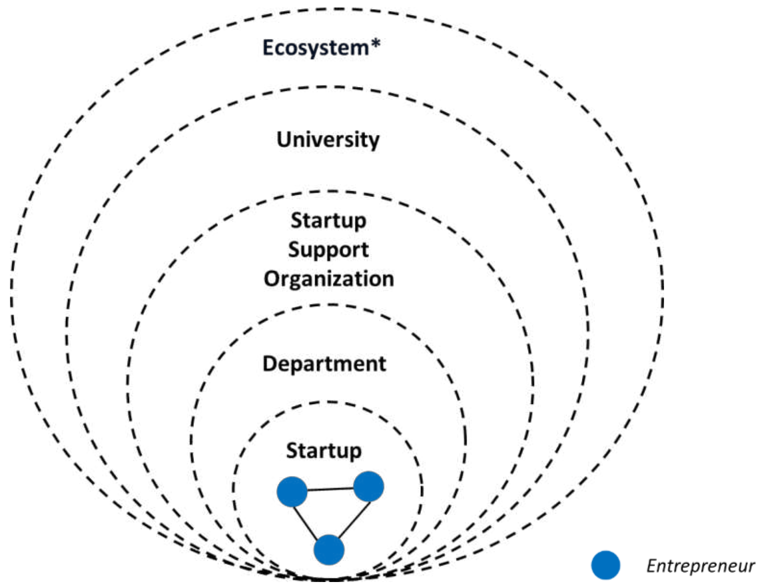
4 http://techcrunch.com/2014/03/15/avoid-stagnation-why-acceleration-trumps-incubation

off success (Hayter 2013). Thus, one important success factor for university startups is the academic entrepreneur's ability to build relationships outside of the research network and connect with actors from the business network. While incubators can act as intermediaries to overcome these weak network problems, it is often poorly understood how they can do this effectively (Rijnsoever 2020). Another recent study concluded that incubators often provide "symptomatic solutions," by creating a protective environment for startups, instead of dealing with the underlying challenges in the entrepreneurship ecosystem (van Weele et al. 2018b).

1.3 Research Objectives and Questions

Against this background, the main notion of this thesis is that university startup development is a complex phenomenon that needs to be studied on different, interdependent levels. Innovation is the knowledge base of entrepreneurship, a systematic examination of the areas of change that can offer entrepreneurial opportunities (Drucker 1985). Sears & Baba (2011) perceive innovation as a multilevel construct that may be best conceptualized as a process. Furthermore, they state that "*individuals' thoughts and actions provide the ´raw materials´ for innovation to occur at higher levels of analysis*" and that "*contextual (structural, environmental, political) factors at higher levels of analysis can facilitate or constrain innovation at lower levels*." (Sears & Baba 2011, p. 359). Conducting research from a multilevel perspective will assist in integrating this perspective, exploring new cross-level relationships that have not been considered in previous work. This will help in building a more comprehensive understanding of the entrepreneurial process and its success factors.

Figure 2: Academic Entrepreneurship as a Multi-level Phenomenon



* local. regional, national, global ecosystem

Source: own illustration

According to Mosey and Wright et al. (2007), further research needs to explore both institutional mechanisms and the informal networks that allow potential entrepreneurs to access this expertise for academic entrepreneurship. A review of research conducted on the intersection between social science and entrepreneurship acknowledges a large body of work in the field of entrepreneurship (Jennings at al. 2013). However, the authors criticize a lack of cultural context in the studies and ascribe too much focus around individual level agency. On the one hand, so they argue, more micro, practice-oriented, highly contextual work is needed to better understand the entrepreneurial processes. On the other hand, and on the other end of the spectrum, more macro, cross-cultural and transnational institutional work is needed to fill the gaps. This thesis aims to incorporate both, an entrepreneur-focused and practice-oriented approach in an international, cross-cultural setup of leading entrepreneurship ecosystems.

Different institutional contexts in various nations (cf. differences in attitudes towards entrepreneurial activity, availability of and access to financial capital, legislation regarding ownership of IP, etc.) mean that merely emulating or"copying" successful institutions, like Stanford University or MIT, may not be the best strategy to pursue for other universities and research institutions (Kenney & Goe 2004). According to the authors, future work should focus on the following areas:

- differences across the different units of analysis
- differences across the phases of development of university startups/spinoffs
- differences between context - both in terms of the academic (scientific) discipline and the institutional context - and
- differences in human capital requirements of those responsible for filling knowledge gaps.

Overall, at each level, the ecosystem reflects the same key success factors (Fetters et al. 2010). For this reason, universities can be perceived as entrepreneurship ecosystems (Rice and Habbershon 2006) and so can incubators (Rice and Habbershon 2006). Still, as in the case of all ecosystem evolutions, the initial conditions are transformed through human action (Grimaldi et al. 2011).

It is the activities on the micro level, the startup level, that impact the higher levels and lead to change. Therefore, one has to understand the entrepreneurs' characteristics and the social dynamics happening on the startup level in order to derive suggestions on how to strengthen the entrepreneurship ecosystem overall.

In order to understand the phenomenon of academic entrepreneurship in more detail, it is necessary to adopt an integrative view. Along those lines, a model is developed that focuses on the human capital endowment of university startups, as well as their social embeddedness in the local ecosystem[5].

In short, the objective is to describe the differences of human and social capital of university startups in the USA and Europe, examine their role in early-stage development and their impact on growth performance.

On the macro level, this thesis aims to contribute to the fast-growing research body on

5 Grimaldi et al. (2011) divides the (eco)system level into Local-Context Support Mechanisms, like the regulatory legislative framework, and University-Level Support Mechanisms, as internal policies, for example. Their results show that regional idiosyncrasies should be taken into account, in order to develop effective spin-off support policies by universities. In this study we refer to the Local Context as Entrepreneurship (or Innovation) Ecosystem.

entrepreneurship ecosystems (see Chapter 2.1. for more details), and examine how this approach can contribute to the discussion on how to support the creation and development of university startups. Degroof and Roberts (2004) suggest that in highly developed entrepreneurial contexts (cp. ecosystems) a strong community is selecting the most promising ventures and allocating resources accordingly. In this scenario, a university might adopt a more passive strategy. In underdeveloped entrepreneurial contexts, universities need to be more proactive, by being selective and providing support (e.g. incubation) to new ventures (Clarysse et al. 2005, Wright et al. 2008). Furthermore, in such a setting, a university can be more successful by supporting bridge building and facilitating contacts (Fini et al. 2009). Heaton et al. (2019) also argue that the role and functions of universities changes, depending on the maturity of the innovation ecosystem it is embedded in. Lendner (2004) identified that more than 80% of the university incubators are located either in the USA or in Europe. For this reason, he recommends focusing on these two geographical areas, when conducting further research in the field of university startup support. Therefore, the first research question can be formulated as follows:

1. *How does the surrounding entrepreneurship ecosystem influence university startup development in the USA and Europe?*

The insights from exploratory interviews at Stanford University`s Startup Accelerator in Silicon Valley (Fürlinger & Leitner 2017) and the literature review revealed that structural holes between scientific networks and industry and market networks are one of the main barriers to successful tech transfer from the university to the market (Mosey & Wright 2007). The need to develop linkages between science, technology, and utilization has been caused among others by the rapid rate of technological change, shorter product lifecycles, and the more intense global competition (O'Shea et al. 2004). Building on these findings, the second research question regards the role of social capital in the university startup process, focusing on the social dimension of context (Hoang & Antoncic 2003, Stuart & Sorenson 2005, Welter 2011, Zahra & Wright 2011):

2. *How does social capital affect the early stages of university startup development?*

The cultural and institutional context in which these startup activities are taking place are influencing the relationship between university research and private sector innovation (Yusof & Jain 2010). Different actors in the research network and the surrounding business network can be helpful to bridge the transition from one environment into the other. Studying academic entrepreneurship on both sides of the Atlantic and given the institutional and cultural differences (Hall and Soskice 2001, Cooke 2004, Asheim 2007), one can assume that considerable differences exist in terms of the social capital endowment of university startups in those two regions. Research question number 2a aims to discover this:

2a. What is the difference between the social capital of university startups in the USA and Europe?

More specifically, more research is needed to explore which kind of actors (cf. social capital) allow academic entrepreneurs to access the know-how, expertise and resources needed to successfully develop their new venture. Those supporting actors can be situated within or outside the research network and can provide assistance through different means, in order to help the newly established startup to successfully develop and cross the Valley of Death (Auerswald & Branscomb 2003). On this level, the study aims to identify the boundary spanners and bridge builders, who are central to the development of university startups in particular, and as a result for the effectiveness of the technology transfer process overall. Therefore, research question number 2b asks:

2b. Who are the most important actors within and outside the research network and how do they support the early stages of university startup development?

The university (and department) that the new companies are spinning out from and its support infrastructure, including institutions like incubators, accelerators or tech transfer offices, are the next level of analysis. These startup support organizations can take on the role of an intermediary (Van Weele et al. 2018b) between the research environment and the market. The role of startup support organizations, like incubators and accelerators, has changed from a property-based approach towards a social network/capital approach of incubation: the emphasis is placed on the network effect the incubator has on its startups, rather than its physical location. Incubation is a process, not a place. Hence, the perception of an incubator moved from an isolated to a networked entity (Etzkowitz 2002, Bøllingtoft & Ulhøi 2005) or a new generation of 'systemic incubators' (van Weele et al. 2018b). Focusing especially on the external networking effect of incubators (Grandi & Grimaldi 2005), research question number 2c states:

2c. How do startup support organizations at universities (e.g. incubators and accelerators) contribute to the development of the university startup's social capital, by providing contacts to actors outside the research network (cp. external networking)?

The micro level focuses on the entrepreneur and the team behind the new venture and the creation of new firms to exploit university technology (Mowery and Shane 2002). The entrepreneur and his team need to have the ability and motivation (Adler & Kwon 2002) – subsequently referred to as human capital - to use resources effectively and efficiently in order to achieve growth and be successful in the long run. Formal education, like a doctoral degree (Hsu 2007), prior startup experience (Steen et al. 2010, Hayter 2013), domain-specific knowledge (Ensley & Hmieleski 2005, Wright et al. 2007, D'Este et al. 2012) and management experience (Brush & Hisrich 1991) have been shown to have an impact on startup performance. Chemmanur et al. (2014), for example, have shown that venture capital financing is associated with higher-quality startup management teams, acknowledging the importance of human capital in the fundraising process. Some research studies (Mosey & Wright 2007, Wright et al. 2007, D'Este et al. 2012) have examined how human capital and networks of entrepreneurs complement each other. However, up to this point, we have only limited knowledge about how academic entrepreneurs identify and establish contacts with partners from the industry that have resources and capabilities they lack (Grimaldi et al. 2011). Few nascent and novice entrepreneurs are actually building those relationships that are crucial for the spin-off process (Mosey & Wright 2007). More insights are needed to further our understanding of how human and social capital interrelate and support a startup's access to resources and its performance. Therefore, the last two research questions focus on those concepts:

3. *How does human capital affect social capital development and access to financing of university startups?*
4. *How do human, social and financial capital affect the early stages of university startup performance?*

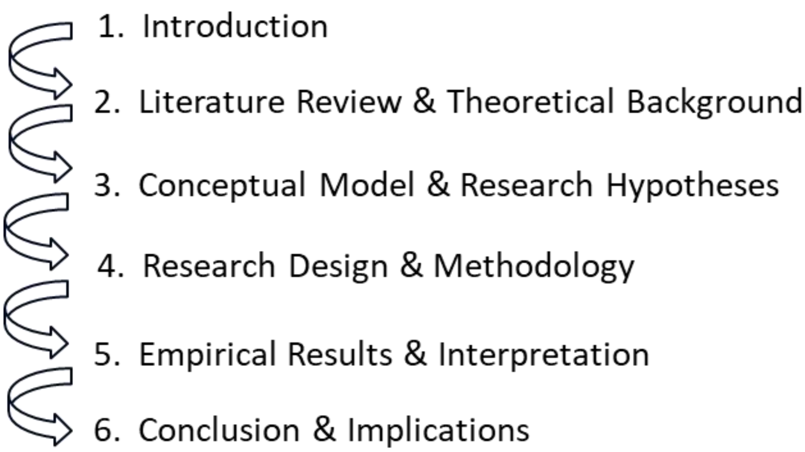
In summary, this research project employs an integrative, multi-level approach to better understand academic entrepreneurship and university startup development in the USA and Europe. On the macro level, institutional and cultural factors, as well as different support actors in the entrepreneurship ecosystem surrounding the university startup are analyzed and compared. At the university (meso) level, the focus shifts to the startup support organizations, like incubators and accelerators, to examine their role in developing the social capital of university startups. In a next step, the research focus zooms into the university startup itself (micro level) and aims to understand the interrelationship of human, social and financial capital. Building upon those findings, the final objective is to identify the effects of those different forms of capital on startup growth performance.

Heaton at al. (2019) also argue in favor of more empirical work around the role of universities in innovation ecosystems and how they can lead and orchestrate other ecosystem members in favor of the development of individual startups in particular, and their region's development overall. According to Mosey and Wright et al. (2007), further large-scale quantitative studies are also required to test the generalizability of the propositions developed in their research (see Chapter 3). This research project follows those suggestions and is conducting a large-scale, quantitative study of university startups in selected ecosystems in the USA and Europe. In order to answer the presented research questions, a new database of university startup companies was compiled. Receiving responses from 409 startups across Austria, Germany, Sweden, Switzerland and the USA led to the compilation of a unique data base. Hence, the results presented in this thesis rely on data not used before and allow new insights into the complex phenomenon of academic entrepreneurship.

1.4 Thesis Outline

In order to answer the research questions stated above, a comprehensive research project was conceptualized and implemented. The structure of this doctoral thesis is presented in the graphic and its description below.

Figure 3: Doctoral Thesis Structure



The first chapter introduces the reader to the topic of academic entrepreneurship and underlines the importance of technology transfer and university startup creation for economic development. Furthermore, it highlights the related challenges (cf. problem statement) and derives the research gap and questions of the study. Chapter Two provides an overview of the current state of the scientific literature in the field of entrepreneurship ecosystems, academic entrepreneurship and university startup success factors. Moreover, a special focus is placed on new insights on the role of social capital in startup development and new business incubation. The third chapter builds upon the current state of the scientific literature. A multi-dimensional model is developed, incorporating different factors influencing university startup development and performance. Based on the literature and the framework developed, hypotheses are posited on the interrelation of the human capital endowment of university startups, their social capital, and funding sources, as well as the ecosystem they are embedded in. Furthermore, hypotheses are derived on the influence of these factors on startup performance and their expected differences between the USA and Europe. Chapter Four introduces the methodological approach of the study, describing the different steps of the project with a particular focus on the large-scale quantitative survey conducted on both sides of the Atlantic. Another part of this chapter is the operationalization, in terms of the variables and statistical methods applied, in order to test the hypotheses proposed in the previous chapter. The next chapter presents the results of the analyzed survey data, first in a descriptive manner and then with respect to the individual hypotheses. The objective in each of the sub-chapters is to verify or reject a specific set of hypotheses and interpret the results in view of the research questions. The thesis concludes by synthesizing the results and stating the main findings of this comprehensive research endeavor. Implications and recommendations for entrepreneurs, universities, startup support organizations and policy makers are also provided. In a last step, certain limitations of the study are discussed and ideas for further research in this field are proposed.

2 Literature Review and Theoretical Background

2.1 Defining Startups and Entrepreneurship Ecosystems

In this chapter, underlying concepts and central terms are defined, which will be used extensively throughout this thesis. This initial theoretical introduction aims to provide a common understanding for readers from different backgrounds and form the basis for further discussion about these specific topics.

2.1.1 Entrepreneurship, Innovation and Startups

The term "entrepreneur", according to Drucker (1985), was coined by J.B. Say at the beginning of the 19th century. "*The entrepreneur*", he further states, "*shifts economic resources out of an area of lower and into an area of higher productivity and greater yield*". Even though in today's language, an entrepreneur is often regarded as somebody that starts or owns a small business, it takes more to be an entrepreneur. Therefore, not every new venture or small business necessarily represents entrepreneurship. An entrepreneur, according to Isenberg (2011) is a person who is continually pursuing economic value through growth and, as a result, is always dissatisfied with the status quo: very generally spoken, entrepreneurs buy inputs low, transform them through risk, and sell them high. Self-employment per se is not entrepreneurship - self-employment plus aspiration is. Aspiration is the divide between entrepreneurs and non-entrepreneurs (Isenberg 2011). It is a trait that will be discussed in more detail later in conjunction with human capital. Compared to a life-style business that is generating enough money for the owner to make a living, a successful entrepreneur is driven by the urge to grow, "[…] *aims high and tries to create value and impact*" (Drucker 1985, p. 35). Entrepreneurship needs different policies and environments than the self-employed and SMEs. Entrepreneurs do not want to be associated with SMEs, since for them being small is instead a transitional state and connotes being static and second-tier. They want to surpass the established large competitors.

“*Entrepreneurship is neither a science nor an art. It is a practice.”* Drucker (1985) stated and described entrepreneurship as *“a distinct feature whether of an individual or of an institution. It is not a personality trait; […] people who need certainty are unlikely to make good entrepreneurs. […] But everyone who can face up to decision making can learn to be an entrepreneur and to behave entrepreneurially. Entrepreneurship, then is behavior rather than personality trait. And its foundation lies in concept and theory rather than in intuition*.”

Even though this definition opens the field of entrepreneurship for a variety of people, substantial research has been done regarding the characteristic traits of entrepreneurs. Among others, those include personal initiative, the ability to consolidate resources, management skills, a desire for autonomy, risk taking, aggressiveness, competitiveness, goal-oriented behavior, confidence, opportunistic behavior, intuitiveness, reality-based actions, the ability to learn from mistakes and the ability to employ human relations skills (Kuratko 2008). Entrepreneurs see the world through different eyes. What others see as market failure, inefficiency, or lower quality, they perceive as room for improvement and opportunity. To be active and action-oriented are their main characteristics. They act because they firmly believe that they can shape the future and the world in which they live. Entrepreneurs firmly believe that everyone is a blacksmith of their fortune—according to Abraham Lincoln's advice: "*The best way to predict the future is to create it*. [6]"

In his book, Burkeman (2012) describes how the psychologist Saras Sarasvathy challenges the widespread view of the entrepreneur or innovator as a goal-oriented go-getter who brings her concrete vision to market. She interviewed forty-five successful entrepreneurs, with a minimum of fifteen years’ experience in launching businesses and at least one company they had taken public. Their precise endpoint was often mysterious to them. None of them suggested creating a detailed business plan or doing comprehensive market research. Instead, the entrepreneurial spirit relies on something completely different, according to Burkeman & Sarasvathy: “*The most*

6 This phrase is often also attributed to Peter Drucker, Alan Kay or Willy Brandt.

valuable skill of a successful entrepreneur […] isn't "vision" or "passion" or a steadfast insistence on destroying every barrier between yourself and some prize you're obsessed with. Rather, it's the ability to adopt an unconventional approach to learning: an improvisational flexibility not merely about which route to take towards some predetermined objective, but also a willingness to change the destination itself.[…]" Sarasvathy (2001) describes this as part of the "effectuation approach" which is guided by four principles: affordable loss, rather than expected returns; strategic alliances, rather than competitive analyses; exploitation of contingencies, rather than preexisting knowledge; and control of an unpredictable future, rather than prediction of an uncertain one. So, you "*Start with your means. Don't wait for the perfect opportunity. Start taking action, based on what you have readily available: what you are, what you know and who you know*." (Burkeman 2012, p. 98) Similarly, Baker & Nelson (2005) explain what entrepreneurs do when they face resource constraints and refer to it as the behavioral theory of "entrepreneurial bricolage": Entrepreneurs apply combinations of the resources at hand to new problems and opportunities.

The Difference between Management and Entrepreneurship

Management, according to Drucker (1985), can be defined as "useful knowledge" that enables productive people of different skills and knowledge to work together in an organization. Based on this definition, it is a general term that can apply to new ventures in the same way as for established organizations. However, there are distinct characteristics between entrepreneurship and business administration. Entrepreneurship is a creative act. It requires the ability to create something out of nothing and requires an inventive mindset (Timmons 1994). Business administration, on the other hand, requires regulatory, controlling and administrative skills.

Table 1: Entrepreneurs vs. Managers

	Entrepreneurial Focus/Mind-Set	Managerial Focus/Mind-Set
Strategic orientation and resources	Driven by perception of opportunity. Lack of predictable resource needs. Lack of control over the environment. Acceptance of reasonable risk.	Driven by controlled resources. Formal planning systems. Performance measurement criteria. Risk reduction.
Management structure	Flat. Multiple informal networks. Desire for independence.	Hierarchy. Clearly defined authority and responsibility.
Values, beliefs & decision making	Law of small numbers: New idea or insight from unique experience provides estimate of emerging trends	Law of large numbers: Past is the best predictor of the future. Decisions can be quantified.

Adapted from Stevenson & Gumpert (1985) and Wright et al. (2001)

Entrepreneurs or "agents of change" (Kent et al. 1982) like to upset and disorganize and to do things differently, rather than doing better what is already being done. An entrepreneur must practice systematic innovation, searching for change and responding to it by exploiting it as an opportunity (Drucker 1985). Schumpeter (1911) describes entrepreneurs as nothing less than the driving force behind economic development: "*Dynamic disequilibrium brought on by the innovating entrepreneur […] is the "norm" of the healthy economy and the central reality for economic theory and economic practice.*" He further states (Schumpeter 1942) that "*the fundamental impulse that sets and keeps the capitalist engine in motion comes from the new consumers' goods, the new methods of production or transportation, the new markets […] incessantly revolutionize the economic structure from within, incessantly destroying the old one, incessantly creating a new one. This process of Creative Destruction is the essential fact about capitalism."*

Entrepreneurship and Innovation

Entrepreneurs innovate. Innovation is the specific instrument of entrepreneurship. It is the act that endows resources – something in nature with economic value - with a new capacity to create wealth. Innovation is an economic or social, rather than a technical term and can be defined as changing the yield of resources (Drucker 1985). Schramm (2008) defines innovation as "*the design, invention, development and/or implantation of new or altered products, services, processes, systems, organizational structures, or business models for the purpose of creating new value for customers and financial returns for the firm.*" Therefore, it is not the quality of an invention that counts, but its acceptance on the market. Patents and inventions are “only” raw materials. The important question is whether they have the potential to have an impact on daily life. Hence, in order to speak of an innovation, at least two criteria must be met: First, the product or service has to solve a specific problem or fulfill a certain need. In short, it needs to bring value to its customers. Secondly, it must bring some value for the organization bringing this innovation to the market. In an ideal case, an innovation also fulfills a third criterion – completing the Triple-Bottom-Line Approach: the positive impact on society and/or the environment.

Amabile’s (1988) general framework of the innovation process describes different stages (organizational) comprised of: setting the agenda, setting the stage, producing the ideas, testing and implementing the ideas and outcome assessment. Her position is that the following components are integral to innovation: motivation, resources (knowledge, expertise and material resources) and skills. In this innovation process, one can argue that entrepreneurship covers the phases of producing, testing and implementing ideas. Following the Amabile’s arguments above, innovation and entrepreneurship are social phenomena. The effectuation approach postulates that an entrepreneur must start with *what you are, what you know and who you know* (Sarasvathy 2001). This dissertation focuses on the interrelation on “what you are and what you know” (cf. human capital) – and the “who you know or know-who” (cf. social capital) and how these contacts will be able to provide the necessary “know-how” for the challenges at hand.

What is a startup?

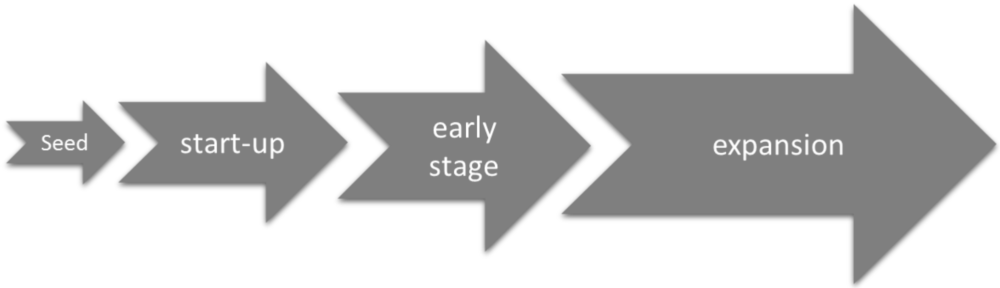
The word ‘startup’ is regularly misused, following various different definitions. Due to this mismatch, it is important to emphasize that this thesis follows the definitions of Steve Blank (2012): Startups are temporary organizations that are designed to evolve into large companies. Blank distinguished between two startups: The first type includes early stage startups that are designed to search for product/market fit under conditions of extreme uncertainty. Late stage startups that are designed to search for a repeatable and scalable business model and then scale into large companies designed to execute under conditions of high certainty. As explained later on, this thesis focuses particularly on science-based technology startups that build their business around a new technology or invention, with the aim to commercialize it or, at least, derive from a university setting.

The Traditional Startup Approach

The conventional approach of starting a company was always closely related to the formulation of a business plan. The business plan is regarded as the central element of a new venture and its key anchor point. For this reason, the entrepreneur (and his team) spends considerable time and effort to derive a convincing plan and try to stick to it as much as possible during implementation. Business plans or product development projects are usually approached like a research exercise and mostly done in isolation – without contact with customers and their feedback. This tendency is supported by the requirements imposed by external investors, who base their funding decision and usually set the milestones based on the information given in the business plan (Ochtel 2009)

It has been widely accepted that each new venture goes through four stages: The seed stage, the startup stage, the early stage, and the expansion stage. In the seed stage, the entrepreneur defines his vision for the new business and develops a strategy on how to develop and market a viable product or service. Furthermore, the financial requirements for building the new business are projected. In the startup stage, the product development process starts, the marketing strategy is refined, and an organizational structure set up. The early stage is focused on launching the product, by following the marketing and sales strategy which was developed earlier. The product reaches its customers (not just beta-testers). In the expansion stage, the focus of the venture is on rapidly scaling the business. The management team is reviewed and eventually re-staffed to suit the shift from building the company to growing the company. In that phase, the organizational structure is frequently adapted in order to meet the new requirements.

Figure 4: ”Traditional Stages” of New Venture Development



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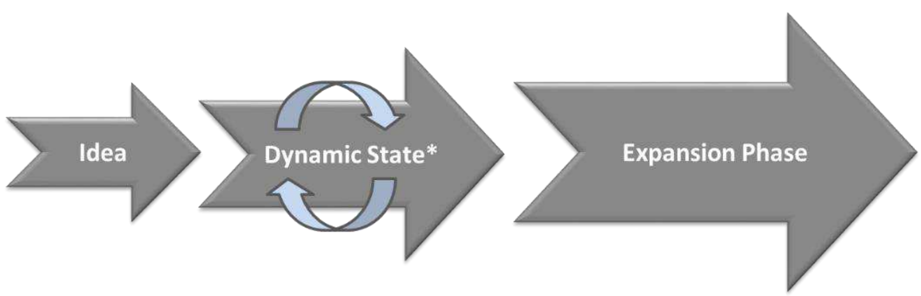
There a several problems inherent in this approach and the business plan. Most of the time, it is not consistent with reality, since the conditions that is assumes may change more or less dramatically. Therefore, strategies to offer a specific product or service, conquer the market or to acquire funding based on certain assumptions will probably not work out as expected. The business plan process is perceived as linear one. However, this linearity can be disrupted by sudden external (market conditions, economy, political regulations, etc.) or internal changes (changing members of the founding team, funding situation, etc.) that demand a quick adaption of the strategic orientation or in the operational focus. Hence, business plans rarely survive first contact with customers, since it is usually based on too many invalidated assumptions (Blank 2012). Long-term projections (three, five or 10 years of costs and revenues most of the time do not represent what is really happening in the volatile course of developing a new venture development.

The Modern Approach: Dynamic State Model

The most comprehensive literature review about entrepreneurial business growth up to this point was done by Levie and Lichtenstein (2008). They examined 104 articles published in the management literature. They conclude that there is no consensus or empirical confirmation of the stage theory that was the prevailing approach to explain new venture growth, especially in the years between 1962 and 2006. Alternatively the authors propose what they call a ”dynamic state model,“ that is defined as ”*a specific business model that generates a configuration of activities supported by an organizational design for a period of time“*. A dynamic state, hence, refers to a business opportunity that the firm aims to capitalize on - the management's attempt to most efficiently/effectively match the organization's internal capacity with the customer demand in the market. Changes in the venture's current dynamic state are triggered by changes in the external demand, or in the capacity of management to lead. This new approach of describing startup growth connects to leading edge thinking in entrepreneurship (Ardichvili et al. 2003) and aims to provide new insights to studies of new venture growth (Nicholls-Nixon 2005).

It must be acknowledged that Levie and Lichtenstein (2008) developed a new approach that mirrors the ambiguity and uncertainty in early phases of a new venture very well. In those early phases (idea, startup und early stage), the new venture engages in constant trial-and-error loops in the search for a viable business model.

Figure 5: Hybrid Model of New Venture Development



Source: own illustration

However, this approach has its limitations, when a new venture enters the expansion phase and focuses on execution. When a venture reaches this stage, it builds on a product-(or service)-market fit and has a proven business model. The focus is now on building and professionalizing the organization and scaling the business. Constant search and trial-and-error are not the norm in this stage. Hence, it is proposed to merge these two approaches – classical and dynamic – in order to accommodate the characteristics of both of the major phases in a new venture – search and execution (see figure above).

The Lean Startup Approach

In a 2013 Harvard Business Review article, a new approach to starting a venture is summarized.

One of the leading figures of "The Lean Startup Approach" is Steve Blank, a successful serial entrepreneur who has taught at U.C. Berkeley, Stanford University, Columbia University, Caltech and UCSF. The next paragraphs describe the paradigm shift away from writing business plans towards a more "hands-on" approach that includes constant feedback loops and modification of the venture's business model and product/service. Using the lean method across a portfolio of startups will result in a lower number of failures than using traditional methods (Blank 2013). Hence, startups should not simply be regarded as smaller versions of large organizations. Large businesses execute a business model, new ventures look for one: "*A startup is a temporary organization designed to search for a repeatable and scalable business model"* (Blank 2013, p. 67). Building on this definition, a startup can be both a new venture, or a new division or business unit in an existing company. In this thesis, however, the focus will be on new venture creation.

Startup success factors

There are different factors that influence the startup process and the survival and success rate of new enterprises. On the one hand, internal success factors are concerned with the entrepreneur/new venture itself and its creation. These factors include the quality and or novelty of the product/service, general organizational aspects, or the management team as examples. On the other hand, some of the success factors are external to the organization and can be attributed to the environment (cf. ecosystem) the new venture is based in. The entrepreneurship ecosystem and its influence on the emergence of new ventures and their development will be discussed in greater detail in Chapter 2.2. In the following, a review on success factors of new ventures is provided.

Gartner (1985), one of the most cited scholars in this field, describes a framework for new venture creation focusing on four areas: characteristics of the founder, the new organization they create, the process of creating a new organization, and the external environment surrounding the new venture

Christensen *(*1997*)* refers to research in the field, which has shown that the majority of successful new business ventures abandoned their original business strategies, when they start to implement their initial plans and learned what works on the market. Therefore, the difference between successful startups and the ones that failed is not the sophistication of their original strategy. In order to prevail and be successful, the ability to iterate towards a new strategy and to conserve enough resources, thus, having strong ties to trusted investors who are willing to back several attempts, is paramount.

Preston (2001), the former associate director of the MIT Entrepreneurship Center, lists the following factors as crucial for building successful high-tech companies: attitude, management team, patents and sustainable management, passionate behavior, product quality and speed to market, flexibility, quality investors and location of the company.

Faltin (2008) coined the term *concept-creative venture formation* (in German: *Konzept-kreative Gruendung*), based on the finding that simple ideas arise at the end of the thought process – not in the beginning. The world is getting more complex every day. We would be overwhelmed, if there would not be innovations that make things easier. However, these game-changing ideas are not derived from brainwaves or out-of-the-blue insights. They are the product of hard consideration.

Isenberg (2011) describes three factors as crucial for the success of a new venture: wisdom in concept, skill in execution and luck in timing.

Song et al. (2008) conducted a meta-analysis to analyze the findings of 31 studies and identified the 24 most widely researched success factors for new technology ventures. Among those studies analyzed, they found that only eight are homogeneous positive significant meta factors that are correlated to venture performance, suggesting they are the only universal success factors for the performance of new technology ventures.

Table 2: Universal Success Factors in New Technology Ventures

Success factor	Definition	References
Supply chain integration	A firm's cooperation across different levels of the value-added chain (e.g., suppliers, distribution channel agents, or customers)	George et al. (2001) George, Zahra and Wood (2002) McDougall et al. (1994)
Market scope	Variety in customers and customer segments, their geographic range, and the number of products	Li (2001) Marino and De Noble (1997)
Firm age	Number of years that a firm has been in existence	Zahra et al. (2003)
Size of founding team	Size of the firm's management team	Chamanski and Waago (2001)
Financial resources	Level of the firm's financial assets	Robinson and McDougall (2001)
Founders' marketing experience	Marketing experience of the firm's management team	McGee, Dowling, and Megginson (1995); Marino and De Noble (1997)
Founders' industry experience	Firm's management team experience in related industries and markets	Marino and De Noble (1997)
Existence of patent protection	Availability of firm's patents protecting product or process technology	Marino and De Noble (1997)

Source: Song et al. (2008)

According to Song et al. (2008), the weak results of the entrepreneurial team factors can be explained in several ways: First, findings may be due to the tendency to limit experience to the number of years the founders spent in a certain area, without measuring the quality, variety, and complementarity of both joint and individual experiences (Eisenhardt and Schoonhoven 1990, Lazear 2004). It is still widely acknowledged, however, that success depends to a large extent on the capabilities and behavior of the entrepreneurs and his team: "*The entrepreneur is ultimately the one who deterministic whether the venture goes or not and who sets it up for failure or success through myriads of other choices*." (Vesper 1990, p. 30-31)

Jacobsen (2003) dedicated her dissertation to the development of a theoretical model of success factors in entrepreneurship. According to her comprehensive research, only the inclusion of all relevant variables in a model - the person (entrepreneur), the organization and the environment - allows to perceive success as the complex socio-economic-technical phenomenon, which it actually is. It is always the interaction between the individual components - the "right mix" – that makes a new venture successful – while "right" can be very different for any two existing companies. In each company, different paths lead to success. Entrepreneurship is still ultimately a very individual process, combining the characteristics and diverse skills of the entrepreneur, the implementation of the organizational processes, as well as the situational and path-dependent factors.

2.1.2 Introduction to Entrepreneurship Ecosystems[7]

The performance of most new ventures has been found to depend on other factors beyond the business itself: the surrounding entrepreneurship ecosystem. However, despite being increasingly central to modern business, entrepreneurship ecosystems are yet not well understood. Like any individual species in a biological ecosystem, each member of an entrepreneurship ecosystem ultimately shares the fate of the network as a whole and is influenced by its comparative strength or weakness. The decisions and moves of a new venture will, to varying degrees, affect its ecosystem health, which, in turn, will affect the venture performance - for bad as well as for good. More recently, different scholars and practitioners have started attempts to describe and/or measure the nature and sustainability of entrepreneurship in a specific geographic area.

The systems of innovation approach emphasizes the importance of interactions among different kinds of actors and technology policy for innovation success (Freeman 1978, Lundvall 1988 & 1992, Fischer 2006). This notion underlines the importance of knowledge exchange among industry and the academic system. Geographically bound social capital creates the opportunities for knowledge exchange (Coleman 1988, Seibert et al. 2001). This approach to social capital was introduced by Putnam (1993), who first looked at social capital as a geographically bound mechanism that promotes knowledge diffusion through informal interactions. Their study highlights the importance of social capital in explaining the differences in economic performance among the Italian regions. Following this seminal study, considerable research focused on the

7 Parts of this chapter are published in Fuerlinger et al. (2015))

relationship between social capital and economic performance (Guiso et al. 2004, Knack & Keefer 1997, Tappeiner et al. 2008) and numerous contributions claim that social interactions in a geographically bound area facilitate learning, knowledge diffusion and relationship formation (Saxenian 1994, Sorenson & Stuart 2001).

Furthermore, the Triple helix concept (Etzkowitz et al. 2000, 2008) highlights the importance of the relationships between industries, universities, and the government. In order to achieve sustainable economic development in a region, these three institutional spheres need to collaborate across institutional boundaries through loosely coupled reciprocal relationships and by starting joint initiatives. Wilson (2012) argues that one of the most important prerequisites for innovation in a certain area is the interrelated cooperation of the four major sectors: government, business, civil society (cf. not-for-profit organizations) and academia – the so called "quad" (or quadruple helix, if referring to the before mentioned helix-concept). The basis for such cross-sector networks between public and private institutions is formed by mutual trust, which can be gradually built by a "social infrastructure," like associations and clubs. Furthermore, the exchange of management practices that embrace innovation and organizational reform and the support of highly skilled and talented individuals are as well crucial for increasing the innovation potential of a region and the emergence of new ventures.

Entrepreneurship as Regional Phenomenon

Entrepreneurship is a regional phenomenon (Bönte et al. 2009, Rocha & Sternberg 2005 and Glaeser et al. 2010). The performance of new ventures has been found to depend on other factors beyond the entrepreneurial team and the business (model) itself: the surrounding environment. For example, Saxenian's (1994) comparative study of Silicon Valley and Route 128 demonstrates that significant differences between communities may result in significantly different economic development outcomes. More recently, different institutions, scholars and practitioners have started to attempt to describe and/or measure the nature and sustainability of entrepreneurship and innovation in a certain geographic area.

Marshall's (1920) approach to industrial districts and Arikan's (2009) regional clusters base their theories on the knowledge exchange approach and describe how knowledge creation is enhanced as knowledge becomes more specialized over time. Porter's definition of clusters is "*a geographically proximate group of interconnected companies and associated institutions"* (Porter 2000, p. 254). Based on this definition, a university is one of these institutions and has its role to support the emergence of an entrepreneurship ecosystem. Moore's (1993) defines an ecosystem as "*an economic community supported by a foundation of interacting organizations and individuals,*" whereas Scott and Sunder (1998, p. 8) came up with a definition for the so called Technopolis as "*emphasizing interlocking relationships between academic, business, and government*". This is similar to the Triple Helix approach (Etzkowitz 2002, 2008) that also focuses on the interaction between these three spheres. Sternberg (2009) describes the regional dimension of entrepreneurship as "*interdependent relationships between regional environments and entrepreneurial activities and outcomes*" and Aulet (2008) understands an entrepreneurship ecosystem as a system of individuals, organizations and resources, government, demand, invention, funding, infrastructure, entrepreneurs and culture. More recently, Autio (2016, p. 20) describes entrepreneurial ecosystems as "*interaction systems comprised of loosely connected, hierarchically independent, yet mutually co-dependent stakeholders*".

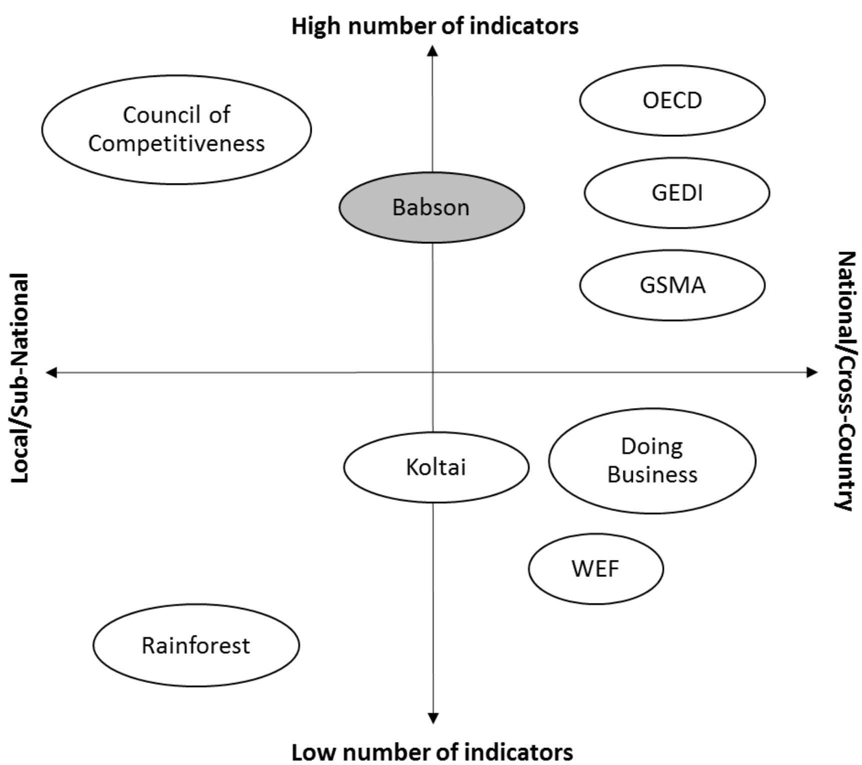
Whereas some recent studies are focused on the macro level, describing factors influencing the level of entrepreneurship on a national level, others are dealing with the micro level, focusing on interpersonal relationships and communities in smaller geographic areas (e.g. cities or organizations). The Aspen Network of Development Entrepreneurs (2013) summarized the research that has been conducted in this new field of study so far and identified several studies developing an entrepreneurship ecosystems assessment framework:

1. Babson College – Babson Entrepreneurship Ecosystem Project
2. Council on Competitiveness - Asset mapping roadmap
3. George Mason University - Global Entrepreneurship and Development Index
4. Hwang, V.H. – Innovation Rainforest Blueprint
5. Koltai and Company - Six + Six
6. GSM Association (GSMA) – Information and Communication Technology Entrepreneurship

7. Organisation Economic Co-operation and Development - Entrepreneurship Measurement Framework
8. World Bank - Doing Business
9. World Economic Forum (WEF) - Entrepreneurship Ecosystem

In the figure below, the different approaches are compared, according to the geographic unit of analysis and the complexity of the model (number of indicators). Some of the models list an extensive list of indicators (OECD: 57 indicators, Asset Mapping Roadmap: 157 indicators), while others are more conceptual and allow more flexibility in assessing entrepreneurial ecosystems (Babson, Koltai).

Figure 6: Entrepreneurial Ecosystem Assessment Frameworks



Source: The Aspen Network of Development Entrepreneurs (2013)

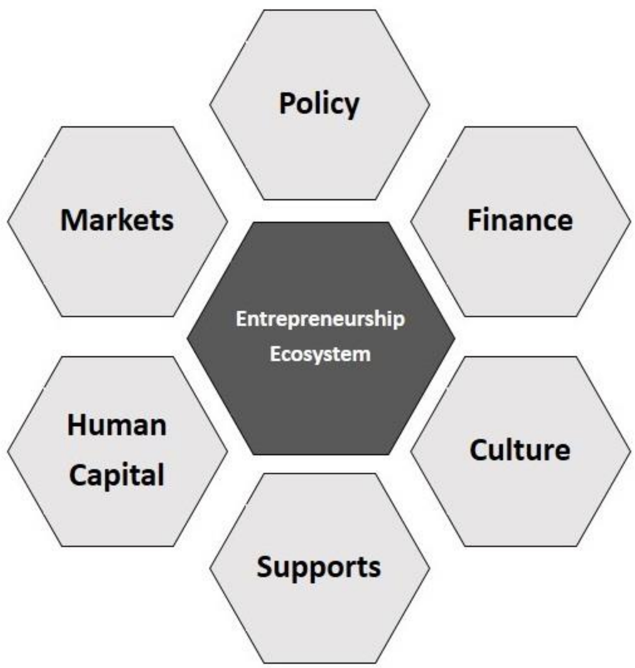
2.1.3 Six Domains of the Entrepreneurship Ecosystem

Daniel Isenberg, leading the Babson Entrepreneurship Ecosystem Project, defines an entrepreneurship ecosystem as "*a set of networked institutions […] with the objective of aiding the entrepreneur to go through all the stages of the process of new venture development. It can be understood as a service network, where the entrepreneur is the focus of action and the measure of success*" (Isenberg 2010, 2011). Therefore, the ecosystem itself consists of various agents, like universities, public and private research organizations, large multinational firms, small and medium-sized companies, startups and spin-off companies, consultants, venture capitalists, public funding organizations, technology-transfer, and regional development agencies and other administrative bodies. He further characterizes an entrepreneurship ecosystem with four characteristics: (1) It consists of six domains (policy, finance, culture, supports, human capital, markets), see Figure 2. (2) Each entrepreneurship ecosystem is unique - that is why Silicon Valley cannot be replicated. (3) Specifying generic root causes of the entrepreneurship ecosystem has limited practical value, due to multi-dimensional cause-effect relations that are impossible to track down to one or two key roots. (4) Entrepreneurship ecosystems become (relatively) self-sustaining, as soon as all six domains are strong enough.

In his presentation at the Institute of International and European Affairs in Dublin, Isenberg (2011) spoke about something he called "entrepreneurship ecosystem strategy" for economic development. In his perspective, it is a cost-effective strategy to foster economic prosperity and create social wellbeing and is a precondition for – or even replaces – cluster strategies, innovation systems, knowledge-based economies and national competitiveness policies. Cluster strategies, for example, following top-down analysis of competitive advantages can be detrimental. It is the entrepreneurs' task to find and seize opportunities and - by trying, failing and iterating - to generate value. Policy makers should spend their limited resources to develop aspirational entrepreneurs – SMEs and self-employed will be spillovers along the way.

Isenberg (2011) talks about twelve elements that he summarizes into six domains: policy, markets, capital, human skills, culture and supports. The diagram shows the different domains from an entrepreneur's perspective, influencing his decisions and success. These elements/domains are interacting in a complex way and are unique in every ecosystem around the world. However, they are always present when entrepreneurship is self-sustaining. Therefore, the only way to establish a thriving entrepreneurial ecosystem, is by an integrative approach, stimulating a positive effect between the different domains. You cannot copy another model because you cannot replicate someone else's ecosystem. There is no magic bullet for an entrepreneurship ecosystem strategy - policy must address many factors at the same time.

Figure 7: Isenberg's Domains of the Entrepreneurship Ecosystem

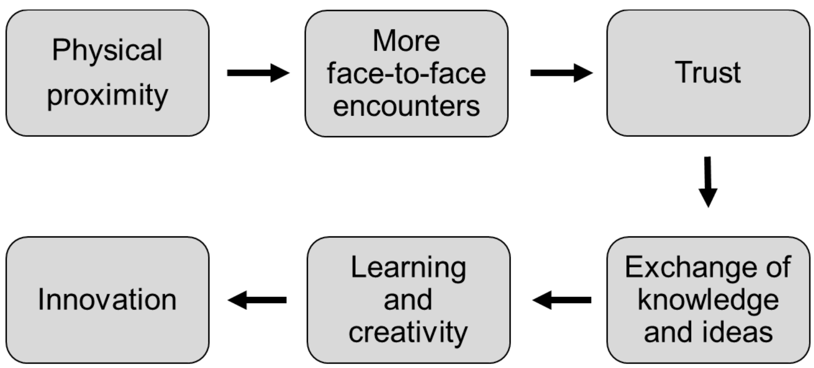


Source: based on Isenberg (2011)

Entrepreneurship tends to be geographically concentrated, in regions, cities, neighborhoods or buildings (Isenberg 2011). Resources are concentrated and attract each other, and spillover effects are also stronger. Politicians often distributed resources evenly across the nation. However, in order to have impact within a reasonable time, resources must be concentrated in a specific geographical area – even if there is tension to geographically focus public resources. Entrepreneurship needs an ecosystem – and an ecosystem requires proximity in order for the different domains to evolve together (Isenberg 2011).

Spatial proximity is indispensable for innovation and entrepreneurship. Studies (Allen 1984, Allen & Henn 2006) showed that the interaction between people across all media (phone, email, etc.) decreases, the less they meet in person[8]. The *Allen curve* is a graphical representation that describes the exponential drop of frequency of communication between people, as the distance between them increases. On the contrary, a short geographical distance between people results in a higher number of (spontaneous) personal meetings and increased communication between them. People who see each other more often, communicate more frequently and, thus, build trust between each other, which is an important prerequisite for an open exchange of knowledge and ideas (see figure below).

Figure 8: Physical Proximity fosters Innovation



Source: Fürlinger 2014

Accordingly, an entrepreneurship ecosystem needs the physical infrastructure that serves the actors as meeting places. The location became the central organizational unit of our time and takes over the function which was once played by organizations (Florida 2002). Large, permanent organizations with a fixed number of employees give place to small flexible networks with constantly changing "free agents" (Pink 2011). Nevertheless, large organizations, such as large universities, still play a crucial role in the innovation mix of an ecosystem, by acting as central hubs.

8 "*For example, rather than finding that the probability of telephone communication increases with distances, as face-to-face probability decays, our data show a decay in the use of all communication media with distance (following a near field rise).*" [...] "*We do not keep separate sets of people, some of which we communicate in one medium and some by another. The more often we see someone face-to-face, the more likely it is that we will telephone the person or communicate in some other medium.*" (Allen & Henn 2006, p. 58)

2.1.4 The Role of the State in the Entrepreneurship Ecosystem[9]

In almost all parts of the world, states are looking for a recipe to promote innovation and entrepreneurship in their country or certain regions. The aim is to create a supportive environment that encourages people to act outside of their usual patterns of thinking and to set up new companies, in order to commercialize those ideas.

According to Fiona Murray, a professor at MIT Sloan School, there are two perspectives to creating an ecosystem (Regalado 2013). The *pro-government perspective* states that specialized input, such as technology parks and innovation centers, is needed to drive the emergence of an ecosystem. Along those lines, Mazzucato (2011) describes the important role of the state in the innovation ecosystem in her book "The Entrepreneurial State". Many young companies benefit primarily from early-stage financing and government-sponsored technologies, which often form the basis for their new products and services. Take, for example, the globally successful iPhone. Every technology that makes this phone "smart"—the Internet, GPS, the touchscreen screen and, more recently, SIRI—has received government funding. By investing heavily in the research and development of new technologies, mostly by public investment or development banks, the state has the opportunity to play an active role in shaping the markets of the future. This involvement has enabled the emergence of capital-intensive and high-risk sectors, such as biotechnology, the aerospace industry, and renewable energies—consequently, new companies have emerged in these sectors. Therefore, the state should best act as a (largely unnoticed) pioneer of new trends. To continue to actively shape the innovation ecosystem in the future, the government should choose a long-term perspective with regard to its investment strategy. A functioning ecosystem also presupposes that the public sector and private companies invest together in promising areas of the future and thus jointly create the basis for a sustainable innovation landscape and a dynamic entrepreneurship ecosystem. Furthermore, the special effect of entrepreneurship and the entrepreneurship policy on the development of an economy, and especially the positive impact on economic growth has been highlighted by numerous scholars (Audretsch et al. 2002,

9 Parts of this chapter are published in Fuerlinger et al. (2015)

Gilbert et al. 2004, Acs & Szerb 2007, Baumol et al. 2007). Hence, the government's essential role in promoting innovation and entrepreneurship throughout a country or in certain regions cannot be ignored.

The other perspective laid out by Murray (2004), focuses exclusively on a "bottom-up" approach of *people and their networks*. According to the second perspective, the market can get distorted by an excessive "top-down" approach with no momentum developing in the private sector. Josh Lener, professor at Harvard Business School, is also skeptical regarding a government's active involvement in the entrepreneurship ecosystem (Regalado 2013). He believes that governments cannot predict where innovations will emerge, so they should limit themselves to creating the right environment. In his opinion, the government should focus on creating laws that do not stigmatize unsuccessful entrepreneurs but should also foster low taxation and targeted support for research and development. In other words, the state should rather act as a supporting force ('feeder') rather than leading the movement (Feld 2012).

The government is given the difficult task of finding the right balance. Targeted measures and support can make a decisive contribution and provide the impulse that the ecosystem needs towards becoming self-sustaining. New companies are created through the constant recombination of ideas, talents and capital (Timmons 1994), embedded in a supportive culture. Cultural change towards a startup-friendly environment, however, is difficult to initiate "top-down." The associated values and habits must emerge organically, from the bottom up, to promote the development of a sustainable entrepreneurship ecosystem.

2.2 Academic Entrepreneurship and University Startup Success Factors

This chapter explains how technology transfer from the university to the market takes place in the form of university startups and spin-offs. This new venture development process at the university is often referred to as academic entrepreneurship, which will be discussed in the context of the entrepreneurial university.

2.2.1 Technology Transfer via Startups and Spin-offs

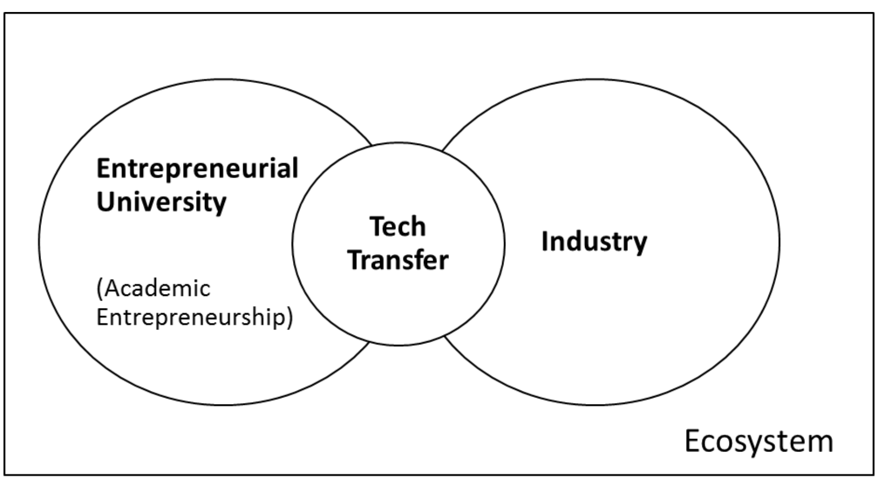
In his seminal work on MIT spin-offs, Shane (2004) defined a spin-off is "*a new company founded to exploit a piece of intellectual property created in an academic institution*". He focused only on spin-offs that disclosed their intellectual property to university administration and protected it by legal means (cp. patents). However, he did not take into account the *informal ways* of tech transfer, in cases where the inventor chose to circumvent the Tech Transfer Office and the IP or knowledge found its way to the market through different means. The problem is that even though it is prescribed by law, many university scientists in the United States do not disclose their inventions to their university (Siegel et al. 2003). University administrators will, therefore, have an interest in better understanding the determinants of informal technology transfer, given their objective to create revenues for the university. Formal technology transfer is a mechanism to allocate property rights, while informal technology transfer is much more about communication among individuals (Grimpe & Fier 2014). Some authors (Siegel et al. 2003) argue that formal and informal technology transfer may go well together. Informal contacts can improve the quality of a formal relationship and formal contracts are usually accompanied by an informal relation of mutual exchange on technology-related aspects. Hence, a spin-off can be defined more generally as "*a new venture initiated within a university setting and based on technology derived from university research*" (Rasmussen & Borch 2010).

Chrisman et al. (1995) viewed academic entrepreneurship as a mechanism of facilitating efficient university-industry technology transfer but narrowed down the meaning of academic entrepreneurship to '*the creation of new business ventures by any of the university agents.*' More specifically, they speak about "faculty entrepreneurship" to compare and contrast the level of entrepreneurial activities between faculties at the university. According to Shane (2004), all of the three groups mentioned below are lead entrepreneurs in one third of the spin-off companies from a university: 1) university affiliates: a) faculty (most of the intellectual property is created by this group, according to Shane 2004), b) staff and c) student; 2) external entrepreneurs; and 3) investors. On the other hand, an academic or university startup (in the following: university startup) is a wider term referring to a new company founded by people who were or are working in science or at a university, respectively. In comparison, these kinds of companies do not necessarily depend on new research findings or new scientific processes/methods/skills developed at the university (Egeln et al. 2007). Hence, university startups are founded by people who recently started to study, were studying at the time of founding or those that have dropped out of their studies. Furthermore, it could be people who work/ed at a scientific institution (cf. university).

2.2.2 Academic Entrepreneurship and University Technology Transfer

Entrepreneurship at the university level is the mindset which pervades the entire university organization and supports entrepreneurship. It is capable of overcoming various hierarchical and internal constraints (Yusof & Jain 2010). In an entrepreneurial university, academic entrepreneurship processes and activities are embedded in the university system, encultured in its academic faculties, embodied in its community of practice and within each individual academic (Brennan et al. 2005, Brennan & McGowan 2006). Academic entrepreneurship is a process that occurs within the organizational boundary of the entrepreneurial university. The entrepreneurial university interacts with the industry and extends its academic entrepreneurship processes and activities beyond the organizational boundary through university technology transfer (Yusof & Jain 2010, see figure below).

Figure 9: Relationship between University-level entrepreneurship, Industry, and the Ecosystem



Source: Adapted from Yusof & Jain 2010

The Entrepreneurial University

The term 'entrepreneurial university' was coined by Etzkowitz (1983, 1998, 2000, 2008) and encompasses the evolution of a university system that emphasizes economic development, in addition to the more traditional missions of teaching/education and research. Entrepreneurial university focuses on institutional-level analysis and deals with issues like institutional policy (Gibb and Hannon 2006), the triple-helix model (Etzkowitz et al. 2000; Etzkowitz 2003) and national policies and socio-economic development (Etzkowitz and Klofsten 2005). Universities increasingly see research as multi-faceted, as '*polyvalent knowledge'* (Etzkowitz and Viale 2010), which can simultaneously have theoretical and practical consequences across all science, rather than restrict itself to a particular sphere. This also means that the role of academic scientists is changing, as they become researchers, managers and entrepreneurs individually and through skills distributed within their research groups. It is no longer unusual for scientists to move from academia to industry and vice versa in the course of a career or to have dual roles in both domains.

Impact and critics on academic entrepreneurship

Some scholars perceive academic entrepreneurship as detrimental to the universities' traditional missions of research and teaching (e.g. Ambos et al 2008). There is also a political discussion going on in Germany about whether a focus on commercialization of research results and entrepreneurship could undermine the effects of the other functions (research and teaching) of a university (Egeln et al. 2007). On the other hand, others argue that the impact of technology transfer can be truly transformational to a university and to the community (McDevitt et al. 2014):

- A culture of entrepreneurship that promotes recruitment and retention of faculty, who reap the rewards of the practical application of their research
- Public benefits from applied research, by addressing global challenges
- Economic development through licensing revenue boosting the economy, retention of local talent, and new jobs from university startups
- Student participation in real world research, exposure to the patenting process, and

increased job prospects

- Opportunities for funding through inter-institutional and interdisciplinary grants, new startups, and international research relationships
- A stronger university brand increases prestige and fundraising and donor ties deepen through relationships with startups.

However, until universities change their incentives for promotion and tenure towards more tech-transfer related issues, knowledge will continue to flow out the backdoor (Grimpe & Fier 2014). Sanberg et al. (2014) also argue that faculty members should be motivated to "unleash the innovation potential of university research" and institutions need to expand the criteria they use to judge their faculties beyond the traditional publishing, teaching, and service. Along those lines, innovation-focused activities including patents, licensing and commercialization should be also counted toward tenure and promotion.

Types of academic entrepreneurship

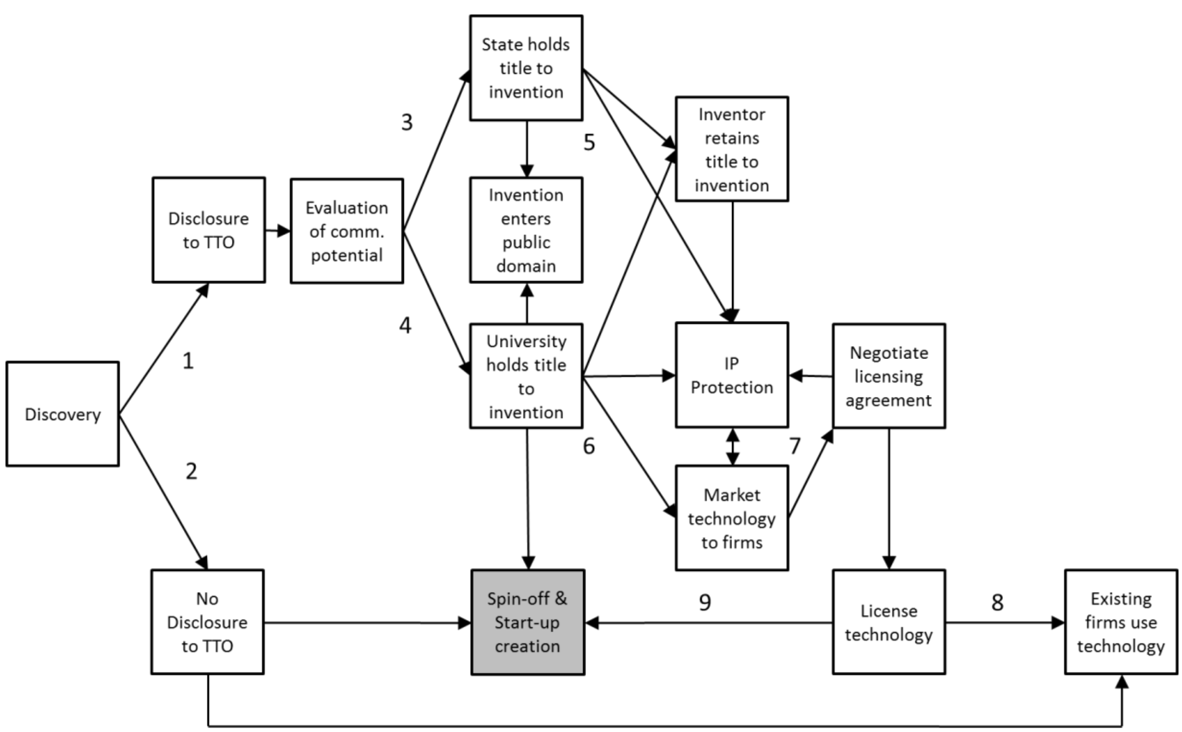
Research on academic entrepreneurship is building on management or entrepreneurship theory and focusing on the commercialization of technology and new venture creation (Klofsten & Jones-Evans 2000, Powers & McDougall 2005) and identifying enablers and barriers to academic entrepreneurship (Brennan et al. 2005, Brennan & McGowan 2006).

The research of technology transfer includes the commercialization of research results through patenting, licensing and new ventures. However, it also includes the role of certain agents, the institutional (incubators, tech transfer offices, etc.) or organizational (e.g. processes and incentives) context (Yusof & Jain 2010). According to a comprehensive study in tech transfer research (Yusof & Jain 2010), the majority of scholars agree that tech transfer is a process and can occur by formal (licensing, patenting, strategic alliances and spin-offs) or informal (knowledge transfer, consulting, joint publications) means. Klofsten and Jones-Evans (2000), identified eight specific types of academic entrepreneurship, including consulting, contract research, large-scale science projects, external teaching, testing, patenting/licensing, spin-offs and sales, which can be distinguished by the amount of external contact with industry. Some of these forms are more conducive (such as joint research) to fostering social networks, whereas others (such as licensing) are not (Wright et al. 2008).

A new model for tech transfer

The traditional, linear model of tech transfer has certain inaccuracies and inadequacies (Bradley et al. 2013): These include strict linearity and simplification of the process, composition, a one-size-fits-all approach and an overemphasis on patents. Furthermore, it fails to account for informal mechanisms of technology transfer, like the impact of organizational culture. The university reward systems within the model is an example. For this reason, Bradley et al. (2013) propose a new model for university tech transfer, which is depicted and described in the following:

Figure 10: From Discovery to Spin-off and Startup Creation



Source: simplified from Bradley et al. (2013)

Whether the discovery is disclosed (1) to the Tech Transfer Office (TTO) or not (2) is influenced by the university's culture and reward system. If the invention is disclosed to the TTO, it evaluates the commercialization potential and decides whether to bring it to the market. If the TTO decides to do so, the source of funding becomes relevant, in order to assess the owner of the rights. For private sources of funding (for example private grants, corporate contracts and donations), the university automatically holds title to the invention. If the discovery results from a federally-funded research project, the university can decline to retain title (and the state, e.g. its federal funding agency, can then request title to the invention) or the university can retain title to the invention. The extent to which a university traditionally engages in technology transfer activities influences the path to commercialization the discovery will take.

If the state retains the title (3) it has three options (5): First, it requests the title to the invention and lets it enter the public domain, effectively ending the technology transfer process. Second, it requests the title to the invention and files an application for IP protection. Third, it allows the inventor(s) to retain title to the invention (as long as the university approves) and the inventor has the option to file their own application for IP protection. The federal funding agencies and the inventor, however, will likely seek IP protection, before taking steps to commercialization and development of the invention.

If the university retains title (4) it has five options (6). First, it may decide that a spinoff or startup is way to commercialize the invention. Second, the university can market the technology to firms or entrepreneurs that develop the technology. Third, it starts the process of acquiring IP protection (patents, copyrights, trademarks, trade secrets, etc.). Fourth, the university could - with the funding agency's approval - allow the inventor(s) to retain title to the invention. Lastly, if the invention is not federally funded, it may be allowed to enter the public domain. This option is likely, if the invention does not promise to have any commercial value or there is no market/need for the invention. The processes of marketing the invention, applying for IP protection, and negotiating licensing agreements are not necessarily a linear path and can overlap or occur simultaneously (7). Whether the marketing to potential customers or the application of for IP protection comes first, depends on the invention's market potential.

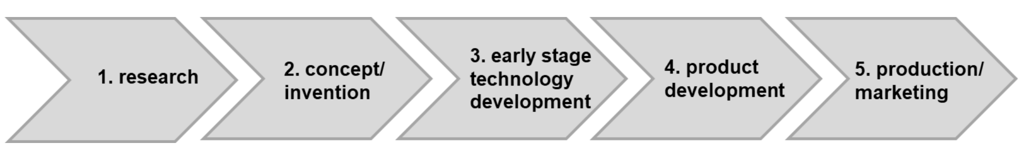
Once the technology has been protected, successfully marketed, and a licensing agreement is signed, the technology is officially licensed. If the licensee is an existing firm or organization (8) it usually adapts and further develops the technology into a product or service. If the licensee is an entrepreneur (inventing faculty member or an outside party), a spinoff company (9) is established around the invention.

If the inventor chooses not to disclose the invention to the TTO (2), the technology transfer process is carried out through informal mechanisms and involves the exchange of ideas and knowledge, rather than the property of a specific invention or technology. Similar to the formal transfer means, informal mechanisms can also lead to spin-offs or startups, being used by existing organizations or enter the public domain. The decision to engage in informal technology transfer again might depend on incentives to engage in formal technology transfer.

2.2.3 The University Startup Process

In order to spur radical technological change, we need to better understand the process of turning science-based "inventions" into commercially viable "innovations". The figure below illustrates the processes from publicly funded research to successful market entry – the transition of "invention to innovation" (Auerswald & Branscomb 2003, Fuerlinger et al. 2015): The process starts with research (Phase 1) leading to a technical concept of commercial value that is protected, perhaps by a patent (Phase 2). Phase 3 is the most critical phase in the transition from invention to innovation. The technology is adapted to industrial practice, the production process is defined, costs are estimated, and a market is identified and quantified. Once early-stage technology development work is completed, product development (Phase 4) begins. A pilot line is produced, and the company is ready to enter the market and in Phase 5 – through customer feedback and further product development – a business is created, which is ready to be financed or perhaps acquired.

Figure 11: The Science-based Innovation Process



Source: Fuerlinger et al. (2015) adapted from Auerswald & Branscomb (2003)

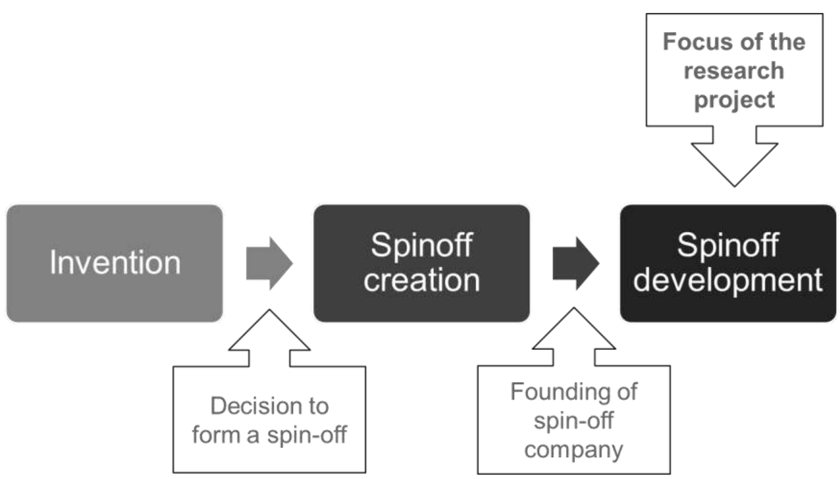
2.2.4 University Startup/Spinoff Development

Pressman (2002) found that 86% of all licenses go to existing companies and with them 14% new ventures are created. Spin offs are minus two stage companies – compared to regular seed stage startups. "*We had a research idea to make devices that had never been produced to serve an application that no one had ever targeted*" (Shane 2004, p.174) Spin-offs - particularly inventor-founded spin-offs - are complementary to licensing to established firms, when they are unwilling or unable to develop university technology. The model presented by Shane (2004) differentiates between spin-off creation and development:

- **Spin-off creation** encompasses the steps from research, invention, discovery of the entrepreneurial opportunity and ends with the founding of the spin-off company.

- **Spin-off development** is concerned with the development of the technology and the identification of customer needs.

Figure 12: Spinoff Creation and Development



Source: based on Shane (2004)

Since customers do not buy raw technology but products and services, the raw technology has to be further developed. It has to be proven that it has the potential to solve a customer problem or meet a need (*proof of principal*). In the next step, a prototype is developed in order to have a *proof of concept*. Changes in market application requires a redoing of the prototype, by going back to the proof of principle and starting over again. Ultimately, the founders of the spin-off have to create a product or service – through iterations and fine-tuning - that is adopted by the customers and meets the standard of the commercial environment/market. "[…] T*he founders of the spin-off need to change the emphasis of their efforts from the creative part of invention to the nitty gritty process of making things commercially useful […]*" (Shane 2004, p. 185), they need to *productize the invention*.

2.2.5 The Three Startup Development Domains

The goal of technology-based spin-offs is to bring a new product or technology to the market through the establishment of a new organization (Bhave 1994, Vohora et al. 2004). In the process of creating a product or service around a technology by establishing a new business, spin-offs need to develop different forms of knowledge. A common distinction is made between technological knowledge (or product knowledge) and market knowledge (Burgers et al. 2008, Scillitoe & Chakrabarti 2010, Sullivan & Marvel 2011, Shane 2004). On the economic side, the team should possess business, management and market knowledge, as well as product development and production knowledge (Shane 2004). Technological knowledge (also called `product(ion) know-how` - Shane 2004) refers to knowledge associated with technologies, products or processes and includes product design, manufacturing and optimization (Van Weele & Van Rijnsoever 2015). Market knowledge refers to knowledge about what customers need and how markets operate. It includes knowledge about potential customer's problems and preferences, as well as knowledge about market size, distribution channels, pricing and entry barriers, such as competition and regulations (Van Weele & Van Rijnsoever 2015). Besides the technological and market knowledge, spin-offs also need to develop organizational knowledge, which is also referred to as 'managerial knowledge', `management know-how` or 'venture development knowledge' (Barbero et al. 2013, Becker & Gassmann 2006, Vohora et al. 2004, Shane 2004, Mosey & Wright 2007). Management knowledge refers to knowledge about how to start, manage, and grow a business and includes knowledge on hiring employees, raising capital, defining a business plan, and drawing contract. *Building on these principles a new model of university startup development was derived for this study, focusing on three different startup development domains.*

Technological and product development

Technological and product development refers to the transformation of new research findings, technologies and prototypes into viable products or services.

University technologies are often created without the goal of satisfying customer needs. Furthermore, many of the inventor(-founders) have spent their entire careers focused on basic research and were not involved with product development or marketing: "*Research is one thing. It's theoretical. […] when you really need to make something that students can use, you need skills that don't exist inside of MIT. Those kinds of skills generally don't live in a university in the way that they can live outside the university of the needs of production*." (Shane 2004, p. 184). Hence, product development skills are different from research skills and inventor-founders often find the product development process difficult and requires them to learn new knowledge to be successful. Turning an invention into a product requires much more iteration and fine-tuning and less elegant theorizing than is the case with inventing itself. Additional developments are required to make technologies suitable for customers willing to pay for it, creating a product or service that solves a customer problem or meets a customer need.

Market and business development

Market and business development refer to gathering market information and identifying customer needs as well as marketing and selling your products or services. Principles of customer development (Blank 2006), business model generation (Osterwalder et al. 2010) and the lean startup (Ries 2011) are central concepts.

Business development involves all activities that aim at creating value and revenue potential for the company and building relationships with potential partners. According to Sorensen (2012), business development can be defined "*as the tasks and processes concerning analytical preparation of potential growth opportunities, and the support and monitoring of the implementation of growth opportunities, but does not include decisions on strategy and implementation of growth opportunities*." According to Davis and Sun (2006), business development can be referred to as a corporate entrepreneurial capability which emerged in the

IT-industry, focusing on the co-creation of value with customers and partners. The authors summarize the principal business development functions as follows: finding profitable opportunities in business networks, developing and maintaining partnerships, providing support for new product development, and recognizing and responding to customer needs.

Some argue that developing products and technologies so that they can be commercialized are also part of business development. Given the special nature of university startups and the importance of these tasks, those activities are attributed to the separate domain “technological and product development”. However, these are not separate processes or tasks. Feedback generated through conversations with partners and customers are important input for those dealing with product development. Hence, there is the overlap among the three different development domains in the model depicted below.

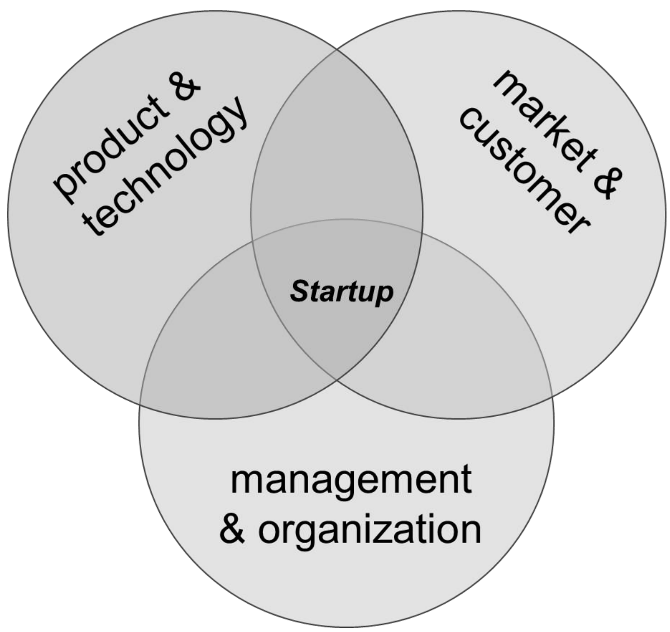
Organizational development

Organizational development refers to starting, managing and growing a professional company. The integration of a complementary founder team of business, technology and design experts is as important as financial, legal and strategic aspects.

Managerial capabilities in a new venture are a relevant factor because the firm's capabilities around organizational systems, routines or relationships between the firm's members are not initially developed (Heirman & Clarysse 2004). Studies cited by Ortin-Angel and Vendrell-Herrero (2014) argue that a lack of managerial skills can influence the behavior of academic entrepreneurs and, therefore, the performance of university startups. In order to build a scalable organization, it is essential to establish the organizational, legal and cultural foundation to cope with the challenges of rapid growth. In some cases, the founding team of the university startup already brings this experience into the new organization, even though these cases are rare (Shane and Khurana 2003). Hence, external support can fill this void, by tapping into the knowledge and experience base needed to establish and grow a new technology startup.

Following the development domains laid out above, a university startup or spin-off company is situated at the intersection of three domains and developing its capabilities in these three areas, respectively. Technological and product development, as well as market and business development, are situated on the intersection of the product and technology and market and customers domain, transforming the initial technology into products/services based on customer/market feedback. The business and organization domain intersects with the product and technology as well as the market and customers domain. Since in order to build and sell more of the companies' products and increase revenue, it is crucial to scale both production and marketing and sales efforts. In summary, it is necessary to take all three domains into account in order to build a successful firm that develops a great product or service that appeals to customers in the market and to build a scalable organization that supports value creation and capture.

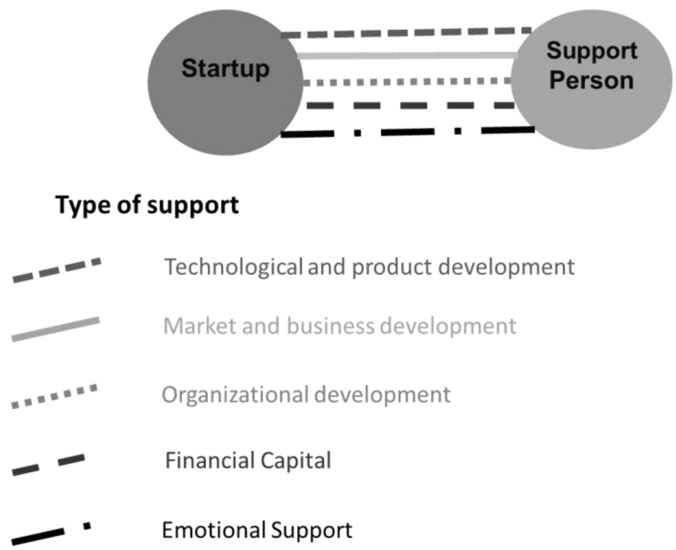
Figure 13: The Three Startup Development Domains



Source: own illustration

In order to accomplish this, entrepreneurs have to be resilient towards rapid changes in the environment and maintain their emotional stability (Brüderle & Preisendörder 1998). In many situations of daily operations, encouragement is needed to cope with work-related stress. Different people in the entrepreneur's network, especially informal relations, satisfy those different socioemotional needs (Batjargal et al. 2013) and provide the founder with the strength to overcome these challenges (= emotional support).

Figure 14: Startup Development Support



Source: own illustration

2.2.6 University Startup Success Factors on the Startup Level

There are a myriad of factors influencing a university startup's success on different levels (see figure above). Looking at the startup itself, it is crucial to consider those factors: overcoming the technology push problem, securing financial capital, employing the right focus and technology strategy and assembling the right team – human capital - which drives the venture forward.

Overcoming the technology push problem is closely related to the spin-off development process. The founders of a spin-off need to be able to create products, identify market applications and know how to assess and satisfy customer needs (Shane 2004).

Financial capital is needed to further develop the technology, hire employees, etc. Raising money from a trusted source (e.g. high-profile venture capital firm) signals quality and can make it look more appealing to external stakeholders (Shane 2004). The causes for problems that are approaching or in the growth stage, according to Drucker (1985) are usually one of the following: lack of cash or the inability to raise the capital needed for expansion or loss of control. In order to overcome those challenges or event prevent them, a new venture has to apply financial foresight methods and engage in active cash management. A new venture usually is under cash pressure when opportunities are greatest. For this reason, Drucker continues, it should know 12 months ahead of time how much cash it will need (cf. cash flow analysis/forecast). Otherwise, by being forced to take capital at the last minute, the entrepreneur might face the danger of losing control to new investors.

The spin-off strategy also has a considerable influence on the spin-off performance. A focus strategy allows founders to make more effective use of resources available, minimizes the need to raise additional capital, is appealing to investors and makes it easier for the founders to gather information from their customers. Furthermore, spin-off founders have to be able to adapt their strategic direction and change their technology or market application (Shane 2004).

Regarding its technology strategy, the strength of spin-offs intellectual property protection enhances its performance and, moreover, successful spin-offs adapt general-purpose technologies that can be applied in multiple applications (Shane 2004). Successful ventures often serve other markets than originally intended, with products or services different from the initial ones, bought by customers it did not think of before and used for a purpose besides the one it was originally designed for. Hence, a venture needs to organize itself to take advantage of the unexpected and unseen markets – it needs to be market-focused, or even market-driven, especially in an early stage (Drucker 1985). Market research does not make sense for new ventures. You cannot do market research for something that is genuinely new. Therefore, it must start with assumptions and expect that the product or service will find fields of application and customers outside the area that was initially targeted. People managing a new venture need to be able to experiment and to spend time outside in the market to talk to and listen to customers. Constant challenging of the product or service value proposition is key to deliver the highest utility to the user. Furthermore, developing a board with the right mix of networks and skills can help the new venture succeed and add competitive advantage to the spin-off (Bercovitz and Feldman 2011).

2.2.7 Human Capital as Success Factor for University Startups

The influence of the (management) team constellation should not be underrated. The rate of success is higher, if you start a business around a first-rate management team with average technology, than to start it around a first-rate technology and a second-rate management team (Preston 2001). Human capital is crucial for new venture development, as is the complementary developing of the technology and business side of a startup. It also showed that inventor involvement and a full-time entrepreneur (shows commitment) increase the chances of the spin-off's success (Shane 2004). Furthermore, Hsu (2007) argues that founding teams with a doctoral degree holder are more likely to be funded by venture capitalists and receive higher valuations, suggesting a signaling effect. Furthermore, especially in relation to the concept of social capital (see next chapter) human capital plays a central role. Since it appears that access to social capital may not necessarily lead to its utilization (Bandera & Thomas 2019), it is not sufficient for resources (know-how, financial capital, etc.) to be merely available to a startup. Even more importantly, the entrepreneur and his team need to have the ability (human capital) and motivation (Adler & Kwon 2002) to use those resources effectively and efficiently, in order to achieve growth and be successful in the long run. In the following section, four different types of human capital are described in more detail, since studies have shown them to be relevant in university startup success.

Prior industry experience

Entrepreneurs who enter industries in which they have prior experience as employees perform better than others (Dahl & Sorensen 2013). It is argued that the knowledge they gather in previous occupations in the industry and its inner workings provides them with an advantage, compared to newcomers in this field. Dahl's study (2013) concluded that entrepreneurs with prior industry experience work harder and run companies that are more profitable. They also recruit coworkers that are more experienced. Other studies (D'Este et al. 2012) highlight that previous collaboration with industry partners drives the exploitation of entrepreneurial opportunities.

Prior research experience

Research experience is important for the effectiveness of technology transfer and the commercialization of scientific findings (Agrawal 2006), by supporting opportunity discovery and exploitation (D'Este et al. 2012). Domain-specific knowledge and experience in the research field can provide benefits for university startups and academic entrepreneurs (Ensley & Hmieleski 2005, Wright et al. 2007, D'Este et al. 2012). Scientists who are successful in their respective field of research are in an advantageous position to start a successful university startup (Scholten 2006). Their success is, in part, due to knowing the academic environment, which allows them to access equipment and personnel more easily (Murray 2004). Hence, human capital can support early development of a university startup, by providing access to relevant resources on preferential terms. Corolleur et al. (2004) found that more experienced scientists run spin-offs that are more innovative, making the startup more valuable.

Prior management experience

According to Drucker (1995), management can be defined as "useful knowledge" that enables productive people of different skills and knowledge to work together in an organization. Based on this definition, it is a general term that can apply to new ventures in the same way as it does for established organizations. Studies have attributed differences between high growth-oriented enterprises and low growth ones to factors, such as strategic origins, previous experience and the ability of the entrepreneur to establish goals for staff and effectively handling disputes and conflicts (Brush & Hisrich 1991). Management concerns the organization of business activities, such as marketing, logistics, finance human resources and other activities to negotiate and coordinate the deployment of these recourses (Scholten 2006). Through management activities, a company converts its resources into value-generating activities (Castanias & Helfat 2001). Management experience, thus, refers to an individual's knowledge of how to run a business.

Prior startup experience

Prior spin-off experience – more generally speaking **startup experience** - was identified as an important success factor (Hayter 2013) for academic entrepreneurs and university startups. Also referred to as entrepreneurial experience, its important role for early-stage startup development has often been described (Clarysse & Moray 2004, Steen et al. 2010). As discussed in Chapter 2.1, starting a new venture is substantially different from managing an existing company. Large businesses execute a business model, new ventures look for one: "*A startup is a temporary* *organization designed to search for a repeatable and scalable business model"* (Blank 2013, p. 67). Hence, startups should not simply be regarded as smaller versions of large organizations. They need different management approaches in order to succeed, such as, for example, the lean startup methodology (Ries 2011) or business model thinking (Osterwalder et al 2010). To deal with the liability of newness (Stinchcombe 1965), they need to understand how to overcome the critical junctures in the startup process (Vohora et al. 2004): opportunity recognition, showing entrepreneurial commitment, gaining credibility and ultimately gaining sustainability. Hence, entrepreneurs who have been through this process before are more likely to successfully grow their next startup once again. In terms of prior startup experience, Mosey & Wright (2007) differentiate entrepreneur's human capital in the following way:

- Nascent entrepreneurs are individuals considering starting their own businesses (Ucbasaran et al. 2003).
- Novice entrepreneurs are individuals who have created a venture for the first time.
- Habitual entrepreneurs undertake multiple entrepreneurial ventures.

Growth aspirations

The Global Entrepreneurship Monitor (2020) measures mind-set, motivations, activities, and ambition of entrepreneurs, as well as the national framework conditions in more than 50 countries around the world. Among other questions and measures, respondents, who are currently starting or running a company, were asked to assess the following statements concerning their motives for starting their business: a) to make a difference in the world and b) to build great wealth or very high income. In the sub-chapter "growth expectations," three levels of self-reported growth expectations – referring to the number of employees entrepreneurs project to hire in the next five years – are reported from the participating countries. Those anticipating six or more hires can be seen as medium to high-growth-oriented entrepreneurs. The results of the answers to those three questions are presented in the table below.

Table 3: Motivations, Aspirations and Job Creation Expectation from Selected Countries

Country	To make a difference in the world; percentage of TEA	To build great wealth or very high income; percentage of TEA	Job creation expectations (create more than 6 jobs ins 5 years), percentage of TEA; Ranking from 50 countries
Germany	44.4%	32%	32
Sweden	50.3%	55%	46
Switzerland	43.2%	38.1%	22
USA	66.4%	69%	9
Austria	No data available	No data available	30*

TEA (Total early-stage Entrepreneurial Activity) the proportion of adults who are actively engaged in starting or running new businesses in each economy; Source: Global Entrepreneurship Monitor 2019/2020; * Global Entrepreneurship Monitor 2018/2019

2.3 Social Capital and University Startup Performance

As discussed in the introductory chapter, **structural holes** (which can be defined as unconnected parts of a social network due to missing links; more details are provided later in this chapter) between scientific research networks (academics) and industry or business networks (financiers, professional managers, industry partners and potential customers) are barriers to successful tech transfer from university to the market (Mosey and Wright 2007). In order to facilitate academic entrepreneurship, systematic ways should be developed on how to bridge those gaps and overcome those barriers. This is not a simple task, since research logic and market logic have a different focus and follow different rationales and metrics. The factors mentioned in the previous chapter are important – but not sufficient – to successfully establish a new university startup venture in the market. Therefore, the success of university startups and spinoffs is dependent on, among other things, an academic entrepreneur's ability to break out of their traditional research networks and access non-academic contacts (Hayter 2013). The literature on innovation and entrepreneurship ecosystems (see Chapter 2.1), on the one hand, discusses the availability of resources with which new ventures can build social capital. The social capital literature, on the other hand, discusses the use of these assets by new ventures (Bandera & Thomas 2019).

2.3.1 Networks as Competitive Advantage

From a transaction cost point of view, networks can be described as "hybrid" forms that exist between the flexibility and autonomy of markets and the force and control of organisational authority (cf. hierarchy). Networks are regarded as more flexible than internal organizational structures, because they are based on common goals rather than hierarchical instructions. At the same time, networks are more stable than market transactions, since they benefit from mutual understanding and trust (DeBresson & Amesse 1991). Because of their high degree of flexibility coupled with intermediate levels of transaction costs (Williamson 1991), they have a comparative organizational advantage, compared to market and hierarchy.

Powell (1990), however, perceives networks not necessarily as a “hybrid” form between markets and hierarchies, but rather as a distinctly different form of coordinating economic activity and as a mode of exchange. In Table 1, an overview of the main differences between markets, hierarchies and networks is given. In regard to sanctions, markets rely on the power of legal sanctions, whereas in networks, which are characterized by sequential interactions and transactions, they are rather normative. In hierarchies, communication is organized via the employment contract. The typical competitive market is made of self-interested and non-cooperative social interactions. It offers choice and opportunity and enables the individual actors to fulfill their internal goals by establishing strong ties. Prices are the mechanism through which coordination takes place. As a result, markets are not an appropriate form for learning and the transfer of specific know-how (Powell 1990). Hierarchical organizations are characterized by administrative procedures and an internal system of authority. Its pre-defined hierarchical structure is adequate for routine tasks and stands for reliability. However, in fast changing environments, where adaptation to contingencies is necessary to succeed, these rigid structures can easily become a bane. In networks, actors exist in relation to each other and are engaged in reciprocal actions. The basic assumption that underlies network relationships is the fact that one actor needs the resources controlled by another, and that both parties can gain, if they pool their resources. Therefore, complementarity and accommodation can be seen as the cornerstones of successful networks (Powell 1990). Networks are especially useful, when it comes to the exchange of resources which cannot be easily measured, such as know-how. These kinds of commodities can neither be easily traded on the market nor communicated through an organizational hierarchy. The relational features and the special set-up of networks make it the perfect location for learning and the exchange of new knowledge and skills (Powell 1990).

Basing his conclusions on the analysis on a wide range of networks, Powell (1990) summarized the circumstances under which networks may arise and why participants are motivated to join networks:

- Cooperation can be sustained over the long run
- Networks create incentives for learning and the transfer of information, allowing ideas to be translated into action rapidly
- The open-ended quality of networks is useful, when resources are variable and the environment is uncertain
- Networks allow the utilization and enhancement of intangible assets, like tacit knowledge and technological innovation

Table 4: Comparison of three different Forms of Economic Oorganization

Characteristics	Market-governed transaction	Hierarchically governed transaction	Network mode
Normative basis	Contract property rights	Employment relationship	Complementary strength
Communication means	Prices	Routines	Relations
Conflict resolution	Haggling resorts to court for enforcement	Administrative fiat supervision	Norm of reciprocity, Reputable concerns
Flexibility	High	Low	Medium to High
Commitment between economic actors	Low	Medium to high	Medium to high
Relations between economic actors	Independence	Hierarchical	Interdependence
Tone of climate	Precision and/or suspicion	Formal bureaucratic	Open-end mutual benefits

Source: Fischer (2006), the initial concept of this table, however, hast to be attributed to Powell (1990)

Criticism of the Transaction Cost Approach

Despite its contribution to the understanding of networks, transaction cost theory had to contend with criticism. Firstly, Demesetz (1991) argued that the definition of transaction cost is very vague and all-encompassing and has been simply subsumed as organizational costs, irrespective if those arise from within the firm or across the market. Furthermore, he is convinced that the organizations' resources and capabilities on organizational choices have not received sufficient attention. The second criticism refers to the fact that transaction cost theory only focuses on individual transactions. Transaction cost theory focuses on the minimization of cost, rather than the creation of values through innovation. For this reason, it does not go that far in capturing the importance of the dynamics of technological and organisational innovation (Kogut & Zander 1992) and it almost completely neglects the idea-creating aspects (Pyka 2002).

Resource-based view of the firm

Drawing on the seminal work of Penrose (1959), the resource-based view of the firm became popular among scholars in the late 1980s and early 1990s. Referring to this point of view, organizations are characterized by a unique bundle of resources which provide competitive advantage and are important for the success and existence of the firm (Penrose 1959, Barney 1991). Moreover, valuable resources are distributed unevenly across different organizations. In order for the actors to be successful, it is crucial to engage in an exchange process of those resources. The resource-based view provides insight as to how firms can compete more effectively, since having control over critical resources is essential to maintain and strengthen their position on the market (Scholten 2006). Developing key resources – like special skills, expert knowledge and novel technologies - adds value and creates a competitive advantage and distinguishes the organization from its competitors.

Knowledge-based approach

More recent approaches are inspired by the knowledge-based view of organizations, in which an organization is defined by two of the main scholars as "*a social community specializing in the speed and efficiency in the creation and transfer of knowledge*" (Kogut & Zander 1992, p. 503). This approach builds on an evolutionary perspective (e.g. Nelson Winter 1982) on economics and recognizes especially the role of knowledge for economic development and the success of organizations. From this view, actors are characterized by incomplete knowledge-bases and capabilities. Moreover, and in contrast to classical theories, actors are seen as heterogeneous and diversity is perceived as one of the main prerequisites for the emergence of novelty. Beyond that, the time dimension in which learning and interaction takes place is crucial. In this regard, the creation of knowledge through interaction between heterogeneous actors, dynamic technological accumulation and learning are the main issues of innovation networks (Pyka 2002). Furthermore, Dosi et al. (1992) argued that networks should not only be seen from the perspective of transaction costs, but rather also in terms of learning, path dependencies, technological opportunities, and complementary assets. The transfer of tacit, local and complex knowledge especially requires a common knowledge base and shared experience in order to be transferred — requirements that cannot be found in markets (Pyka 2002). Therefore, it requires another organizational form that is appropriate to transfer technological knowledge and know-how. In this regard, networks provide a mechanism for the diffusion of innovation through collaboration and interactive relationships and constitute the locality to create resources (Zuscovitch and Justman 1995).

Through different paths of development, every organization builds up its specific set of resources (Nooteboom et al. 2007). That is why the capabilities of an organization are not given, but rather are determined by what an organization has done in the past. Innovation networks offer the possibility of path convergences and to build on different specific knowledge bases. Through this fusion of different capabilities, the emergence of new opportunities is possible - the cross-fertilization effects (Pyka 2002). Another effect of innovation networks, is the pooling of complementary assets. According to Teece (1986), successful innovations require a complex form of business organization. This especially involves linkages to other organizations, upstream and downstream as well as lateral and horizontal. Drawing on this notion, the network form brings together a different set of assets and competencies that are necessary for an organization to commercialize a new technology.

2.3.2 Networks, Social Capital and the Impact on University Startup Development

Academic entrepreneurship (Grimaldi et al. 2011) provides an interesting example in which social networks have been found to be especially important in fostering innovation and entrepreneurship (Leyden et al. 2014). Stuart and Sorenson (2005) underline the importance of social networks in the startup process at universities, since those networks include graduate students, post-doctoral researchers, current and former colleagues and associates who can provide advice, expertise, and access to financial capital. Many other scholars argued that the key determinant of a university's ability to generate spin-offs is the size of its academic social networks (Lockett et al. 2003, Niclaou & Birley 2003, Mustar et al. 2006). Moreover, other studies found that the market attractiveness of a business idea is positively influenced by the market orientation of the founders and by their frequency of interaction with external agents (Grandi & Grimaldi 2005). Despite those findings, there is still little known about how social networks within and around the university support (or hinder) spin-off creation and development.

Networks Concepts and Dimensions of Social Capital

According to Hoang and Antoncic (2003), there are three essential components of networks: the content of the relationships; the governance of these relationships; and the structure or pattern that emerges from these ties. In the following section, the authors' elaborations on these three components are summarized: The network structure (cf. structural dimension of social capital) refers to the pattern of relationships of direct and indirect ties between actors. A general proposition guiding the focus on network structure is that differential network positioning has an important impact on resource flows, and hence, on entrepreneurial outcomes. Whereas network size and centrality delimit the amount of resources an actor can access, the presence of structural holes in the network challenges the ability of actors to gain access to a diversity of resources. Network governance refers to the coordination of relationship exchanges. This is especially true of trust between partners, which is a crucial element that enhances the flow of resources from one actor to the other. In terms of network content (cf. relational dimension of social capital) one of the key benefits of networks for the entrepreneurial process, is the access they provide to specific resources. The structural dimension may better reflect the sources of social capital, while the relational and cognitive dimensions reflect social capital resources (Pearson et al. 2008). The structural dimension is treated as an antecedent to both the cognitive and relational dimensions, while the cognitive dimension is an antecedent to the relational dimension. Therefore, these dimensions of social capital represent both the relationships or networks of an entity (cf. structural dimension) and the resources derived from those ties (cf. cognitive and relational dimension) (Gedajlovic et al. 2013).

Table 5: Dimensions of Social Capital and Respective Network Concepts

Dimension	Focus	Concepts	Network perspective
Structural dimension	Position of entrepreneurs in a structure of relationships creates advantage	Structural holes vs. network closure	Network structure
Cognitive dimension	Shared systems of meaning among parties	Shared language and vocabulary, common codes, collective narratives or norms	Network governance
Relational dimension	Nature and quality of interactions	Weak vs. strong tie	Network (tie) content
Resource dimension	Considering the resources held by entrepreneurs' network contacts	Diverse ties vs. homogenous networks	Network (actor) content

Source: Granovetter (1992), Gulati et al. (2011), Hoang and Antoncic (2003), Nahapiet and Ghoshal (1998)

2.3.3 Defining Social Capital

One can differentiate the term social capital depending on whether it refers to the relations an actor maintains with other actors (external view), the structure of relations among actors within a certain collectivity (internal view), or both kind of linkages (Adler & Kwon 2002). A focus on an actor's external relations is referred to as "bridging" forms of social capital. In this view, social capital can be defined as "*the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance or recognition*" (Bourdieu 1985, p.248) or as "*friends, colleagues, and more general contacts through whom you receive opportunities to use your financial and human capital*" (Burt 1992:9). In contrast to these external relations, if the focus is on internal ties within collectivities, this is called "bonding" forms of social capital (Putnam 2000). Under this perspective, social capital can be defined as "*features of social organization, such as networks, norms, and social trust that facilitate coordination and cooperation for mutual benefit*" (Putnam 1995: 67) or it "*refers to the collective value of all 'social networks' and the inclinations that arise from these* *networks to do things for each other*.” (Putnam 2000).

Table 6: Bridging vs. Bonding Social Capital

Form of social capital	Focus of relationships
Bridging	Actor’s external relations (egocentric view)
Bonding	Collectivity’s internal structure

Source: Adler & Kwon 2002

Furthermore, there are definitions of social capital that encompass both views. Since the distinction between the external and internal view is usually a matter of perspective, it makes sense to incorporate both of them in the research analysis. Moreover, the behavior of an individual, as well as his capacity for effective action, is typically a function of both (Adler & Kwon 2002). Under this premise, social capital can be defined as: "*the sum of the actual and potential resources embedded within, available through, and derived from the network of relationships possessed by an individual or social unit. Social capital thus comprises both the network and the assets that may be mobilized through that network*" (Nahapiet & Ghoshal 1998: 243).

Burt (1992) suggests that firms that have bridging ties, i.e., disconnected parts of a network, have access to a broader scope and more novel information and, therefore, perform better than those that do not. These bridging ties between disconnected networks may be particularly important to academic spin-offs, when they try to commercialize scientific findings in a business environment and aspire to early growth.

Hence, in this study, a broader definition of social capital is adopted, following Gabbay and Leenders (1999) and Lin (1999) who argues for a more expansive definition of social capital that includes these abilities as constitutive of social capital. Gabbay and Leenders (1999) see social capital as the resource provided by an actor's network of connections, with its extent dependent on the resources made available to the actor through those contacts in the network. Therefore, an actors' social capital includes the resources that they could potentially mobilize via their social relations (Adler & Kwon 2002).

2.3.4 Dimensions of Social Capital

Granovetter (1992) came up with the distinction between structural and relational embeddedness: On the one hand, the structural dimension of social capital refers to social interactions, the sum of relationships within a social structure. On the other hand, the relational dimension is about the direct relationships of a person to others and the assets involved in these connections. Adding the view from other scholars, entrepreneurs' personal networks can be evaluated along three key facets: the relational, structural and resource dimensions of social capital (Gulati et al. 2011, Hoang and Antoncic 2003, Nahapiet and Ghoshal 1998). Building on this distinction, Nahapiet and Ghoshal (1998) argue for an additional dimension of social capital: the cognitive dimension. It is about shared values or paradigms that allow a common understanding of appropriate ways of acting (Stockhammer 2006). According to the authors, these three dimensions of social capital "*are likely to be interrelated in important and complex ways*" (p. 250). These different dimensions of social capital are described next.

Structural dimension of social capital

The structural dimension consists of network ties, network configuration and appropriable organization (Nahapiet and Ghoshal 1998). Whereas network ties provide access to resources – they are the channels via which those resources are mobilized – network configuration refers to the overall structure of these ties. There are three main properties of a network – density, connectivity and hierarchy – that constitute a network's configuration. Overall, structural capital determines the potential or the possibilities of actors to access information and resources (Liao and Welsch 2003).

Coleman (1988) argues that closure of the network structure, which is defined as the extent to which actors' contacts are themselves connected, supports the effectiveness of norms, since collective sanction is possible. Hence, closure creates trustworthiness in a social structure, thereby strengthening social capital. In contrast with Coleman, Burt (1992) argues that a sparse network with few redundant ties often provides greater social capital benefits. A network with such characteristics provides an opportunity to broker the flow of information between people across these "structural holes". In accordance with this theory, brokers, boundary spanners or gate keepers enjoy a very valuable position in the network, since they act as interpersonal bridges facilitating the flow of information – and ultimately resources. Burt (2000) describes the role of information brokers who span structural holes and bring advantages to the groups they tie together. The definition focuses on the ability of actors to link together other entities.

Burt furthermore argues that "*a study can show exclusive evidence of both arguments without calling either argument into question*" (Burt 1992, p.23). The closure view, therefore, argues that dense networks lower the risk associated with transaction and trust and, thus, lead to better performance. The structural hole argument, on the other hand, underlines the importance of brokerage. By bridging those holes, new opportunities are created which also lead to increased performance. Second, it requires attention to both direct and indirect ties. Granovetter (1973), Coleman (1988), and Burt (1992), among others, point out that direct and indirect network ties provide access both to people who can themselves provide support and to the resources those people can mobilize through their own network ties. Following the arguments of Burt's (1992, 1997) structure hole and Granovetter's (1985) strength of weak ties argument: A sparse social network is actually a beneficial factor for technology entrepreneurs, in that they can access rich non-redundant information and knowledge and also lower costs in maintaining few ties (Liao & Welsch 2003).

In this thesis, a closer look is taken at the social structure – network configuration – among research and business networks, which often operate separately of each other. In order to overcome those structural holes, brokers, who have a foothold in both of the networks, can facilitate the technology transfer process.

Emphasis should be placed on nurturing the entrepreneur's ability to exploit social networks through what Burt (2005) terms brokerage and closure: bringing together heterogeneous social ties to form social networks and facilitating the coordination of those networks.

Cognitive dimension of social capital

Nahapiet and Goshal defined this dimension as those resources providing "*shared representations, interpretations and systems of meaning among parties"* (Nahapiet and Ghoshal

1998 p. 243). It is the degree to which people share language and vocabulary, common codes, collective narratives or norms.

Relational Dimension of Social Capital

The relational dimension describes the quality of personal relations people have developed over time. This connection between actors is decisive for the accessibility of resources held by one of them. It has been interpreted as relational content, tie strength and relational trust (Stockhammer 2006). Relational embeddedness is based on relations between one person (ego) and another person (alters) and can be expressed in tie strength and tie content. Tie content will be discussed in the next chapter, referring to the resource dimension of social capital. Tie strength reflects the social proximity in a dyadic relationship (Granovetter 1973, Marsden & Campbell 1984). Research indicates that both strong ties and weak ties are fundamental to the innovation process and firm success (Elfring & Hulsink 2003). Closeness can be derived through the frequency and duration of a relationship.

- **Strong tie**: people you maintain a close and/or frequent relationship with and higher levels of trust and familiarity. These are strong, affective and time-honored relationships.
- **Weak tie**: people you are in contact with occasionally and/or feel less close to, with lower levels of trust and familiarity.

Whereas the frequency, intimacy etc. specify the quality of a relationship, the network content refers to the actual resource(s) exchanged, based on those relationships. Hence a fourth dimension of social capital may be articulated as resource dimension.

Resource dimension of social capital

The resource dimension of social capital refers to the degree to which network connections possess valuable instrumental resources (Lai et al 1998, Batjargal 2003). The resource embeddedness has been referred as "*the material quality of ties*" (Uzzi, 1996: 675). Stam et al (2014) summarizes that researchers have used social resource theory (Lin 2001) to argue that diverse networks, comprising members of different backgrounds, can be beneficial, since they enable entrepreneurs to access needed resources (Birley 1985). Other researchers have underscored the value of homogeneous networks, basing their research on theories of absorptive capacity (Hansen 1999). This notion follows the argument that knowledge sharing works better when entrepreneurs and people in their network have shared cognitions, like common language or shared narrative (Nahapiet & Ghoshal 1998).

2.3.5 Knowledge and Resource Acquisition through Social Capital

According to the ‘‘liabilities of newness’’ phenomenon (Stinchcombe 1965, Freeman et al. 1983), new ventures are limited by a resource constraint. They lack resources to compete effectively and lack knowledge about how to compete intelligently (Hughes et al. 2007). The liability of newness phenomenon describes an organization’s risk to die during its life course. Whereas the risk of dying is highest at the point of founding, the probability decreases with growing age of the organization. Hence, the liability of newness substantially inhibits a new venture’s growth rates and can lead to firm mortality (Thornhill & Amit 2003). Therefore, new organizations must resolve the problems of information asymmetry (Certo et al. 2001) and compensate for lack of experience and reputation (Honig et al. 2006). Developing social capital and actively seizing network opportunities is a pathway to competitive advantage (Ireland et al. 2003). Social capital is created through a venture‘s networking activities and increases with the extent of interactive relations (Coleman 1988, Koka & Prescott 2002, Rodan & Galunic 2004). Hence, social capital can help new firms to overcome the disadvantages that are due to the liability of newness.

The main objectives of networking are access to resources and acquisition of knowledge (Grant & Baden-Fuller 2004): new ventures must rely heavily in outreach to access expertise and resources (Rice et al 2008). Hence, new ventures must engage in networking activities to access those missing factors. These activities can either be resource seeking or knowledge seeking behavior (Hughes et al. 2007). Behaviors needed to access resources are different from those needed to acquire knowledge (Coff et al 2006). In order to better understand these two distinct behaviors, one has to first distinguish between resource and knowledge.

Knowledge (know-how, know-who and experience) is required to combine resources in a way that creates value and can be explorative (novel, insightful) or exploitative (refining, adapting) in nature (Hughes et al. 2007): The type of knowledge that firms typically acquire through interaction is exploitative in nature, which means it reflects experience and information already in existence and so it is not unique. Explorative knowledge is acquired through close interaction, while using resources to experiment. Therefore, the new firm has to maintain separate linkages with other organizations to exchange knowledge by discussing, sharing experience and interpreting information to resolve certain problems or challenges. Knowledge sharing is the basic reason for firms to congregate together (cp. community). It is widely recognized that face-to-face interaction is a basic requirement for the transfer of knowledge (Lawson & Lorenz 1999) and that such contact is facilitated by geographical proximity. See also Chapter 2.3.1 for a more detailed discussion of how physical proximity fosters personal exchange, trust and innovation (Fürlinger 2014).

Evidence suggests that actively pursuing relations leads to greater value creation because synergistically leveraging collaborators' abilities and activities enables firms to outperform jointly what they could achieve alone (Dyer & Singh 1998, Ireland et al. 2003). In their study of alliances among young biotechnology firms, Rothaermel and Deeds (2004) find that intensive involvement in relationships fuels organizational learning, which strengthens firms' capacity for new product development. Tsai (2001) also showed that expanding the organization's network to external partners will stimulate the creation of new knowledge and finally increase its innovation performance. However, in order to be able to recognize value and utilize these external sources, an internal learning capacity is necessary - known as "absorptive capacity" (Cohen and Levinthal 1989, 90). Therefore, absorptive capacity can be understood as the prerequisite for the transfer of knowledge.

Resources, on the other hand, are assets possessed or controlled by the organization, including physical, financial, trademark or patent, goods, services, technology (e.g. technical capabilities) and skills (e.g. marketing capabilities). Compared to knowledge acquisition, organizations can draw on each other's resources through a more arm's-length relationship and less interaction is necessary. Resource pooling activity increases firms' opportunity space to use and combine resources in new ways to create value (Hakansson & Snehota 1995). Several studies find that resource-based collaborative arrangements can help generate superior business performance, create new competencies for partnering firms, encourage synergy and spur innovation (Andersson et al 2002, Kelley & Rice 2002, Shan et al 1994, Sarkar et al 2001).

2.3.6 Network Functions depending on Stage in Entrepreneurial Process

Shane and Venkataraman (2000, p. 218) propose that (process-oriented) entrepreneurship can be defined as "*the study of sources of opportunities; the processes of discovery, evaluation, and exploitation of opportunities; and the set of individuals who discover, evaluate, and exploit them*." An entrepreneur identifies the desired innovation and then engages in a two-step exploratory process of discovery to develop that innovation: the formulation of the problem and the search (exploration) for various combinations of knowledge, actions, and resources (Leyden et al. 2014).

Social networks are the key to the acquisition of these input factors. Some entrepreneurship scholars (Hoang & Antoncic 2003, Welter 2011, Zahra & Wright 2011) have referred to it as the social dimension of context. Network-based arguments clearly have significant potential to enhance our understanding of two critical tasks comprising the entrepreneurial process: the discovery of new business opportunities and the mobilization of resources (Stuart and Sorenson 2005). According to Elfring and Hulsink (2003), depending on the stage of the process they are currently in, also add "gaining legitimacy" as an additional impact of network - with some contacts providing multiple resources (cf. multiplexity):

1) **Opportunity discovery**: Networks and especially those consisting of weak ties (Granovetter 1973) provide access to a wide range of non-redundant information and therefore, increase the probability for the entrepreneur to spot opportunities.

2) **Resource acquisition**: Networks and, in particular, strong ties play an important role in gathering the necessary resources to exploit the identified opportunity (Stockhammer 2006). Network actors to whom the entrepreneur has strong tie relationships are, in general, more eager to provide the required resources than occasional weak tie relations. From an entrepreneurship perspective, social capital is instrumental in obtaining the benefits from social relationships (Greene and Brown 1997). Entrepreneurship literature argues that entrepreneurs

tend to rely on their informal ties and pre-existing networks to obtain advice and feedback on ideas (Birley 1985, Elfring & Hulsink 2003) in order to increase the likelihood that their ventures will survive (Brüderl & Preisendorfer 1998). Social transactions support the entrepreneur in accessing the resources below the market price (Elfring & Hulsink 2003), so one of the main advantages of social capital is the access to resources on preferential terms (Robinson & McDougall 2001).

3) **Gaining legitimacy**: Obtaining legitimacy is crucial, when starting a new company (DiMaggio 1992). Due to the "liability of newness" (Stinchcombe 1965), a startup has to organize institutional support and build legitimacy. Therefore, entrepreneurs seek legitimacy to reduce the perceived risk, by associating with or gaining support from well-regarded individuals and organizations, since positive perceptions based on a firm's network linkages can lead to beneficial resource exchanges. (Elfring & Hulsink 2003).

Leyden et al (2014) argue that entrepreneurial opportunities are formed endogenously by the entrepreneurs who create them, and the social network is a mechanism for the entrepreneur to create and exploit such opportunities. Ventures are building blocks of resources, including social capital that must connect to other resources and capabilities (Brush et al 2001). Social structures shape the flow of knowledge across organizations' boundaries and define the possibilities for firms to access external resources (Sorenson & Stuart 2001). In summary, entrepreneurship networks evolve over time and may differ, depending on the startup's stage of development (Vohora et al.2004, Hayter 2013).

2.3.7 Social Capital and Small Firm Performance

Entrepreneurs are operating in networks, rather than in organizational and hierarchical settings (Feld 2012). Hence, **social capital and social networks have a strong impact on entrepreneurship at various levels of aggregation** (Stuart & Sorenson 2005, Kwon & Arenius 2010). As described in previous chapters, network connections enable entrepreneurs to identify new business opportunities, obtain resources (below the market price), and secure legitimacy from external stakeholders. Building upon those facts, Stam et al (2014) conducted a meta-analysis on the social capital of entrepreneurs and its impact on small firm performance. Small firms were defined as firms with less than 500 employees (Rosenbusch et al. 2011). They synthesized empirical findings from 59 studies (N=13,263) of new (less than 6 years old) and old (older than 6 years) small firms, and for firms that operate in high- or low-technology industries and emerging or established economies. Their overall finding was that social capital was significantly and positively related to small firm performance (corrected r = .211). Effect sizes of weak ties were smaller than those of structural holes, while network diversity had the strongest relationship with performance. The strength of the social capital to performance link depended on the age of small firms and firms' industry and institutional contexts. While weak ties, structural holes, and network diversity were more valuable for new firms, network size and strong ties were more positively related to the performance of older firms (Stam et al 2014).

In order to get a better insight into the methodologies and the operationalization of their variables, a closer look at selected papers was taken (see "closer paper examination" in the table below). Since this thesis is concerned with new ventures (in a university setting), the focus was on those studies mentioned in the meta-analysis that analyzed new (less than 6 years old) firms. In the table below, there is an overview of the studies that is analyzed in more detail.

Table 7: Studies on Social Capital and new Small Firm Performance

Authors (year)	Sample size	Indus-try	Coun-try	Effect size[1]	Social capital construct labels[2]	Performance construct label[3]	Closer paper exami-nation
Armanios et al. (2012)	94	High-tech	China	−.05 (C)	Government official ties (S,I)	Venture growth (G,R)	YES
Atuahene-Gima and Li (2004)	373	High-tech	China	.02 (C)	Government ties, financial ties (N,I)	Sales growth (G,R)	YES
Batjargal (2003)	75	Mixed	Russia	.05 (L)	Network size and heterophily, strong and weak ties, resourcefulness (N,H,S, W,D,T)	Revenue growth, profit margin, ROA (G,P,A)	YES
Batjargal (2010)	159	High-tech	Multiple	−.05 (L)	Network size, structural holes (N,H,T)	Profit growth (G,R)	YES
Bratkovic et al. (2009)	103	Mixed	Slovenia	.11 (C)	Resource network intensity, contact intensity, friendship (S,T)	Firm growth (G,R)	NO
Cantner and Stuetzer (2010)	182	Mixed	Germany	.02 (C)	Weak ties, strong ties (W,S,I)	Employment growth (G,A)	YES
Chrisman et al. (2005)	159	Low-tech	U.S.	.01 (C)	Guided preparation (S,I)	Sales, employment (G,R)	YES
Dai and Liu (2009)	711	High-tech	China	.51 (C)	International business networks (D,I)	Business performance (M,R)	NO
Davidsson and Honig (2003)	380	Mixed	Sweden	.08 (L)	Parent/friends in business, encouragement, married, agency	Profit (P,R)	YES

Filatotchev et al. (2009)	711	High-tech	China	.51 (C)	Global networks (D,I)	Export performance (N,R)	NO
Grandi and Grimaldi (2003)	40	High-tech	Italy	.50 (C)	Frequency of interaction with external agents (S,I)	Technological excellence (N,R)	YES
Hansen (1995)	44	Mixed	U.S.	.18 (C)	Action set size, degree, and frequency (N,H,S,T)	New organization growth (G,A)	NO
Hmielesky and Carr (2008)	223	Mixed	U.S.	−.10 (C)	Social capital (N,I)	New venture performance (G,A)	YES
Hormiga et al. (2011)	130	Mixed	Multiple	.16 (C)	Relationships with customers and suppliers, informal network, connectivity	New business venture success (M,R)	YES
Hsu (2007)	149	High-tech	U.S.	.23 (C)	High network recruiting (N)	Pre-money valuation (N,R)	YES
Jensen and Greve (2002)	100	Mixed	Norway	.27 (C)	Acquaintances, friends, network redundancy (W,S,H,T)	Revenues (G,R)	YES
Kessler (2007)	756	Mixed	Multiple	.06 (C)	Network importance, positive role models (N,S,I)	New venture success (M,R)	YES
Lee and Tsang (2001)	168	Mixed	Singapore	.24 (C)	Communication frequency, breadth of communication (S,D,I)	Sales and profit growth (M,R)	NO
Liao and Welsch (2003)	462	Mixed	U.S.	.09 (L)	Family and friends have started new firms (S,I)	Revenue growth (G,R)	YES
Lin et al. (2006)	125	High-tech	Taiwan	.00 (C)	Social capital (N,I)	New venture performance (N,R)	YES

Ma et al. (2009)	250	Low-tech	China	.10 (C)	Structural holes (H,T)	Strategic adaptive capability (N,R)	NO
Manev et al. (2005)	160	Low-tech	Bulgaria	.16 (C)	Client network, institutional network, strong ties, weak ties (N,S,W,T)	Performance index, growth (G,N,R)	NO
Manolova and Manev (2006)	623	Low-tech	Bulgaria	.18 (C)	Diversity of network (D,T)	External financing (N,R)	NO
Manolova et al. (2010)	555	Low-tech	Bulgaria	11 (C)	Personal networking (D,T)	Internationalization (N,R)	NO
Ndofor and Priem (2011)	103	Low-tech	U.S.	.04 (C)	Co-ethnic and non-coethnic contact fre-quency (S,D,T)	Venture profits, entrepreneur returns (P,R)	NO
Peña (2004)	114	Mixed	Spain	−.05 (C)	Networking (N,I)	Sales, employment, and profit growth (G,P,R)	NO
Scholten (2006)	65	High-tech	Netherlands	.15 (C)	Network size, structural holes, tie strength, heterogeneity (N,H,S,D,T)	Employment growth (G,R)	YES
Vissa and Chacar (2009)	470	High-tech	India	.36 (C)	Network constraints (H,T)	Revenue growth (G,A)	NO
West and Noel (2009)	83	High-tech	U.S.	.18 (C)	External networking (N,S,I)	Sales growth, ROA, net income (G,P,R)	YES
Wright et al. (2008)	349	High-tech	China	.01 (C)	International networks (D,I)	Employment growth (G,R)	NO

Source: Stam et al. (2014); [1] cross-sectional (C) or longitudinal (L) study design; [2] social capital constructs coded into network size (N), strong ties (S), weak ties (W), structural holes (H), and network diversity (D); operationalized using tie-based measures (T) or scale items (I); [3] small firm performance operationalized using growth measures (G), profit measures (P), or nonfinancial measures (N), combine multiple performance indicators (M); Performance was self-reported (R) or based on archival data (A)

This comprehensive study (Stam et al 2014) underlines the value of cultivating diverse personal networks that are rich in structural holes. Furthermore, it also showed that distinct networking strategies are needed at different points in time and in different industries and countries. Hence, entrepreneurs should adapt their social connection over time to accommodate their business's evolving resource needs.

2.4 University Startup Support and Business Incubation

2.4.1 Development of the Business Incubator Industry

It is generally accepted that the first incubator was established as the "Batavia Industrial Center" in 1959 at Batavia, New York (Lewis 2002). After the initial owner company exited this large building, the developer was unable to rent out the facility as a whole. Therefore, he sublet subdivided partitions of the building to a variety of tenants. Some of these tenants requested business advice and/or assistance with raising capital. Hence, the first business incubator was born (Adkins 2001).

In the following decades, the incubation programs diffused slowly. It was usually done as government-sponsored initiatives for economic revitalization or to rationalize the process of commercializing basic research outputs (Adkins 2001). In the 1970s the National Science Foundation started the Innovation Centers Program to stimulate and institutionalize best practices in the processes of evaluating and commercializing selected technological inventions (Scheirer 1985). The next two decades were characterized by a high rate of incubator diffusion. On the one hand, the US legal system increasingly recognized the importance of innovation and intellectual property rights protection (Somsuk et al. 2012). On the other hand, the commercialization of biomedical research increased profit opportunities. Furthermore, the NBIA (National Business Incubation Association) was established in 1985 – an event that underlined the growing interest in business incubation.

Business incubators had their heyday in the late 1990s, especially supporting dot-com startups. With the burst of the dot-com bubble, not only did many high-tech businesses vanish – but also many business incubators did. Nevertheless, the incubator industry has matured into an international economic-development tool with more than 5,000 programs in more than 100 different countries (Kanter 2012). The United States remains the leader in this industry and the strong increase in the number of incubator programs is a result of strong government support. The number of incubators in North America has grown from an estimated 425 in 1991 to about 1100 in 2006. Ventures supported by incubators generated an estimated 315,000 full-time jobs, 41,000 part-time jobs and $18.7 billion in annual revenue in 2008 (Kanter 2012). The number of incubators has been increasing steadily in countries throughout the world (Bøllingtoft & Ulhøi 2005). In the beginning of the new millennium, the industry of incubators experienced especially high growth numbers.

2.4.2 Traditional View on Incubators

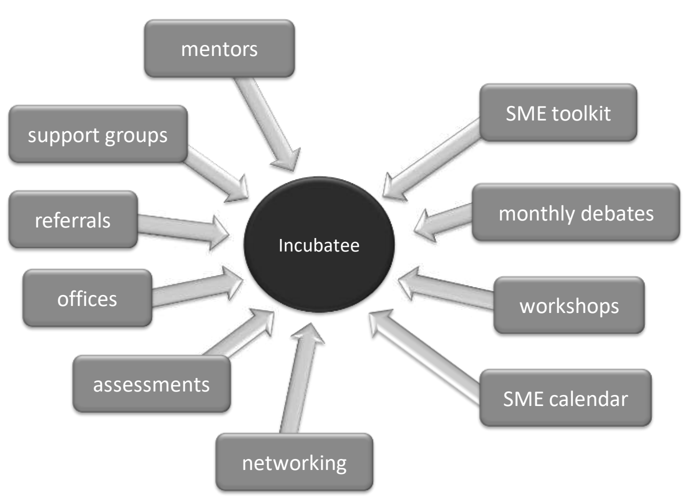
The universal purpose of an incubator is to increase the chances of an incubated firm surviving its formative years (Allen and Rahman 1985): The universal goal is to create successful firms that will leave the incubation program financially viable and freestanding and develop as a corporate financial entity. Therefore, incubators are an important component of a local economic development strategy and can serve a market failure bridging function, by enabling entrepreneurship (Hackett & Dilts 2004). Even though the main goals and the purposes of business incubators are the same, it is hard to find a clear definition that fits all different kinds of incubators in the market. There are several reasons for this definitional ambiguity. First, one can observe an adaptation of the original business incubator concept in accordance with varying local needs and conditions (Kuratko and LaFollette 1987). Second, the literature uses terms like ''Technology Innovation Center'' ''Research Park'' and ''Business Incubator'' in an interchangeable manner (Swierczek 1992). However, Temali and Campbell (1984) set the standard for describing incubators and their configurations. They believe that an incubator is not only a shared-space office facility, infrastructure and mission statement. The incubator should rather be perceived as a network of different individuals and organizations including: the incubator manager and staff, incubator advisory board, incubatee companies and employees, local universities and university community members, industry contacts and professional services providers (like lawyers, accountants, consultants, marketing specialists) as well as venture capitalists, angel investors and volunteers.

2.4.3 Incubator Services

In the *Guide to Business Incubation,* Davies (2009) describes the role of an incubator program to accelerate the successful development of startup firms, by supporting entrepreneurs with various resources and services. Hackett and Dilts (2004, p. 79) define a business incubator as "*a shared office-space facility that seeks to provide its incubates (i.e. ''portfolio-'' or ''client-'' or ''tenant-companies'') with a strategic, value-adding intervention system (i.e. business incubation) of monitoring and business assistance. This system controls and links resources with the objective of facilitating the successful new venture development of the incubatees, while simultaneously containing the cost of their potential failure.*"

There are policy prescriptions and guidelines that help to operate an incubator (Hackett and Dilts 2004). To begin with, it is recommended to strategically construct an advisory board and to compose a menu of support services that are offered by the business incubator. According to Davies (2009), it is essential for a newly established incubator to consider the services it aims to provide to its tenant firms, thus its incubatees (see figure below). To have a clear strategy of which integrated services the incubator will provide, will also allow a better assessment of its success.

Figure 15: Incubator's integrated Services for Incubatees



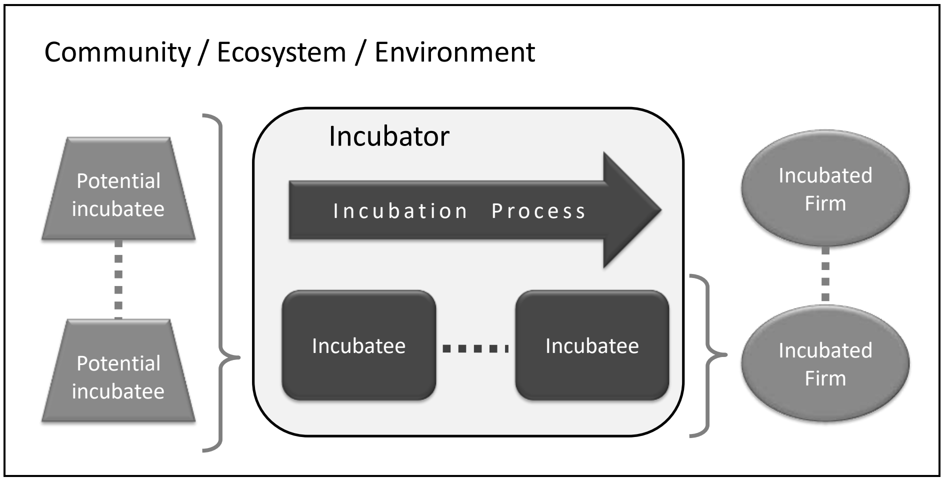
Source: based on Davies (2009)

The ‘State of the business incubation industry’ report, produced by the United States National Business Incubation Association in 2006, identifies 33 distinct services which can be offered to client companies by business incubators. Best practices of business incubators include: business plan writing and business basics, legal assistance (e.g. IP-rights), access to capital, marketing assistance, mentoring, close ties with institutions of higher education, financial management services, networking with other entrepreneurs, networking with the business community, developing presentation skills, developing business etiquette and commercialization assistance. Regarding the financial assistance for incubatees, the incubator has to decide whether they want to manage their own investment fund or if they merely function as a broker. Whatever the strategy is for a specific incubator – a dynamic readjustment of the incubation programs adapted to local needs is essential to guarantee long-term success.

2.4.4 Incubation Process

In 1985, Campbell et al. attempted a definition of the incubation process, by emphasizing the value-adding characteristic of incubation (in Hackett & Dilts 2004, p. 75): *‘‘(1) The diagnosis of the total business needs of a new business, from the collective experience of a diverse group of business generalists and specialists. (2) The cost-effective selection, provision and monitoring of the acquisition, implementation and coordination of the various business services needed by the new business. (3) The provision of capital—if needed—to pay for product development and the business services provided by third party professionals. (4) The provision of a growing network of business development expertise*’’. They locate this process inside the incubator (see figure below).

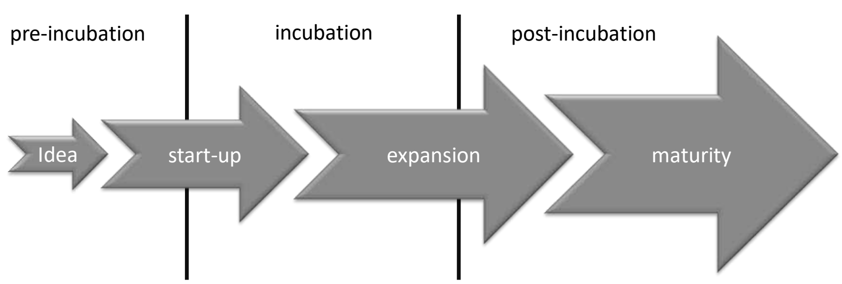
Figure 16: Incubation Process



Source: based on Campbell at al. (1985)

The National Business Incubation Association has noted on many occasions, that the incubation process is much more important than the incubator facility (Adkins 2001). However, the research on business incubation lacks a business incubation process model. The framework described by Davies (2009) differentiates between a pre-incubation phase, the incubation phase itself and a subsequent post-incubation phase.

Figure 17: Incubation Phases and Venture Progress



Source: based on Davies (2009)

2.4.5 Business Incubator Models

There are various approaches on how to distinguish and classify different incubator types and models. In the following studies, some of these taxonomies are introduced. Brooks (1986) was one of the first scholars who distinguished between incubators as *real estate development efforts*, and incubators as systematic *business development assistance efforts.* He further describes a two-type incubator continuum: First, the startups center an ''economic growth incubator,'' in order to gain access to the incubator's support network, its support services, and the resources of a local university affiliated with the incubator. In a next step, once the startups have attained a more advanced state of business development, they can move into a ''real estate incubator'' which provides office space and shared services.

The Allen and McCluskey continuum (1990), who elaborated on Brooks' model, focuses on the primary and secondary objectives of four types of incubators that are distributed along a value-adding continuum: From least value-adding to most value-adding, these incubator types include: (a) for-profit property development incubators, (b) non-profit development corporation incubators, (c) academic incubators and (d) for-profit seed capital incubators.

Table 8: Allen and McCluskey Continuum

	For-Profit Property Development Incubators	Non-Profit Development Corporation Incubators	Academic Incubators	For-Profit Seed Capital Incubators
Primary Objectives	- Real estate appreciation - Sell proprietary services to tenant	- Job creation - Positive statement of entrepreneurial potential	- Faculty-Industry collaboration - Commercialize university research	- Capitalize investment opportunity
Secondary Objectives	- Create opportunity for technology transfer - Create investment opportunity	- Generate sustainable income for the organization - Diversify economic base - Bolster tax base - Complement existing programs - Utilize vacant facilities	- Strengthen service and instructional mission - Capitalize investment opportunity - Create good will between institution and community	- Product development

Source: Allen and McCluskey (1990)

For-profit incubators constitute a relatively small segment of the total incubator population. The majority of incubators are non-profit, which incubate below the ‘‘radar screens’’ of most journalists (Hackett and Dilts 2004). Carayannis and von Zedtwitz (2005) distinguish between five incubator archetypes. They argue that most incubators can be associated with one of these archetypical forms, even though some incubators integrate elements of two or more incubation archetypes. More details about those five types of incubators can be found in von Zedtwitz (2002).

- **Regional business incubators’** main objective is to serve a local community, by creating jobs and supporting local commerce and wealth.
- **University incubators** are focused on serving the scientific community at the university and typically do not have financial pressure to return a profit.
- **Independent commercial incubators** are often focused on a particular technology or specific industry and usually oriented to generate profit.
- **Company-internal incubators** are more difficult to categorize. On the one hand, their parent companies have strong commercial objectives, but on the other hand, the internal incubator serves (both internal and external) political interests, as well as corporate development objectives.
- **Virtual incubators** are also for-profit but focus on needs in the entrepreneurial community rather than a particular industry.

The different concepts and objectives of the previously described incubator models obviously have consequences on their business models and strategic orientation (Carayannis & von Zedtwitz 2005). Whereas the regional- and the university incubators are generally not-for-profit oriented, the other three forms follow pronounced for-profit objectives. Furthermore, not-for-profit incubators generally follow a public mission, such as regional development/employment and growth. Alternatively, they serve goals that are indirectly related to operational profits (cf. innovation capacity building or stock market valuations for example). One can argue that the strategic objectives of a not-for-profit incubator are also economic in the long term. However, these benefits are gained outside the incubator by a parent, partnering or sponsoring organization. This fact makes it hard – or even impossible – to measure the incubator's contributions.

Virtual incubators

The traditional incubator model operates "within the walls" and requires a startup venture to establish itself at site of the incubator. Newer models often only have a virtual presence, without any physical space for their clients – often referred to as "virtual incubation" or as incubation "without walls". Virtual business incubation programs are on the rise both in the U.S. and abroad (Lewis 2008). These virtual incubators do not restrict themselves to deliver their services and activities to a specific site. They can rather be perceived as a community platform or a network of enablers, which provide support and advice to entrepreneurs by allowing them to maintain their own offices, warehouses, etc. This is a factor that is highly valued by some entrepreneurs, as some of them do not want to relocate into an incubator facility. Furthermore, virtual incubation programs are usually less expensive to operate and especially in rural areas, where the client base is often spread out over larger areas, it may a good alternative to commuting. On the other hand, one significant challenge for virtual incubation is delivering entrepreneurial support services efficiently and building the relationships among clients that support peer-to-peer learning and facilitate collaborative business development (Lewis 2008).

Positive effects triggered by the aggregation and interaction of different startups in the venue are an important asset of incubators. The absence of such symbiotic effects raised the discussion of whether virtual incubator programs can be considered incubators per se. Some (Hackett and Dilts 2004) would argue that including virtual programs on the list of incubators would obscure the term "incubator" even more and that these kinds of programs should instead be referred to "intervention programs". However, virtual incubators offer important services to their clients, helping them to establish themselves. For this reason, leading ample discussions on how to define them should not become the main focus of academic discourse.

2.4.6 University-based Incubation

Fetters et al. (2010) describe a university entrepreneurship ecosystem (UEE) as a multidimensional enterprise that supports entrepreneurship development through a variety of initiatives related to teaching, research and outreach. The outreach initiatives help to build a meta-ecosystem, linking the university to the regional/local entrepreneurship ecosystem. Hence, an UEE is "integrated and comprehensive, connecting teaching, research and outreach, and is woven into the fabric of the entire university and its extended community for the purpose of fostering entrepreneurial thought and action throughout the system (Fetters et al. 2010, p. 2). Etzkowitz (2002) describes the university as a natural incubator that sometimes plays an informal entrepreneurial role in the incubation of companies.

The influence of the department from which potential academic entrepreneurship emerges has so far attracted little attention (Murray 2004, Bercovitz & Feldman 2008). Only limited research exists suggesting that the local work environment at the department level can influence the engagement of faculty in academic entrepreneurship (Bercovitz & Feldman 2008). It is easily conceivable that different departments exhibit different cultures, either supporting or suppressing academic entrepreneurship.

University technology business incubators (short UTBI, cf. Mian 1997, in the following simply referred to as "university incubators") seems like a promising concept to link talent, technology, capital, and know-how, in order to accelerate the development of new technology-based firms and to speed the commercialization of technology (Smilor and Gill 1986). In addition to the services offered by a business incubator in general, a university incubator can support new business with a number of additional services and benefits (Mian 1997): One is the access to university facilities, such as libraries, laboratories, etc. Furthermore, tenants have better access to the qualified university personnel and the university reputation may also contribute to the incubatees' marketing potential. On the other hand, universities enjoy several benefits, including student employment and training and the potential for faculty consulting. According to Kanter (2012), those incubators associated with universities generate the most positive results. When incubators establish ties between the new businesses and strategic partners and capital sources, their performance can improve considerably. It is mentioned that the average five-year survival rate for startups increased from about 50% to 75%, by creating jobs in the host region at the same time.

Furthermore, an admission pipeline for incubatee firms should be established in order to optimize tenancy. In this regard, it is advisable to differentiate the types of applicants for admission to a business incubator (Hackett & Dilts 2004):

(a) those that cannot be helped through business incubation
(b) those that should be incubated, due to the existence of some resource gap(s)
(c) those that do not need incubation.

In an ideal world, only those startups that are "weak-but-promising" - weak due to a lack of resources, but promising in the sense that they have built a compelling business case and convince with a strong management team - should be considered for incubation (Hackett & Dilts 2004).

One key question is whether the success of founding teams coming out of an accelerator or incubator is due to the institution's ability to attract and select great teams (selection value) or to the actual added value created in the program (added value) (Aulet 2014). A study done by Columbia professor Morten Sorensen (2007) showed in venture capital deals that 60 percent of the value created is based on selection value, and only 40 percent is added after the selection.

2.4.7 Network Approach to Business Incubation

Recent theoretical developments suggest that the likelihood of value creation increases, when the incubator is structured as a strategic network (Hughes et al. 2007). Therefore, incubation gets defined as the process that enables new businesses to create value, by embedding them in a network system that provides extensive powerful business connections (Hansen et al 2000). Hackett and Dilts (2004) define incubation as a strategic, value-adding intervention system within a network context. An incubator network, therefore, is a generic network available to each incubating firm. Hansen et al. (2000) employ network theory (Nohria & Eccles 1992) to argue that the primary value-added feature of networked incubators is the set of institutionalized processes. Through this approach, they carefully structure and transfer knowledge throughout the incubator network, in order to create conditions that facilitate the development of incubatees, the incubated firms. Hence, the network size, configuration and accessibility of resources form the social capital of the incubator, which supports the commercialization of innovations. The importance of the network design factor is supported by research that concludes that network relationship-building is the most important value-added component of the incubation process (Lichtenstein 1992). Rather than locate the incubation process either inside the incubator or in the local community, network theory asserts that the incubation process includes and transcends the incubator (Hackett & Dilts 2004).

Hence, the emphasis is placed on the network effect the incubator has, rather than its physical location. Incubation is a process, not a place. Hence, the perception of an incubator moved from an isolated to a networked entity (Etzkowitz 2002). Through interactions within the network, incubating firms generate social capital, which can create substantial value and, ultimately, increase performance (Kambil et al. 2000). Support institutions for (potential) entrepreneurs, like incubators, provide meaningful relationships that help to access needed knowledge and other resources. This can accelerate the development of a startup and save considerable time and search costs. Hence, the major advantage that incubators offer are the means to overcome the new ventures' liability of newness (lack of experience, resources and reputation).

Networking support from incubators happens at two different levels (Bøllingtoft & Ulhøi 2005, Bruneel et al. 2012): internal networking (*bonding social capital*) with the incubator and external networking (*bridging social capital*) with actors outside the startup support organization. Even though both types of interactions, bonding and bridging, are regarded as important features of an incubator's program, internal networking activities and relationships among the startups are outside the scope of this research project. The focus is primarily on bridging social capital and the role external actors play in the development of university startup development.

Internal networks refer to the exchange among tenant companies and fellow entrepreneurs who are also part of the startup support community (*peer networking*). As Lyons (2000) points out, these kinds of interactions and exchanges are important, since this kind of social capital enables the entrepreneurs to share all kinds of resources and learn from each other. Furthermore, the exchange with incubator sponsors and/or managers is also part of social capital building within the incubator. For them to understand the needs and expectations of their tenant companies is a crucial requirement, in order for them to be able to structure and deliver the best assistance through the incubation program. As a prerequisite for an exchange, a culture of trust has to be established between the founders (Bergh et al. 2011, Van Weele et al. 2018a).

External networks, on the other hand, primarily refers to connecting startups to potential partners, customers, investors, other companies and other actors outside of the university. Following Grandi and Grimaldi (2003), the access to academic facilities and specialized knowledge within the university are also considered a specific form of value creation. Hence, within the context of the different services provided (see Chapter 5.3.2),the network building effect of startup support organization is emphasized. This is also referred to as network mediation (Bergek & Norrman 2008). Hence, incubators can be considered as a bridge between the incubated firms and the surrounding ecosystem, with the purpose of leveraging entrepreneurial talent and/or resources (Bollingtoft & Ulhoi 2005 Grimaldi & Grandi 2005).

Overall, providing access to external networks aids in the resource and know-how acquisition of startups and allows them to build legitimacy. Whereas all of those points are important for early-stage startups, the focus of this study will be on resource and knowledge acquisition, rather than legitimacy building (see Chapter 6.4 for future research).

2.4.8 Incubators vs. Accelerators

However, especially with regard to the development stage of the startup (Fuerlinger 2014b), different startup organizations offer different kinds of support. The terms “incubator” and “accelerator” should not be used interchangeably. Steve Blank (2013) argues that the development of a new venture can be divided into a search (for a business model) and an execution (of the business model) phase. Referring to these two phases, incubators mainly support new ventures during an earlier search/discovery/exploration stage, with the aim of finding a repeatable and saleable business model. Incubators encourage their tenants to engage in quick iterations through trial-and-error and frequent feedback loops from early adopters. Hence, incubators are a test bed for experimentation, assessment and refinement. At the end of the incubation phase, the tenant's prototypes (service or product) have been tested/validated in the market (cf. product-market-fit) and, ideally, the new venture gains some traction (cf. first users or customers, revenue, etc.). Accelerators, on the other hand, are institutions that "accelerate" the growth of new ventures. The prerequisite to enter an (usually time-limited) acceleration program is a working prototype and initial market traction. By providing specific services, resources and contacts an accelerator enables the new venture to grow its business (i.e. increase its users/customer base, generate more profits) and to professionalize its organization, in order to lay the foundation for scaling of the business.

3 Conceptual Model and Research Hypotheses

In order to understand what drives individual behavior, it is necessary to understand the importance of the social context within which economic action is embedded (Granovetter 1985). That economic action is not solely the function of the self-interest of the individual or other social entity (e.g. organization), rather, economic action is also influenced by the web of social relationships and institutions in which the individual or organization is embedded (Kenney & Goe 2004). In the case of a university, they argue, the individual faculty member is a member of a department, an important organizational sub-unit of the university that has a certain measure of autonomy, and the department is embedded in the larger university. In turn, the university is embedded in an exogenous environment (cf. ecosystem) at the regional, national, and international levels.

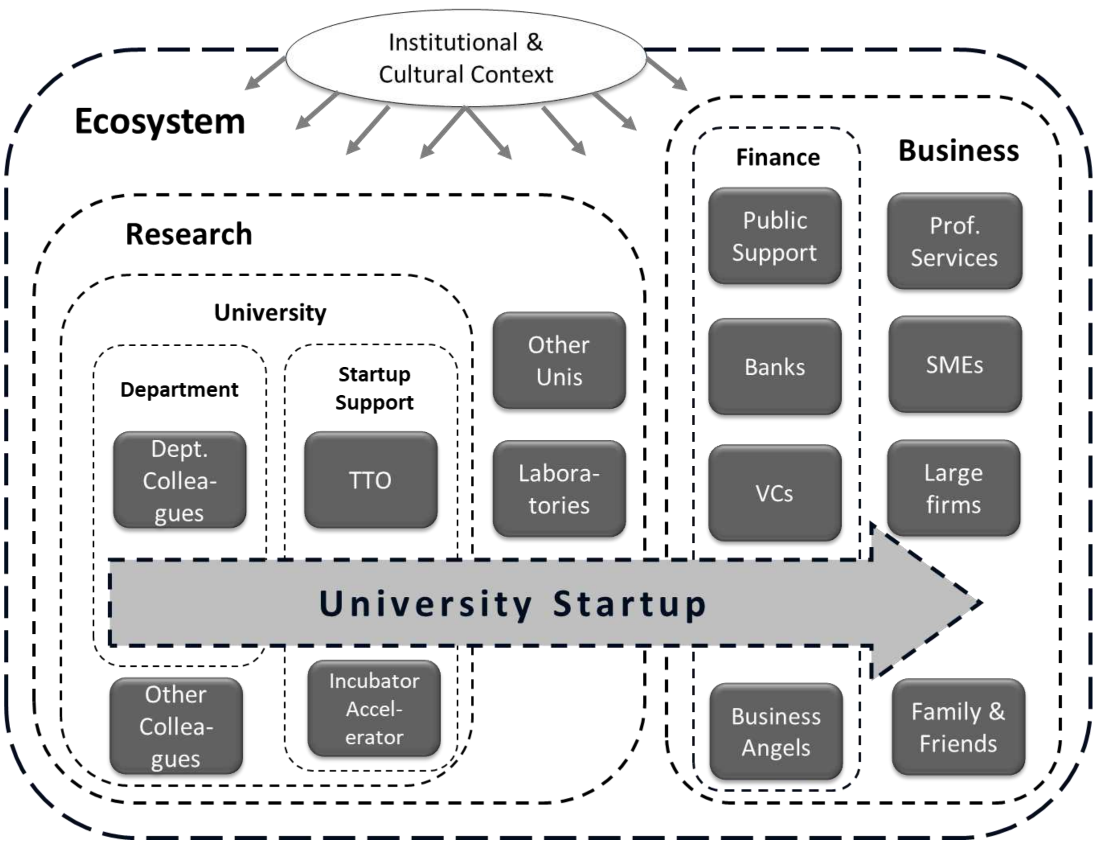
3.1 University Startup Ecosystem Framework

Fetters et al. (2010) describe a university entrepreneurship ecosystem as a multidimensional enterprise that supports entrepreneurship development through a variety of initiatives related to teaching, research, and outreach. The outreach initiatives help to build a meta-ecosystem, linking the university to the regional/local entrepreneurship ecosystem. A key ingredient for a successful entrepreneurship ecosystem is the continued existence of a network between startups and other stakeholders (Spigel, 2017; Van Weele et al. 2018a). Hence, a university entrepreneurship ecosystem is "*integrated and comprehensive, connects teaching, research and outreach, and is woven into the fabric of the entire university and its extended community for the purpose of fostering entrepreneurial thought and action throughout the system* (Fetters et al. 2010, p. 2). Etzkowitz (2002) describes the university as a natural incubator that sometimes plays an informal entrepreneurial role in the incubation of companies.

The overall entrepreneurship ecosystem can further be divided into two different subsystems and distinguished in the knowledge (or research) and business subsystem (Clarysse et al. 2014). According to this description, the knowledge subsystem produces new knowledge and inventions, which are then commercialized as products and services in the business subsystem. According to Bandera & Thomas (2019) the (innovation) ecosystem also integrates invention with commercialization, and includes profit-driven systems and policies that support innovation and economic development. Each of these systems consists of different actors who perform different roles or professions. To simplify the model and be able to compare the involvement of different actors across countries, they are categorized into selected actor groups. These actor groups were selected based on a thorough literature review – see Ecosystem Actors Comparison in the appendix – and considering the relevant research questions and hypotheses.

A schematic model of the actors within the university, in the research or knowledge ecosystem overall, as well as in the business or industry ecosystem is depicted in the figure below.

Figure 18: University Startup Ecosystem



Source: own illustration

In the following, the different actor groups are listed, according to the sub-network they are embedded in, and their role in the university startup development process is briefly described.

3.1.1 Research Support Network

The research support network consists of actors within the university, as well as actor groups outside the university. The university startup interacts with their colleagues in the university, but especially with those who are working in the same department. The goal of startup support organizations is to help the startup develop, by providing specific services and strategic introductions to other actors in the ecosystem.

Department support

The influence of the department from which potential academic entrepreneurship emerges, has so far attracted little attention (Murray 2004, Bercovitz & Feldman 2008). Only limited research exists suggesting that the local work environment at the department level can influence the engagement of faculty in academic entrepreneurship (Bercovitz & Feldman 2008). It is easily conceivable that different departments exhibit different cultures, either supporting or suppressing academic entrepreneurship. Furthermore, being embedded in an academic department supportive of entrepreneurial activity can mitigate the unfavorable conditions at the university level or in the ecosystem that may not are beneficial for entrepreneurship in the first place. (Kenney & Goe 2004). Therefore, a department can act as a creative incubator as well.

Other University Colleagues

In addition to colleagues working in the same university department, other colleagues across the university can be instrumental in developing the university startups. The importance of social networks for the startup process is reinforced by the trend of engaging so called star scientists with a strong entrepreneurial reputation to foster entrepreneurship at the university (Leyden et al. 2014). According to the author, hiring a star scientist may provide access to that scientist's social network, which can leverage the entrepreneurial process, by attracting additional financial support for research and commercialization.

Other universities and Research Laboratories

Outside the university, other actor groups are also part of the research support network. These could be other universities and higher education institutions or public and private research laboratories. Through the research they are conducting across different fields, they can provide complementary knowledge, expertise and other support to university startups in their early development phase.

Startup Support Organizations

From an ecosystem perspective, SSOs are important innovation intermediaries, bridging the research and the business network. Hence, practically they are part of both networks at the same time, taking over a boundary spanning role introducing the university startups to actors in the surrounding ecosystem. This thesis differentiates between Technology Transfer Offices (TTOs), incubators and accelerators. Those support organizations help the startup in different stages of development, and through different methods and means. The incubation process overall and the different types of Startup Support Organizations - as well as their advantages and shortcomings - are briefly described in the introduction and in more detail in Chapter 2.4.

3.1.2 Business Support Network

Industry networks and partners outside the university are important for university startup development to establish and grow their ventures offering capabilities and resources that academic entrepreneurs lack (Grimaldi et al. 2011). Furthermore, the connections maintained to partners in the business environment could be another differentiator possibly facilitating the tech transfer process.

Public Support

Governments in ecosystems with less maturity in venture capital funding provide capital to close the financing gap (Fuerlinger et al. 2015). This public support is essential to jump-start new business and especially to fund the earlier stages of a new venture. However, by doing this excessively the marketplace for venture financing gets distorted and private equity investors eventually move to other markets. To establish a link to the private investment market is important, as the market applies the law of natural selection (Isenberg 2010, 2011). Furthermore, developing a functioning ecosystem also requires that public authorities and private companies jointly invest in promising areas and thus co-create the basis for a sustainable innovation landscape and a dynamic entrepreneurship ecosystem together.

Large firms

The research of Castilla et al. (2000) on social networks in Silicon Valley has not only been on the important networks within institutional sectors, but also on the flow of people, resources, and information among sectors. They argue that these inter-sectoral flows are what make Silicon Valley unique, and that the ability to leverage value by shifting resources among previously separated sectors has always provided a competitive advantage for regions able to do so. Silicon Valley is not unique in this regard. These networks are the basis of the economic structure of many regions around the world, regardless of the success and attention drawn to them. According to the authors, it is not a question of whether networks are important in a region, but rather which kinds of networks are associated with different outcomes.

Business Angels

Business angels are usually successful founders or experienced managers who generated a considerable fortune, and are now willing to support emerging startup companies in their endeavor. They invest in the early stages of a new venture and, thus, are closing a gap in the funding landscape, since banks usually do not provide loans to companies in this high-risk early phase. For business angels, next to altruistic reasons, the return rate and the founder or founding team is central to their decision making (Mason & Stark 2004). They pay attention to the background and experience of the entrepreneurs and trust their personal assessment of whether he or she "has what it takes” to successfully build the company. For reasons of risk diversification, experienced business angels, therefore, usually do not just invest in one young company, but in several at the same time (cf. investment portfolio). In addition, business angels offer support to the startup in terms of business and organizational development and are an important source for personal introductions to partners, customers, and other investors. Thus, they are not only financiers, but also take on an important role as mentor and coach.

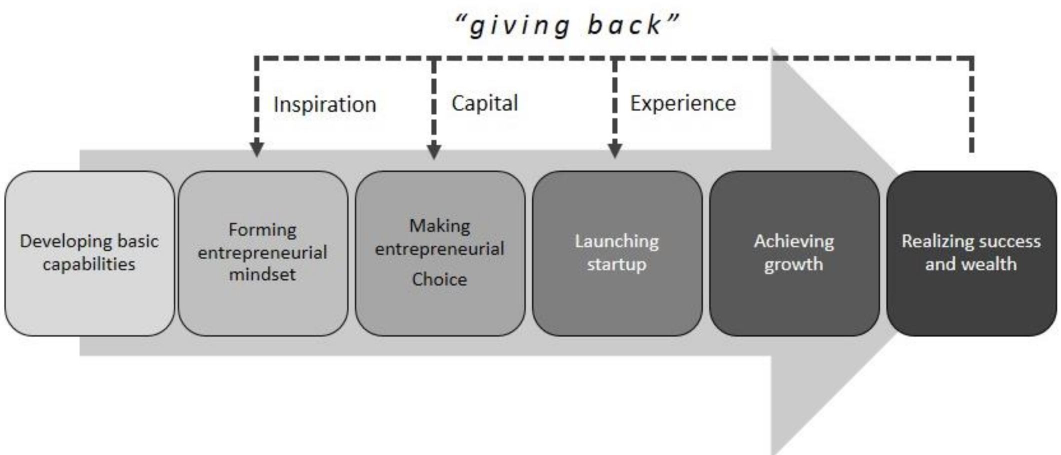
Venture Capitalists

High tech is connected to high risk, which makes projects less attractive to banks. However, by contrast, they are more attractive to venture capitalists (Audretsch et al. 2003). Even though the VC sector finances only a minority of new firms, it plays a very prominent role in policies designed to overcome finance gaps and to grow entrepreneurial, innovation-driven economies (OECD 2014). Many young companies, especially in the web and IT sector, are encouraged to grow quickly, in order to stay ahead of their competition and not to lose market share. To be able to finance the scaling of the business, many companies need large sums of capital and, therefore, seek financing from a venture capitalist (or simply VCs). VCs are professional investors who invest large sums of capital from wealthy individuals or financial institutions (e.g. pension funds) in new ventures. The main interest of a VC is to increase the valuation of the new company that they are invested in. If these companies are acquired by a large company or go public, the VC receives a share of the profits (usually around 20 percent). Investing in new companies is still an extremely risky business and a difficult task - even for experienced VCs (Freeman & Engel 2007). However, the role of VCs is not just that of the financier. Similar to the business angel, a good VC helps a founder to build his company (Senor & Singer 2011). Active venture capitalists provide support in strategic decision-making and provide access to a network of business contacts (Hellmann & Puri 2002) and other investors. They can also help to raise additional financing, recruit key employees and professionalize the company (Dushnitsky 2006). Increasing the supply of venture capital does not always imply better support for high-tech firms, especially if venture capitalists provide “more money than advice” (Bottazzi & Da Rin 2005). Aside from the financial capital they provide, investors can also play an important role in the professionalization of the venture (Gorman et al. 1997). Venture capitalists typically have a control function, supervising the startup`s business to protect their own investment, at the same time as supporting the growth of their portfolio firms. Thus, venture capitalists support the startup’s development, by providing financial capital as well as professionalizing the organizational structure and management processes (Hellmann & Puri 2002).

Entrepreneurs & Small business owners

One of the most interesting phenomena in a thriving entrepreneurship ecosystem is the rule of "entrepreneurship reinforcing entrepreneurship". Many successful entrepreneurs become investors, advisors or board members of new ventures and provide capital, experience, and connections to up and coming entrepreneurs. This, maybe the most important, principle for a functioning entrepreneurship ecosystem can be referred to as "giving back" (see figure below). This phenomenon is also described as "The Cycle of Entrepreneurship" (Fürlinger 2014).

Figure 19: Successful Entrepreneurs „giving back" to the Community



Source: based in Isenberg 2010

Professional support

The presence of intermediaries, such as service providers, to facilitate entrepreneurship, has been known for decades (Bahrami & Evans 1995). This network of service professionals that can help with legal questions, accounting, staffing needs and human resource issues, consulting services and important introductions to investors and partners is also referred to as "the entrepreneurial life support system" (Pages et al. 2003). Furthermore, service providers embedded in the ecosystem can also serve as brokers and dealmakers, shaping and supporting entrepreneurial networks (Feldman & Zoller 2012).

3.1.3 Summary of Support Actors in the Research and Business Network

The entrepreneur is embedded in web of social relationships from the research and business sphere. In order to successfully launch and develop the startup, the entrepreneur needs to leverage the contacts in both the research support network, as well as the business support network. Building upon the work of Mosey and Wright (2007), Batjargal (2003) and Totterman and Sten (2005) we classified support actors in the research and business network in eight categories and twelve actor groups. The comparison of ecosystem actors used by the other authors in their research can be found in the appendix under “Ecosystem Actors Comparison”.

Table 9: University Startup Support Actors in the Research and Non-research Network

Research Network	Non-Research Network
Inside university	Finance
Department colleagues	Private Financiers (e.g. business angels, venture capital firms)
Other university colleagues	Firms
Tech Transfer Office (TTO) or equivalent	Entrepreneurs and small businesses (SMEs)
Outside university	Large firms
Other universities	Policy
Research laboratories	Public support organizations (e.g. government grant providers, regional development agencies)
Intermediary Organization	Support
Startup Support Organization (e.g, incubators, accelerators)	Professional services (e.g. consultants, legal firms, accountants)
	Private
	Private support (e.g. family & friends)

Source: own list building on Mosey & Wright (2007), Batjargal (2003) and Totterman & Sten (2005)

Overall, at each level the ecosystem reflects the same key success factors (Fetters et al. 2010). For this reason, universities can be perceived as entrepreneurship ecosystems (Rice and Habbershon 2006) and so can incubators (Rice and Habbershon 2006). Still, as in the case of all ecosystem evolutions, the initial conditions are transformed through human action (Grimaldi et al. 2011). Hence, it is the activities on the micro level, the startup level, that impact the higher levels and lead to change. Therefore, iti is necessary to understand the entrepreneurs' characteristics and the social dynamics happening on the startup level, in order to derive suggestions on how to strengthen the overall ecosystem.

In the following section, hypotheses are developed to examine the role of human and social capital on university startup development and performance.

3.2 Hypotheses regarding the Influence of Human Capital

On the micro level, the university startup itself and especially its founder and the founding team is the object of investigation. More specifically, this chapter develops hypotheses around the research question: *How does human capital affect social capital development, access to financing and startup performance?* This question contains two different sub-questions. First, hypotheses on the effect of human capital on social capital development are posited, with a particular focus on its influence on raising financial capital. Second, the effect of entrepreneur's human capital on startup performance are formulated in hypotheses.

3.2.1 Hypotheses 1 and 2: Human Capital influencing Social and Financial Capital

This chapter builds upon the qualitative studies conducted by Mosey & Wright in 2007, who explored the influence of different levels of academic entrepreneur's human capital – measured by entrepreneurial experience – on their ability to develop social capital. This follows the notion that the human capital of entrepreneurs may be influential in developing social capital (Adler & Kwon 2002). The authors also identified the need for further large-scale quantitative studies to test the generalizability of the propositions they developed. Hence, the hypotheses stated in this chapter are largely based on their work. The level of analysis is the entrepreneur itself and the unit of analysis is the social capital developed by the entrepreneur (Mosey & Wright 2007). They further differentiate entrepreneur's human capital, in terms of prior startup experience, the following way: Nascent entrepreneurs are individuals considering starting their own businesses (Ucbasaran et al. 2003). Novice entrepreneurs are individuals who have created a venture for the first time and habitual entrepreneurs undertake multiple entrepreneurial ventures (Westhead & Wright 1998).

In terms of social capital content or know-how that the entrepreneur can access through their network contacts, the classification developed in Chapter 2.2 is used: technological and product development refers to the transformation of new research findings, technologies and prototypes into viable products or services. Market and business development refers to gathering market information and identifying customer needs, as well as marketing and selling your products or services. Principles of customer development (Blank 2006), business model generation (Osterwalder et al. 2010), and the lean startup (Ries 2011) are central concepts. Organizational development refers to starting, managing, and growing a professional company. The integration of a complementary founder team of business, technology and design experts is as important as the financial, legal and strategic aspects.

In their qualitative study on academic entrepreneurs, Mosey & Wright (2007) found differences regarding the resources used within and external to the university and research network. Nascent entrepreneurs were mostly concerned about legal advice regarding IP protection, and developing their research to meet a viable business opportunity. They are also inspired by more experienced colleagues, and had difficulties in engaging with actors external to the university. Nascent entrepreneurs also felt frustrated by the lack of assistance provided by the TTO and expressed difficulties in engaging with the TTO. In contrast to nascent and habitual entrepreneurs, novice entrepreneurs, engaged in their first venture, described their experience with the TTO as thoroughly positive. Since novice entrepreneurs lack prior business ownership experience, they expressed problems in gaining credibility outside of the university (Vohora et al. 2004). This subsequently limits their ability to raise equity finance. Habitual entrepreneurs, on the other hand, appear more likely to gain equity finance from contacts external to the university than nascent or novice entrepreneurs. Moreover, they are more likely to receive support from actors external to the university, potentially building on their social capital established through their prior experience in starting a business. Overall, according to Mosey & Wright (2007), academic entrepreneurs with prior startup experience have broader social networks and more effective in developing network ties. Less experienced academic entrepreneurs encounter more structural holes between their research networks and business networks, which can inhibit opportunity recognition and new venture development.

Building on these findings, the following hypotheses are posited in terms of the influence of human capital on social capital:

- Hypothesis 1a*: Nascent and novice academic entrepreneurs are more likely to gain organizational development support (i.e. "management resources") from their research colleagues than are habitual academic entrepreneurs.*

- *Hypothesis 1b: Novice academic entrepreneurs are more likely to gain market and business development support (i.e. "market and industry knowledge") using the university technology transfer office than habitual and nascent entrepreneurs.*

- *Hypothesis 1c: Prior business ownership experience is more important than industrial experience in gaining organizational support (i.e. "management knowledge") from network actors external to the university.*

Human capital and financial capital

The findings of Mosey and Wright (2007) underline the importance of an entrepreneur's startup experience in securing venture funding from actors external to the university. The figure of the entrepreneur, the founder/manager or the management team of a new business, is the first and most relevant factor in obtaining funding for the new venture (Minola and Giorgino 2008). There is further evidence that suggests that the manager's or team's education and track record in the field of the new project are positively correlated with the probability of obtaining capital (Colombo & Grilli 2005).

- *Hypothesis 2a: Prior business ownership experience has a positive impact in gaining equity finance from network actors external to the university.*

- *Hypothesis 2b: Prior business ownership experience is more important than industrial experience c) management experience d) research experience in gaining equity finance from network actors external to the university.*

3.2.2 Hypothesis 3: Human Capital and Startup Performance

As described in Chapter 2.3, human capital – measured by the prior experience of the entrepreneur and or the founding team - is crucial for the development of new ventures. Specific prior experience refers to domain-specific capabilities that are embodied in individuals and represent an important asset of a firm (Pfeffer 1994). It is not without reason that most investors say they would rather invest in a first-class team with a medium-good idea than vice versa (Preston 2001). Furthermore, especially in relation to the concept of social capital (see next chapter), human capital plays a central role. Since it appears that access to social capital may not necessarily lead to its utilization (Bandera & Thomas 2019), it is not sufficient for resources (know-how, financial capital, etc.) to be merely available to a startup. Even more importantly, the entrepreneur and his team need to have the ability (human capital) and motivation (Adler & Kwon 2002) to use those resources effectively and efficiently in order to achieve growth and be successful in the long run. Ultimately, the skills, expertise and experience of an entrepreneur and the founding team overall are a decisive factor whether a new established company will be successful or not.

The role of startup experience

Prior spin-off experience – more generally speaking startup experience - was also identified as an important success factor (Hayter 2013) for academic entrepreneurs and university startups. Also referred to as entrepreneurial experience, its important role for early stage startup development has been often described (Clarysse & Moray 2004, Steen et al. 2010). As discussed in Chapter 2.1, starting a new venture is substantially different from managing an existing company. Large businesses execute a business model, new ventures look for one: *"A startup is a temporary organization designed to search for a repeatable and scalable business model"* (Blank 2013, p. 67). Hence, startups should not simply be regarded as smaller versions of large organizations and need different management approaches in order to succeed as, for example, the lean startup methodology (Ries 2011) or business model thinking (Osterwalder et al 2010). To deal with the liability of newness (Stinchcombe 1965), they need to understand how to overcome the critical junctures in the startup process (Vohora et al. 2004). Hence, entrepreneurs who have been through this process before, are more likely to successfully grow their startup once again. For this reason, we can posit the hypothesis:

- *H3a: More entrepreneur startup experience will lead to higher startup performance.*

The role of management experience

In a study on Taiwanese high-tech ventures (Lin 2006), it was found that an entrepreneurs' management capability had a significantly negative impact on startup performance. The authors suggested that management capabilities needed for innovative high-tech entrepreneurial firms are different from the ones for established companies. This interpretation aligns with the arguments mentioned with regard to startup experience (in the paragraph above), and the notion that a different skill set is needed to start a new venture from scratch and develop it into an established company. This process was described by the successful entrepreneur and venture capitalist Peter Thiel in his book Zero to One (Thiel & Masters 2014). Given the different nature of startups compared to established businesses and the different skills need to develop them, it can be argued that:

- *Hypothesis 3b: More entrepreneur management experience will not lead to higher startup performance.*

The role of industry experience

Entrepreneurs who enter industries in which they have prior experience as employees perform better than others (Dahl & Sorensen 2013). Through work experience in a specific industry or sector, the entrepreneur familiarizes himself with the habits of that industry (Shane & Stuart 2002) and its stakeholders. Furthermore, the founder is aware of the newest trends and technological developments in the field and understands the problems and needs that pertain to the industry. Their industry-specific experience is crucial to understand how to serve markets and solve customer problems (Shane 2000). Thus, they should be better equipped to develop needed products or services within a specific business community. This is because ultimately, the founders of the university startup have to create a product or service – through iterations and fine-tuning - that is adopted by the customers and meets the standard of the commercial environment/market. Following these arguments, the following hypotheses is formulated:

- *Hypothesis 3c: More entrepreneur industry experience will lead to higher startup performance.*

The role of research experience

Domain-specific knowledge and experience in the research field can provide benefits for university startups and academic entrepreneurs (Ensley & Hmieleski 2005, Wright et al. 2007, D'Este et al. 2012). Research experience is important for the effectiveness of technology transfer and the commercializing of scientific findings (Agrawal 2006), by supporting opportunity discovery and exploitation (D'Este et al. 2012). Scientists who are successful in their respective fields of research are in an advantageous position to start a successful spin-off (Scholten 2006). Their success is, in part, due to knowing the academic environment (Murray 2004), which allows them to access equipment and personnel more easily. Hence, human capital can support early development of a university startup, by providing access to relevant resources on preferential terms. Corolleur et al. (2004) explains that more experienced scientists run spin-offs that are more innovative, increasing the value of the startup. Overall, the following statement is formulated as hypothesis with regard to research experience:

- *Hypothesis 3d: More entrepreneur research experience will lead to higher startup performance.*

The role of growth aspiration

Using growth aspirations has robust empirical validity with regard to predicting performance (Covin & Wales 2011, Estrin et al. 2013). There is also empirical evidence that entrepreneurial aspirations are related to entrepreneurial outcomes, showing a positive significant link between an entrepreneur's growth aspirations and actual startup growth (Kolvereid & Bullvag 1996, Baum et al. 2001, Wiklund & Shepherd 2003 and Delmar & Wiklund 2008). "Go big or go home" is a popular phrase in Silicon Valley. This notion refers to the prerequisite of having challenging expectations for one's startup growth, in order to attract investors attention and, ultimately venture capital. For business angels, the return rate and the founder or founding team is central to their decision making (Mason & Stark 2004). The same is true for venture capitalists. Private investors follow a portfolio approach– investing in multiple startups in order to reduce risk for the overall portfolio. Given the high risk involved in investing in early-stage ventures, they have to anticipate a fairly high rate of their investments failing. On the other hand, this implies that investors are predominantly investing in startups with high-growth potential. Ultimately, the successful startups in their portfolio need to make up for the lost investments from the ones that failed and return a profit for the fund overall. Hence, investors are looking for startups – and entrepreneurs – with a "growth mindset".

- *Hypothesis 3e: Higher level of an entrepreneur's growth aspiration will lead to higher startup performance.*

- *Hypothesis 2c: Higher level of an entrepreneur's growth aspiration will lead to a higher probability of equity financing by private financiers (business angels and venture capitalists).*

The role of entrepreneurial commitment

An entrepreneur being committed full-time increases the chances of the startup's success (Shane 2004). In addition, investors know about the value of entrepreneurial commitment and prefer to invest in founders who show a high level of commitment to their startup and are willing to work intensively on realizing their vision. Starting a new venture is a risky endeavor with an unknown outcome, following no pre-determined playbook. An entrepreneur with passion, stamina and commitment is needed to guide the startup through the highs and lows of the startup journey. Furthermore, entrepreneurship is a team effort and studies suggest that the ideal number of members in the founding team is three or four (Clarysse & Moray 2004). Incorporating the commitment and team effort aspect it can be stated:

- *Hypothesis 3g: A higher number of full-time committed founders will lead to higher startup performance*

- *Hypothesis 2d: A higher number of full-time committed founders will lead to higher probability of equity financing by private financiers (business angels and venture capitalists).*

3.2.3 Overview of Hypotheses regarding Human Capital

Table 11 below summarizes the hypotheses developed regarding human capital.

Table 10: Hypotheses on Human Capital influencing Social-, Financial Capital & Startup Performance

No.	Hypotheses
H.1a	Nascent and novice academic entrepreneurs are more likely to gain organizational development support from their research colleagues than are habitual academic entrepreneurs.
H.1b	Novice academic entrepreneurs are more likely to gain market and business development support using the university technology transfer office than habitual and nascent entrepreneurs.
H.1c	Prior business ownership experience is more important than more industrial experience in gaining organizational support from network actors external to the university.
H.2a	Prior business ownership experience has a positive impact in gaining equity finance from network actors external to the university.
H.2b	Prior business ownership experience is more important than industrial experience c) management experience d) research experience in gaining equity finance from network actors external to the university.
H.2c	A higher level of an entrepreneur's growth aspiration will lead to a higher probability of equity financing by private financiers (business angels and venture capitalists).
H.2d	A higher number of full-time committed founders will lead to higher probability of equity financing by private financiers (business angels and venture capitalists).
H.3a	More entrepreneur startup experience will lead to higher startup performance
H.3b	More entrepreneur management experience will NOT lead to higher startup performance
H.3c	More entrepreneur industry experience will lead to higher startup performance
H.3d	More entrepreneur research experience will lead to higher startup performance
H.3e	A higher level of an entrepreneur's growth aspiration will lead to higher startup performance.
H.3g	A higher number of full-time committed founders will lead to higher startup performance

3.3 Hypotheses regarding the Influence of Social Capital

The previous section laid out the hypotheses regarding the influence of human capital of the entrepreneur and the founders' team on social capital development, raising funds and startup performance. In a next step, the attention is drawn to the social capital of university startups, focusing on the research question: *How does social capital affect the early stages of university startup development and their performance?* More particularly, it is explored which types of network actors within the university as well as external actors in the surrounding ecosystem are helpful to create and develop these ventures. *Who are the most important actors within and outside the research network?* One of the premises of this study is to examine which actors are most helpful in bridging the gap between the research and business ecosystems. Once identified, the question is and *how do they support the early stages of university startup development?* More specifically, how do those intermediaries provide value to the university startups, in terms of technological, business and organizational support? Startup support organizations at universities (e.g. incubators and accelerators) are a central actor and important boundary spanner between the research and business environment. The question raised is *how do startup support organizations at universities (e.g. incubators and accelerators) contribute to the development of the university startup's social capital?* It is important to understand how those bridging organizations help university startups develop their social networks, *by providing access to actors outside of the research network*. By conducting a comparative analysis between Europe and USA, this study will also highlight differences in the endowment of social capital of university startups in different ecosystems and the efficiency of the respective support actors in those regions.

3.3.1 Hypotheses 4 and 5: Social Capital, Startup Development and Performance

An entrepreneur is embedded in social networks that influence the development and performance of the spin-off or startup. A firm's social capital is a measure of its relationships in the ecosystem, how those connections facilitate collaboration, and ultimately result in a competitive advantage (Feldman & Zoller 2012). These social networks exist within the universities (cp. research network) as well as in the surrounding business environment (cp. business network). The aim of this study is to take a closer look at the social structure between research and business networks, which often operate separately of each other (Mosey & Wright 2007, Clarysse et al. 2014). Unveiling the structural dimension of social capital – or social network configuration – of academic entrepreneurs can help to identify brokers who are able to bridge those structural holes, facilitating the technology transfer process. This section aims to develop hypotheses around the research question: *Who are the most important actors within and outside the research network, and how do they support the early stages of startup development?*

The role of intermediaries within and outside the university

University startups emerge out of the university context, embedded in the networks of their department and the institution overall. Shane (2004) differentiates between spin-off creation and development: the former encompasses the steps from research, invention, and discovery of the entrepreneurial opportunity, until the founding of the company. Spin-off development is concerned with the development of the technology and the identification of customer needs - the *process of making things commercially useful.* A specific challenge for universities for building competencies in technology transfer through startups is the existence of both internal and external intermediaries. The former, it is argued, support the commercialization of research results, whereas the latter are bridging the academic and commercial context (Wright et al. 2009). Internal intermediaries are defined as the actors within the university (department colleagues, research colleagues in other departments and TTO members). External intermediaries, on the other hand, are all other actors within and outside the research network, in the surrounding ecosystem. Burt (1992) argues that sparse networks with few redundant ties often provide greater social capital benefits. A network with such characteristics provides the opportunity to broker the flow of information and resources between people across these structural holes. Hence, it is important to nurture the entrepreneur's ability to exploit social networks through "brokerage and closure" (Burt 2005). It brings together heterogeneous social ties to form social networks and facilitate the coordination of those networks. The probability of a successful innovation is positively correlated with the size of the region to be searched for knowledge, with the size of the search-region itself depending on the expansiveness and heterogeneity of the entrepreneur's social network (Leyden et al. 2014). Therefore, the authors argue, the ability of an entrepreneur to access different sources of knowledge is determined by the size and heterogeneity of his/her effective networks. Hence, business networks and partners outside the university are important for university startup development to establish, develop and grow their ventures because they offer knowledge, capabilities and resources that academic entrepreneurs cannot find within the research network. Whereas their contacts in the research network can be helpful in their research endeavors, those same contacts arguably do not have the skills and contacts necessary to develop a successful venture. Following the argument of heterogeneity and complementarity, one can accredit the value of external intermediaries and posit:

- *Hypothesis 4a: Non-research actors are used relatively more often by university startups to develop the company compared to research actors.*

Startup support from internal and external intermediaries

The differentiation between internal and external intermediaries can be compared to the bonding and bridging effects of social capital, as discussed in Chapter 2.3. The bonding form (Coleman 1988) of social capital comprises the collectivity's internal structure (Adler & Kwon 2002), in our case the university internal network of research connections. In contrast to the arguments laid out before, other scholars underscore the value of homogeneous networks. This research stream, grounded in theories of absorptive capacity (Hansen 1999), argues that knowledge sharing occurs more readily, when entrepreneurs and their network contacts have shared cognitions due to a common language or shared narrative (cf. cognitive capital, Nahapiet & Ghoshal 1998). Actors in the research network – within a university and between research institutions - spend considerable time together working on scientific projects and developing new technologies. This includes department colleagues, other university colleagues, the Tech Transfer Office (or equivalent), and other universities or research laboratories (public or private). Through the duration, frequency and intensity of the collaboration, strong ties will form among the collaborators and colleagues. These strong relationships are the basis necessary to work on engineering or analytical problems and come up with technical innovations. Hence, we can posit the following hypotheses:

- *Hypothesis 4b: Research actors support technological and product development comparatively more than business actors.*

On the other hand, external intermediaries perform a bridging function (Burt 1983, 2000, Kwon & Adler 2002). They support the development of the university startup, by providing the entrepreneur with contacts outside the university. These are usually contacts to people the university startup team has not maintained a relationship with, actors from the non-research environment. It includes private financiers (like business angels or venture capitalists), entrepreneurs and small firms, large firms, public support (governmental expert organizations, government grant providers, regional development agencies, etc.), professional support (e.g. consultants, legal firms, accountants, etc.) and private support (family, friends, etc.). Since those actors usually meet the entrepreneurs for the first time, their relationship needs to develop over time. Compared to colleagues they have worked for before for a substantial time, these linkages can be defined as weak ties. The missing depth of the relationship to those external actors – and their missing know-how in the startup's technology - does not necessarily support the intense process of joint technology development. However, these new contacts can provide access to complementary knowledge and resources that research colleagues lack: business know-how and market intelligence, experience with leadership and negotiations, and especially contacts with potential customers, partners or investors – to name just a few examples. Service professionals, like consultants, legal firms and accountants, are also referred to as "the entrepreneurial life support system" (Pages et al. 2003). Through their specific domain knowledge, those actors provide the support startups need in order to establish a scalable organization. In addition, private investors, business angels and venture capitalists, play a crucial role in driving the professionalization of the startups they invest in, in organizational terms (Hellmann & Puri 2002, Dushnitsky 2006). Furthermore, they are providing the startups with business contacts (Hellmann and Puri 2002) and, therefore, supporting them in the market and in business development. Based on those notions, the following hypotheses are derived in terms of social capital impact on university startup development:

- *Hypothesis 4c: Non-research actors (esp. small and large businesses, private financiers, public support actors) support market and business development comparatively more than research actors.*

- *Hypothesis 4d: Non-research actors (esp. professional support actors, private financiers) support organizational development comparatively more than research actors.*

Different people in the entrepreneurs' networks, such as friends and family members, satisfy different socioemotional needs of entrepreneurs (Carsrud et al. 1987). The emotional support of the business founder's life partner or spouse can also add value to the firm, by providing emotional stability (Brüderl & Preisendörfer 1998) and are important for entrepreneurial performance. A study has shown that those who enjoy this kind of support earn approximately 40% more than their fellow entrepreneurs who do not have it (Bosma et al. 2004). Furthermore, disconnected support networks make it less likely that social problems and the challenges they generate would migrate from work to families and the other way around (Batjargal et al. 2013). Therefore, emotional support received from the private sphere of an entrepreneur's life can function as a buffer. Enhanced confidence and commitment can enable them to concentrate on revenue generation activities (Krueger & Dickson 1994). Hormiga et al. (2011) also stresses that family provides emotional support as well as active help to the entrepreneur. Overall, these are numerous reasons why entrepreneurs who receive much support from the family might be more successful (Brüderl & Preisendörfer 1998). Building on those insights, the following hypothesis with regard to emotional support is formulated:

- *Hypothesis 4e: Private actors (family and friends) provide comparatively more emotional support than other support actors.*

Startup Support Organizations fostering social capital

The role of the university in the innovation system is changing towards an "entrepreneurial university" (Etzkowitz 1983, 1998, 2008). This concept emphasizes economic development in addition to the more traditional missions of teaching/education and research. Following their counterparts in the USA, higher education institutions in Europe are also adopting new policies and starting new initiatives to foster entrepreneurial spirit among their faculty, employees and especially students. In particular, startup support organizations like incubators and accelerators are widely adopted and there is an open discussion about how such support institutions can effectively foster university startup and spin-off development.

Davies (2009) describes in the *Guide to Business Incubation,* the role of an incubator program to accelerate the successful development of startup firms, by supporting entrepreneurs with various resources and services. More specifically, university technology business incubators (short “university incubators” cp. Mian 1997) link talent, technology, capital, and know-how, in order to accelerate the development of new technology-based firms and to speed the commercialization of technology. More current research on incubators focuses on creating value, by embedding startups in a network system that provides extensive powerful business connections (Hansen et al 2000). In terms of technology transfer and university startup development, startup support organizations (like incubators and accelerators) are intermediary organizations, with the mission of bridging the gap between the field of research/science/academia and business/industry/market. They are doing so by providing a strategic, value-adding intervention system within a network context (Hackett & Dilts 200). Networking support from incubators takes place on two different levels (Bøllingtoft & Ulhøi 2005; Bruneel et al. 2012). They are internal networking (cp. “bonding social capital”) with the incubator and external networking (cp. “bridging social capital”) with actors outside the startup support organization. Hence, access to external networks eases the acquisition of resources and knowledge, providing learning opportunities, and allows new firms to build up legitimacy faster (Bruneel et al. 2012).

The author spent three months working with the startup accelerator program *StartX* of Stanford University in Silicon Valley. He interacted with his staff colleagues, startup founders participating in the program, as well as with mentors and other stakeholders involved in the program. Research conducted by the StartX management has shown, and the author’s experience has confirmed that successful entrepreneurs – compared to those who fail – were able to build a system of people (cf. social network/capital) around themselves that helps them get their venture off the ground and grow it. Once they have established this system, the probability that they will succeed (multiple times) increases dramatically. StartX has recognized the importance of interpersonal relationships and – besides offering other services and resources - leverages the exchange among the founders within the program to learn from, motivate, and support one another (cf. community, internal-networking). Furthermore, their program provides committed and engaged mentorship from hundreds of Silicon Valley veterans who support the entrepreneurs with know-how, feedback and contacts in the ecosystem, cp. external networking (Fürlinger & Leitner 2017).

The main learning from StartX and Silicon Valley is that the most crucial contribution a startup support organization (cp. incubator, accelerator, etc.) can provide, is access to the most important resource overall – the right people.

Referring to the literature as well as conversations with entrepreneurs in Silicon Valley, we can state the following hypotheses regarding the perceived value of incubator services offered:

- *Hypothesis 4f: University startups perceive "external networking" to be more valuable than other services provided by the incubator.*

- *Hypothesis 4g: The higher the number of introductions provided to the startup, the higher the perceived effectiveness of the startup support organization in terms of external networking.*

Social capital influencing Startup Performance

This chapter builds upon the notions developed in the previous chapter and aims to develop hypotheses with regard of the influence of social capital on university startup performance. As highlighted in Chapter 2.3, network connections enable entrepreneurs to identify new business opportunities, obtain resources (below the market price, Stam et al. 2014) and knowledge, as well as secure legitimacy from external stakeholders (Bruneel et al. 2012). Social capital and social networks are shown to have a strong impact on entrepreneurship at various levels of aggregation

(Stuart & Sorenson 2005, Kwon & Arenius 2010). Hence, the right connections can have a substantial influence on the development – and ultimately success or failure – of new ventures. A meta-study by Stam et al. (2014) found that for new firms, weak ties, structural holes, and network diversity are particularly valuable.

The structural dimension of social capital theory focuses on the position of an entrepreneur or startup in a network structure (cf. network configuration), and how it can be an advantage. There are several studies focusing on social capital within the academic network. For example, Stuart & Sorenson (2005) underline the importance of social networks in the startup process at universities, since these networks include graduate students, post-doctoral researchers, current and former colleagues and associates who can provide advice, expertise, and access to financial capital. Many other scholars argued that the size of academic social networks play a crucial factor a university's ability to generate spin-offs (Lockett et al. 2003, Niclaou & Birley 2003, Mustar et al. 2006). Generating university startups and spin-offs is the initial step in commercialization, but there is no guarantee for them to succeed in the market. Different mechanisms are in play in the next step to further develop these new ventures, meet market demand, and further grow their business. Other studies have found that the market attractiveness of a business idea is positively influenced by the market orientation of the founders and by their frequency of interaction with external agents (Grimaldi & Grandi 2005). However, there was still limited research conducted on the role of social networks outside the university to support university startup development and ultimately performance. The focus of the following analyses is centered around bridging social capital and the entrepreneur's and startup external relationships outside of the university network.

The resource dimension of social capital theory considers the resources held by an entrepreneurs' / startup's network contacts (Batjargal 2003). Along those lines, Teece (1986) noted that successful innovations require a complex form of business organization, involving linkages to other organizations, upstream and downstream, as well as lateral and horizontal. In addition, several arguments in the previous chapter highlighted the importance of complementary networks bringing together a different set of assets and competencies that are necessary for a university start up to commercialize a new technology. The key drivers for maintaining networks to actors outside of the academic realm are the acquisition and pooling of complementary assets that are not readily available in a research setting (industry and market know how, financial capital, etc.). It is argued at this point that support received from outside the research network will lead to increased performance of university startups:

- *Hypothesis 5a: Using private financiers to develop the startup will lead to higher startup performance.*

- *Hypothesis 5b: Using entrepreneurs and small firms to develop the startup will lead to higher startup performance.*

- *Hypothesis 5c: Using large firms to develop the startup will lead to higher startup performance.*

- *Hypothesis 5d: Using professional service providers to develop the startup will lead to higher startup performance.*

3.3.2 Hypotheses 6 and 7: Social Capital, Funding Sources and Startup Performance

It is argued that an entrepreneurship ecosystem consists of research (or knowledge, science) and business (or commercial, industry) sub-systems or networks (Rijnsoever 2020, Clarysse et al. 2014, Powell et al. 2012). Those parts are connected to different degrees, depending on regional idiosyncrasies, leading to smaller or larger gaps between them. Previous research in the field argues that investors and venture capitalists play a crucial role as bridge between the knowledge production systems and the commercialization of that knowledge (Powell et al 2010). Clarysse et al. (2014) argue that this “financial support network” of investors are important for entrepreneurship ecosystems and - in the light of the research of this study - for the development and success of university startups.

Private financiers – business angels and venture capitalists – play a crucial role in the development and growth of early-stage startups. They provide essential funding for new ventures, which is usually not readily available on regular capital markets, from banks, for example (Minola & Giorgino 2008). However, it is not only the financial capital which makes private investors such important actors in the ecosystem. Moreover, business angels support founders through advice and feedback and open their personal network to them. Thus, they are not only financiers, but also take on an important role as mentors and connectors. Analogous to the business angel, the role of VCs is not just that of the financier. A good VC helps a founder to build his company (Senor & Singer 2011). Furthermore, engaged venture capitalists can provide assistance in strategic decision-making and provide access to contacts in their business network (Hellmann & Puri 2002).

In order to reap the financial capital and those benefits from investors, startups need to establish social capital, especially relational capital, with the financiers they seek investment from. Social capital is created through a venture‘s networking activities and increases with the extent of interactive relations (Coleman 1988, Koka & Prescott 2002, Rodan & Galunic 2004). The main objectives of networking are access to resources and the acquisition of knowledge (Grant & Baden-Fuller 2004). New ventures must rely heavily on outreach to access expertise and resources (Rice et al 2008). Hence, entrepreneurs must engage in networking activities with investors, in order secure investment for their startup. In Silicon Valley, investors must often meet several times with an entrepreneur before undertaking an investment. The social aspect of getting to know the founder and his motivations for starting the company are central for the investment decisions. For that reason, investors often engage as mentors of entrepreneurs, supporting them – even before they invest in them. As the relationship strengthens through those interactions, the information asymmetries (Minola and Giorgino 2008) regarding the new venture between the entrepreneur and the investor can be reduced and lead to a higher chance of investment. Therefore, the following hypotheses can be proposed in terms of social capital’s influence on securing funding, and the impact of venture funding on startup performance:

- *Hypothesis 6a: Using private financiers to develop the startup, will increase the likelihood of receiving business angel funding.*

- *Hypothesis 6b: Using private financiers to develop the startup will increase the likelihood of receiving venture capital funding.*

- *Hypothesis 7a: Startups who receive business angel funding will experience higher startup performance.*

- *Hypothesis 7b: Startups who receive venture capital funding will experience higher startup performance.*

3.3.3 Overview of Hypotheses regarding Social Capital

The table below summarizes the hypotheses developed regarding human capital.

Table 11: Hypotheses on Social Capital influencing Financial Capital and Startup Performance

No.	Hypotheses
H.4a	Non-research actors are used relatively more often by university startups to develop the company, compared to research actors.
H.4b	Research actors support technological and product development comparatively more than business actors.
H.4c	Non-research actors (esp. small and large businesses, private financiers, public support actors) support market and business development comparatively more than research actors.
H.4d	Non-research actors (esp. professional support actors, private financiers) support organizational development comparatively more than research actors.
H.4e	Private actors (family and friends) provide comparatively more emotional support than other support actors.
H.4f	University startups perceive “external networking” to be more valuable, compared to other services provided by the incubator.
H.4g	The higher the number of introductions provided to the startup, the higher the perceived effectiveness of the startup support organization, in terms of external networking.
H.5a	Using non-research actors to develop the startup will lead to higher startup performance than research actors.
H.5b	Using private financiers to develop the startup will lead to higher startup performance.
H.5c	Using entrepreneurs and small firms to develop the startup will lead to higher startup performance.
H.5d	Using large firms to develop the startup will lead to higher startup performance.
H.5e	Using professional service providers to develop the startup will lead to higher startup performance.
H.6a	Using private financiers to develop the startup will increase the likelihood of receiving business angel funding.
H.6b	Using private financiers to develop the startup will increase the likelihood of receiving venture capital funding.
H.7a	Startups who receive business angel funding will experience higher startup performance.
H.7b	Startups who receive venture capital funding will experience higher startup performance.

3.4 Hypotheses regarding the Differences in the USA and Europe

The last chapters discussed the interdependencies of human, social and financial capital, as well as their assumed impact on university startup performance. Since those activities are embedded in an institutional and cultural context, one can assume that differences in the surrounding ecosystem will lead to different capital endowment, which impacts startup growth and performance. Thus, another key aspect of this study is to examine *how the surrounding entrepreneurship ecosystem influences university startup development in the USA and Europe?* Another research question refers to the hypotheses in Chapter 3.4., and aims to find *the difference between the social capital of university startups in the USA and Europe.* Based on the literature on cultural and institutional environments, hypotheses are developed on how the analyzed countries might differ in terms of capital endowment and, ultimately, startup performance.

3.4.1 Varieties of Market Capitalism in the USA and Europe

In their seminal work, Hall and Soskice (2001) differentiates between *liberal market economies* and *coordinated market economies* and explores the impact of these variations on economic performance and many spheres of policymaking. The book examines the institutional complementarities across spheres of the political economy, including labor markets, markets for corporate finance, the system of skill formation, as well as inter-firm collaboration on research and development. The key differences of these two forms of capitalism are described in the figure below. Due to these characteristics, in the sphere of innovation Hall and Soskice ascribe comparative institutional advantage to liberal market economies, since they are better placed to sponsor radical innovation, compared to coordinated market economies, who sponsor incremental innovation.

Table 12: Comparing Liberal and Coordinated Market Economies

Varieties of Capitalism	Liberal Market Economies	Coordinated Market Economies
Financial regulation	Short-term financial markets, equity financing	Long-term patient capital, debt financing
Corporate governance	Shareholder value, limited business coordination; antitrust laws	Stakeholder value, strong business associations, intercorporate networks
Innovation systems	Radical innovation, involving sharp breaks with extant processes	Incremental innovation involving continuous process development
Capital-labor relations	Decentralized bargaining, contentious workplace relations	Coordinated bargaining, statutory worker representation
Training and employment	Basic education and firm specific training, short tenure, high turnover jobs, high interfirm labor mobility	Vocational training, long tenure, low turnover jobs, low interfirm labor mobility

Source: Asheim (2007) based on Hall and Soskice (2001)

Building upon those two architypes of capitalism, Cooke (2004) further differentiates between "institutional regional innovation systems" (IRIS) and "entrepreneurial regional innovation system" (ERIS). The traditional IRIS is more typical of regions in Germany or in the Nordic countries. Their leading industries take advantage of the positive effects of systemic relationships between the production structure and the knowledge infrastructure. Innovation is R&D driven and technology/production focused, often leading to Incremental innovations. In terms of financing, bank borrowing is common. These regional networking governance structures and supporting regulatory and institutional frameworks are at the national level (Asheim 2007) and value calculability and stability (Heidenrich 2004).

The USA, and especially in regions like Silicon Valley, in contrast, lack these strong systemic elements, and receive their dynamism from local venture capital, entrepreneurs, scientists, and incubators (Asheim 2007). Those ERIS, or venture capital driven systems (Cooke 2004) are more flexible and adjustable than the system in Europe, relying less on historic technological trajectories. These regions are characterized by serial startup founders and active capital markets (cf. IPO, initial public offerings). Furthermore, firms are less restricted by legal, political, ethical and social considerations, and, therefore, more closely coupled with economic, scientific and technical perspectives (Heidenrich 2004). On the other hand, this reduced level of systemic support can lead to less stability, raising questions about long-term economic sustainability (Asheim & Gertler 2005).

3.4.2 Government Activism and Entrepreneurial Aspirations

There are several key institutions for entrepreneurs that are related in a complex way (Estrin et al. 2013): The authors of the study found strong support for the idea that high growth entrepreneurship will be crowded out by government activism. A large, active government may play many important roles in society, but there is a cost in terms of entrepreneurial employment aspirations. European governments, in comparison to the USA for example, have always played a very active role in the economy, since industry was often state owned or closely guided by the state (Fuerlinger et al. 2015): Social security of the population is a main focus of government action. Higher and progressive taxation allows the establishment of a "social safety net" that mitigates risks, such as unemployment or illness through a state insurance system. In addition, most of the employees enjoy a regulated number of working hours a week and a high number of vacation days. Moreover, in most US states employment is "at-will," meaning the employee or your employer can terminate your job on a moment's notice. It can be done for any reason, or no reason at all. In comparison, labor laws in Europe are stricter, granting more rights to the employee through certain dismissal protections and cancellation periods. Overall, the role of governments in Europe can be described as more active or with a stronger influence compared to its role in the USA. This suggests lower growth aspirations for entrepreneurs in Europe. Furthermore, entrepreneurs in the USA expressed higher aspirations in terms of generating wealth, "changing the world," as well as creating jobs through their venture than their European counterparts (GEM 2019/2020). Newly established companies in the USA are also growing faster than in the EU, and more startups develop into large companies in the USA than in Europe (OECD/European Commission 2013). Along those lines, the following hypothesis takes into account the different institutional and cultural settings on both sides of the Atlantic:

- *Hypothesis 8a: Entrepreneurs in Europe exhibit a lower level of growth aspiration than entrepreneurs in the USA.*

- *Hypothesis 8b: University startups in the USA grow faster than their counterparts in Europe.*

- *Hypothesis 8c: The supporting actors of university startups differ between the USA and Europe.*

- *Hypothesis 8d: In the USA, university startups use actors from the business network (private financiers, entrepreneurs and small firms, large firms, professional support) more often compared to Europe.*

- *Hypothesis 8e: In Europe, the central supporting actors are more often government-related (public support) than in the USA.*

3.4.3 Importance of Startup and Large Firm Networks

Lazerson and Lorenzoni (1999) argue that the crucial connections within an ecosystem are the networks between small firms and larger firms, which can connect them among others to global partners and suppliers. It is not a question of whether large or small firms will triumph, but rather how the regional economy links firms of various sizes and competencies together, and with what outcomes. This notion is also true for Silicon Valley, even though most of the attention has gone to the network of small firms and startups and the connections among them. However, the Valley's success also depends crucially on the Hewlett-Packards, the Intels, and the Cisco Systems (as the authors pointed out in 1999) – or now on the Googles, Facebooks and Apples. These firms do not simply compete to death with small firms and startups, but instead have an elaborate and complex relation to them that has been a source of vitality for the region. The authors also pointed out that these connections should be a subject for further research

- *Hypothesis 8f: University startups in Silicon Valley use large firms more often to develop their companies than in other ecosystems.*

3.4.4 Financial Support Network in US and Europe

The lack of financial/venture capital for startups in Europe is well-documented and often discussed (Bottazzi & Da Rin 2002, Philippon & Veron 2008, OECD 2018). While it is still possible to raise rounds of three to five million Euros (e.g., through government support programs), there is little funding available between five and 30 million Euros - the growth stage of the venture (Fuerlinger et al. 2015). Hence, there is capital and support available to start a new business, but it becomes much harder to scale a startup in Europe.

Table 13: Venture Capital Investment across selected Countries

Country	Inhabitants (2018)	Venture and Growth Capital[1]	Venture and Growth Capital per Capita[1]	Venture capital investment % of GDP[1]
Austria	8.82 mil	123 mil	13.9 mil (EUR)	0.026%
Germany	82.8 mil	n.a.	n.a.	0.035%
Sweden	10.23 mil	499 mil	48.8 mil (EUR)	0.06
USA	327.2 mil	132 bil	403 mil (USD)	0.4%

Source: [1] OECD (2018)

Some reason, for example the lower risk propensity in Europe and fear of failure, are discussed in this study. Others argue, that these cultural traits are also found with investors: "*In my eyes, venture capitalists here [in Germany] think like bankers, that is, they try to avoid risk*' (Neufeldt 2013, p. 40). On the other hand, European entrepreneurs are also more hesitant to give up equity to investors (Audretsch et al. 2002): ''*I don't want anyone to interfere. (…) I want to be the one in charge*" (van Weele et al. 2018b, p. 1170). The financial support network, arguably plays an important role in bridging the science and business networks and fostering the development of university startups (Clarysse et al. 2014). Its underdeveloped role in many European regions in the literature on innovation systems is referred to as a "weak network problem." (Rijnsoever 2020). Autio (2016) also argues that one of the reasons for a less dynamic sector for small enterprises is – among other factors - the dominance of bank lending as a source of finance being one of them. In his report, he compares the small and medium sized (SME) enterprise sector of the US and Europe. The US SME sector, despite its 16% smaller workforce, generated about the same amount of value as the EU SME sectors. The amount of bank loans and government financing is about 2.5 times higher in Europe, compared to the USA. In contrast, non-bank financing (private equity, venture capital, business angels, funding through family members and friends, and crowdfunding) is about 2.5 times the size in the USA compared to Europe. It is expected that these differences in the financial landscape are also be represented in the data sample:

- *Hypothesis 8g: In the USA, university startups receive financial capital from private financiers more often than in Europe.*

- *Hypothesis 8h: In Europe, university startups receive financial capital more often from government-related actors and banks than from private ones.*

3.4.5 Overview of Hypotheses comparing the USA and Europe

In terms of the difference between the USA and Europe, these additional hypotheses were formulated:

Table 14: Overview of Hypotheses regarding Europe and USA Differences

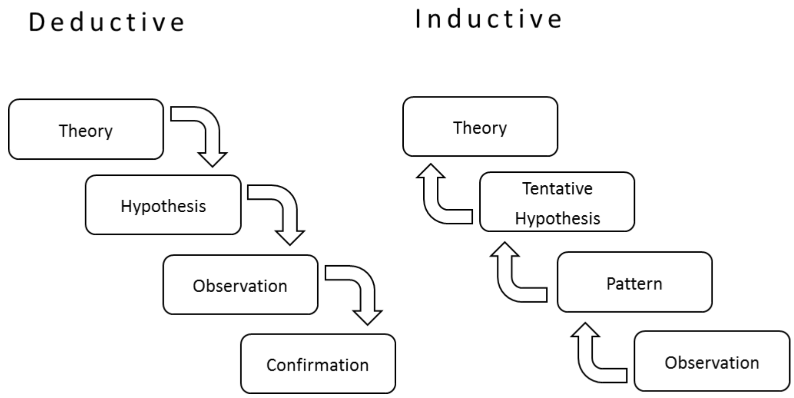
No.	Hypotheses
H.8a	Entrepreneurs in Europe exhibit a lower level of growth aspiration than entrepreneurs in the USA.
H.8b	University startups in the USA grow faster than their counterparts in Europe.
H.8c	The supporting actors of university startups differ between the USA and Europe.
H.8d	In the USA, university startups use actors from the business network (private financiers, entrepreneurs and small firms, large firms, professional support) more often, compared to Europe
H.8e	In Europe, the central supporting actors are more often government-related (public support) than in the USA
H.8f	University startups in Silicon Valley use large firms more often to develop their companies than in other ecosystems
H.8g	In the USA, university startups receive financial capital from private financiers more often than in Europe
H.8h	In Europe, university startups receive financial capital more often from government-related actors and banks than from private ones

4 Research Design and Methodology

In order to answer the research questions (see Chapter 1), an inductive (exploratory) research approach was combined with a deductive (hypothesis-testing) one. The main contribution of this thesis is based on the deductive part and quantitative methods. However, the insights from explorative interviews and especially the observations and practical experience in the field helped to focus the research on what seemed to be the most important and impactful areas influencing university startup performance.

Deductive reasoning works from the more general to the more specific. This approach is sometimes informally called a "top-down". The process begins with articulating a theory about our topic of interest, based on a literature review and reasoning. Specific hypotheses are formulated to become more specific with regard to the research topic, in order to be able to scientifically prove or reject them. In the next step, empirical data is collected to test those hypotheses. The results from this analysis allow for conclusions regarding the initial theory. On the other hand, inductive reasoning works the other way around. It starts with specific observations and aims to formulate generalizations and theories. This approach is often informally called a "bottom up" approach. Beginning with observations and specific measurements, one is able to detect patterns. Based on those patterns, tentative hypotheses are formulated that can tested in order to derive some general conclusions or theories. Inductive reasoning, compared to deductive, is more open-ended and exploratory, especially at the beginning of the process.

Figure 20: Deductive and Inductive Reasoning



Normative research seeks to clearly define the study population, outline the phenomena under research and appropriately interpret the results. Scientists use the scientific method to gather this data and apply it to the generated hypothesis. Individuals conducting normative research can do so through cross-sectional studies for which information comes from a population at one set time, or through longitudinal studies for which information comes repeatedly in time to measure rates of change. This study relies on a combination of inductive and deductive approaches on a cross-sectional study. The population includes university startups in selected ecosystems that were part of a startup support organization (e.g. incubator, accelerator, etc.). The study took place in fall 2015.

Reliability is concerned with the question of whether the results of a study are repeatable and each independent variable is measured without error (Cohen et al. 2013). In order to assess the reliability of a measure of a concept, the procedures must be replicable by someone else (cf. replication). Measurement or construct validity is about "*the question whether a measure that is devised of a concept really does reflect the concept that it is supposed to*" (Bryman & Bell 2007, p. 41). If a measure is unreliable, it cannot be valid. Internal validity is concerned with the question of whether a conclusion that is derived from causal relationships between two or more variables holds true. If we propose that X (independent variable) causes Y (dependent variable), can we be really sure that Y is (at least in part) caused by X and not by something else? External validity is about the question of whether the result of a study can be generalized (cf. representative samples). Ecological validity raises the question of whether the findings are applicable to peoples’ everyday life. The more the scientist intervenes in natural settings, the more likely the findings are ecologically invalid.

4.1 Methodological Approach

First, the literature research focuses on the analysis of different publications and other studies in the field of entrepreneurship ecosystems, business incubators and startup support centers, technology transfer, as well as human and social capital’s influence on university startup performance in order to identify research gaps. Furthermore, through the review, the research objective and the research questions could be specified, with regard to the success factors of university startups and the influence of the surrounding entrepreneurship ecosystem. The initial review took place in 2012 and 2013 and another update of the relevant literature was conducted in 2019 and 2020, in order to refer to the current developments regarding the concepts laid out above.

In addition to the literature review, exploratory interviews were conducted to gain a deeper understanding of the research field during the development of the research hypotheses. Interviews and conversations (either face-to-face or via telephone) included talks with incubator or tech-transfer-offices managers, entrepreneurs, startup employees, public officials, investors (cf. venture capitalists and business angels) and scholars in the field of entrepreneurship and innovation ecosystems. The list of interviewees and conversational partners, as well as the main findings and insights of these interviews, are provided in the appendix. The aim of these interviews was to get a better insight into the entrepreneurship ecosystem of the different regions surveyed, the role that startup support organizations play and to refine the model and the hypotheses of this study before conducting the survey. The author`s work experience at Stanford’s University Startup Accelerator StartX offered unique insights into one of the world’s most prestigious startup accelerator programs. Embedded into both the Silicon Valley as well as the Stanford innovation ecosystem, this is a special location in terms of its support for aspiring academic entrepreneurs. The author also attended a course on “cross-border innovation” at Harvard University during the summer of 2009. This enabled him to learn more about the special innovation and entrepreneurship ecosystem in the Boston area, where Harvard University, MIT and many other renowned research institutions are located. His work as an adjunct professor and research scholar at the New York Institute of Technology also provided insights into the emerging technology and startup ecosystem in New York City. These on-site experiences across the USA, in conjunction with numerous conversations, meetings and conferences, revealed the importance of the proper contacts and networking opportunities (social capital) for newly established companies. It also highlighted the value of the vision and skills of the entrepreneurs and their teams (human capital), as well as the central role that startup support organizations can play in the entrepreneurial process.

Based on the findings from the extensive literature review, combined with the insights from exploratory interviews and personal, practical experience, a conceptual framework was developed. During this process, a new model for startup development was derived for this study. It focuses on three different development domains (technological and product, market and business, management and organizational) – see Chapter 2.2. This new perspective on startup development is combined with a social network analysis approach, allowing a quantitative assessment of the influence of actors in the entrepreneurship ecosystem on university startup performance. Furthermore, human and financial capital are added to the model, to allow a more nuanced examination of the relationship of those central types of capital for startup development and performance. Based on this central framework, specific hypotheses were derived with regard to relationship of the different constructs involved.

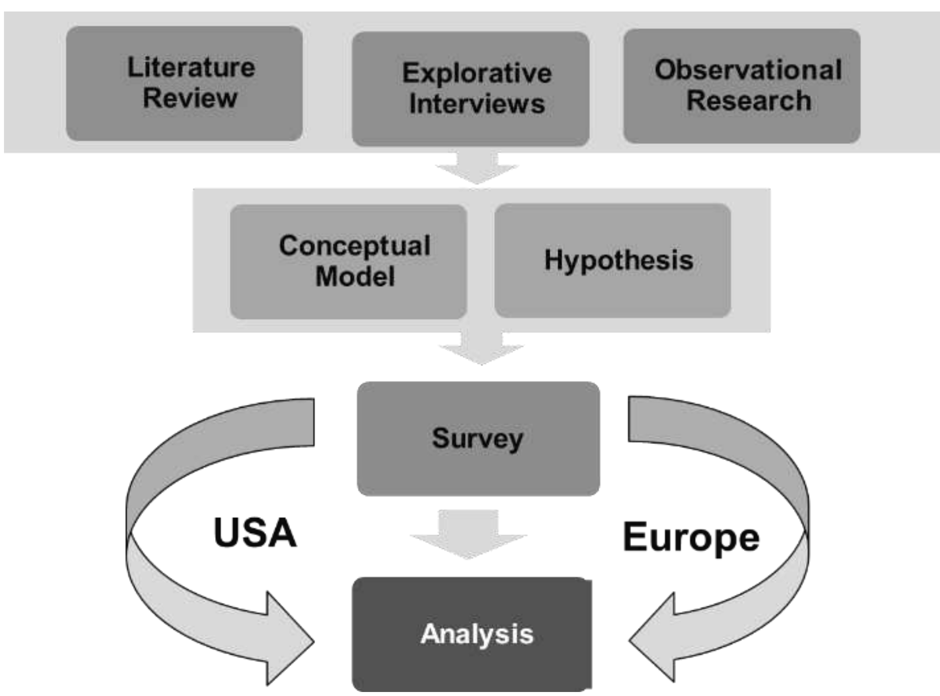
Building upon the research questions and drawing from scientific literature, a questionnaire was developed that measures the relevant constructs. Chapter 4.3. provides an in-depth discussion of the constructs and variables used in this study. The questionnaire itself was added to the appendix. To reduce potential common method bias, the survey instrument was carefully designed. The intention was to avoid the use of any wording of the variables in the questionnaire that might induce item priming effects. Feedback from and discussions with entrepreneurs and entrepreneurship scholars (after sending them the questionnaire), helped to further improve the clarity of the survey questions, with slight amendments to the wording, if needed.

In order to verify those hypotheses, a quantitative, large-scale, web-based survey was conducted among university startups that attended a startup support program (incubator, accelerator) in selected ecosystems in the USA or Europe. More information about the sample is provided in the next chapter. The quantitative study examines the role of human, social and financial capital in the development process of university startups and their impact on performance. Furthermore, the role of startup support organizations (cf. incubators and accelerators, short SSO) was examined and demographic data on the founder, as well as further characteristics on the university startup was included.

The data was then analyzed by different quantitative statistical methods (see Chapter 4.3.) in order to investigate the research questions and test the formulated hypotheses (see Chapter 3). Those empirical findings were interpreted with regard to the scientific literature and conclusions were drawn with reference to the initial research questions and hypotheses.

A summary of the methodological approach is depicted in the figure below:

Figure 21: Methodological Approach



Source: own illustration

4.2 Data Collection and Sample

The initial motivation for this study was to compare the status quo of university startup development and support in the author's home country, Austria, with the USA, which is often referred to as the leading nation for university startup creation and development. Building on this initial plan, it was decided to extend the study and also add an intra-European comparison component. Germany and Sweden, according to the European Innovation Scoreboard (EIS) 2014, belong to the group of European innovation leaders. In 2014, Sweden was number one in the EIS Scoreboard 2014 (EIS 2020: still 1st in EU), Germany second (2020: fell to 6th in EU) and Austria constant in 7th place in 2014 and 2020. Therefore, Sweden, as the continuous innovation leader in Europe, and Germany, given its strong 2nd position in 2014 and also due to many economic and cultural similarities with Austria, are also included in this study.

In a next step, the main entrepreneurship ecosystems in each country were identified, characterized by leading universities in the region, university startup activity and the existence of startup support organization (SSO, like incubators and accelerators). The areas that were studied include Vienna in Austria, Berlin and Munich in Germany, Zurich in Switzerland, Stockholm in Sweden and Silicon Valley, Boston and New York in the USA. For Austria, the scope was extended to other ecosystems around the country, in order to increase the number of responses for subsequent analysis and country comparisons. Since one of the research questions relates to the role of SSOs in the university startup process, the population of this study are university startups in the selected countries/ecosystems, who participated in a SSO program. Therefore, a list of SSOs in the selected regions was compiled, which served as a reference for contacting university startups to participate in the study (see list in the appendix). The list provided represents the status at the time of the study, which occurred between December 2015 and February 2016. Some incubators have since changed their name, merged or ceased operations, which can lead to different names and web links than the ones stated in the list.

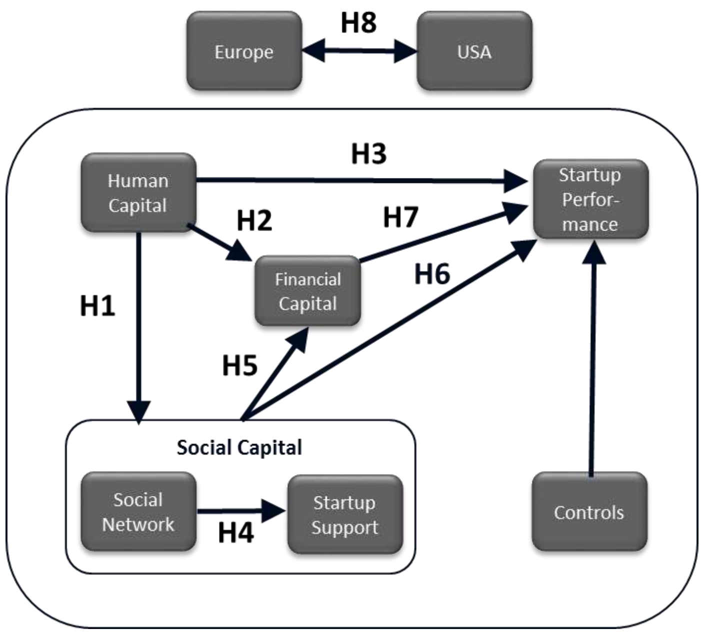
In the beginning of the research project, the approach was to contact the manager at each SSO to encourage him or her to become a partner in this study and to motivate their incubated startups to participate in the survey. This approach, however, turned out to be very time consuming. With some notable exceptions, the results, in terms of participating startups who filled out the questionnaire, was limited. Moreover, since most of the SSO managers were reluctant to provide their tenants' email addresses, the survey was usually sent out through SSO personnel. In addition to a limited response rate, it was also not possible to track which of the companies had already filled out the questionnaire and which had not. This made it impossible to selectively send reminders to those missing companies, in order to increase the overall response rate. For those reasons, the approach to receive survey responses changed to a more direct one, by contacting the startups directly, without necessarily involving either SSO managers or staff. The selected SSOs feature a list of their current and prior tenant startups on their website. Based on this publicly available data, a new database of university startups was compiled, serving as the sampling frame, containing company name, office email, founder(s) name(s), personal email, phone number(s), website URL, founding year and a short company description. This unique, hand-selected database enabled allowed for the contacting of each startup directly via email and track the status of their responses. Previous studies have shown that personalization in the email text increases the response rate. Thus, the founders were addressed with their names and the email also mentioned the company name in the email. For the survey, several online web survey tools were reviewed *SurveyMonkey* was ultimately chosen, because of its usability, reliability and the easy transferability of data to the statistics software *SPSS*.

The web-based survey took place between December 2015 and February 2016. After sending the initial email with the call for participation, recipients received a follow-up reminder email one, two and three weeks after the first email. With regard to **non-response bias,** the sample was grouped into early and late respondents and a comparison of t-values for equality of means was performed. Non-significant differences were identified between both groups. Overall, responses were received from 409 university startups across Austria, Germany, Sweden, Switzerland and the USA. More details on the data collected are provided in Chapter 5.1. and a list of response rates per startup SSO affiliation is presented in the appendix.

4.3 Operationalization and Variables

Based on the findings from the extensive literature review, combined with the insights from the practical experience and explorative interviews, a conceptual framework was developed. Based on this central framework specific hypotheses were derived with regard to relationship of the different constructs involved: human, social and financial capital, university startup performance, US and Europe differences, as well as controls. See the figure below for an overview of the hypotheses (H) formulating the impact between those constructs.

Figure 22: Conceptual Model & Hypotheses Overview



4.3.1 Human Capital

As outlined in Chapter 2.2, human capital is a central factor for startup development and success. In the following paragraphs, it will be explained in more detail, including which variables were used to measure an entrepreneur's human capital. Following Scillitoe and Chakrabarti (2010) and Batjargal et al. (2013), the educational background of the founder was measured by the highest degree obtained: ''1''=less than bachelors, ''2''=bachelors, ''3''=masters, ''4''=doctorate. The following question was asked: *What is the highest level of education you have completed or the* *highest degree you have received?* In a next step, the numbers were transformed into a dichotomous variable, “1” for all doctorates and “0” for everyone else.

As described in Chapter 2.3, human capital can be measured by the prior experience of the entrepreneur, since specific prior experience refers to domain-specific capabilities that are embodied in individuals and represent an important asset of a firm (Pfeffer 1994). In this context, human capital is measured based on experiences in four different fields – startup, management, research and industry - all of which are briefly described below.

Respondents had to indicate – see question No. 9 in the survey - their prior startup experience in the following way: *no prior startup experience (1); have worked in a startup before as a non-founding employee (2); have started a startup before as part of the founding team (3); have started more than one startup before as part of the founding team (4)*.

Mosey & Wright (2007) differentiate entrepreneur’s human capital in terms of prior startup experience the following way: Nascent entrepreneurs are individuals considering starting their own businesses (Ucbasaran et al. 2003); novice entrepreneurs are individuals who have created a venture for the first time; habitual entrepreneurs undertake multiple entrepreneurial ventures (Westhead & Wright 1998).

For some analyses, it was merely necessary to distinguish between founders who founded a company as part of the founding team and those who have not. For this purpose, a variable was transformed from the answers to the original question to derive the dichotomous variable HC2 with two values. Value 0 was derived by combining 1. and 2. (no prior startup experience; have worked in a startup before as a non-founding employee); and value 1 was derived by combining 3. and 4. (have started a startup before as part of the founding team; have started more than one startup before as part of the founding team).

For other analyses, it was necessary to differentiate between the three types of entrepreneurs mentioned above (Mosey & Wright2007). In order to classify them based on these definitions, data from Question 9 was used together with input from Question 17 (company development stage). The variable mentioned above (HC_2) was transformed in the following way to derive

*HC_3***:** Value 0 was assigned to represent "nascent entrepreneurs, if variable HC_2 had the value 0 (no startup experience as founding member) and the company stage variable had value 1 (Research and opportunity framing). Value 1 was assigned to represent "novice entrepreneurs," if the variable HC_2 had the value 0 (no startup experience as founding member) and the company stage was not value 1 (Research and opportunity framing). Every stage after the first one (research and opportunity framing) - pre-organization, re-orientation and sustainable returns – indicates that the startup is already in the formation phase and its founder can be referred to being a novice entrepreneur. Value 3 was assigned to represent "habitual entrepreneurs," if variable HC_2 had the value 1 (have started a startup before as part of the founding team; have started more than one startup before as part of the founding team) indicating that the founder has at least started one company before.

In order to derive the level of prior industry experience, the respondents had to choose one of the answers to the following question. *Please indicate your experience in the current industry your company operates in, before starting the current company:* I have prior industry experience in a scientific/research role (1); I have prior industry experience in a non-scientific/research role (2); I have prior industry experience in a scientific/research role and non-scientific/research role (3).

According to Batjargal et al. (2013), an entrepreneur's managerial experience can be derived from the number of years the entrepreneur worked as a manager, before starting the new venture. Respondents were asked to specify the number of years, answering *How many years have you worked in a management position, before starting your current company? (0 if none)* the numbers were then aggregated into a dichotomous variable, with "0" for all who showed not to have any management experience and "1" for everyone else.

Similarly, the research experience was derived, by asking for the years the entrepreneur worked in research: *How many years have you worked in research before starting your current company? (0 if none). As was the case with management experience, the numbers were aggregated into a dichotomous variable.*

The expected revenue in five years from when the survey was taken, measures the growth aspirations of the entrepreneur. The five-year horizon is commonly used by researchers to measure growth aspirations, either in terms of revenue (Liao & Welsh 2003) or employee growth (Estrin et al. 2013).

The number of full-time founders variable counts the number of team members on the startup's founding team, who devote more than 35 hours a week to the firm. Team experience is related to the size of the founding team (Eisenhardt & Schoonhoven 1990) and can be a proxy for human capital (Baum & Silverman 2004, Hsu 2007).

An overview of the different concepts relating to human capital and the respective variables are listed in the table below.

Table 15: Human Capital Variables

<table>
<tr><th>Measured concept</th><th>Values</th><th>Type of Variable</th></tr>
<tr><td colspan="3">HUMAN CAPITAL – Entrepreneur/Founder (question 9 ff. in the questionnaire, see appendix)</td></tr>
<tr><td>Educational background; PhD</td><td>0 = other
1 = PhD / doctorate</td><td rowspan="6">Binary / Dichotomous</td></tr>
<tr><td>Growth aspirations, revenue in 5 years</td><td>0 = less than 10 mil per year
1 = more than 10 mil per year</td></tr>
<tr><td>Founder's prior startup experience in two categories*)</td><td>0 = no startup experience
1 = has startup experience as non-founding or founding member of one or more startups</td></tr>
<tr><td>Founder industry experience in two categories</td><td>0 = no industry experience
1 = industry experience</td></tr>
<tr><td>Founder's management experience in two categories</td><td>0 = no management experience
1 = has management experience</td></tr>
<tr><td>Founder research experience in two categories</td><td>0 = no research experience
1 = has research experience</td></tr>
<tr><td colspan="3">HUMAN CAPITAL – Founding Team (question 19 ff. in the questionnaire, see appendix)</td></tr>
<tr><td>Number of full-time Founders (>= 35 hours a week) founders currently working in the startup</td><td>Mean = 1.73, SD = 0.976</td><td>Metric</td></tr>
</table>

*) for Hypotheses other classifications are used, see according chapter

4.3.2 Social Capital

Scholars are generally consistent in the basic definition of social capital - resources embedded within the relationships between actors (e.g. Nahapiet & Ghoshal 1998). How social capital is actually operationalized, modeled and measured in research, however, varies greatly (Gedajlovic et al. 2013). Social capital researchers have suggested several principles to construct measures from available data (Flap et al. 1999). Many approaches are based on information about total networks (see Borgatti 1998), which comprise *'the general ever-ramifying, ever-reticulating set of linkages that stretches within and beyond the confines of any community or organisation*' (Mitchell 1969:12). However, this kind of data is mostly unavailable in data retrieved from common measurement methods. Therefore, two types of abstractions are used. Global network characteristics focus on and calculate measures drawn from a particular aspect or sub-set of social activity, e.g. the ties and relationships in politics, friendships, work environments, etc. This approach is most useful for studies of social capital within an organization or a small network among organizations. However, it is not the case in this research endeavor. Furthermore, it is almost impossible to derive a social network map with every single person involved in the startup process.

For larger and less definable networks, ego-network sampling techniques are used: "ego-centered networks", are 'anchored' around a specific individual, in order to generate those person-specific networks of social relations (Scott 2000). In the ego-centered network approach, respondents describe their networks, activities and their relations with other network members (Burt & Minor 1983, Knoke & Kuklinski 1982, Greve & Salaff 2003). For this reason, an ego-centered approach "is especially *appropriate for collecting network data from a target population that is a small percentage of a population, and whose relations are not concentrated in a single social structure. Entrepreneurs are one such group* (Greve & Salaff 2003, p. 20). Hence, an ego-centered network analysis approach is applied in this study, examining the support actors in the entrepreneurs' social network.

Ego-centered measurement methods

Most of the research conducted around ego-centered social capital refers to either one of these three methods: name generator, position generator, or resource generator (Van der Gaag & Snijders 2003, Van der Gaag 2005):

One of the techniques employed in ego-centered network analysis is the **name generator** (Wellman 1979, McCallister & Fischer 1978). In this technique, the respondent is asked to provide the name and characteristics of individuals whom he or she can get help from or consult with for important tasks (Najarzadeh et al. 2014), or with whom they feel close (Wellman 1979). A number of questions are then asked about these individuals in order to clarify their characteristics and the type of relationship with the respondent and with each other. This method provides a description of social capital, including all its details and provides a complete picture of relationships and resources (Najarzadeh et al. 2014). However, the disadvantages include the lack of frames for sampling naming items, and a bias toward the inclusion of stronger ties (Van der Gaag & Snijders 2003). Furthermore, it is difficult and costly for the respondents and for the interviewers to carry out this method. It depends on the interviewer's characteristics and, therefore, it is fragile (Najarzadeh et al. 2014).

With a **resource generator,** the objective is to access a particular fixed list of (social) resources, which represent sub-categories and aspects of social capital (Van der Gaag and Snijders 2003). The survey respondents indicate which resources they can access, based on their social network. The method is somewhat similar to the position generator (see below) but measures the accessibility to resources and not to jobs and positions. Whereas it is easier to administer than the name generator method and its interpretation is more explicit than the position generator method, a significant disadvantage of this method is to finding a comprehensive list of the important resources in different areas and it faces theoretical issues (Najarzadeh et al. 2014).

By applying a **position generator**, the respondent is asked to indicate, if he or she knows anyone with a certain position or job, for example (Scott 2000). The theoretical foundation of the position generator is based on the concept of social resources. Lin (2001) believes that social resources are hidden within their social network. The current popularity of the position generator in social capital studies can easily be explained by its methodological advantages (Van der Gaag et al. 2008): First, the instrument is constructed from a firm theoretical basis (Flap 1999), which is universal enough to enable similar applications across various populations and cultures. Furthermore, many studies and articles dealing with certain groups of a society, such as entrepreneurs, have used the position generator method (Campbell and Lee 1991, Najarzadeh et al. 2014). Since one of the aims of this study is to compare social capital endowment in the USA and Europe, the comparability across populations was an important argument for the position generator. Another argument for applying the position generator method in this study, was the possibility to conduct it through a questionnaire. Therefore, it does not require detailed interviews with the entrepreneurs (cf. name generator).

Operationalization of Social Capital

One aim of this study is to identify the influence of social capital in university startup development. In particular, there was a focus on the most helpful actors in the ecosystem are and how they support academic entrepreneurship. For this reason, it was necessary to ask the founders of the newly established companies a) about the actors in the ecosystem that supported them (cf. network structure) and b) how they supported them (cp. network resources).

Following Bandera & Thomas (2019), a startup's use of social capital can be measured by counting the collaborations that contribute to the startup's success. These actors offer complementary resources for the commercialization, such as production, sourcing, distribution, marketing know-how and/or financing. Those relationships to selected actors are the entrepreneur's relational capital, emerging through the interaction and collaboration between them. Other studies (Liao & Welsch 2003) also confirm that technology-based entrepreneurs benefit more from relational embeddedness - the freer and greater exchange of non-redundant information.

In order to measure the social capital of the university startups surveyed in this study, a two-step approach – network structure vs. network resources - was applied. First, the respondent was asked to identify the actor groups they have used to develop their company ("*Which type of actors have you used to develop your company? (check all that apply)*"). This approach is similar to West and Noel 2009, who asked entrepreneurs to indicate the people (actor groups) who provided especially important information or advice to them to develop their company. By 'especially important' they refer to the support the entrepreneurs believe was critical to their success in starting up and/or developing their company. The list provided was compiled by incorporating actor groups, who were previously identified to support the development of new ventures (Mosey & Wright 2007, Batjargal 2003, Totterman & Sten 2005). The 12 actors in total can be divided into six actor groups in the research network and six actors groups in the business support network (see table below, and Chapter 3.1).

In a next step, the respondents were asked to determine the extent of support they received from the selected actors in the different startup domains. This second level question only refers to actors that were selected in the question before. *Please indicate for all actor groups, how useful they were in supporting your company with regard to [each of the four categories below]:*

1. **Technological and product development**: support you received for the transformation of technologies and prototypes into viable products or services that solve a customer problem or meets a customer need

2. **Market and business development**: support you received with gathering market information and identifying customer needs through obtaining customer feedback and the ability to market and sell your products and services profitably.

3. **Organizational development**: support you received with starting, managing and growing a professional organization, including areas like hiring employees, raising capital, defining a business strategy and drawing contracts, etc.

4. **Emotional support**: encouragement you received for business achievements or support to cope with work-related stress, competitive pressures and frustrating events in order to sustain emotional stability

They ranked the support of each actor they selected in the question before, according to the following scheme: (1) not at all useful, (2) not useful, (3) neither not useful nor useful, (4) useful, and (5) very useful. In summary, the two sequential questions lead to a support matrix. Table 16 and Table 17 provide an overview of the variables used to measure social capital.

Table 16: Social Capital Operationalization Matrix

	2nd Level Question			
1st Level Question	Startup Development Support			
Support Actors	Technological & Product	Market & Business	Management & Organization	Emotional
RESEARCH SUPPORT NETWORK				
University department colleagues	(1) to (5) useful	(1) to (5) useful	(1) to (5) useful	(1) to (5) useful
Colleagues in other departments	(1) to (5) useful	(1) to (5) useful	(1) to (5) useful	(1) to (5) useful
Tech Transfer Office	(1) to (5) useful	(1) to (5) useful	(1) to (5) useful	(1) to (5) useful
Startup Support Organization[1]	(1) to (5) useful	(1) to (5) useful	(1) to (5) useful	(1) to (5) useful
Other universities	(1) to (5) useful	(1) to (5) useful	(1) to (5) useful	(1) to (5) useful
Research laboratories	(1) to (5) useful	(1) to (5) useful	(1) to (5) useful	(1) to (5) useful
NON-RESEARCH SUPPORT NETWORK				
Investors[2]	(1) to (5) useful	(1) to (5) useful	(1) to (5) useful	(1) to (5) useful
Entrepreneurs and small firms	(1) to (5) useful	(1) to (5) useful	(1) to (5) useful	(1) to (5) useful
Large firms	(1) to (5) useful	(1) to (5) useful	(1) to (5) useful	(1) to (5) useful
Public Support[3]	(1) to (5) useful	(1) to (5) useful	(1) to (5) useful	(1) to (5) useful
Professional Support[4]	(1) to (5) useful	(1) to (5) useful	(1) to (5) useful	(1) to (5) useful
Private Support[5]	(1) to (5) useful	(1) to (5) useful	(1) to (5) useful	(1) to (5) useful

[1] Incubators, Accelerators; [2] Business Angels, Venture Capitalists; 3 governmental expert organizations, government grant providers, regional development agencies, etc.; [4] consultants, legal firms, accountants, etc.; [5] family, friends

Table 17: Social Capital Variables

Measured concept	Values	Type of Variable
SOCIAL CAPITAL (question 35 ff. in the questionnaire, see appendix)		
Department Colleagues	0 = not used 1 = received support from [actor group]	Binary / Dichotomous
Other Uni Colleagues		
Tech Transfer Office (or equivalent)		
Startup Support Organization (Incubator, Accelerator, etc.)		
Other Universities		
Research Labs (public or private)		
Private Financiers (Business Angels or Venture Capitalists)		
Entrepreneurs and SMEs		
Large Firms		
Public Support		
Professional Support		
Private Support (family, friends, etc.)		
For each of the actors selected with 1 above, the following additional questions were asked		
Tech Support [for each of the actors selected earlier]	1 = not at all useful, 2, 3, 4, 5 = very useful	Likert Scale
Business Support [for each of the actors selected earlier]		
Organizational Support [for each of the actors selected earlier]		
Emotional Support [for each of the actors selected earlier]		

4.3.3 Financial Capital

In order to determine the type and level of financial capital received by each startup, the respondents were asked to "*Please indicate the amount of funding you have received so far from the actor groups listed below*". The sources of funding were divided into government, business angel, venture capitalist, corporate venture, family members and friends as well as bank. For each of the sources, the respondent had to specify the amount received, stating separately the type of currency: nothing; less or equal to 50,000; 51,000 to 250,000; 251,000 to 1,000,000; 1 mil to 5 mil and more than 5 mil. The responses were used either as categorical variable or dichotomous, see Table 18 below.

Table 18: Financial Capital Variables

<table>
<tr><th>Measured concept</th><th>Values</th><th>Type of Variable</th></tr>
<tr><td colspan="3">FINANCIAL CAPITAL (question 65 ff. in the questionnaire, see appendix)</td></tr>
<tr><td>Government funding received</td><td rowspan="6">Option 1
0 = nothing
1 = <= 50,000
2 = 51,000 - 250,000
3 = 251,000 - 1,000,000
4 = 1 mio - 5 mio
5 = > 5 mio

Option 2
Transformed to:
0 = nothing
1 = received funding (values 1-5)</td><td rowspan="6">Option 1 = Categorical

Option 2 = Binary</td></tr>
<tr><td>Business angel funding received</td></tr>
<tr><td>Venture capitalist funding received</td></tr>
<tr><td>Corporate venture funding received</td></tr>
<tr><td>Family members and friends funding received</td></tr>
<tr><td>Bank funding received</td></tr>
</table>

4.3.4 Startup Support Organization

The university startups that were surveyed are all affiliated with an incubator, accelerator or another type of startup support organization. Through specific questions on the survey, the aim is to examine the importance and effectiveness of different support services offered to the startups (Abduh et al. 2007). In particular, these services include: 1) exchange with peers in the support organization (internal networking), 2) access to contacts outside the university and support organization (external networking), 3) facility related services (cf. access to shared office space, technical equipment, etc.) as well as 4) professional business support and related services. The survey respondents had to ascribe a value to both the importance and effectiveness of the four service types mentioned above on a four-point scale: 1) not at all important/effective, 2) little, 3) moderate, 4) very important/effective. The overall level of satisfaction is derived by comparing the mean values between the perceived importance of the service and the perceived effectiveness (Abduh et al. 2007).

Furthermore, startup support organizations are intermediaries, bridging the research and the business networks in the ecosystem. They do so, by providing introductions to startups, acquainting them with actors outside the research network, who can support the startups by providing complementary knowledge and resources. In this survey, the number of introductions to private financiers, small and medium sizes enterprises, large firms and public support actors are measured. The table below provides an overview of the variables relating to startup support organizations.

Table 19: Startup Support Organization Variables

Measured concept	Values	Type of Variable
STARTUP SUPPORT ORGANIZATION (question 40 ff. in the questionnaire, see appendix)		
Importance: Exchange with peers in the support organization (internal networking)	1 = not at all important, 2, 3, 4, 5 = very important	Likert Scale
Importance: Access to contacts outside the university and support organization (external networking)		Likert Scale
Importance: Facilities related services (cf. access to shared office space, technical equipment, etc.)		Likert Scale
Importance: Professional business support and related services		Likert Scale
Effectiveness: Exchange with peers in the support organization (internal networking)	1 = not at all important, 2, 3, 4, 5 = very important	Likert Scale
Effectiveness: Access to contacts outside the university and support organization (external networking)		Likert Scale
Effectiveness: Facilities related services (cp. access to shared office space, technical equipment, etc.)		Likert Scale
Effectiveness: Professional business support and related services		Likert Scale
Introductions to Private Financiers	1 = no introductions 2 = 1 introduction 3 = 2 introductions 4 = 3 introductions or more	Categorical
Introductions to small and medium sizes enterprises		Categorical
Introductions to Large Firms		Categorical
Introductions to Public Support[1]		Categorical

[1] e.g. governmental expert organizations, government grant providers, regional development agencies

4.3.5 Performance (Employment Growth)

Employee growth is used to measure the performance of university startups. According to Davila et al. (2003), a headcount variable is used as proxy for growth. Headcount is operationally defined as the number of people on a company's payroll. The measure of growth is the change in the headcount over a certain period. In this study, it is a year, for example. This growth measure is commonly used to analyze the relationship between the startup's network, internal capabilities, and growth (Rauch et al. 2005, Scholten et al. 2015) and to differentiate between successful and less successful startups (Baum et al. 2000).

There is also an advantage to using the number of employees as indicator for size, as compared to revenue, for example. Firms born in the start year of a growth period do not need to be excluded from the sample, because employment is measured as a point-in-time value at the end of a given year and does not accumulate over a year, as sales do (Erhardt 2019). Furthermore, from a policy perspective, "*interest in high-growth firms can be explained in one word: jobs*." (Coad et al. 2014, p. 92). Hence, measuring startup growth in employment seems the natural choice (Delmar et al. 2003). Following Armanios et al. (2012), relative employee growth is defined as percentage change in full-time employees within a two-year period.

In order to calculate employee growth, respondents were asked to state "*How many employees worked at the company at the end of 2013 (full-time equivalent)?"* as well as for the years 2014 and 2015, respectively, deriving three variables accordingly each year (PERF_empl_2013; PERF_empl_2014; PERF_empl_2015). 180 out of 409 respondents answered with "0" for the 2013 employees' number, implying that there was only the founder or the founding team, respectively, working at the startup, but no additional employees. As a result, it was not possible to calculate relative employee growth over the years for these 180 startups, since the "0" stated does not allow to carry out divisions. In order to be able to include those 180 startups - and not having to leave them out for certain calculations - the data was edited accordingly, to get rid of the "0" in the divisor. The rationale behind the changes: adding the founder, that is the respondent, of the survey to the overall employee numbers provided. Hence, plus 1 was added to the number of employees for every startup in all three years (2013, 2014 and 2015). This created three new variables to form the basis for further calculations of the employee growth performance variable.

With reference to Patzelt et al. (2008), the employee growth variable was calculated measuring the relative growth over a two-year time period (2013 to 2015). It was decided to transform the performance variable in order to derive a better normality distribution for further statistical analyses. In order to account for their skewed distributions, following Törnqvist et al. (1985), the logarithm was used to measure relative change. Hence, the following calculation was performed to derive the new performance variable and define relative growth as: ln(Empl_2015_plus1/ Empl_2013_plus1). This leads to the **metric performance variable of relative employee growth.**

With regards to the normality distribution, the tests show much better results in terms of skewness, which is now reduced to 0.268 (standard error: 0.121). The kurtosis could also be substantially reduced to 0.615 (standard error: 0.241). According to different scholars in the field of statistics, certain ranges of skewness and kurtosis are acceptable to consider a that a variable is normally distributed. According to Schmider et al. (2010), for skewness a range between minus and plus 2.0, and for the kurtosis less 9.0 and more than -9.0, respectively, are recommended values. Others set the indices for acceptable limits at ±2 (Trochim & Donnelly 2006; Field 2000 & 2009; Gravetter & Wallnau 2014) or consider values for skewness and kurtosis between -1.96 and +1.96 as acceptable, in order to prove a normal univariate distribution (George & Mallery 2010). For the performance variable under discussion, the numbers are in an acceptable range for skewness as well as kurtosis and can be regarded as normally distributed. Therefore, it was used as the dependent variable for the regression analysis

Furthermore, in order to distinguish between startups with fast employee growth and moderate to slow employee growth, a new dichotomous performance variable was created. This was conducted by recoding the existing variable described above into a new variable according to this logic: The top 25% or 100 startups with the highest employee growth were consolidated in Group 1, the remaining 75% or 309 startups in Group 0. This leads to a dichotomous performance variable, indicating a high relative employee growth. The table below summarizes the two performance variables used for the regression analyses in the next chapter.

Table 20: Performance Variables

Measured concept	Values	Type of Variable
Employee Growth, relative, 2013-2015, logarithmic (original values)	-2.3 to 3.43	Metric (logarithmic)
Employee Growth, relative, 2013-2015, Top 25% Growth	0 = bottom 75% growth 1 = top 25% growth	Binary / Dichotomous

4.3.6 Control Variables

The following variables have been selected as controls, since they are commonly used throughout the literature reviewed for this study: company age and size, country where the startup is based, and the industry the company is operating in.

Company Age

Startup performance is especially sensitive to company age, due to liabilities of newness (Stinchcombe 1965). Therefore, company age is used as a control variable in this research. The company age was calculated by subtracting the founding year from 2016 (2016 – founding year). All companies that have not founded their company yet are set to 0. Hence, age is measured as the number of years since the startup was founded.

Company Size

New technology ventures with a larger firm size have a larger pool of resources, and are more likely to survive in an uncertain environment (Lin et al. 2006). Furthermore, other studies show a positive relation between a company's initial size and their probability of survival (Colombo et al. 2004). Company size is measured by the full-time equivalent of employees in 2015, the year of the survey: *How many employees (are expected to) work at the company by the end of 2015 (full-time equivalent)?*

Country & Local Ecosystem

One of the objectives of this study is to examine the difference in the human and social capital endowment of university startups in USA and Europe. In order to compare the results among the different countries, dummy variables were created to represent Austria, Germany, Sweden and USA. The responses also included 26 completed surveys from Switzerland, which are included in the analyses at times. However, the majority of the research focuses in the other four countries. Most of the analyses in the following chapter will refer to the country level, highlighting the differences between the countries mentioned above. In order to verify some more specific hypotheses, it will be necessary to verify the region the university startup is based in. To locate the startup geographically, the respondents were asked "*In which city is the headquarters of the company?*" The next step was to reduce the number of different locations provided as responses, in order to make the comparisons viable and to focus on the metropolitan areas or ecosystems of Vienna, Stockholm, Berlin, Boston, New York and Silicon Valley. Headquarter locations that are less than 50 km away from one of those hubs, where specified as "Vienna region" for example, and in the next aggregation step labeled as "Vienna". Hence, the final variable HQCity_6categ includes companies with the headquarters directly within the respective city and those in the larger metropolitan area.

Industry

In order to account for potential differences in sector dynamics the university startups are operating in, industry was included as a control variable in the analysis. The taxonomy was, on the one hand, derived from scholars listing trade, service, IT/software, biotechnology/pharmaceuticals and light manufacturing as choices for industry selection (Batjargal et al. 2013). On the other hand, this classification was combined with that of others - following the National Science Foundation (2006) - defining hardware (products that require large-scale manufacturing processes), energy, and life sciences and medical devices as R&D-intensive sectors. The non-R&D-intensive companies in their sample are primarily startups in the consumer web / mobile, enterprise software, and consumer-products industries (Scott et al. 2015).

The respondents answered the question "*In which industry does your company operate in?*" They initially had these options to select from: life sciences/medical devices, information technology (IT)/software, light manufacturing/hardware, service, trade and other (to specify in more detail).

Almost 40% of the respondents selected information technology (IT)/software, making it the most selected industry category. The second most selected was life sciences/medical devices with almost 20%. There less was than 10% for light manufacturing/hardware, service, trade and 25% for others.

In a next step, the aim was to reduce the “other” category, in order to have a higher number of startups affiliated with a meaningful category. Therefore, the webpages of the 104 companies labeled “other” were reviewed in order to understand in which field and sector each company was operating in. If suitable, the companies where added to one of the pre-selected categories. Furthermore, three new categories were created to be able to cluster those who did not fit any of the pre-selected categories: 1) entertainment, video & design, 2) material science and 3) cleantech. All of those who did not fit into a pre-selected or newly created category, remained in the “other group,” which was now reduced to 9%. In a last step, the aim was to again reduce the number of categories, in order to be able to create a dummy variable with limited groups to represent. The final industry classification, and the percentage of total, used for the analyses were: IT/software (39.4%), life sciences/medical devices (19.8%), light manufacturing/hardware (17.8%) and service, trade & other (22.7%).

An overview of all control variables is provided in the table below:

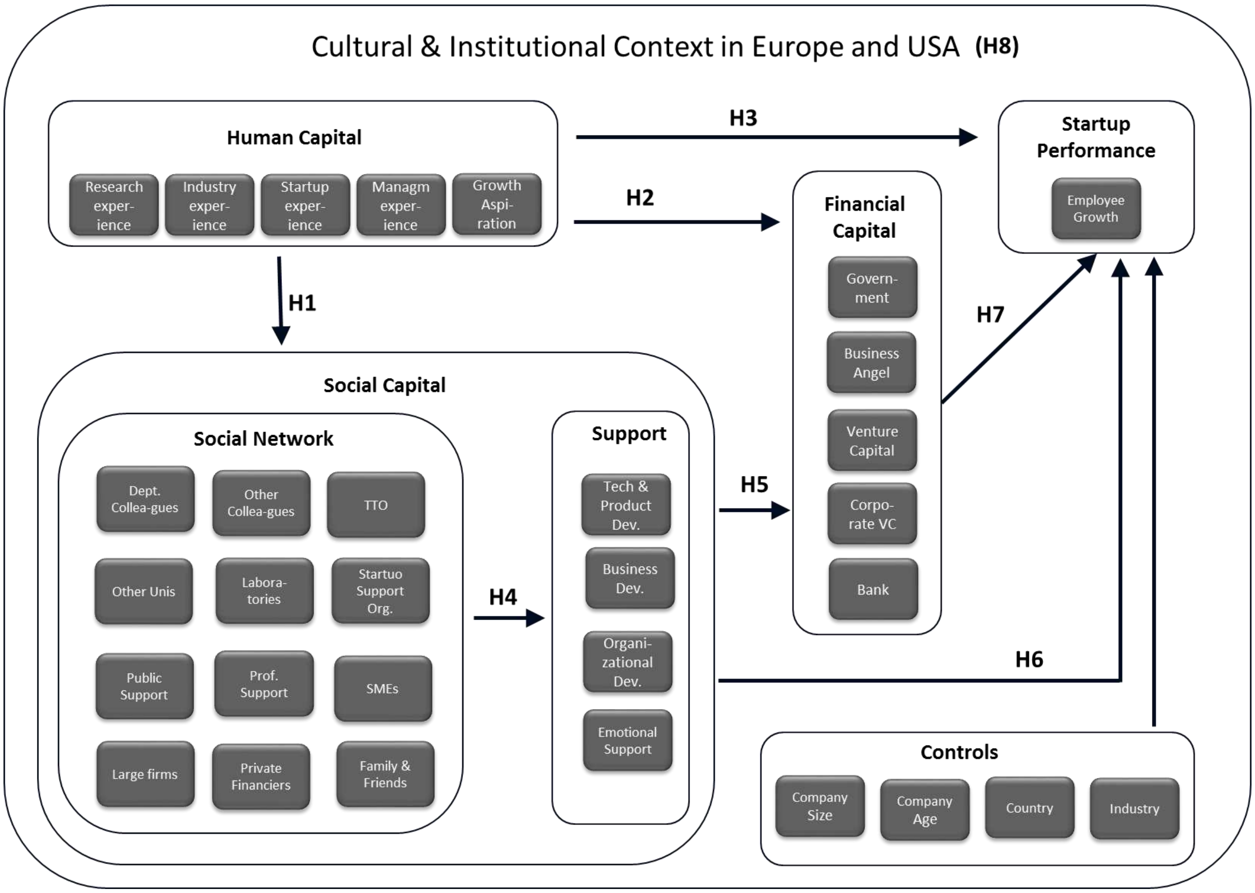
Table 21: Control Variables

Measured concept	Values	Type of Variable
Company Age	Mean = 3.43, SD = 2.96	Metric
Company Size in 2015	Mean = 7.29, SD = 25.18	Metric
Industry		
Industry; IT and software companies	0 = other industry 1 = IT & software companies	Binary / Dichotomous
Industry; Life Science and Medical Devices companies	0 = other industry 1 = Life Science and Medical Devices companies	Binary / Dichotomous
Industry; Light Manufacturing and Hardware companies	0 = other industry 1 = Light Manufacturing and Hardware companies	Binary / Dichotomous
Industry; service, trade and other companies	0 = other industry 1 = Service, trade and other	Binary / Dichotomous
Country / Continent		
Country; Austria	0 = other countries 1 = Austria	Binary / Dichotomous
Country; Germany	0 = other countries 1 = Germany	Binary / Dichotomous
Country; Sweden	0 = other countries 1 = Sweden	Binary / Dichotomous
Country; USA	0 = other countries 1 = USA	Binary / Dichotomous

4.3.7 Conceptual Model and Variables Summary

The overall conceptual model, including all variables used for the analyses, is depicted below. It is an extension to the model presented in the beginning of Chapter 4.3. and refers to the hypotheses posited in the previous chapter. Each set of variables is allocated to the overarching concept (human capital, social capital, etc.), represented by the rounded rectangles. The letter H stands for hypotheses and the number represents the group of hypotheses that describe the relationship between the concepts connected by the arrow. Hypotheses 1 to 7 are represented through an arrow and the according label (H1, etc.). The group of Hypotheses number 8, referring to the differences between USA and Europe, are captured next to "cultural and institutional context in Europe and USA. It should be pointed out here that each of the hypotheses will is tested individually, and no structural equation modelling was applied.

Figure 23: Conceptual Model, Hypotheses Overview & Variables



4.4 Statistical Methods

The last chapter provided an overview of concepts and variables used in this study. In the forthcoming paragraphs, the methods are presented that are used to analyze the data collected and to answer the research questions underlying this study. The data comprises ratio (interval) variables, ordinal variables with ranked categories (cp. Likert scales), nominal variables (non-ranked categories) and dichotomous or binary variables that describe just two categories. The data was collected via the online survey tool *SurveyMonkey*. It was then transferred to *SPSS* (version 26) to prepare the data, conduct the analyses and export the results for interpretation.

4.4.1 Descriptive Statistics

In a first step, applying descriptive statistics quantitatively describes the sample, or a selected sub-set, and helps to understand specific characteristics and distributions of the data. Univariate analysis refers to one variable at the time, applying frequency tables, diagrams, percentages, mean/median and standard deviation. Bivariate analysis involves the analysis of two variables in order to determine the empirical relationship between them. To see if the variables are related to one another, it is common to measure how those two variables simultaneously change together (cf. covariance).

Contingency, cross or pivot tables are used to examine the relationship between two variables. They show how variables relate and can help identify interactions among them. This approach might already answer some of the questions raised in previous chapters, but some of the results of these analyses will also raise further questions, that need to be studied in alternative ways. In this context, Pearson's (1900) Chi-Square tests are used for categorical variables to derive the probability that the relationship in the sample also exists in the basic population. When conducting a Chi-Square test, the value together with the significance level or p-value (> or < 0.05) will also be reported.

Some hypotheses relate to comparing the difference in means of two groups (e.g. entrepreneurs with prior startup experience vs. less experienced entrepreneurs; comparing characteristics in two different countries, etc.). In this case, t-tests or ANOVA analyses are applied in order to estimate the probability that the mean in a sample is also exists in the basic population. Alternatively, it is used to compare means of two variables, or sub-categories of a sample, respectively.

Correlation (which does not imply causality) refers to the degree to which a pair of variables are linearly related and correlation coefficients measure the degree of correlation. *Pearson's correlation coefficient* is the most commonly used type, which refers mainly to a linear relationship between variables. *Spearman's and Kendall's correlation coefficient*, on the other hand measure non-linear interaction.

4.4.2 Multiple Regression Analysis

Multivariate statistics is concerned with simultaneous observation and analysis of more than one outcome variable. Depending on the scale of the independent and dependent variable(s), different analysis methods are used (see table below).

Table 22: Multivariate Statistics Methods

		Independent variable	
		Metric scale	Nominal scale
Dependent variable	Metric scale	Regression analysis	Variance analysis
	Nominal scale	Discriminant analysis, "Logistic" regression	Contingency analysis

Metric scale = ratio scale and interval scale; nominal scale = nominal scale and ordinal scale

Linear regression - often also called Ordinary Least Square or OLS regression - is an approach for modeling the relationship between a scalar dependent variable y and one or more independent variables (or explanatory variables) denoted X. A simple linear regression involves one independent variable, whereas multiple linear regression encompasses more than one explanatory variable. Hence, one dependent variable is explained through one or several independent variables. Regression analysis allows us to answer the following questions: "How strong is the influence of the independent variable on the dependent variable?" (cf. cause analysis) and "How much does the dependent variable change, when the independent variable is changed?" (cp. effect analysis). Hence, the question in linear regression is how well we can predict a dependent variable with one or more independent variable and how much of the dependent variable score is explained by the independent variables.

The regression is formulized the following way: $a + b1\ X + b2\ Y + b3\ Z = y$ (dependent variable). The aim is to find the regression coefficients b1, b2, b3 and the constant a. The larger the regression coefficient, the larger the assumed influence on the dependent variable. However, the coefficients might not be comparable due to different scales. Therefore, the standardized b* helps t to compare coefficients. A rule of thumb states that at least double as many observations are needed as there are independent variables in the regression.

Furthermore, the completeness of the regression model is intended. On the one hand, all relevant variables have to be considered, without "underfitting" (too few relevant variables in model) or "overfitting" (too many independent variables) the model. The danger of the latter is that more variables due to chance may lead to a statistically significant regression coefficient. Another danger is that real influencing factors do not show impact, perhaps due to confounding factors. In general, as long as the result is not contradictory to considerations based on relevant theory (e.g. wrong sign of a coefficient), there is no reason to reject a factually based hypothesis.

The variables need to meet certain requirements, before regression analysis can be conducted. The researcher needs to be able to differentiate between independent and dependent variables. If this is not possible, one cannot examine a directional relationship through the regression and correlation analysis needs to be applied. The dependent variable needs to be metric, whereas the independent variables can be either metric or binary/dichotomous.

Underlying Assumptions

Furthermore, in order to conduct a multiple regression analysis, specific assumptions must be given. These assumptions are conditions that should be met before conclusions regarding the model estimates are taken or before a model is used to make predictions. If they are not met, the estimate of the regression coefficient (R^2), significance tests and confidence intervals may be biased or incorrect. On the other hand, the estimate of the standard error of the regression coefficient may be biased, which can lead to incorrect hypotheses tests or confidence intervals (Cohen et al. 2013).

Testing for Linearity, Independence & Homoskedasticity

Another assumption of linear regression is that the conditional variance of the residuals are constant (homoscedasticity) (Cohen et al. 2003). A lack of this is referred to as heteroskedasticity, which violates this basic assumption. In order to check for homoskedasticity, a scatterplot is created. This includes a histogram and normal probability plot. The standardized predicted scores are plotted on the X-axis against standardized residuals on the X-axis. A rectangular pattern of dots of that scatterplot indicates homoscedasticity, linearity and independence of variables, which confirms those underlying assumptions. If it does not indicate a rectangle, heteroscedasticity and non-linearity are present, violating these two assumptions and implying that the model does not predict the result accurately. Alternatively, the Breusch-Pagan (1979) test can be applied to have an unambiguous result, in terms of heteroscedasticity being present or not.

Furthermore, the residuals of the observations must be independent of one another. Independence of residual issues, however, happen to occur mostly in studies of single individuals or across several time points (Cohen et al. 2003).

Testing for Multicollinearity

In order to check for multicollinearity in a first step a bivariate regression table is compiled with just the independent variables. Once the table is calculated, one can observe the bivariate relationship between the variables in the model and detect if there are high levels of correlation between any of them. As is the case with many statistics there is now definitive agreed upon value when interpreting correlation when deciding if multicollinearity is present or not. Popular cut-off scores are 0.7, 0.8 and 0.9. In a next step, collinearity diagnostics is applied in the SPSS software, which provides a collinearity statistic including a tolerance and a VIF value. The Variance Inflation Factor (VIF) is calculated by dividing 1 by the tolerance. Most common guidelines for VIF are 5 (tolerance of 0.2) or 10 (tolerance of 0.1). Another rule of thumb refers to values above 3 to probable multicollinearity issues, above 5 quite likely to have multicollinearity and above 10 to definitely have multicollinearity issues present. If multicollinearity is present one of the predictor variables involved needs to be dropped, depending on the structure of the study. Once this variable is removed from the model, the VIF factors should be in the acceptable range when conducting the test again.

Testing for Normality of Residuals

A common misconception is that the normality assumption in a linear regression applies to the variables. However, it applies to the residuals around the regression line that are assumed to have a normal distribution (cp. bell curve). Whereas non-normality does not lead to serious problems with the interpretation in larger samples (as is the case in this study), it could point to other potential issues in the regression model. The test for normality can be done either graphically or numerically. According to Cohen et al. (2003), graphical examination allows the researcher to reveal the magnitude of potential non-normality in the residuals, which often is more useful that the (non-)significance of formal statistical tests. In order to graphically test the normal distribution of residuals, one has to plot the standardized residuals on the Y-axis and the standardized predicted values on the X-axis of scatterplot. The points depicted should form a rectangle with no point outside of negative 3 and 3 on either the Y-axis or the X-axis. This confirms the assumption of constant variance of the residuals. In order to check for normality, the scatterplot is kept the same and a normal probability plot is added. The points need to more or less follow the line depicted, in order to confirm that the standardized residuals are normally distributed. The Shapiro-Wilk or the Kolmogorov-Smirnov are the most common numerical tests. If their significance is greater than 0.05, these tests confirm normality.

4.4.3 Logistic Regression Analysis

Linear regression or ordinary least square regression (OLS) models assume that the residuals from the analyses are normally distributed and exhibit homoscedasticity. Sometimes the dependent variable does not meet these requirements. An example is if it is dichotomous (assuming just one of 2 values: 1 or 0). If this is the case, OLS regression models are not efficient and can lead to inaccuracies. Hence, for outcome variables that are dichotomous, or dummy coded, a generalized linear model – the logistic regression model – is applied. The current recommendation among statisticians is to favor logistic regression over discriminant analysis in this two-group case (Cohen et al. 2003).

In a logistic regression model, however, the predicted score is not itself dichotomous. This means it is not predicted whether an observation is a case versus a non-case, but rather the probability of being a case. There are three ways to depict the logistic regression equation, depending which of the three entities are referred to: the probability in the population of being a case (π_1 for person i), predicted probability of being a case (p_1 for person i) and the proportion of individuals who are cases (*P*). More details on those specific equations can be found in Cohen et al. (2003, p. 483 ff.).

The coefficients for predictors in logistic regression analysis are presented in two forms in SPSS and in publications: First, as regression coefficient (B_1) - the linear increment in the logit for a one-unit increment in the predictor - and regression constant (B_0). Each of the regression coefficients in multiple logistic regression is a partial regression coefficient, analog to linear regression. Second, coefficients for the predictors are presented as odds ratios, e^B or exp(B). The odds ratio refers to the amount the odds of being in the case group are multiplied when the predictor is incremented by a value of one unit. Cohen et al. describe odds ratios the following way (2003, p .492): "*Odds ratios greater than 1.0 correspond to positive B (regression) coefficients and reflect the increase in odds of being in the case category associated with each unit increase in X. Thus, an odds ratio of 1.80 indicates that the odds of being a case are multiplied by 1.80 each time X is incremented by one unit. Because the relationship is multiplicative in the odds ratio, a two-unit increase in X would be associated with 1.8 x 1.8 = 3.24 times the odds of being a case. Odds ratios falling between 0.0 and just below 1.0 correspond to negative B coefficients and signify that the odds of being a case decrease as predictor X increases.*" Standard computer programs, like SPSS used for the analysis in this study, report both the linear regression coefficients and the odds ratios.

Whereas in OLS regression the solution is an analytical one, in logistic regression the solution to the regression coefficient estimates is iterative. That means different values of the coefficients are tried until a set of coefficients – parameter estimates - is found that makes the solution as close to the statistical criterion – referred to maximum likelihood - as possible. This convergence might fail under certain circumstances, e.g. if multicollinearity among or large number of predictors (Cohen et al 2003).

Compared to OLS regression, in which measures of variation (sums of squares) constitute R^2 and describe the overall fit of the model, in logistic regression, measures of deviance replace the sums of squares. Although deviance derives from different calculations, it can be perceived analogously to sums of squares. Deviance measures are built from maximum likelihoods and often referred to as -2LL or -2 log likelihood (as it is the case in SPSS for example). In contrast to R^2, a single agreed upon measure of goodness of fit of the model, there is no single agreed upon index of goodness of fit in logistic regression. As a substitute, so called Pseudo-R^2 have been derived, which all come with certain limitations (Estrella 1998, Long, 1997, Hosmer and Lemeshow 2000): Cox and Snell Index (Cox and Snell 1989) offer an index of overall goodness of model fit that is related to R^2 from OLS regression. Somewhat problematic is the fact that it does not reach a maximum value of 1 but rather of 0.75 instead - when the proportion of cases in the sample equals 0.5. The Nagelkerke Index (Nagelkerke 1991) aims to improve the Cox and Snell index, by reaching a maximum of 1. For this reason, it will always be larger than Cox and Snell.

Furthermore, the Hosmer and Lemeshow (2000) goodness of fit test examines whether the S-shaped function of the logistic regression is appropriate for the observed data. Non-significance indicates the fit of observed frequencies of cases in the categories, compared to those expected based on the logistic regression. Thus, the assumed model is correctly specified. The validity of the test of fit depends on there being large, expected frequencies in all cells and the power of the test is not as high for sample sizes less than 400 (Hosmer and Lemeshow 2000).

4.4.4 Detecting Outliers

Before applying multivariate statistical methods, the data was checked for multivariate outliers. Outliers are one or more atypical data points that do not fit with the rest of the data and can influence the results dramatically (Cohen et al. 2003). Since several metric, independent variables are part of the analysis, regression diagnostics was applied to identify multivariate outliers, based on calculate Mahalanobis Distance (MD) through SPSS.

In order to do this, the metric, independent variables (founder's age, company age, company size and full-time founders) were used to calculate the MD. This process leads to five outliers, which were identified in a separate binary variable "outliers." In this way, they can be easily excluded from further regression analyses.

Furthermore, the dependent variable relative employee growth was visually checked for outliers. According to the boxplot, two outliers were identified: case 54 and 209. These two cases were added to the outlier variable described above. This brought the total number of outliers to seven.

5 Empirical Results and Interpretation

5.1 Descriptive Statistics: University Startup Characteristics

5.1.1 Response Rate and Geographical Distribution

In a first step, the main entrepreneurship ecosystems in each country were identified - Vienna in Austria, Berlin and Munich in Germany, Zurich in Switzerland, Stockholm in Sweden and Silicon Valley, Boston and New York in the USA. In those regions, the main universities and their corresponding startup support organizations (SSO) were selected. The goal was to survey startups that are affiliated to those SSOs, in order to be able to draw conclusions on their support and impact on university startup development and performance.

The survey took place in January and February 2015 and in total, across all countries, universities and SSOs, 2314 startup companies were invited to participate in the study. The received a reminder to fill out the survey four or five times, respectively, in the course of the two-month period during which the survey took place. Overall responses from 409 university startups were received, which represents a total response rate of 18%. The research was conducted in the six countries described above, with a majority of the respondents from Austria and the United States. Additional responses were collected from Switzerland, Germany and Sweden, respectively. Specific numbers regarding the companies contacted and answers received are listed in the table below.

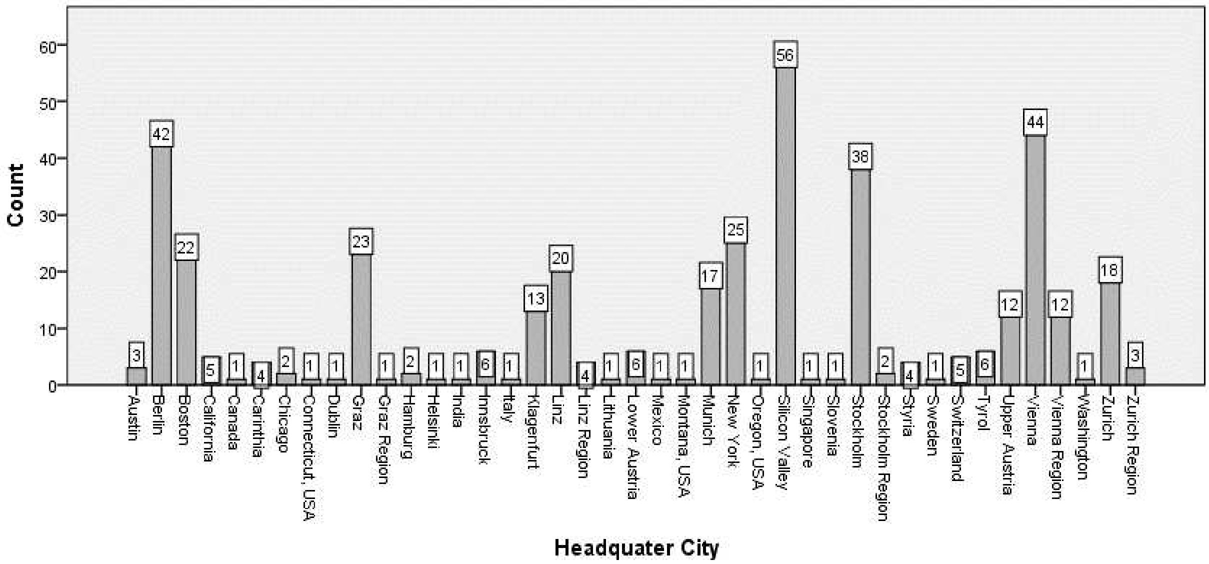
Table 23: Survey Details by Countries

Country	Companies contacted	Completed surveys	Response rate
Austria	529	155	29%
Germany	402	64	16%
Sweden	182	40	22%
Switzerland	125	26	21%
USA	1076	124	12%
Total	2,314	409	18%

In order to locate the startup more accurately in terms of region / metropolitan area / ecosystem, the questionnaire asked the question: *"In which city is the headquarters of the company?"* This question was intended to identify the center of business operation of the different startups, since the jurisdiction of incorporation (which was a different question in the survey) may differ. In the USA, for example, and especially for startups from Silicon Valley, it is common practice to incorporate in the state of Delaware, even though the headquarters and most business activities take place in another state. In the sample that was collected, 67% of the startups surveyed across Silicon Valley, New York and Boston are incorporated in Delaware.

In a next step, the aim was to cluster the different locations named in the open field question, in order to attribute the startups to the selected ecosystems (Vienna, Stockholm, Berlin, Boston, New York and Silicon Valley). For headquarters close to one of those metropolitan areas (less than 50 km away) the company was referred to be headquartered in "Silicon Valley", "Vienna Region", "Stockholm Region", etc. (see figure below).

Figure 24: Company Headquarter Location



The highest number of responses were received from university startups in Silicon Valley and Vienna Region (56 complete surveys each), followed by Stockholm (38) and Berlin (42).

5.1.2 Startup Founder Demographics

The questionnaire had to be filled out by one of the founders of the university startup. Across all countries, 86% of the respondents are male and only 14% are female. The highest percentage of male founders represented was in Austria (90.9%) and the lowest in Sweden (80%). A total of 72.3% of the respondents were younger than 40 years and 26% were younger than 30. Across all countries, the percentage of founders younger than 30 years old varied from 19% in Austria to about one third in USA and Sweden. About one third of the founders in Austria and Sweden were older than 40 years old, whereas this number is slightly lower in Germany (15.6%) and USA (20.9%). In terms of highest degree received, the percentage of PhD and master degree holders was highest in Switzerland with 100% (80.8% with PhD), followed by Austria with 84.9% (29.89% with PhD), Germany with 77.8% (23.8% with PhD), USA with 73.7% (34.4% with PhD) and Sweden with 51.2% (17.1% with PhD).

5.1.3 University Startups vs. Spin-Offs

Whereas a spin-off can be defined as "*a new venture initiated within a university setting and based on technology derived from university research*" (Rasmussen & Borch 2010), a university startup, on the other hand, is a broader term referring to a new company founded by people who were or are working in science or at a university, respectively. In comparison, those kinds of companies do not necessarily depend on new research findings or new scientific processes/methods/skills developed at the university (Egeln et al. 2007). Furthermore, university startups can be founded by people who recently started to study, were studying at the time of founding or have dropped out of their studies. Following those definitions, every university spin-off is also a university startup, but not the other way around. One of the questions in the questionnaire asked if "t*he establishment of the company was dependent on new research findings or new scientific processes/methods/skills developed at the university*" referring to the definition of a spin-off. In Austria, Germany and the USA, a close to 2 to 1 ratio of university startups to spin-offs can be observed, whereas in Sweden this ratio is about 3 to 1. In the following, the more general term "university startup" will be used rather than "university spin-off", in order to account for both types of companies dependent on new research findings and those who are not.

5.1.4 Industry Distribution

In the survey, the respondents had six categories to choose from in terms of **industry**: 1) Life sciences/medical devices. 2) Information technology (IT)/software, 3) Light manufacturing/hardware, 4) Service, 5) Trade and 6) Other (please specify). The aim was to reduce the number of companies in the "other" category, as well as to reduce the overall number of categories used, in order to be able to create a dummy variable with limited groups to represent. More details on how the final allocation of each startup to the industry categories can be found in Chapter 4.2.6. The final distribution of companies among the categories and countries is listed in the table below.

Table 24: Industry Distribution across Countries

Country	Total number of respondents (N)	IT/software	Life science/medical devices	Light manufacturing/hardware	Service, trade and other
Austria	155	45.2%	13.5%	22.6%	18.7%
Germany	64	39.1%	15.6%	14.1%	31.3%
Sweden	40	47.5%	20%	5%	27.5%
Switzerland	26	19.2%	30.8%	26.9%	23.1%
USA	124	34.7%	27.4%	16.1%	21.8%

5.1.5 Company Age and Development Stage

Another important aspect is the founding year of the company: "*In what year was the current company founded?*". The responses are clustered into four categories for comparison: 1) 2009 and before (seven years and older), 2) 2010-12 (four to six years old), 3) 2013/14 (two to three years old), 4) 2015/not yet founded. An overview of the founding year category in terms of country is depicted below:

Table 25: Company founding Year across Countries

Country	Total number of respondents (N)	2009 and before	2010-12	2013/14	2015/not yet
Austria	155	20.6%	18.7%	31.6%	29%
Germany	64	6.3%	26.6%	35.9%	31.3%
Sweden	40	5%	30%	40%	25%
USA	124	8.9%	26.6%	40.3%	24.2%

Furthermore, the respondents were asked "*In which stage of development is your company currently in?*" There were five categories to choose from (Vohora et al. 2004): 1) *Research phase*: Conducting research with the potential opportunity for commercialization; 2) *Opportunity framing*: Evaluating technological validity (towards proof of concept) and commercial potential (towards problem/solution fit); 3) *Pre-organization*: Prioritizing market(s) to focus on and developing/implementing strategic plans; 4) *Re-orientation*: (Attempting to) Generating returns by offering something of value to customers. Often changing business model, market, marketing or the strategic focus; 5) *Sustainable returns*: The company has figured out its precise business model, has traction on the market and is attaining sustainable returns. In a next step "Research phase" and "Opportunity framing" were consolidated to create four final categories – see below with reference to each country.

Table 26: Company Development Stage across Countries

Country	Total number of respondents (N)	Research and opportunity framing	Pre-organization	Re-orientation	Sustainable returns
Austria	155	26.5%	20.6%	21.3%	31.6%
Germany	64	18.8%	15.6%	34.4%	31.3%
Sweden	40	20%	27.5%	35%	17.5%
USA	124	23.4%	24.2%	32.3%	20.2%

Stages derived from Vohora et al. 2004

Another aspect is the development stage of the product or service the company is building: "*At what stage of development is the product or service?*" Based on Davidsson & Honig (2003), the respondents had four options to choose from: 1) Idea or concept; 2) Initial development; 3) Tested on customers; 4) Ready for sale or delivery. Consolidating 1) and 2) leads to three final categories, depicted by country below:

Table 27: Product/Service Development Stage across Countries

Country	Total number of respondents (N)	Idea/concept, initial development	Tested on customers	Ready for sale or delivery
Austria	155	24.7%	29.2%	46.1%
Germany	64	25%	20.3%	54.7%
Sweden	40	15%	25%	60%
USA	124	22.8%	26%	51.2%

5.2 Human Capital influencing Social and Financial Capital

This chapter aims to describe how human capital – measured by the founder's experience prior to starting the current startup – influences the support received from actors within and outside the university (cf. social capital). The hypotheses presented in Chapter 3 and also in the figure at the end of this chapter are tested by looking at the total sample and at the US and EU sub-samples separately. Chi-square tests are applied to examine the observed results in terms of the used actor groups, which were measured by dichotomous variables. Independent T-tests are conducted to examine the statistical significance of the different support values of the actor groups, which assessed the usefulness on a Likert scale (cp. F values of Levene's test).

5.2.1 Human Capital influencing Social Capital

The first set of hypotheses (H.1a, H.1b, H.1c) is concerned with the influence of human capital on social capital development. More specifically, it is examined if prior business ownership, that is prior startup experience, affects whether entrepreneurs receive support from actors within the research field or from the business environment.

Startup experience and research colleagues support (H.1a)

Hypothesis H.1a states "*Nascent and novice academic entrepreneurs are more likely to gain organizational development support from their research colleagues than are habitual academic entrepreneurs*". Hence, prior startup experience is the independent variable in this case and department colleagues or other university colleagues, respectively, as well as organizational development support from research colleagues are the dependent variables in this context. To remind the reader, following Mosey & Wright (2007): Nascent entrepreneurs are individuals considering starting their own businesses (Ucbasaran et al. 2003). Novice entrepreneurs are individuals who have created a venture for the first time. Habitual entrepreneurs undertake multiple entrepreneurial ventures (Westhead & Wright 1998) – often also referred to as serial entrepreneur.

The ratio of nascent and novice entrepreneurs to habitual entrepreneurs is about 7:3 in Europe as well as in the USA, with the Chi-square test showing no significant differences between those regions. The tables below show the results of the Chi-Square and Levene test conducted with regard to department colleagues (see the first table below) and other university colleagues (see the second table below) used and their usefulness in supporting the development of the company. The respondents could rank the usefulness of these support actors on a Likert Scale from (1) not at all useful to (5) very useful. First scores are provided for all startups in the USA and EU together, than for both regions separately.

Table 28: Prior Startup Experience and Department Colleague Support

Region	Prior startup experience	Used Department Colleagues to develop company (yes/no)	Chi-Square	Usefulness of Department Colleagues Organizational Support[1] (Likert scale 1-5)	t-value (df)
Total Sample (N = 409)	Nascent and Novice entrepreneurs (N = 294)	29.3%	6.06*	Mean = 2.11 (SD = 1.17; N = 82)	-2.47* (98)
	Habitual entrepreneurs (N = 115)	17.4%		Mean = 2.89 (SD = 1.41; N = 18)	
EU (N = 285)	Nascent and Novice entrepreneurs (N = 208)	29.3%	4.53*	Mean = 2.09 (SD = 1.17; N =58)	-3.6** (68)
	Habitual entrepreneurs (N = 77)	16.9%		Mean = 3.33 (SD = 1.41; N =12)	
US (N = 124)	Nascent and Novice entrepreneurs (N = 86)	29.1%	1.56	Mean = 2.11 (SD = 1.17; N = 24)	0.26 (28)
	Habitual entrepreneurs (N = 38)	18.4%		Mean = 2.0 (SD = 1.41; N = 6)	

**p<0.01 *p<0.05 †p<0.1; Note: Separate Chi Square & Levene tests were conducted for each region
[1] Likert Scale from (1) not at all useful to (5) very useful

Overall, looking at EU and USA together, nascent and novice entrepreneurs use department colleagues and other university colleagues significantly more often than habitual entrepreneurs to develop their company. This significant difference in the use of department colleagues can also be observed by examining just the EU startups. However, it is not significant with the US startups.

On the other hand, when examining the whole sample of EU and USA, as well as just the European part, habitual entrepreneurs rank department colleagues (though no significant differences are noted in terms of other university colleagues) as significantly more helpful than nascent and novice entrepreneurs do, in terms of organizational support.

Table 29: Prior Startup Experience and Other University Colleagues Support

Region	Prior startup experience	Used other University colleagues to develop company (yes/no)	Chi-Square	Usefulness of other University colleagues Organizational Support[1] (Likert scale 1-5)	t-value (df)
Total Sample (N = 409)	Nascent and Novice entrepreneurs (N = 294)	26.2%	4.3*	Mean = 2.2 (SD = 1.29; N = 75)	-0.34 (92)
	Habitual entrepreneurs (N = 115)	16.5%		Mean = 2.31 (SD = 1.45; N = 19)	
EU (N = 285)	Nascent and Novice entrepreneurs (N = 208)	26.0%	1.87	Mean = 2.32 (SD = 1.30; N = 53)	-0.62 (65)
	Habitual entrepreneurs (N = 77)	18.2%		Mean = 2.57 (SD = 1.55; N = 14)	
US (N = 124)	Nascent andNovice entrepreneurs (N = 86)	26.7%	2.78†	Mean = 1.91 (SD = 1.27; N = 22)	0.51 (25)
	Habitual entrepreneurs (N = 38)	13.2%		Mean = 1.6 (SD = 0.89; N = 5)	

**p<0.01 *p<0.05 †p<0.1; Note: Separate Chi Square & Levene tests were conducted for each region
[1] Likert Scale from (1) not at all useful to (5) very useful

Table 29 reveals the results concerning the usefulness of other university colleagues. One can assume that nascent and novice entrepreneurs are more likely to consult their department colleagues on a more diverse set of issues and questions. Hence, there is a higher ratio when it comes to their involvement. Given the close collaboration and personal connection between colleagues, it seems natural to involve them early and often in the entrepreneurial process. Novice entrepreneurs might lack the experience and ability to differentiate between the support fields their colleagues are knowledgeable in or not, leading to a higher number - but also less specific - support requests that lead to the lower value overall. Habitual entrepreneurs, on the other hand, rank department colleagues higher in terms of organizational support – while consulting them less frequently. This suggests that more experienced entrepreneurs have a better understanding of which questions or problems their colleagues will be able to help them with and for which issues they would rather consult other actors in the research or business network. A more selective approach in engaging their colleagues can lead to a higher perceived value of support they receive from them than nascent and novice entrepreneurs, who will engage them in a more diverse set of questions and do not always receive the level of support they hoped for.

On the one hand, nascent and novice entrepreneurs work significantly more often with department colleagues and other university colleagues than habitual entrepreneurs. Nevertheless, habitual entrepreneurs rank organizational support received from department colleagues higher than nascent and novice entrepreneurs do.

Startup experience and technology transfer office support (H.1b)

Hypothesis H.1b states "*Novice academic entrepreneurs are more likely to gain market and business development support using the university technology transfer office (TTO) than habitual and nascent entrepreneurs.*" Hence, *prior startup experience* is the independent variable in this case and technology transfer office (TTO), as well as *market and business development support received from TTO* are the dependent variables in this context.

The tables below show the results of the Chi-Square and Levene tests conducted with regard to TTO used and their usefulness in supporting the development of the company, as ranked by the respondents. First scores are provided for all startups in USA and EU together, than for both regions separately.

Table 30: Prior Startup Experience and Technology Transfer Office Support

Region	Prior startup experience	Used Tech Transfer Office to develop company	Chi-Square	Usefulness of Tech Transfer Office Business Support[1]	t-value (df)
Total Sample (N = 409)	Nascent and Novice entrepreneurs (N = 294)	17.7%	0.005	Mean = 2.4 (SD = 1.25; N = 50)	0.734 (68)
	Habitual entrepreneurs (N = 115)	17.4%		Mean = 2.15 (SD = 1.39; N = 20)	
EU (N = 285)	Nascent and Novice entrepreneurs (N = 208)	16.3%	0.12	Mean = 2.39 (SD = 1.14; N = 33)	0.21 (44)
	Habitual entrepreneurs (N = 77)	16.9%		Mean = 2.30 (SD = 1.55; N = 13)	
US (N = 124)	Nascent and Novice entrepreneurs (N = 86)	20.9%	0.103	Mean = 2.41 (SD = 1.46; N = 17)	0.91 (22)
	Habitual entrepreneurs (N = 38)	18.4%		Mean = 1.86 (SD = 1.07; N = 7)	

**$p<0.01$ *$p<0.05$ $^{+}p<0.1$; Note: Separate Chi Square & Levene tests were conducted for each region
[1] Likert Scale from (1) not at all useful to (5) very useful

Overall, as well as for EU and USA separately, no significant differences are observed between nascent/novice and habitual entrepreneurs in terms of the usage of Technology Transfer Office (TTO) for developing the startup company. Furthermore, neither of the two groups ranked the TTO significantly more useful than the other with respect to the business development support they received from the TTOs.

Both the utilization of the TTO as well as its perceived support value is relatively low with nascent/novice as well as habitual entrepreneurs. These results as well as the relatively low score of usage of the TTO (around 17% as compared to around 26% of department colleagues for example; see more usage rates in Chapter 5.3.1) suggests that the TTO is not a focal point for startup development support, regardless of the prior startup experience of the entrepreneur.

This underlines the limited influence and support of TTOs in the spin-off process and proposes a critical review of the strategic orientation, organizational setup and practical involvement of TTOs and their employees in the development of university startups.

The results thus show no evidence that nascent and novice academic entrepreneurs are more likely to gain market and business development support from a TTO. To the contrary, regardless of the entrepreneurial experience of the founders, the TTO is used comparatively sparsely and their support in market and business development limited.

Startup vs. industry experience and organizational support (H.1c)

Hypothesis H.1c states "*Prior business ownership experience is more important than more industrial experience in gaining organizational support from network actors external to the university.*" In this case, *prior startup experience* or *prior industry experience,* respectively, are the independent variables and *non-research actors* as well as o*rganizational development support from non-research actors* are the dependent variables.

To begin with, across all countries, about 70% of all habitual entrepreneurs have prior industry experience. By contrast, only about 30% of the entrepreneurs with prior industry experience had started a company before. In order to test this hypothesis, it was necessary to define *network actors external to the university*. In this study, they comprise the following five actor groups: *private financiers (business angels or venture capitalists), entrepreneurs and SMEs, large firms, public support* and *professional support*. For this analysis, the actor group *family and friends* is left out, since it is assumed that professional experience does not directly relate to the support received from private actors.

First, the number of ties in the external network are examined separately across the industry and startup experience field. Habitual entrepreneurs worked with an average of two types of extra-university actors to develop their company, compared to 1.9 in entrepreneurs with prior industry experience. Therefore, no significant differences with regard to the number of extra-university ties could be noted. Furthermore, the extent of organizational support was measured for entrepreneurs with different startup experience levels. Also, along those lines, no significant differences could be identified: Habitual entrepreneurs ascribe a mean support value of 2.59 (from a maximum of 5) across the five actor types. For entrepreneurs with prior industry experience, the value is slightly higher, at 2.76.

The results thus deliver evidence that prior experiences, regardless of whether they are in a startup or in industry overall, support the expansion of the social network outside the university to a similar extent. The same holds true for the extent of organizational support received from those actors. Apparently, both types of experiences enable the entrepreneur to gain the necessary know-how from their support actors external to the university to build their startup organization.

Hence, it can be concluded that prior business ownership does not lead to significantly more organizational support from actors outside the university, as compared to prior industry experience, respectively. Neither in terms of a) the number of university-external actors who supported the startup, nor in b) the extend of support those actors provided to the university startups.

5.2.2 Human Capital influencing Financial Capital

The aim of this chapter is to examine the influence of the entrepreneur’s human capital – especially prior startup and industry experience – on securing financial capital investment from outside the university network. In order to test this hypothesis, it is necessary to define “financial capital from network actors external to the university”. In this case, we refer to the following five potential sources of funding: 1) government funding, 2) business angel funding, 3) venture capital (VC) funding, 4) corporate venture funding and 5) bank funding.

These five funding sources are the dependent variables of the following regression analyses. They are coded as dichotomous variables (1 = received this type of funding, 0 = did not receive), regardless of the amount of funding received from the respective source. The independent variables are the entrepreneurs or founder’s prior experience in four different fields: 1) founder's prior startup experience, 2) founder's industry experience, 3) founder's management experience, 4) founder's research experience. Furthermore, in relation to hypotheses H.2c and H.2b (funding from private investors), the entrepreneur's growth aspiration as well as the number of full-time committed founders were added to the list of independent variables.

Gender and the age of the founder were included as control variables. The company age, size and industry and the continent (USA vs Europe) were added as controls. Logistic regression modelling was applied to verify the hypotheses.

All independent variables were checked for multicollinearity using collinearity diagnostics. All values for the independent variables are below 2 (only life science and medical devices was at 2.006) and, hence, well below even the most conservative cut-off values of 3. Therefore, it can be concluded that no multicollinearity issues are present.

Table 31: Logistic Regression Model: Human Capital influencing Financial Capital

	Model	1	2	3	4	5	6
		Govern-ment funding	Business angel funding	Venture capital (VC) funding	Corporate venture funding	Bank funding	Equity funding[1]
Controls	Company Age	.056	-.079	-.006	-.057	.209***	-.126†
	Company Size	-.015	.022	.103**	.084*	.032	.070*
	Continent (USA)	-2.147***	.468	2.416***	2.180***	-1.629**	1.029**
	Software and IT	.410	.044	-.219	-1.115†	-.078	.042
	Life Science and Medical Devices	.391	-.111	-.466	-1.014	.122	-.133
	Light Manufacturing and Hardware	.718	-.054	-1.210	-.632	.330	-.119
Human Capital	Founder Age	.061	.067	-.229	-.122	.100	.102
	Founder Gender	.419	.676	.622	.259	-.673	.751†
	Founder's startup experience	-.143	.761*	1.171**	.846†	.079	1.068**
	Founder's industry experience	.609†	-.635*	.095	.127	.284	-.542†
	Founder's management experience	-.508	.044	.003	-.715	.116	-.188
	Founder's research experience	.597†	-.142	.744	.699	-.108	.097
	Growth aspiration	.147	.855**	.687	-.403	-2.703	.596†
	Full-time founders	.258	.411*	-.117	.061	.209	.316†
	Constant	-.525	-2.185***	-3.847***	-3.227***	.032***	-2.129
	-2 Log likelihood	293.249	329.645	175.240	141.159	194.276	326.615
	Pseudo R^2 (Nagelkerke)	.338	.227	.438	.267	.165	.292

***p<0.001 **p<0.01 *p<0.05 †p<0.1; [1] either Business Angel, VC or Corporate VC funding

Business angel and venture capital funding

In Model 2, the binary variable *business angel funding* is the dependent variable. The Hosmer and Lemeshow (2000) test is not significant (p = 0.636) with a chi-square of 6.099, suggesting that the model is appropriate for the observed data. The same test also showed no significance (p = 0.839 and a chi-square of 4.196) for Model 3, with *venture capital funding* as dependent binary variable, also showing that model to be appropriate for the analysis at hand.

Prior startup experience increases the likelihood for receiving either business angel or VC funding, with even more significant results on the latter. The influence is also comparatively stronger compared to the other experience fields included in the analyses. This underlines the clout that private investors attribute to habitual – often also referred to as – serial entrepreneurs when taking their funding decisions. Investing in a startup that is led by an entrepreneur who has been through the process before, in their eyes increases the likelihood of success.

Interesting to note is the negative impact of prior industry experience on the likelihood of receiving business angel funding. This result could be surprising for some who attribute prior work experience in a respective industry as an asset, since it can be linked to knowing the peculiarities of a certain sector and having established a professional network in this field. However, this finding is consistent with the literature on commitment (Dietrich and Srinivasan 2007, Stephens et al 2019). The more time somebody spends working in a career field, the more committed they become to climbing the pre-defined career ladder. On the other hand, it is less likely this person will come up with disruptive ideas that challenge the status quo of this specific industry. They further would not want to jeopardize the position and reputation they have assumed over the year, by starting a new venture with an unknown outcome.

Growth aspiration has a significant impact on receiving business angel funding (overall model), but also shows to increase the likelihood of receiving VC funding (EU model). This is no surprise, since private investors aim to invest in startups with a high growth potential. Given the risk involved investing in early-stage companies, each of the investments in their portfolio must have the potential to return many times the capital invested. The willingness of the founder to grow the startup accordingly and, hopefully, achieve a certain size and revenue, from their perspective, should offset the money they lost investing in startups that fail and turn their investment portfolio positive. Along those lines, the number of full-time founders committed shows significant influence in raising financing from business angels in the overall model. This finding is consistent with the literature which acknowledges, besides the characteristics and vision of the founder, the founding team as a crucial factor to the decision-making process for private investors (Mason & Stark 2004). Having more people committed to the startup, ideally with complementary skills and experiences, attribute more personnel resources to the startup in the important early stages of development.

There is a significant positive impact of prior research experience to receive VC funding from investors in Europe (see EU model). An explanation could be that VC investors in Europe ascribe higher value to founders with a scientific background, compared to their US counterparts.

The low number of cases with female founders who received venture capital (1 in EU and 5 in USA) or corporate venture capital (0 in EU and 4 in USA) leads to a comparatively high coefficient with regard to gender, especially in the EU only model, limiting the fit of the model in this regard.

Government funding

It was found that prior industry and also especially research experience are relevant to receive funding from government sources. This represents a stark contrast to the selection criteria from private investors, like business angels and VCs, who focus primarily on prior startup experience, when taking their funding decisions. Furthermore, the significance of the corresponding coefficient was only slightly above the threshold of 0.1 for life science and medical device companies (p = 0.110) at a coefficient of 0.634 and for light manufacturing and hardware companies (p = 0.111) for a coefficient of 0.69. This suggests that - compared to other funding sources - government funding leans towards those types of industries when making funding decisions, focusing less on software related businesses. Gender was also shown to have a significant influence on receiving government funding, with male founders being more likely to receive capital. To be fair, without growth aspiration and the number of full-time committed founders in the equation, gender is also a significant variable in Model 2, pointing to a significantly higher likelihood to receive business angel funding, when the founder is male (B=1.232, p=0.004). As for the previous models, the Hosmer and Lemeshow (2000) test is not significant (p = 0.923) and a chi-square of 3.174 suggests that the model is appropriate for the observed data.

Corporate VC and bank funding

For Model 4, the Hosmer and Lemeshow (2000) test is not significant (p = 0.402; chi-square of

8.328) as well as for model 5 (p = 0.522 and a chi-square of 7.138) suggesting that both models are appropriate for the observed data. The results of Model 5 – bank funding – point to the fact that banks are primarily focusing on the age of the companies, when considering lending them money. They follow their assumption that startups that are successfully running their business for a longer time period are less likely to go bankrupt and, therefore, present higher creditworthiness. As pointed out in previous chapters, banks are mainly in the business of lending money to established business and less likely to invest in early-stage, higher risk startups along the lines of business angels or venture capitalists. Therefore, their funding decisions are also based on different factors than private investors.

The same analysis as in the table above was also conducted exclusively for startups from the US and EU, respectively, filtering the responses by country, in order to focus on each region separately. For all "US only" and "EU only" models, the Hosmer and Lemeshow (2000) test was conducted and also showed that those regionally focused models are appropriate for the observed data. In the US only analysis, however, the bank funding Model 5 did not lead to any interpretable results. This was because the number of US startups that received bank funding (5.3%) was too low. The other results are listed in the figures below, respectively, and their results are interpreted together with the ones from the overall model from the figure above.

Table 32: Logistic Regression Model: Human Capital influencing Financial Capital (USA ONLY)

	Model	1	2	3	4	5	6
		Govern-ment funding	Business angel funding	Venture capital (VC) funding	Corporate venture funding	Bank Funding[1]	Equity funding[1]
Controls	Company Age	.280*	.063	.143	.051	-	.127
	Company Size	-.088†	.059	.120*	.084†	-	.225*
	Software and IT	-.232	.687	-.241	-.013	-	.791
	Life Science and Medical Devices	.786	-1.301	-.992	-.253	-	-1.821†
	Light Manufacturing and Hardware	-.022	-.355	-2.028†	.869	-	-.335
Human Capital	Founder Age	-.083	-.486*	-.298	-.126	-	-.342
	Founder Gender (male)	-.027	1.428†	.584	-.242	-	1.210
	Founder's startup experience	.128	1.166†	1.093†	.172	-	1.361†
	Founder's industry experience	-.043	-.629	.414	.808	-	.310
	Founder's management experience	-.537	.083	-.602	-.081	-	-1.255
	Founder research experience	1.243†	.513	.433	.639	-	.827
	Growth aspiration	.468	1.450*	.647	-.472	-	1.716*
	Full-time founders	.554	.317	.208	-.147	-	.283
	Constant	-2.740*	-1.629	-1.636†	-1.936†	-	-1.955†
	-2 Log likelihood	93.414	92.057	98.296	84.473	-	72.511
	Pseudo R^2 (Nagelkerke)	.275	.406	.318	.174	-	.528

***p<0.001 **p<0.01 *p<0.05 †p<0.1; [1] not sufficient cases that received bank funding in the US to calculate Model 5; [1] either Business Angel, VC or Corporate VC funding

Table 33: Logistic Regression Model: Human Capital influencing Financial Capital (EU ONLY)

	Model	1	2	3	4	5	6
		Govern-ment funding	Business angel funding	Venture capital (VC) funding	Corporate venture funding	Bank funding	Equity funding[1]
Controls	Company Age	-.087	-.155†	-.821*	-.873*	.175*	-.236**
	Company Size	.058	.026	.279**	.222†	.018	.057†
	Software and IT	.764	-.171	.210	-2.816*	.151	-.294
	Life Science and Medical Devices	.064	.621	.497	-2.672	.202	.390
	Light Manufacturing and Hardware	1.134	.185	-.727	-21.187	.359	-.241
Human Capital	Founder Age	.231	.280+	-.010	-.663	-.067	.190
	Founder Gender	.784	.683	18.129	19.493	-.122	1.027
	Founder's startup experience	-.129	.720*	1.962*	1.868	.182	1.064**
	Founder's industry experience	.681	-.615	-2.151*	-1.428	.268	-.849*
	Founder's management experience	-.734	-.111	1.039	-1.510	.317	.102
	Founder research experience	.388	-.569	3.174*	2.448	.178	-.046
	Growth aspiration	-.331	.728†	1.953†	.204	.426	.642
	Full-time founders	.212	.463*	-1.614*	-.013	-.142	.268
	Constant	-1.097	-2.622**	-20.920	-19.047	-2.541*	-2.053*
	-2 Log likelihood	181.921	215.709	49.176	31.902	166.272	220.889
	Pseudo R^2 (Nagelkerke)	.151	.217	.474	.511	.100	.254

***p<0.001 **p<0.01 *p<0.05 †p<0.1; [1] either Business Angel, VC or Corporate VC funding

Concerning the hypotheses regarding equity financing, habitual entrepreneurs are significantly more likely to receive funding from private investors – business angel as well as venture capital funds – than nascent and novice entrepreneurs (see Table 31). There is also some increased likelihood for them to receive funding from corporates, but no significant results for government or bank funding. Hence, hypothesis H.2a "*prior business ownership experience has a positive impact in gaining equity finance from network actors external to the university"* can be accepted, since government and bank funding are usually not equity financing but rather grants or loans, respectively. It comes as no surprise that private investors – business angels and venture capitalists – prefer to invest in startups with a more experienced founder. Starting a new startup company is a risky endeavor. There are different internal and external factors influencing its success or failure. The entrepreneur - and the team itself - play a crucial role in the development of the startups and are often cited in the literature (Colombo & Grilli 2005, Mosey & Wright 2007, Minola & Giorgino 2008) and mentioned by investors as being one of the single most important factors influencing successful startup development. It also underlines the fact that novice entrepreneurs who lack prior business ownership experience express problems in gaining credibility outside the university (Vohora et al. 2004), limiting their ability to raise equity finance. Furthermore, the notion that prior business ownership experience is more important than other types of experiences examined (H.2b) can also be accepted. This is especially true, given the result that prior industry experience had a *negative* effect on receiving business angel funding. The last two hypotheses refer to the impact of growth aspiration (H.2c) and full-time committed founders (H.2d) on funding from business angels and VCs. Statistically significant results can be observed for both hypotheses, especially for business angels in the overall model, but also for both types of funding types in the EU model. Hence, both hypotheses are also accepted.

5.2.3 Summary of tested Hypotheses: Human Capital

In the table below, a summary of the first two groups of hypotheses tested (H.1a-c, H.2a-d) is provided, including the assessment of whether they are accepted or rejected.

Table 34: Summary of Hypotheses regarding Human Capital influencing Social and Financial Capital

No.	Hypotheses	Validation
H.1a	Nascent and novice academic entrepreneurs are more likely to gain organizational development support from their research colleagues than are habitual academic entrepreneurs.	Mixed results
H.1b	Novice academic entrepreneurs are more likely to gain market and business development support using the university technology transfer office than habitual and nascent entrepreneurs.	Rejected
H.1c	Prior business ownership experience is more important than more industrial experience in gaining organizational support from network actors external to the university.	Rejected
H.2a	Prior business ownership experience has a positive impact in gaining equity finance from network actors external to the university.	Accepted[1]
H.2b	Prior business ownership experience is more important than industrial experience c) management experience d) research experience in gaining equity finance from network actors external to the university.	Accepted[1,2]
H.2c	Higher level of an entrepreneur's growth aspiration will lead to a higher probability of equity financing by private financiers (business angels and venture capitalists).	Accepted
H.2d	A higher number of full-time committed founders will lead to higher probability of equity financing by private financiers (business angels and venture capitalists).	Accepted

[1] especially valid for private financiers, like business angels and venture capitalists; [2] the only exception being VC investors in Europe for who prior research experience seems to have a stronger impact than startup experience

5.3 Social Capital and University Startup Development

The previous chapter examined the role and impact of the entrepreneur's human capital on university startup development. On the one hand, the analysis revealed the importance of previous startup experience on raising equity financing, underlying the importance of human capital in raising financial capital. On the other hand, the influence of human capital on social capital development was closely scrutinized. These analyses already revealed the limited role that Tech Transfer Offices play in the startup process and supported our understanding of how human capital affects the support entrepreneurs receive from certain support actors (cf. social capital). In a next step, the following chapter focuses even more on those supporting relationships the university startup is embedded in. This chapter aims to shed light on the question (cp. Research question 3) *how social capital affects the early stages of university startup development?* The chapter is further divided in four sections, each dealing with a specific aspect of this overall question. The corresponding sub-research question, as well as the equivalent hypotheses are presented in each sub-chapter, with a synthesis of the findings and a summary of the assessment of the hypotheses presented toward the end of the chapter.

5.3.1 Most supportive Actors in the University Startup Process

As described in more detail in Chapter 3.1, a university startup is embedded in a research network as well as in a business network, each comprising actors that support the startup during its development. In the startup process, these support actors are referred to as intermediaries. They are either situated in the research domain - within the university (department colleagues, research colleagues in other departments and TTO members) or external to the university (other universities, research laboratories) – or in the non-research, that is business, domain (private financiers, entrepreneurs and small firms, large firms, public support, professional support, private support)

The research question guiding this sub-chapter aims to identify the most supportive actors during the early stages of startup development, and their contribution to the startups' development. *Who are the most important actors within and outside the research network and how do they support the early stages of university startup development?* This question can be divided into two sub-questions, with the first one referring to research vs. business support actors, examining which actors are most helpful in bridging the gap between the research and business ecosystems: *Who are the most important actors within and outside the research network?* In a next step, the second sub-question refers to *how they support the early stages of university startup development?* More specifically, how do those support actors provide value to the university startups, in terms of technological, business and organizational support (cp. 2.2.4).

Research vs. business support actors

In a first step, the respondents were asked the following question: "*Which type of actors have you used to develop your company?"* (see question 35 in appendix). They could select none to all twelve types of actors that helped them build their company. The high percentage of startup support organization (short "SSO") used can be explained through the sampling process: the contact details of the founders were retrieved from the websites of the selected incubators and accelerators. It does not sum up to 100%, since some of the respondents might not identify their support organization as the type of organization it was asked for: SSO (incubator, accelerator, etc.). The numbers presented in the table below are across all countries and do not differentiate between certain ecosystems. The comparative analyses are part of the following sub-chapter.

Table 35: Support Actors used by Founders to develop their Startup

	Actor groups	Count	Percentage of sample size (N = 409)
Research Actors	Department colleagues	106	25.9%
	Other university colleagues	96	23.5%
	Tech Transfer Office	72	17.6%
	Other universities	77	18.8%
	Research laboratories	84	20.5%
	Startup Support Organization	311	76.0%
Non-research Actors	Private financiers	162	39.6%
	Entrepreneurs and Small Firms	151	36.9%
	Large Firms	69	16.9%
	Public Support	195	47.7%
	Professional Support	226	55.3%
	Private Support	239	58.4%

Upper five are research actors, lower six are non-research actors; Startup Support Organization as intermediary

Overall, all the actors in the non-research field (besides large firms) were used more often than the actors in the research field (besides the SSO for previously explained reason). More than half of the respondents have been supported by their private network, like family and friends, and received professional support from consultants, accountants or lawyers. Almost 50% used public support actors, like governmental expert organizations, government grant providers and regional development agencies, for example. In comparison, private financiers (cp. business angels and venture capitalists), entrepreneurs and small business owners were used only from slightly less than 40% of the respondents. This is an interesting finding and will be discussed in the sub-chapter on Europe and USA differences in more detail.

On the research actors' side, we can identify department colleagues and other university colleagues as the groups that were used the most to develop the startup company – around one quarter of the founders has collaborated with either of the groups. With regard to research actors, this is not surprising. This is because it can be expected that people closer to the founder (cf. at the same university, or department even) are more likely to be asked for support than people from other external organizations (e.g. other universities, research labs). Whereas on average (without SSO), 21% of the respondents have used research actors to develop their startup, the percentage goes up to almost 40% for non-research actors. Hence, the latter group of actors was used almost twice as much by university startup founders. To sum up, the hypothesis "*non-research actors are used relatively more often by university startups to develop the company compared to research actors*" can be accepted.

Support actors and startup development domains

In a next step, the intensity with which actors are used for company development was analyzed. To gain a better understanding of new venture development, a new model of university startup development was derived for this study. It focuses on three different development domains (technological and product, market and business, organizational) – see 2.2.4 for more details. This allows us to examine which actors were most helpful in each of this development domains. Specifically, the research question was "*to what extent does social capital affect the early stages of university startup development*?" Based on scientific literature, a set of hypotheses was derived that assumed certain relationships between a specific type of actors and their expected contribution to the development domains (see table at the end of this sub-chapter). We operationalized these hypotheses by a set of questions that were part of the survey (see question 36-39 in appendix), which is also described in more detail in Chapter 4.2. The respondents were asked to rank each actor group according to the level of support they received in each of the startup development categories (Likert scale from 1…not at all useful to 5…very useful). Obviously, the respondents only answered those questions, if they have previously selected that they have used this actor in the first place (question 35). Hence, there is a different sample size for each of the actor groups.

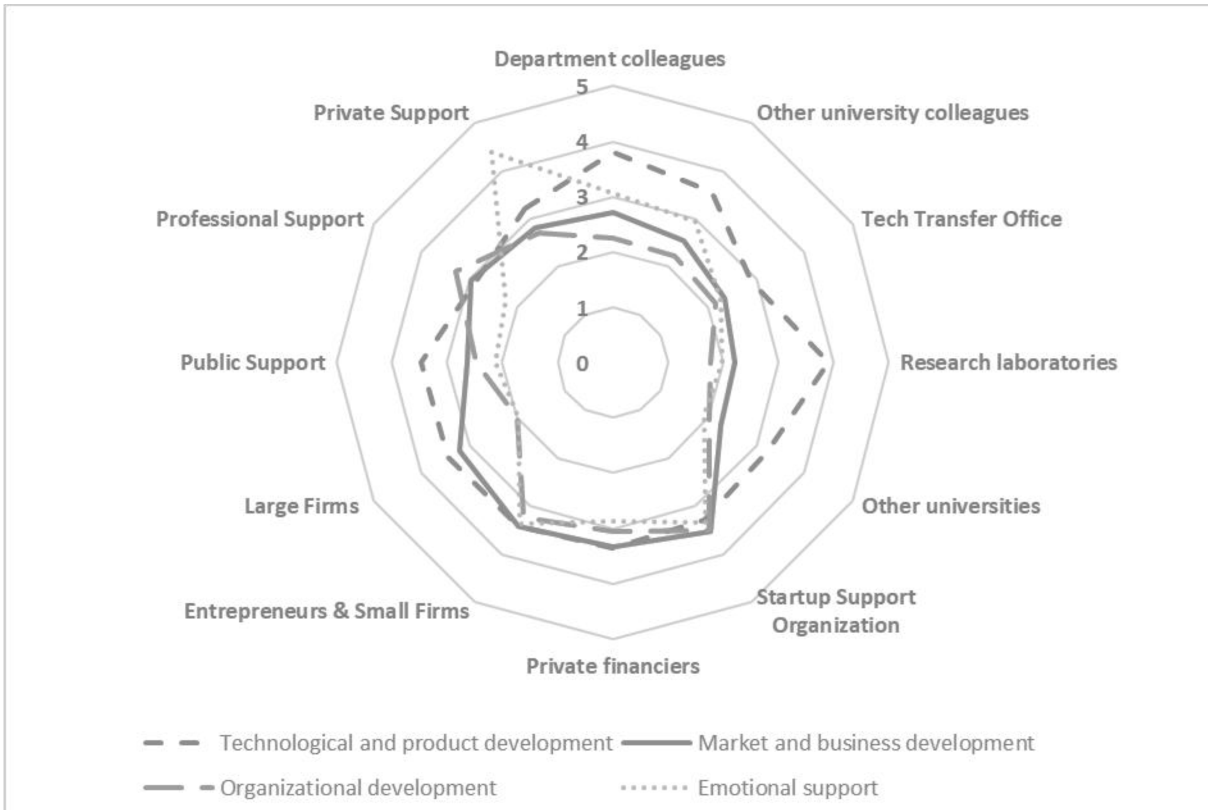
Table 36: Actors Support Factor per Startup Development Domains

Actor groups	Technological and product development	Market and business development	Organizational development	Emotional support
Department colleagues	3.80 (N=104, SD=1.22)	2.72 (N=105, SD=1.26)	2.25 (N=100, SD=1.24)	3.06 (N=101, SD=1.43)
Other university colleagues	3.57 (N=93, SD=1.29)	2.55 (N=92, SD=1.28)	2.22 (N=94, SD=1.32)	2.96 (N=94, SD=1.46)
Tech Transfer Office	2.91 (N=70, SD=1.39)	2.33 (N=70, SD=1.28)	2.15 (N=66, SD=1.10)	2.25 (N=68, SD=1.36)
Other universities	3.23 (N=73, SD=1.30)	2.25 (N=69, SD=1.22)	2.01 (N=69, SD=1.21)	1.91 (N=70, SD=1.22)
Research laboratories	3.9 (N=79, SD=0.98)	2.21 (N=7, SD=1.16)	1.77 (N=74, SD=1.04)	1.97 (N=75, SD=1.14)
Startup Support Organization	3.29 (N=307, SD=1.40)	3.54 (N=306, SD=1.24)	3.51 (N=306, SD=1.25)	3.33 (N=306, SD=1.38)
Private financiers	3.36 (N=160, SD=1.46)	3.33 (N=162, SD=1.23)	3.05 (N=160, SD=1.31)	2.87 (N=157, SD=1.41)
Entrepreneurs and Small Firms	3.42 (N=149, SD=1.18)	3.43 (N=148, SD=1.20)	3.23 (N=149, SD=1.32)	3.36 (N=148, SD=1.37)
Large Firms	3.44 (N=68, SD=1.30)	3.20 (N=66, SD=1.36)	2.00 (N=67, SD=1.04)	1.97 (N=67, SD=1.19)
Public Support	3.48 (N=190, SD=1.45)	2.64 (N=187, SD=1.32)	2.48 (N=189, SD=1.23)	2.12 (N=188, SD=1.25)
Professional Support	2.89 (N=222, SD=1.43)	2.97 (N=219, SD=1.28)	3.28 (N=219, SD=1.29)	2.25 (N=216, SD=1.27)
Private Support	3.21 (N=237, SD=1.46)	2.82 (N=230, SD=1.30)	2.7 (N=231, SD=1.32)	4.38 (N=236, SD=0.99)

Upper five are research actors, startup support organization as intermediary, lower six are non-research actors; Survey respondents selected the level of support in each field (1…not at all useful to 5…very useful) they received from each actor; SD…standard deviation

In order to provide a better graphical overview of the role the different actors play in the four development domains; the figure below provides a radar diagram. At first glance, one recognizes that support in terms of market and business development, organizational development as well as emotional development differs substantially between the various actor groups. This is reflected in more inhomogeneous lines, that adopt distinguishable values between the actor groups. Technology development, on the other hand, appears more evenly distributed with higher values across all actor groups.

Figure 25: Actors Support Factor per Startup Development Domain



The top-right five are research actors; Startup Support Organization as intermediary, the left six are non-research actors; Survey respondents selected the level of support in each field (1…not at all useful to 5…very useful) they received from each actor.

Since the hypotheses regarding the actor groups are formulated in terms of research actors vs. non-research or business actors,' averages were calculated for each development domain – see table below. This allows for a comparison of the mean support value for the research versus the non-research actors.

Table 37: Average Influence of Actors in Research and Non-research Field

	Technological and product development	Market and business development	Organizational development	Emotional support	Average across all fields
Average across actors in research field[1]	3.48	2.42	2.12	2.57	2.65
Average across actors in non-research field[2]	3.29	3.09	2.92	3.04	3.09
T-Test	1.953†	-7.735***	-8.196***	-5.215***	

[1]Research actors comprise Department colleagues, Other university colleagues, Tech Transfer Office, Other universities and Research laboratories; [2]Non-Research actors comprise Private financiers, Entrepreneurs and Small Firms, Large Firms, Public Support, Professional Support and Private Support; ***p<0.001 **p<0.01 *p<0.05 †p<0.1

In order to check the hypothesis in terms of research and non-research actors' influence on the different development domains, *paired-sample T-test* were conducted.

Even though we see higher support values in terms of technological and product development with some research actors (especially research labs and department colleagues), there is no statistically significant difference between research and non-research actors overall. This suggests that research and technology know how are as important as market know how and industry insights for a successful transformation of new technologies (developed at universities) and prototypes into viable products or services. Hence, hypothesis H.4b, stating that research actors support technological and product development comparatively more than business actors, needs to be rejected.

Regarding market and business development, the mean support values of SSO, entrepreneurs and small businesses, private financiers and partially also for large firms are significantly higher than those of the other actors – especially compared to the (average value) of research actors. This means that support received from non-research actors is better suited to support startups in marketing and selling their products or services than the support they receive from research actors. Hence, hypothesis H.4c, stating non-research actors (esp. small & large businesses, private financiers, public support actors) support market and business development comparatively more than research actors, can be accepted.

SSOs came out on top of all other actors in terms of organizational development. The following are still very helpful – even though significantly less than SSOs – are private financiers, entrepreneurs and small businesses and professional support organizations. Hypothesis H.4d which suggests that non-research actors (esp. professional support actors, private financiers) support organizational development comparatively more than research actors, can be accepted. This implies that actors outside the research environment are better suited to provide guidance in building a professional and scalable organization, as compared to research actors.

SSOs and entrepreneurs and small businesses again play an important role in supporting the founders on an emotional level. However, private actors (cf. family and friends) are by far the most supportive actors, in terms of emotional stability and are significantly on top of all other actors – research and non-research actors alike. For this reason, hypothesis H.4e can be accepted, so private actors (family & friends) provide comparatively more emotional support than other support actors.

In summary, it can be noted that - besides the technological and product development domain – non-research actors are shown to be more supportive in developing the startup overall. One notable exception are SSOs – who can be directly affiliated with a university or just partner with them – who were ranked highly across all development domains. Among non-research actors, private financiers and entrepreneurs and small businesses play a crucial role in the development process, by supporting the business/market and organizational development domain. This implies that a startup support measure should be considered that increases the heterogeneity of sources of knowledge that the entrepreneur relies on (Leyden et al. 2014). Including actors from outside the university – e.g. as mentors and coaches - is crucial in order to provide a more integrative approach to startup support.

5.3.2 Startup Support Organizations and Social Capital

The previous chapters analyzed which actors are used by university startups and which are most helpful for developing the company. A significant difference was identified in terms of the engagement of public and private support actors in the companies' development process.

Startup support organizations (SSOs), as shown in the previous chapter, rank high in terms of technology, business and organizational development and, therefore, are an integral part in the development of university startups. Furthermore, they play an important role as intermediary organizations, connecting entrepreneurs from the academic field with actors in the surrounding ecosystem. By providing access to important contacts outside the research network, they act as boundary spanners – or bridges - and help newly established companies to get access to non-research actors (Bergek & Norrman 2008, Bøllingtoft & Ulhøi 2005, Grimaldi & Grandi 2005). This is essential, since they are providing support in fields or access to resources that are not covered in the research field (cf. business & organizational development, financial capital).

The aim of analyzing the role of SSO was twofold. First, the importance and effectiveness of four support services is examined – see table below – in order to answer the hypotheses formulated around external networking support. In a next step, the focus will be on the support that university startups receive from the SSO in terms of contacts to actors outside the research environment (cf. external networking). These findings will be discussed with reference to the different countries, in order to highlight regional differences in networking support.

Value of Startup Services provided

The first set of analysis on the SSO level was concerned with the importance and effectiveness of different services provided. The table below provides an overview of the results of the analyses across all countries, depicting the mean value for the importance and effectiveness of each service. Moreover, a paired t-test was conducted in order to estimate the mean difference between the importance and the effectiveness of each service and its statistical significance.

Table 38: Importance and Effectiveness of Startup Support Organization Services

Startup Support Organization Services	Importance Mean	Effectiveness Mean	Mean difference
Exchange with peers in the support organization (internal networking)	3.13 (N=342, SD=1.02)	2.92 (N=338, SD=1.10)	0.21**
Access to contacts outside the university and support organization (external networking)	3.24 (N=342, SD=1.05)	2.86 (N=337, SD=1.06)	0.38**
Facilities related services (cf. access to shared office space, technical equipment, etc.)	2.92 (N=343, SD=1.29)	2.80 (N=337, SD=1.33)	0.12*
Professional business support and related services	3.10 (N=342, SD=1.04)	2.78 (N=336, SD=1.09)	0.32**

Importance & Effectiveness Range: 1 = not at all important/effective, 2 = little, 3 = moderate, 4 = very important/effective 1 – 4; SD = Standard Deviation; **p < 0.01 *p < 0.05 †p < 0.1;

Comparing the importance of the four support services provided, respondents ranked "*Access to contacts outside the university and support organization (external networking)*" as the most important service provided by the SSO. The perceived importance of internal networking and facilities related services were ranked in second and third place, respectively. Hypothesis H.4f formulates the expectation that *external networking is more valuable compared to other services provided* and can, therefore, be accepted. This underlines the value that university startups place on receiving introductions to the right actors in the ecosystem. In contrast, however, the external networking services showed the highest delta between ascribed importance and perceived effectiveness. Abduh et al. (2007) created a satisfaction matrix, referring to the relationship between importance of certain service and the effectiveness. The situation with external networking – high importance value > 3 and low effectiveness value < 3 – indicates a marked difference between expected and delivered level of services and can be interpreted as a *higher level of dissatisfaction*. Apparently, across all countries, the external networking aspect of SSO does not live up to the entrepreneurs' expectations. This result underscores the significance the right networking activities offered by the support organization have for university startups and that not all support programs provide those meaningful connections which entrepreneurs seek.

Hence, analyzing the kind of university-external introductions made by the SSO to the startup company allows us to draw conclusions about their effectiveness in terms of their boundary spanning role.

The effect of networking support with external actors

The second set of analyses on the startup support organization (SSO) level refer to the number of introductions the SSO facilitated between the startups and the actors in the surrounding ecosystem. To accomplish this, both were examined, including: a) the type of introductions made by the SSO (e.g. private vs. public actors) and b) the number of introductions made by each type. This is to how many of these actors was the startup introduced to (see question 46 in appendix). The respondents were able to choose for each non-research actor group (see list above) *0, 1, 2, 3, 4 or "5 or more"* introductions received. During the data analysis phase, these categories were reduced to just four groups *"None", 1, 2 or "3 or more"* to allow better comparability between countries.

A regression analysis with external networking effectiveness as dependent and the introductions to the four external actor groups as independent variables was conducted, with company age, size and continent as controls. Introductions to *private financiers* showed a statistically significant ($p < 0.05$) influence on the perceived effectiveness of the SSO's networking service. The results regarding introductions to *entrepreneurs and small businesses* as well as *large firms* were not significant and are not discussed further. In the following, the results for the actor groups *private financiers* and *public support organizations* - given the strong focus of European SSOs on this type of actor - are presented in the tables below.

Table 39: Startup Support Organization introducing Founders to Private Financiers

Country	Total number of respondents (N)	No intro to Private Financiers	Intro to 1 Private Financiers	Intro to 2 Private Financiers	Intro to 3 or more Private Financiers
Austria	113	44.2%	24.8%	18.6%	12.4%
Germany	45	42.2%	28.9%	13.3%	15.6%
Sweden	37	27.0%	29.7%	8.1%	35.1%
USA	97	19.6%	19.6%	15.5%	45.4%
Chi-Square value	39.231*				

*Sig. < 0.01

The SSOs in Austria and Germany introduce their tenant companies to only a limited number of private financiers. About 2/3 of the startups gain none or only one contact to this type of actors, and only one third to two or more. Compared to Sweden (56.7% received intros to none or one, and 43.2% to two or more) and especially the USA, where 60.9% of the tenants are introduced to two or more private financiers, this number is low. Of course, the density of investors in each country or region (see chapter x) as well as their availability for mentoring and support varies greatly - depending on the specific institutional and cultural environment that the SSO is embedded in. Nevertheless, the previous chapter has highlighted the value private investors add to the development to university startups, not only in terms of financial capital, but across all development domains. Therefore, one of the main objectives of every dedicated SSO should be to provide those valuable introductions to business angels and venture capitalists, regardless of where the SSO is situated geographically.

Table 40: Startup Support Organization introducing founders to Public Organizations

Country	Total number of respondents (N)	No Intro to Public Organizations	Intro to One Public Organizations	Intro to Two Public Organizations	Intro to Three or more Public Organizations
Austria	115	19.1%	30.4%	27.0%	23.5%
Germany	46	39.1%	26.1%	21.7%	13%
Sweden	36	41.7%	30.6%	13.9%	13.9%
USA	93	67.7%	10.8%	11.8%	9.7%

Chi-Square Value = 52.928, Sig. < 0.01

Similar to the other aggregation levels of comparison (continent, country and city region), the picture is reversed when looking at the introductions made to public support organizations. The vast majority of spin-offs in the USA (78.5%) receive no or one introduction to public actors. This number drops continuously in Sweden (72.3%), Germany (65.2%) and Austria (49.5%). To formulate it in a different way, less than one quarter of companies are introduced to two or more public support organizations in the USA. This number is twice as high in Austria where every second company receives two or more of introductions. Analogous to the discussion on private investors, the same argument of geographical differences holds true for public support services in various regions. In contrast, however, public support actors only scored relatively high in the technology and product development domain. In terms of business and organizational development support, the values are average to low. This suggests that support received from public support actors is less complementary to the support already received from actors in the university. For this reason, even in regions and countries where the number of private investors is limited, and the number of public support agencies considerably high, SSOs should increase their networking efforts with a focus on the former instead or additional to the latter.

In order to provide the best service for the university startups, SSO managers must understand the underlying social dynamics between the academic entrepreneur - the university startup - and the actors in the surrounding entrepreneurship ecosystem. The SSO must create internal organizational structures and support mechanisms that are compatible with the local context and the characteristics of the specific university, like its history, culture, internal values and organizational identity (Jain & George 2007, Clarysse et al. 2005).

5.3.3 Impact of Social Capital on raising Financial Capital

This section examines how social capital – resources potentially mobilized via social relations (Gabbay & Leenders 1999) – facilitates receiving financing from different funding sources. In this context, the bridging form of social capital (Adler & Kwon 2002) is considered, focusing on the startup´s external relations to actors outside the university. More particularly, the following analyses seek to unveil which social network structure – close interactions with different actors in the ecosystem – are actually instrumental in raising capital.

Receiving risk capital – in the form of business angel and venture capital (VC) funding – is of special interest for startups. On the one hand, more traditional sources of funding (cp. bank loans) are usually not available for early-stage companies. On the other hand, the monetary involvement of private investors also provides them with valuable advice, assistance in strategic decision-making and access to their network of business contacts (Hellmann & Puri 2002).

The two hypotheses for this chapter posit that *Using private financiers to develop the startup will increase the likelihood of receiving business angels funding (H.6a) or venture capital funding (H.6b)*, respectively. Before running logistic regression analysis, descriptive statistics was developed. In total, across all countries, about one third of the university startups surveyed received investments from business angels and about one in 5 (18%) from venture capitalists (for a more detailed analysis across countries please refer to Chapter 5.4.2). Not all startups that used private financiers to develop their company have received funding from business angels (69.1%) or VCs (34.9%). However, this number is considerably higher compared to about only 10% who received business angel funding, from those who have not worked with business angels, or 6.6% for VCs, respectively. Conversely, 80% of the startups who worked with private financiers actually also received investments from them. All the values mentioned are statistically significant. This suggests, that working with a VC or a business angel does not guarantee the securing of funding. However, it could potentially increase the chances considerably. This is the question that was examined in the following logistic regression analyses. Furthermore, there are only minor differences in terms of the company stage when they received the investment. In the Research and Opportunity Framing phase, 62.1% received business angel investment, 68.3% in the pre-organization phase, 71.7% in the re-orientation phase and 69.1% in the sustainable returns phase, respectively.

Five potential sources of funding are used as dependent variables in the upcoming analyses: 1) government funding, 2) business angel funding, 3) venture capital (VC) funding, 4) corporate venture funding, 5) bank funding. They are coded as dichotomous variables (1 = received this type of funding, 0 = did not receive), regardless of the amount of funding received from the respective source. The independent variables are the 12 actor groups that were already used in the previous sub-chapters on social capital analyses. The first six (Department Colleagues, Other Uni Colleagues, Tech Transfer Office, Startup Support Organization (Incubator, Accelerator, etc.), Other Universities and Research Labs) are summarized as research actors. The other six actor groups (Private Financiers (Business Angels or Venture Capitalists), Entrepreneurs & SMEs, Large Firms, Public Support, Professional Support, Private Support (family, friends, etc.) are referred to as non-research actors. As control variables, gender and age of the founder were included. Regarding the firm itself, the company age, size and industry were added as controls, as well as the continent (USA vs Europe). Logistic regression modelling was applied to verify the hypotheses.

The independent variables were checked for multicollinearity using collinearity diagnostics. All values for the independent variables are below 2, and, therefore, well below even the most conservative cut-off values of 3. As a result, it can be concluded that no multicollinearity issues are present. The seven outliers identified (see Chapter 4.3.4) are excluded from the logistic regression analysis, hence N for all models is 402 (409 total responses minus 7 outliers). In addition, a Hosmer and Lemeshow (2000) test was conducted for each model presented in the following. All these tests are not significant, unless stated differently, suggesting that these models are appropriate for the observed data. In order to validate the hypotheses, Models 2 and 3 have business angel funding and venture capital funding as dependent binary variables.

The Impact of Social Capital on Business Angel Funding

In Model 2 of Table 41, the binary variable *business angel funding* serves as the dependent variable. Focusing on the control variables, it is possible to conclude that that university startups in the EU are more likely to raise investment from business angels, if they are operating in life science. Taking a closer look at the research actors, there is a significant negative influence of the TTO on business angel funding in the overall model. This finding is consistent with the findings in Chapter 5.2, which revealed that only a limited number of entrepreneurs (17.6%) have actually used the TTO to develop their company, regardless of whether they are experienced entrepreneurs or working on their first startup. It is interesting to note is that other university colleagues (cp. USA only analysis) and other universities (cp. EU only analysis) have a significant negative impact on the likelihood of raising business angel funding. On the non-research actor side, there is clear evidence that working with private investors will lead to a significantly higher chance of receiving business angels. This notion holds true of the overall model, as well as the US only or the EU only model. Social capital is created through networking activities and is increased through interactive relations (Coleman 1988, Koka & Prescott 2002, Rodan & Galunic 2004). This finding underlines the importance of establishing a working relationship with an investor, seeking mentorship and advice, in order to establish trust before an investment is secured. Hypothesis H.6a that *using private financiers to develop the startup will increase the likelihood of receiving business angels funding* is confirmed.

The Impact of Social Capital on Venture Capital Funding

Compared to business angel investments, being located in the USA has significant positive influence on the likelihood of receiving VC funding. Along those lines, the size of the startup company in terms of number of employees also positively affects the investment decision of VCs (in the overall and EU only model). This underlines the somewhat later stage of development – compared to business angels – in which institutional venture capital investors opt to invest. Other universities, again, show a significant negative effect on the chance of receiving VC funding, at least in the overall and the US only analysis. Similar to business angel funding, working with private financiers showed to be positively related to the likelihood of receiving VC investment, across all three different levels of analyses (overall, EU, US). As the relationship strengthens between the university startup and the investor through ongoing interactions, the information asymmetries are reduced (Minola & Giorgino 2008), which leads to a higher chance of receiving investment. For this reason, also with regard to venture funding, hypothesis *H.6b using Private*

Financiers to develop the startup will increase the likelihood of receiving venture capital funding can be accepted.

Government, Corporate venture and Bank funding

For the sake of completeness, the remaining models on government, corporate venture and bank funding are also briefly discussed here. In Model 1 the binary variable *government funding* is the dependent variable and for Model 4 *corporate venture funding* is the dependent variable. As described before, the Hosmer and Lemeshow (2000) tests suggest that the Models 1 and 4 are appropriate for the observed data in those models. For bank funding, however, the Hosmer and Lemeshow (2000) test was significant, suggesting that the model does not fit the data observed. Therefore, the influence of banking funding was not examined through logistic regression analysis. The control variable continent shows a significant influence of the geographic location of a startup on the likelihood for receiving government funding, with USA having a negative influence. Working with a Startup Support Organization, research labs and especially public support agencies, on the other hand, show a significant positive impact on receiving government funding. Since close collaboration with a government support organization leads to an increased chance of government funding shows, analogous to business angel and VC funding, that working with actors in the public domain helps to secure funding from public agencies.

In terms of corporate venture capital, the Hosmer and Lemeshow (2000) test showed no significance for the overall and the US only model, which suggests a good fit of the model for those data points. However, for the EU only analyses, it did not pass this test and, therefore, no results or interpretations are offered for this region. For the overall model and the US model, department colleagues were shown to be helpful in receiving corporate venture capital funding. This suggests both that relationships between university employees and corporations already exist and that those colleagues are helpful in leveraging those relationships for their entrepreneurial coworkers in order to secure funding from those organizations. A similar role can be ascribed to private investors, who also showed to be helpful in raising financing from corporations, in the overall model. It is interesting to note that companies working in software and IT are less likely to receive corporate venture funding.

Results on bank funding were only available for the EU only model, with the Hosmer and Lemeshow (2000) test being not significant (p = 0.760), accepting the model as appropriate for the observed data. For the overall and the US model, the Hosmer and Lemeshow test revealed that the model is not appropriate for bank funding. Therefore, analyses had to be excluded for this type of funding accordingly. Company age is the only variable with a positive influence on the likelihood of bank funding in the EU model. Banks again are primarily in the business of giving out loans to established companies, assuming only calculated and low levels of risk. Startups that are too early in their development process usually don’t meet the strict requirements for bank funding. Therefore, this type of funding is – if at all – rather an option for more established companies, who are already operative for some years.

Table 41: Social Capital influencing Financial Capital, Logistic Regression Model Results

	Model	1	2	3	4	5	6
		Government funding	Business Angel funding	Venture capital funding	Corporate venture funding	Bank Funding[2]	Equity funding[3]
Controls	Company Age	-.050	-.073	-.006	.022	-	-.120†
	Company Size	.027	.025	.108***	.035	-	.094**
	Continent (USA)	-2.648***	.462	2.165***	1.636**	-	.998**
	Software and IT	.367	.335	-.069	-1.386*	-	.092
	Life Science and Medical Devices	-.204	.661	.052	-.619	-	.571
	Light Manufacturing and Hardware	.517	.487	-.368	-.767	-	.430
Social Capital	Department Colleagues	-.214	-.552	-.092	1.237*	-	-.033
	Other Uni Colleagues	-.379	.166	-1.084*	.293	-	.147
	Tech Transfer Office (or equivalent)	.401	-.860*	-.179	.101	-	-.462
	Startup Support Organization (Incubator, Accelerator, etc.)	.858*	-.322	-.600	-.598	-	-.636†
	Other Universities	-.622	-.854*	.204	-.300	-	-.839†
	Research Labs (public or private)	1.419**	.075	.524	.014	-	.052
	Private Financiers (Business Angels or Venture Capitalists)	-.564	3.362***	1.695***	1.053*	-	3.501***
	Entrepreneurs and SMEs	.194	.189	-.197	.173	-	-.196
	Large Firms	-.228	-.133	.302	.526	-	.308
	Public Support	3.289***	.163	-.070	-.133	-	.108
	Professional Support	.034	-.386	-.351	-.014	-	-.326
	Private Support (family, friends, etc.)	-.253	-.275	-.276	-.128	-	-.173
	Constant	-.334	-1.869***	-3.144***	-3.423***	-	-1.471**
	-2 Log likelihood	271.471	309.132	220.851	163.515	-	301.819
	Pseudo R^2 (Nagelkerke)	.609	.502	.477	.288	-	.573
	Pseudo R^2 change to Base Model[1]	.349	.398	.102	.096	-	.367

***p<0.001 **p<0.01 *p<0.05 †p<0.1; [1]each model calculated only with control variables Company Age to Light Manufacturing and Hardware; [2] Hosmer and Lemeshow test showed that model is not appropriate for model 5; [3] either Business Angel, VC or Corporate VC funding

Table 42: Social Capital influencing Financial Capital, Logistic Regression Model Results (EU ONLY)

	Model	1	2	3	4	5	6
		Government funding	Business Angel funding	Venture capital funding	Corporate venture funding[2]	Bank funding	Equity funding[3]
Controls	Company Age	-.071	-.068	-.133	-	.261***	-.108
	Company Size	.090†	.020	.171***	-	.042	.072*
	Software & IT	.476	.006	.699	-	.012	-.234
	Life Science and Medical Devices	-.426	1.434*	1.931†	-	.708	1.440*
	Light Manufacturing and Hardware	1.020†	.669	1.282	-	.363	.418
Social Capital	Department Colleagues	-.075	-.368	-.410	-	.093	.058
	Other Uni Colleagues	-.391	.521	-.301	-	.245	.775†
	Tech Transfer Office (or equivalent)	-.118	-.676	1.053	-	-.040	-.406
	Startup Support Organization (Incubator, Accelerator, etc.)	1.003*	.187	-.251	-	-.266	-.142
	Other Universities	.265	-1.392*	-.200	-	.141	-1.574**
	Research Labs (public or private)	1.336*	-.076	-.446	-	-.144	-.308
	Private Financiers (Business Angels or Venture Capitalists)	-.587	3.650***	1.765**	-	.674	3.999***
	Entrepreneurs and SMEs	.258	-.210	-1.495†	-	.470	-.395
	Large Firms	-.078	-.302	1.492†	-	-.778	.334
	Public Support	2.678***	.321	-.725	-	-.543	.147
	Professional Support	.137	-.414	.163	-	.382	-.017
	Private Support (family, friends, etc.)	-.270	.033	.530	-	.633	.023
	Constant	-.730	-2.601***	-4.862***	-	-3.632***	-2.234***
	-2 Log likelihood	198.731	193.100	92.022	-	198.238	195.977
	Pseudo R^2 (Nagelkerke)	.421	.514	.352	-	.199	.569
	Pseudo R^2 change to Base Model[1]	.352	.461	.155	-	.070	.476

***p<0.001 **p<0.01 *p<0.05 †p<0.1; [1]only with control variables Company Age to Light Manufacturing and Hardware; [2] Hosmer and Lemeshow test showed that model is not appropriate for model 4; [3] either Business Angel, VC or Corporate VC funding

Table 43: Social Capital influencing Financial Capital, Logistic Regression Model Results (USA ONLY)

	Model	1	2	3	4	5	6
		Govern-ment funding	Business Angel funding	Venture capital funding	Corporate venture funding	Bank fun-ding[2]	Equity funding[3]
Controls	Company Age	.098	-.098	.099	.048	-	-.243
	Company Size	-.033	.024	.060	.034	-	.310*
	Software & IT	-.650	1.105	-.025	-.586	-	1.486
	Life Science and Medical Devices	-.657	-.792	-.713	-.352	-	-.596
	Light Manufacturing and Hardware	-1.962	.376	-1.338	.422	-	.800
Social Capital	Department Colleagues	-.961	-.597	-.060	1.756*	-	.428
	Other Uni Colleagues	.291	-1.286†	-1.980*	-1.603†	-	-2.542*
	Tech Transfer Office (or equivalent)	.801	-.730	-.926	.731	-	-.017
	Startup Support Organization (Incubator, Accelerator, etc.)	.486	-1.459†	-1.165	-1.070	-	-2.130†
	Other Universities	-4.062**	.221	1.216	-.195	-	.333
	Research Labs (public or private)	2.605*	.813	.923	.881	-	1.336
	Private Financiers (Business Angels or Venture Capitalists)	-.386	3.749***	2.452**	1.230	-	3.798***
	Entrepreneurs and SMEs	.286	1.350†	.499	-.542	-	.450
	Large Firms	-.847	-.768	-.529	.841	-	-.606
	Public Support	6.577***	-.193	.273	-.257	-	-.498
	Professional Support	-.223	-.474	-1.085	.042	-	-1.425
	Private Support (family, friends, etc.)	-1.444	-.724	-.552	.305	-	-.762
	Constant	-2.240	-.516	-.264	-2.392	-	.865
	-2 Log likelihood	46.505	89.980	104.485	84.719	-	65.925
	Pseudo R^2 (Nagelkerke)	.786	.583	.466	.329	-	.695
	Pseudo R^2 change to Base Model[1]	.686	.348	.251	.212	-	.291

***p<0.001 **p<0.01 *p<0.05 †p<0.1; [1]only with control variables Company Age to Light Manufacturing and Hardware; [2] too little data available; [3] either Business Angel, VC or Corporate VC funding

5.3.4 Summary of tested Hypotheses: Social Capital

In the table below, a summary of the two groups of hypotheses tested (H.4a-g & H.6a-b) is provided, including the assessment of whether they are accepted or rejected.

Table 44: Summary of Hypotheses regarding Social Capital

No.	Hypotheses	Validation
H.4a	Non-research actors are used relatively more often by university startups to develop the company compared to research actors.	Accepted
H.4b	Research actors support technological and product development comparatively more than business actors.	Rejected
H.4c	Non-research actors (esp. small and large businesses, private financiers, public support actors) support market and business development comparatively more than research actors.	Accepted
H.4d	Non-research actors (esp. professional support actors, private financiers) support organizational development comparatively more than research actors.	Accepted
H.4e	Private actors (family and friends) provide comparatively more emotional support than other support actors.	Accepted
H.4f	University startups perceive "external networking" more valuable compared to other services provided by the incubator.	Accepted
H.4g	The higher the number of introductions provided to the startup, the higher the perceived effectiveness of the startup support organization in terms of external networking.	Rejected[1]
H.6a	Using private financiers to develop the startup will increase the likelihood of receiving business angels funding.	Accepted
H.6b	Using private financiers to develop the startup will increase the likelihood of receiving venture capital funding.	Accepted

[1] only introductions to private financiers showed positive impact on perceived effectiveness

5.4 Comparing University Startup Capital Endowment in USA and Europe

The last two chapters shed some light on the relationships and interdependencies of human, social and financial capital, with regard to university startup development. In those chapters, most of the analyses were conducted for the sample across all countries. However, some analyses already differentiated between the subset of data available from the USA and Europe, respectively. This is true especially for examining the impact of human and social capital on financial capital. However, overall, up to this point, the aim was to answer the research questions and validate the hypotheses, by looking at the whole data set. Since startup activities are embedded in an institutional and cultural context, one can assume that differences in the surrounding ecosystem will lead to differences in capital endowment with regard to human, social and financial capital. Thus, one of the research questions of this study aims to explain *how the surrounding entrepreneurship ecosystem influences university startup development in the USA and Europe?* Drawing on the work of Hall and Soskice (2001) on varieties of market capitalism and other scholars in this field, hypotheses were developed regarding how the analyzed countries might differ in terms of human, social and financial capital endowment

5.4.1 Human Capital in USA and Europe

Chapter 5.2 was concerned with the question how human capital – measured by prior experiences in different fields - impacts the support entrepreneurs receive from actors in the research and non-research environment (cf. social capital). One of the main findings was that experienced (habitual) entrepreneurs receive support from different actors, building upon the social network they have established through building their previous ventures. Furthermore, it was analyzed how human capital influences the likelihood of receiving funding from different sources. It was shown that prior startup experience is more important for raising business angel and venture capital funding than prior experiences in the industry, research or management. In this chapter, the differences in human capital of university startups in the various countries surveyed will be analyzed. Prior startup experience is defined as having worked at a startup as a non-founding or founding member of one or more startups.

Table 45: Entrepreneur Human Capital in the US and EU

	EU	USA	Chi-Square
Count (N)	168	51	
Entrepreneurs with prior startup experience[1]	40.8%	58.5%	10.81**
Entrepreneurs with prior industry experience	66.3%	57.4%	2.95^{+}
Entrepreneurs with prior management experience	50.7%	56.6%	1.17
Entrepreneurs with prior research experience	57.7%	54.9%	0.28
Entrepreneurs with PhD	31.2%	34.4%	0.41
Expected revenue in 5 years is larger than 10 mil	23.4%	55.8%	30.47***

***p<0.001 **p<0.01 *p<0.05 $^{+}$p<0.1; Note: Separate Chi Square tests were conducted for each type of experience; [1] as non-founding or founding member of one or more startups

Expected revenue is a variable measuring the growth aspiration of entrepreneurs. It is interesting to note that the significantly higher percentage of "high growth aspiring founders" - those who expect revenues of 10 mil or higher in five years from now - in the USA (as well as in Sweden and Switzerland, respectively) compared to Germany and Austria.

One might assume that the expectations for future growth are connected to the current development stage of the company and the current level of revenue. Therefore, in a first step, the correlations were examined between high growth aspirations and founding year, industry as well as company or product development stage. No significant correlations were detected.

In the next step, taking a closer look at the revenue at the time of the survey, a weak positive correlation (Pearson Correlation of 0.187, p = 0.001) between the revenue in 2015 and the revenue expected in five years could be detected. Deepening the analysis, a closer look was taken at the cross-table between revenue groups in 2015 and expected revenue in five years (Chi-Square 13.76; p =0.008). 31.6% of the group with lower growth aspirations (less than 10 mil revenue expected in five years) belong to the two highest revenue groups of 2015 (100k-1mio, >1mio). In the high growth aspiration group, 33.3% belong to the two highest revenue groups of 2015. Hence, no significant relationship between current revenue and expected revenue in five years could be identified. In other words, the current level of revenue of a startup has no significant influence on the future growth prospects that an entrepreneur has for the startup. In the following chapter, it will be examined, however, what impact growth aspirations have on actual employee growth of the startup.

Table 46: Entrepreneur Human Capital in selected Countries

	Austria	Switzerland	Germany	Sweden	USA	Chi-Square
Count (N)	153	26	64	41	123	
Entrepreneurs with prior startup experience[1]	34.6%	19.2%	46.9%	68.3%	58.5%	31.43**
Entrepreneurs with prior industry experience	71.4%	69.2%	59.4%	56.1%	57.4%	7.97^{+}
Entrepreneurs with prior management experience	58.8%	23.1%	34.4%	63.4%	56.6%	22.67**
Entrepreneurs with prior research experience	58.2%	92.3%	59.4%	31.7%	54.9%	24.36**
Entrepreneurs with PhD	29.6%	80.8%	23.8%	17.1%	34.4%	35.18**
Expected revenue in five years is larger than 10 mio	16.4%	47.1%	19.1%	41.9%	55.8%	42.32**

**p<0.01 *p<0.05 $^{+}$p<0.1; Note: Separate Chi Square tests were conducted for each type of experience; [1] as non-founding or founding member of one or more startups

Regarding the number of founders committed full-time to the startup, no statistically significant differences across the countries were identified. On average, 1.73 founders are committed full-time per startup, with 1.54 founders in Switzerland on the lower end and 1.85 in Sweden on the upper end of the scale.

5.4.2 Social Capital in USA and Europe

One of the main premises of this study is that the social capital of university startups – due to different institutional and cultural environments they are embedded in – differs in the USA and Europe. The previous set of questions focused on the role of each actor group in the development process of university startups, regardless of where they are situated geographically. The main research question in this chapter now focuses on the comparison of university startups' social capital in those two regions: "*What is the difference between the social capital of university startups in the USA and Europe?*" For this comparison, the social capital structure of university startups in Europe and the USA are examined on three different aggregation levels: continent, country and ecosystem (city region). The same set of research and non-research actors presented in previous chapters was analyzed, in order to find differences in social capital in these two regions. Following Bandera & Thomas (2019), a startup's use of social capital can be measured by counting the collaborations that contribute to the startup's success.

Dividing the support actors into research and non-research actors, the analyses showed overall that there were no significant differences in terms of research actor support in either region. In other words, university startup in Europe and USA used department colleagues, other university colleagues, tech transfer offices, startup support organizations, other universities and research laboratories equally often – or rarely. The same is true for private support (cp. family and friends). A detailed discussion of the support value of research actors – and private support actors - can be found in the previous chapter. For this reason, the remainder of this sub-chapter focuses exclusively on the differences of non-research actors used by university startups in Europe and the USA. Depending on the aggregation level, differences in terms of social capital were identified in all (continent level comparison) or some (country and ecosystem level comparison) of the remaining five non-research actor groups: Private Financiers, Entrepreneur & Small Businesses, Large Firms, Public Support, Professional Support. On continent, country and ecosystem level, the social capital questions refer to the type of actors the startup has used to develop the company (see question 35 in questionnaire).

Continent level comparison

The continent level is the most aggregated form of comparison between the USA and Europe. The responses of all European countries (Austria, Germany, Switzerland and Sweden) were compared with the responses from all ecosystems in the USA (Boston, New York and Silicon Valley). In the table below, it is possible to observe the differences regarding the actors used on both sides of the Atlantic.

Table 47: Continent Level Comparison of Actors used for University Startup Development

Region	Total number of respondents (N)	Private Financiers	Entrepreneurs and Small Businesses	Large Firms	Public Support	Professional Support
EU	285	32.6%	32.6%	14%	54.4%	50.5%
USA	124	55.6%	46.8%	23.4%	32.3%	66.1%
Chi-Value		19.13**	7.42**	5.39*	16.96**	8.51**

** Chi Square < 0.01, * Chi Square < 0.05; Note: Separate Chi Square tests were conducted for each actor group

Overall, university startups in the USA used entrepreneurs and small business owners, large firms, private financiers (business angels and venture capitalists) and professional support significantly more often than their European counterparts. In contrast, European companies received significantly more support from public support organizations. It is interesting to observe that the gap (Δ ~22%) between Europe and the USA is about the same with private financiers and public support. More than half of the European companies have used public support, but only a third of them worked with private financiers or entrepreneurs and small businesses. In the USA this picture is reversed: about half of the companies have worked with either private financiers or entrepreneurs and small businesses, but only about a third had support from public organizations. For entrepreneurs and small businesses (Δ 14.2%) and professional support (Δ 15.6%) the gap is still considerable, whereas the difference is reduced to only 9% for working with large firms.

Hypothesis H.8c states that the *supporting actors of university startups differ between the USA and Europe*. This notion is true regarding non-research actors, as described in the paragraph above. However, this statement does not hold for research actors, for which no significant differences were identified. Hence, this hypothesis must be (partially) rejected. Hypothesis H.8d posits that: *In the USA, university startups use actors from the business network (private financiers, entrepreneurs & small firms, large firms, professional support) more often, compared to Europe.* As shown in the table above, the support differs significantly, and this hypothesis can be accepted. The same holds true for hypothesis H.8e: *In Europe, the central supporting actors are more often government-related (public support) than in the USA*, which can also be accepted.

The following sub-chapters offer a more detailed view into the different countries and ecosystems the startups are based in.

Country level comparison

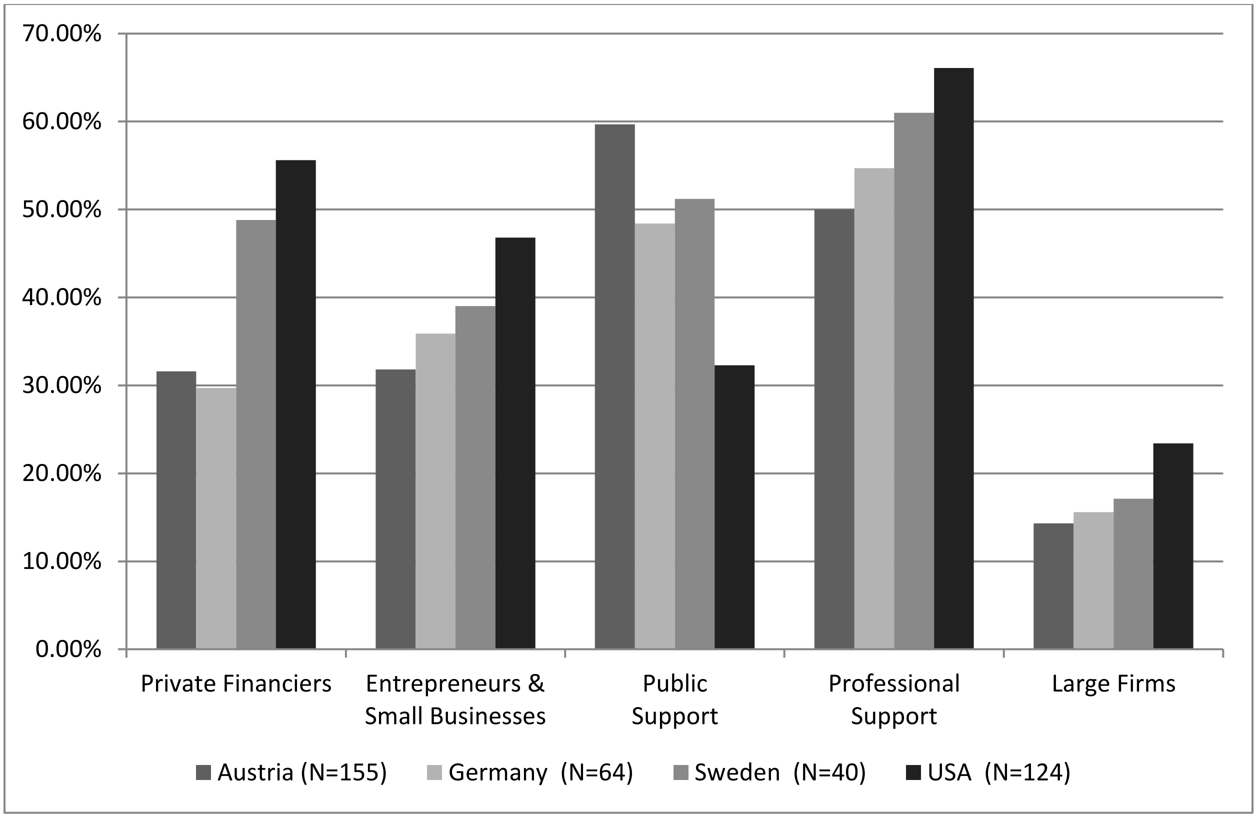
The analysis on the continent level revealed substantial differences in terms of the supporting actors and especially a divide in terms of public or private actor support, respectively. The next step of the analysis was a closer look at the individual European countries with a comparison to the USA. Switzerland was not analyzed in detail, due to limited number of responses (26). In contrast to the continent level analysis, one can only observe significant differences regarding two actor groups: private financiers and public support. These are the two actors that already showed the highest difference on the continent level.

Table 48: Country Level Comparison of Actors used for University Startup Development

Country	Total number of respondents (N)	Private Financiers	Entrepreneurs and Small Businesses	Large Firms	Public Support	Professional Support
Austria	154	31.6%	31.8%	14.3%	59.7%	50.0%
Germany	64	29.7%	35.9%	15.6%	48.4%	54.7%
Sweden	40	48.8%	39.0%	17.1%	51.2%	61.0%
USA	124	55.6%	46.8%	23.4%	32.3%	66.1%
Chi-Value		24.96**	10.49*	7.71	21.32**	16.64**

** Chi Square < 0.01; Note: Separate Chi Square tests were conducted for each actor group

Figure 26: Support Actors used by University Startups for Company Development, Country Level



Since the percentage in terms of public and private support for the USA respondents stays the same, it is interesting to compare the European countries with each other. In Austria, only a third of the companies have worked with private financiers but almost twice as many received support from public organizations. The support from private financiers in Germany is about the same as in Austria, but only every second spin-off worked with public support to develop the company. Sweden has about the same level of public support as in Germany, but considerably more companies worked with private financiers (almost 50%). Among the four countries, Sweden has the most balanced support between private and public actors. The USA has an inverse situation compared to Austria: only about one third of the respondents indicated that they work with public actors, whereas more than every second one received support from private financiers.

City region level comparison

Following the analysis on the country level, especially identifying the differences between private and public support, the question arises if the same pattern can also be observed on the city region or ecosystem level? This question is of particular interest, since it allows us to look at the three ecosystems in the USA (Boston, New York and Silicon Valley) in more detail and compare them among each other.

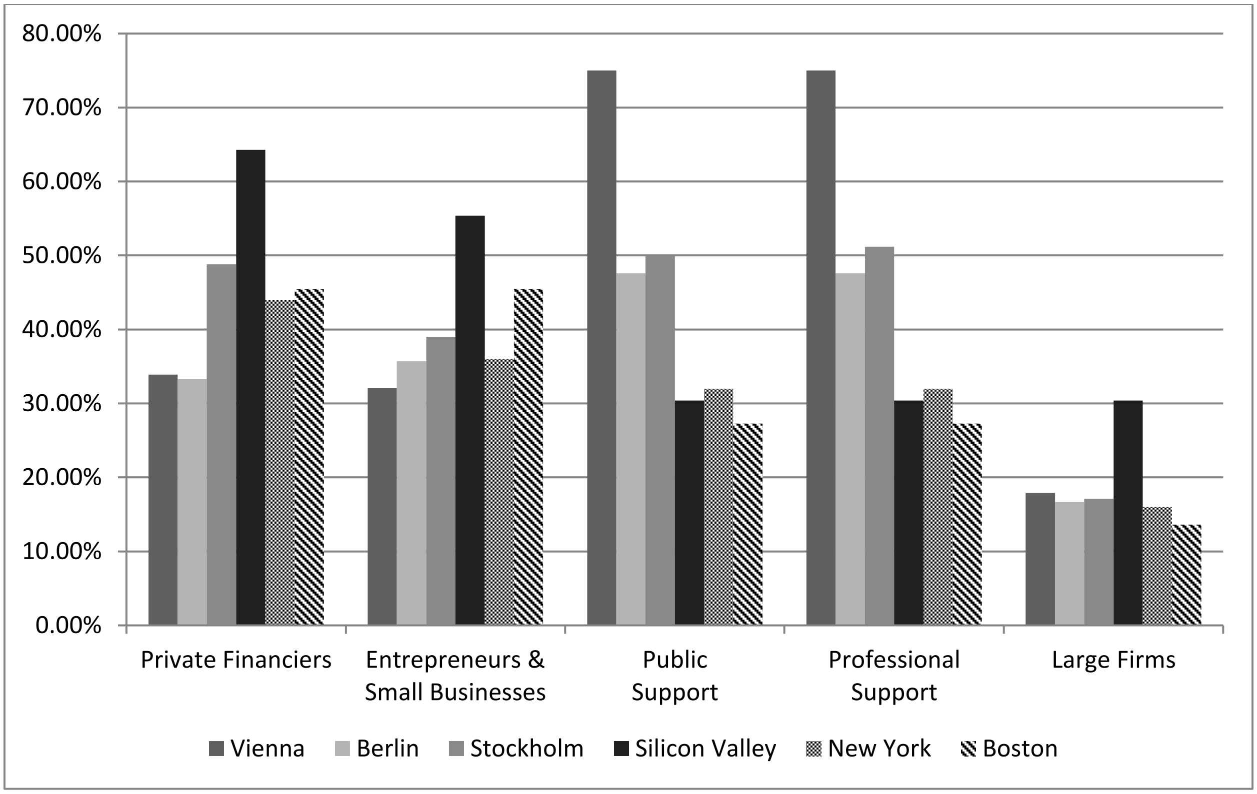
The results for Stockholm, the main ecosystem for startups in Sweden, and Berlin, the main ecosystem in Germany, in terms of public and private support are comparable to the country level. This is not surprising, since data collection in those two countries was mainly conducted in those two cities (in Germany, Munich was the second ecosystem data was collected from). In Austria, however, founders from the other federal states were also included in the sample, which allows a comparison between Vienna, the main ecosystem in Austria, and the rest of the country. In this regard, it was surprising that the number of university startups that worked with public support organizations to develop their companies was even higher than the Austrian average There were three out of four companies in Vienna that worked with these organizations. On the other hand, the level of private financiers' engagement stays about the same for these companies.

Table 49: City Region Level Comparison of Actors used for University Startup Development

City Region	Total number of respondents (N)	Private Financiers	Entrepreneurs and Small Businesses	Large Firms	Public Support	Profession al Support
Vienna	56	33.9%	32.1%	17.9%	75%	75.0%
Berlin	42	33.3%	35.7%	16.7%	47.6%	47.6%
Stockholm	40	48.8%	39.0%	17.1%	50%	51.2%
Silicon Valley	56	64.3%	55.4%	30.4%	30.4%	30.4%
New York	25	44%	36.0%	16.0%	32%	32.0%
Boston	22	45.5%	45.5%	13.6%	27.3%	27.3%
Chi-Value		13.7*	not sign.[1]	not sign.[1]	29.84**	not sign.[1]

** Chi Square < 0.01, * Chi Square < 0.05, [1]Chi Square > 0.05; Note: Separate Chi Square tests were conducted for each actor group

Figure 27: Support Actors used by University Startups for Company Development, City Region Level



In comparison to Europe, there is the same low level of public engagement across the main ecosystems in the USA – only every third company has worked with public organizations to develop their companies. Looking at the role of private financiers, there are some notable differences between the ecosystems on the East Coast and the West Coast of the USA. The percentage of university startups who worked with private financiers in New York and Boston is about 10 percent points higher than in Vienna and Berlin and even a bit lower than in Stockholm. In Silicon Valley, however, almost two out of every three companies have worked with private financiers. This is double the percentage in Vienna and Berlin and even 20% more than in the ecosystems on the East Coast.

Another interesting difference to note is the higher percentage of startups working with large firms in Silicon Valley, 30.4% of the respondents from that region (N = 56). That percentage is almost twice as high as of startups working with corporations in the other US East Coast or European regions surveyed (16.7%, N = 186). In order to verify the hypothesis, a new variable was created by recoding the existing one differentiating the six different ecosystems. Startups based in Silicon Valley were coded 1 and startups from all other regions coded 0. The difference between Silicon Valley startups and those in other regions turned out to be statistically significant (Chi-Square = 5.074, p = 0.024). Hence, the hypotheses H8.f that *university startups in Silicon Valley use large firms more often to develop their companies than in other ecosystems* can be accepted.

In this sub-chapter, the role of supporting actors in Europe and the USA was analyzed. Shifting the focus on different levels of aggregation allows us to understand those regional differences in more detail. The macro level (cf. continent level comparison) gave a rough overview of the support situation on both sides of the Atlantic. The more detailed levels of comparison (country and city region level) revealed even more nuanced differences within each country and between the various regional ecosystems. Notable differences in the social capital endowment of university startups in the USA and Europe are present at the continental level. On this macro level of comparison, significant differences in the usage of entrepreneurs and small businesses, large firms and professional support are visible. However, on the country and city region level, there are also notable differences in terms of private financiers' support and the engagement of public support organizations.

5.4.3 Financial Capital in USA and Europe

In addition to supporting the different development domains (see Chapter 5.3), some actors in the ecosystems can also be a source of financing for a university startup. In this study, we examined the source (differentiated between by government funding, business angel funding, venture capital funding, corporate funding and bank funding) and the amount of funding received by each university startup (see question 65 in the questionnaire, see appendix). In a first step, whether the companies received funding from each source was analyzed. In the table below, the results according to the different comparison levels (continent, country & ecosystem) are depicted.

Table 50: Sources of Funding for University Startups, different Levels of Comparison

Region	Total number of respondents (N)	Govern-ment Funding	Business Angel Funding	Venture Capital Funding	Corporate Funding	Bank Funding
EU	264[2]	76.5%	27.7%	6.8%	3.4%	15.9%
USA	114	30.7%	48.2%	43.9%	20.2%	5.3%
Chi-Value		71.45**	15.09**	74.05**	28.88**	8.14**
Austria	138	90.6%	25.4%	5.8%	3.6%	19.6%
Germany	62	72.6%	24.2%	8.1%	3.2%	9.7%
Sweden	39	59%	48.7%	7.7%	2.6%	10.3%
USA	114	30.7%	48.2%	43.9%	20.2%	5.3%
Chi-Value		106.21**	24.98**	74.25**	28.94**	13.48**
Vienna	52	98.1%	28.8%	3.8%	5.8%	9.6%
Berlin	41	75.6%	24.4%	4.9%	4.9%	14.6%
Stockholm	39	59%	48.7%	7.7%	2.6%	10.3%
Silicon Valley	53	24.5%	58.5%	56.6%	20.8%	3.8%
New York	22	31.8%	40.9%	31.8%	22.7%	4.5%
Boston	19	31.6%	36.8%	26.3%	10.5%	10.5%
Chi-Value		75.51**	15.69**	60.69**	14.51*	not sign.[1]

** Chi Square < 0.01, * Chi Square < 0.05, [1]Chi Square > 0.05; Note: Separate Chi Square tests were conducted for each actor group; [2] including Switzerland

There are significant differences in the source of funding between university startups in the USA and Europe. Similar to the structure of their support network, we can observe a majority of European startups receiving funding from public sources (76.5%). In comparison, the percentage of startups in Europe that receive investment from non-public actors is rather limited. For example, only about 27% got financed by business angels (6.8% for venture capital). In the USA, on the other hand, public funding is received by only about 30% of the startups – substantially less than half the percentage found in Europe. The role of private actors as financiers is much more pronounced in the USA than in Europe. Almost 50% of the university startups in the USA received investment from business angels (about 43% from venture capitalists) - a significant difference compared to Europe (Δ ~20% in business angel funding and almost Δ 30% in VC funding). Nevertheless, 20% of the US companies indicated that they took corporate funding, whereas the corresponding number in Europe is almost insignificant (~3%). In terms of bank funding, the percentage in Europe (15.9%) is three times as high as in the US (5.3%), a statistically significant difference.

At this aggregated comparison level, one can observe substantial and statistically significant differences in funding sources for university startups in the USA and Europe. Hypothesis H.8g states that *university startups in the USA receive financial capital from private financiers more often than in Europe*. Due to the results described above, it can be accepted. Along those lines, Hypothesis H.8h posits that *university startups in Europe receive financial capital more often from government-related actors and banks than from private ones*. Analogous to the previous one, this hypothesis is accepted following the statistically significant results described above.

On the level of individual ecosystems (city regions), the difference between USA and Europe becomes even more obvious. On the one end of the continuum, in Vienna, almost all (98%) of the companies received public funding. Silicon Valley, on the other end, has only about a quarter (24.5%) publicly funded startups. In terms of private investments, the percentage of companies in Silicon Valley is by far the highest, with almost 60% receiving business angel as well as venture capital funding. Even compared to other ecosystems in the USA, New York and Boston, these numbers are high. In Vienna and Berlin, only about every fourth company received business angel funding, while in Stockholm/Sweden it included about every second business. In terms of venture capital investment, the numbers are low across all ecosystems in Europe and at the most only one third (Stockholm, 7.5%) of the lowest number in the USA (Boston, 22.7%).

The higher the amount of business angel funding, the higher the probability for a startup to also receive venture capital funding. Whereas only 10.4% of the startups that received no business angel funding received venture capital, this percentage rises to 22.5% (51.-250.000 Euro/Dollar angel funding) and more than 50% for startups that received more than 251.000 Euro/Dollar in business angel funding (Chi-Value = 54.96, Chi Square < 0.01). The logistic regression model (controlling for company age, size and location) also showed a significant (B = 0.395; p < 0.01) influence of business angel funding on the likelihood of receiving VC funding.

In summary, looking at the three levels of analysis, one can observe a higher rate of engagement of private financiers, especially in the form of venture capital investment, in the USA and public financing in Europe.

5.4.4 Startup Performance across Countries

In a next step, the performance of the university startups across the different countries was analyzed. Hypothesis H.8b expects that university startups in the USA to grow faster than their counterparts in Europe. Whereas employee growth is used as the main performance variable in this thesis (see Chapter 4.2 for more details), revenue growth was also included to highlight the differences between these two distinct startup growth measurements.

The table below depicts the mean growth rates of university startups in the various countries included in the survey. With regard to employee growth, we see a considerably lower growth in Austria and Germany, compared to the USA, between 2013 and 2015. Sweden is a notable exception in Europe, with a growth level comparable to the USA of almost 100%. However, the average growth rate of all startups in Europe is still significantly lower than in the USA. In terms of revenue growth, the situation is even more pronounced. With almost 370% growth in the USA over the two-year period, the rate is more than double the rate in Austria and Sweden and still considerably higher than Germany's 215%. It is interesting to note is the fact that startups from Sweden exhibit a relatively high growth in terms of employee growth, but in contrast, a comparatively low growth rate with regards to revenue growth.

These results confirm what has been argued by both policy makers and researchers (European Commission 2013): European startups grow slower than the ones in the USA. Therefore, hypothesis H.8b can be accepted. For a proof of this hypotheses, also see the next chapter. It also takes other variables into account, in order to explain differences in startup performance.

Table 51: Startup Performance across Countries

Country	Total number of respondents (N)	Employee growth in %[1]		Revenue growth in %[1]	
		Mean	Standard Deviation	Mean	Standard Deviation
Austria	154	49.82%	63.22	143.66%	491.69
Germany	64	75.29%	93.60	215.11%	799.86
Sweden	41	99.30%	133.89	106.45%	196.14
USA	124	96.09%	108.29	368.60%	755.67

[1] mean from 2013/14 and 2014/15

However, this model does not take into account additional factors which might have an effect on startup performance. Thus, further regression models were utilized, which are presented in the next chapter. Chapters 5.2 and 5.3 have already highlighted differences in human and social capital endowment of university startups in Europe and the USA. Consequently, the obvious question is now: how do those differences in human and social capital influence startup performance? This will be the focus of the following chapter.

5.4.5 Summary of tested Hypotheses: Sources of Funding of University Startups in USA and Europe

Table 52: Overview of Hypotheses regarding Europe and USA differences

No.	Hypotheses	Validation
H.8a	Entrepreneurs in Europe exhibit a lower level of growth aspiration than entrepreneurs in the USA.	Accepted
H.8b	University startups in the USA grow faster than their counterparts in Europe.	Accepted
H.8c	The supporting actors of university startups differ between the USA and Europe.	Rejected
H.8d	In the USA, university startups use actors from the business network (private financiers, entrepreneurs and small firms, large firms, professional support) more often compared to Europe	Accepted
H.8e	In Europe, the central supporting actors are more often government-related (public support) than in the USA	Accepted
H.8f	University startups in Silicon Valley use large firms more often to develop their companies than in other ecosystems	Accepted
H.8g	In the USA university startups receive financial capital from private financiers more often than in Europe	Accepted
H.8h	In Europe university startups receive financial capital more often from government-related actors and banks than from private ones	Accepted

5.5 Determinants of University Startup Performance

Each of the preceding chapters focused on the role of human, social and financial capital, respectively, in the university startup development process. Furthermore, referring to the different groups of hypotheses, the interdependences between those different forms of capital were analyzed and discussed. Eventually, the differences between Europe and USA were explored and put into perspective with regard to another set of hypotheses, taking the institutional and cultural context into account.

This final chapter analyses the impact of those different forms of capital on university startup performance. Based on different sets of hypotheses, it was determined how human capital (H.3a-g), social capital (H.5a-e), as well as different forms of financing (cf. financial capital, H.7a-b), influence startup performance, that is startup growth measured by the number of employees.

5.5.1 University Startup Performance Model

The previous chapters described how those variables/concepts relate to each other and highlighted their different manifestations in the USA and Europe. The overall objective of this final chapter is to examine the impact of human capital, social capital and financial capital on university startup performance. Therefore, different models are calculated that focus on the influence of each of those concepts separately. Control variables (company size and age, industry and location) are taken into account in all calculated models. The final full model includes all variables from the three different capital concepts and highlights the most influential variables in this research.

Chapter *4.2. Operationalization and Variables* provides a detailed description on the constructs and variables used for the linear regression model analysis presented in the following. To summarize, a quick overview over the most important variables is provided: Human capital is measured by the educational background (PhD), growth aspirations (expected revenue in fvie years), as well as the founder's prior experience in three categories: startup, industry, management and research experience. In terms of the startup team, the number of full-time committed founders is taken into account. Social capital refers to the six support actors in the research network (university department colleagues, colleagues in other departments, Tech Transfer Office, Startup Support Organization and other universities and research laboratories) and six support actors in the non-research network (investors, entrepreneurs and small firms, large firms, public support, professional support and private support). Due to the large number of variables already incorporated in the models, combined with the insights from the chapter on social capital, the regression model will only focus on the latter six types of support actors from the non-research network. Financial capital refers to the different sources of funding a startup can tap into. They include government, business angel, venture capitalist, corporate venture, as well as bank funding. The dependent variable in all models is university startup performance, measured by relative employee growth over a two-year time period, between 2013 and 2015 (Patzelt et al. 2008). In order to account for their skewed distributions, following Törnqvist et al. (1985) log differences were used to measure relative change.

It was also considered to use revenue growth as the performance variable for the regression model presented below. However, several attempts to normalize the variable did not lead to the desired outcomes. Furthermore, several calculations using relative revenue growth as the dependent variable did not yield an acceptable model fit and statistically significant results. Therefore, the analysis of startup performance was exclusively based on relative employee growth, as described above.

Testing underlying Assumptions for Linear Regression

In order to test the hypotheses developed around startup performance, linear regression analysis was applied. In the first step, the underlying assumptions are checked to confirm that linear regression analysis – or OLS regression – is used appropriately. These assumptions are conditions that should be met before conclusions regarding the model estimates are taken or before a model is used to make predictions (Cohen et al. 2013).

Furthermore, the seven identified outliers (as described in Chapter 4.3) are filtered out before the next analytical steps are taken. To check the assumptions, linear regression that is based on all variables were loaded into the model (see Full Model No. 6 in the following table).

To test for multicollinearity, collinearity diagnostics are applied in the SPSS software. The collinearity statistics provided include a tolerance and a VIF value. The Variance Inflation Factor (VIF) is calculated by dividing 1 by the tolerance. The most common guidelines for VIF are 5 (tolerance of 0.2) or 10 (tolerance of 0.1). Another rule of thumb refers to values above 3 to probable multicollinearity issues, above 5 quite likely to have multicollinearity and above 10 to definitely have multicollinearity issues present. Conducting these analyses, all of the mentioned independent and control variables exhibit a VIF value of below or around 2 (maximum is 2.27 for founder's prior startup experience). This suggests that multicollinearity is not a major concern in the following analyses.

Another assumption of linear regression is that the conditional variance of the residuals is constant (homoscedasticity). In order to check for homoskedasticity, a scatterplot is created with standardized predicted scores that are plotted on the X-axis against standardized residuals on the X-axis. A rectangular pattern of dots of that scatterplot indicates homoscedasticity, linearity and independence of variables, which confirms those underlying assumptions. Furthermore, the Breusch-Pagan (1979) test was applied and showed unambiguously that heteroscedasticity is not present.

Finally, the residuals around the regression line are assumed to have a normal distribution (cf. bell curve). First, one has to examine the responding scatterplot, analogous to the previous assumptions. The points depicted should form a rectangle, with no point outside of negative 3 and 3 on either the Y-axis or the X-axis. Since this is the case, it confirms the assumption of constant variance of the residuals. Moreover, in order to check for normality, a normal probability plot is added. The points need to more or less follow the line depicted in order to confirm that the standardized residuals are normally distributed. This is also the case here. The numerical tests - Shapiro-Wilk and Kolmogorov-Smirnov test - were also applied to check for normality. The significance for both tests was 0.227 and, therefore, greater than 0.05. Hence, it can also be concluded that these numerical tests confirm normality.

Linear Regression Model Results

Checking the underlying assumptions, as described in the previous sub-chapter, showed no irregularities and allows us to apply linear regression models to test the various hypotheses. The table below shows the estimation results for five different models. Base Model 1 encompasses only the control variables and represents the basic model to which changes in R^2 of the other models are compared. Models 2, 3 and 4 focus on the impact of human, social and financial capital, respectively. Each model aims to verify the set of hypotheses that are posited for each of the main concepts – see the according sub-chapter of Chapter 3 for more background information. The Full Model 5 is the complete model that incorporates all independent variables from the previous models. However, only direct effects have been taken into account and it did not deal with indirect and/or mediation effects.

Table 53: University Startup Performance: Linear Regression Model Analysis

	Model	1	2	3	4	5
	Subset	Base Model	Human Capital	Social Capital	Financial Capital	Full Model
	Constant	.909***	.567***	.860***	.952***	.602***
Controls	Company Age	-.146***	-.135***	-.145***	-.151***	-.134***
	Company Size	.036***	.025***	.034***	.040***	.024**
	Continent (USA)	.223**	.156†	.209**	.117	.122
	Software & IT	.067	.009	.056	.079	.036
	Life Science and Med. Devices	.042	-.017	.045	.017	.007
	Light Manufacturing and Hardware	.077	.087	.075	.092	.117
Human Capital	Founder's startup experience		.129†			.129†
	Founder industry exp.		.107			.121
	Founder's management exp.		.052			.072
	Founder research exp.		-.042			-.033
	Growth aspirations		.232**			.239**
	Educational background (PhD)		-.061			-.063
	No. of full-time Founders		.142***			.133**
Social Capital	Private Financiers			.069		-.043
	Entrepreneurs and SMEs			-.082		-.117
	Large Firms			.090		.125
	Public Support			.011		.028
	Professional Support			.053		.072
	Private Support			.028		-.009
Financial Capital	Government funding				-.073	-.139
	Business angel funding				.155*	.101
	Venture capitalist funding				-.066	-.213†
	Corporate venture funding				.221†	.223†
	Bank funding received				-.013	.053
	R^2	.299	.388	.307	.341	.420
	Adj. R^2	.288	.359	.286	.321	.366
	ΔAdj. R2	-	.071	-.002	.033	.078
	F (df)	28.042 (6)	13.336 (13)	14.353 (12)	17.004 (11)	7.813 (24)
	P value (Model)	0.000	0.000	0.000	0.000	0.000

***p<0.001 **p<0.01 *p<0.05 †p<0.1

Linear regression estimation results are presented in the table above. From this table, conclusions are drawn concerning the hypotheses developed in Chapter 3 on human capital (H.3a-g), social capital (H.5a-e), as well as different forms of financing (cp. financial capital, H.7a-b).

Furthermore, separate analyses were conducted for university startups in the EU and US only – see appendix "University Startup Performance Models for US and EU".

The Effect of Control Variables

Before those hypotheses are validated based on the empirical results, some general observations on the control variables are presented below.

Company age, measured as the number of years since the startup was founded, has a continuous negative effect on startup growth. This implies that younger companies grow faster than their counterparts founded later. Whereas a two-year old startup grew by an average of 92% in the two years leading to the survey, a 3 to 5-year-old startup grew their employees by an average of 23%.

Company size is measured by the full-time equivalent of employees in 2015, the year when the survey was conducted. The size of the startup appears to have a statistically significant positive, if somewhat quite limited, effect on startup growth. This is true for all calculated models.

Company location is included in the models, by using a dummy variable. A positive effect of the continent variable means that being based in the USA has a positive impact on startup growth. There is a statistically significant positive effect in the base model (including only the control variables) and social capital model, and somewhat statistically significant positive effect in the human capital model. There was no effect, however, in the financial capital and full model. The other countries included in the study have no significant effect on either of the models and, therefore, are not included in the results table.

Industry affiliation are the last control variables added to the models. None of the different industries (Software and IT, Life Science and Medical Devices, Light Manufacturing and

Hardware) appear to have any statistically significant impact on startup performance. This applies to all calculated models.

The next sub-chapters each present the validation of the different sets of hypotheses, determining how the independent variables influence startup growth measured by the number of employees, which is startup performance.

Human Capital & University Startup Performance

Human capital appears to have an influence on university startup performance. To be more specific, the growth aspiration of the founder, the number of full-time committed founders, as well as the founder's prior startup experience improve the performance measure positively. Hypotheses H.3a stating that *more entrepreneur's startup experience will lead to higher startup performance* can, therefore, be accepted. Hence, this underlines the fact that entrepreneurs who have been through the startup process before, increase the likelihood to successfully grow their subsequent startup once again. Hypotheses H.3e & f refer to the notion that a *higher level of an entrepreneur's growth aspiration* (H.3e) and a *higher number of full-time committed founders* (H.3f) *will lead to higher startup performance*. Both of those hypotheses are also accepted. The significant positive effect of growth aspirations on startup performance relates to previous empirical evidence underlying this link (Kolvereid & Bullvag 1996, Baum et al. 2001, Wiklund & Shepherd 2003 and Delmar & Wiklund 2008). The same holds true for the number of committed founders, since Shane (2004) already pointed out that full-time committed entrepreneurs increase the chances of the startup's success. This finding is consistent with other studies on entrepreneurial characteristics across different innovative context conditions (Capello & Lenzi 2016) who found that a strategic entrepreneurial vision always plays a central role in different innovative contexts.

Prior management experience does not significantly impact startup performance. This result corresponds with the formulated hypothesis H.3b that *more entrepreneur's management experience will NOT lead to higher startup performance.* Since startups should not be regarded as smaller versions of large organizations (Blank 2013), different management approaches and methods are needed in order for them to succeed. A study of French biotech spin-offs also indicates that management experience does not seem to be a factor in performance (Corolleur et al. 2004). However, a significantly negative effect on startup performance – as Lin (2006) points out based on her research on Taiwanese high-tech ventures – could not be verified in this study.

Against expectations, prior industry and research experience showed no significant influence on startup performance. For this reason, the hypotheses stating that *more entrepreneur's industry experience (H.3c) and more entrepreneur's research experience (H.3d) will lead to higher startup performance* both have to be rejected. In terms of prior industry experience, one explanation could come from the literature on commitment (Dietrich & Srinivasan 2007, Stephens et al 2019). The more time somebody spends working in a career field, the more committed they become to the way things are done in this industry. Subsequently, it will be less likely that this person successfully challenges the status quo of this specific industry with disruptive ideas or approaches. With regard to research experience, the alleged advantage of knowing the scientific field allows them to access equipment and personnel more easily (Murray 2004) and makes their startup more innovative (Corolleur 2004). Since the startup environment is arguably very different than working in a research setting, different skills are needed to prevail and build a successful company. Therefore, those alleged advantages are less impactful on startup success than expected, and cannot replace prior experience in the startup scene – as described above. The same seems to hold true for founders with PhD, for which one can assume similar experience in the research setting.

Social Capital & University Startup Performance

In terms of social capital, the hypotheses were centered around the notion that the entrepreneur's and startup external relationships outside of the university network (cp. bridging social capital, Burt 1992, Adler & Kwon 2002) will help them to access complementary resources and know-how, and, therefore, have a positive impact on startup performance. In terms of a direct effect on startup performance, however, this analysis showed no significant results. None of the actors outside of the university context (non-research actors) – private financiers, entrepreneurs and small firms, large firms, professional service providers – appear to have a direct impact of university startup growth. Therefore, the hypotheses referring to the argument that *using private financiers (H.5a) / entrepreneurs & small firms (H.5b) / large firms (H.5c) / professional service providers (H.5d) to develop the startup will lead to higher startup performance* are all rejected.

However, Chapter 5.3.3 already described the positive impact social relations with investors can have on different forms of equity funding (cp. business angel or venture capital investments), for example. Chapter 5.3.1 also showed the support startups receive across the business, technology and organizational development domains, highlighting the importance of support actors external to the research network. Therefore, those non-research actors definitely play an important role in the development process of university startups. The missing direct effects on startup performance could be explained by social capital actually moderating the effects of entrepreneurial strategies (cf. growth aspiration; human capital) and resources on startup performance (Lin 2001). Hence, social capital per se might not positively affect startup performance directly, but it is central in developing certain entrepreneurial traits within the entrepreneur, help in gaining valuable, complementary resources and providing the support that can ultimately lead to enhanced performance. Social capital can, therefore, be perceived as a mediating variable, rather than one influencing startup performance directly.

Financial Capital & University Startup Performance

New organizations – like university startups - must resolve the problems of information asymmetry (Certo et al. 2001) and compensate for lack of experience and reputation (Honig et al. 2006) in order to secure funding for their venture. In 1985, Drucker mentioned that a lack of cash is often a cause for problems approaching or being in the growth stage of a startup. Private investors (cf. business angels and venture capitalists), however, do not just take over the role of a financier, but help a founder to build his company (Senor & Singer 2011). Along those lines, hypotheses were developed stating that *startups who receive business angel (H.7a) or venture capital funding (H.7b) will experience higher startup performance*.

With regard to business angel funding, one can observe a statistically significant, positive impact on startup growth in the Financial Capital Model 4. This effect, however, is not visible in the Full Model 5, where a larger set of variables is incorporated. Still, with a clear positive effect in Model

4, taking the main control variables into account, hypothesis H.7a can be labeled as accepted.

In terms of venture capital funding, no statistically significant effect on startup growth is visible in the Financial Capital Model 4. In the Full Model 5, however, the analysis unveiled a somewhat significant ($p<0.1$) *negative* effect on startup performance. This is surprising and counter to the expected effect of a positive impact of venture capital funding. Therefore, hypothesis H.7b must be rejected, noting the inverse effect. One explanation could be the measured effect on employee growth, instead of revenue growth. Further analysis showed a significant ($p=0.053$) impact of VC funding on revenue growth in the two-year period leading to the survey. 84% of the startups who received VC funding grew more than 20% over that period, in contrast to only 64% of startups without VC funding. The average revenue growth rate for startups with VC funding was also 446%, compared to just 160% for those without.

Surprisingly, corporate financing is shown to have a somewhat significant impact on startup performance. In the Financial Capital Model 4 as well as in the Full Model 5, it shows to have positive effect on employee growth. Bank funding, on the other hand, does not appear to have any effect on startup growth or performance. Furthermore, the relatively low ratio of startups funded by banks (15.9% in Europe and 5.3% in the USA, see Chapter 5.4.3 for more detail) underlines the fact that startups, due to their high-risk propensity, are less attractive for banks to finance them (Audretsch et al. 2003).

5.5.2 Summary of tested Hypotheses: University Startup Performance

In summary, human capital factors appear to have the strongest impact on university startup performance, in terms of employee growth. Model 2 shows the positive impact of both the entrepreneur´s growth aspiration as well as the number of full-time committed founders have. Furthermore, the type of financing received can also impact the growth of a startup in different directions. Whereas business angels and corporate funding show positive effects on startup growth, venture capital funding, surprisingly, has a somewhat negative effect on employee growth. Social capital, measured by close collaboration with specific actors external to the university, as mentioned already above, showed no direct effect on startup performance across all actor types. However, based on the results described in previous chapter, social capital is instrumental in receiving support and access to resources that do have a direct impact on startup performance.

The table below summarizes the results of the chapter, but validating the hypotheses derived in Chapter 3.

Table 54: Summary of Hypotheses regarding University Startup Performance

No.	Hypotheses	Validation
H.3a	More entrepreneur's startup experience will lead to higher startup performance	Accepted
H.3b	More entrepreneur's management experience will NOT lead to higher startup performance	Accepted
H.3c	More entrepreneur's industry experience will lead to higher startup performance	Rejected
H.3d	More entrepreneur's research experience will lead to higher startup performance	Rejected
H.3e	Higher level of an entrepreneur's growth aspiration will lead to higher startup performance.	Accepted
H.3f	A higher number of full-time committed founders will lead to higher startup performance	Accepted
H.5a	Using private financiers to develop the startup will lead to higher startup performance.	Rejected
H.5b	Using entrepreneurs and small firms to develop the startup will lead to higher startup performance.	Rejected
H.5c	Using large firms to develop the startup will lead to higher startup performance.	Rejected
H.5d	Using professional service providers to develop the startup will lead to higher startup performance.	Rejected
H.7a	Startups who receive business angel funding will experience higher startup performance.	Accepted
H.7b	Startups who receive venture capital funding will experience higher startup performance.	Inverse Effect

6 Conclusion and Implications

6.1 Summary of Research Topic, Problem Statement and Methodology

The importance of universities in developing new knowledge and technology, as well as educating talent is widely accepted. Their role has also evolved to an 'entrepreneurial university,' due to its 'third mission' of economic and social development, in addition to research and teaching (Etzkowitz et al. 2000, 2003, 2019). Universities are no longer isolated 'ivory towers' that operate separated from their environment but engaged institutions that interact with actors in the innovation ecosystems. Entrepreneurial universities extend their academic entrepreneurship processes (Brennan et al. 2005, Brennan & McGowan 2006) and activities beyond the organizational boundary through university technology transfer (Yusof & Jain 2010).

This is especially relevant to the transfer of scientific knowledge to the market through the creation of science-based startup and spin-off companies (short: university startups). This has generated considerable recent attention for several good reasons. Minola and Giorgino (2011): they foster economic growth in terms of employment (Acs 2004) are a source of radical innovation (Audretsch 1995) and bring technologies to the market, that otherwise would be left undeveloped (Etzkowitz 2003). Nevertheless, recent efforts to support the creation and development of university startups have fallen short of their expectations. This is especially true for Technology Transfer Offices (Lowe 2006, Mosey & Wright 2007, Faltin 2008, AUTM 2009, US National Research Council 2009, Grimaldi et al. 2011) but also for incubators to a certain degree (Hayter 2013, European Union 2014, van Weele et al. 2018b, Rijnsoever 2020). Similar shortcomings of those efforts can be observed in Europe, as well as in the United States, where most of the studies conducted in this field take place, but presumably in most countries all over the world.

The literature review has shown that academic entrepreneurship is a multilevel phenomenon and an integrative approach is needed to better understand the complexity of the university startup development process and the interrelatedness of the various levels and actors involved.

Factors on the (eco)system or macro level, like the institutional and cultural environment, influence entrepreneurial activity on the micro level, and vice-versa. Since the traditional, linear model of technology transfer has certain inaccuracies and inadequacies (Bradley et al. 2013), attention has recently shifted increasingly to the informal mechanisms of technology transfer. The same is true for our understanding of the development of university startups and how to best support them. The entrepreneurship and innovation ecosystem approach (see Chapter 2.2) and the role of human and social capital have taken on greater significance in studying this field. It is argued that an entrepreneurship ecosystem consists of research (or knowledge, science) and business (or commercial, industry) sub-systems or networks (Rijnsoever 2020, Clarysse et al. 2014, Powell et al. 2012). From a social network perspective, structural holes between those two sub-sets of actors - cf. 'Valley of Death' (Auerswald & Branscomb 2003) - are barriers to successful tech transfer from university to the market (Mosey & Wright 2007).

A specific challenge for universities in building competencies in technology transfer is to bridge those existing, separate networks and support university startups in bringing their (science-based) products and services to the market. For those reasons, one has to understand the underlying social dynamics between academic entrepreneurs and the actors in the surrounding entrepreneurship ecosystem, in order to develop better policies (at the university, regional and national levels) and to design more effective startup support programs. Therefore, the objective of this thesis was to describe the differences of human and social capital of university startups in the USA and Europe, examine their role in early-stage development and their impact on growth performance.

In order to fulfill this objective, an inductive, bottom-up research approach was combined with a top-down, deductive one (see Chapter 4.1 for more details). In the exploratory stage of the project, interviews were conducted at Stanford University's startup accelerator program StartX, as well as in the New York and Boston innovation ecosystems. In parallel, the literature review focused on publications in the field of entrepreneurship ecosystems, entrepreneurial university and technology transfer, business incubation and acceleration, as well as human and social capital's influence on university startup performance in order to identify academic voids. Based on those findings, a conceptual framework was developed, employing a new model for startup development focusing on three different development domains (technological and product, market and business, management and organizational). This framework and model formed the basis for the research hypotheses and the large-scale, web-based survey conducted among over 400 university startups in selected ecosystems in the USA (Boston, New York and Silicon Valley) and Europe (Vienna, Berlin and Stockholm). The data from this unique, hand-selected database was analyzed by different quantitative statistical methods in order to test the formulated hypotheses and answer the research questions.

6.2 Answering the Research Questions and Scientific Contributions

In the following section, the research question is presented again, with summarized answers referring to both the literature presented in Chapter 2 and the results from analyzing the empirical data presented in Chapter 5.

6.2.1 The Influence of the Entrepreneurship Ecosystem

Research Question 1: How does the surrounding entrepreneurship ecosystem influence university startup development in the USA and Europe?

The topic of entrepreneurship (often also entrepreneurial) ecosystems has gained substantial interest from researchers, practitioners and policy makers. Different studies develop their own entrepreneurship ecosystem assessment framework, according to the geographic unit of analysis and the complexity of the model (see Chapter 2.1 for more details). In order to discuss the influence of the ecosystem on university startup development in detail, a comprehensive analysis of all those domains is needed. Given the limited scope and specific focus of this study, however, only certain aspects of these interrelated fields could be discussed in this thesis. Nevertheless, the author has dedicated considerable time and energy on this overall research question and has written several publications, each dealing with one or more of those specific entrepreneurship ecosystem domains. Some of the main findings of those publications formed the basis for the in-depth study of this thesis and guided the development of the questionnaire (see appendix). In the following section, these publications are briefly described and placed in relation to the main findings of the research in this thesis.

Isenberg (2011) breaks an entrepreneurship ecosystem down into six domains: policy, markets, financial capital, human capital, culture and support. Following this framework, these domains were elaborated on in more detail for the introductory chapter of a book on entrepreneurship ecosystems (Fürlinger 2014). In the chapter "the pillars of an entrepreneurship ecosystem" (English translation from the original title in German "Die Grundpfeiler eines Gründerökosystems"), the characteristics of ecosystems in Europe and the USA were described in more detail. The main notion of this chapter was that a sustainable ecosystem needs to strengthen all of its domains in order to become sustainable. Furthermore, each ecosystem has to find its own development path, focusing on its specific local strengths and acknowledging the weaknesses. The history of Silicon Valley goes further back as many might think, with roots as far back as the 1940s or 1950s (Saxenian 1994, Stephens et al. 2019). Therefore, one has to allow time for an ecosystem to establish itself. Efforts that try to mimic the success of other ecosystems with the aim to transform themselves "overnight" are doomed to fail. However, there are certain aspects that can be learned from regions that are further along in this process, which could be applied somewhere else in the world, by taking the local peculiarities into account. The role of government involvement or the institutional context and a specific culture inducive for innovation are two of those aspects that merit closer attention. Therefore, the author completed two more publications on these two topics, which are discussed briefly in the following. For more in-depth discussion of the impact of all those domains, please refer to this book (Fürlinger 2014). There are hardly any studies that investigates the differences between university startups in the USA and Europe. Therefore, the comparison of the institutional and cultural contexts in those two regions in conjunction with entrepreneurship can be regarded as one of the major scientific contributions of this thesis.

Focusing on institutional context, the policy domain (Isenberg 2011), the role of the state and the impact of certain innovation policies on science-based startup development was discussed in a separate paper (Fuerlinger et al. 2015). Building upon the arguments of Mazzucato (2011), the role of government in the innovation process is highlighted, by drawing on the experience of

Germany as a concrete case study. The main finding of this paper was the importance of government involvement, especially in the earlier stages related to research funding and aligning the incentive schemes for scientific staff to encourage more tech transfer activities. This is particularly relevant to the foundation of university startups. In the later stages of the startup or spin-off process, however, more engagement of private actors and investors is needed to develop market-proven products and services and to transfer them to the market successfully. These findings underline the importance of private sector involvement and social networks that transcend the university boundaries, in order to foster university startup development.

In order to engage those actors from outside the university, a specific culture is needed that helps to bridge the divide between the research and the business networks in the ecosystem. Building upon the author's work experience at Stanford's startup accelerator StartX (see also Etzkowitz 2013) the cultural aspects of a thriving entrepreneurship community are described (Fürlinger & Leitner 2017), with a particular focus on the university startup development process. One of the most interesting cultural phenomena in a sustainable entrepreneurship ecosystem is that entrepreneurs support each other (Leitner & Fürlinger 2016). Many successful entrepreneurs are investing in early-stage startups (cf. business angels) or engage as mentors and share their experience and contacts from their personal network with the aspiring entrepreneur. This dedication to the principle of "giving back" can be an important catalyst for engaging private actors in the startup process of university ventures. Understanding the power of mentorship will lead to the insight that the right "social infrastructure" (in terms of social capital) is more important for the success of the startup development process than the physical infrastructure (cf. building of the startup support organization) provided. Furthermore, drawing on the selection criteria from StartX, the entrepreneurial personality and his/her vision (cp. human capital) are more important than their specific idea for a product or service (Fürlinger & Leitner 2017). Entrepreneurs recognize a problem that needs to be resolved or discover a need in the market that they want to satisfy. Their vision gives them and their work meaning and direction, representing the "guiding star" that defines the general direction of the company. Ideas for products and services are more fluid, iteratively changing over time, adapting to market feedback.

Further differences on the institutional and cultural level differences were described in terms of attitude towards governments (Kohut 2011), the fear of failure (Johansson 2006) and various forms of capitalism (Hall & Soskice 2001) that have the potential to influence behavior as well as entrepreneurial spirit and aspirations on a micro level. Hence, diving deeper into those two domains described above has confirmed the importance of human, social and financial capital for unlocking the full growth potential of university startups. The major findings regarding the role of those factors in the startup process, their interrelation between each other and the differences in USA and Europe are described in more detail in the following pages.

6.2.2 Social Capital and University Startup Development

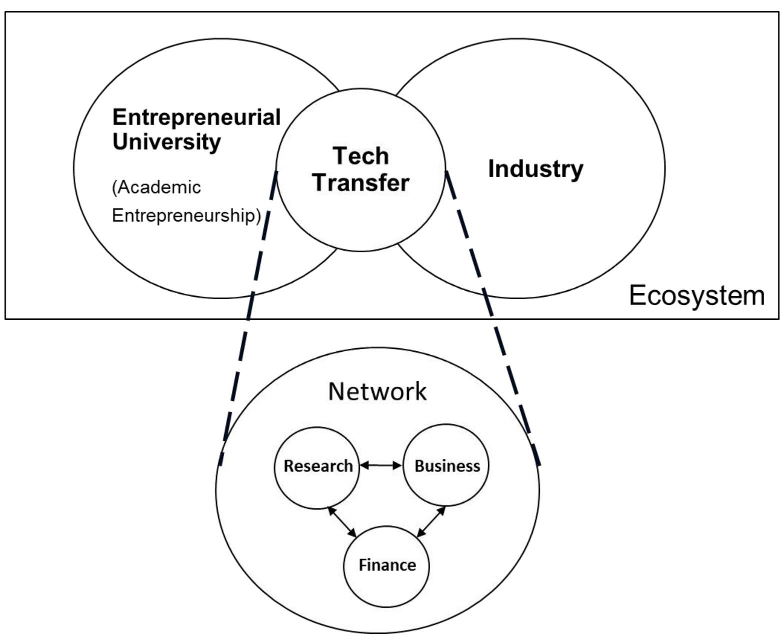
Research Question 2: How does social capital affect the early stages of university startup development?

Economic action is also influenced by the web of social relationships and institutions in which the individual or organization is embedded (Granovetter 1985, Kenney & Goe 2004). Research Question 1 focuses on the influence of institutional factors on the individual and the social network in the startup process. The research question focuses on the social networks that surrounds the entrepreneur and the startup and how it influences the startup development process. Referring to social capital as a source of competitive advantage, one has to understand the potential value that resides within social networks and the ways this value can be used for the development of startups. This is because social capital comprises both the social network and the actual and potential assets or resources that can be mobilized through this network (Nahapiet & Ghoshal 1998). Social capital is defined as a combination of network size, the relationship strength and the resources possessed by those in the network (Flap 1995).

Studying university startup development from various angels and in different cultural settings over the course of this research project confirms what other authors have described before: social capital is crucial for the success of university startups (Shane 2004, Mosey & Wright 2007) and have a strong impact on entrepreneurship at various levels of aggregation (Stuart & Sorenson 2005, Kwon & Arenius 2010). It was especially helpful and complementary to switch between the study of the theoretical foundations of social capital and experience its value firsthand, when working with academic entrepreneurs in USA and Europe. This unique background in science and practice enabled the author to incorporate the most relevant aspects into the conceptual model, the formulation of the research hypotheses and ultimately in the survey questionnaire and the interpretation of the data gathered.

When looking at the initial model of technology transfer (see Chapter 2.2) from a social network perspective, an extra layer can be added describing the social dynamics involved in this transfer process. Despite previous findings on the importance of social networks, there is still little known about how social networks within and around the university support (or hinder) spin-off creation and development (Grimaldi & Grandi 2005). Therefore, this thesis adds to the current literature, by taking a closer look at the various actors involved in the transfer process and how their interaction can foster the development of university startups. The approach that was applied can be referred to as a "social network approach to technology transfer". These insights can help us understand which social structures are needed to bridge the Valley of Death and consequently support the overall technology process.

Figure 28: Social Network Approach to Technology Transfer



Source: Adapted from Yusof & Jain 2010

Social aspects, however, are often considered fuzzy concepts, that are difficult to measure and understand. However, building on the right theoretical framework and applying suitable empirical methods allow us to unveil those hidden structures of social networks and the value they can provide to university startups – that is social capital. This study aims to bring clarity and show how these concepts (considered vague) can, in fact, be measured and better understood. Understanding the social dynamics between the academic entrepreneur and the actors in the surrounding entrepreneurship ecosystem is crucial for developing better entrepreneurship and innovation policies (on the university, regional and national level) and to design more effective startup support programs.

Research Question 2b. Who are the most important actors within and outside the research network and how do they support the early stages of university startup development?

In order to analyze the role of social capital on the university startup development process, two dimensions of social capital were taken into account. One is the structural dimension that focuses on the position of an entrepreneur in a structure of relationships. In this dimension, the main questions were framed around who the most supportive actors are, and whether they are hailing from the research or non-research network. Who are the boundary spanners and brokers in the technology transfer process? Who are the actors that bridge the structural holes between science and business (Morsey & Wright 2007)? Secondly, the resource dimension refers to the resources held by entrepreneurs' network contacts. In this thesis, resources are measured in terms of the support the startup receives across the three Startup Development Domains - technological and product, market and business, management and organization development - as well as emotional support. Once an entrepreneur’s most valuable support actors are identified, the focus switches to *how* they support the early stages of university startup development? An ego-centered network analysis approach is applied in this study, examining the support actors in the entrepreneurs’ social network and the kind of the support they offer.

Table 55: Dimensions and Measurements of Social Capital

Dimension	Focus	Concepts	Measure
Structural dimension	Position of entrepreneurs in a structure of relationships creates advantage	Structural holes, boundary spanners and brokers	Collaborative ties with actors in the research network vs. non-research (business) network
Resource dimension	Considering the resources held by entrepreneurs' network contacts	Diverse vs. homogenous ties	Support received across three Startup Development Domains; Financial Capital Investment

First, in order to get a better understanding of the network structure that a university startup is embedded in, the survey respondents were asked which kind of actors they used to develop their company (see Chapter 5.3 for more details). Looking at the empirical evidence, it became clear that non-research actors - private financiers (business angels and venture capitalists), entrepreneurs and small businesses, public support organizations, professional support actors (e.g. consultants, legal firms, accountants) and family and friends – are used comparatively more often by university startups to develop the company than research actors. Investors, other entrepreneurs and professional support organizations (e.g. consultants, accountants or lawyers) often turned out to be chosen collaborators to develop the startup company. However, differences can be observed depending on the ecosystem in which the startup is operating. Those differences in social capital across countries will be discussed in the next sub-chapter. This finding suggests that actors external to the university play a crucial role in bridging the voids between research and market, emphasizing the importance of external boundary spanners and intermediaries for university startup development.

In other words, from a social network perspective, an "ecosystem pull" can be observed – representatives from the business community collaborating more often with the university startup – rather than a "university push" effect led by actors within the university. These findings are consistent with the arguments of Burt (2005), who argues in favor of bringing together heterogeneous social ties to form social networks and facilitating the coordination of those networks. Furthermore, these results fit together with those of a comprehensive study on social capital and new small firm performance (Stam et al. 2014) that underlines the value of cultivating diverse personal networks that are rich in structural holes. Hence, those external brokers or boundary spanners have a valuable position in the entrepreneurship ecosystem overall, since they act as interpersonal bridges facilitating the transfer from the research environment into the market.

The analyses on the structural level unveiled the relative importance of certain actors, in terms of how often are used by the startups to develop their company. However, those relationships between the university startups and the support actors are not just formed and maintained for their own sake. The main motivation for entrepreneurs to engage in networking behavior and connect with other actors, is to gain access to resources and to acquire knowledge (Grant & Baden-Fuller 2004, Rice et al 2008). The theoretical foundation of the position generator used in this research is based on the concept of social resources. Lin (2001) believes that social resources are hidden within their social network. Therefore, the resource dimension of social capital takes a closer look at those ties in order to understand the quality of these relationships. What are those connections to actors within and outside the research network used for? In the next step, the goal was to examine how those actors support the startup in the development of the technology and the identification of customer needs - the process of making things commercially useful (Shane 2004).

In order to bring a science-based product or service to the market, a startup must master different competencies in order to be successful. A common distinction is made between technological knowledge (or product knowledge) and market knowledge (Burgers et al. 2008, Scillitoe and Chakrabarti 2010, Sullivan & Marvel 2011, Shane 2004). However, one of the key characteristics of a startup – as compared to small businesses and self-employment overall – is fast growth. The first challenge for the startup team is to develop a great product or service that appeals to customers in the market, relentlessly working on adapting its product or service to those market requirements. Once the product-market-fit is established, the additional challenge is to build and manage a scalable organization and successful firm that is able to support value creation and capture. Hence, this study adds a third layer of "organizational development" to the dichotomy of "market and business development" and "technological and product development". This contributes to the scientific literature, by creating a new model of university startup development, focusing on these three different startup development domains. In some cases, the founding team of the university startup already brings this experience into the new organization, even though these cases are rare (Shane & Khurana 2003). Therefore, external support can fill this void by tapping into the knowledge and experience base needed to establish and grow a new technology startup.

Following this logic, it was expected that non-research actors, in particular, will support the university startups with business and market, as well as organizational development know-how. This expectation was confirmed when analyzing the data. Investors, small firms and other entrepreneurs, as well as representatives from large firms exhibit high support values across those domains. This is consistent with other studies which found that the market attractiveness of a business idea is positively influenced by the market orientation of the founders and by their frequency of interaction with external agents (Grimaldi & Grandi 2005).

Hailing from the university, the university startup team engages with their department and university colleagues early on in the process, or even have some of their colleagues on the startup team. Through the continuous interaction in their daily work, strong ties form between them, which form the basis for close collaboration that is necessary to invent and develop new technologies. The analyzed data confirms strong support from all research actors involved in terms of technology and product development, especially from department colleagues and, surprisingly, from external research labs. However, non-research actors also play a key role in supporting technology and product development. Public support, large firms as well as entrepreneurs and small firms also exhibit comparatively high support values in this domain. On the other hand, research actors support market, business and organizational development only in a limited way. This underlines again the importance for an academic entrepreneur's social network to transcend the university boundaries. Not only are those actors outside of the university helpful to develop the business side of the new ventures and help build a scalable organization, they are also play an important role in helping to develop new technologies into products and services that fit market needs.

Research Question 2a. What is the difference between the social capital of university startups in the USA and Europe?

One of the aims of this study was to compare social capital endowment of university startups in the USA and Europe. Building upon Research Question 1, it can be assumed that the cultural and institutional context in which startup activities take place also influence the social capital of university startups. In other words, depending on the macro level conditions, different actors will support the entrepreneur and, therefore, help to bridge the transition from the research environment into the market. The comparability across populations was an important argument for choosing the position generator as the measurement method to measure social capital. The position generator is constructed from a firm theoretical basis (Flap 1999), which allows its application across various populations and cultures.

The comparative analysis of social capital was conducted on the continent, country as well as city region level, as described in more detail in Chapter 5.4. In summary, no significant differences in terms of research actor support in Europe and USA could be detected. University startups work with university/department colleagues, tech transfer offices, other universities and research laboratories to the same degree on both sides of the Atlantic. The same is true for the private support they receive from family and friends. However, the analysis found significant differences with regard to the usage of non-research actors in the startup development process. University startups in the USA rely significantly more on private actors - especially private investors as well as other entrepreneurs and small business owners - to support them with their company development, and rarely with public support actors. Their European counterparts, in contrast, have fewer ties to private actors and collaborate more with actors from the public sphere. This public involvement in the startup development process is especially pronounced in Austria, compared to the USA. These differences are even more distinct on the city region level of comparison. Silicon Valley, often considered the most developed innovation ecosystem in the world, showed the highest numbers in terms of private investor involvement in the startup process. Especially when compared to Vienna and Berlin, the differences are substantial. This also applies to the involvement of entrepreneurs and small businesses.

One might argue that startups receive support either way and that the type of support – whether from private or public actors – does not matter for startup development. However, this conclusion would be a delusion, since there are qualitative differences in terms of the support these different actors are able to offer to the startup, as discussed in more detail in Chapter 5.3. Less private actor engagement is a disadvantage for university startups in Europe, since the analysis has shown that private financiers and other entrepreneurs and small businesses play a central role in supporting business and organizational development. These areas of development are especially important in order to build a professional and scalable business. If a new venture receives less support from these private actors, then they are lacking the experience, knowledge and contacts those people and organizations could provide. Hence, more engagement of entrepreneurs and small business owners, as well as private investors, is needed in Europe – and especially Austria – in order provide better support for university startups.

Given the different institutional and cultural environment in USA and Europe (Asheim 2007, Cooke 2004, Hall & Soskice 2001, Estrin, Korosteleva, and Mickiewicz 2013, European Commission 2013), these results confirm what has been formulated as hypotheses in the beginning of this research. Nevertheless, this study contributes to the discussion, and our understanding of the university startup development process, by providing empirical, quantifiable results, collected directly from the entrepreneurs themselves. Studying those results allows for a more accurate assessment of how the differences on the macro level impact the social structure on the micro level, and the associated support received by the entrepreneurs across various countries.

As expected, startups in Silicon Valley are also working with large firms considerably more often, than entrepreneurs in other ecosystems in Europe or the US. According to Lazerson and Lorenzoni (1999) these are crucial relationships within an ecosystem, since startups can connect to global partners and suppliers. One might conclude that these startup-corporate networks are also a central characteristic of mature entrepreneurship ecosystems.

Research Question 2c. How do startup support organizations (e.g. incubators and accelerators) at universities contribute to the development of the university startup's social capital, by providing contacts to actors outside the research network (cp. external networking)?

A key determinant of a university's ability to generate spin-offs is the size of its academic social networks (Lockett et al. 2003, Niclaou & Birley 2003, Mustar et al. 2006). Therefore, universities aim to contribute to and support the creation of academic entrepreneur's social capital, by various activities and different forms of Startup Support Organizations (SSOs), like incubators and accelerators. Networking support from incubators occurs at two different levels (Bøllingtoft & Ulhøi 2005, Bruneel et al. 2012): Internal networking (cf. "bonding social capital") within the incubator, e.g. other startups and incubator management, and external networking (cp. "bridging social capital") with actors outside the startup support organization. Facilitating access to external networks eases the acquisition of resources as well as specialized knowledge and expertise, providing learning opportunities, and allows new firms to build up legitimacy faster (Bruneel et al 2012).

Regarding the development stage of different ecosystems, Degroof and Roberts (2004) suggest that in high-developed entrepreneurial contexts (cf. ecosystems), a university might adopt a more passive strategy with regard to connecting their startups to the surrounding ecosystem. This is due to the fact that a strong community is selecting the most promising startups and providing resources accordingly. In less developed entrepreneurial contexts, however, universities need to be more proactive, by selecting and supporting startups (Clarysse et al. 2005, Wright et al. 2008). Therefore, this research question is concerned with how university can support bridge building and facilitating contacts (Fini et al. 2009), with providing access to incubators or accelerators.

Comparing the importance of different support services provided (see more details in 5.3.2), university startups ranked "*Access to contacts outside the university and support organization (external networking)*" as the most important service provided by the SSO. Hence, entrepreneurs are aware of the bridge-building function that an SSO has, and the value it can create by introducing them to the right contacts in the ecosystem. Introductions to private financiers had a significant influence on the perceived effectiveness of the SSO's networking service.

Europe is characterized by a less dynamic business angel and venture capital scene, compared to the USA and fewer investors are actively engaged in the university startup development process (see Chapter 5.4). Following the logic presented above, especially in regions and countries where the number of private investors is limited, and the number of public support agencies considerably high, SSOs should increase their networking efforts with a focus on the former instead of or in addition to the latter. The empirical evidence shows, however, that SSOs in Europe - compared to the ones in the USA - introduce their tenant startups primarily to public support organizations and to only a limited number of private financiers, entrepreneurs and small business owners. Acting as important intermediaries between the university and the market, SSOs should connect European startups to more of those helpful private actors. Hence, new policies and initiatives of SSOs should focus on more targeted networking activities between startups and investors and other business representatives. Bringing their tenant companies in touch with more of the right business contacts, could provide them with better access to business and organizational development support as well as financial sources needed to reach their full potential.

Besides this area of improvement, SSOs already fulfil an important role in the ecosystem, by providing support in all three development domains (product/technology, business/market and organizational) and also rank highly – next to family and friends – in terms of emotional support for the entrepreneurs.

The importance of the bridging function of SSOs between the research and business environment underline the research focus on networked incubators (Hansen et. al 2000, Etzkowitz 2002, Bøllingtoft & Ulhøi 2005) in this field. Their main goal is to provide a strategic, value-adding intervention system within a network context (Hackett & Dilts 2000). Furthermore, other authors, also taking the institutional shortcomings on the macro level into account, are also calling for a new generation of 'systemic incubators' that aim to address the institutional challenges that constrain startup activity (van Weele et al. 2018b). Following these concepts and building upon the findings of this research, a "social network approach of incubation" is proposed that focuses the incubators' activities on curating the relationships between the university startups and specific actors in the surrounding ecosystem, recognizing its role as an important bridge builder between the research and the business network.

6.2.3 Human Capital and University Startup Development

Research Question 3. How does human capital affect social capital development and access to financing of university startups?

This question follows the notion that the human capital of entrepreneurs may be influential in developing social capital (Adler & Kwon 2002). Mosey and Wright in 2007 followed a qualitative approach exploring the influence of different levels of academic entrepreneur's human capital – measured by entrepreneurial experience – on their ability to develop social capital.

The results from this quantitative study confirmed that first-time entrepreneurs are more likely to rely on colleagues from the university setting for organizational development support. As shown before, however, the support value received from research actors in terms of organizational as well as business development is rather limited. In other words, they are missing out on receiving more valuable support from other, non-research actors, who have shown to be more supportive, especially in organizational and business development.

These findings are consistent with other research, which attests to problems in gaining credibility outside of the university due to the lack of prior business ownership experience (Vohora et al. 2004). Mosey and Wright (2007) also acknowledge that less experienced academic entrepreneurs encounter more structural holes between their research networks and business networks, which can hamper startup development. Serial entrepreneurs, on the other hand, potentially building on their social capital established through their prior experience in starting a business, are more likely to receive support from actors external to the university. This can be linked to their experience in effectively developing network ties, leading to broader, heterogenous social networks overall (Mosey & Wright 2007). Having been through the process before, they know of the value that those external actors can bring to the startup.

For first-time entrepreneurs it is especially important to have someone on their side who can point out the value they can receive by working with people from outside the research network.

Therefore, they could profit a lot from joining a Startup Support Organization (SSO), supporting them directly with organization and business development issues and connecting them to the right individual in the business network. SSOs can support legitimacy building for first-time entrepreneurs, by providing strategic introductions to people in the business environment who support them, especially with know-how and contacts that the university startup lacks early on. These findings are also supported the author's experience working at Stanford's startup accelerator StartX (Fürlinger & Leitner 2017). The mentoring network in this program is designed to support those first-time entrepreneurs, who lack these important connections in the business network. Assigning aspiring entrepreneurs with a well-connected, experienced mentor can act as a "social catalyst", with regard to new network ties formed outside the research community. Therefore, those mentors perform an important bridge-building function in the entrepreneurship ecosystem overall. By introducing the entrepreneur to their trusted business contacts, they convey legitimacy from their own persona to the entrepreneur. This ultimately endorses the entrepreneur and the university startup overall, leading to a higher likelihood for them to receive support in the various development domains or secure resources, such as financing, needed to further build their venture.

In terms of financing, the experience level of the entrepreneur – especially regarding prior startup experience – has considerable impact. Experienced entrepreneurs are more likely to gain equity finance from business angels and ventures capitalists. They are also somewhat more likely to receive corporate venture capital. The findings of Mosey and Wright (2007) underline the importance of an entrepreneur's startup experience, in securing venture funding from actors external to the university. The entrepreneur, who is the founder/manager or the management team of a new business, is the first and most relevant factor in obtaining funding for the new venture (Minola & Giorgino 2008). The other types of experience – research, management and industry – did not lead to a higher likelihood of those types of funding. Industry experience even has a negative impact on business angel funding – which is consistent with the literature on commitment (Dietrich & Srinivasan 2007, Stephens et al 2019). Therefore, as already pointed out, first-time entrepreneurs need mentors and SSOs who are willing to vouch for them and highlight their skills and commitment. This could help to underline the potential of the aspiring startup and establish legitimacy towards investors.

Besides the entrepreneur's professional experiences, a pronounced growth aspiration - measured by expected revenue five years from now - showed a significant impact on receiving business angel funding. The preference of private investors for entrepreneurs with a "think big" mentality is well-known. Given the risk involved in investing in early-stage startups, each of the investments in their portfolio must have the potential to return many times the capital invested. This will offset the money lost in startups that fail. Regardless of the experience level of the entrepreneur, a growth mindset seems to be the central feature for all entrepreneurs who want to raise risk capital.

In terms of funding from government sources, the entrepreneur's startup experience did not seem to matter. Prior industry and especially research experience turned out to be relevant. This highlights the different standards that are applied by private and public investors. On the one hand, this can be considered an advantage for first-time entrepreneurs, who might not be able to receive funding from the private market due to a lack of startup experience. Through grants, loans and investments from public agencies, they are able to operate their startup for a longer time. They can potentially reach the point where they can show enough traction (revenue, customers, etc.) to then induce private financiers to invest in their startup. On the other hand, one might argue that resources invested in less experienced entrepreneurs would be more efficient, if deployed to a team with more startup experience, given their higher likelihood to substantially grow the venture (see next chapter).

6.2.4 University Startup Performance

Research Question 4. How do human, social and financial capital affect the early stages of university startup performance?

The role of human, social and financial capital, respectively, in the university startup development process has been discussed separately in the chapters throughout this thesis. The objective was to unveil the interdependences between those different forms of capital and describe their observed differences in university startups in Europe and USA. This final research question was intended to shed light on the impact of human, social and financial capital as on a startup's performance. Startup performance, in this study, is defined by employee growth, a common proxy and a way to measure growth in startups (Baum et al. 2000, Rauch et al. 2005, Scholten et al. 2015; see Chapter 4.2.5 for more details). In summary, based on the results from the quantitative analysis, it can be concluded that certain aspects of human capital and specific sources of financing have a significant influence on university startup performance. These particular, impactful factors will be discussed in the following section. Social capital, on the other hand, did not show any direct effects on startup performance.

Social Capital

Social capital in the statistical models, however, was measured by the actors the startups has used to develop the company. Thus, it was the collaborative ties to certain actors in the research and business environment that were used to define social capital in this context. This perspective is described as the structural dimension of social capital, which determines the potential to mobilize or access information, resources or assets (Liao & Welsch 2001, Nahapiet & Ghoshal 1998). Gabbay and Leenders (1999) argue that if social capital is the resource provided by an actor's network of ties, its magnitude depends on the resources made available to the actor from others in this network. Therefore, the structural dimension measured in these models does not account for the resource dimension of social capital, taking into account the degree to which network connections possess valuable instrumental resources (Lai et al 1998, Batjargal 2003) and actually share them with the entrepreneur. This perspective was discussed in previous chapters, focusing on the contribution of social capital university startup development, measuring the resources (cf. financial capital, support in various development domains) held and provided to the startup by contacts in the research and business network.

The results from the empirical evidence not showing direct effects on startup performance, supports the notion that social capital can be perceived as mediating variable in the formula of startup performance. Although social capital can provide new firms with access to diverse sets of resources (e.g. know-how and financial capital) held by contacts in the network, it appears that access to social capital alone may not necessarily lead to their utilization (Bandera & Thomas 2019). Startups need to be motivated (Shaw 2006) and capable of tapping into those resources and using them accordingly. In order to be able to recognize value and utilize these external sources, an internal learning capacity is necessary. This is known as absorptive capacity (Cohen & Levinthal 1989). Therefore, the entrepreneur and or the startup team already need to possess prior related knowledge in a certain field, in order to be able to learn more. This highlights the link between social capital and human capital: whereas social capital determines the potential to mobilize or access information, resources or assets – like financial capital - it is the human capital of the entrepreneur that recognizes and, more importantly, captures its value for the startup. Hence, social capital needs to be combined with strong human capital, in order for the startup to exploit the full potential.

Human capital

In terms of human capital, the founder's growth aspirations and prior startup experience, as well as the number of full-time committed founders appear to improve the performance measure positively. With regard to the entrepreneur's prior experiences, it was expected that those who have worked in a startup before, will be able to grow their current one more successfully. Entrepreneurs who have been through the process of founding and growing a company before, have all encountered challenges and made mistakes during their previous ventures. Regardless of whether their prior startup has succeeded, they have learned important lessons along the way. They can apply those insights to their current startup and are, therefore, more likely to successfully grow their startup. This finding is consistent with the current literature, since startup or entrepreneurial experience was previously identified as an important success factor for startups in numerous studies (Clarysse & Moray 2004, Steen et al. 2010**,** Hayter 2013). Some authors ascribe the positive impact of experiences in the research field (Ensley & Hmieleski 2005, Wright et al. 2007, D'Este et al. 2012) or the same industry the startup is operating in (Shane 2000, Shane & Stuart 2002) on startup performance. The empirical evidence in this study, however, did not show any impact of other forms of experience, including management experience, in either a positive or negative way. Hence, it can be concluded that running and growing a new company requires a unique set of skills, which is arguably very different than working in or managing an established company or gaining experience in a research setting.

Apparently, it is not only the skills and experience gathered through prior startup experience that influence university startup performance. An entrepreneur's attitude, in terms of growth ambition, appears to also have a significant impact on startup growth. The data revealed that startups run by entrepreneurs who are thinking big and want to grow their company to more 10 million (Euro or USD, depending where they are based) in five years are more likely to experience growth. A bold, ambitious vision for the company will influence its strategic alignment, goal setting and operative decisions, impacting its future trajectory. An ambitious mission and fast growth are what separates a lifestyle-business from a startup. Aspiration is the divide between entrepreneurs and non-entrepreneurs (Isenberg 2011). The significant positive effect of growth aspirations on startup performance relates to previous empirical evidence underlying this link (Kolvereid & Bullvag 1996, Baum et al. 2001, Wiklund & Shepherd 2003 and Delmar & Wiklund 2008). Furthermore, a study (Capello and Lenzi 2016) also found that a strategic entrepreneurial vision always plays a central role across different innovative contexts.

Growth ambitions, however, are significantly less pronounced among entrepreneurs in Europe, compared to the ones in the USA. In the analyzed sample, Austria and Germany exhibit the lowest ratio of entrepreneurs with high growth ambitions. Less than 20% expect their startup to generate revenue of more than 10 mil Euros in 5 years. In Sweden, this ratio is already 40% and, in the USA, around 55%. Given that growth aspirations play such a central role in funding decisions by private investors, it is worth examining why these geographic differences exist. One potential explanation could be that that high growth entrepreneurship will be crowded out by government activism (Estrin et al. 2013). The authors suggest that a large, active government may play many important roles in society, but there is a cost in terms of entrepreneurial aspirations. The implications and recommendations for policy makers in the EU are discussed later in the corresponding chapter.

An entrepreneur's prior startup experience and growth aspiration are important traits on the individual level fostering startup growth. There is also strong evidence that the number of committed founders has a significant impact on startup performance. The higher the number of full-time members in the startup team, the higher the likelihood for stronger startup growth. Starting a new company is a time-consuming endeavor. The more people are willing to contribute to its success and dedicate substantial time and effort to it, the faster the company can move. Shane (2004) has pointed out that full-time committed entrepreneurs increase the chances of a startup's success. This finding is also consistent with the literature which acknowledges - besides the characteristics and vision of the founder - the founding team as a crucial factor to the decision-making process for private investors (Mason & Stark 2004). Entrepreneurship is a team effort and studies suggest that the ideal number of members in the founding team is three or four (Clarysse & Moray 2004). A strong team of committed founders is important for both securing funding from private investors and successfully growing a university startup.

Financial Capital

Due to the 'liabilities of newness' phenomenon (Stinchcombe 1965, Freeman et al. 1983), startups are limited by a resource constraint, which inhibits their growth rates and can lead to firm mortality (Thornhill & Amit 2003). Startups lack resources to compete effectively and lack knowledge about how to compete intelligently. The risk of failure is highest at the point of company founding and the probability decreases with the growing age of the organization. The entrepreneur 's ability to access different sources of knowledge is determined by the size and heterogeneity of his/her effective networks (Leyden et al. 2014). While the access to and the role of knowledge was discussed in the previous chapter, the quantitative models gave insights into the impact of one of the most important resource for startups overall – financial capital. However, not all capital is the same. As discussed in previous chapters, each type of funding comes with certain advantages and shortcomings (see Chapters 5.4 and 5.5). University startups tap into different sources for financing, depending on the availability and accessibility in their specific ecosystem. This, as will be discussed in the following, has different consequences for their performance.

Funding from the bank showed no effect on university startup performance. This underlines the fact that startups, due to the high risk involved, are less attractive for banks to finance them

(Audretsch et al. 2003). Furthermore, across all countries in the survey, the ratio of startups who received bank funding was neglectable. Government funding also appears to have no effect on startup growth. In contrast to bank funding, however, the ratio of startups who are publicly funded is much higher, especially in the EU overall and particularly in Austria (90.6%) and Germany (72%). Therefore, this insight has much larger implications, since government funding plays such a central role in these ecosystems. The potential explanations for the why this is the case goes beyond the question of financial capital. One of the most important contributions for entrepreneurs is the additional advice and support they receive from specific financiers or investors, on top of the financial investment itself – often referred to as "smart money". As the analyses have shown, public actors, on the one hand, provide decent support in terms of technology and product development, but fall short, on the other hand, in the business and organizational development domain (cp. Chapter 5.3). These areas of expertise, however, become more important as the size and operation of the startup increases and become crucial for successful growth. It is true, however, that receiving government funds is often available earlier or a bit less competitive than receiving private funding, allowing startups to finance their operation before they fit into the selection criteria of private investors. Furthermore, funding from public sources has more preferential terms than investment from private sources. This can be an important advantage for entrepreneurs, especially in a very early stage of startup development. It can prevent them from giving up a substantial stake of their company, in exchange for a modest seed investment amount from investors at a low valuation, compared to later in the development process. However, once the startup has found its product-market-fit, has paying customers and generates revenue, the focus needs to shift to scaling the startup through business and organizational development. As this study has shown, private investors and other actors from the business network are better suited to support a startup in these domains.

This could also explain why business angel funding showed a positive impact on university startup performance. In addition to the funding they provide, business angels offer support to the startup, in terms of business and organizational development. They are an important source for personal advice and introductions to partners, customers and other investors. Thus, they are not only investors from a financial standpoint, but also take on an important role as mentor, coach and strategic advisor. Unexpectedly, for venture capital funding, the results were ambivalent in the different models calculated. Further examination will be needed to better understand the impact of VC funding on startup growth, measured by the number of employees.

Corporate funding showed a somewhat positive impact on university startup growth. The arguments for their involvement in the startup process can be similar to the ones for business angels, since previous analysis has shown their strong support value, especially in terms of business and market development. It is also often the case that corporations invest in startups from which they are customers. This implies that the startup succeeded in marketing their product or service to a large firm and convinced them of its value. Hence, having an established, large corporation as investors (customer) underlines the startup's foothold in the market and establishes the base for future business and employee growth. Corporations are a potential source of financing in the USA, whereas their involvement is very limited across all other countries involved in the study. There are two potential explanations for this. For one, the economy in the US, and especially the ecosystems surveyed in for this study, are home to comparatively more large corporations than in the European ecosystems. Secondly, those corporations, especially in regions like Silicon Valley, are more often part of the "new economy" providing digital product or services or working in the field of information technology. These types of corporations are more likely to be involved in corporate venture capital, by maintaining their own venture capital funds or employing technology and innovation scouts.

6.3 Practical Implications

The research has shown that actors from the research as well as the business network have to be actively engaged in the startup process, in order to bring new science-based products and services to the market. The insights that this thesis has provided not only contributed to our theoretical understanding of academic entrepreneurship and its adjacent fields, but also has practical implications for the different actors involved. In the following section, recommendations for the course of action for entrepreneurs, university representatives, startup support organizations as well as policy makers are provided.

6.3.1 Implications for Academic Entrepreneurs and Startups

In order to develop and further grow their startup, entrepreneurs need to be aware of certain factors that can foster or inhibit their success. On the individual level, growth aspiration and startup experience had the highest impact on startup growth and the probability to raise venture funding. However, especially first-time entrepreneurs often lack this valuable entrepreneurial experience when starting their venture. Whereas experience in research and management can teach you certain aspects, they are no substitute for hands-on startup experience. Startup experience can only be acquired, by starting or working in a startup itself. Therefore, entrepreneurial minded researchers should look for opportunities to work for or with startups early in their career, so they can be exposed to this fast-paced environment and better understand the inner workings of new ventures. Overall, understanding the principles of business, marketing and entrepreneurship can be a valuable asset for all researchers, regardless of whether they are aiming to pursue a career in business or not. There are different paradigms at work in science and business, which manifest themselves in different ways. For example, your achievement in science is usually measured by the number of publications, citations or patents you have to your name. In business, on the other hand, metrics like the number/growth of users/customers, profit margin, market share and return of investment are key parameters to gauge success. These differences, however, can be observed in several aspects apart from key performance indicators. Understanding these different paradigms early in a career will not only help to be better prepared as a potential future entrepreneur, but also help to communicate more effectively across department or university borders.

Being able to recognize one's specific strength and weaknesses in the three startup development domains – technology/product, business and organizational development – is also critical for entrepreneurs. This awareness combined with a basic understanding of other domains, can help them to team up with the right co-founder. This thesis has also highlighted the importance of a team of committed founders. Complementary know-how, skills and personal networks of the entrepreneurs in the founding team already adds competitive advantage to the startup. With regard to startup experience, adding a member to the founding team who has started or worked in a startup before, can substantially increase the legitimacy of the startup. This fact alone, for example, can increase the likelihood to receive business angel or venture capital funding.

Investors are also especially interested in the vision of the entrepreneur for the startup and its future growth perspective. Are you planning to market your product or service to a specific local region and generate enough revenue for you and your team to live comfortably? Or are you building a scalable startup that brings a game-changing innovation to the global market and will generate billions in revenue globally? However, growth aspiration not only draws financial investment to a startup. The empirical evidence also points to a strong link with startup performance. The vision the entrepreneur formulates for the company will have a strong impact on its future trajectory. Therefore, thinking big from the beginning and making sure the co-founders, team members, mentors and investors are aligned with that vision is of utmost importance.

The research in this thesis also showed the importance of leveraging the social connections within the research as well as the business network. The exchange with university and department colleagues has certain advantages, especially with regard to technology and early-stage product development. Those strong ties between the startup founder and the colleagues, that have been established over years of close collaboration, are a source of trust and often lead to the invention of a new technology, process or approach. Understanding the technology and the potential use cases it can cater to, is essential for building the first prototypes of products and services and exploring certain applications in the market. However, the results also emphasize the importance for academic entrepreneurs to connect with actors outside the scientific community. Engaging with fellow entrepreneurs, investors, professional managers, industry representatives, potential customers and professional service providers will allow the startup to access resources and know-how, which is not available in the university setting. Especially in terms of business and organizational development, actors external to the university were shown to be much better suited to help the entrepreneur. Finding the right mentors and following their advice can be very helpful for an early-stage startup. Through their reputation and business network, they can help to provide access to potential customers, partners and investors and gain support in the various startup development domains or secure resources, such as financing, needed to further build the venture.

Startup Support Organizations, like incubators and accelerators, can be helpful for startups, by providing access to financial capital, office space, business related support as well as a community of fellow entrepreneurs. An entrepreneur, however, has to look beyond these services offered and examine what the organization has to offer in terms of networking support and strategic introductions. Who are the mentors in the program? Do they have the background, network and experience that you need to further grow your startup? How often do you have the chance to engage with them in person? Incubators and accelerators can be important bridge-builder organizations and help open doors that otherwise would remain closed or would be hard to open. Understanding who the people are that are engaged in the program and how they can add value to your startup is as – if not more - important as the free office space, investment and other services you might receive.

6.3.2 Implications for Universities and Startup Support Organizations

Universities' role in society is changing and encompasses more than the traditional missions of teaching and research. In order to live up to their full potential and transform themselves into entrepreneurial universities (Etzkowitz 1998), they must acknowledge their important role as engaged institutions in the innovation ecosystem. Furthermore, governments – who are providing most of the base funding for university research – are more than ever urging universities to increase their knowledge and technology transfer efforts. Policy makers want to ensure that the publicly funded research findings and inventions will actually find their way into the market and society overall, in the form of new products, services and social innovations. For this reason, universities increasingly face the challenge of evolving into an ambidextrous organization (Centobelli et al. 2019), able to balance exploration and exploitation. On the one side, universities must adhere to their academic freedom and devote themselves to exploration and discovery through basic research. On the other side, universities have to find ways and means to exploit those new findings, by translating them into applicable and marketable products and services that solve real-word problems and fulfill market needs.

Whereas there are multiple ways that a university can engage in knowledge and technology transfer (see Chapter 2.2.1), university startups can be powerful vehicles. They are organizations searching for product-market-fit, by engaging in dynamic experimentation and, therefore, conducting these translational efforts. However, startups are not able do this in isolation. This research has highlighted the importance of the complementary support they receive from actors external to the university, compared to actors within its borders. Investors as well as entrepreneurs and representatives from small and large businesses are central for the business and organizational development of early-stage startups, but also support technology and product development (see Chapter 5.3). In order to support the development of a university startup, universities need to understand of the social networks that exist within, outside, and - most importantly - between its boundaries and the surrounding ecosystem. Understanding the ecosystem that they are embedded in and the key stakeholder – especially in the business network within it are central to developing a university's "network intelligence" and a first step in actively managing its strategic relations within the ecosystem. Therefore, it is proposed to adapt (entrepreneurial) university metrics to the effect that they incorporate measures on social capital.

The are different ways for universities to strengthen their networks and provide the best possible support to university startups. The most suitable approach for each university will largely depend on the regional settings' idiosyncrasies (Fini et al. 2011), since the interactions between a university and its environment or ecosystem are co-evolutionary (Heaton et al. 2019). Therefore, depending on the current development stage of each university and the maturity of the ecosystem it is embedded in, different approaches might yield different results. In highly-developed entrepreneurial contexts, like Silicon Valley, a strong community is selecting the most promising ventures and allocating resources accordingly (Degroof & Roberts 2004). In such circumstances, a university might adopt a more passive strategy, whereas in less developed entrepreneurial contexts universities need to be more proactive by providing support to new ventures (Clarysse et al. 2005, Wright et al. 2008) through Startup Support Organizations (SSOs), like incubators or accelerators. In order to provide the best service for the university startups, SSO managers must understand the underlying social dynamics between the academic entrepreneur - the university startup - and the actors in the surrounding entrepreneurship ecosystem. The SSO has to create internal organizational structures and support mechanisms that are consistent with the local context and the characteristics of the specific university, like its history, culture, internal values and organizational identity (Jain & George 2007, Clarysse et al. 2005). Etzkowitz et al. (2019) recently laid out a framework of entrepreneurial university development strategies, that can help university officials to navigate the process of further establishing their university's entrepreneurial capabilities.

Based on these insights, it becomes clear that some ecosystems and organizations are better suited than others to support the development of university startups. It is interesting to note that among the university organizations, there is the low degree of engagement of the Technology Transfer Office (TTO) in university startup development. The results of this study show no evidence that first-time or experience academic entrepreneurs are more likely to gain market and business development support from a TTO. To the contrary, regardless of the entrepreneurial experience of the founders, the TTO is used comparatively sparsely. Across all countries and ecosystems surveyed, less only 17% of the startups used the TTO to develop their company. Department and university colleagues have been used by around 25% of the startups to develop their company and even other universities and external research labs, where they are used more often. This result from this large-scale international study adds empirical evidence to what other authors (Lockett & Wright 2005, Lowe 2006, Faltin 2008, Grimaldi et al. 2011, Valdivia 2013) have argued before. TTOs play a very limited role in supporting university startup and spin-off development. Therefore, a critical review of the strategic orientation, organizational setup and practical involvement of their employees in the development of university startups is proposed.

To be fair, these conclusions must be discussed with regard to their involvement in other technology transfer areas, like negotiating licensing agreements with established companies, for example. So, one might argue, that a TTO's main focus is to maximize the university's return on its intellectual capital, by commercializing its intellectually property (IP). However, limiting the scope of a TTO on the management of *intellectual capital*, would imply that an additional function or organization in the university is needed to focus on the management of its *social capital*. For a university to recognize the relationship it entertains as a strategic asset and an important catalyst for technology transfer, especially via startups and spin-offs, is one of the major contributions of this thesis.

Well-established, entrepreneurial universities in highly-developed entrepreneurship ecosystems can also profit from startup support efforts focusing on leveraging social capital. Stanford University's Startup Accelerator program StartX is such an example (Etzkowitz 2013, Fürlinger & Leitner 2017). One of the main advantages that StartX provides to their participating startups is the engagement of influential people from the business community in Silicon Valley as mentors and coaches in the startup program. The evidence from this research has confirmed that startups value "external networking" as the most important service provided by Startup Support Organizations. Therefore, measuring and managing the quantity and quality of personal introductions provided per startup, especially to investors and other experienced entrepreneurs, should be a key metric for Startup Support Organizations. Next to monitoring community interactions, a curated matchmaking process between startups and actors outside the research network (cf. mentors) can help to increase networking effectiveness. Instead of open, unstructured networking events for startups and mentors, the SSO is advised to set up a formal matching process between them. This matching can be conducted using different matching criteria, like industry focus, startup development stage, domain (technology, business or organizational development) or support needed by the startup. However, cultural values differ across ecosystems. Depending where the SSO is set up, the ease with which to recruit mentors may also differ. One good way to start, is by tapping into networks that already exist formally or informally. One example can be the alumni from the university. Research from Stanford (Eesley & Miller 2012) and MIT (Roberts & Eesley 2009) have shown that the economic clout their alumni have established over time is immense. Many of the former university students, researchers and professors are currently holding exciting positions, either in research, business or government. Building upon their affiliation and affinity with the university can help to leverage those existing ties for the startup program, in particular, and the university overall, contributing to bridging the gap between research and business networks.

Managers of SSOs can also apply the findings of this research to their startup selection process. Human capital has been shown to have a significant impact on startup growth performance, especially the entrepreneur's prior startup experience and growth aspiration. The mission of SSOs very often is to support first-time entrepreneurs, who lack the experience and the network to successfully establish their venture on the market. Therefore, including prior entrepreneurial experience in the selection criteria would somehow contradict their very mission. However, vetting the vision and growth ambition of the entrepreneur and ascribing it particular weight in the selection process has some merit. Startups are too often selected to support programs based on their product idea, its underlying technology or the total addressable market. While these factors are important, they often fail to provide an integrative view of the startup, often undervaluing its most important asset: the founder's vision for the company.

Entrepreneurs see problems that need to be solved or have discovered a need in the market that they want to satisfy. This is their vision, their "guiding star", which gives them, their team and their work meaning and direction. In order to get there, they will start with an initial (product/service) idea. If it turns out, however, that this initial plan does not deliver the desired result, they will revise (iterate, pivot) this idea and see if it works better in this adapted way. This process is repeated until product-market-fit is found or the business model is proven. It is, therefore, important to differentiate between visions and ideas. Ideas are of a lower order and are subject to frequent change, whereas visions, on the other hand, must be ambitious and inspiring, igniting passion for the higher cause of the startup among those involved.

The admission criteria at StartX, Stanford University's startup accelerator, for example, are clearly laid out. If the entrepreneur and his team do not meet certain expectations, even though the idea may be good, the startup will not be admitted to the program. Ultimately, a committed founding team, as empirical evidence in the research confirms, is a decisive factor for the growth and success of a university startup. It is not without reason that most investors say that they would rather invest in a first-class team with a medium to good idea than vice versa. All this speaks for attributing more weight to human capital in the selection criteria of SSOs - and not primarily focus on product characteristics, business models and market sizes. After all, what's the value of the best plan, if you don't have someone who is able to put it into practice?

6.3.3 Implications for Policy Makers

Since science and technology-based startups are a major driver for innovation and job-growth, policy makers around the world are curious about how they can support their creation and development. One of the main takeaways from this study is, however, that academic entrepreneurship is a complex phenomenon influenced by many factors on different levels of aggregation. In order to foster technology transfer and university startups, policy makers must adopt an integrative view and recognize the interdependences between different actors involved. The entrepreneurship or innovation ecosystem approach (see Chapter 2.1) can be helpful for understanding these complexities and developing a roadmap on how to foster a fertile environment in a specific region or country. Governments have different means and instruments at their disposal to support science-based innovation overall, and university startup development in particular. The United Nations summarized those tools and approaches in a guidance paper (United Nations Conference on Trade and Development 2012). Comparing the ecosystems in Germany and the USA, Fuerlinger et al. (2015) combined the UN approach with the science-based innovation process (Auerswald & Branscomb 2003) in order to derive a policy analysis framework that ascribes policy means and instruments to those four areas: legislative and regulatory environment, entrepreneurship education and awareness, access to finance and technology exchange and networking. For the sake of brevity, not all of these aspects can be discussed in conjunction with the findings of this thesis. Since this thesis focused on the role of human and social capital, as well as different sources of funding, the central observations and recommendations for action discussed are primarily related to these concepts. Furthermore, one of the objectives of this research was to compare selected European and US ecosystems. Therefore, the implications are mainly targeted to European policy makers, since it is often argued that Europe still lags behind the USA in terms of high-growth entrepreneurship.

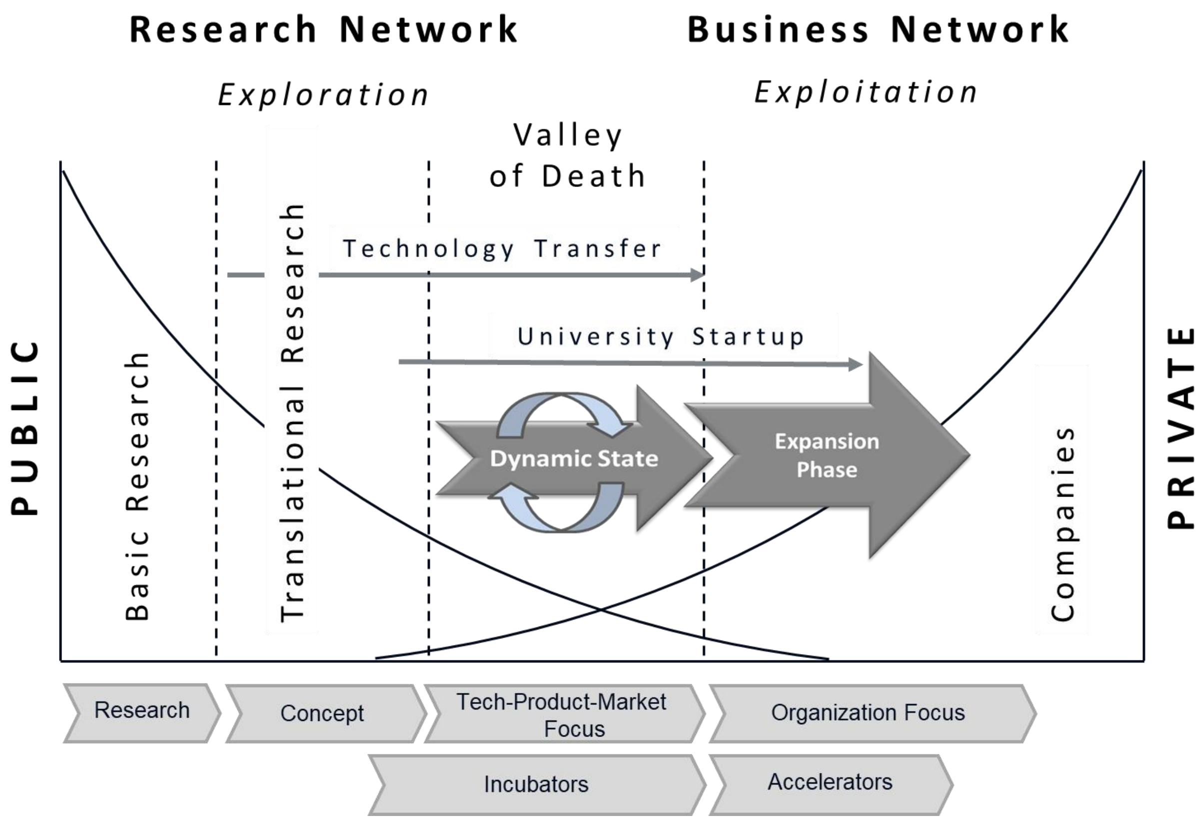
To this point, research conducted around the startup ecosystem challenges in Western Europe identified five main shortcomings for this region (Van Weele et al. 2018b). They include lack of market orientation, entrepreneurial culture and early-stage capital, a small domestic market and universities that are not focused on entrepreneurship. Despite many well intended efforts in Europe startups are often growing slower and fewer of them, compared to the USA, turn into large companies (European Commission 2013). The empirical evidence from this study confirmed a slower growth rate of university startups across the European countries included in this study, Austria, Germany and Sweden, compared to their US counterparts. The difference was especially pronounced in terms of revenue growth, but also visible with regard to employee growth.

This study found that human capital, especially an entrepreneur’s growth ambition, has significant impact on startup growth. Growth ambitions, however, are significantly less pronounced among entrepreneurs in Europe compared to those in the USA. In the analyzed sample, Austria and Germany exhibit the lowest ratio of entrepreneurs with high growth ambitions. Less than 20% of them expect their startup to generate revenue of more than 10 mio Euros in 5 years. In Sweden, this ratio is already 40% and, in the USA, around 55%. Interviews that were conducted with investors and incubators in Western Europe confirmed that startups have limited ambitions for growth and entrepreneurs are primarily motivated by a desire to be self-employed, rather than aspiring to grow their startup into a large company (Van Weele et al. 2018b). Given that growth aspirations also play such a central role in startup growth as well as in funding decisions by private investors (see Chapter 5.2), it is worth examining why these geographic differences exist. One potential explanation could be that that high growth entrepreneurship will be crowded out by government activism (Estrin et al. 2013). The authors suggest that a large, active government may play many important roles in society (cp. affordable education and healthcare, etc.), but there is a cost in terms of entrepreneurial aspirations. In other words, this would imply that people – and, therefore, startups - perform better without a (social) safety net. Obviously more research needs to be conducted in this field to further examine this proposed relationship. If this proves to be true, however, policy makers in Europe are facing a dilemma: How can you encourage high growth ambitions among entrepreneurs, without compromising the advantages of a social market economy? This dilemma is also discussed in the context of the different types of innovation systems in Europe and USA (Heidenrich 2004), highlighting the importance of calculability and stability in Europe, for example. While there is no easy answer to such a complicated question, recognizing the challenge, however, is a first step in dealing with it. Autio (2016) suggests that lawmakers in Europe need to differentiate between high-growth entrepreneurship policy and SME (small and medium-sized enterprises) policy. Important features of the former embrace, among other focus areas, policy initiatives that include high selectivity on the basis of strong growth motivation and ability (cf. growth ambition), support tied to milestones and extensive use of private-sector service providers. This study confirmed the important role that professional service providers play in the development of university startups. However, even more so, it is the involvement of the private investors, like business angels and venture capitalists, and other entrepreneurs and business owners that support the entrepreneurs with complementary skills and contacts, compared to their research colleagues (see Chapter 5.3).

This research also contributed to a better understanding of the different types of funding sources that a university startup can tap into, and the implications on its growth. For policy makers, it is crucial to understand the important role that public funding has in the innovation process, but also the limitations and potential distortive effects it can entail. Many university startups base their new products and services on government-sponsored technologies. Through a high level of investment in research and development of new technologies, mostly through public investment, the state has the opportunity to actively shape the markets of the future (Fuerlinger et al. 2015). Mazzucato (2011) also describes the important role of the state in an innovation ecosystem, by highlighting the benefit from these investments in basic research and early-stage financing. Therefore, government funding is essential for inventing and developing new technology in the first place, but also to support the translational work of early-stage technology and product development. This phase is especially crucial and most critical in the transition from invention to innovation (Auerswald and Branscomb 2003). The technology is adapted to industrial practice, the production process is defined, costs are estimated and a market is identified and quantified. Furthermore, a business model must be developed, which connects the technology with the economics domain and forms the basis for the viability of the company. Providing public funding in this crucial stage can prevent startups from becoming yet another victim in the "valley of death", before it even has the chance to develop a promising technology into a marketable product or service.

Nevertheless, involvement from private, non-research actors already in this early stage of startup development is essential. Their market and industry insight, as well as business and organizational support (see Chapter 5.3), are needed in order to identify customer needs and develop go-to-market strategies. Private investors, like business angels and venture capitalists, fulfill an important role in this early-stage technology and product development. On the one hand, they invest capital into a startup, when other financial institutions are not getting involved. On the other hand, and some argue even more importantly, they support the startup with business and organizational support and with contacts in the business network. Other research underlines the important role of investors as a bridge between the knowledge production systems and the commercialization of that knowledge (Powell et al 2010). Some argue that an entrepreneurship ecosystem consists of a research and a business network (Rijnsoever 2020, Clarysse et al. 2014, Powell et al. 2012). Along those lines, Clarysse et al. (2014) proposed that this "financial support network" of investors are important for entrepreneurship ecosystems and for the development and success of university startups. Depending on regional characteristics, however, these three different networks are connected to varying degrees, fostering or hindering the transfer from the science sphere into the market.

Figure 29: University Startups and the Valley of Death



Source: Adapted from Katehi (2010)

The characteristics of the financial support network itself also differs between the USA and Europe. The empirical evidence indicates that support and financing in Europe is provided primarily by public actors. The advantages and disadvantages of government funding for startups are discussed in Chapter 6.2.4 in more detail. The bottom line is that public financing can never fully substitute for private investor investment and engagement. For this reason, the stronger private actor support network and investor involvement in the USA, as confirmed in this study, is a competitive advantage for university startups operating in US ecosystems. The results from the research also showed that the difference in form of business angel funding is less pronounced as it is in the case of venture capital. In Europe, one third of the startups in this study received business angel funding and less than 10% got VC funding. In the USA, these numbers are between 40 and 50% for both types of funding. Therefore, in ecosystems with a less sophisticated financial support network, governments might also provide capital in a later stage of startup development.

Policy makers must be aware, however, that by doing this too extensively, the marketplace for venture financing could get distorted and private investors might move to other ecosystems. Hence, establishing a link to the private investment market is also important, to the effect that the market applies the law of natural selection (Isenberg 2010, 2011).

The research also indicated the positive impact corporate venture funding has on startup growth and that university startups in the USA receive considerably more investment from this source, compared to their European counterparts. Given that established firms, comparable to business angel and VCs, also provide more support than just financing, they are an important partner for startups. Therefore, policy makers in Europe could focus on engaging more established firms earlier in the innovation process. Central European economies, like Germany and Austria, are characterized by strong "Mittelstand" – often family-owned small and medium-sized enterprises – particularly in industries like manufacturing, construction, trade or tourism. In contrast to capital market financed and growth-oriented firms in the US, Mittelstand-companies favor stability, a long-term focus and are usually also more risk averse. Due to these cultural differences, their engagement in startup collaboration or venture investments is usually limited. Therefore, there will need to be special incentives and a gradual cultural change, in order to engage those companies earlier in the university startup process and position them as an alternative funding source. Alternatively, European governments could strive to attract offices of large "new economy" technology corporations to their ecosystems and support ways to connect them with universities and Startup Support Organizations. Once those firms recognize the potential of the technologies and startups developed in the region, they can be an additional potential source of venture capital funding for technology-based startups. Furthermore, aside from the potential investment they provide, these kinds of corporations are often early adopters of new technology products and services and can be important customers for university startups. Lastly, technology corporations often act as incubators, since many of their employees go on to be become entrepreneurs themselves, applying the technological know-how, organizational values and processes as well as management approaches, that they learned from their former employer.

In order to bridge the research and the business network, Startup Support Organizations, like incubators and accelerators, are often set up. Different organizational forms mentioned have specific strengths and weaknesses and support startups in different phases of their development. Incubators foster exploration and experimentation on the product and business model side, aiming for product-market-fit. A strong focus on product and technology development, as well as incorporating market insights is essential in this stage. Accelerators, on the other hand, help startups to scale their business, once product-market-fit and a proven business model exist. In this phase, the focus shifts toward business development and sales, as well as establishing a professional and scalable organization. Depending on the phase the Startup Support Organization aims to support, a different set of people and organizations are needed to cater to the needs of the startup and ensure its progress. Recognizing the needs in these different phases and including the right actors, especially from the business network, is essential. Entrepreneurs and founders need to support each other (cf. community) and have access to mentors, who are willing to share their knowledge, experience and contacts with them. Therefore, systematic support of the development of university startups in a region is not enough to provide the physical office infrastructure for entrepreneurs. Even more important is the social infrastructure of people, groups and organizations that constitute the support.

In summary, government officials must adapt their policies and activities, depending on the maturity of the ecosystem and the characteristics and deficiencies of the existing support networks. On the other hand, it must be understood that social relations at the micro level can help to mitigate the effects of some institutional deficiencies (Granovetter 1985) and that support based on social capital can be especially important for new growth-orientated startups in weaker institutional contexts (Estrin et al. 2013).

6.4 Limitations and Recommendations for Future Research

In this last chapter, the limitations of the research conducted and recommendations for future research are presented.

6.4.1 Limitations

The comprehensive scope of this multi-level international study provided unique insights into the complex phenomenon of academic entrepreneurship. This thesis touches upon many relevant factors (human, social, financial capital) for the startup process on different levels (startup, regional, national and continent) of aggregation. The author was eager to explain the role and impact of each of these factors in the startup process individually and, at the same time, analyze how they interrelate with each other. Furthermore, due to the international nature of this research, comparing the results between ecosystems in Europe and the USA further added to its complexity and scope. One might argue, and rightfully so, that this comprehensive approach constitutes the scientific contribution of this thesis to the knowledge base around academic entrepreneurship and university startup development. However, this broad approach might lead to certain shortcomings and limitations that need to be addressed. In other words, by raising a variety of research questions and including many factors in the analyses a unique overview can be provided, but, perhaps, at the expense of a more detailed discussion of each individual factor.

The detailed questionnaire led to a high number of potential variables that could be used for the statistical analyses conducted. The methods applied, depending on the research question, comprised descriptive statistics, as well as multiple and logistic regression analyses. The idea of a structural equation model was briefly discussed. However, due to the fact that the specific research questions could be answered with the methods described above; the idea was dismissed. Having said this, it could still be interesting to estimate and test the correlative relationships between the dependent and independent variables and explore potential hidden structures between them. Hence, this study only analyzed the direct effects and did not take mediation and indirect effects into account. That would require, as mentioned above, a structural equation model. The fact that financial capital is a binary variable also complicates the classic test of a mediation effect, according to Baron and Kenny (1986), which is used for metric variables only.

In the conceptualization phase of this research project, substantial time was spent on exploring the different ways that social networks and social capital can be measured. Ego-centered measurement methods, like the name, position or resource generator were taken into consideration and compared with each other (see Chapter 4.2.2. for more detail). The position generator was chosen as the preferred method due to its firm theoretical basis (Flap 1999) and methodological advantages (Van der Gaag et al. 2008). It can also be applied across various populations and cultures, which turned out to be a decisive factor. This is because one of the research goals of this thesis was to compare the social capital endowment of university startups in USA and Europe. Therefore, for the sake of comparability of the startups' social capital across countries, a standardized set of actor groups was presented to the entrepreneur to choose from, when characterizing their support network. In this way, the respondents could choose if they had worked with a specific group (e.g. private investors) or not, without needing to specify the total number of actors in this group. This is one shortcoming of ego-centered network analysis, since it only explores the types of relations. It does not specify the actual number of support actors. Future studies that are not comparative across cultures, could use an alternative method in order specify an entrepreneur's support network more accurately. More ideas about future research in this direction are presented in the following sub-chapter.

This study has focused on data collected and analyzed from Central Europe, Sweden and the USA. Therefore, the results presented in terms of the impact of human and social capital have to take this economic and cultural background of the survey respondents into account. Other studies in the field of university ecosystems (Rijnsoever 2020) have called for conducting similar studies in other countries of the world, in order to explore if the results are comparable or different. This would be useful in order to verify the impact of the cultural and institutional environment on both the university startups' endowment in terms of social and human capital, and the existence of different forms of financial capital, and their impact on startup performance.

Certain data collection certain limitations also need to be discussed. The data gathered through the survey was collected from one of the startup's founders. Even though several steps were taken to limit concerns of single-informant data, key informant bias and common method bias cannot be completely ignored (Podsakoff et al. 2003). Similar to other studies (Scholten et al. 2015), the respondent provided information about the other team members' human capital. In order to gain a more comprehensive picture of a startup's social capital endowment, it would make sense to incorporate the responses of more (founding) team members, especially when applying social capital measurement methods other than the position generator.

When assessing startup performance, it was not dealt with endogeneity or reverse causality issue and the fact that growth of a company has an influence on funding opportunities and vice versa. A longitudinal study design and panel data could be used in the future.

6.4.2 Future research

This research contributes to our understanding of academic entrepreneurship and highlights the role of human, social and financial capital in university startup development. Furthermore, the comparative nature of the study allowed for detailed analyses of the differences in the entrepreneurship ecosystems between the USA and Europe. An extensive literature review, the author's personal work-experience in the studied field, as well as hand-collected data provided the foundation for the insights provided in this thesis. Throughout the research process, however, further questions arose, which are not discussed in more detail in this thesis. This is due to the lack of specific data, limited relevance for the research questions guiding this research or simply for the sake of focus and brevity. For this reason, some of those considerations are mentioned below, as well as an agenda for future research topics in the field of academic entrepreneurship and ecosystems.

Shane (2004) differentiates between the creation and development of a university spin-off or startup. The former encompasses the steps from research, invention, discovery of the entrepreneurial opportunity until the founding of the company. The latter is concerned with the development of the technology, identification of customer needs and the searching for a suitable and scalable business model. This thesis focuses on the startup development phase, in particular the impact of human and social capital on startup growth. The results from this thesis underlined the importance of a committed founding team and its influence on startup performance. Therefore, future studies could explore the social dynamics within the university or research department that eventually lead to the decision to start a new company to commercialize research results. It was argued before that research groups operate comparable to firm-like organizations, without the profit motive (Etzkowitz 2003). There are some interesting questions to explore regarding human capital and the team aspect as well as social capital of academic entrepreneurship. What are the motivating factors for starting a company and how are they influencing this decision? What does the pre-startup process look like, especially in terms of team dynamics and team formation? With regard to bridging social capital, which types of social networks support the startup creation phase? How are they comparable or different to the startup support networks described in this thesis?

Within the startup development stage, more research could to be conducted on the growth stage of startup development. In Europe, in particular, startups often grow slower and fewer of them turn into large companies, compared to their US counterparts (European Commission 2013). What kind of support infrastructure from a social network perspective, as well as policies and incentives, are needed in this crucial scaling phase?

Another question is: how does the entrepreneur's initial vision for the company and growth ambition impact growth in the later stage of startup development? This research has concluded that growth ambition has a significant influence on startup performance and that those ambitions are comparatively low in Europe, compared to the USA. One potential explanation could be that that high growth entrepreneurship will be crowded out by government activism (Estrin et al. 2013). The authors suggest that a large, active government may play many important roles in society. However, there is a cost in terms of entrepreneurial aspirations. Therefore, it would be interesting to continue this line of research in order to explore this notion. What is the relationship between a strong and active government and entrepreneurial growth ambition? Which mechanisms are at work that foster or hinder growth aspirations in entrepreneurs? Is it possible to maintain a strong, engaged government from a social politics perspective and, at the same time, encourage a growth mindset among entrepreneurs?

This study has also highlighted the importance of the bridge building role that Startup Support Organizations (SSO; like incubators and accelerators) can play in the startup development process. External networking (bridging social capital), connecting the startups with people from outside the research network, was identified as the most important service offered to startups. Therefore, how can incubators and accelerators identify, vet and engage successful entrepreneurs, managers and other individuals from the business network as mentors in their programs? Moreover, how do you structure the matching process between mentors and startups and what does an ideal mentor-mentee relationship look like? There are some overarching questions in this regard. How do you motivate and incentivize private actors to get involved as early as possible in the technology development process? Moreover, internal networking among the startups (cf. bonding social capital) within the SSOs can be an important source of support for aspiring entrepreneurs. Connectedness between the founders leads to a higher perceived value of the support program. What are appropriate methods and policies to foster trust and encourage community building among the entrepreneurs?

Regardless of the involvement of support organizations, increased involvement of external actors, especially from industry and government, is a central task of an entrepreneurial university (Etzkowitz 2019). Technology transfer, especially through university startups, is highly dependent on strong ties into the business network. Those startup support actors are important intermediaries that help to translate technologies into marketable products and services. Based on the model of the three development support domains (technology/product, business and organizational development), this thesis contributes to our understanding about the strength and weaknesses of the different actor groups involved. It helped to identify the area in which different actors are able to support the startup and examined the structural differences of a startup's social capital in Europe and the USA. In a next step, future research can focus on the relational and cognitive dimension of social capital, exploring in more depth the social ties between an entrepreneur and their mentors. Which role does the entrepreneur's personal, research and business network play in finding a mentor and how helpful are Startup Support Organizations in this regard? What characteristics does an effective mentor have and how do you structure a productive mentoring relationship productive mentoring relationship, especially in terms of time commitment and remuneration? Furthermore, the number of support actors in each of the categories presented in this thesis, as well as the nature of their relationship (cf. weak vs. strong tie strength) would be interesting to explore further. Together with the insights provided in this thesis, answers to the proposed questions would help universities and support organizations to design better mentoring programs.

Further research can also be conducted with a focus on the Public Support Network. In European ecosystems, public actors play an active role in early-stage startup development. This study analyzed whether a startup has received public support. However, it did not further differentiate between various public organizations or agencies. Upcoming studies can define and include different sub-actors in the public support category, in order to gain additional insights into which of their agencies and support programs offer the most value to the entrepreneurs.

Similarly, a more detailed view on the form of financial capital provided to university startups from public sources can provide guidance on the strength and weaknesses of those instruments. In conjunction with a closer macro-level analysis of the role of the state in various entrepreneurship ecosystems (Fuerlinger et al. 2015), these micro-level insights can help governments to choose the appropriate instruments to support the creation and development of university startups and technology transfer.

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About the Author

Georg Fuerlinger conducted his doctoral research at the Vienna University of Technology under the supervision of Prof. Dr. Karl-Heinz Leitner and was a research scholar at the Innovation Department of the Austrian Institute of Technology. He co-authored the book "Abseits von Silicon Valley" (Beyond Silicon Valley) and publishes and presents in the field of innovation and entrepreneurship.

Georg Fuerlinger is currently Technology Officer at Advantage Austria, the Austrian Internationalization and Innovation Agency and the Co-Director of the Open Austria office in San Francisco. He joined the Austrian Trade Commission in 2016, with the mission of establishing Austria`s first innovation office in Silicon Valley. Georg Fuerlinger and his team provide support for Austrian businesses on US market entry and business development, as well as technology, startup and investor scouting. Managing the startup initiative GoSiliconValley, organizing delegation visits around future technology trends and hosting local innovation workshops and networking events are also part of his responsibilities.

His previous work experience in the USA include StartX, Stanford University`s startup accelerator in Silicon Valley, teaching as adjunct professor at the New York Institute of Technology and supporting the university incubator at the Center for Entrepreneurial Studies. A passionate traveler himself, he led educational tour groups from North American through Europe and managed a European entrepreneur exchange program. As a consultant, Georg successfully implemented projects with corporations, public agencies (e.g. United Nations), and startups around the world. He started his career in international project management at VAMED, part of Fresenius, a Global Fortune 500 healthcare corporation. Georg holds a Masters degree in international business from the Vienna University for Economics and Business and studied abroad at the University of Western Australia and Harvard University in the USA.

Appendix

Startup Support Organizations by Ecosystem

The table below lists the startup support organizations (incubators, accelerators, etc.) which worked with the university startups selected for the survey.

Country	Ecosystem	Startup Support Organization	Website
Austria	Carinthia	A&B KTN	http://www.aplusb.biz/start-ups-unternehmen.html
Austria	Carinthia	build	https://www.build.or.at
Austria	Lower Austria	accent	https://www.accent.at/en/home/
Austria	Lower Austria	A&B Lower Austria	http://www.aplusb.biz/start-ups-unternehmen.html
Austria	Upper Austria	Softwarepark Hagenberg	http://www.softwarepark.at/companies.php
Austria	Upper Austria	akostart	http://www.akostart.at/startups.html
Austria	Upper Austria	Tech2b	http://www.tech2b.at/start-ups-archiv
Austria	Upper Austria	A&B Upper Austria	http://www.aplusb.biz/start-ups-unternehmen.html
Austria	Styria	Science Park Graz	https://www.sciencepark.at/
Austria	Styria	A&B Styria	http://www.aplusb.biz/start-ups-unternehmen.html
Austria	Tyrol	Cast Tyrol	http://www.aplusb.biz/start-ups-unternehmen.html
Austria	Tyrol	A&B Tyrol	https://www.startup.tirol/
Austria	Vienna	inits	https://www.inits.at/en/home/
Germany	Berlin	Charlottenburg Innovation Center	https://www.campus-charlottenburg.org/index.php?id=37
Germany	Berlin	TU CfE	http://www.entrepreneurship.tu-berlin.de/menue/start-ups_events/gruendungsteams/
Germany	Berlin	Humboldt Innovation	https://humboldt-innovation.de/en
Germany	Berlin	Beuth Startup Hub	https://www.beuth-hochschule.de/startup
Germany	Berlin	Profund Innovation	http://www.fu-berlin.de/sites/profund/gruendungsservice/profund-XL/Teilnehmer/index.html
Germany	Munich	LMU SpinOff Service	https://www.en.uni-muenchen.de/scholars/services/researchservices/technology_transfer/spin_off/index.html
Germany	Munich	Strascheg Center for Entrepeneurship	http://www.sce.de/start-ups.html
Germany	Munich	CDTM	https://www.cdtm.de/collaborate/cdtm-ecosystem/affiliated-startups/
Germany	Munich	TUM Venture Labs	https://www.tum.de/en/innovation/entrepreneurship/ou

			r-entrepreneurs/
Sweden	Stockholm	Karolinska Development	https://www.karolinskadevelopment.com/
Sweden	Stockholm	SU Inkubator	https://suinkubator.se/bolagsinnehav/
Sweden	Stockholm	KI Science Park	https://www.kisciencepark.se/en/
Sweden	Stockholm	STING	https://sting.co/
Sweden	Stockholm	SSE Business Lab	https://www.hhs.se/en/outreach/sse-initiatives/sse-business-lab/
Sweden	Stockholm	KTH Innovation	https://www.kth.se/en/innovation/studentinc/bolag-1.416369
Switzerland	Zurich	ETH Innovation & Entrepreneurship Lab	https://ethz.ch/en/industry-and-society/entrepreneurship/Innovation%20&%20Entrepreneurship%20Lab.html
USA	Austin	UTA Seal	http://ati.utexas.edu/seal/
USA	Boston	MIT MediaLab	https://www.media.mit.edu/groups/spinoffs/overview/
USA	Boston	Harvard ilab	https://innovationlabs.harvard.edu/
USA	Boston	Umass Boston VDC	http://vdc.umb.edu/
USA	Boston	MIT VMS	https://vms.mit.edu/
USA	Boston	BU Photonics Innovation Center	http://www.bu.edu/photonics/research/innovationcenter
USA	Boston	NE idea	https://www.northeastern.edu/idea/ventures/
USA	New York	NYU Poly Inc	https://www.digital.nyc/incubators/nyu-poly-incubators
USA	New York	Pace Entrepreneurship Lab	http://www.pace.edu/lubin/departments-and-research-centers/entrepreneurship-lubin/entrepreneurship-lab/student-businesses
USA	New York	Columbia TF	https://entrepreneurship.columbia.edu/
USA	New York	NYC ACRE / Urban Future Lab	http://ufl.nyc/members/
USA	New York	NYC Powerbridge	http://powerbridgeny.com/news#pbny_teams
USA	New York	Columbia Startup Lab	http://entrepreneurship.columbia.edu/founders/
USA	New York	Zahn Innovation Center	http://www.zahncenternyc.com/
USA	New York	NY Design (CUNY)	http://nydesigns.org/community/
USA	Silicon Valley	Berkeley Skydeck	https://skydeck.berkeley.edu/
USA	Silicon Valley	Stanford StartX	https://startx.com/companies
USA	Silicon Valley	UC Davis VentureWell	https://team.ucdavis.edu/venturewell-at-mpbil/
USA	Silicon Valley	UC SF Innovation Ventures	https://innovation.ucsf.edu/featured-startups
USA	Silicon Valley	QB3	https://qb3.org/for-startups
USA	Silicon Valley	UC Berkeley Launch Accelerator	https://www.uclaunch.com/

Response rate by Startup Support Organization / Ecosystem / Country

In the table below, the number of university startups contacted per startup support organization, as well as their corresponding response rates are listed.

Country	Ecosystem	Startup Support Organization	Startups contacted	Startups complete responses	Response rate
Austria	Vienna	inits	94	39	41%
Austria	Carinthia	build	64	16	25%
Austria	Lower Austria	accent	20	12	60%
Austria	Upper Austria	Tech2b	74	30	41%
Austria	Upper Austria	akostart	17	4	24%
Austria	Upper Austria	Softwarepark Hagenberg	53	5	9%
Austria	Styria	Science Park Graz	22	17	77%
Austria	Tyrol	Cast Tyrol	55	12	22%
Austria	South-Eastern Austria	A&B Centers	130	18	14%
Germany	Berlin	TU CfE	56	17	30%
Germany	Berlin	Humboldt Innovation	32	8	25%
Germany	Berlin	Charlottenburg Innovation Center	41	8	20%
Germany	Berlin	Beuth Startup Hub	43	4	9%
Germany	Berlin	Profund Innovation	41	7	17%
Germany	Munich	Strascheg Center for Entrepeneurship	43	7	16%
Germany	Munich	TUM Venture Labs	37	5	14%
Germany	Munich	CDTM	70	7	10%
Germany	Munich	LMU SpinOff Service	39	2	5%
Sweden	Stockholm	SU Inkubator	4	2	50%
Sweden	Stockholm	KI Science Park	13	2	15%
Sweden	Stockholm	STING	90	23	26%
Sweden	Stockholm	KTH Innovation	34	7	21%
Sweden	Stockholm	SSE Business Lab	29	7	24%
Sweden	Stockholm	Karolinska Development	12	0	0%
Switzerland	Zurich	ETH Innovation & Entrepreneurship Lab	125	26	21%
USA	Austin	UTA Seal	48	3	6%
USA	Boston	BU Photonics Innovation Center	12	2	17%
USA	Boston	NE idea	62	5	8%
USA	Boston	MIT VMS	60	7	12%
USA	Boston	Harvard ilab	85	7	8%
USA	Boston	MIT MediaLab	128	9	7%
USA	Boston	Umass Boston VDC	25	1	4%
USA	New York	Columbia TF	13	3	23%
USA	New York	Columbia Startup Lab	144	19	13%
USA	New York	Zahn Innovation Center	23	4	17%
USA	New York	NYU Poly Inc	29	2	7%
USA	New York	NYC ACRE / Urban Future Lab	26	2	8%
USA	New York	NY Design (CUNY)	38	1	3%
USA	New York	Pace Entrepreneurship Lab	7	0	0%
USA	New York	NYC Powerbridge	6	0	0%
USA	Silicon Valley	UC Berkeley Launch Accelerator	7	3	43%
USA	Silicon Valley	UC SF Innovation Ventures	16	4	25%
USA	Silicon Valley	Berkeley Skydeck	67	16	24%
USA	Silicon Valley	QB3	49	7	14%
USA	Silicon Valley	UC Davis VentureWell	15	2	13%
USA	Silicon Valley	Stanford StartX	216	27	13%
		Total	**2314**	**409**	**18%**
		Austria	**529**	**153**	**29%**
		Germany	**402**	**65**	**16%**
		Sweden	**182**	**41**	**23%**
		Switzerland	**125**	**26**	**21%**
		USA	**1076**	**124**	**12%**

Variables Correlation Matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
1 Company Age	1																												
2 Company Size	.222**	1																											
3 Continent (USA)	-0.002	.104*	1																										
4 Software & IT	0.042	.105*	-0.067	1																									
5 Life Science & Medical Devices	-0.047	-0.031	.126*	-.402**	1																								
6 Light Manufcaturing & Hardware	0.021	-0.044	-0.030	-.377**	-.232**	1																							
7 Founder's Age	.372**	.109*	-.103*	-.147**	.163**	0.046	1																						
8 Founder's Gender	0.056	0.056	-.100*	0.083	-0.055	0.072	.101*	1																					
9 Founderr's Education Level	.130**	0.064	-0.002	-.187**	.225**	.112*	.313**	0.081	1																				
10 Founder's prior startup experience	-0.031	0.067	.163**	0.097	0.007	-0.068	0.075	.101*	-.112*	1																			
11 Founder's industry experience	0.006	0.016	-0.085	0.016	-0.033	-0.019	.160**	.118*	.134**	.103*	1																		
12 Founder's management experience	-0.017	-0.057	0.054	0.081	0.031	-0.030	.326**	0.078	-0.013	.323**	.209**	1																	
13 Founder's research experience	0.056	0.017	-0.026	-.169**	.206**	.196**	.241**	0.024	.489**	-0.062	.223**	-0.012	1																
14 Growth Aspiration	-0.031	.308**	.319**	-0.044	.173**	0.039	-0.019	0.017	0.088	.145*	-0.063	-0.023	0.020	1															
15 Full-time Founders	-.123*	.191**	0.067	.164**	-0.071	-0.057	-.205**	0.084	-0.043	.114*	0.038	0.057	0.018	.210**	1														
16 Department Colleagues	0.041	0.025	-0.002	0.057	0.056	-0.013	0.012	0.005	.149**	-.123*	0.084	-.108*	.121*	0.071	0.097	1													
17 Other Uni Colleagues	-0.047	0.011	-0.014	-0.024	0.029	-0.017	-0.021	-0.056	0.036	-0.045	-0.034	-0.056	-0.006	0.056	-0.018	.239**	1												
18 Tech Transfer Office	0.031	-0.014	0.044	-0.086	.173**	0.070	0.040	-0.062	.270**	-0.062	0.047	-.114*	.230**	.202**	0.070	.225**	0.077	1											
19 Private Financiers (Business Angels or VC)	-0.028	.134**	.216**	.121*	-0.026	-0.051	-0.002	0.026	-.135**	.198**	-.130**	0.061	-.118*	.228**	.183**	0.069	0.012	0.046	1										
20 Entrepreneurs & SMEs	-0.059	-0.003	.135**	0.054	0.001	-0.039	-.129**	-.158**	-0.042	.125*	-0.058	0.039	-0.020	0.112	.131**	0.068	0.031	0.006	.157**	1									
21 Large Firms	0.085	0.024	.115*	0.089	-0.060	-0.057	0.017	0.006	-0.022	-0.032	-0.023	-0.042	0.017	.117*	0.086	0.046	0.012	-0.054	.142**	.237**	1								
22 Public Support	0.080	-0.017	-.204**	-0.022	0.091	0.066	0.065	-0.024	.168**	-0.036	0.073	-0.047	.111*	0.069	.125*	.173**	.199**	.240**	0.068	0.071	0.093	1							
23 Professional Support	-0.031	0.087	.144**	0.085	0.028	-0.030	-0.070	-0.038	0.039	.100*	-0.026	0.064	-0.014	.214**	.190**	0.095	.115*	0.080	.266**	.210**	.130**	.219**	1						
24 Private Support (family, friends, etc.)	-0.049	-0.055	-0.059	0.014	-0.091	0.043	0.039	-0.085	-0.048	-0.005	-0.029	.112*	0.022	-0.051	0.056	0.012	0.069	-.105*	0.044	.152**	0.075	.110*	.189**	1					
25 Government funding	0.030	-0.070	-.435**	0.032	-0.010	0.081	0.069	.129*	.184**	-0.096	.157**	-0.026	.164**	-0.099	0.066	0.077	0.050	.147**	-0.081	0.020	-0.002	.567**	0.070	0.053	1				
26 Business angel funding	-0.050	0.015	.200**	0.083	0.008	-0.035	-0.018	.137**	-.160**	.262**	-.103*	0.060	-0.089	.287**	.192**	-0.049	-0.037	-0.058	.610**	0.081	0.079	-0.018	.111*	-0.002	-0.072	1			
27 VC funding	.111*	.215**	.443**	0.050	0.041	-0.052	-0.034	0.065	0.000	.215**	0.010	0.056	0.028	.299**	.131*	-0.007	-0.079	0.022	.360**	0.022	.156**	-0.086	.114*	-0.097	-.194**	.276**	1		
28 Corporate venture funding	0.083	0.052	.276**	-0.067	0.050	-0.015	-0.029	0.009	0.033	0.099	-0.007	-0.056	0.013	0.087	0.028	.169**	0.057	0.073	.196**	0.049	0.091	-0.041	0.081	-0.035	-0.100	.144**	.179**	1	
29 Bank funding	.286**	0.019	-.147**	-0.027	-0.006	0.034	.161**	-0.011	0.071	-0.051	0.057	0.041	0.008	-0.017	-0.015	0.049	0.016	-0.021	0.028	0.045	-0.045	0.020	0.005	0.078	.130*	0.046	0.008	-0.002	1

** Correlation is significant at the 0.01 level (2-tailed); * Correlation is significant at the 0.05 level (2-tailed)

Ecosystem Actors Comparison

ECOSYSTEM DOMAIN	**Publication**			
	Xu 2008	**Mosey & Wright 2007**	**Totterman & Sten 2005**	**Batjargal 2003**
RESEARCH within university	Professionals in universities, research institutes and government labs	University challenge/proof of concept fund		
		Business link		
		TTO		
		Research colleagues		
outside university		Other universities		
		Science Parks		
FINANCE	Managers of large banks, venture capital firms or other financial institutions	Venture capital firms	Financiers	Managers of large banks
	Other staff members of large banks, venture capital firms or other financial institutions	Business angels		Managers of medium and small banks
	Managers of medium and small banks, venture capital firms or other financial institutions			
	Other staff members of medium and small banks, venture capital firms or other financial institutions			
POLICY	High-rank official in local governments	Government grant providers	Governmental expert organizations	high rank official in ministries and agencies
	Middle- and low-rank official in local governments	Regional development agencies		middle and low rank official in ministries and agencies
	High-rank official in ministries and agencies			high rank official in local governments
	Middle- and low-rank official in ministries and agencies			middle and low rank official in local governments

ECOSYSTEM DOMAIN	Publication			
	Xu 2008	**Mosey & Wright 2007**	**Totterman & Sten 2005**	**Batjargal 2003**
INDUSTRY, BUSINESS	Owners or managers of large firms in your own industry	(Surrogate) entrepreneurs	Potential suppliers	Managers of large manufacturing plants
	Other staff members of large firms in your own industry	SMEs		Managers of medium and small manufacturing plants
	Owners or managers of medium and small firms in your own industry	Large firms/industry		Managers of large trade firms
	Other staff members of medium and small firms in your own industry			Managers of medium and small trade firms
	Owners or managers of large firms in different industries			Managers large resource sector firms
	Other staff members of large firms in different industries			Managers of medium and small resource sector firms
	Owners or managers of medium and small firms in different industries			
	Other staff members of medium and small firms in different industries			
	Professionals in trade associations and industry associations			
SUPPORT		Professional venture management firms	Consultants	
		Management consultants	Other entrepreneurs	
		Legal firms (intellectual property)	Mentors	
		Business incubators	Bookkeepers/Accountants	
		Science Parks	Lawyers	
			Former incubator tenants	

Survey Questionnaire

Social Capital & Startup Performance

Demographics and Contact Details

1. What is your age?
   - ≤ 25
   - 26 to 30
   - 31 to 35
   - 36 to 40
   - 41 to 45
   - ≥ 46

2. What is your gender?
   - Female
   - Male

3. What is the name of your company? (it will not be associated with your responses)

4. Please provide your email address (it will not be published or shared) so we can
- send you the results of the study if you are interested
- maybe ask some questions for clarification

5. Do you want to receive the results of the study?
   - yes
   - no

Social Capital & Startup Performance

Respondent Details

* 6. What is your position in the company? (more than 1 answers possible)
   - (Co-)founder
   - CEO/Managing Director
   - Other (please specify)

7. What role do/did you assume in the university?
   - Full Professor
   - Associate Professor
   - Assistant Professor
   - PostDoc
   - Phd Student
   - Master Student
   - Bachelor Student
   - Other (please specify)

8. What is the highest level of education you have completed or the highest degree you have received?
   - Less than Bachelor
   - Bachelor
   - Masters
   - Doctorate

9. Please indicate your startup experience before starting your current company

- No prior startup experience
- Worked in a startup before as a non-founding employee
- Founded a startup before as part of the founding team
- If you founded more than one company please state how many

10. Please indicate your experience in the current industry your company operates in before starting the current company

- I do not have any considerable industry experience
- I have prior industry experience in a research role
- I have prior industry experience in a non-research role
- I have prior industry experience in a research role and non-research role

11. How many years have you worked in a management position before starting your current company? (0 if none)

12. How many years have you worked in research before starting your current company? (0 if none)

Social Capital & Startup Performance

Company related questions

* 13. In what year was the current company founded? (please write "0" if the company is not officially founded yet)

* 14. In which city is the headquarter of the company?

15. Where are you incorporated?

* 16. In which industry does your company operate in?

- Life sciences/medical devices
- Information technology (IT)/software
- Light manufacturing/hardware
- Service
- Trade
- Other (please specify)

* 17. In which stage of development is your company currently in?

- **Research phase**
  Conducting research with the potential opportunity for commercialization.
- **Opportunity framing**
  Evaluating technological validity (towards proof of concept) and commercial potential (towards problem/solution fit).
- **Pre-organization**
  Prioritizing market(s) to focus on and developing/implementing strategic plans.
- **Re-orientation**
  (Attempting to) Generating returns by offering something of value to customers. Often changing business model, market, marketing or the strategic focus.
- **Sustainable returns**
  The company has figured out its precise business model, has traction on the market and is attaining sustainable returns.

18. Which market region is your company planning to serve in the long-term?

- A specific neighborhood
- City or metropolitan area the company is operating in
- State
- Multistate
- National
- International (home continent)
- International (several continents / global)

Social Capital & Startup Performance

Founding Team

* 19. How many founders were in the company during the time of incorporation?

- 1
- 2
- 3
- 4

Other (please specify)

20. How many founders are currently working in the company?

- 0
- 1
- 2
- 3
- 4

Other (please specify)

21. How many of them are women?

- 0
- 1
- 2
- 3
- 4
- more than 4

22. How many of the founders, before entering the company, have worked more than two years…
(in each line insert between "0" and the total number of founders)

...in a start-up?

...in the industry of the current company?

...in a management position?

...in research?

23. How many of the founders are presently devoting full time (35 or more hours per week) to the business?

* 24. At least one founder was officially affiliated (student, staff, faculty) with a university prior to the founding of the company

- Yes
- No

Social Capital & Startup Performance

University and research related questions

25. Which university were the founders affiliated with? (separate by comma if more than one)

* 26. The establishment of the company was dependent on new research findings or new scientific processes/methods/skills developed at the university.

- Yes
- No

Social Capital & Startup Performance

Research & IP questions

27. Which university did it originate from?

28. Which department did it originate from?

29. Please indicate the role of the academic inventor of the commercialized research finding

- at least one of the academic inventors is fully engaged in the new company (quits his/her university position)
- at least one of the academic inventors has some kind of part time position within the company (retaining his/her university position)
- none of the academic inventors has a formal connection with the newly established company (might have equity in the company and/or offering advice on a consultancy basis)
- Other (please specify)

30. At what stage of development is the product or service?

- Idea or concept
- Initial development
- Tested on customers
- Ready for sale or delivery

31. Have you applied for a patent, copyright or trademark?

- Patent
- Copyright
- Trademark

32. Has the patent, copyright or trademark been granted?

- Patent
- Copyright
- Trademark

33. Who is the patent/copyright/trademark holder?

- University
- Inventor
- Other (please specify)

34. Who has the exploitation rights?

- University
- Inventor
- Other (please specify)

Social Capital & Startup Performance

Social Capital Questions

* 35. Which type of actors have you used to develop your company? (check all that apply)

- [ ] Department colleagues
- [ ] Other university colleagues
- [ ] Tech Transfer Office (or equivalent)
- [ ] Startup Support Organization (Incubator, Accelerator, etc.)
- [ ] Other universities
- [ ] Research laboratories (public or private)
- [ ] Private Financiers (like Business Angels or Venture Capitalists)
- [ ] Entrepreneurs & small firms
- [ ] Large firms
- [ ] Public Support (governmental expert organizations, government grant providers, regional development agencies, etc.)
- [ ] Professional Support (e.g. consultants, legal firms, accountants, etc.)
- [ ] Private Support (family, friends, etc.)

In the following section please provide more information on how helpful the selected actor groups have been in supporting the following areas of your company:

1) Technological and product development
2) Market and business development
3) Organizational development
4) Emotional support

Social Capital & Startup Performance

Technological and product development support

in this questions only the actors selected in question 35 will be shown

36. Please indicate for all actor groups you have used how useful they were in supporting your company with regard to

Technological and product development: support you received for the transformation of technologies and prototypes into viable products or services

	(1) not at all useful	(2)	(3)	(4)	(5) very useful
Department colleagues	○	○	○	○	○
Other university colleagues	○	○	○	○	○
Tech Transfer Office (or equivalent)	○	○	○	○	○
Startup Support Organization (Incubator, Accelerator, etc.)	○	○	○	○	○
Other universities	○	○	○	○	○
Research laboratories (public or private)	○	○	○	○	○
Private Financiers (like Business Angels or Venture Capitalists)	○	○	○	○	○
Entrepreneurs & small firms	○	○	○	○	○
Large firms	○	○	○	○	○
Public Support (governmental expert organizations, government grant providers, regional development agencies, etc.)	○	○	○	○	○
Professional Support (e.g. consultants, legal firms, accountants, etc.)	○	○	○	○	○
Private Support (family, friends, etc.)	○	○	○	○	○

Social Capital & Startup Performance

Market and business development support	in this questions only the actors selected in question 35 will be shown

37. Please indicate for all actor groups you have used how useful they were in supporting your company with regard to

Market and business development: support you received with gathering market information and identifying customer needs and with marketing and selling your products or services

	(1) not at all useful	(2)	(3)	(4)	(5) very useful
Department colleagues	○	○	○	○	○
Other university colleagues	○	○	○	○	○
Tech Transfer Office (or equivalent)	○	○	○	○	○
Startup Support Organization (Incubator, Accelerator, etc.)	○	○	○	○	○
Other universities	○	○	○	○	○
Research laboratories (public or private)	○	○	○	○	○
Private Financiers (like Business Angels or Venture Capitalists)	○	○	○	○	○
Entrepreneurs & small firms	○	○	○	○	○
Large firms	○	○	○	○	○
Public Support (governmental expert organizations, government grant providers, regional development agencies, etc.)	○	○	○	○	○
Professional Support (e.g. consultants, legal firms, accountants, etc.)	○	○	○	○	○
Private Support (family, friends, etc.)	○	○	○	○	○

Social Capital & Startup Performance

Organizational development support	in this questions only the actors selected in question 35 will be shown

38. Please indicate for all actor groups you have used how useful they were in supporting your company with regard to

Organizational development: support you received with starting, managing and growing a professional company

	(1) not at all useful	(2)	(3)	(4)	(5) very useful
Department colleagues	○	○	○	○	○
Other university colleagues	○	○	○	○	○
Tech Transfer Office (or equivalent)	○	○	○	○	○
Startup Support Organization (Incubator, Accelerator, etc.)	○	○	○	○	○
Other universities	○	○	○	○	○
Research laboratories (public or private)	○	○	○	○	○
Private Financiers (like Business Angels or Venture Capitalists)	○	○	○	○	○
Entrepreneurs & small firms	○	○	○	○	○
Large firms	○	○	○	○	○
Public Support (governmental expert organizations, government grant providers, regional development agencies, etc.)	○	○	○	○	○
Professional Support (e.g. consultants, legal firms, accountants, etc.)	○	○	○	○	○
Private Support (family, friends, etc.)	○	○	○	○	○

Social Capital & Startup Performance

Emotional support

in this questions only the actors selected in question 35 will be shown

39. Please indicate for all actor groups you have used how useful they were in supporting your company with regard to

Emotional support: encouragement you received or support to cope with work-related stress

	(1) not at all useful	(2)	(3)	(4)	(5) very useful
Department colleagues	◯	◯	◯	◯	◯
Other university colleagues	◯	◯	◯	◯	◯
Tech Transfer Office (or equivalent)	◯	◯	◯	◯	◯
Startup Support Organization (Incubator, Accelerator, etc.)	◯	◯	◯	◯	◯
Other universities	◯	◯	◯	◯	◯
Research laboratories (public or private)	◯	◯	◯	◯	◯
Private Financiers (like Business Angels or Venture Capitalists)	◯	◯	◯	◯	◯
Entrepreneurs & small firms	◯	◯	◯	◯	◯
Large firms	◯	◯	◯	◯	◯
Public Support (governmental expert organizations, government grant providers, regional development agencies, etc.)	◯	◯	◯	◯	◯
Professional Support (e.g. consultants, legal firms, accountants, etc.)	◯	◯	◯	◯	◯
Private Support (family, friends, etc.)	◯	◯	◯	◯	◯

Social Capital & Startup Performance

Support organization participation

40. With the current company, have you participated in a startup support organization (like an incubator, accelerator, etc.) that is affiliated with the university?

◯ yes

◯ no

Social Capital & Startup Performance

Support organization participation

41. With the current company, have you participated in any startup support organization, like an incubator, accelerator, etc.?

- ◯ yes
- ◯ no

Social Capital & Startup Performance

Support Organization Questions

question 42-46 only will be shown if "yes" is selected in either question 40 or 41

42. What is the name of the startup support organization (incubator, accelerator etc.) you participated in?
(if you have participated in more than one please refer to the most helpful one)

43. Which year did you participate?

44. Please indicate the importance of individual types of business assistance services provided by the support organization (N/A = did not offer this kind of service)

	1 - not at all important	2 - little	3 - moderate	4 - very important	N/A
Exchange with peers in the support organization (internal networking)	◯	◯	◯	◯	◯
Access to contacts outside the university and support organization (external networking)	◯	◯	◯	◯	◯
Facilities related services (cp. access to shared office space, technical equipment, etc.)	◯	◯	◯	◯	◯
Professional business support and related services	◯	◯	◯	◯	◯

45. Please indicate the effectiveness of the support organization to provide individual types of business assistance services (N/A = did not offer this kind of service)

	1 - not at all effective	2	3	4 - very effective	N/A
Exchange with peers in the support organization (internal networking)	◯	◯	◯	◯	◯
Access to contacts outside the university and support organization (external networking)	◯	◯	◯	◯	◯
Facilities related services (cp. access to shared office space, technical equipment, etc.)	◯	◯	◯	◯	◯
Professional business support and related services	◯	◯	◯	◯	◯

46. Please indicate the number of people (in each group) who provided especially important information or advice you were introduced to via the support organization 'Especially important' means critical to your success in developing this company.

	Please select
Other universities	
Research laboratories (public or private)	
Private Financiers (e.g. Business Angels or Venture Capitalists)	
Entrepreneurs & small firms	
Large firms	
Public Support (e.g. governmental expert organizations, government grant providers, regional development agencies, etc.)	
Professional Support (e.g. consultants, legal firms, accountants, etc.)	

47. Please describe the support organization's level of involvement on external networking activities

	1 - none	2	3	4 - very much
A formal matching process between you and the external actors	○	○	○	○
Training, orientation, or other interaction support you and/or the external actors received	○	○	○	○
An evaluation or assessment of the interaction between you and the external actors	○	○	○	○

Social Capital & Startup Performance

Add-on questions

48. Are you willing to answer additional questions regarding supportive people in you network (~5 min)?

- ○ yes
- ○ no

Social Capital & Startup Performance

Most supportive people

question 48-55 only will be shown if "yes" is selected in question 47

Please think about the *three people* who provided especially important information, advice, contacts and encouragement to you at the time you started or joined your present company. 'Especially important' means critical to your success in developing this company.

In the following we will refer to this three people as Person A, Person B and Person C

49. How was the contact to these three people made? Through the…

	Please select
Person A	
Person B	
Person C	

Select for each person:
- Personal network (family and friends)
- Research network (universities, research institute)
- Business network
- Support organization network (incubator, accelerator, etc.)

50. What is the current position/profession of each person?

	Please select
Person A	
Person B	
Person C	

Owner or managers of large firms
Other staff member of large firms
Owner or manager of medium and small firms
Other staff member of medium and small firms
High-rank official in local government, ministry or agency
Middle- and low-rank official in local government, ministry or agency
Professional in universities, research institute or government lab
Manager of a bank, venture capital firm or other financial institution
Other staff members of a bank, venture capital firm or other financial institution

Other (please specify for each person if applicable)

51. Are these people invested in your company or do they get any other form of return?

	Please select
Person A	
Person B	
Person C	

Holds stock in the company
Receives monetary return
Receives other form of return
No return

52. How well do you know these people?

	Please select
Person A	
Person B	
Person C	

Very well
Somehow
Very little

53. Please provide more information about the three most supportive people:

	How many years have you known this person?	How often do you meet with this person?
Person A		
Person B		
Person C		

less than two years
between two and four years
more than five years

(more than) 1 day a week
(more than) 1 day a month
Less than 1 day a month

54. Please indicate if the person has significant experience in the following areas:

	Person A	Person B	Person C
Mentoring/coaching experience	☐	☐	☐
Startup founding experience	☐	☐	☐
Management experience	☐	☐	☐
Research experience	☐	☐	☐
Industry experience (industry you are operating in)	☐	☐	☐

55. Please indicate in which field you received support from each person:

	Person A	Person B	Person C
Technological and product development	☐	☐	☐
Market and business development	☐	☐	☐
Organizational development	☐	☐	☐
Personal/professional development	☐	☐	☐

56. Please indicate by what means each person supported you:

	Person A	Person B	Person C
Knowledge and advice (e.g., information and suggestions)	☐	☐	☐
Contacts (e.g. to suppliers, customers, investors)	☐	☐	☐
Other resources (e.g., finances, supplies)	☐	☐	☐
Emotional support (e.g. encouragement)	☐	☐	☐

Social Capital & Startup Performance

Company Performance

* 57. How many employees worked at the company at the end of 2013 (full-time equivalent)?

* 58. How many employees worked at the company at the end of 2014 (full-time equivalent)?

* 59. How many employees (are expected to) work at the company by the end of 2015 (full-time equivalent)?

60. What was your company's revenue by the end of 2013? (write "0" if no revenue yet)

61. Currency

US Dollar   Euro

62. What was your company's revenue by the end of 2014?

63. What is your company's revenue by the end of 2015?

64. What is your projected annual revenue in five years from now?

65. Please indicate the amount of funding you have received so far from the actor groups listed below

	nothing	≤ 50,000	51,000 - 250,000	251,000 - 1,000,000	1 mio - 5 mio	> 5 mio
Government						
Business angels						
Venture capitalists						
Corporate venture fund						
Family members & friends						
Bank						
Other (please specify below)						

Please specify "Other" here

66. How satisfied are you with the development of the company in comparison with that of your competitors?

very unsatisfactory ... very satisfactory

67. How satisfied are you with the overall development of the company?

very unsatisfactory ... very satisfactory

Exploratory Interviews: Main Findings

Date	Interview Partner Company / Organization / Role	Main findings & key learnings
March 2012	Babson College, Professor of Entrepreneurship	Entrepreneurship centers at universities support startups through training, without an agenda, provide an unbiased view and real-world exposure Influential factors in the ecosystem are contact to research, venture capital and business angels; an appealing area/location; educated workforce and access to alumni
March 2012	Baruch College, Small Business Development Center	Entrepreneurship centers integrate research, teaching and outreach The value of incubation is access to a network and community, not the physical location Entrepreneurship ecosystems foster startups EU relies on grants (no equity) vs. US on private funding (equity) to foster entrepreneurship
March 2012	Cambridge Innovation Center, Community Manager	Coworking space is different to incubators, e.g. no defined processes for incubation, no equity in startups Entry barriers are the ethical perspective and the goal of the business and the founder person itself Established companies participate to have access to talent "built the incubator from within – do not just build a house"
March 2012	Education Technology Startup, Founder	Applied to seven accelerators and got accepted to one Went through the program with 11 other startup teams Reasons to join an incubators or accelerator include - Honest criticism & feedback - Mentors provide guidance and subject expertise - Access to technical resources and domain experts - Mentorship by business and thought leaders and entrepreneurs - Seed-funding - Co-location with other startup teams form community - Demo-days create visibility
March 2012	Harvard University, Doctoral student	Maker movement focuses on how people produce things Different forms of hacker and maker spaces around the world
March 2012	Harvard Innovation Lab, Business School Professor	Connectedness of US-universities to the world is a competitive advantage Knowing the university alumni community is key for an innovation center Alumni offer advice and feedback and can refer entrepreneurs to other people People come to the Innovation Lab to refine their idea
March 2012	Harvard University, Engineering Professor	Importance of tacit knowledge for startups; a lot happens unseen We have to change how knowledge is delivered; Professors have to understand themselves as service providers University professor are one person for teaching, researching and training – potential to split this role
March 2012	Massachusetts Institute of Technology (MIT), Research	Universities and research institutes need to increase the number of foreigners in order to increase innovation

	Fellow	E.g. ETH university in Zurich consist of 70-80% people outside of Switzerland Boston: startup founders are often from 1st tier universities (Harvard, MIT) and first employees often from 2nd tier universities (Babson, Northeastern, Tufts, Boston University, Brandeis, Boston College, University of Massachusetts)
March 2012	Massachusetts Institute of Technology (MIT), Director Entrepreneurship Center	It takes patience to establish an Entrepreneurship Center Focus on the premise "alumni helping alumni" Entrepreneurs love/respect/help other entrepreneurs Advisory board of successful entrepreneurs Importance of Professors of Practice (practitioner lecturers) Get industry involved and understand what keeps CEOs awake late at night
March 2012	New York Institute of Technology, Director Center of Entrepreneurial Studies	Some universities have intellectual rights on students' ideas when developed through university equipment NYIT tries to establish contacts through trust network & emotional ties (e.g. speakers & mentoring for free) Incubators either hunt for technologies (run by professional) or support students (run by academic) MIT network is closed for MIT only, therefore Route 128 is not as successful as Silicon Valley
March 2012	Massachusetts Institute of Technology (MIT), Startup from the Media Lab	For technology startups space is not so important; they want to scale their business and sell millions of items For a consultancy company/startup space is important Legal aspects are the hardest when starting a company; incorporating is easy, but developing a legal framework that shields you from trouble is hard Media Lab used to be a space to BUILD cool stuff and is now a space to DO cool stuff US universities have strength in marketing the university itself and provide visibility of technology and its importance Corporate sponsors of research labs provide possibilities to brainstorm with science and business community
April 2012	Austrian Business Angel and Investor	Idea and people (management team) are important for startup success Often wrong expectations from investors: they think idea is 90% of the business, but execution is. Importance to estimate and understand the target market correctly Structural support works better in the USA than in Europe
March 2012	University of Pennsylvania, Director Center for Technology Transfer	Students and faculty come to the Tech Transfer Office with a technology and TTO helps them to start-up TTO provides support with the managing team, forming the company, financing and access to service providers Difference between USA and EU: universities in the USA are non-profit businesses, but BUSINESSES
February 2013	Digital Media Zone, Director	Value of peer-to-peer mentoring groups Selection criteria include the social and economic input of the idea; business plan and prototype (not in ideation phase); be collaborative – help everybody; Pitch all the time Cross pollination with other incubators and accelerators is important Gain reputation that helps companies help be successful
March 2013	German Center for Research & Innovation, Director	Competitions are important for innovation, fostering creativity Open mentality in an ecosystem is important to foster exchange between people

		Exist Program (supporting university startups) in Germany requires at least one business expert in the team
July 2013	Stanford University, Engineering Professor	Differentiate between different types of incubators and between incubators, accelerators and science and technology parks Selection criteria of incubators and accelerators are central to successful incubation Incubators should focus on throughput rather than occupancy rates Ownership of incubators (city, region, private, etc.) influences objectives and business models
April-July 2015	Stanford University, Senior Research Associate	Importance of innovation culture in a region (cp. Silicon Valley) Central role of trust, failure tolerance, long-term thinking, feedback and low barriers of social exchange in mature innovation ecosystems

University Startup Performance Models for US and EU

The analysis in Chapter 5.5 “Determinants of University Startup Performance” is based on a regression model across all regions. In the tables below, these regression models were also calculated for European and US university startups separately – see tables below. The results presented below show a more distinct influence of human capital on startup performance in Europe, especially in terms of growth aspiration and the number of committed founders. Of interest is the somewhat significant impact of corporate venture funding on startup growth in Europe. This is even more surprising, with regard to the fact that less than 5% of university startups in Europe receive that kind of funding (see Chapter 5.4.3 for a more detailed discussion). As mentioned in the implications (Chapter 6.3), this underlines the importance of engaging corporations in the startup process and finding ways to incentivize their investments in early-stage technology startups. Similarly, we see a significant impact of large firms as support actors on startup performance in the US. Therefore, it is not exclusively the corporate venture capital large firms provide that has an impact on startup growth (see EU case), but maintaining collaborative relationships with corporations per se (see US case) can already have a positive influence on startup growth. The importance of large firms and corporations in the startup process is discussed in Chapter 6 in more detail, taking the differences in cultural and institutional ecosystem factors in Europe and USA into account.

Table 56: University Startup Performance: Linear Regression Model Analysis (EU ONLY)

	Model	1	2	3	4	5
	Subset	Base Model	Human Capital	Social Capital	Financial Capital	Full Model
	Constant	.861***	.432**	.839***	.853***	.508**
Controls	Company Age	-.140***	-.125***	-.137***	-.147***	-.119***
	Company Size	.036***	.025**	.036***	.047***	.023**
	Software & IT	.046	-.037	.031	.113	-.007
	Life Science and Med. Devices	.156	.064	.134	.144	.107
	Light Manufacturing and Hardware	.137	.167	.125	.207†	.237†
Human Capital	Founder's startup experience		.110			.084
	Founder industry exp.		.130			.153
	Founder's management exp.		.036			.041
	Founder research exp.		-.083			-.085
	Educational background (PhD)		-.049			-.102
	Growth aspirations		.270*			.241*
	No. of full-time Founders		.200***			.200***
Social Capital	Private Financiers			.069		.017
	Entrepreneurs and SMEs			-.112		-.101
	Large Firms			-.049		-.150
	Public Support			.045		.045
	Professional Support			.119		.105
	Private Support			-.056		-.115
Financial Capital	Government funding				-.079	-.100
	Business angel funding				.111	-.002
	Venture capitalist funding				.015	-.031
	Corporate venture funding				.474*	.400†
	Bank funding received				-.046	.043
	R^2	.262	.408	.277	.330	.437
	Adj. R^2	.249	.369	.248	.303	.361
	ΔAdj. R2	-	.120	-.001	.054	.112
	F (df)	19.597 (5)	10.512 (12)	9.413 (11)	12.369 (10)	5.742 (23)
	P value (Model)	0.000	0.001	0.000	0.000	0.000

***p<0.001 **p<0.01 *p<0.05 †p<0.1

Table 57: University Startup Performance: Linear Regression Model Analysis (US ONLY)

	Model	1	2	3	4	5
	Subset	Base Model	Human Capital	Social Capital	Financial Capital	Full Model
	Constant	1.268***	.997***	1.091***	1.309***	.889***
Controls	Company Age	-.169***	-.155***	-.165***	-.161***	-.136***
	Company Size	.035***	.023*	.030**	.027**	.020†
	Software & IT	.129	.106	.108	.029	-.019
	Life Science and Med. Devices	-.152	-.128	-.052	-.189	-.013
	Light Manufacturing and Hardware	-.060	-.065	-.008	-.173	-.058
Human Capital	Founder's startup experience		.170			.196
	Founder industry exp.		.095			.086
	Founder's management exp.		.152			.174
	Founder research exp.		.013			-.141
	Educational background (PhD)		-.106			-.064
	Growth aspirations		.156			.129
	No. of full-time Founders		.017			.042
Social Capital	Private Financiers			.162		.069
	Entrepreneurs and SMEs			-.012		-.060
	Large Firms			.251†		.397*
	Public Support			-.075		.062
	Professional Support			-.082		-.154
	Private Support			.190†		.210
Financial Capital	Government funding				-.072	-.130
	Business angel funding				.253†	.243
	Venture capitalist funding				-.150	-.331*
	Corporate venture funding				.207	.155
	Bank funding received				-.035	-.341
	R^2	.328	.341	.380	.364	.480
	Adj. R^2	.299	.239	.316	.300	.298
	ΔAdj. R2	-	-.060	.017	.001	-.001
	F (df)	11.127 (5)	3.361 (12)	6.006 (11)	5.721 (10)	2.646 (23)
	P value (Model)	0.000	0.001	0.000	0.000	0.001

***p<0.001 **p<0.01 *p<0.05 †p<0.1